

HP0680W with Tall Clear Fresnel Dome

HP0680WFT_TestResults1.doc
May 8, 2012

Overview

Protobox LLC tested FEC Heliports' HP0680W perimeter light with tall clear Fresnel dome lens on May 3, 2010. The light was mounted in the angular test fixture and a Photo Research Model 525 Photometer with diffuser head used to measure the illuminance in foot-candles at a distance of 49.625" from the reference surface. The smooth portion of the lens located mid-way up the LED array near the center of the Fresnel dome was used as the reference for this test. Illuminance data was collected in two +/-90 degree elevation sweeps; one sweep was made at 0 degrees azimuth, the second at 90 degrees azimuth. A third sweep was made at an azimuth angle of 45 degrees to measure the effect of the square matrix of LED PCBs inside the light. Data was collected every 5 degrees in elevation. Spreadsheets of results are provided at the end of this report. The resulting data was converted to candela for comparison with the requirement data.



Figure 1. HP0680W with Tall Clear Fresnel Dome

Illuminant A with a CIE coordinate of $x = 0.4475$, $y = 0.4075$ was used as the reference.

Results

Results of the illuminance measurements are shown in figure 2 and 3, and plotted in figures 4 & 5. All measured values in candela. The 0 degree and 90 degree azimuth corresponds to an elevation cut perpendicular to the 4 LED PCBs. The 45 degree azimuth corresponds to an elevation cut through the corner of the 4 LED PCBs. The 45 degree intensity readings were approximately 76% of the intensity of measurements made perpendicular to the LED PCBs.

Elevation Angle (Deg)	AZ = 0	AZ = 90
-90	1298.0	1557.6
-85	1404.3	1763.5
-80	1749.2	2082.8
-75	1796.9	1958.9
-70	1769.9	2049.5
-65	1388.4	1897.0
-60	608.0	1433.8
-55	239.7	617.1
-50	219.6	249.1
-45	225.1	234.5
-40	201.8	236.9
-35	169.4	219.7
-30	179.1	202.2
-25	179.5	194.1
-20	201.3	192.6
-15	211.1	217.2
-10	236.6	238.8
-5	193.8	253.1
0	165.7	214.8
5	190.3	198.6
10	221.2	207.8
15	204.0	249.0
20	189.4	239.7
25	169.2	227.0
30	164.4	193.8
35	172.4	200.0
40	185.4	206.5
45	201.0	224.2
50	194.9	216.2
55	221.2	231.6
60	755.6	584.5
65	1015.7	1322.3
70	1782.6	1588.7
75	1827.1	1781.0
80	1871.5	1870.0
85	2017.7	1754.0
90	1636.4	1557.6

Figure 2. Illuminance Summary (candela); 0 deg. & 90 deg.azimuth

Elevation Angle (Deg)	AZ = 0	AZ = 45
-90	1298.0	1054.0
-85	1404.3	1368.9
-80	1749.2	1372.2
-75	1796.9	1426.7
-70	1769.9	1391.6
-65	1388.4	1019.3
-60	608.0	473.8
-55	239.7	246.7
-50	219.6	251.2
-45	225.1	247.5
-40	201.8	211.1
-35	169.4	200.3
-30	179.1	187.2
-25	179.5	181.1
-20	201.3	181.0
-15	211.1	241.8
-10	236.6	242.0
-5	193.8	214.5
0	165.7	196.4
5	190.3	212.9
10	221.2	228.0
15	204.0	242.1
20	189.4	180.6
25	169.2	175.9
30	164.4	178.7
35	172.4	189.2
40	185.4	200.7
45	201.0	236.4
50	194.9	245.9
55	221.2	227.8
60	755.6	425.3
65	1015.7	926.6
70	1782.6	1340.9
75	1827.1	1393.3
80	1871.5	1386.8
85	2017.7	1432.9
90	1636.4	1217.3

Figure 3. Illuminance Summary (candela); 0 deg. & 45 deg. azimuth

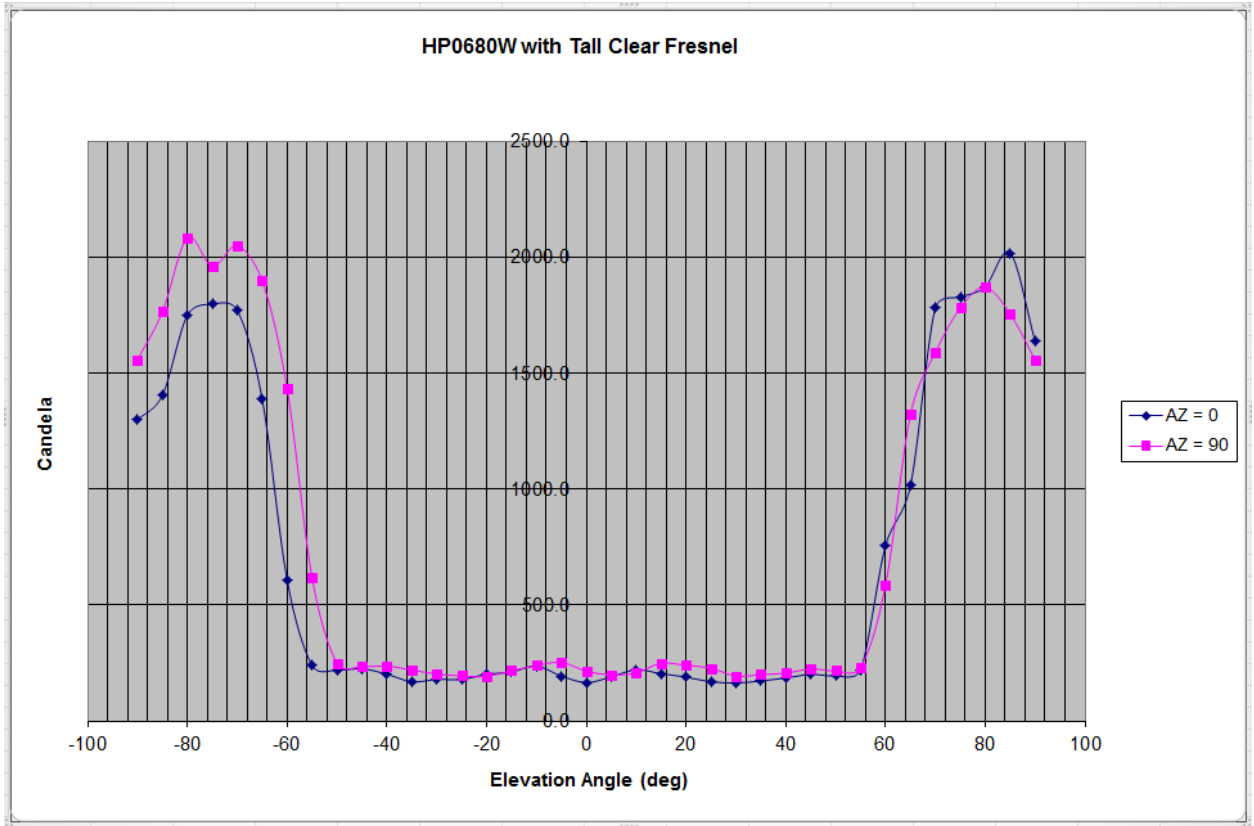


Figure 4. Illuminance in candela as a function of Elevation Angle in degrees;) 0 deg. & 90 deg. azimuth

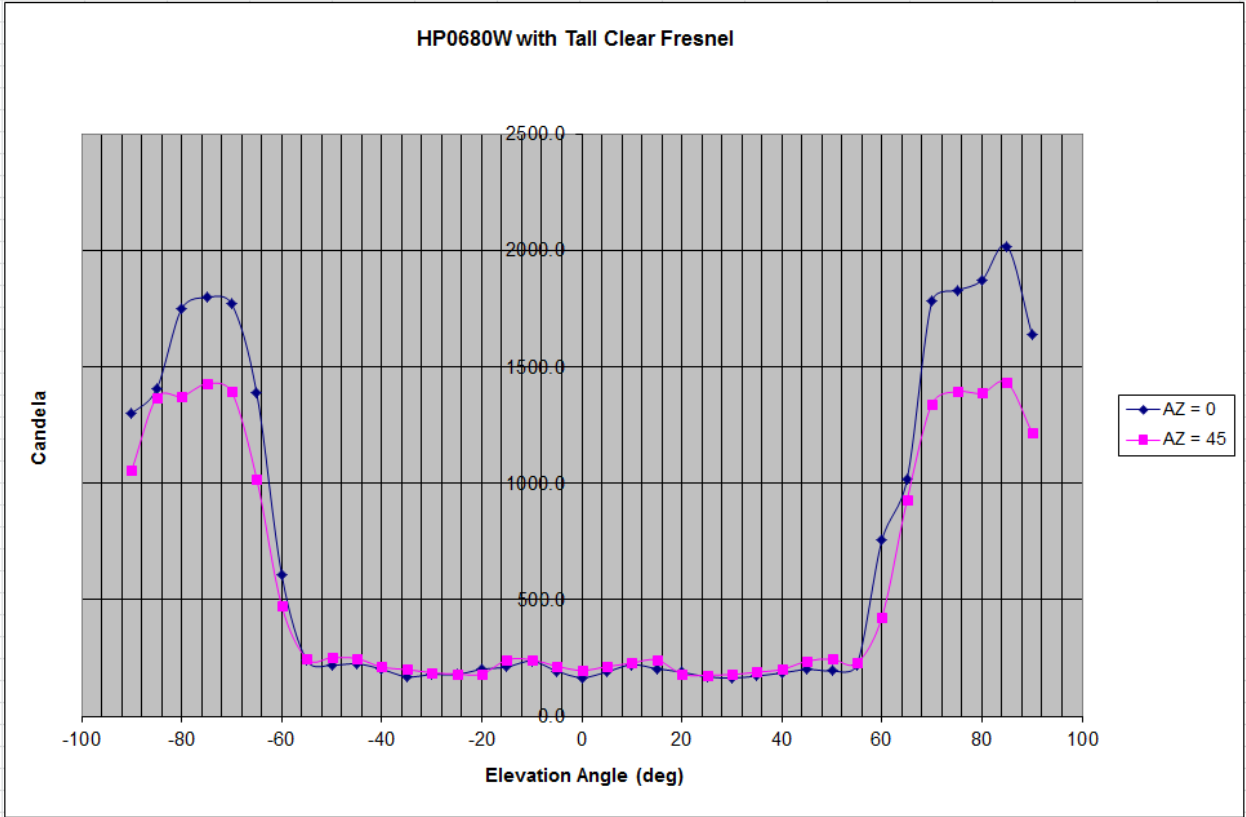


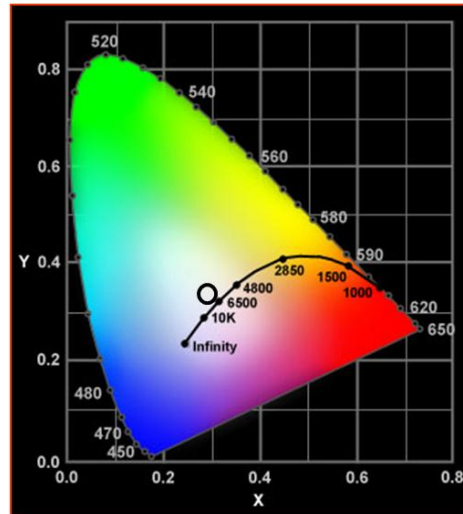
Figure 5. Illuminance in candela as a function of Elevation Angle in degrees;) 0 deg. & 45 deg. azimuth

CIE Color and Dominant Wavelength

The average of the CIE color coordinates measured for the white light is $x = 0.28$ and $y = 0.33$.

CIE Color Coordinate HP0680WFT

- Average CIE color coordinate
 - See black circle
 - $x = 0.28$
 - $y = 0.33$



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Figure 6. CIE color coordinates

Total Light Output

The integrated light output was calculated to be approximately 5300 lumens. This was calculated based on averaging the two elevation sweeps at azimuth angles of 0 degrees and 90 degrees to obtain 6040 lumens. Since only one 45 degree azimuth sweep was made, the 4600 lumens was averaged with the 6040 lumens to obtain the approximate 5300 lumen value. In actuality, it is unlikely that the brightness function between on-axis and 45-degree off-axis azimuth angle is linear, and the 5300 lumen value gives only an approximation. Readings were integrated over the closest 5 degree spherical section. The variations in the illuminance plots make the lumen integration less accurate than for a similar well-behaved curve. Please note that the term “lumen” assumes that the light covers the photopic spectrum which is approximate.

AZ = 90 d=	49.625 "												at d	at 12"	sq-ft	
	Y	X	Z	x	y	CCT	Time	Primary	Quality	ft-cd	ft-cd	at 1 foot	S=2R*pi*h	lumens		
-90	9.80E+02	9.25E+02	1.45E+03	0.276	0.2917	10301.68	May 03 10:09:48 2012	IR-525	Good	9.11E+01	1.56E+03	0.137034231	2.13E+02			
-85	1.11E+03	1.05E+03	1.64E+03	0.2768	0.2916	10224.13	May 03 10:10:07 2012	IR-525	Good	1.03E+02	1.76E+03	0.273025549	4.81E+02			
-80	1.31E+03	1.24E+03	2.01E+03	0.2723	0.2872	11074.38	May 03 10:10:19 2012	IR-525	Good	1.22E+02	2.08E+03	0.269904747	5.62E+02			
-75	1.23E+03	1.17E+03	1.85E+03	0.275	0.29	10521.82	May 03 10:10:31 2012	IR-525	Good	1.15E+02	1.96E+03	0.264729806	5.19E+02			
-70	1.29E+03	1.20E+03	1.82E+03	0.2779	0.3	9654.943	May 03 10:10:43 2012	IR-525	Good	1.20E+02	2.05E+03	0.257540112	5.28E+02			
-65	1.19E+03	1.10E+03	1.59E+03	0.2829	0.3076	8901.758	May 03 10:10:52 2012	IR-525	Good	1.11E+02	1.90E+03	0.248390382	4.71E+02			
-60	9.03E+02	8.41E+02	1.12E+03	0.2933	0.3149	7890.365	May 03 10:11:04 2012	IR-525	Good	8.38E+01	1.43E+03	0.237350251	3.40E+02			
-55	3.88E+02	3.23E+02	4.54E+02	0.277	0.3335	8561.958	May 03 10:11:13 2012	IR-525	Good	3.61E+01	6.17E+02	0.224503741	1.39E+02			
-50	1.57E+02	1.28E+02	1.57E+02	0.2895	0.3553	7430.543	May 03 10:11:22 2012	IR-525	Good	1.46E+01	2.49E+02	0.209948623	5.23E+01			
-45	1.48E+02	1.20E+02	1.47E+02	0.2897	0.3556	7419.082	May 03 10:11:33 2012	IR-525	Good	1.37E+01	2.34E+02	0.193795668	4.54E+01			
-40	1.49E+02	1.21E+02	1.47E+02	0.2904	0.3576	7356.633	May 03 10:11:44 2012	IR-525	Good	1.39E+01	2.37E+02	0.176167812	4.17E+01			
-35	1.38E+02	1.13E+02	1.39E+02	0.2889	0.3545	7473.159	May 03 10:11:54 2012	IR-525	Good	1.28E+01	2.20E+02	0.157199212	3.45E+01			
-30	1.27E+02	1.04E+02	1.26E+02	0.2903	0.3571	7369.29	May 03 10:12:06 2012	IR-525	Good	1.18E+01	2.02E+02	0.137034231	2.77E+01			
-25	1.22E+02	9.97E+01	1.22E+02	0.2901	0.3556	7401.04	May 03 10:12:15 2012	IR-525	Good	1.14E+01	1.94E+02	0.115826337	2.25E+01			
-20	1.21E+02	9.87E+01	1.20E+02	0.2901	0.3563	7388.769	May 03 10:12:25 2012	IR-525	Good	1.13E+01	1.93E+02	0.093736935	1.80E+01			
-15	1.37E+02	1.12E+02	1.36E+02	0.2905	0.3561	7372.819	May 03 10:12:39 2012	IR-525	Good	1.27E+01	2.17E+02	0.070934138	1.54E+01			
-10	1.50E+02	1.21E+02	1.46E+02	0.2907	0.3604	7309.597	May 03 10:12:51 2012	IR-525	Good	1.40E+01	2.39E+02	0.047591489	1.14E+01			
-5	1.59E+02	1.28E+02	1.52E+02	0.2911	0.3625	7269.463	May 03 10:13:02 2012	IR-525	Good	1.48E+01	2.53E+02	0.02388664	6.05E+00			
0	1.35E+02	1.09E+02	1.29E+02	0.2923	0.3629	7209.361	May 03 10:13:27 2012	IR-525	Good	1.26E+01	2.15E+02	0.002990098	6.42E-01			
5	1.25E+02	1.01E+02	1.18E+02	0.2934	0.3642	7146.733	May 03 10:13:51 2012	IR-525	Good	1.16E+01	1.99E+02	0.02388664	4.74E+00			
10	1.31E+02	1.06E+02	1.25E+02	0.2935	0.362	7165.323	May 03 10:14:11 2012	IR-525	Good	1.22E+01	2.08E+02	0.047591489	9.89E+00			
15	1.57E+02	1.27E+02	1.51E+02	0.2918	0.361	7252.192	May 03 10:14:25 2012	IR-525	Good	1.46E+01	2.49E+02	0.070934138	1.77E+01			
20	1.51E+02	1.22E+02	1.44E+02	0.2925	0.3616	7212.621	May 03 10:14:36 2012	IR-525	Good	1.40E+01	2.40E+02	0.093736935	2.25E+01			
25	1.43E+02	1.15E+02	1.39E+02	0.2903	0.3603	7330.152	May 03 10:14:50 2012	IR-525	Good	1.33E+01	2.27E+02	0.115826337	2.63E+01			
30	1.22E+02	9.93E+01	1.22E+02	0.2893	0.3554	7439.966	May 03 10:15:27 2012	IR-525	Good	1.13E+01	1.94E+02	0.137034231	2.66E+01			
35	1.26E+02	1.03E+02	1.27E+02	0.2886	0.3537	7502.577	May 03 10:15:41 2012	IR-525	Good	1.17E+01	2.00E+02	0.157199212	3.14E+01			
40	1.30E+02	1.07E+02	1.34E+02	0.2875	0.351	7601.803	May 03 10:15:57 2012	IR-525	Good	1.21E+01	2.07E+02	0.176167812	3.64E+01			
45	1.41E+02	1.15E+02	1.44E+02	0.2882	0.3528	7535.425	May 03 10:16:06 2012	IR-525	Good	1.31E+01	2.24E+02	0.193795668	4.34E+01			
50	1.36E+02	1.12E+02	1.41E+02	0.2869	0.35	7647.013	May 03 10:16:19 2012	IR-525	Good	1.26E+01	2.16E+02	0.209948623	4.54E+01			
55	1.46E+02	1.21E+02	1.58E+02	0.284	0.3435	7912.671	May 03 10:16:28 2012	IR-525	Good	1.35E+01	2.32E+02	0.224503741	5.20E+01			
60	3.68E+02	3.20E+02	5.11E+02	0.2669	0.3069	10384.88	May 03 10:16:39 2012	IR-525	Good	3.42E+01	5.84E+02	0.237350251	1.39E+02			
65	8.32E+02	7.93E+02	1.10E+03	0.2907	0.3052	8341.394	May 03 10:16:49 2012	IR-525	Good	7.73E+01	1.32E+03	0.248390382	3.28E+02			
70	1.00E+03	9.49E+02	1.43E+03	0.2812	0.2963	9508.691	May 03 10:17:03 2012	IR-525	Good	9.29E+01	1.59E+03	0.257540112	4.09E+02			
75	1.12E+03	1.05E+03	1.63E+03	0.2758	0.2951	10136.84	May 03 10:17:18 2012	IR-525	Good	1.04E+02	1.78E+03	0.264729806	4.71E+02			
80	1.18E+03	1.11E+03	1.78E+03	0.272	0.2894	10934.43	May 03 10:17:26 2012	IR-525	Good	1.09E+02	1.87E+03	0.269904747	5.05E+02			
85	1.10E+03	1.04E+03	1.69E+03	0.2719	0.2881	11048.32	May 03 10:17:36 2012	IR-525	Good	1.03E+02	1.75E+03	0.273025549	4.79E+02			
90	9.80E+02	9.27E+02	1.45E+03	0.276	0.2918	10301.68	May 03 10:17:48 2012	IR-525	Good	9.11E+01	1.56E+03	0.137034231	2.13E+02			
		Average	90 Deg Az	0.285008	0.333478									6.280189902		
			0 Deg Az	0.284465	0.333689											
			Average	0.284736	0.333584									total lumens	6.39E+03	

Figure 8. Data Spreadsheet for Elevation Sweep at Az = 90 degrees

AZ = 45													sq-ft	
d=	49.625 "											at d	at 12"	at 1 foot
	Y	X	Z	x	y	CCT	Time	Primary	Quality	ft-cd	ft-cd	S=2R*pi*h	lumens	
1	-90	6.63E+02	5.33E+02	6.38E+02	0.2905	0.3618	7302.419	May 03 10:21:33 2012	IR-525	Good	6.16E+01	1.05E+03	0.137034231	1.44E+02
2	-85	8.62E+02	7.73E+02	8.71E+02	0.3084	0.3439	6612.65	May 03 10:21:44 2012	IR-525	Good	8.00E+01	1.37E+03	0.273025549	3.74E+02
3	-80	8.64E+02	7.77E+02	8.84E+02	0.3079	0.3421	6652.955	May 03 10:21:59 2012	IR-525	Good	8.02E+01	1.37E+03	0.269904747	3.70E+02
4	-75	8.98E+02	8.01E+02	8.87E+02	0.3096	0.3473	6526.155	May 03 10:22:10 2012	IR-525	Good	8.34E+01	1.43E+03	0.264729806	3.78E+02
5	-70	8.76E+02	7.80E+02	8.47E+02	0.3116	0.3499	6413.868	May 03 10:22:25 2012	IR-525	Good	8.14E+01	1.39E+03	0.257540112	3.58E+02
6	-65	6.42E+02	5.12E+02	5.86E+02	0.2941	0.3689	7062.825	May 03 10:22:38 2012	IR-525	Good	5.96E+01	1.02E+03	0.248390382	2.53E+02
7	-60	2.98E+02	2.38E+02	2.80E+02	0.2914	0.3655	7223.961	May 03 10:22:46 2012	IR-525	Good	2.77E+01	4.74E+02	0.237350251	1.12E+02
8	-55	1.55E+02	1.25E+02	1.46E+02	0.293	0.3648	7156.787	May 03 10:22:54 2012	IR-525	Good	1.44E+01	2.47E+02	0.224503741	5.54E+01
9	-50	1.58E+02	1.27E+02	1.46E+02	0.2942	0.3668	7082.808	May 03 10:23:02 2012	IR-525	Good	1.47E+01	2.51E+02	0.209948623	5.27E+01
10	-45	1.56E+02	1.24E+02	1.40E+02	0.296	0.3709	6961.267	May 03 10:23:17 2012	IR-525	Good	1.45E+01	2.48E+02	0.193795668	4.80E+01
11	-40	1.33E+02	1.07E+02	1.23E+02	0.2945	0.3665	7070.14	May 03 10:23:34 2012	IR-525	Good	1.23E+01	2.11E+02	0.176167812	3.72E+01
12	-35	1.26E+02	1.01E+02	1.17E+02	0.2944	0.3663	7078.225	May 03 10:23:51 2012	IR-525	Good	1.17E+01	2.00E+02	0.157199212	3.15E+01
13	-30	1.18E+02	9.51E+01	1.11E+02	0.294	0.3644	7117.359	May 03 10:24:00 2012	IR-525	Good	1.09E+01	1.87E+02	0.137034231	2.56E+01
14	-25	1.14E+02	9.21E+01	1.07E+02	0.2939	0.3637	7127.616	May 03 10:24:10 2012	IR-525	Good	1.06E+01	1.81E+02	0.115826337	2.10E+01
15	-20	1.14E+02	9.21E+01	1.08E+02	0.2933	0.3628	7163.516	May 03 10:24:20 2012	IR-525	Good	1.06E+01	1.81E+02	0.093736935	1.70E+01
16	-15	1.52E+02	1.23E+02	1.42E+02	0.2938	0.3651	7117.377	May 03 10:24:31 2012	IR-525	Good	1.41E+01	2.42E+02	0.070934138	1.72E+01
17	-10	1.52E+02	1.22E+02	1.42E+02	0.2934	0.3663	7125.704	May 03 10:24:40 2012	IR-525	Good	1.41E+01	2.42E+02	0.047591489	1.15E+01
18	-5	1.35E+02	1.08E+02	1.25E+02	0.2939	0.3662	7099.623	May 03 10:25:02 2012	IR-525	Good	1.25E+01	2.14E+02	0.02388664	5.12E+00
19	0	1.24E+02	9.91E+01	1.13E+02	0.2956	0.3687	6997.64	May 03 10:25:11 2012	IR-525	Good	1.15E+01	1.96E+02	0.002990098	5.87E-01
20	5	1.34E+02	1.07E+02	1.24E+02	0.2936	0.3666	7109.853	May 03 10:25:35 2012	IR-525	Good	1.24E+01	2.13E+02	0.02388664	5.09E+00
21	10	1.44E+02	1.17E+02	1.38E+02	0.2927	0.3601	7221.453	May 03 10:25:48 2012	IR-525	Good	1.33E+01	2.28E+02	0.047591489	1.09E+01
22	15	1.52E+02	1.22E+02	1.42E+02	0.2929	0.3659	7150.119	May 03 10:26:03 2012	IR-525	Good	1.42E+01	2.42E+02	0.070934138	1.72E+01
23	20	1.14E+02	9.19E+01	1.10E+02	0.2915	0.3607	7270.804	May 03 10:26:15 2012	IR-525	Good	1.06E+01	1.81E+02	0.093736935	1.69E+01
24	25	1.11E+02	8.95E+01	1.06E+02	0.2925	0.3615	7214.852	May 03 10:26:33 2012	IR-525	Good	1.03E+01	1.76E+02	0.115826337	2.04E+01
25	30	1.13E+02	9.09E+01	1.07E+02	0.2927	0.3624	7193.862	May 03 10:26:48 2012	IR-525	Good	1.05E+01	1.79E+02	0.137034231	2.45E+01
26	35	1.19E+02	9.60E+01	1.13E+02	0.2928	0.3631	7184.525	May 03 10:27:02 2012	IR-525	Good	1.11E+01	1.89E+02	0.157199212	2.97E+01
27	40	1.26E+02	1.02E+02	1.20E+02	0.293	0.3628	7179.227	May 03 10:27:13 2012	IR-525	Good	1.17E+01	2.01E+02	0.176167812	3.53E+01
28	45	1.49E+02	1.20E+02	1.40E+02	0.2933	0.3641	7151.641	May 03 10:27:26 2012	IR-525	Good	1.38E+01	2.36E+02	0.193795668	4.58E+01
29	50	1.55E+02	1.25E+02	1.48E+02	0.2919	0.3621	7234.527	May 03 10:27:37 2012	IR-525	Good	1.44E+01	2.46E+02	0.209948623	5.16E+01
30	55	1.43E+02	1.17E+02	1.43E+02	0.2897	0.3563	7410.123	May 03 10:27:46 2012	IR-525	Good	1.33E+01	2.28E+02	0.224503741	5.11E+01
31	60	2.68E+02	2.22E+02	2.90E+02	0.2844	0.3434	7891.926	May 03 10:27:57 2012	IR-525	Good	2.49E+01	4.25E+02	0.237350251	1.01E+02
32	65	5.83E+02	4.70E+02	5.83E+02	0.2873	0.3564	7528.78	May 03 10:28:07 2012	IR-525	Good	5.42E+01	9.27E+02	0.248390382	2.30E+02
33	70	8.44E+02	7.51E+02	8.53E+02	0.3066	0.3448	6691.773	May 03 10:28:17 2012	IR-525	Good	7.84E+01	1.34E+03	0.257540112	3.45E+02
34	75	8.77E+02	7.82E+02	9.17E+02	0.3037	0.3404	6877.774	May 03 10:28:27 2012	IR-525	Good	8.15E+01	1.39E+03	0.264729806	3.69E+02
35	80	8.73E+02	7.83E+02	9.33E+02	0.3024	0.3372	6978.911	May 03 10:28:35 2012	IR-525	Good	8.11E+01	1.39E+03	0.269904747	3.74E+02
36	85	9.02E+02	8.11E+02	9.67E+02	0.3026	0.3366	6976.776	May 03 10:28:43 2012	IR-525	Good	8.38E+01	1.43E+03	0.273025549	3.91E+02
37	90	7.66E+02	6.97E+02	8.11E+02	0.3065	0.3369	6763.095	May 03 10:28:58 2012	IR-525	Good	7.12E+01	1.22E+03	0.137034231	1.67E+02
38														
39			Average	90 Deg Az	0.296043	0.358195							6.280189902	
40				0 Deg Az	0.284465	0.333689								
41														
42			Average		0.290254	0.345942							total lumens	4.60E+03

Figure 9. Data Spreadsheet for Elevation Sweep at Az = 45 degrees