



Product Test Report - Goniometer Luminaire Evaluation

Method: LM-79:2019
Evaluation: Horticulture Summary
Test: Horticulture Near-Field Performance

Test results reported for:
Horticulture Lighting Group
Product Description: HLG350 R

Issued Report:
HORP002-020_HLG350 R
Project: 80073926 - TPPPT

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First Issue

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TABLE OF CONTENTS

Subject	Page(s)
Sample Description	3
Flat-Field Description	4
Optical Stabilization	5
Electrical Stabilization	6
Horticulture Summary	7
Spectral Quantum Distribution	8
Photosynthetic Photon Intensity	9
PPID TABLE	10
PPID at Application Distance	11
PPID Table for Flat Field	12
Equipment	13
About Accredited Testing	14
Revision History	15

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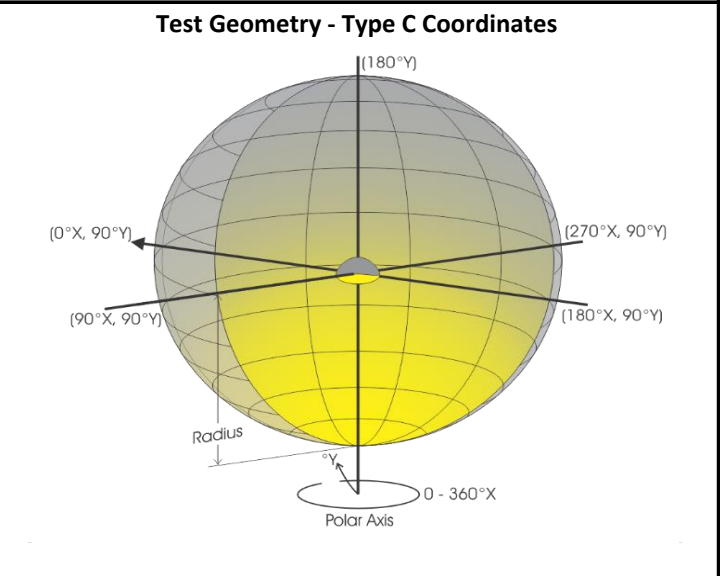
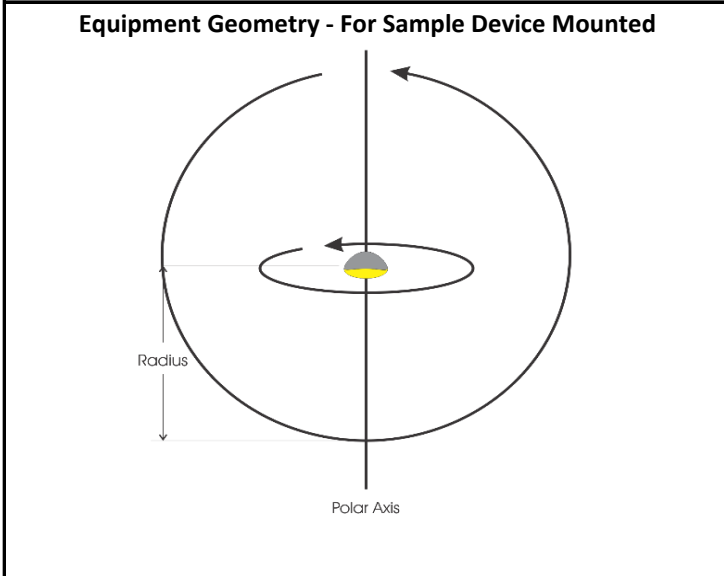
SAMPLE DESCRIPTION

Lab sample identification: 2 Customer Identification: HLG350 R Manufacturer: Horticulture Lighting Group Part number: NA Model Number: HLG350 R Description: Scorpion Diablo	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;">Manufacturer's ratings</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px;">Max Current (A):</td> <td style="padding: 2px;">NA</td> </tr> <tr> <td style="padding: 2px;">Operating voltage:</td> <td style="padding: 2px;">120-277 V AC</td> </tr> <tr> <td style="padding: 2px;">CCT:</td> <td style="padding: 2px;">NA</td> </tr> <tr> <td style="padding: 2px;">Frequency (Hz):</td> <td style="padding: 2px;">50-60</td> </tr> <tr> <td style="padding: 2px;">Type:</td> <td style="padding: 2px;">LED (Variable, tested max)</td> </tr> </tbody> </table>	Manufacturer's ratings		Max Current (A):	NA	Operating voltage:	120-277 V AC	CCT:	NA	Frequency (Hz):	50-60	Type:	LED (Variable, tested max)
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Max Current (A):	NA												
Operating voltage:	120-277 V AC												
CCT:	NA												
Frequency (Hz):	50-60												
Type:	LED (Variable, tested max)												

Sample Device as Received

Sample Device Mounted to Test Apparatus

Image At 0° and 0°, See Equipment Geometry



Coordinate System Description

Reference: LM-75-01 Goniophotometer Types and Photometric Coordinates

Type C coordinate system, the polar axis is vertical. The angles measure in the vertical half planes of data are called vertical angles, and the angles to the horizontal half planes are called lateral angles. The vertical V angles range in value from 0° to 180°. The lateral L planes range in value from 0° to 360°.

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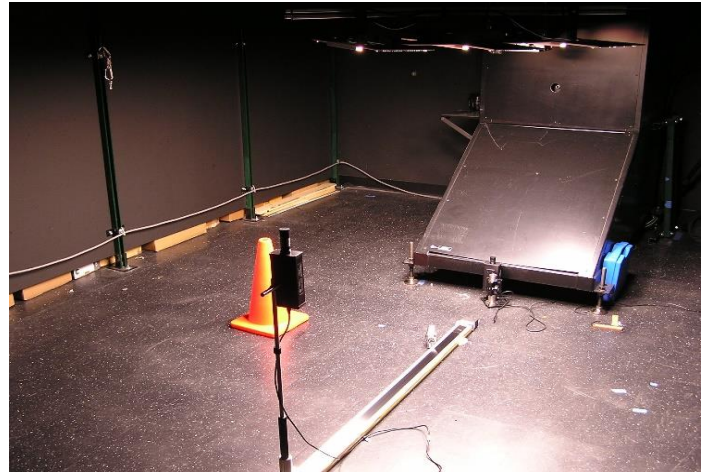
FLAT-FIELD DESCRIPTION

An additional flat-field measurement for a specified application distance(s) was performed on this luminaire for IES horticulture applications. IES files, are generally used to calculate lighting performance in the far-field (10x diameter aperture). For horticulture applications, the use of far-field measurements for near-field projections, creates large errors at the field/plane of interest. However, an application specific measurement can be performed using a radial measurement geometry as a fixed height (z) from the measurement plane to the aperture of the luminaire (see figure below). The resulting IES file is valid for use at the specified application distance (z) only.

Sample Device as Received

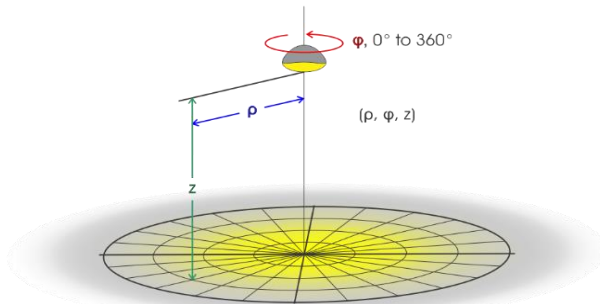


Sample Device Mounted to Test Apparatus



Radius Step Size (ρ): 2.5°
 Angular Resolution (ϕ): 22.5°
 Height from plane (z): 18 inches

Base Orientation: ↓



Reference: Radial Coordinates on a Horizontal Plane

The three coordinates (ρ , ϕ , z) of a point P are defined as:

- The axial distance or radial distance ρ is the Euclidean distance from the z-axis to the point P.
- The azimuth ϕ is the angle between the reference direction on the plane and the line from the origin to the projection P.
- The axial coordinate or height z is the signed distance from the chosen plane to the point P.

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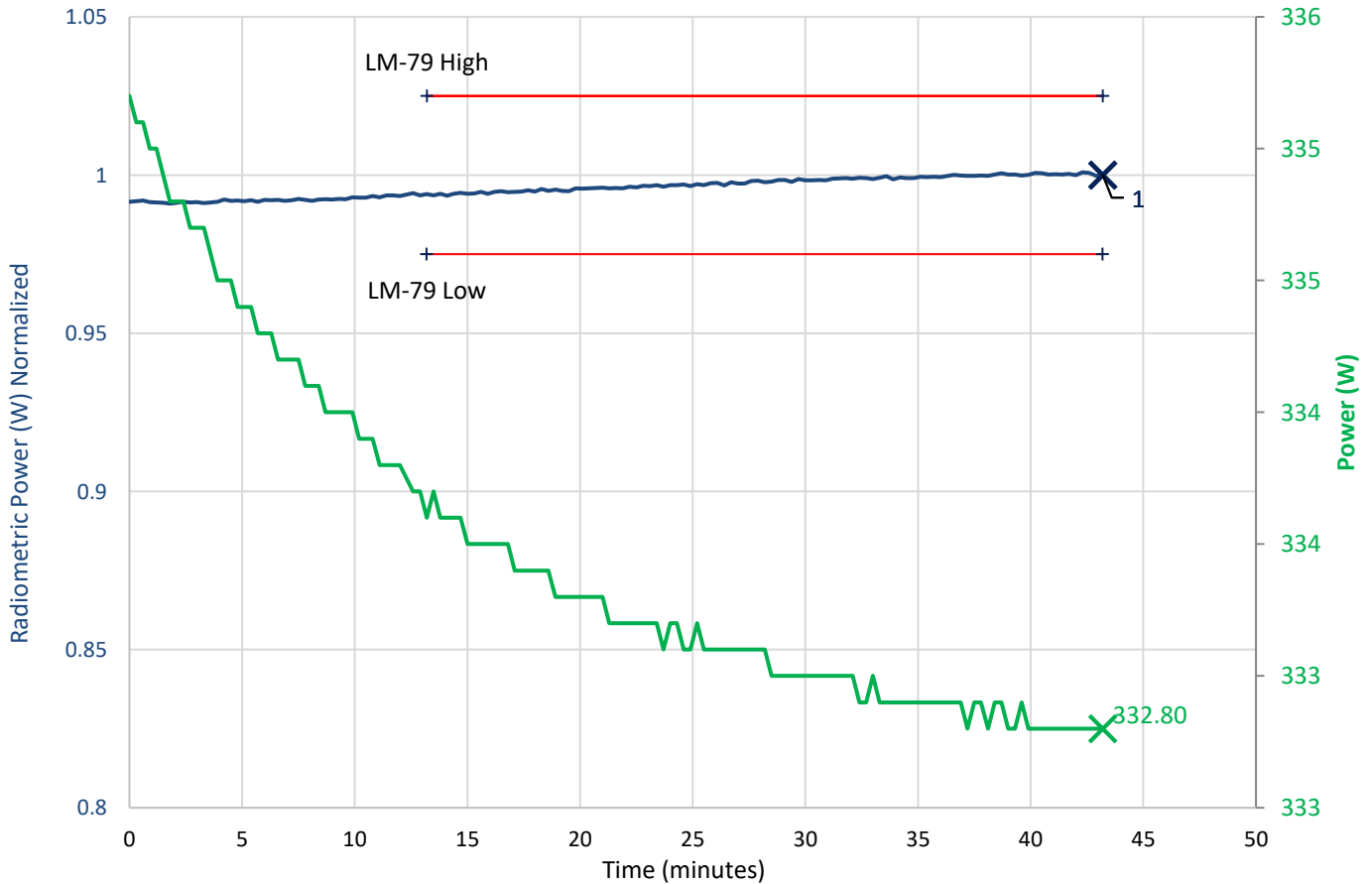
Release Date: 3/23/2021

OPTICAL STABILIZATION

Stabilization Description - A series of 142 measurements are recorded during the stabilization period. The final stabilized measurement of normalized radiant power, as defined by LM-79:2019, is reported after 43 minutes of recorded device runtime. The 'Measurements in Range', provided below, are a histogram of measurements recorded during the 30 minute stabilization window.

% of range	Radiometric Power (W)	Measurements in Range
99.347%	0.99	10
99.421%	0.99	11
99.495%	0.99	6
99.570%	1.00	10
99.644%	1.00	10
99.718%	1.00	8
99.792%	1.00	9
99.866%	1.00	13
99.940%	1.00	16
100.014%	1.00	10
100.000%	1.00	Reported

% of range	Power (W)	Measurements in Range
100.000%	332.80	16
100.027%	332.89	19
100.054%	332.98	13
100.081%	333.07	13
100.108%	333.16	11
100.135%	333.25	8
100.162%	333.34	6
100.189%	333.43	7
100.216%	333.52	5
100.243%	333.61	3
100.000%	332.80	Reported



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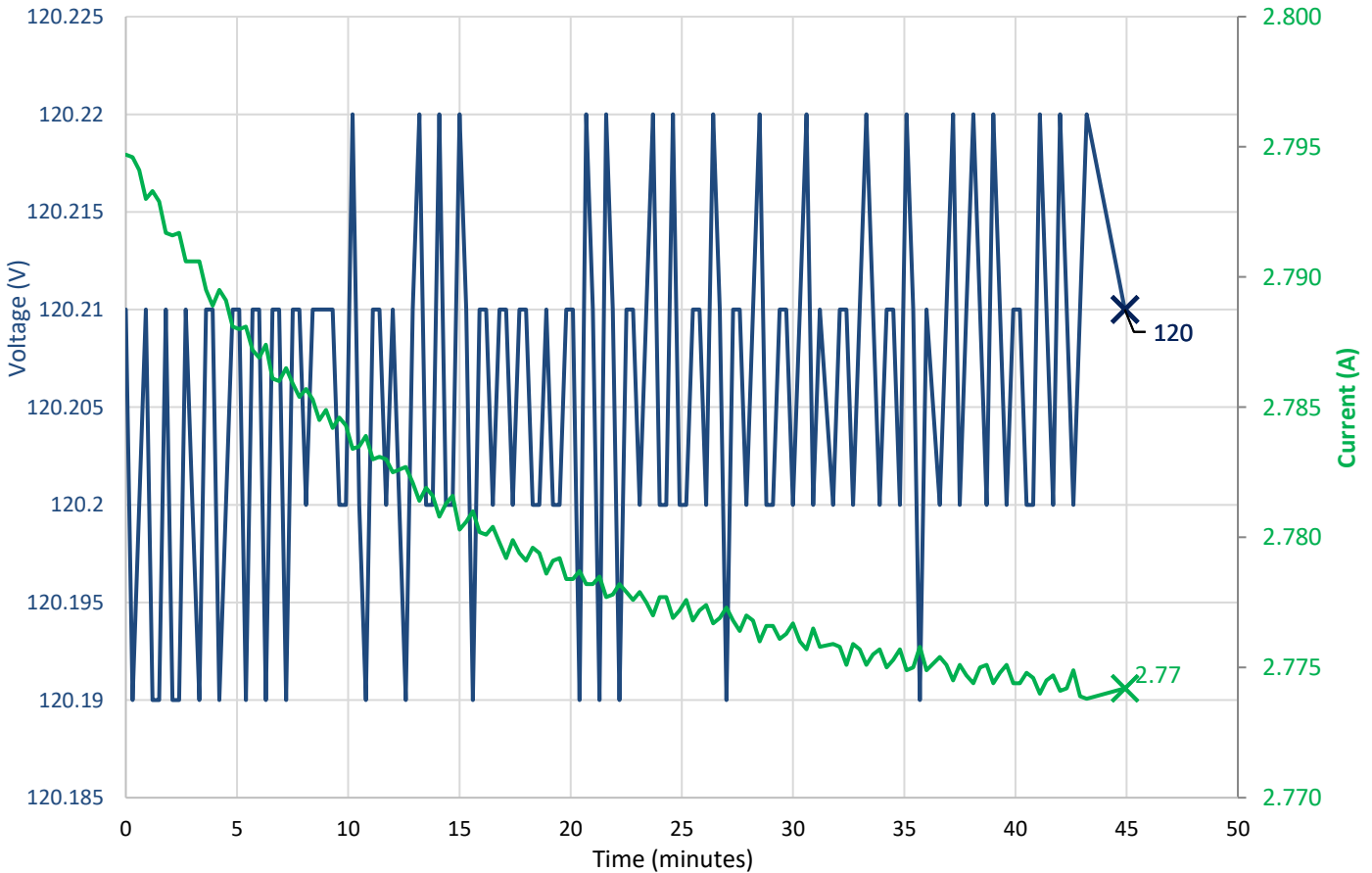
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ELECTRICAL STABILIZATION

Stabilization Description - A series of 143 measurements are recorded during the stabilization period. The final stabilized measurement, as defined by LM-79:2019, is reported after 45 minutes of recorded device runtime. The 'Measurements in Range', provided below, are a histogram of measurements recorded during the 30 minute stabilization window.

% of range	Voltage (V)	Measurements in Range
99.983%	120.19	18
99.986%	120.19	0
99.988%	120.20	0
99.991%	120.20	41
99.993%	120.20	0
99.996%	120.21	0
99.998%	120.21	65
100.001%	120.21	0
100.003%	120.21	0
100.006%	120.22	19
100.000%	120.21	Reported

% of range	Current (A)	Measurements in Range
99.986%	2.774	12
100.014%	2.775	18
100.042%	2.775	14
100.070%	2.776	12
100.098%	2.777	12
100.126%	2.778	11
100.154%	2.778	7
100.182%	2.779	5
100.211%	2.780	5
100.239%	2.781	2
100.000%	2.774	Reported



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HORTICULTURE SUMMARY

Photon Flux (μmol/s)				
WL (nm)	50 nm BIN	100 nm bin	300 nm bin	Total Bin
350-400	1.85 0.2%	-	-	970.86 100%
400-450	39.99 4.1%	150.79	926.03 95.4%	
450-500	110.80 11.4%	15.5%		
500-550	143.18 15%	367.01		
550-600	223.83 23.1%	37.8%		
600-650	230.10 23.7%	408.23		
650-700	178.12 18.3%	42.0%		
700-750	21.20 2.2%	27.15	32.93 3.4%	
750-800	5.96 0.6%	2.8%		
800-900	-	5.69 0.6%		
900-1000	-	9.94 1.0%		

	<i>Value</i>	<i>units</i>	<i>Description</i>
① Photosynthetic Photon Flux:	926	μmol/s	(400 - 700nm)
PPF Efficacy :	2.782	μmol/joule	(PPF/Active Power)
Photon Flux:	971	μmol/s	(350 - 1000nm)
Photon Efficacy :	2.917	μmol/joule	(Photon Flux/Active Power)
Total Integrated YPF (μmol/s):	827.2	μmol/s	(Yield Photon Flux)
② YPF Efficacy:	2.486	μmol/joule	(Total Integrated YPF/Active Power)
Photosynthetically Active Yield Efficiency :	89.34	%	(YPF/PPF)

NOTE 1: Photosynthetic Photon Flux: weighted equally by wavelength and summed between 400nm and 700nm.
 NOTE 2: Yield Photon Flux: PPF weighted by action spectrum (average of 20 plant species as defined by McCree) and summed between 350nm and 750nm. (See Spectrum)

Electrical Performance			Thermal Performance		
Voltage:	120.2 V	THD Voltage:	0.0 %	Ambient Temperature:	25.0 °C
Current:	2.8 A	THD Current:	6.7 %		
Frequency:	60.0 Hz				
Active Power:	332.8 W				
Apparent Power:	333.5 VA				
Power Factor:	1.00 W/VA				



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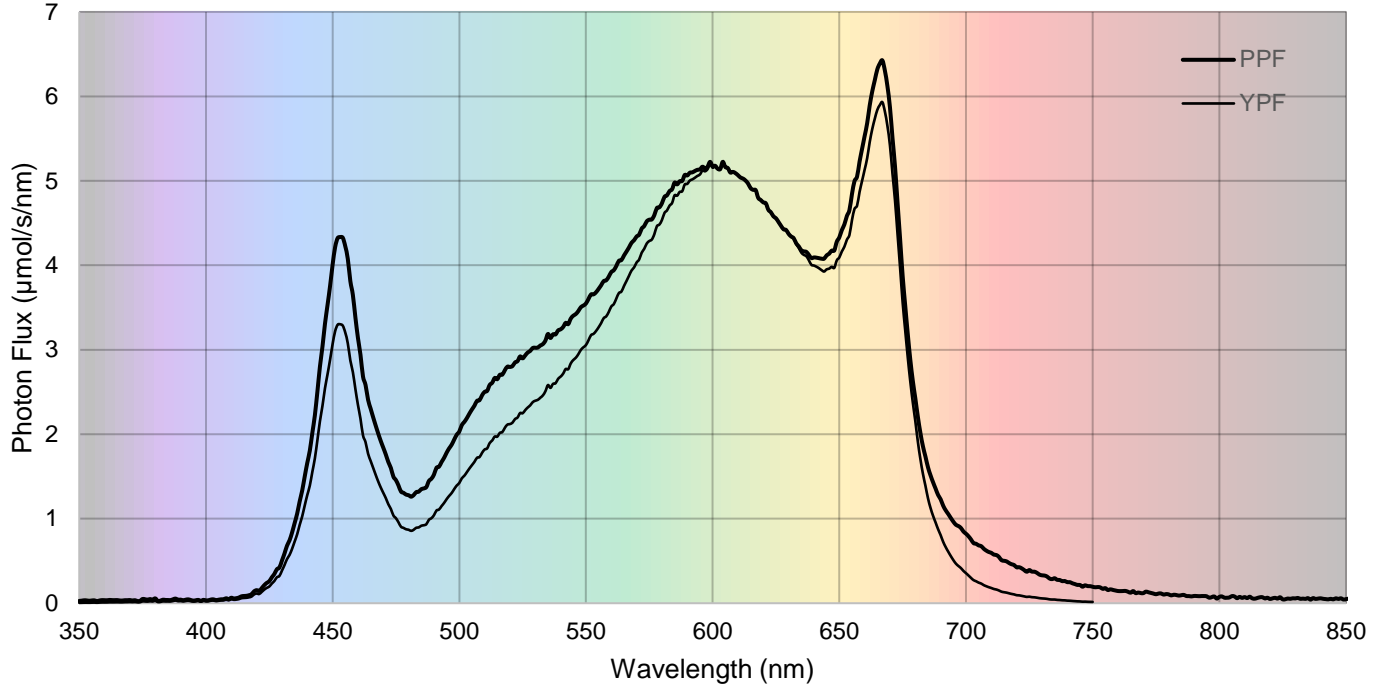
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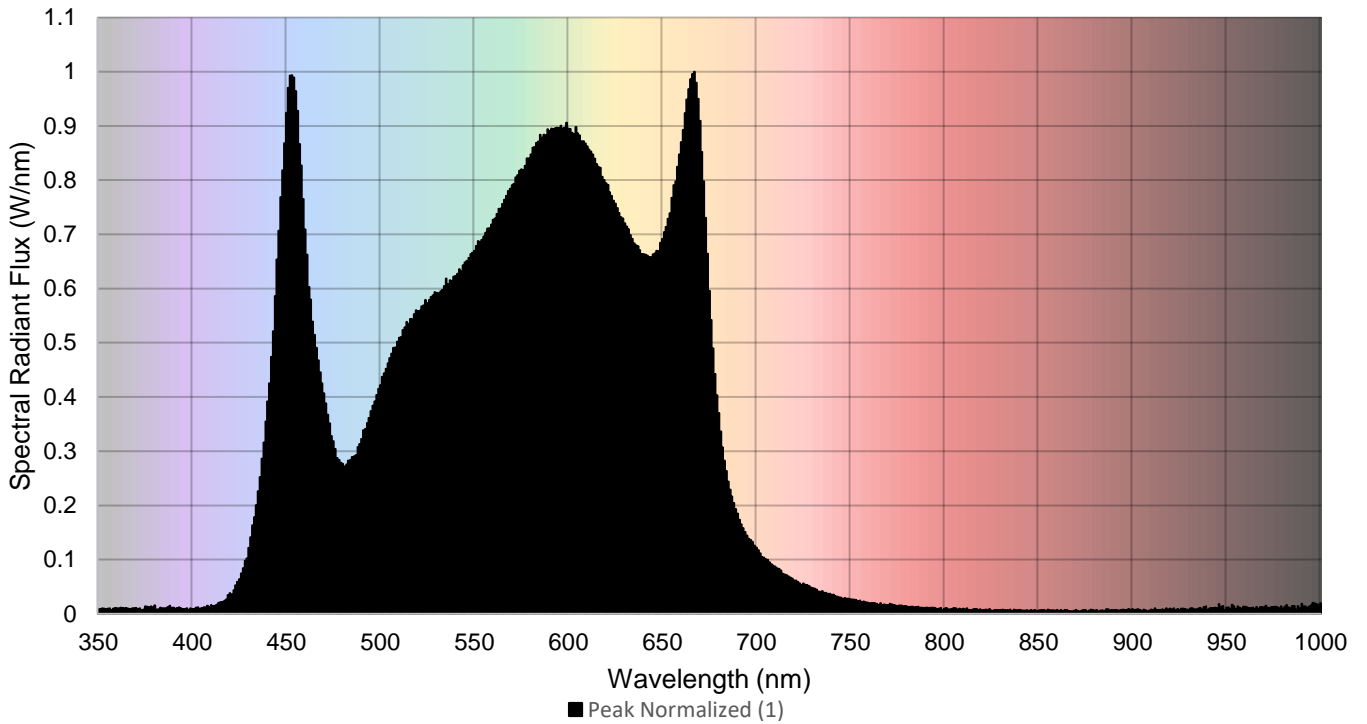
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SPECTRAL QUANTUM DISTRIBUTION

Spectral Quantum Distribution



Spectral Radiant Flux (Normalized)



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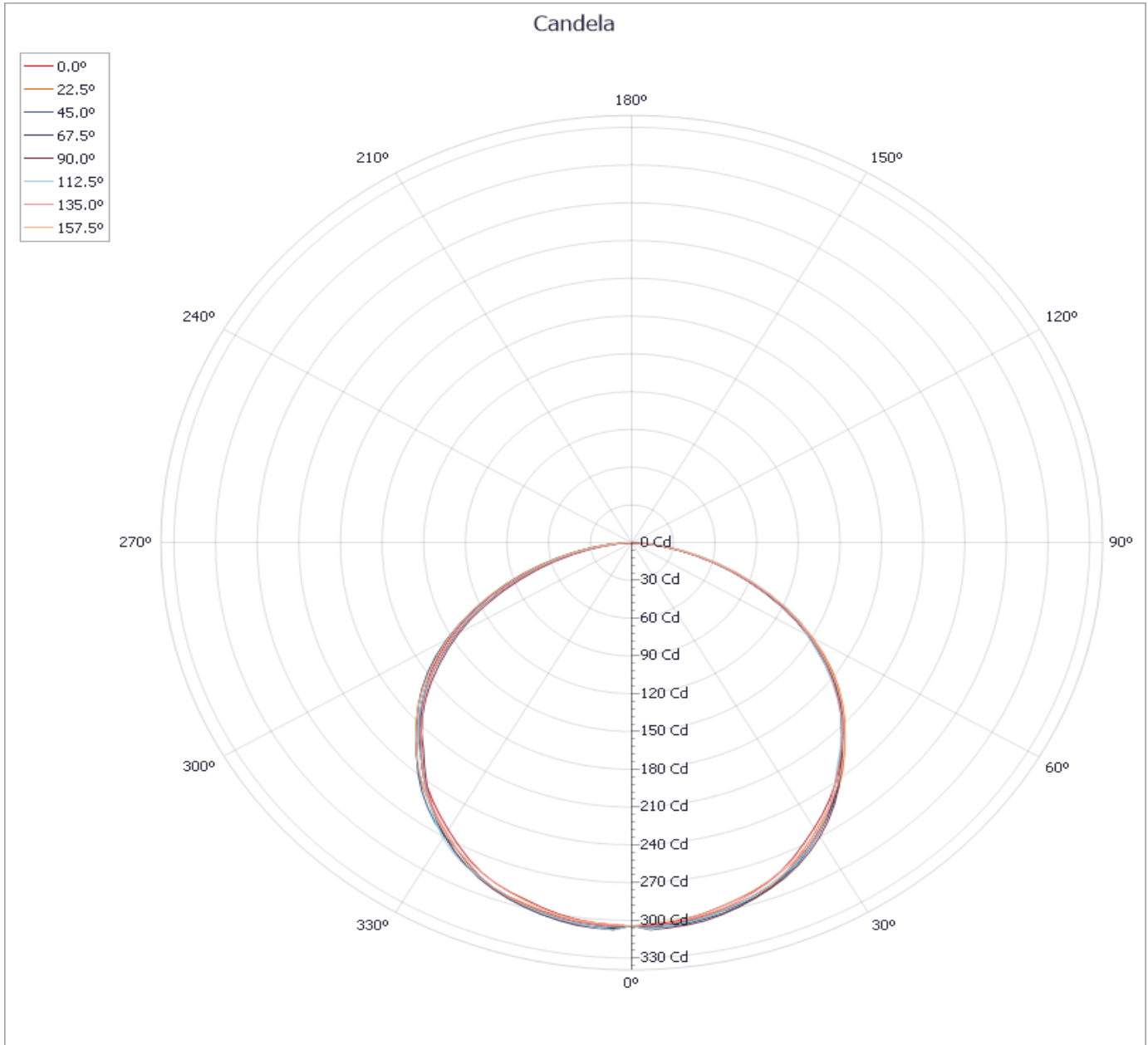
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PHOTOSYNTHETIC PHOTON INTENSITY

Axis values of Candela (Cd) do not represent units of measurement. Actual value reported are Photosynthetic Photon Intensity Distribution (PPID) in units of ($\mu\text{mol/s}\cdot\text{sr}$)



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PPID TABLE

LOWER HEMISPHERE

	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5	360	
South Pole	0	304.25	304.25	304.25	304.25	304.25	304.25	304.25	304.25	304.25	304.25	304.25	304.25	304.25	304.25	304.25	304.25	
	2.5	303.79	304.72	304.92	305.95	307.8	307.47	304.81	302.57	303.79	304.86	305.22	306.46	307.72	308.04	304.92	303.63	304.19
	5	302.85	303.87	304.44	306.04	307.06	305.89	303.84	301.77	303.1	304.19	304.8	306.51	307.25	306.73	304.44	303.08	303.39
	7.5	301.23	302.79	303.74	305.14	306.27	304.27	302.29	300.86	301.85	303.39	304.08	305.61	306.47	305.2	303.74	302.26	302.04
	10	298.92	300.97	302.2	303.5	304.91	302.27	300.27	299.07	299.81	301.68	302.5	304.1	304.66	303.54	302.2	300.52	299.97
	12.5	296.08	298.7	299.93	301.74	302.45	299.87	298.07	296.31	296.99	299.38	300.33	302.33	302.14	301.4	299.93	297.88	297.24
	15	293.3	296.31	297.85	299.03	299.44	296.79	295.13	293.07	293.78	296.95	298.34	299.59	299.06	298.65	297.85	294.78	294.38
	17.5	290.5	293.94	295.44	295.84	295.99	293.34	291.43	289.86	291.02	294.69	295.73	296.5	295.59	295.22	295.44	291.49	291.75
	20	286.91	290.68	291.76	292.11	292.24	289.3	287.19	286.14	287.68	291.55	291.92	292.8	292.2	291.52	291.76	287.88	288.41
	22.5	281.77	285.72	286.84	287.51	288.29	284.96	282.8	281.86	283.29	287.05	286.63	288.34	288.08	287.62	286.84	283.71	283.95
	25	275.7	279.12	280.46	282.09	283.2	280.43	278.39	277.04	277.48	280.9	280.38	282.92	282.8	283.54	280.46	278.96	278.11
	27.5	268.92	271.91	273.9	275.45	277.12	275.1	273.76	271.64	270.84	273.7	273.99	276.59	276.43	278.34	273.9	273.76	271.5
	30	262.31	264.9	267.04	268.49	270.4	268.39	267.86	265.42	263.97	266.73	269.39	269.49	269.21	271.52	267.04	267.78	264.64
	32.5	255.72	258.08	259.86	260.97	262.78	259.67	259.71	258.55	257.16	259.9	263.88	262.01	261.42	263.14	259.86	261.11	258.12
	35	248.62	251.58	252.23	253.01	254.27	250.34	250.46	250.95	250.24	253.43	256.63	253.76	252.48	253.92	252.23	253.81	251.18
	37.5	240.98	244.51	243.85	243.65	244.88	240.65	240.72	243.26	242.95	246.74	248.67	244.33	242.88	244.24	243.85	246.16	243.78
	40	232.42	236.22	234.37	233.99	234.78	230.69	231.88	235	234.84	238.79	239.54	234.94	232.45	234.61	234.37	238.06	235.49
	42.5	223.32	226.75	224.48	224.24	224.08	222.33	223.55	226.21	225.82	229.67	229.58	225.03	222.35	226.16	224.48	229.39	226.58
	45	214.35	217.36	214.67	213.84	215.05	214.29	214.59	217	216.75	220.24	219.75	214.83	214.24	218.16	214.67	220.19	217.44
	47.5	204.98	208.03	205.06	204.86	206.36	204.61	204.88	207.59	207.63	210.81	209.97	206.24	204.86	208.58	205.06	210.82	208.36
	50	194.93	198.05	195.45	195.74	196.04	193.76	194.25	197.38	197.7	201.04	200.63	196.82	194.34	197.81	195.45	200.83	198.7
	52.5	184.1	187.29	184.97	184.84	184.34	182.44	183.09	186.27	187.14	190.59	190.53	185.83	182.4	186.55	184.97	189.77	188.01
	55	172.66	175.98	173.52	172.56	171.83	169.89	171.8	174.55	176.09	179.28	179.43	173.26	169.72	174.29	173.52	178.12	176.85
	57.5	160.22	163.47	161.26	159.54	159.24	157.28	160.03	162.24	164.08	166.95	167.41	160.16	157.12	161.3	161.26	165.72	164.92
	60	147.11	150.15	147.95	146.57	146.49	145.44	147.39	149.42	151.15	153.66	154.25	147.02	144.05	148.61	147.95	153.14	152.01
	62.5	133.46	136.41	133.34	132.86	133.23	137.93	133.26	136.07	137.52	140.09	140.06	133.08	130.36	135.26	133.34	139.79	138.27
	65	119.42	122.45	118.88	118.5	118.17	123.68	118.54	122.21	123.68	125.96	125.04	118.67	114.97	120.69	118.88	125.93	131.07
	67.5	104.56	108.05	104.67	103.58	103.39	108.16	104.07	107.63	109.4	111.74	110.96	103.5	100.1	105.25	104.67	111.29	117.18
	70	89.77	93.45	90.45	89.32	88.97	93.6	89.13	92.61	94.2	97.22	96.58	89.27	85.33	90.76	90.45	96.32	102.1
	72.5	75.44	79	75.79	75	74.89	79.14	74.24	78.09	79.64	82.9	81.85	74.9	71.52	76.09	75.79	81.75	87.44
	75	61.19	64.57	61.57	61.06	60.73	65.33	60.36	63.46	65.41	68.14	67.54	60.86	57.69	62.34	61.57	67.13	73.06
	77.5	47.47	50.63	48.17	47.36	47.11	51.77	47.19	49.81	51.51	54.09	53.66	47.14	43.91	48.93	48.17	53.33	58.88
	80	34.3	37.66	35.61	34.75	34.64	38.76	34.41	36.91	38.12	40.87	40.78	34.44	31.02	35.98	35.61	40.18	44.98
	82.5	22.2	25.63	23.82	23.24	22.85	26.83	22.89	24.79	25.49	28.61	28.49	22.8	19.58	24.21	23.82	27.82	31.94
	85	12.05	14.87	13.33	12.85	12.02	16.18	12.67	13.9	14.56	17.25	17.54	12.27	9.3	13.6	13.33	16.61	20.02
	87.5	4.47	6.27	5.36	5.34	4.29	7.39	5.03	5.62	6.42	7.96	8.03	5.09	2.67	5.7	5.36	7.54	10.43
Equator	90	0.02	1.43	0.83	0.59	0	1.96	0.69	1.2	0.99	2.29	2.44	0.5	0	0.86	0.83	2.06	3.3

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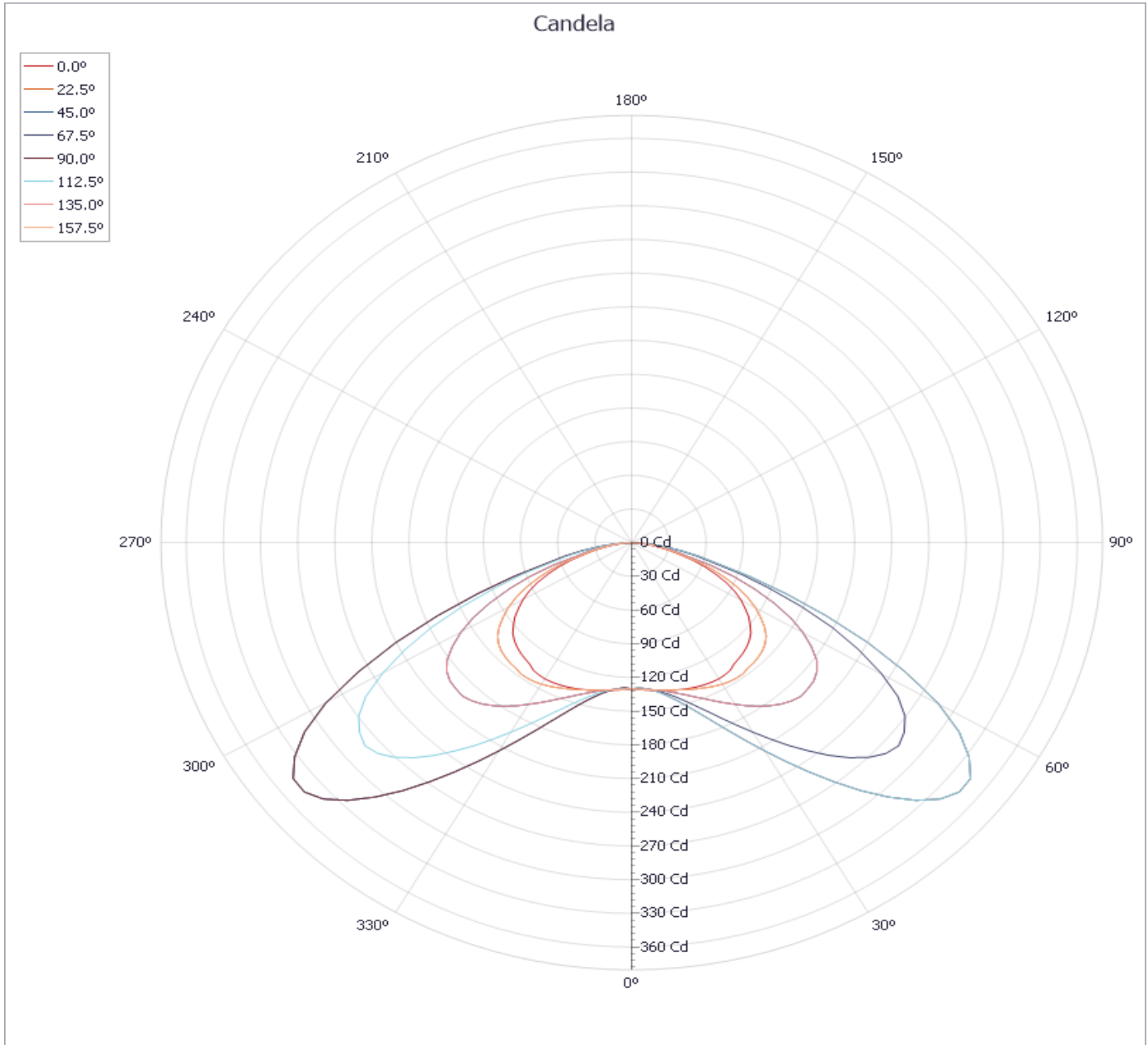
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PPID AT APPLICATION DISTANCE

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PPID TABLE FOR FLAT FIELD

Angle of measurement from center of lamp to Application Distance of 18 inches	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5	360		
0	130.06	130.06	130.06	130.06	130.06	130.06	130.06	130.06	130.06	130.06	130.06	130.06	130.06	130.06	130.06	130.06	130.06	130.06	0.00
2.5	130.83	130.94	130.47	129.96	129.28	129.28	130.47	130.94	130.83	130.94	130.47	129.28	129.28	129.96	130.47	130.94	130.83	130.83	0.07
5	131.81	131.48	130.97	130.65	130.39	130.39	130.97	131.48	131.81	131.48	130.97	130.39	130.39	130.65	130.97	131.48	131.81	131.81	0.13
7.5	132.72	132.33	132.04	132.17	132.57	132.57	132.04	132.33	132.72	132.33	132.04	132.57	132.57	132.17	132.04	132.33	132.72	132.72	0.20
10	133.79	133.27	133.56	134.73	135.91	135.91	133.56	133.27	133.79	133.27	133.56	135.91	135.91	134.73	133.56	133.27	133.79	133.79	0.26
12.5	134.8	134.48	135.76	138.32	140.51	140.51	135.76	134.48	134.8	134.48	135.76	140.51	140.51	138.32	135.76	134.48	134.8	134.8	0.33
15	135.77	135.82	138.56	142.86	146.35	146.35	138.56	135.82	135.77	135.82	138.56	146.35	146.35	142.86	138.56	135.82	135.77	135.77	0.40
17.5	136.85	137.25	141.83	148.58	153.58	153.58	141.83	137.25	136.85	137.25	141.83	153.58	153.58	148.58	141.83	137.25	136.85	136.85	0.47
20	137.88	138.93	145.83	155.46	162.31	162.31	145.83	138.93	137.88	138.93	145.83	162.31	162.31	155.46	145.83	138.93	137.88	137.88	0.55
22.5	138.75	140.59	150.09	163.4	172.59	172.59	150.09	140.59	138.75	140.59	150.09	172.59	172.59	163.4	150.09	140.59	138.75	138.75	0.62
25	139.46	142.31	155.15	172.66	184.63	184.63	155.15	142.31	139.46	142.31	155.15	184.63	184.63	172.66	155.15	142.31	139.46	139.46	0.70
27.5	139.94	144.08	160.56	183.12	198.35	198.35	160.56	144.08	139.94	144.08	160.56	198.35	198.35	183.12	160.56	144.08	139.94	139.94	0.78
30	140.14	145.56	166.08	194.45	213.72	213.72	166.08	145.56	140.14	145.56	166.08	213.72	213.72	194.45	166.08	145.56	140.14	140.14	0.87
32.5	139.67	146.68	172.02	206.9	230.52	230.52	172.02	146.68	139.67	146.68	172.02	230.52	230.52	206.9	172.02	146.68	139.67	139.67	0.96
35	138.66	147.25	177.65	220.18	248.91	248.91	177.65	147.25	138.66	147.25	177.65	248.91	248.91	220.18	177.65	147.25	138.66	138.66	1.05
37.5	135.92	147.28	182.96	233.4	268.28	268.28	182.96	147.28	135.92	147.28	182.96	268.28	268.28	233.4	182.96	147.28	135.92	135.92	1.15
40	134.49	145.73	187.6	247.06	288.21	288.21	187.6	145.73	134.49	145.73	187.6	288.21	288.21	247.06	187.6	145.73	134.49	134.49	1.26
42.5	133.11	145.39	191.06	259.61	307.11	307.11	191.06	145.39	133.11	145.39	191.06	307.11	307.11	259.61	191.06	145.39	133.11	133.11	1.37
45	131.2	144.36	193.35	270.34	324.42	324.42	193.35	144.36	131.2	144.36	193.35	324.42	324.42	270.34	193.35	144.36	131.2	131.2	1.50
47.5	128.76	142.91	192.7	278.03	337.87	337.87	192.7	142.91	128.76	142.91	192.7	337.87	337.87	278.03	192.7	142.91	128.76	128.76	1.64
50	125.49	140.46	191.76	281.35	345.29	345.29	191.76	140.46	125.49	140.46	191.76	345.29	345.29	281.35	191.76	140.46	125.49	125.49	1.79
52.5	120.55	136.81	188.44	277.37	344.89	344.89	188.44	136.81	120.55	136.81	188.44	344.89	344.89	277.37	188.44	136.81	120.55	120.55	1.95
55	115.35	130.87	182.35	269.43	332.59	332.59	182.35	130.87	115.35	130.87	182.35	332.59	332.59	269.43	182.35	130.87	115.35	115.35	2.14
57.5	108.39	123.18	171.77	254.9	313.47	313.47	171.77	123.18	108.39	123.18	171.77	313.47	313.47	254.9	171.77	123.18	108.39	108.39	2.35
60	101.67	115.23	159.37	232.55	285.62	285.62	159.37	115.23	101.67	115.23	159.37	285.62	285.62	232.55	159.37	115.23	101.67	101.67	2.60
62.5	93.574	105.37	144.49	206.72	249.2	249.2	144.49	105.37	93.574	105.37	144.49	249.2	249.2	206.72	144.49	105.37	93.574	93.574	2.88
65	84.279	94.525	126.14	178.8	210.26	210.26	126.14	94.525	84.279	94.525	126.14	210.26	210.26	178.8	126.14	94.525	84.279	84.279	3.22
67.5	73.374	81.688	106.8	147.85	169.97	169.97	106.8	81.688	73.374	81.688	106.8	169.97	169.97	147.85	106.8	81.688	73.374	73.374	3.62
70	62.705	68.977	87.068	117.59	132.08	132.08	87.068	68.977	62.705	68.977	87.068	132.08	132.08	117.59	87.068	68.977	62.705	62.705	4.12
72.5	51.398	55.163	66.901	91.436	99.734	99.734	66.901	55.163	51.398	55.163	66.901	99.734	99.734	91.436	66.901	55.163	51.398	51.398	4.76
75	38.977	40.515	45.892	66.985	71.29	71.29	45.892	40.515	38.977	40.515	45.892	71.29	71.29	66.985	45.892	40.515	38.977	38.977	5.60
77.5	30.238	31.768	35.904	51.955	55.301	55.301	35.904	31.768	30.238	31.768	35.904	55.301	55.301	51.955	35.904	31.768	30.238	30.238	6.77
80	21.849	23.63	26.542	38.122	40.663	40.663	26.542	23.63	21.849	23.63	26.542	40.663	40.663	38.122	26.542	23.63	21.849	21.849	8.51
82.5	14.141	16.082	17.754	25.495	26.823	26.823	17.754	16.082	14.141	16.082	17.754	26.823	26.823	25.495	17.754	16.082	14.141	14.141	11.39
85	7.6757	9.3303	9.9356	14.097	14.11	14.11	9.9356	9.3303	7.6757	9.3303	9.9356	14.11	14.11	14.097	9.9356	9.3303	7.6757	7.6757	-
87.5	2.8473	3.9341	3.9951	5.8581	5.0359	5.0359	3.9951	3.9341	2.8473	3.9341	3.9951	5.0359	5.0359	5.8581	3.9951	3.9341	2.8473	2.8473	-
90	0.0127	0.8973	0.6186	0.6472	0	0	0.6186	0.8973	0.0127	0.8973	0.6186	0	0	0.6472	0.6186	0.8973	0.0127	0.0127	∞

Equator

Radial distance from center of lamp in feet



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Product Test Report - Goniometer Luminaire Evaluation

Manufacturer: Horticulture Lighting Group

Report Number: HORP002-020

Product Description: HLG350 R

Release Date: 3/23/2021

EQUIPMENT

Item	Description/use	Manufacturer	Model	Serial #	Calibration Due
Spectrometer	Spectrum	Orb Optronix	SP-75	4013726	7/16/2021
Radiometer	Power Meter	Newport	2936R	18953	3/25/2021
Quantum Sensor	PAR vs Angle	Gigahertz-Optik	PS-3701	44466	3/25/2021
AC Power Supply	DUT AC Voltage	QuadTech	31015	QT3101500128	Not Applicable
Power Analyzer	Electrical	Yokogawa	WT310E	C25K10003V	8/16/2021
Goniometer	Angular & IES data	Orb Optronix	Gono 7_M	GONO007	8/16/2021
Spectral Suite	Software - Spectrum	Orb Optronix	SS V3	3.1.17.901	Not Applicable
Spectral Suite	Software - IES	Orb Optronix	SS V3	3.0.16.951	Not Applicable

Product Test Report - Goniometer Luminaire Evaluation

Manufacturer:
Product Description:

Report Number:
Release Date:

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Product Test Report - Goniometer Luminaire Evaluation

Manufacturer: Horticulture Lighting Group

Report Number: HORP002-020

Product Description: HLG350 R

Release Date: 3/23/2021

REVISION HISTORY

REVISION	DATE	APPROVED	DESCRIPTION OF REVISION
020	3/23/2021	ACM	① ORIGINAL

END OF REPORT