IES LM-79-08

MEASUREMENT AND TEST REPORT

For

P.Q.L., Inc.

2285 Ward Avenue / Simi Valley, CA 93065

Test Model: 91756

Report Type:	Electrical and Photometric tests including: Luminous Flux, Chromaticity, Luminous Intensity Distribution
Test Engineer:	Hill Liu
Report Number:	R1KS181017092-10
Test Date:	2018-10-22
Report Date:	2020-06-11
Reviewed By:	Bill Xiong / EE Engineer
Prepared By:	Bay Area Compliance Laboratories Corp. (Dongguan). No.69, Pulongcun, Puxinhu Industrial Area, Tangxia, Dongguan, Guangdong, China. Tel: +86-0769-86858888 Fax:+86-0769-86858588
Accreditation:	The IAS Accreditation Number TL-460.

1. Product Description

General Information:

Two samples were received on 2018-10-17. One was tested in integrating sphere and the other was tested in goniophotometer.

Model Tested:	91756
Manufacturer:	P.Q.L., Inc.
Brand Name:	Superior Life®
Product Designation:	Directional LED Lamp
Burning Time Before Test:	0hour(For New Products)

Rated Values:

Rated Voltage/Frequency:	120-277VAC 60Hz
Rated Power:	19.5W
Nominal CCT:	4000K
Nominal Lumen Output:	1800lm

2. Standards Used

IES LM-79-08: Approved Method: Electrical & Photometric Measurement of Solid-state Lighting Products
ANSI C82.77-10-2014: Harmonic Emission Limits – Related Power Quality Requirements for Lighting
IES TM-30-18:IES Method for Evaluating Light Source Color Rendition (This method is not in IAS accreditation scope)

3. Description of Test Equipment

Device	Manufacture	Model No	Serial No	Calibration date	Calibration due date
1.5m integrating sphere	SENSING	1.5m	NA	2018-03-18	2019-03-18
Digital power meter	EVERFINE	PF9811	G135717CN1361159	2017-12-14	2018-12-14
High-precision rapid spectral radiometer	EVERFINE	HAAS-2000	N/A	2018-03-18	2019-03-18
Precision frequency power supply	ALL Power	APW-105N	970663	2018-03-19	2019-03-19
Standard Light Source	EVERFINE	D204	G100283CA8351158	2018-01-08	2019-01-08
thermometer	SENSING	NA	NA	2018-03-17	2019-03-17
Programmable Precision DC Power Supply	ITECH	IT6154	0061 0417 6471 0010 19	2018-03-26	2019-03-26
AC POWER SUPPLY	EVERFINE	VPS1030 PWM	1012017	2018-03-19	2019-03-19
Digital CC&CV DC Power Supply	EVERFINE	WY12010	1009009	2018-03-26	2019-03-26
Digital power meter	YOKOGAWA	WT-210	91j926132	2018-03-26	2019-03-26
full-field speed goniophotometer	EVERFINE	GO-R5000	YG108492N10120001	2018-03-18	2019-03-18
Wireless Remote Sensor	N/A	433MHz	N/A	2018-03-17	2019-03-17

Device	Manufacture	Model No	Serial No	Calibration date	Calibration due date
Standard Light Source	EVERFINE	D908	1012003	2018-01-05	2019-01-05

Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attested that all calibration has been performed using suitable standards traceable to National Primary Standards and International System of Units (SI).

4. Test Method

Product was tested with no seasoning. All stabilization and measurements were made in compliance with IES LM-79-08. The product was operated at rated voltage or at voltage required by manufacturer.The ambient temperature of the sample was maintained at 25°C±1°C during measurement. And relative humidity is less than 65%.

Integrating Sphere System

The system includes AC power source, digital power meter, DC power supply, Spectroradiometer, and integrating sphere.The integrating sphere system is calibrated by standard spectrum light source before measurement.

4π geometry was used during measurement. The product was operated in its intended orientation in application and was recorded in this report.

The uncertainty of the light output (luminous flux) measurements is U=1.6% (K=2), at the 95% confidence level. The uncertainty of the correlated color temperature measurements is U=20K (K=2), at the 95% confidence level. The uncertainty of the CRI is U=1.6(K=2), at the 95% confidence level.

The uncertainty of power meter AC current U=0.19 % of rdg, AC Voltage U=0.17% of rdg, Power U=0.48% (K=2), at the 95% confidence level.

Goniophotometer System

The goniophotometer system is calibrated by standard light source before measurement.

Type C goniophotometer was used for measuring total luminous flux, luminous intensity distribution, and color spatial uniformity. The product was operated in its intended orientation in application and was recorded in this report. The vertical angle (*γ*) test intervals were set no more than 1 degree while data for 5 degree intervals is reported. The horizontal angle (C plane) test intervals were set no more than 22.5 degree.

The uncertainty of the luminous intensity is U=2.82% (K=2), at the 95% confidence level.

Fidelity Index and GamutIndex Calculation

The R_f, R_g was calculated according to IES TM-30-18 by using calculation tools. The calculation was based on the measured SPD from 380nm to 780nm with 1nm intervals. All the colors in this report is for reference only.

5. Test Result

[Integrating Sphere System]

Total operating time for integrating sphere test: **1.0 hour**

Test orientation: **Base up**

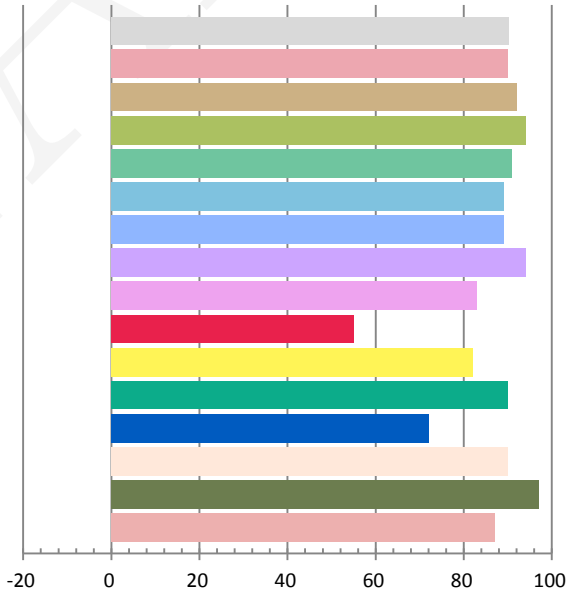
Photometric and Electrical Measurement Result

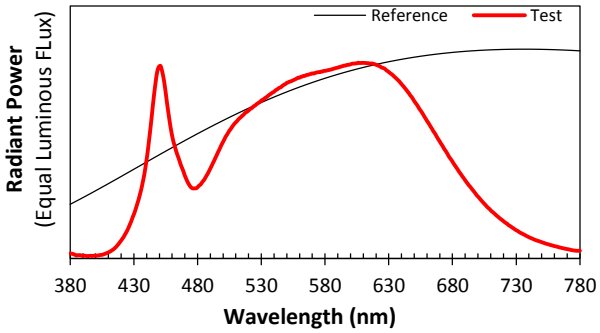
Voltage(V)	Frequency(Hz)	Current(A)	Power (W)	Power Factor	Luminous Flux(lm)	Efficacy(lm/W)
120.0	60	0.1580	18.75	0.9890	2115.0	112.83

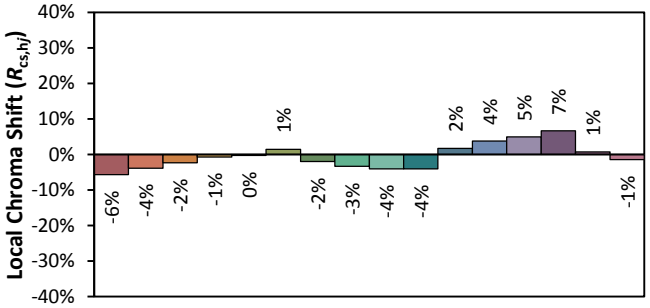
Radiant Flux (W)	CCT (K)	Duv	x	y	u'	v'
7.1157	3937	0.00253	0.3852	0.3851	0.2249	0.5059

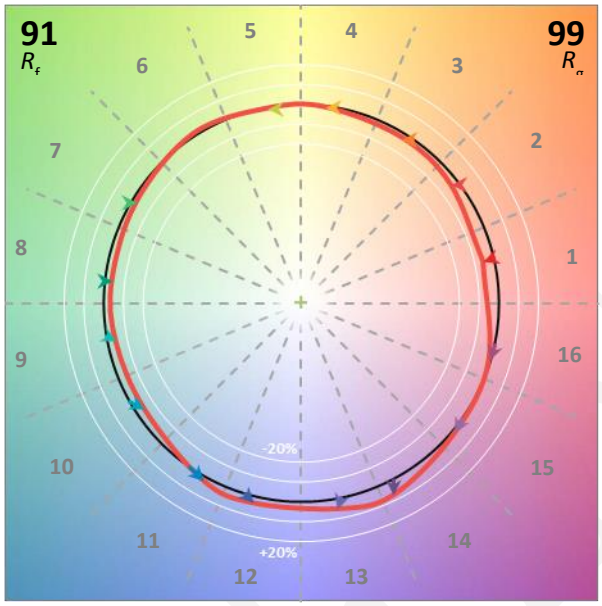
Color Rendering Index

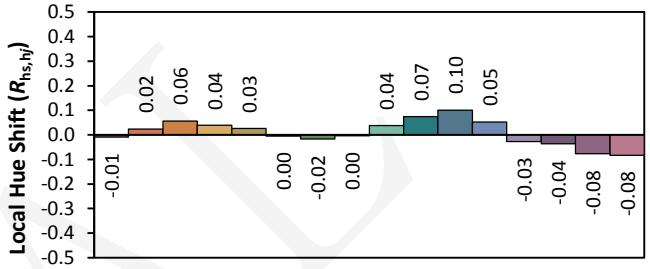
Ra			
90.3			
R1	R2	R3	R4
90	92	94	91
R5	R6	R7	R8
89	89	94	83
R9	R10	R11	R12
55	82	90	72
R13	R14	R15	
90	97	87	

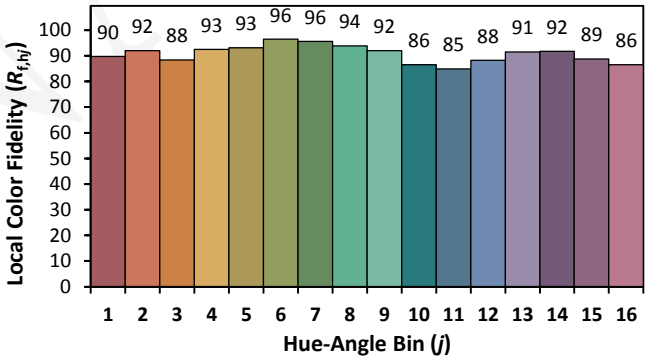


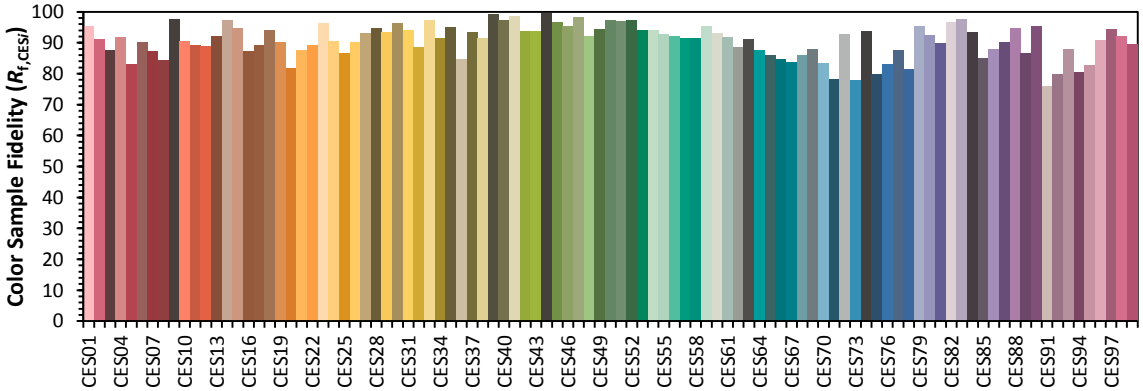

Reference
Test
Radiant Power
(Equal Luminous FLux)
380 430 480 530 580 630 680 730 780
Wavelength (nm)


Local Chroma Shift ($R_{cs,hj}$)
40% 30% 20% 10% 0% -10% -20% -30% -40%
-6% -4% -2% -1% 0% 1% -2% -3% -4% -4% 2% 4% 5% 7% 1% -1%

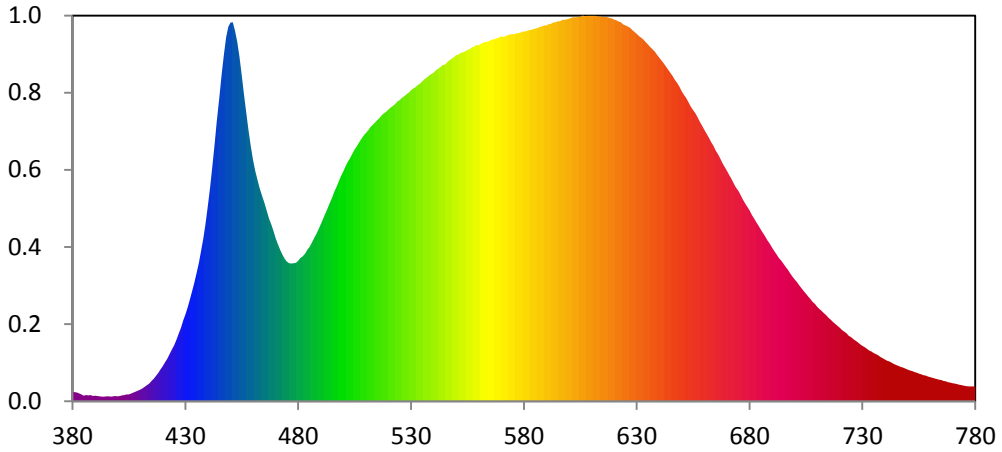

91
R_f
99
R_g
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
-20%
+20%


Local Hue Shift ($R_{hs,hj}$)
0.5 0.4 0.3 0.2 0.1 0.0 -0.1 -0.2 -0.3 -0.4 -0.5
-0.01 0.02 0.06 0.04 0.03 0.00 -0.02 0.00 0.04 0.07 0.10 0.05 -0.03 -0.04 -0.08 -0.08


Local Color Fidelity ($R_{f,hj}$)
100 90 80 70 60 50 40 30 20 10 0
90 92 88 93 93 96 96 94 92 86 85 88 91 92 89 86
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Hue-Angle Bin (j)


Color Sample Fidelity ($R_{f,CESi}$)
100 90 80 70 60 50 40 30 20 10 0
CES01 CES04 CES07 CES10 CES13 CES16 CES19 CES22 CES25 CES28 CES31 CES34 CES37 CES40 CES43 CES46 CES49 CES52 CES55 CES58 CES61 CES64 CES67 CES70 CES73 CES76 CES79 CES82 CES85 CES88 CES91 CES94 CES97

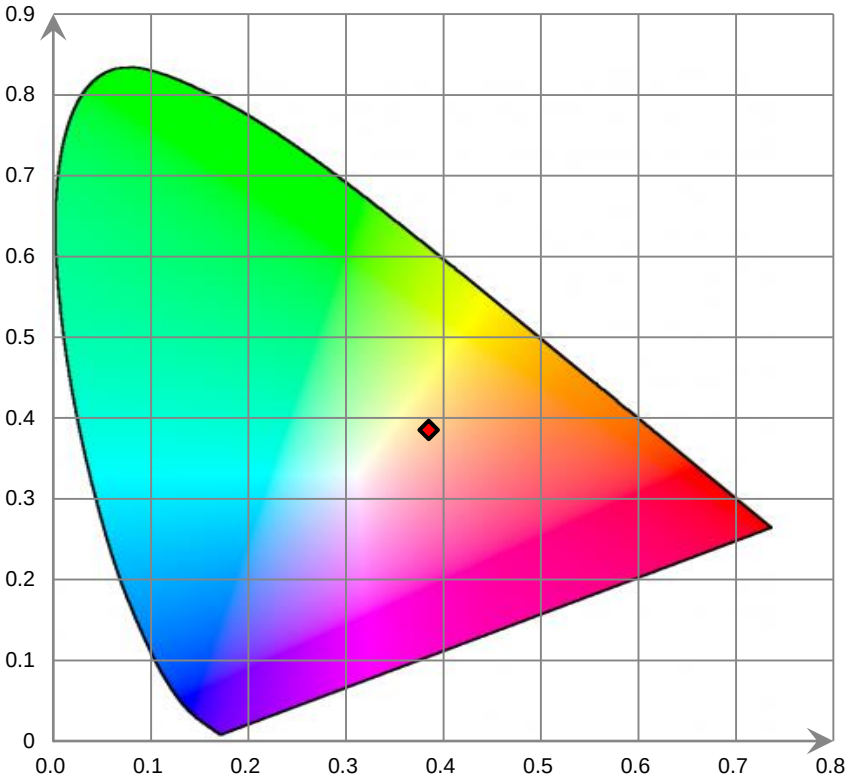
Relative Spectral Power Distribution



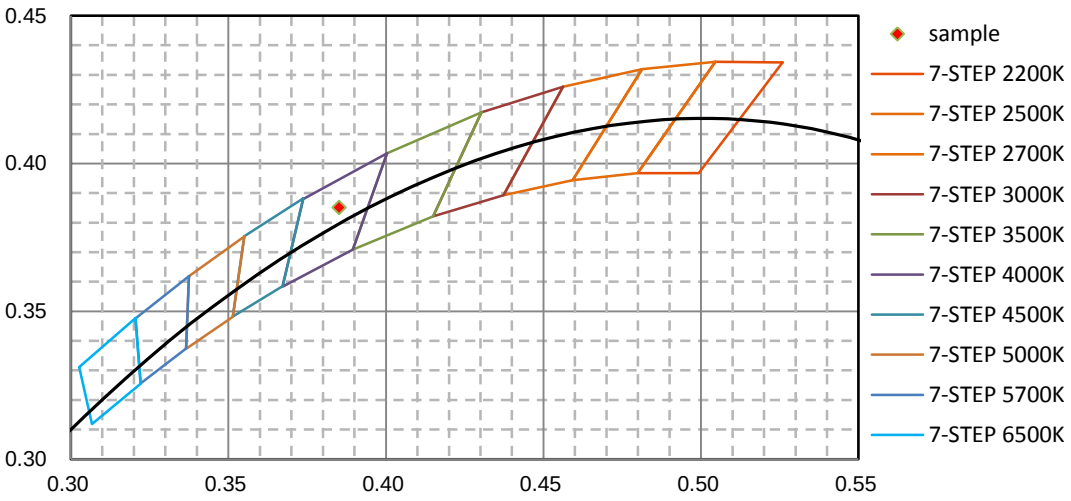
nm	mW	nm	mW	nm	mW	nm	mW	nm	mW
380	8.471E-01	421	3.374E+00	462	1.931E+01	503	2.120E+01	544	2.927E+01
381	8.040E-01	422	3.692E+00	463	1.855E+01	504	2.158E+01	545	2.934E+01
382	7.615E-01	423	4.084E+00	464	1.785E+01	505	2.194E+01	546	2.951E+01
383	6.856E-01	424	4.463E+00	465	1.727E+01	506	2.222E+01	547	2.969E+01
384	5.832E-01	425	4.880E+00	466	1.660E+01	507	2.255E+01	548	2.984E+01
385	4.809E-01	426	5.369E+00	467	1.594E+01	508	2.286E+01	549	2.995E+01
386	5.548E-01	427	5.881E+00	468	1.542E+01	509	2.313E+01	550	3.013E+01
387	5.289E-01	428	6.402E+00	469	1.484E+01	510	2.337E+01	551	3.020E+01
388	5.479E-01	429	7.036E+00	470	1.420E+01	511	2.358E+01	552	3.033E+01
389	4.487E-01	430	7.565E+00	471	1.368E+01	512	2.386E+01	553	3.038E+01
390	4.927E-01	431	8.187E+00	472	1.318E+01	513	2.407E+01	554	3.048E+01
391	4.644E-01	432	8.877E+00	473	1.277E+01	514	2.425E+01	555	3.058E+01
392	4.440E-01	433	9.589E+00	474	1.242E+01	515	2.448E+01	556	3.068E+01
393	3.902E-01	434	1.034E+01	475	1.217E+01	516	2.465E+01	557	3.079E+01
394	4.008E-01	435	1.118E+01	476	1.202E+01	517	2.490E+01	558	3.090E+01
395	4.152E-01	436	1.206E+01	477	1.200E+01	518	2.507E+01	559	3.104E+01
396	4.437E-01	437	1.311E+01	478	1.202E+01	519	2.521E+01	560	3.101E+01
397	4.112E-01	438	1.420E+01	479	1.204E+01	520	2.539E+01	561	3.115E+01
398	4.336E-01	439	1.551E+01	480	1.221E+01	521	2.559E+01	562	3.121E+01
399	4.666E-01	440	1.702E+01	481	1.246E+01	522	2.574E+01	563	3.132E+01
400	4.447E-01	441	1.858E+01	482	1.261E+01	523	2.589E+01	564	3.132E+01
401	4.612E-01	442	2.045E+01	483	1.287E+01	524	2.611E+01	565	3.143E+01
402	5.123E-01	443	2.233E+01	484	1.319E+01	525	2.622E+01	566	3.150E+01
403	5.351E-01	444	2.438E+01	485	1.344E+01	526	2.643E+01	567	3.153E+01
404	5.904E-01	445	2.648E+01	486	1.381E+01	527	2.658E+01	568	3.162E+01
405	5.972E-01	446	2.840E+01	487	1.420E+01	528	2.673E+01	569	3.167E+01
406	6.772E-01	447	3.014E+01	488	1.456E+01	529	2.687E+01	570	3.177E+01
407	7.564E-01	448	3.167E+01	489	1.498E+01	530	2.709E+01	571	3.173E+01
408	8.381E-01	449	3.261E+01	490	1.543E+01	531	2.723E+01	572	3.181E+01
409	9.289E-01	450	3.299E+01	491	1.587E+01	532	2.735E+01	573	3.189E+01
410	1.013E+00	451	3.302E+01	492	1.634E+01	533	2.754E+01	574	3.193E+01
411	1.137E+00	452	3.226E+01	493	1.678E+01	534	2.767E+01	575	3.199E+01
412	1.255E+00	453	3.127E+01	494	1.727E+01	535	2.785E+01	576	3.197E+01
413	1.411E+00	454	2.998E+01	495	1.772E+01	536	2.804E+01	577	3.207E+01
414	1.556E+00	455	2.838E+01	496	1.822E+01	537	2.818E+01	578	3.207E+01
415	1.753E+00	456	2.669E+01	497	1.865E+01	538	2.834E+01	579	3.218E+01
416	1.963E+00	457	2.514E+01	498	1.913E+01	539	2.849E+01	580	3.220E+01
417	2.220E+00	458	2.361E+01	499	1.960E+01	540	2.861E+01	581	3.223E+01
418	2.476E+00	459	2.223E+01	500	2.000E+01	541	2.882E+01	582	3.230E+01
419	2.773E+00	460	2.106E+01	501	2.043E+01	542	2.896E+01	583	3.233E+01
420	3.059E+00	461	2.007E+01	502	2.088E+01	543	2.911E+01	584	3.239E+01

nm	mW	nm	mW	nm	mW	nm	mW	nm	mW
585	3.244E+01	626	3.265E+01	667	2.116E+01	708	8.663E+00	749	2.863E+00
586	3.251E+01	627	3.253E+01	668	2.076E+01	709	8.491E+00	750	2.774E+00
587	3.258E+01	628	3.232E+01	669	2.041E+01	710	8.231E+00	751	2.700E+00
588	3.264E+01	629	3.216E+01	670	2.007E+01	711	8.043E+00	752	2.629E+00
589	3.271E+01	630	3.200E+01	671	1.970E+01	712	7.867E+00	753	2.539E+00
590	3.274E+01	631	3.182E+01	672	1.937E+01	713	7.668E+00	754	2.491E+00
591	3.284E+01	632	3.166E+01	673	1.900E+01	714	7.472E+00	755	2.407E+00
592	3.287E+01	633	3.149E+01	674	1.863E+01	715	7.260E+00	756	2.361E+00
593	3.297E+01	634	3.127E+01	675	1.833E+01	716	7.105E+00	757	2.279E+00
594	3.301E+01	635	3.107E+01	676	1.796E+01	717	6.893E+00	758	2.240E+00
595	3.310E+01	636	3.087E+01	677	1.756E+01	718	6.731E+00	759	2.165E+00
596	3.309E+01	637	3.065E+01	678	1.723E+01	719	6.562E+00	760	2.108E+00
597	3.320E+01	638	3.045E+01	679	1.694E+01	720	6.389E+00	761	2.059E+00
598	3.322E+01	639	3.018E+01	680	1.661E+01	721	6.205E+00	762	2.001E+00
599	3.325E+01	640	2.992E+01	681	1.624E+01	722	6.050E+00	763	1.943E+00
600	3.332E+01	641	2.967E+01	682	1.593E+01	723	5.915E+00	764	1.876E+00
601	3.340E+01	642	2.941E+01	683	1.560E+01	724	5.699E+00	765	1.837E+00
602	3.344E+01	643	2.913E+01	684	1.529E+01	725	5.577E+00	766	1.767E+00
603	3.343E+01	644	2.887E+01	685	1.494E+01	726	5.427E+00	767	1.732E+00
604	3.349E+01	645	2.857E+01	686	1.463E+01	727	5.267E+00	768	1.666E+00
605	3.348E+01	646	2.830E+01	687	1.433E+01	728	5.134E+00	769	1.639E+00
606	3.359E+01	647	2.795E+01	688	1.399E+01	729	4.970E+00	770	1.578E+00
607	3.354E+01	648	2.770E+01	689	1.372E+01	730	4.826E+00	771	1.552E+00
608	3.355E+01	649	2.737E+01	690	1.339E+01	731	4.722E+00	772	1.501E+00
609	3.356E+01	650	2.700E+01	691	1.309E+01	732	4.570E+00	773	1.439E+00
610	3.357E+01	651	2.669E+01	692	1.280E+01	733	4.422E+00	774	1.397E+00
611	3.355E+01	652	2.640E+01	693	1.250E+01	734	4.320E+00	775	1.362E+00
612	3.355E+01	653	2.605E+01	694	1.227E+01	735	4.204E+00	776	1.334E+00
613	3.350E+01	654	2.568E+01	695	1.197E+01	736	4.095E+00	777	1.307E+00
614	3.351E+01	655	2.538E+01	696	1.170E+01	737	3.986E+00	778	1.295E+00
615	3.345E+01	656	2.506E+01	697	1.143E+01	738	3.848E+00	779	1.298E+00
616	3.346E+01	657	2.470E+01	698	1.114E+01	739	3.747E+00	780	1.300E+00
617	3.346E+01	658	2.432E+01	699	1.084E+01	740	3.630E+00		
618	3.338E+01	659	2.398E+01	700	1.061E+01	741	3.527E+00		
619	3.334E+01	660	2.361E+01	701	1.037E+01	742	3.454E+00		
620	3.324E+01	661	2.328E+01	702	1.010E+01	743	3.343E+00		
621	3.316E+01	662	2.294E+01	703	9.850E+00	744	3.250E+00		
622	3.306E+01	663	2.255E+01	704	9.600E+00	745	3.152E+00		
623	3.299E+01	664	2.224E+01	705	9.375E+00	746	3.077E+00		
624	3.281E+01	665	2.182E+01	706	9.134E+00	747	3.002E+00		
625	3.272E+01	666	2.153E+01	707	8.893E+00	748	2.936E+00		

CIE 1931xy Chromaticity Diagram



7-StepChromaticity Quadrangles



[Goniophotometer System]

Total operating time for luminous intensity distribution: **1.0 hour**

Test orientation: **Base up**

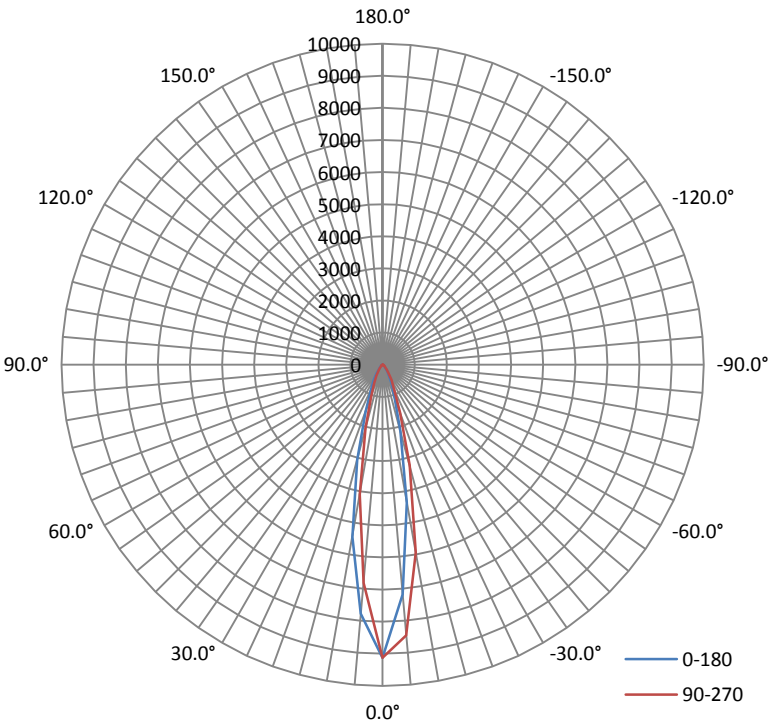
Electrical Measurement

Input Voltage(V)	Frequency(Hz)	Input Current(A)	Power (W)	Power Factor
120.0	60	0.1582	18.77	0.9886

Photometric Measurement

Luminous Flux(lm)	Efficacy(lm/W)	I_{max}(cd)	S/MH(C0/180)	S/MH(C90/270)
2116.88	112.78	9522	0.33	0.42

Luminous Intensity Distribution



	C0/180	C45/225	C90/270	C135/315	AVG.
Beam Angle(50%I_{max}):	21.2	21.2	21.0	21.0	21.1
Field Angle(10%I_{max}):	45.9	45.6	45.2	45.5	45.6

Luminous Intensity (cd) Distribution Data

C / γ	0°	22.5°	45°	67.5°	90°	112.5°	135°	157.5°
0.0°	9127	9127	9127	9127	9127	9127	9127	9127
5.0°	7780	7514	7237	6994	6816	6725	6715	6842
10.0°	5437	5115	4754	4400	4103	3933	3895	3967
15.0°	3075	2796	2505	2241	2039	1919	1878	1930
20.0°	1568	1416	1258	1127	1036	989	975	988
25.0°	861	796	724	669	632	610	608	619
30.0°	544	498	447	410	383	370	371	384
35.0°	333	294	256	234	221	215	219	230
40.0°	200	175	149	134	127	124	129	138
45.0°	120	105	91	86	83	81	84	88
50.0°	82	72	65	63	62	61	63	66
55.0°	60	55	51	49	48	47	48	50
60.0°	46	42	40	39	38	38	37	39
65.0°	36	33	32	31	30	29	29	30
70.0°	27	25	24	23	23	22	22	22
75.0°	19	18	17	16	16	15	15	15
80.0°	12	11	10	9	9	8	8	8
85.0°	5	5	4	3	3	2	2	2
90.0°	0	0	0	0	0	0	0	0
95.0°	0	0	0	0	0	0	0	0
100.0°	0	0	0	0	0	0	0	0
105.0°	0	0	0	0	0	0	0	0
110.0°	0	0	0	0	0	0	0	0
115.0°	0	0	0	0	0	0	0	0
120.0°	0	0	0	0	0	0	0	0
125.0°	0	0	0	0	0	0	0	0
130.0°	0	0	0	0	0	0	0	0
135.0°	0	0	0	0	0	0	0	0
140.0°	0	0	0	0	0	0	0	0
145.0°	0	0	0	0	0	0	0	0
150.0°	0	0	0	0	0	0	0	0
155.0°	0	0	0	0	0	0	0	0
160.0°	0	0	0	0	0	0	0	0
165.0°	0	0	0	0	0	0	0	0
170.0°	0	0	0	0	0	0	0	0
175.0°	0	0	0	0	0	0	0	0
180.0°	0	0	0	0	0	0	0	0

Luminous Intensity (cd) Distribution Data (cont.)

C / γ	180°	202.5°	225°	247.5°	270°	292.5°	315°	337.5°
0.0°	9127	9127	9127	9127	9127	9127	9127	9127
5.0°	7179	7466	7825	8177	8456	8589	8566	8334
10.0°	4364	4723	5131	5562	5935	6145	6129	5985
15.0°	2142	2365	2633	2924	3240	3427	3501	3430
20.0°	1104	1195	1312	1432	1589	1726	1797	1773
25.0°	666	702	747	802	872	937	974	964
30.0°	419	441	468	505	544	579	602	600
35.0°	249	262	276	299	326	352	370	373
40.0°	151	159	170	184	198	210	224	228
45.0°	97	101	105	113	122	130	137	140
50.0°	72	76	78	78	81	84	88	90
55.0°	53	57	57	58	59	61	64	65
60.0°	42	44	46	47	48	49	51	50
65.0°	32	34	36	36	37	38	39	39
70.0°	23	24	26	27	27	28	29	28
75.0°	16	17	18	19	20	20	21	20
80.0°	9	10	11	12	12	13	13	13
85.0°	3	4	5	6	6	7	7	7
90.0°	0	0	0	1	1	1	1	1
95.0°	0	0	0	0	0	0	0	0
100.0°	0	0	0	0	0	0	0	0
105.0°	0	0	0	0	0	0	0	0
110.0°	0	0	0	0	0	0	0	0
115.0°	0	0	0	0	0	0	0	0
120.0°	0	0	0	0	0	0	0	0
125.0°	0	0	0	0	0	0	0	0
130.0°	0	0	0	0	0	0	0	0
135.0°	0	0	0	0	0	0	0	0
140.0°	0	0	0	0	0	0	0	0
145.0°	0	0	0	0	0	0	0	0
150.0°	0	0	0	0	0	0	0	0
155.0°	0	0	0	0	0	0	0	0
160.0°	0	0	0	0	0	0	0	0
165.0°	0	0	0	0	0	0	0	0
170.0°	0	0	0	0	0	0	0	0
175.0°	0	0	0	0	0	0	0	0
180.0°	0	0	0	0	0	0	0	0

Zonal Lumen Density Measurement

Deg	Flux (lm)	%
0-5	197.8	9.34
5-10	442.5	20.91
10-15	431.9	20.40
15-20	308.5	14.58
20-25	209.7	9.90
25-30	152.5	7.21
30-35	108.4	5.12
35-40	73.2	3.46
40-45	49.3	2.33
45-50	35.3	1.66
50-55	27.7	1.31
55-60	22.7	1.07
60-65	18.8	0.89
65-70	14.8	0.70
70-75	11.1	0.52
75-80	7.4	0.36
80-85	4.0	0.18
85-90	1.1	0.06
90-95	0.0	0.00
95-100	0.0	0.00
100-105	0.0	0.00
105-110	0.0	0.00
110-115	0.0	0.00
115-120	0.0	0.00
120-125	0.0	0.00
125-130	0.0	0.00
130-135	0.0	0.00
135-140	0.0	0.00
140-145	0.0	0.00
145-150	0.0	0.00
150-155	0.0	0.00
155-160	0.0	0.00
160-165	0.0	0.00
165-170	0.0	0.00
170-175	0.0	0.00
175-180	0.0	0.00

Deg	Flux (lm)	%
0-5	197.8	9.34
0-10	640.3	30.25
0-15	1072.2	50.65
0-20	1380.8	65.23
0-25	1590.5	75.13
0-30	1743.0	82.34
0-35	1851.5	87.46
0-40	1924.6	90.92
0-45	1973.9	93.25
0-50	2009.2	94.91
0-55	2036.9	96.22
0-60	2059.6	97.29
0-65	2078.3	98.18
0-70	2093.2	98.88
0-75	2104.3	99.40
0-80	2111.7	99.76
0-85	2115.7	99.94
0-90	2116.8	100.00
0-95	2116.8	100.00
0-100	2116.8	100.00
0-105	2116.8	100.00
0-110	2116.8	100.00
0-115	2116.8	100.00
0-120	2116.8	100.00
0-125	2116.8	100.00
0-130	2116.8	100.00
0-135	2116.8	100.00
0-140	2116.8	100.00
0-145	2116.8	100.00
0-150	2116.8	100.00
0-155	2116.8	100.00
0-160	2116.8	100.00
0-165	2116.9	100.00
0-170	2116.9	100.00
0-175	2116.9	100.00
0-180	2116.9	100.00

6. Product Photo

**********END OF REPORT**********