

IES LM-79-08

MEASUREMENT AND TEST REPORT

For

Soraa Inc.

6500 Kaiser Drive, Fremont, CA 94555

Test Model: SP38-18-60D-927-03

| | |
|-----------------------|--|
| Report Type: | Electrical and Photometric tests including: Luminous Flux, Color, Luminous Intensity Distribution, Spatial Non-uniformity of Chromaticity |
| Test Engineer: | Daniel Duan <i>Daniel Duan</i> |
| Report Number: | R2DG160316055-10A1 |
| Test Date: | 2016-03-17 to 2016-04-05 |
| Report Date: | 2016-04-15 |
| Reviewed By: | Jeanne Han/Safety Manager <i>Jeanne Han</i> |
| Prepared By: | Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F, the 3rd Phase of WanLi Industrial Building, ShiHua Road, FuTian Free Trade Zone Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 |
| Test Facility: | Test facility was located at Pu Long Cun 69, Puxinghu Industrial Area, Tangxia Town, Dongguan, Guangdong, P.R.China. |

1. Product Description

General Information:

Two samples were received on 2016-03-16 and used for testing.

| | |
|---------------------------|-------------------------|
| Model Tested: | SP38-18-60D-927-03 |
| Manufacturer: | Soraa Inc. |
| Brand Name: | SORAA VIVID |
| Product Designation: | LED PAR38 |
| Burning Time Before Test: | 0hour(For New Products) |

Rated Values:

| | |
|--------------------------|----------------------|
| Rated Voltage/Frequency: | 100-120 V AC 50/60Hz |
| Rated Power: | 18.5 W |
| Nominal CCT: | 2700K |
| Nominal Lumen Output: | 930 lm |

2. Standards Used

- IESNA LM-79-08: Approved Method: Electrical & Photometric Measurement of Solid-state Lighting Products
- ANSI C82.77-2002: Harmonic Emission Limits – Related Power Quality Requirements for Lighting

3. Description of Test Equipment

| Device | Manufacture | Model No | Serial No | Test Range | Calibration date | Calibration due date |
|---------------------------------------|-------------|-------------|-------------------|------------------------|------------------|----------------------|
| 2.0m integrating sphere | EVERFINE | R98 | 11010018 | R98 | 2015-11-09 | 2016-11-08 |
| High accuracy array spectroradiometer | EVERFINE | HAAS-2000 | 1012016T | 380-780nm | 2016-03-10 | 2017-03-09 |
| DC Power Supply | EVERFINE | WY305-V1 | 1101047 | 30V/5A | 2015-07-27 | 2016-07-26 |
| Thermal Meter | Anymetre | JR900A | N/A | 25°C | 2016-01-12 | 2017-01-11 |
| Standard Light Source | SENSING | N/A | LSD090808 | N/A | 2015-09-25 | 2016-09-24 |
| AC Power Supply | EVERFINE | DPS1010-YF | 1011001T | 30V/5A | 2016-03-04 | 2017-03-03 |
| AC Power Supply | EVERFINE | VPS1030 PWM | 1012017 | 0-150V, 0-300V | 2016-03-04 | 2017-03-03 |
| DC Power Supply | EVERFINE | WY12010 | 1009009 | 30V/5A | 2016-03-04 | 2017-03-03 |
| Power Meter | YOKOGAWA | WT-210 | 91KB35700 | 15/30/60/150/300/600 V | 2016-03-04 | 2017-03-03 |
| Goniophotometer | EVERFINE | GO-R5000 | YG108492N10120001 | 1600mm,3000W/10A | 2016-03-10 | 2017-03-09 |
| Wireless Remote Sensor | N/A | 433MHz | N/A | 0°C~50°C;-20°C~60°C | 2016-03-21 | 2017-03-20 |
| Standard Light Source | EVERFINE | D908 | 1012003 | N/A | 2015-09-08 | 2016-09-07 |

Statement of Traceability: Bay Area Compliance Laboratories Corp. (Shenzhen) 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 $25^{\circ}\text{C}\pm 1^{\circ}\text{C}$ during measurement. And relative humidity is less than 65%.

Integrating Sphere System

The system includes AC power source, digital power meter, DC power supply, spectrophotometer, and integrating sphere. The integrating sphere system is calibrated by standard 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 $U=2.1\%$ ($K=2$), at the 95% confidence level. The uncertainty of the correlated color temperature measurements is $U=32\text{K}$ ($K=2$), at the 95% confidence level. The uncertainty of the CRI is $U=2.1$ ($K=2$), 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 uncertainty of the luminous intensity is $U=2.82\%$ ($K=2$), at the 95% confidence level.

5. Test Result

[Integrating Sphere System]

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

Test orientation: **Base up**

Electrical Measurement

| Voltage (V) | Frequency (Hz) | Current (A) | Power (W) | Power Factor |
|-------------|----------------|-------------|-----------|--------------|
| 120.0 | 59.98 | 0.155 | 18.41 | 0.9893 |

Photometric Measurement

| Luminous Flux (lm) | Radiant Flux (W) | Efficacy (lm/W) | CCT (K) | Duv |
|--------------------|------------------|-----------------|---------|-----------|
| 1092.8 | 4.5679 | 59.38 | 2694 | -0.000361 |

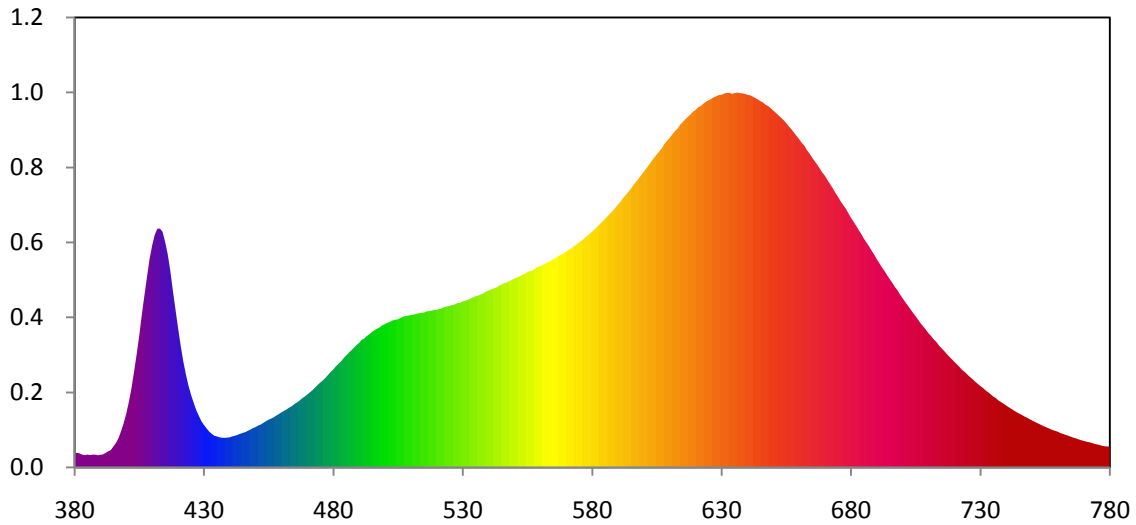
Chromaticity Coordinate

| x | y | u | v | u' | v' |
|--------|--------|--------|--------|--------|--------|
| 0.4598 | 0.4096 | 0.2629 | 0.3513 | 0.2629 | 0.5270 |

Color Rendering Index

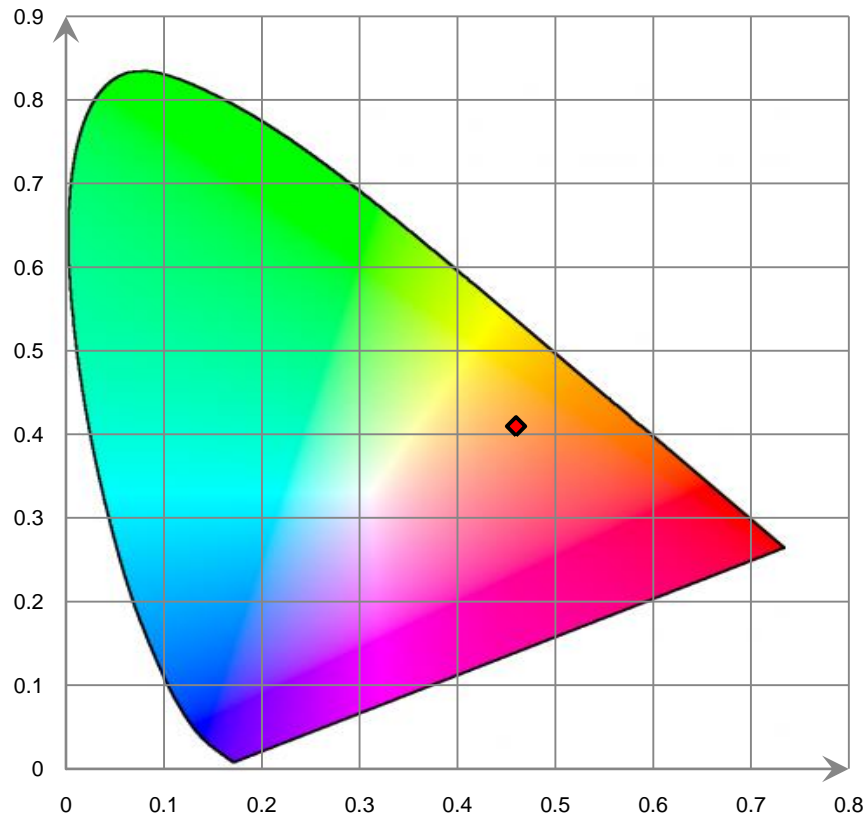
| | | | |
|-----------|-----------|-----------|-----------|
| Ra | | | |
| 95.9 | | | |
| R1 97 | R2 97 | R3 98 | R4 94 |
| R5 94 | R6 92 | R7 98 | R8 97 |
| R9 93 | R10 93 | R11 90 | R12 76 |
| R13 96 | R14 99 | R15 98 | |

Relative Spectral Power Distribution

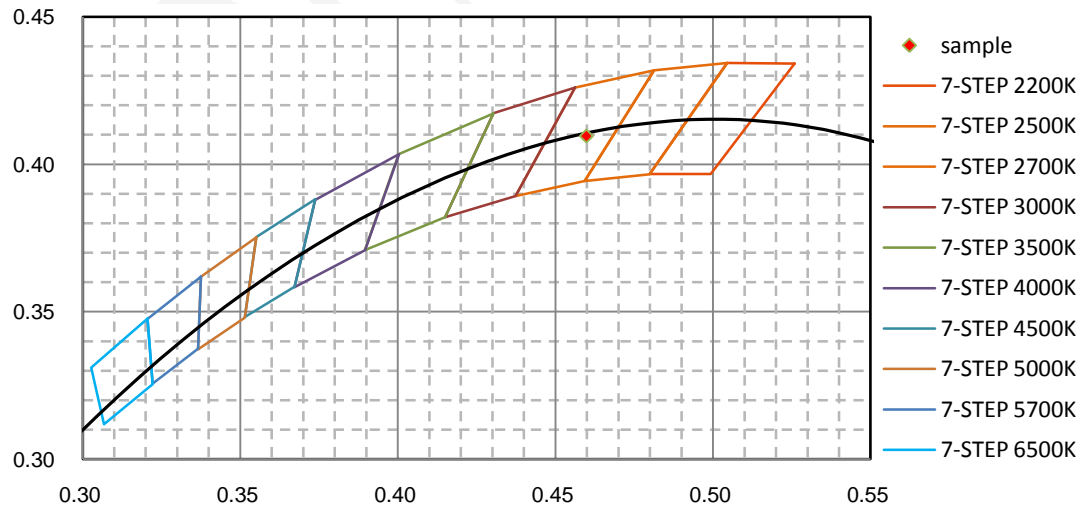


| nm | mW | nm | mW | nm | mW | nm | mW | nm | mW |
|-----|-----------|-----|-----------|-----|-----------|-----|-----------|-----|-----------|
| 380 | 9.313E-01 | 465 | 4.009E+00 | 550 | 1.193E+01 | 635 | 2.362E+01 | 720 | 6.658E+00 |
| 385 | 8.136E-01 | 470 | 4.616E+00 | 555 | 1.234E+01 | 640 | 2.352E+01 | 725 | 5.864E+00 |
| 390 | 7.998E-01 | 475 | 5.367E+00 | 560 | 1.270E+01 | 645 | 2.312E+01 | 730 | 5.141E+00 |
| 395 | 1.326E+00 | 480 | 6.190E+00 | 565 | 1.315E+01 | 650 | 2.252E+01 | 735 | 4.477E+00 |
| 400 | 3.410E+00 | 485 | 7.073E+00 | 570 | 1.364E+01 | 655 | 2.173E+01 | 740 | 3.910E+00 |
| 405 | 8.311E+00 | 490 | 7.868E+00 | 575 | 1.421E+01 | 660 | 2.072E+01 | 745 | 3.404E+00 |
| 410 | 1.403E+01 | 495 | 8.563E+00 | 580 | 1.488E+01 | 665 | 1.956E+01 | 750 | 2.967E+00 |
| 415 | 1.425E+01 | 500 | 9.053E+00 | 585 | 1.571E+01 | 670 | 1.840E+01 | 755 | 2.567E+00 |
| 420 | 8.812E+00 | 505 | 9.353E+00 | 590 | 1.659E+01 | 675 | 1.709E+01 | 760 | 2.252E+00 |
| 425 | 4.599E+00 | 510 | 9.608E+00 | 595 | 1.760E+01 | 680 | 1.576E+01 | 765 | 1.941E+00 |
| 430 | 2.679E+00 | 515 | 9.775E+00 | 600 | 1.867E+01 | 685 | 1.445E+01 | 770 | 1.678E+00 |
| 435 | 1.960E+00 | 520 | 9.948E+00 | 605 | 1.976E+01 | 690 | 1.314E+01 | 775 | 1.464E+00 |
| 440 | 1.906E+00 | 525 | 1.020E+01 | 610 | 2.082E+01 | 695 | 1.188E+01 | 780 | 1.325E+00 |
| 445 | 2.182E+00 | 530 | 1.048E+01 | 615 | 2.179E+01 | 700 | 1.067E+01 | | |
| 450 | 2.548E+00 | 535 | 1.081E+01 | 620 | 2.257E+01 | 705 | 9.545E+00 | | |
| 455 | 3.016E+00 | 540 | 1.117E+01 | 625 | 2.318E+01 | 710 | 8.465E+00 | | |
| 460 | 3.485E+00 | 545 | 1.154E+01 | 630 | 2.352E+01 | 715 | 7.530E+00 | | |

CIE 1931 x y Chromaticity Diagram



7-Step Chromaticity Quadrangles



[Goniophotometer System]

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

Test orientation: **Base up**

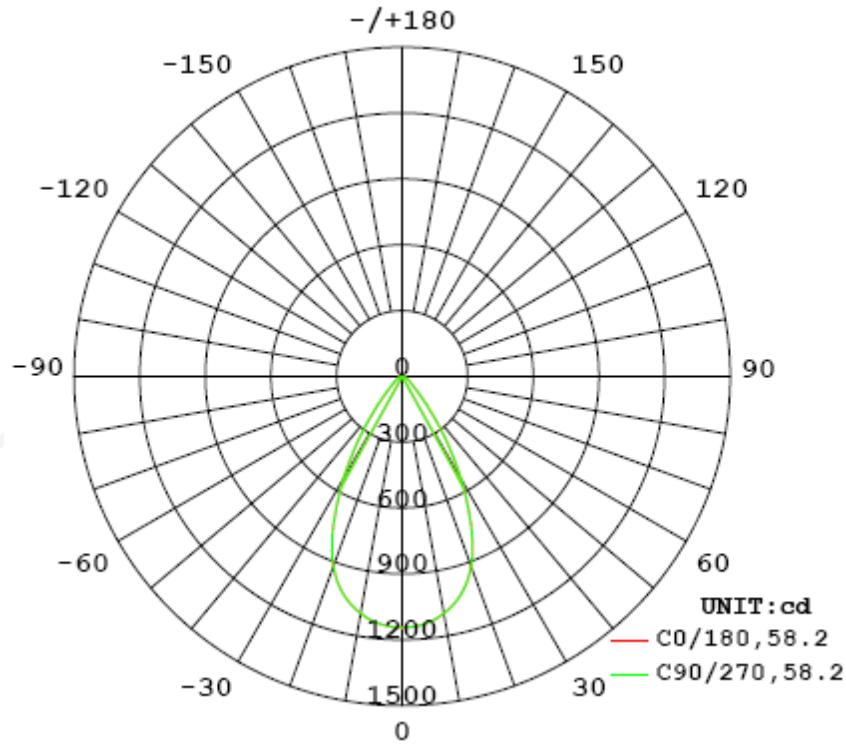
Electrical Measurement

| Input Voltage (V) | Frequency (Hz) | Input Current (A) | Power (W) | Power Factor |
|-------------------|----------------|-------------------|-----------|--------------|
| 119.91 | 60 | 0.1556 | 18.49 | 0.9910 |

Photometric Measurement

| Luminous Flux (lm) | Efficacy (lm/W) | I _{max} (cd) | S/MH (C0/180) | S/MH (C90/270) |
|--------------------|-----------------|-----------------------|---------------|----------------|
| 1100.32 | 59.51 | 1145 | 0.88 | 0.88 |

Luminous Intensity Distribution



| | C0/180 | C45/225 | C90/270 | C135/315 | AVG. |
|--------------------------------------|--------|---------|---------|----------|------|
| Beam Angle (50% I _{max}): | 58.2 | 58.2 | 58.2 | 58.2 | 58.2 |
| Field Angle (10% I _{max}): | 88.1 | 88.1 | 88.1 | 88.1 | 88.1 |

Luminous Intensity (cd) Distribution Data

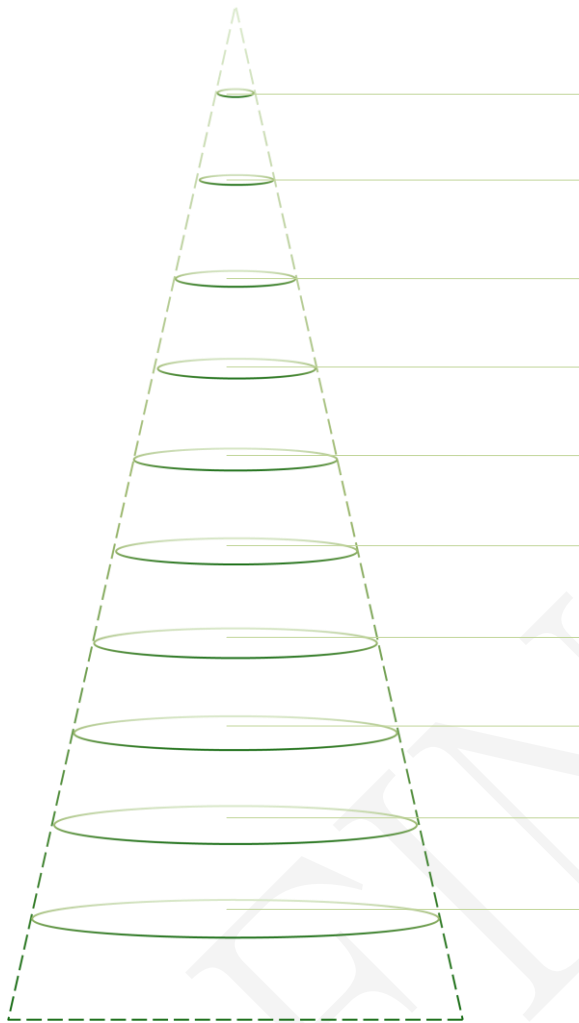
| C y | 0° | 22.5° | 45° | 67.5° | 90° | 112.5° | 135° | 157.5° |
|--------|------|-------|------|-------|------|--------|------|--------|
| 0.0° | 1145 | 1145 | 1145 | 1145 | 1145 | 1145 | 1145 | 1145 |
| 5.0° | 1133 | 1133 | 1133 | 1133 | 1133 | 1133 | 1133 | 1133 |
| 10.0° | 1096 | 1096 | 1096 | 1096 | 1096 | 1096 | 1096 | 1096 |
| 15.0° | 1032 | 1032 | 1032 | 1032 | 1032 | 1032 | 1032 | 1032 |
| 20.0° | 922 | 922 | 922 | 922 | 922 | 922 | 922 | 922 |
| 25.0° | 745 | 745 | 745 | 745 | 745 | 745 | 745 | 745 |
| 30.0° | 538 | 538 | 538 | 538 | 538 | 538 | 538 | 538 |
| 35.0° | 341 | 341 | 341 | 341 | 341 | 341 | 341 | 341 |
| 40.0° | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 |
| 45.0° | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 |
| 50.0° | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 |
| 55.0° | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 |
| 60.0° | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| 65.0° | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| 70.0° | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| 75.0° | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 80.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 85.0° | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 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° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 150.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 155.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 160.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 165.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 170.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 175.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 180.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Luminous Intensity (cd) Distribution Data (cont.)

| C γ | 180° | 202.5° | 225° | 247.5° | 270° | 292.5° | 315° | 337.5° |
|--------|------|--------|------|--------|------|--------|------|--------|
| 0.0° | 1145 | 1145 | 1145 | 1145 | 1145 | 1145 | 1145 | 1145 |
| 5.0° | 1133 | 1133 | 1133 | 1133 | 1133 | 1133 | 1133 | 1133 |
| 10.0° | 1096 | 1096 | 1096 | 1096 | 1096 | 1096 | 1096 | 1096 |
| 15.0° | 1032 | 1032 | 1032 | 1032 | 1032 | 1032 | 1032 | 1032 |
| 20.0° | 922 | 922 | 922 | 922 | 922 | 922 | 922 | 922 |
| 25.0° | 745 | 745 | 745 | 745 | 745 | 745 | 745 | 745 |
| 30.0° | 538 | 538 | 538 | 538 | 538 | 538 | 538 | 538 |
| 35.0° | 341 | 341 | 341 | 341 | 341 | 341 | 341 | 341 |
| 40.0° | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 |
| 45.0° | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 |
| 50.0° | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 |
| 55.0° | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 |
| 60.0° | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| 65.0° | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 |
| 70.0° | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| 75.0° | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 80.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 85.0° | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 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° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 150.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 155.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 160.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 165.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 170.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 175.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 180.0° | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Average Area Illumination Figure

Angle:58.2°. Flux out:731.2lm

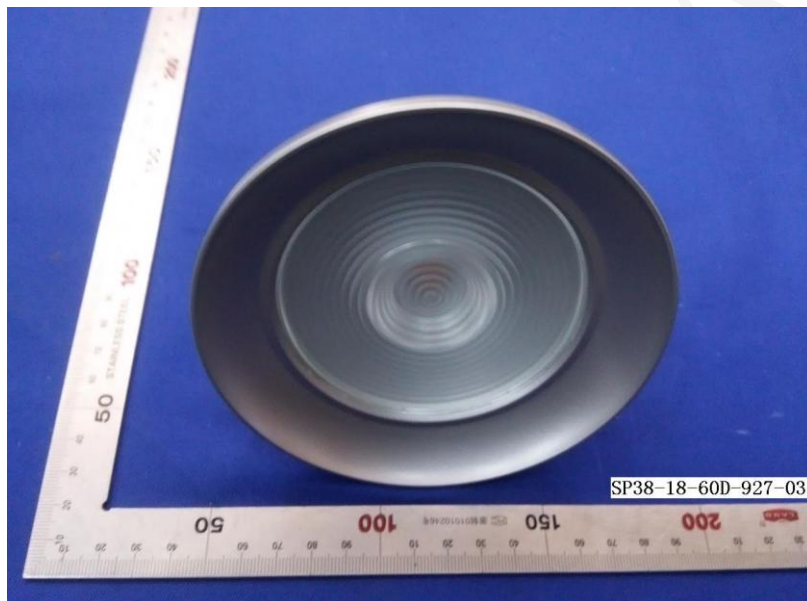


| Height (m) | Diameter (cm) | E _{avg} (lx) | E _{max} (lx) |
|------------|---------------|-----------------------|-----------------------|
| 0.5 | 55.66 | 2793.0 | 4578.0 |
| 1.0 | 111.32 | 698.2 | 1145.0 |
| 1.5 | 166.98 | 310.3 | 508.7 |
| 2.0 | 222.64 | 174.5 | 286.1 |
| 2.5 | 278.30 | 111.7 | 183.1 |
| 3.0 | 333.96 | 77.6 | 127.2 |
| 3.5 | 389.62 | 57.0 | 93.4 |
| 4.0 | 445.27 | 43.6 | 71.5 |
| 4.5 | 500.93 | 34.5 | 56.5 |
| 5.0 | 556.59 | 27.9 | 45.8 |

Zonal Lumen Density Measurement

| Deg | Flux (lm) | % | Deg | Flux (lm) | % |
|---------|-----------|-------|-------|-----------|--------|
| 0-5 | 27.2 | 2.47 | 0-5 | 27.2 | 2.47 |
| 5-10 | 79.8 | 7.25 | 0-10 | 107.0 | 9.72 |
| 10-15 | 126.3 | 11.48 | 0-15 | 233.3 | 21.20 |
| 15-20 | 161.3 | 14.66 | 0-20 | 394.6 | 35.86 |
| 20-25 | 175.2 | 15.93 | 0-25 | 569.8 | 51.79 |
| 25-30 | 161.3 | 14.66 | 0-30 | 731.2 | 66.45 |
| 30-35 | 128.0 | 11.63 | 0-35 | 859.1 | 78.08 |
| 35-40 | 86.8 | 7.89 | 0-40 | 945.9 | 85.97 |
| 40-45 | 52.1 | 4.73 | 0-45 | 998.0 | 90.70 |
| 45-50 | 32.4 | 2.94 | 0-50 | 1030.3 | 93.64 |
| 50-55 | 22.9 | 2.08 | 0-55 | 1053.2 | 95.72 |
| 55-60 | 17.5 | 1.59 | 0-60 | 1070.7 | 97.31 |
| 60-65 | 13.2 | 1.20 | 0-65 | 1083.9 | 98.51 |
| 65-70 | 9.4 | 0.85 | 0-70 | 1093.3 | 99.36 |
| 70-75 | 4.1 | 0.37 | 0-75 | 1097.4 | 99.73 |
| 75-80 | 1.2 | 0.11 | 0-80 | 1098.5 | 99.84 |
| 80-85 | 0.2 | 0.02 | 0-85 | 1098.7 | 99.86 |
| 85-90 | 0.0 | 0.00 | 0-90 | 1098.8 | 99.86 |
| 90-95 | 0.0 | 0.00 | 0-95 | 1098.8 | 99.86 |
| 95-100 | 0.0 | 0.00 | 0-100 | 1098.8 | 99.86 |
| 100-105 | 0.0 | 0.00 | 0-105 | 1098.8 | 99.86 |
| 105-110 | 0.0 | 0.00 | 0-110 | 1098.8 | 99.86 |
| 110-115 | 0.0 | 0.00 | 0-115 | 1098.8 | 99.86 |
| 115-120 | 0.0 | 0.00 | 0-120 | 1098.8 | 99.86 |
| 120-125 | 0.0 | 0.01 | 0-125 | 1098.8 | 99.87 |
| 125-130 | 0.0 | 0.00 | 0-130 | 1098.9 | 99.87 |
| 130-135 | 0.1 | 0.01 | 0-135 | 1099.0 | 99.88 |
| 135-140 | 0.1 | 0.01 | 0-140 | 1099.1 | 99.89 |
| 140-145 | 0.2 | 0.01 | 0-145 | 1099.2 | 99.90 |
| 145-150 | 0.2 | 0.02 | 0-150 | 1099.4 | 99.92 |
| 150-155 | 0.2 | 0.02 | 0-155 | 1099.7 | 99.94 |
| 155-160 | 0.2 | 0.02 | 0-160 | 1099.9 | 99.96 |
| 160-165 | 0.2 | 0.02 | 0-165 | 1100.1 | 99.98 |
| 165-170 | 0.1 | 0.01 | 0-170 | 1100.2 | 99.99 |
| 170-175 | 0.1 | 0.01 | 0-175 | 1100.3 | 100.00 |
| 175-180 | 0.0 | 0.00 | 0-180 | 1100.3 | 100.00 |

6. Product Photo



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