

Cooper Lighting Solutions Photometric Lab  
1121 Highway 74 South  
Peachtree City, GA 30269



Scaled data based on original data using  
LM-79-2019 Approved Method: Electrical and Photometric Measurements of Solid-  
State Lighting Products

Test Report Prepared for  
Cooper Lighting Solutions

Brand: FAIL-SAFE

Report Number: P1356760

Luminaire Tested: 1ASL4-35VHE-3-A59-UNV

Issue Date: 2/17/2026

**Test Information**

Test Method: LM-79-2019  
Report Number: P1356760  
TEST IS SCALED FROM IESNA LM-79-08 TEST DATA (G2-2511-597-12)  
Test Lab: INNOVATION CENTER  
Issue Date: 2/17/2026  
Manufacturer: COOPER LIGHTING SOLUTIONS  
Product Line: FAIL-SAFE  
Catalog Number: 1ASL4-35VHE-3-A59-UNV  
Description: 1FT 3500 LUMEN PER FOOT 4ASL LED LUMINAIRE WITH OPL LENS AND A59 LEDS 3 ROW  
Light Source: -  
Ballast/Driver: -

**Summary**

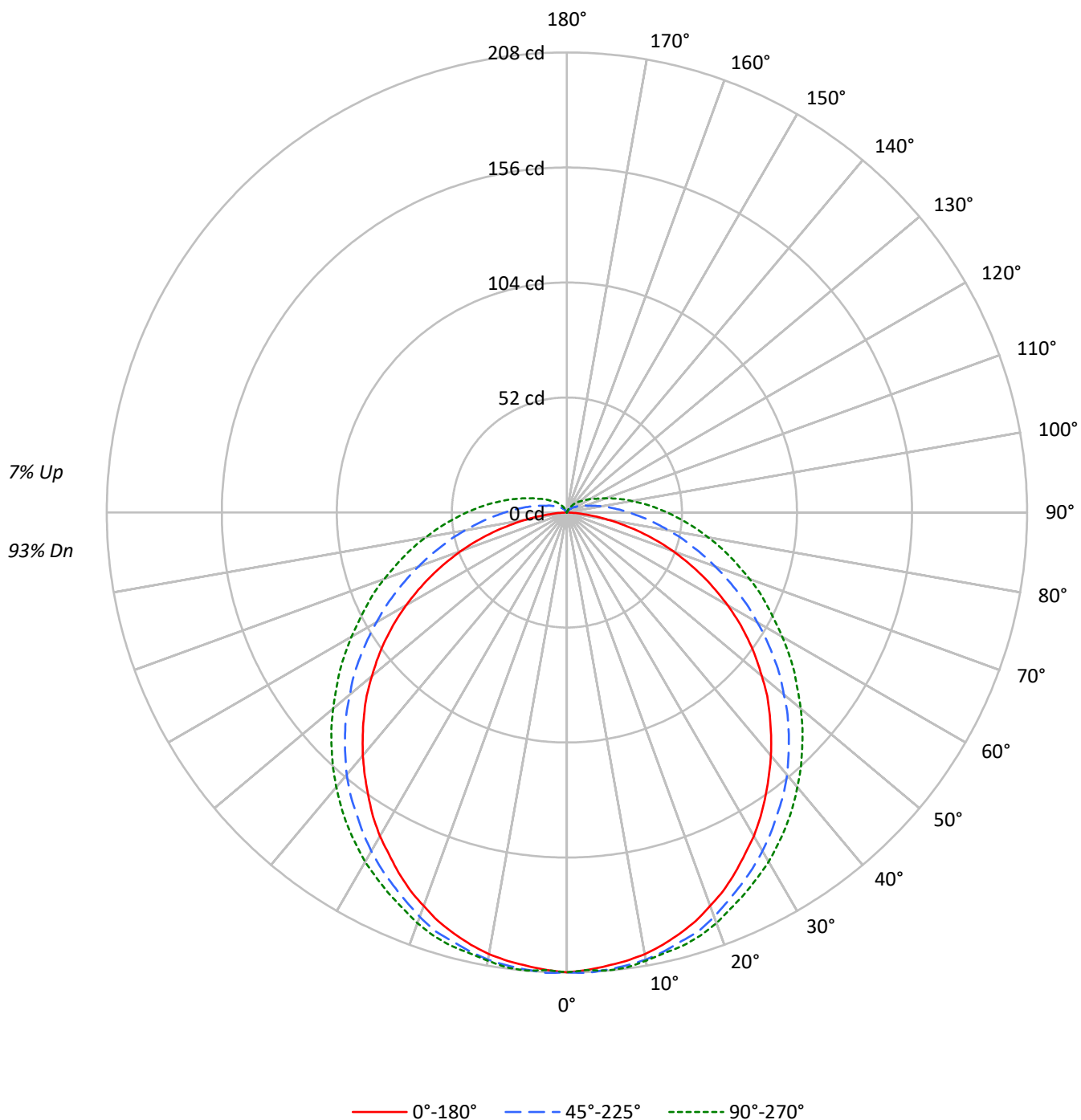
Lumens per Lamp: N/A  
Luminaire Lumens: 707.0 lumens  
Efficiency: N/A  
Efficacy: 32.3 lumens/watt  
Spacing Criteria (0/90/45): 1.21 / 1.3 / 1.39  
Luminous Opening: Rectangular w/ Sides (W: 0.33' x L: 0.98' x H: 0.1')  
CIE Type: Direct

Input Watts (W): 21.9  
Input Voltage (V): NR  
Input Current (Ain): NR  
Voltage Rise (V): NR  
Power Factor: NR  
Total Harmonic Distortion (THDi): NR  
Frequency (hertz): 60  
Stabilization Time: NR  
Operation Time: NR  
Ambient Temperature (°C): NR  
Test Distance: 24 FT

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CATALOG NUMBER: 1ASL4-35VHE-3-A59-UNV

### Luminous Intensity Polar Plot



TEST NUMBER: P1356760

CATALOG NUMBER: 1ASL4-35VHE-3-A59-UNV

**COEFFICIENT OF UTILIZATION - ZONAL CAVITY METHOD:**

|     |     |     |     |     |  |     |     |     |     |  |     |     |     |  |     |     |     |  |    |    |    |
|-----|-----|-----|-----|-----|--|-----|-----|-----|-----|--|-----|-----|-----|--|-----|-----|-----|--|----|----|----|
| RF  | 20  |     |     |     |  | 20  |     |     |     |  | 20  |     |     |  |     | 20  |     |  |    |    | 20 |
| RC  | 80  |     |     |     |  | 70  |     |     |     |  | 50  |     |     |  |     | 30  |     |  |    |    | 10 |
| RW  | 70  | 50  | 30  | 10  |  | 70  | 50  | 30  | 10  |  | 50  | 30  | 10  |  | 50  | 30  | 10  |  | 50 | 30 | 10 |
| RCR |     |     |     |     |  |     |     |     |     |  |     |     |     |  |     |     |     |  |    |    |    |
| 0   | 117 | 117 | 117 | 117 |  | 114 | 114 | 114 | 114 |  | 107 | 107 | 107 |  | 101 | 101 | 101 |  | 96 | 96 | 96 |
| 1   | 105 | 100 | 95  | 91  |  | 102 | 97  | 92  | 88  |  | 91  | 88  | 84  |  | 86  | 83  | 80  |  | 81 | 79 | 77 |
| 2   | 95  | 86  | 79  | 72  |  | 92  | 84  | 77  | 71  |  | 79  | 73  | 68  |  | 75  | 70  | 66  |  | 71 | 67 | 63 |
| 3   | 86  | 75  | 67  | 60  |  | 83  | 73  | 65  | 59  |  | 69  | 62  | 57  |  | 65  | 60  | 55  |  | 62 | 57 | 53 |
| 4   | 79  | 66  | 57  | 50  |  | 76  | 65  | 56  | 49  |  | 61  | 54  | 48  |  | 58  | 52  | 47  |  | 55 | 50 | 45 |
| 5   | 73  | 59  | 50  | 43  |  | 70  | 58  | 49  | 42  |  | 55  | 47  | 41  |  | 52  | 45  | 40  |  | 49 | 44 | 39 |
| 6   | 67  | 53  | 44  | 37  |  | 64  | 52  | 43  | 37  |  | 49  | 42  | 36  |  | 47  | 40  | 35  |  | 45 | 39 | 34 |
| 7   | 62  | 48  | 39  | 33  |  | 60  | 47  | 38  | 32  |  | 45  | 37  | 32  |  | 43  | 36  | 31  |  | 41 | 35 | 30 |
| 8   | 58  | 44  | 35  | 29  |  | 56  | 43  | 35  | 29  |  | 41  | 34  | 28  |  | 39  | 32  | 28  |  | 37 | 32 | 27 |
| 9   | 54  | 40  | 32  | 26  |  | 52  | 39  | 31  | 26  |  | 38  | 30  | 25  |  | 36  | 30  | 25  |  | 35 | 29 | 24 |
| 10  | 50  | 37  | 29  | 24  |  | 49  | 36  | 29  | 23  |  | 35  | 28  | 23  |  | 33  | 27  | 23  |  | 32 | 26 | 22 |

**AVERAGE LUMINANCE (cd/sqm):**

|     | 0°   | 45°  | 90°  |
|-----|------|------|------|
| 0°  | 6856 | 6856 | 6856 |
| 5°  | 6750 | 6696 | 6699 |
| 10° | 6666 | 6534 | 6532 |
| 15° | 6543 | 6345 | 6389 |
| 20° | 6396 | 6162 | 6227 |
| 25° | 6233 | 5944 | 6041 |
| 30° | 6063 | 5749 | 5884 |
| 35° | 5864 | 5535 | 5711 |
| 40° | 5672 | 5338 | 5529 |
| 45° | 5467 | 5102 | 5344 |
| 50° | 5236 | 4854 | 5155 |
| 55° | 4986 | 4610 | 4985 |
| 60° | 4673 | 4333 | 4810 |
| 65° | 4283 | 4066 | 4668 |
| 70° | 3805 | 3790 | 4555 |
| 75° | 3156 | 3534 | 4476 |
| 80° | 2251 | 3310 | 4439 |
| 85° | 1110 | 3167 | 4511 |

**MAXIMUM LUMINANCE 45°-90°:**

Horizontal Angle: 0°

Vertical Angle: 45°

Luminance: 5467 cd/sqm

TEST NUMBER: P1356760

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**ZONAL LUMENS:**

| Zone      | Lumens | % Fixture |
|-----------|--------|-----------|
| 0°-10°    | 19.7   | 2.8       |
| 10°-20°   | 56.6   | 8.0       |
| 20°-30°   | 85.6   | 12.1      |
| 30°-40°   | 103.6  | 14.7      |
| 40°-50°   | 108.9  | 15.4      |
| 50°-60°   | 101.6  | 14.4      |
| 60°-70°   | 83.9   | 11.9      |
| 70°-80°   | 60.4   | 8.5       |
| 80°-90°   | 37.6   | 5.3       |
| 90°-100°  | 22.0   | 3.1       |
| 100°-110° | 12.6   | 1.8       |
| 110°-120° | 7.1    | 1.0       |
| 120°-130° | 4.1    | 0.6       |
| 130°-140° | 2.2    | 0.3       |
| 140°-150° | 0.9    | 0.1       |
| 150°-160° | 0.2    | 0.0       |
| 160°-170° | 0.0    | 0.0       |
| 170°-180° | 0.0    | 0.0       |
| 0°-30°    | 161.9  | 22.9      |
| 0°-40°    | 265.6  | 37.6      |
| 0°-60°    | 476.0  | 67.3      |
| 0°-90°    | 657.9  | 93.1      |
| 90°-120°  | 41.7   | 5.9       |
| 90°-150°  | 48.9   | 6.9       |
| 90°-180°  | 49.0   | 6.9       |
| 0°-180°   | 707.0  | 100.0     |

**CANDELA DISTRIBUTION:**

|      | 0°  | 22.5° | 45° | 67.5° | 90° | Flux |
|------|-----|-------|-----|-------|-----|------|
| 0°   | 208 | 208   | 208 | 208   | 208 |      |
| 5°   | 206 | 208   | 208 | 208   | 208 | 20   |
| 15°  | 197 | 200   | 201 | 202   | 203 | 56   |
| 25°  | 180 | 183   | 186 | 188   | 190 | 83   |
| 35°  | 156 | 161   | 166 | 171   | 173 | 98   |
| 45°  | 130 | 134   | 142 | 148   | 150 | 100  |
| 55°  | 100 | 106   | 114 | 122   | 125 | 89   |
| 65°  | 67  | 74    | 85  | 96    | 100 | 67   |
| 75°  | 35  | 43    | 58  | 71    | 76  | 37   |
| 85°  | 6   | 20    | 37  | 50    | 54  | 8    |
| 90°  | 0   | 12    | 28  | 40    | 45  | 0    |
| 95°  | 0   | 7     | 21  | 32    | 37  | 0    |
| 105° | 0   | 3     | 12  | 20    | 24  | 0    |
| 115° | 0   | 1     | 7   | 12    | 15  | 0    |
| 125° | 0   | 1     | 4   | 8     | 10  | 0    |
| 135° | 0   | 0     | 3   | 5     | 6   | 0    |
| 145° | 0   | 0     | 1   | 3     | 4   | 0    |
| 155° | 0   | 0     | 0   | 1     | 1   | 0    |
| 165° | 0   | 0     | 0   | 0     | 0   | 0    |
| 175° | 0   | 0     | 0   | 0     | 0   | 0    |
| 180° | 0   | 0     | 0   | 0     | 0   | 0    |

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**CANDELA DISTRIBUTION (FULL):**

|        | 0°    | 22.5° | 45°   | 67.5° | 90°   |
|--------|-------|-------|-------|-------|-------|
| 0°     | 207.9 | 207.9 | 207.9 | 207.9 | 207.9 |
| 2.5°   | 207.1 | 208.4 | 208.4 | 207.1 | 207.1 |
| 5°     | 205.8 | 207.5 | 207.5 | 207.5 | 207.9 |
| 7.5°   | 204.5 | 206.6 | 206.6 | 206.6 | 207.5 |
| 10°    | 202.8 | 204.9 | 205.3 | 205.3 | 205.8 |
| 12.5°  | 200.2 | 202.8 | 203.2 | 203.6 | 204.0 |
| 15°    | 197.1 | 199.7 | 200.6 | 201.9 | 202.8 |
| 17.5°  | 193.7 | 196.7 | 198.4 | 199.7 | 200.6 |
| 20°    | 189.3 | 192.4 | 194.5 | 196.3 | 197.6 |
| 22.5°  | 185.0 | 187.6 | 190.2 | 192.4 | 193.7 |
| 25°    | 179.8 | 182.9 | 185.9 | 188.5 | 190.2 |
| 27.5°  | 174.2 | 177.7 | 181.6 | 184.6 | 186.3 |
| 30°    | 169.0 | 172.5 | 176.8 | 180.7 | 182.4 |
| 32.5°  | 163.0 | 166.9 | 171.6 | 175.5 | 177.7 |
| 35°    | 156.5 | 160.8 | 166.0 | 170.8 | 172.9 |
| 37.5°  | 150.0 | 154.3 | 160.8 | 165.6 | 167.7 |
| 40°    | 143.5 | 147.8 | 154.8 | 160.0 | 162.1 |
| 42.5°  | 136.6 | 140.9 | 148.3 | 153.9 | 156.5 |
| 45°    | 129.7 | 134.4 | 141.8 | 147.8 | 150.4 |
| 47.5°  | 122.8 | 127.5 | 135.3 | 141.8 | 144.4 |
| 50°    | 115.0 | 120.2 | 128.0 | 135.3 | 137.9 |
| 52.5°  | 107.6 | 112.8 | 121.5 | 128.8 | 131.4 |
| 55°    | 99.9  | 105.5 | 114.1 | 122.3 | 125.4 |
| 57.5°  | 92.1  | 97.7  | 106.8 | 115.4 | 118.9 |
| 60°    | 83.9  | 89.9  | 99.4  | 108.5 | 112.4 |
| 62.5°  | 75.7  | 82.1  | 92.5  | 102.0 | 105.9 |
| 65°    | 67.4  | 73.9  | 85.2  | 96.0  | 99.9  |
| 67.5°  | 59.2  | 66.1  | 78.2  | 89.5  | 94.2  |
| 70°    | 51.0  | 58.4  | 71.3  | 83.0  | 87.8  |
| 72.5°  | 42.8  | 50.6  | 64.8  | 77.0  | 81.7  |
| 75°    | 34.6  | 43.2  | 58.4  | 70.9  | 76.1  |
| 77.5°  | 26.4  | 36.3  | 52.7  | 65.3  | 70.5  |
| 80°    | 19.0  | 30.3  | 46.7  | 59.7  | 64.8  |
| 82.5°  | 12.1  | 24.2  | 41.5  | 54.5  | 59.7  |
| 85°    | 6.5   | 19.5  | 36.7  | 49.7  | 54.5  |
| 87.5°  | 2.2   | 15.1  | 32.0  | 45.0  | 49.7  |
| 90°    | 0.0   | 11.7  | 28.1  | 40.2  | 45.4  |
| 92.5°  | 0.0   | 9.1   | 24.6  | 36.3  | 41.1  |
| 95°    | 0.0   | 7.3   | 21.2  | 32.4  | 37.2  |
| 97.5°  | 0.0   | 6.1   | 18.6  | 29.0  | 33.3  |
| 100°   | 0.0   | 4.8   | 16.0  | 25.9  | 29.8  |
| 102.5° | 0.0   | 3.9   | 13.8  | 22.9  | 26.8  |
| 105°   | 0.0   | 2.6   | 11.7  | 20.3  | 23.8  |
| 107.5° | 0.0   | 2.2   | 9.9   | 18.2  | 21.2  |
| 110°   | 0.0   | 1.7   | 9.1   | 15.6  | 18.6  |



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CATALOG NUMBER: 1ASL4-35VHE-3-A59-UNV

**CANDELA DISTRIBUTION (continued):**

|        | 0°  | 22.5° | 45° | 67.5° | 90°  |
|--------|-----|-------|-----|-------|------|
| 112.5° | 0.0 | 1.3   | 8.2 | 13.8  | 16.9 |
| 115°   | 0.0 | 1.3   | 6.9 | 12.5  | 14.7 |
| 117.5° | 0.0 | 1.3   | 6.1 | 11.2  | 13.4 |
| 120°   | 0.0 | 0.9   | 5.6 | 9.9   | 12.1 |
| 122.5° | 0.0 | 0.9   | 4.8 | 9.1   | 10.8 |
| 125°   | 0.0 | 0.9   | 4.3 | 8.2   | 9.5  |
| 127.5° | 0.0 | 0.4   | 3.9 | 7.3   | 8.6  |
| 130°   | 0.0 | 0.4   | 3.5 | 6.5   | 7.8  |
| 132.5° | 0.0 | 0.4   | 3.0 | 6.1   | 7.3  |
| 135°   | 0.0 | 0.0   | 2.6 | 5.2   | 6.5  |
| 137.5° | 0.0 | 0.0   | 2.2 | 4.8   | 5.6  |
| 140°   | 0.0 | 0.0   | 1.7 | 3.9   | 5.2  |
| 142.5° | 0.0 | 0.0   | 1.3 | 3.5   | 4.3  |
| 145°   | 0.0 | 0.0   | 1.3 | 3.0   | 3.5  |
| 147.5° | 0.0 | 0.0   | 0.9 | 2.2   | 3.0  |
| 150°   | 0.0 | 0.0   | 0.4 | 1.7   | 2.2  |
| 152.5° | 0.0 | 0.0   | 0.0 | 1.3   | 1.7  |
| 155°   | 0.0 | 0.0   | 0.0 | 0.9   | 1.3  |
| 157.5° | 0.0 | 0.0   | 0.0 | 0.0   | 0.4  |
| 160°   | 0.0 | 0.0   | 0.0 | 0.0   | 0.0  |
| 162.5° | 0.0 | 0.0   | 0.0 | 0.0   | 0.0  |
| 165°   | 0.0 | 0.0   | 0.0 | 0.0   | 0.0  |
| 167.5° | 0.0 | 0.0   | 0.0 | 0.0   | 0.0  |
| 170°   | 0.0 | 0.0   | 0.0 | 0.0   | 0.0  |
| 172.5° | 0.0 | 0.0   | 0.0 | 0.0   | 0.0  |
| 175°   | 0.0 | 0.0   | 0.0 | 0.0   | 0.0  |
| 177.5° | 0.0 | 0.0   | 0.0 | 0.0   | 0.0  |
| 180°   | 0.0 | 0.0   | 0.0 | 0.0   | 0.0  |

TEST NUMBER: P1356760

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**CIE UGR TABLE:**

| Reflectances:   |      |                  |       |       |       |       |                |       |       |       |       |
|-----------------|------|------------------|-------|-------|-------|-------|----------------|-------|-------|-------|-------|
| Ceiling         |      | 0.7              | 0.7   | 0.5   | 0.5   | 0.3   | 0.7            | 0.7   | 0.5   | 0.5   | 0.3   |
| Wall            |      | 0.5              | 0.3   | 0.5   | 0.3   | 0.3   | 0.5            | 0.3   | 0.5   | 0.3   | 0.3   |
| Reference plane |      | 0.2              | 0.2   | 0.2   | 0.2   | 0.2   | 0.2            | 0.2   | 0.2   | 0.2   | 0.2   |
| Room dimensions |      | Viewed crosswise |       |       |       |       | Viewed endwise |       |       |       |       |
| X=2H            | Y=2H | 15.93            | 17.47 | 16.40 | 17.92 | 18.41 | 17.71          | 19.25 | 18.18 | 19.71 | 20.19 |
|                 | 3H   | 17.43            | 18.84 | 17.91 | 19.30 | 19.83 | 20.08          | 21.48 | 20.56 | 21.95 | 22.47 |
|                 | 4H   | 17.92            | 19.25 | 18.42 | 19.73 | 20.27 | 21.19          | 22.52 | 21.70 | 23.01 | 23.54 |
|                 | 6H   | 18.19            | 19.43 | 18.71 | 19.93 | 20.48 | 22.32          | 23.56 | 22.83 | 24.06 | 24.61 |
|                 | 8H   | 18.25            | 19.44 | 18.77 | 19.95 | 20.51 | 22.87          | 24.06 | 23.40 | 24.58 | 25.14 |
|                 | 12H  | 18.26            | 19.40 | 18.80 | 19.91 | 20.50 | 23.44          | 24.58 | 23.98 | 25.10 | 25.69 |
| 4H              | 2H   | 16.76            | 18.09 | 17.26 | 18.57 | 19.11 | 18.16          | 19.49 | 18.66 | 19.97 | 20.51 |
|                 | 3H   | 18.50            | 19.63 | 19.01 | 20.16 | 20.72 | 20.75          | 21.89 | 21.27 | 22.41 | 22.97 |
|                 | 4H   | 19.10            | 20.14 | 19.64 | 20.68 | 21.27 | 22.04          | 23.08 | 22.57 | 23.61 | 24.21 |
|                 | 6H   | 19.51            | 20.42 | 20.06 | 20.99 | 21.59 | 23.36          | 24.28 | 23.91 | 24.84 | 25.44 |
|                 | 8H   | 19.60            | 20.46 | 20.16 | 21.03 | 21.65 | 24.01          | 24.88 | 24.58 | 25.44 | 26.06 |
|                 | 12H  | 19.65            | 20.43 | 20.23 | 21.02 | 21.65 | 24.71          | 25.49 | 25.29 | 26.08 | 26.70 |
| 8H              | 4H   | 19.73            | 20.60 | 20.29 | 21.16 | 21.78 | 22.27          | 23.13 | 22.83 | 23.69 | 24.31 |
|                 | 6H   | 20.31            | 21.04 | 20.90 | 21.65 | 22.27 | 23.76          | 24.49 | 24.35 | 25.09 | 25.72 |
|                 | 8H   | 20.49            | 21.15 | 21.10 | 21.77 | 22.41 | 24.55          | 25.21 | 25.16 | 25.83 | 26.47 |
|                 | 12H  | 20.61            | 21.20 | 21.22 | 21.80 | 22.51 | 25.43          | 26.02 | 26.03 | 26.62 | 27.33 |
| 12H             | 4H   | 19.90            | 20.69 | 20.48 | 21.28 | 21.90 | 22.28          | 23.06 | 22.86 | 23.65 | 24.27 |
|                 | 6H   | 20.57            | 21.23 | 21.18 | 21.85 | 22.49 | 23.80          | 24.46 | 24.40 | 25.07 | 25.71 |
|                 | 8H   | 20.85            | 21.44 | 21.46 | 22.04 | 22.75 | 24.67          | 25.26 | 25.27 | 25.86 | 26.56 |

LM-79-2019: Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

Report Prepared for

Cooper Lighting Solutions

Fail-Safe

Report Number: SP1-2511-597-9

Test Date: 01/22/2026

Luminaire Tested: 4ASL-2-A590-UNV-OPL-1\_600mA

Data in this report applies to families of products including 4ASL

### Test Information

Test Method: LM-79-2019  
 Report Number: SP1-2511-597-9  
 Test Lab: COOPER LIGHTING SOLUTIONS  
 Photometer: SP1 - 76IN SPHERE  
 Measurement Geometry:  $4\pi$   
 Issue Date: 01/29/2026  
 Manufacturer: COOPER LIGHTING SOLUTIONS  
 Product Line: Fail-Safe  
 Catalog Number: **4ASL-2-A590-UNV-OPL-1\_600mA**  
 Description: 2foot 4ASL LED LUMINAIRE WITH OPL LENS AND AMBER 590 LEDS with 1 rows at 600mA

### Spectral Parameters

|                           |          |           |        |      |        |
|---------------------------|----------|-----------|--------|------|--------|
| CCT (K):                  | 1535     | CRI (Ra): | -20.0  |      |        |
| CIE u':                   | 0.3534   | R1:       | -32.1  | R9:  | -380.5 |
| CIE v':                   | 0.5468   | R2:       | 53.1   | R10: | 29.9   |
| Duv:                      | 0.0117   | R3:       | 18.5   | R11: | -92.0  |
| CIE x:                    | 0.5921   | R4:       | -65.7  | R12: | -8.5   |
| CIE y:                    | 0.4072   | R5:       | -38.6  | R13: | -13.5  |
| CIE z:                    | 0.0007   | R6:       | 42.8   | R14: | 47.1   |
| Peak Wavelength (nm):     | 598      | R7:       | -6.2   | R15: | -65.4  |
| Dominant Wavelength (nm): | 592      | R8:       | -132.3 |      |        |
| Purity:                   | 99.97894 |           |        |      |        |
| Rf:                       | 1.3      |           |        |      |        |
| Rg:                       | 0.1      |           |        |      |        |



### Test Conditions

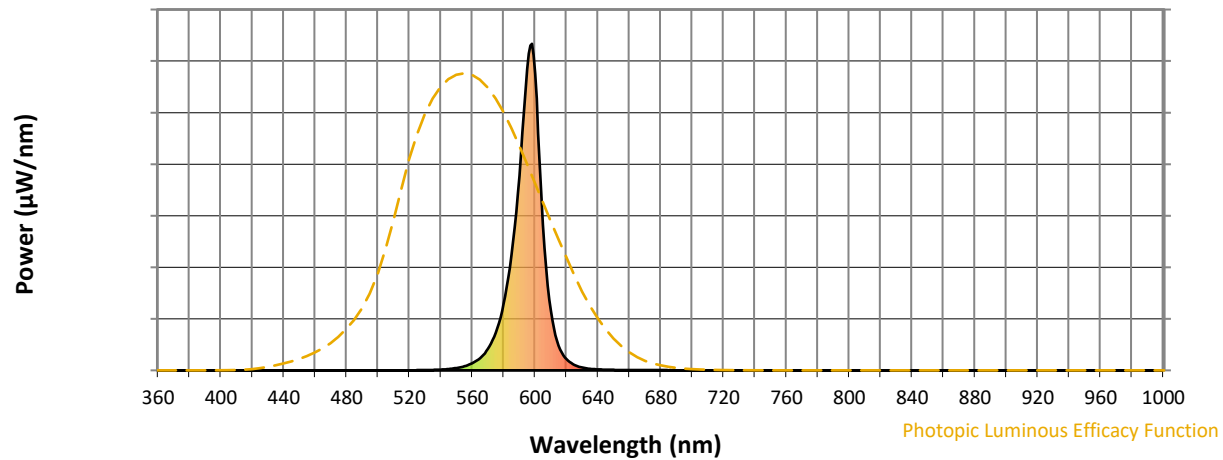
Stabilization Time: 77M  
 Operation Time: 2H 17M  
 Sphere Temperature (°C): 25.1

REPORT NUMBER: SP1-2511-597-9

| Measurement and Test Equipment |                       |                  |                      |
|--------------------------------|-----------------------|------------------|----------------------|
| Instrument                     | Identification Number | Calibration Date | Calibration Due Date |
| Photometer                     | 76INCH SPHERE IN0058  | 12/16/2025       | 6/16/2026            |
| Power Meter                    | XITRON INXT2011004    | 10/21/2025       | 10/21/2026           |
| AC Power Source                | CHROMA 61603 IN0063   | 10/21/2025       | 10/21/2026           |
| DC Power Source                | AGILENT E3634A IN0208 | 10/21/2025       | 10/21/2026           |
| Sphere Thermometer             | ONSET IN0085          | 10/21/2025       | 10/21/2026           |
| Room Thermometer               | ONSET IN0046          | 10/21/2025       | 10/21/2026           |



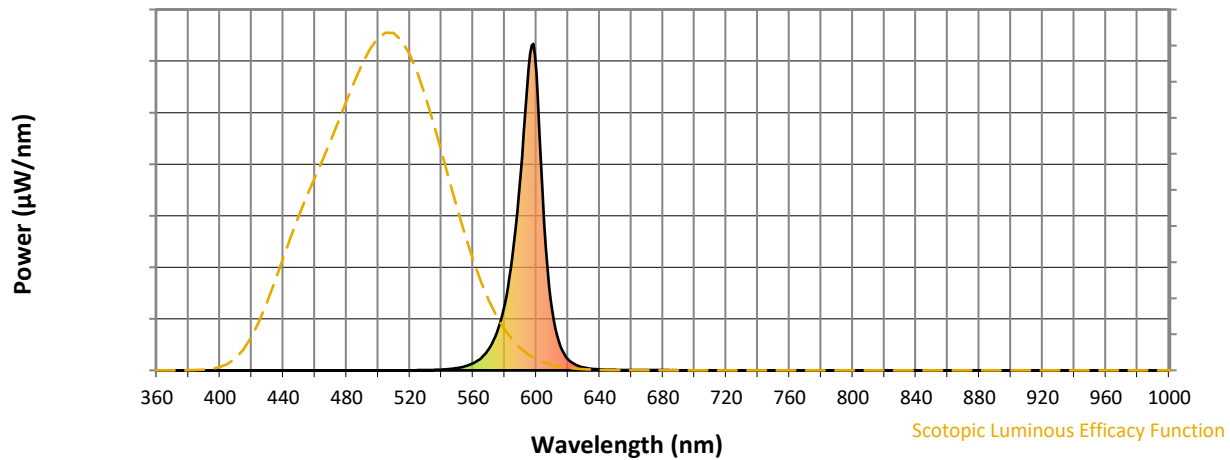
REPORT NUMBER: SP1-2511-597-9

**Photopic Flux vs. Wavelength**

**Photopic Lumens: NR**

| $\lambda$<br>(nm) | Power<br>$\text{W}^{\wedge}/\text{nm}$ | Lumens<br>( $\phi/\text{nm}$ ) | $\lambda$<br>(nm) | Power<br>$\text{W}^{\wedge}/\text{nm}$ | Lumens<br>( $\phi/\text{nm}$ ) | $\lambda$<br>(nm) | Power<br>$\text{W}^{\wedge}/\text{nm}$ | Lumens<br>( $\phi/\text{nm}$ ) | $\lambda$<br>(nm) | Power<br>$\text{W}^{\wedge}/\text{nm}$ | Lumens<br>( $\phi/\text{nm}$ ) | $\lambda$<br>(nm) | Power<br>$\text{W}^{\wedge}/\text{nm}$ | Lumens<br>( $\phi/\text{nm}$ ) |
|-------------------|----------------------------------------|--------------------------------|-------------------|----------------------------------------|--------------------------------|-------------------|----------------------------------------|--------------------------------|-------------------|----------------------------------------|--------------------------------|-------------------|----------------------------------------|--------------------------------|
| 360               | 0                                      | NR                             | 490               | 0                                      | NR                             | 620               | 35                                     | NR                             | 750               | 0                                      | NR                             | 880               | 0                                      | NR                             |
| 365               | 0                                      | NR                             | 495               | 0                                      | NR                             | 625               | 17                                     | NR                             | 755               | 0                                      | NR                             | 885               | 0                                      | NR                             |
| 370               | 0                                      | NR                             | 500               | 0                                      | NR                             | 630               | 9                                      | NR                             | 760               | 0                                      | NR                             | 890               | 0                                      | NR                             |
| 375               | 0                                      | NR                             | 505               | 0                                      | NR                             | 635               | 5                                      | NR                             | 765               | 0                                      | NR                             | 895               | 0                                      | NR                             |
| 380               | 0                                      | NR                             | 510               | 0                                      | NR                             | 640               | 3                                      | NR                             | 770               | 0                                      | NR                             | 900               | 0                                      | NR                             |
| 385               | 0                                      | NR                             | 515               | 0                                      | NR                             | 645               | 2                                      | NR                             | 775               | 0                                      | NR                             | 905               | 0                                      | NR                             |
| 390               | 0                                      | NR                             | 520               | 0                                      | NR                             | 650               | 2                                      | NR                             | 780               | 0                                      | NR                             | 910               | 0                                      | NR                             |
| 395               | 0                                      | NR                             | 525               | 1                                      | NR                             | 655               | 1                                      | NR                             | 785               | 0                                      | NR                             | 915               | 0                                      | NR                             |
| 400               | 0                                      | NR                             | 530               | 1                                      | NR                             | 660               | 1                                      | NR                             | 790               | 0                                      | NR                             | 920               | 0                                      | NR                             |
| 405               | 0                                      | NR                             | 535               | 1                                      | NR                             | 665               | 1                                      | NR                             | 795               | 0                                      | NR                             | 925               | 0                                      | NR                             |
| 410               | 0                                      | NR                             | 540               | 2                                      | NR                             | 670               | 1                                      | NR                             | 800               | 0                                      | NR                             | 930               | 0                                      | NR                             |
| 415               | 0                                      | NR                             | 545               | 4                                      | NR                             | 675               | 1                                      | NR                             | 805               | 0                                      | NR                             | 935               | 0                                      | NR                             |
| 420               | 0                                      | NR                             | 550               | 7                                      | NR                             | 680               | 1                                      | NR                             | 810               | 0                                      | NR                             | 940               | 0                                      | NR                             |
| 425               | 0                                      | NR                             | 555               | 12                                     | NR                             | 685               | 0                                      | NR                             | 815               | 0                                      | NR                             | 945               | 0                                      | NR                             |
| 430               | 0                                      | NR                             | 560               | 22                                     | NR                             | 690               | 0                                      | NR                             | 820               | 0                                      | NR                             | 950               | 0                                      | NR                             |
| 435               | 0                                      | NR                             | 565               | 38                                     | NR                             | 695               | 0                                      | NR                             | 825               | 0                                      | NR                             | 955               | 0                                      | NR                             |
| 440               | 0                                      | NR                             | 570               | 66                                     | NR                             | 700               | 0                                      | NR                             | 830               | 0                                      | NR                             | 960               | 0                                      | NR                             |
| 445               | 0                                      | NR                             | 575               | 115                                    | NR                             | 705               | 0                                      | NR                             | 835               | 0                                      | NR                             | 965               | 0                                      | NR                             |
| 450               | 0                                      | NR                             | 580               | 203                                    | NR                             | 710               | 0                                      | NR                             | 840               | 0                                      | NR                             | 970               | 0                                      | NR                             |
| 455               | 0                                      | NR                             | 585               | 354                                    | NR                             | 715               | 0                                      | NR                             | 845               | 0                                      | NR                             | 975               | 0                                      | NR                             |
| 460               | 0                                      | NR                             | 590               | 596                                    | NR                             | 720               | 0                                      | NR                             | 850               | 0                                      | NR                             | 980               | 0                                      | NR                             |
| 465               | 0                                      | NR                             | 595               | 923                                    | NR                             | 725               | 0                                      | NR                             | 855               | 0                                      | NR                             | 985               | 0                                      | NR                             |
| 470               | 0                                      | NR                             | 600               | 909                                    | NR                             | 730               | 0                                      | NR                             | 860               | 0                                      | NR                             | 990               | 0                                      | NR                             |
| 475               | 0                                      | NR                             | 605               | 447                                    | NR                             | 735               | 0                                      | NR                             | 865               | 0                                      | NR                             | 995               | 0                                      | NR                             |
| 480               | 0                                      | NR                             | 610               | 183                                    | NR                             | 740               | 0                                      | NR                             | 870               | 0                                      | NR                             | 1000              | 0                                      | NR                             |
| 485               | 0                                      | NR                             | 615               | 75                                     | NR                             | 745               | 0                                      | NR                             | 875               | 0                                      | NR                             |                   |                                        |                                |

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### Scotopic Flux vs. Wavelength



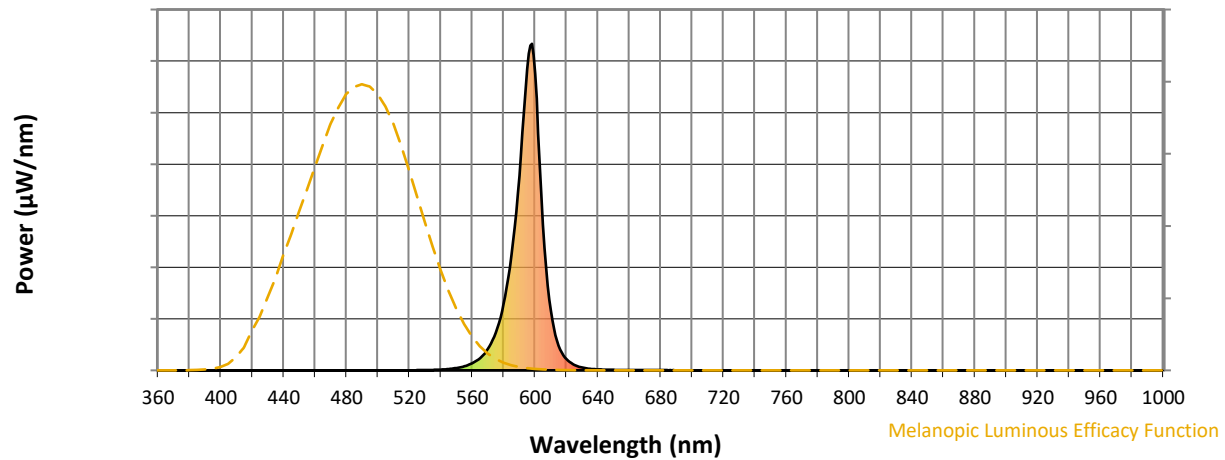
Scotopic Lumens: NR

S/P: 0.22

| λ (nm) | Power W <sup>^</sup> /nm | Lumens (Φ/nm) | λ (nm) | Power W <sup>^</sup> /nm | Lumens (Φ/nm) | λ (nm) | Power W <sup>^</sup> /nm | Lumens (Φ/nm) | λ (nm) | Power W <sup>^</sup> /nm | Lumens (Φ/nm) | λ (nm) | Power W <sup>^</sup> /nm | Lumens (Φ/nm) |
|--------|--------------------------|---------------|--------|--------------------------|---------------|--------|--------------------------|---------------|--------|--------------------------|---------------|--------|--------------------------|---------------|
| 360    | 0                        | NR            | 490    | 0                        | NR            | 620    | 35                       | NR            | 750    | 0                        | NR            | 880    | 0                        | NR            |
| 365    | 0                        | NR            | 495    | 0                        | NR            | 625    | 17                       | NR            | 755    | 0                        | NR            | 885    | 0                        | NR            |
| 370    | 0                        | NR            | 500    | 0                        | NR            | 630    | 9                        | NR            | 760    | 0                        | NR            | 890    | 0                        | NR            |
| 375    | 0                        | NR            | 505    | 0                        | NR            | 635    | 5                        | NR            | 765    | 0                        | NR            | 895    | 0                        | NR            |
| 380    | 0                        | NR            | 510    | 0                        | NR            | 640    | 3                        | NR            | 770    | 0                        | NR            | 900    | 0                        | NR            |
| 385    | 0                        | NR            | 515    | 0                        | NR            | 645    | 2                        | NR            | 775    | 0                        | NR            | 905    | 0                        | NR            |
| 390    | 0                        | NR            | 520    | 0                        | NR            | 650    | 2                        | NR            | 780    | 0                        | NR            | 910    | 0                        | NR            |
| 395    | 0                        | NR            | 525    | 1                        | NR            | 655    | 1                        | NR            | 785    | 0                        | NR            | 915    | 0                        | NR            |
| 400    | 0                        | NR            | 530    | 1                        | NR            | 660    | 1                        | NR            | 790    | 0                        | NR            | 920    | 0                        | NR            |
| 405    | 0                        | NR            | 535    | 1                        | NR            | 665    | 1                        | NR            | 795    | 0                        | NR            | 925    | 0                        | NR            |
| 410    | 0                        | NR            | 540    | 2                        | NR            | 670    | 1                        | NR            | 800    | 0                        | NR            | 930    | 0                        | NR            |
| 415    | 0                        | NR            | 545    | 4                        | NR            | 675    | 1                        | NR            | 805    | 0                        | NR            | 935    | 0                        | NR            |
| 420    | 0                        | NR            | 550    | 7                        | NR            | 680    | 1                        | NR            | 810    | 0                        | NR            | 940    | 0                        | NR            |
| 425    | 0                        | NR            | 555    | 12                       | NR            | 685    | 0                        | NR            | 815    | 0                        | NR            | 945    | 0                        | NR            |
| 430    | 0                        | NR            | 560    | 22                       | NR            | 690    | 0                        | NR            | 820    | 0                        | NR            | 950    | 0                        | NR            |
| 435    | 0                        | NR            | 565    | 38                       | NR            | 695    | 0                        | NR            | 825    | 0                        | NR            | 955    | 0                        | NR            |
| 440    | 0                        | NR            | 570    | 66                       | NR            | 700    | 0                        | NR            | 830    | 0                        | NR            | 960    | 0                        | NR            |
| 445    | 0                        | NR            | 575    | 115                      | NR            | 705    | 0                        | NR            | 835    | 0                        | NR            | 965    | 0                        | NR            |
| 450    | 0                        | NR            | 580    | 203                      | NR            | 710    | 0                        | NR            | 840    | 0                        | NR            | 970    | 0                        | NR            |
| 455    | 0                        | NR            | 585    | 354                      | NR            | 715    | 0                        | NR            | 845    | 0                        | NR            | 975    | 0                        | NR            |
| 460    | 0                        | NR            | 590    | 596                      | NR            | 720    | 0                        | NR            | 850    | 0                        | NR            | 980    | 0                        | NR            |
| 465    | 0                        | NR            | 595    | 923                      | NR            | 725    | 0                        | NR            | 855    | 0                        | NR            | 985    | 0                        | NR            |
| 470    | 0                        | NR            | 600    | 909                      | NR            | 730    | 0                        | NR            | 860    | 0                        | NR            | 990    | 0                        | NR            |
| 475    | 0                        | NR            | 605    | 447                      | NR            | 735    | 0                        | NR            | 865    | 0                        | NR            | 995    | 0                        | NR            |
| 480    | 0                        | NR            | 610    | 183                      | NR            | 740    | 0                        | NR            | 870    | 0                        | NR            | 1000   | 0                        | NR            |
| 485    | 0                        | NR            | 615    | 75                       | NR            | 745    | 0                        | NR            | 875    | 0                        | NR            |        |                          |               |

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### Melanopic Flux vs. Wavelength



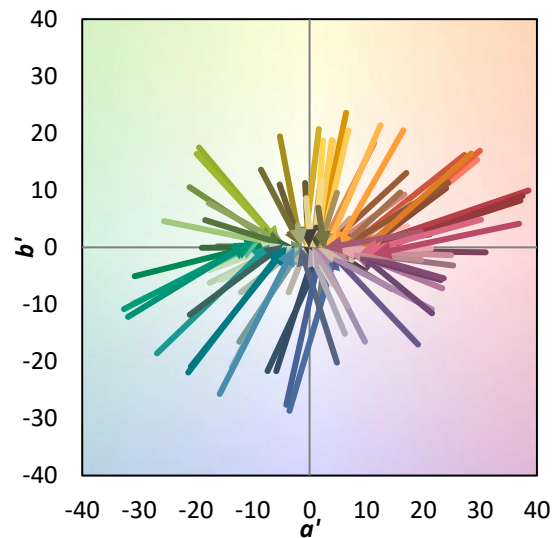
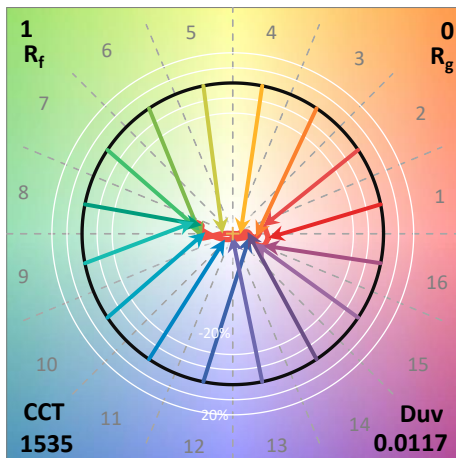
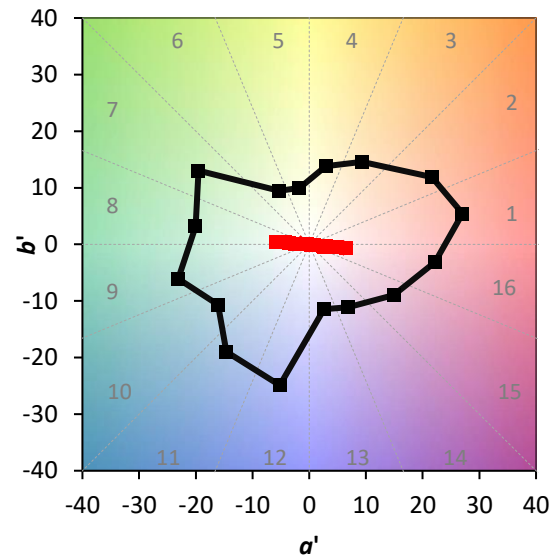
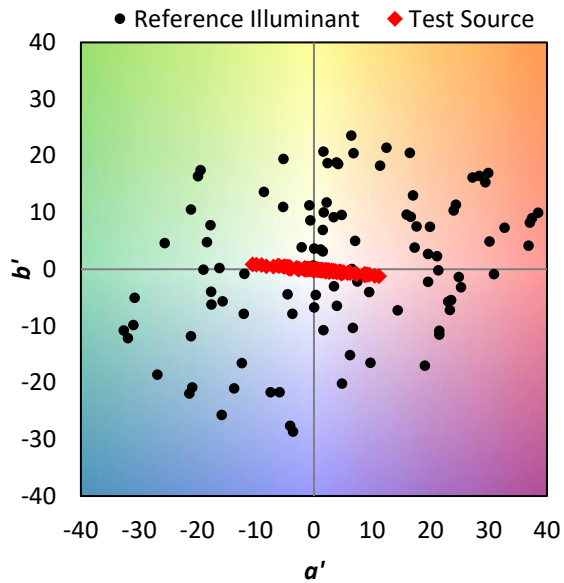
Melanopic Lumens: NR

M/P: 0.12

| $\lambda$<br>(nm) | Power<br>$\text{W}^{\wedge}/\text{nm}$ | Lumens<br>( $\phi/\text{nm}$ ) | $\lambda$<br>(nm) | Power<br>$\text{W}^{\wedge}/\text{nm}$ | Lumens<br>( $\phi/\text{nm}$ ) | $\lambda$<br>(nm) | Power<br>$\text{W}^{\wedge}/\text{nm}$ | Lumens<br>( $\phi/\text{nm}$ ) | $\lambda$<br>(nm) | Power<br>$\text{W}^{\wedge}/\text{nm}$ | Lumens<br>( $\phi/\text{nm}$ ) | $\lambda$<br>(nm) | Power<br>$\text{W}^{\wedge}/\text{nm}$ | Lumens<br>( $\phi/\text{nm}$ ) |
|-------------------|----------------------------------------|--------------------------------|-------------------|----------------------------------------|--------------------------------|-------------------|----------------------------------------|--------------------------------|-------------------|----------------------------------------|--------------------------------|-------------------|----------------------------------------|--------------------------------|
| 360               | 0                                      | NR                             | 490               | 0                                      | NR                             | 620               | 35                                     | NR                             | 750               | 0                                      | NR                             | 880               | 0                                      | NR                             |
| 365               | 0                                      | NR                             | 495               | 0                                      | NR                             | 625               | 17                                     | NR                             | 755               | 0                                      | NR                             | 885               | 0                                      | NR                             |
| 370               | 0                                      | NR                             | 500               | 0                                      | NR                             | 630               | 9                                      | NR                             | 760               | 0                                      | NR                             | 890               | 0                                      | NR                             |
| 375               | 0                                      | NR                             | 505               | 0                                      | NR                             | 635               | 5                                      | NR                             | 765               | 0                                      | NR                             | 895               | 0                                      | NR                             |
| 380               | 0                                      | NR                             | 510               | 0                                      | NR                             | 640               | 3                                      | NR                             | 770               | 0                                      | NR                             | 900               | 0                                      | NR                             |
| 385               | 0                                      | NR                             | 515               | 0                                      | NR                             | 645               | 2                                      | NR                             | 775               | 0                                      | NR                             | 905               | 0                                      | NR                             |
| 390               | 0                                      | NR                             | 520               | 0                                      | NR                             | 650               | 2                                      | NR                             | 780               | 0                                      | NR                             | 910               | 0                                      | NR                             |
| 395               | 0                                      | NR                             | 525               | 1                                      | NR                             | 655               | 1                                      | NR                             | 785               | 0                                      | NR                             | 915               | 0                                      | NR                             |
| 400               | 0                                      | NR                             | 530               | 1                                      | NR                             | 660               | 1                                      | NR                             | 790               | 0                                      | NR                             | 920               | 0                                      | NR                             |
| 405               | 0                                      | NR                             | 535               | 1                                      | NR                             | 665               | 1                                      | NR                             | 795               | 0                                      | NR                             | 925               | 0                                      | NR                             |
| 410               | 0                                      | NR                             | 540               | 2                                      | NR                             | 670               | 1                                      | NR                             | 800               | 0                                      | NR                             | 930               | 0                                      | NR                             |
| 415               | 0                                      | NR                             | 545               | 4                                      | NR                             | 675               | 1                                      | NR                             | 805               | 0                                      | NR                             | 935               | 0                                      | NR                             |
| 420               | 0                                      | NR                             | 550               | 7                                      | NR                             | 680               | 1                                      | NR                             | 810               | 0                                      | NR                             | 940               | 0                                      | NR                             |
| 425               | 0                                      | NR                             | 555               | 12                                     | NR                             | 685               | 0                                      | NR                             | 815               | 0                                      | NR                             | 945               | 0                                      | NR                             |
| 430               | 0                                      | NR                             | 560               | 22                                     | NR                             | 690               | 0                                      | NR                             | 820               | 0                                      | NR                             | 950               | 0                                      | NR                             |
| 435               | 0                                      | NR                             | 565               | 38                                     | NR                             | 695               | 0                                      | NR                             | 825               | 0                                      | NR                             | 955               | 0                                      | NR                             |
| 440               | 0                                      | NR                             | 570               | 66                                     | NR                             | 700               | 0                                      | NR                             | 830               | 0                                      | NR                             | 960               | 0                                      | NR                             |
| 445               | 0                                      | NR                             | 575               | 115                                    | NR                             | 705               | 0                                      | NR                             | 835               | 0                                      | NR                             | 965               | 0                                      | NR                             |
| 450               | 0                                      | NR                             | 580               | 203                                    | NR                             | 710               | 0                                      | NR                             | 840               | 0                                      | NR                             | 970               | 0                                      | NR                             |
| 455               | 0                                      | NR                             | 585               | 354                                    | NR                             | 715               | 0                                      | NR                             | 845               | 0                                      | NR                             | 975               | 0                                      | NR                             |
| 460               | 0                                      | NR                             | 590               | 596                                    | NR                             | 720               | 0                                      | NR                             | 850               | 0                                      | NR                             | 980               | 0                                      | NR                             |
| 465               | 0                                      | NR                             | 595               | 923                                    | NR                             | 725               | 0                                      | NR                             | 855               | 0                                      | NR                             | 985               | 0                                      | NR                             |
| 470               | 0                                      | NR                             | 600               | 909                                    | NR                             | 730               | 0                                      | NR                             | 860               | 0                                      | NR                             | 990               | 0                                      | NR                             |
| 475               | 0                                      | NR                             | 605               | 447                                    | NR                             | 735               | 0                                      | NR                             | 865               | 0                                      | NR                             | 995               | 0                                      | NR                             |
| 480               | 0                                      | NR                             | 610               | 183                                    | NR                             | 740               | 0                                      | NR                             | 870               | 0                                      | NR                             | 1000              | 0                                      | NR                             |
| 485               | 0                                      | NR                             | 615               | 75                                     | NR                             | 745               | 0                                      | NR                             | 875               | 0                                      | NR                             |                   |                                        |                                |

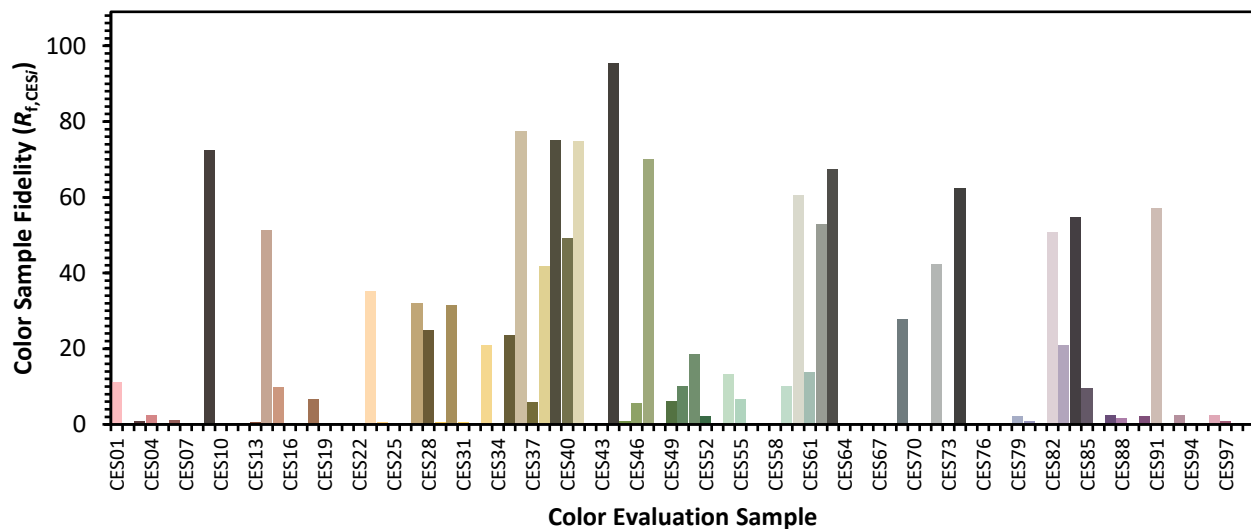
REPORT NUMBER: SP1-2511-597-9

**TM-30-18**
**Summary**
 $R_f = 1.3$   
 $R_g = 0.1$   
 $CIE\ R_a = -20.0$   
 $R_g = -380.5$ 

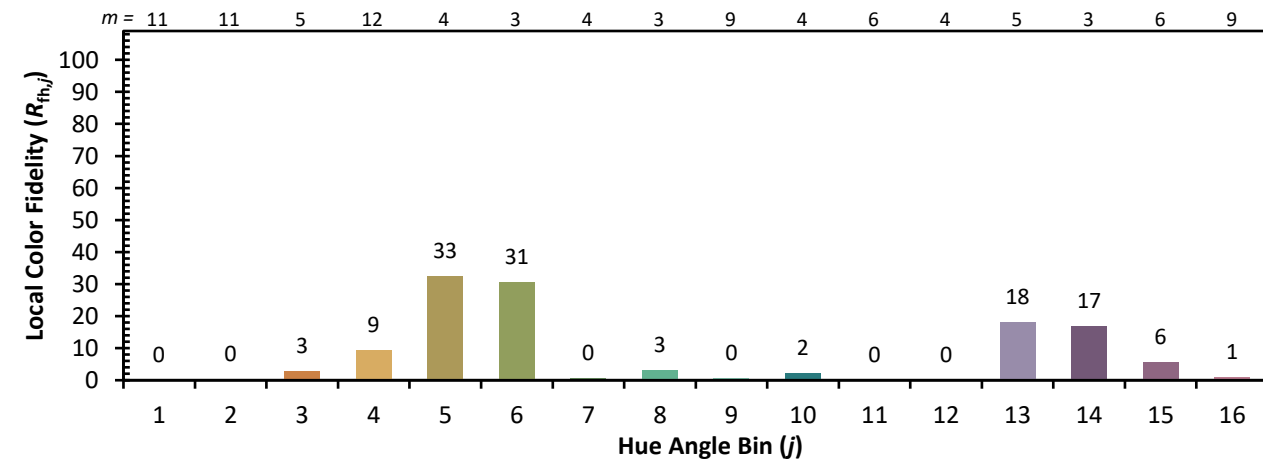
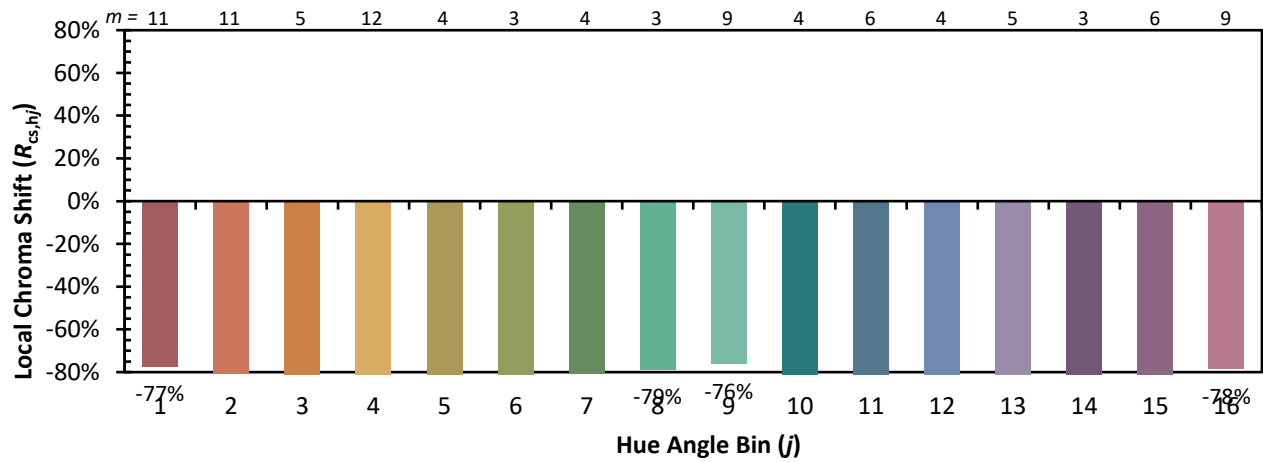
**Color Vector Graphics**


**Individual Sample Fidelity Index ( $R_{f,i}$ )**

|            |            |            |            |
|------------|------------|------------|------------|
| CES01 = 90 | CES26 = 0  | CES51 = 19 | CES76 = 0  |
| CES02 = 70 | CES27 = 32 | CES52 = 2  | CES77 = 0  |
| CES03 = 31 | CES28 = 25 | CES53 = 0  | CES78 = 0  |
| CES04 = 77 | CES29 = 1  | CES54 = 13 | CES79 = 2  |
| CES05 = 52 | CES30 = 31 | CES55 = 7  | CES80 = 1  |
| CES06 = 56 | CES31 = 1  | CES56 = 0  | CES81 = 0  |
| CES07 = 41 | CES32 = 0  | CES57 = 0  | CES82 = 51 |
| CES08 = 39 | CES33 = 21 | CES58 = 0  | CES83 = 21 |
| CES09 = 29 | CES34 = 0  | CES59 = 10 | CES84 = 55 |
| CES10 = 87 | CES35 = 24 | CES60 = 60 | CES85 = 10 |
| CES11 = 70 | CES36 = 77 | CES61 = 14 | CES86 = 0  |
| CES12 = 76 | CES37 = 6  | CES62 = 53 | CES87 = 2  |
| CES13 = 47 | CES38 = 42 | CES63 = 68 | CES88 = 2  |
| CES14 = 77 | CES39 = 75 | CES64 = 0  | CES89 = 0  |
| CES15 = 74 | CES40 = 49 | CES65 = 0  | CES90 = 2  |
| CES16 = 49 | CES41 = 75 | CES66 = 0  | CES91 = 57 |
| CES17 = 56 | CES42 = 0  | CES67 = 0  | CES92 = 0  |
| CES18 = 60 | CES43 = 0  | CES68 = 0  | CES93 = 3  |
| CES19 = 80 | CES44 = 95 | CES69 = 28 | CES94 = 0  |
| CES20 = 71 | CES45 = 1  | CES70 = 0  | CES95 = 0  |
| CES21 = 94 | CES46 = 6  | CES71 = 0  | CES96 = 2  |
| CES22 = 87 | CES47 = 70 | CES72 = 42 | CES97 = 1  |
| CES23 = 94 | CES48 = 0  | CES73 = 0  | CES98 = 0  |
| CES24 = 95 | CES49 = 6  | CES74 = 62 | CES99 = 0  |
| CES25 = 79 | CES50 = 10 | CES75 = 0  |            |



Color Rendition by Hue-Angle Bin



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**TM-30-18**

**Measure Comparisons**



(END OF REPORT)