

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: P1357146

Luminaire Tested: 4ASL4-15HE-2-65-UNV

Issue Date: 2/17/2026

**Test Information**

Test Method: LM-79-2019  
Report Number: P1357146  
TEST IS SCALED FROM IESNA LM-79-08 TEST DATA (G2-2511-597-7)  
Test Lab: INNOVATION CENTER  
Issue Date: 2/17/2026  
Manufacturer: COOPER LIGHTING SOLUTIONS  
Product Line: FAIL-SAFE  
Catalog Number: 4ASL4-15HE-2-65-UNV  
Description: 4FT 1500 LUMEN PER FOOT 4ASL LED LUMINAIRE WITH OPL LENS AND 6500K LEDS 2 ROW  
Light Source: -  
Ballast/Driver: -

**Summary**

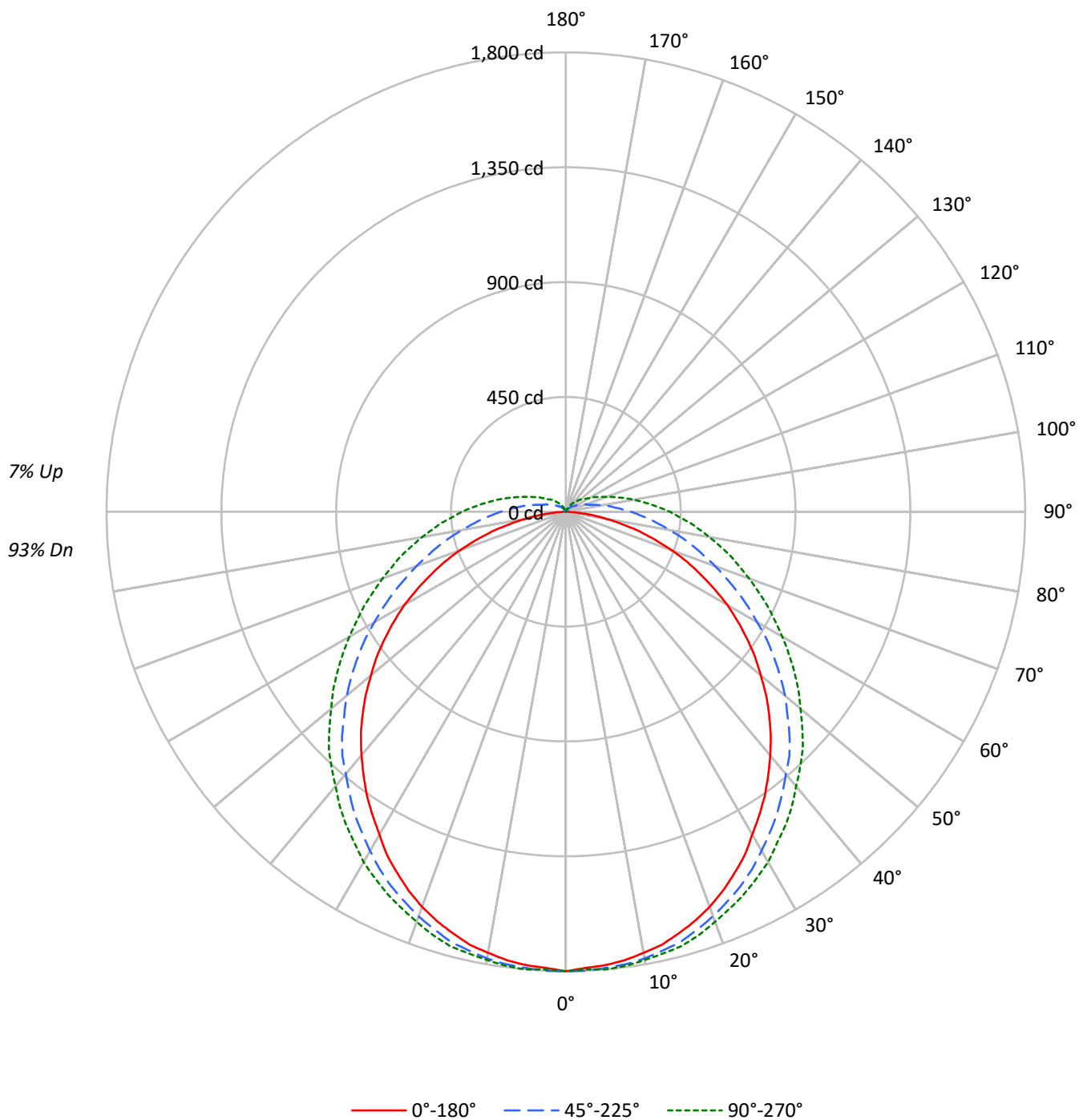
Lumens per Lamp: N/A  
Luminaire Lumens: 6180.0 lumens  
Efficiency: N/A  
Efficacy: 118.8 lumens/watt  
Spacing Criteria (0/90/45): 1.21 / 1.3 / 1.4  
Luminous Opening: Rectangular w/ Sides (W: 0.33' x L: 3.98' x H: 0.1')  
CIE Type: Direct

Input Watts (W): 52  
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: 4ASL4-15HE-2-65-UNV

### Luminous Intensity Polar Plot



TEST NUMBER: P1357146

CATALOG NUMBER: 4ASL4-15HE-2-65-UNV

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

|     |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |  |    |    |    |    |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|-----|-----|-----|--|----|----|----|----|
| RF  | 20  |     |     |     | 20  |     |     |     | 20  |     |     |  | 20  |     |     |  | 20 |    |    |    |
| RC  | 80  |     |     |     | 70  |     |     |     | 50  |     |     |  | 30  |     |     |  | 10 |    |    | 0  |
| RW  | 70  | 50  | 30  | 10  | 70  | 50  | 30  | 10  | 50  | 30  | 10  |  | 50  | 30  | 10  |  | 50 | 30 | 10 | 0  |
| RCR |     |     |     |     |     |     |     |     |     |     |     |  |     |     |     |  |    |    |    |    |
| 0   | 117 | 117 | 117 | 117 | 114 | 114 | 114 | 114 | 107 | 107 | 107 |  | 101 | 101 | 101 |  | 95 | 95 | 95 | 93 |
| 1   | 105 | 100 | 95  | 90  | 102 | 97  | 92  | 88  | 91  | 87  | 84  |  | 86  | 83  | 80  |  | 81 | 79 | 77 | 74 |
| 2   | 95  | 86  | 79  | 72  | 92  | 84  | 77  | 71  | 79  | 73  | 68  |  | 74  | 70  | 65  |  | 70 | 66 | 63 | 60 |
| 3   | 86  | 75  | 66  | 59  | 83  | 73  | 65  | 58  | 69  | 62  | 56  |  | 65  | 59  | 55  |  | 62 | 57 | 53 | 50 |
| 4   | 79  | 66  | 57  | 50  | 76  | 64  | 56  | 49  | 61  | 54  | 48  |  | 58  | 51  | 46  |  | 55 | 49 | 45 | 42 |
| 5   | 72  | 59  | 50  | 43  | 70  | 57  | 49  | 42  | 54  | 47  | 41  |  | 52  | 45  | 40  |  | 49 | 43 | 39 | 36 |
| 6   | 67  | 53  | 44  | 37  | 64  | 52  | 43  | 37  | 49  | 41  | 36  |  | 47  | 40  | 35  |  | 44 | 39 | 34 | 32 |
| 7   | 62  | 48  | 39  | 33  | 60  | 47  | 38  | 32  | 45  | 37  | 32  |  | 43  | 36  | 31  |  | 41 | 35 | 30 | 28 |
| 8   | 58  | 44  | 35  | 29  | 56  | 43  | 34  | 29  | 41  | 33  | 28  |  | 39  | 32  | 28  |  | 37 | 31 | 27 | 25 |
| 9   | 54  | 40  | 32  | 26  | 52  | 39  | 31  | 26  | 37  | 30  | 25  |  | 36  | 29  | 25  |  | 34 | 29 | 24 | 22 |
| 10  | 50  | 37  | 29  | 24  | 49  | 36  | 28  | 23  | 35  | 28  | 23  |  | 33  | 27  | 22  |  | 32 | 26 | 22 | 20 |

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

|     | 0°    | 45°   | 90°   |
|-----|-------|-------|-------|
| 0°  | 14609 | 14609 | 14609 |
| 5°  | 14493 | 14318 | 14275 |
| 10° | 14395 | 14054 | 13927 |
| 15° | 14263 | 13766 | 13648 |
| 20° | 14092 | 13401 | 13256 |
| 25° | 13821 | 13041 | 12919 |
| 30° | 13482 | 12629 | 12583 |
| 35° | 13217 | 12247 | 12193 |
| 40° | 12910 | 11834 | 11783 |
| 45° | 12599 | 11479 | 11484 |
| 50° | 12198 | 11009 | 11040 |
| 55° | 11812 | 10504 | 10688 |
| 60° | 11339 | 9936  | 10313 |
| 65° | 10602 | 9409  | 10023 |
| 70° | 9775  | 8912  | 9756  |
| 75° | 8569  | 8528  | 9669  |
| 80° | 6682  | 8189  | 9639  |
| 85° | 4056  | 8179  | 9914  |

**MAXIMUM LUMINANCE 45°-90°:**

Horizontal Angle: 0°

Vertical Angle: 45°

Luminance: 12599 cd/sqm

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**ZONAL LUMENS:**

| Zone      | Lumens | % Fixture |
|-----------|--------|-----------|
| 0°-10°    | 170.7  | 2.8       |
| 10°-20°   | 490.7  | 7.9       |
| 20°-30°   | 743.6  | 12.0      |
| 30°-40°   | 899.3  | 14.6      |
| 40°-50°   | 948.1  | 15.3      |
| 50°-60°   | 884.9  | 14.3      |
| 60°-70°   | 730.6  | 11.8      |
| 70°-80°   | 530.0  | 8.6       |
| 80°-90°   | 334.9  | 5.4       |
| 90°-100°  | 199.9  | 3.2       |
| 100°-110° | 114.6  | 1.9       |
| 110°-120° | 65.1   | 1.1       |
| 120°-130° | 37.1   | 0.6       |
| 130°-140° | 20.1   | 0.3       |
| 140°-150° | 8.8    | 0.1       |
| 150°-160° | 1.6    | 0.0       |
| 160°-170° | 0.0    | 0.0       |
| 170°-180° | 0.0    | 0.0       |
| 0°-30°    | 1405.0 | 22.7      |
| 0°-40°    | 2304.4 | 37.3      |
| 0°-60°    | 4137.4 | 66.9      |
| 0°-90°    | 5732.9 | 92.8      |
| 90°-120°  | 379.5  | 6.1       |
| 90°-150°  | 445.6  | 7.2       |
| 90°-180°  | 447.0  | 7.2       |
| 0°-180°   | 6180.0 | 100.0     |

**CANDELA DISTRIBUTION:**

|      | 0°   | 22.5° | 45°  | 67.5° | 90°  | Flux |
|------|------|-------|------|-------|------|------|
| 0°   | 1800 | 1800  | 1800 | 1800  | 1800 |      |
| 5°   | 1783 | 1800  | 1794 | 1794  | 1800 | 169  |
| 15°  | 1710 | 1732  | 1744 | 1749  | 1760 | 482  |
| 25°  | 1562 | 1585  | 1619 | 1642  | 1653 | 720  |
| 35°  | 1359 | 1393  | 1444 | 1483  | 1500 | 849  |
| 45°  | 1126 | 1172  | 1240 | 1291  | 1313 | 869  |
| 55°  | 866  | 917   | 996  | 1064  | 1093 | 774  |
| 65°  | 583  | 645   | 742  | 832   | 872  | 579  |
| 75°  | 300  | 379   | 515  | 623   | 668  | 316  |
| 85°  | 57   | 176   | 328  | 442   | 487  | 69   |
| 90°  | 0    | 108   | 255  | 362   | 408  | 2    |
| 95°  | 0    | 68    | 192  | 294   | 334  | 0    |
| 105° | 0    | 23    | 108  | 187   | 215  | 0    |
| 115° | 0    | 11    | 62   | 113   | 136  | 0    |
| 125° | 0    | 6     | 40   | 74    | 85   | 0    |
| 135° | 0    | 0     | 23   | 45    | 57   | 0    |
| 145° | 0    | 0     | 11   | 28    | 34   | 0    |
| 155° | 0    | 0     | 0    | 6     | 11   | 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°     | 1800.2 | 1800.2 | 1800.2 | 1800.2 | 1800.2 |
| 2.5°   | 1788.8 | 1805.8 | 1800.2 | 1794.5 | 1794.5 |
| 5°     | 1783.2 | 1800.2 | 1794.5 | 1794.5 | 1800.2 |
| 7.5°   | 1771.9 | 1788.8 | 1788.8 | 1788.8 | 1794.5 |
| 10°    | 1754.9 | 1777.5 | 1777.5 | 1777.5 | 1783.2 |
| 12.5°  | 1737.9 | 1754.9 | 1760.5 | 1766.2 | 1771.9 |
| 15°    | 1709.6 | 1732.2 | 1743.6 | 1749.2 | 1760.5 |
| 17.5°  | 1681.3 | 1698.3 | 1715.3 | 1732.2 | 1737.9 |
| 20°    | 1647.3 | 1670.0 | 1687.0 | 1703.9 | 1709.6 |
| 22.5°  | 1607.7 | 1630.3 | 1653.0 | 1670.0 | 1681.3 |
| 25°    | 1562.4 | 1585.1 | 1619.0 | 1641.7 | 1653.0 |
| 27.5°  | 1517.1 | 1539.8 | 1579.4 | 1607.7 | 1619.0 |
| 30°    | 1460.5 | 1494.5 | 1534.1 | 1568.1 | 1585.1 |
| 32.5°  | 1409.6 | 1443.5 | 1488.8 | 1528.4 | 1539.8 |
| 35°    | 1358.6 | 1392.6 | 1443.5 | 1483.2 | 1500.1 |
| 37.5°  | 1302.0 | 1341.6 | 1392.6 | 1437.9 | 1454.9 |
| 40°    | 1245.4 | 1285.0 | 1341.6 | 1392.6 | 1403.9 |
| 42.5°  | 1188.8 | 1228.4 | 1296.3 | 1341.6 | 1358.6 |
| 45°    | 1126.5 | 1171.8 | 1239.7 | 1290.7 | 1313.3 |
| 47.5°  | 1064.3 | 1109.5 | 1177.5 | 1234.1 | 1256.7 |
| 50°    | 996.3  | 1047.3 | 1120.9 | 1177.5 | 1200.1 |
| 52.5°  | 934.1  | 985.0  | 1058.6 | 1120.9 | 1149.2 |
| 55°    | 866.1  | 917.1  | 996.3  | 1064.3 | 1092.6 |
| 57.5°  | 798.2  | 849.1  | 934.1  | 1007.6 | 1035.9 |
| 60°    | 730.3  | 781.2  | 866.1  | 951.0  | 979.3  |
| 62.5°  | 656.7  | 713.3  | 803.8  | 888.8  | 922.7  |
| 65°    | 583.1  | 645.3  | 741.6  | 832.2  | 871.8  |
| 67.5°  | 515.1  | 577.4  | 679.3  | 781.2  | 815.2  |
| 70°    | 441.6  | 509.5  | 622.7  | 724.6  | 764.2  |
| 72.5°  | 368.0  | 441.6  | 566.1  | 673.6  | 713.3  |
| 75°    | 300.0  | 379.3  | 515.1  | 622.7  | 668.0  |
| 77.5°  | 226.4  | 322.7  | 464.2  | 577.4  | 617.0  |
| 80°    | 164.2  | 266.1  | 413.2  | 532.1  | 571.8  |
| 82.5°  | 107.6  | 215.1  | 368.0  | 486.8  | 526.5  |
| 85°    | 56.6   | 175.5  | 328.3  | 441.6  | 486.8  |
| 87.5°  | 17.0   | 135.9  | 288.7  | 401.9  | 441.6  |
| 90°    | 0.0    | 107.6  | 254.7  | 362.3  | 407.6  |
| 92.5°  | 0.0    | 84.9   | 220.8  | 328.3  | 368.0  |
| 95°    | 0.0    | 67.9   | 192.5  | 294.4  | 334.0  |
| 97.5°  | 0.0    | 56.6   | 169.8  | 266.1  | 300.0  |
| 100°   | 0.0    | 45.3   | 147.2  | 237.8  | 271.7  |
| 102.5° | 0.0    | 34.0   | 124.5  | 209.5  | 243.4  |
| 105°   | 0.0    | 22.6   | 107.6  | 186.8  | 215.1  |
| 107.5° | 0.0    | 17.0   | 90.6   | 164.2  | 192.5  |
| 110°   | 0.0    | 17.0   | 84.9   | 141.5  | 169.8  |



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**CANDELA DISTRIBUTION (continued):**

|        | 0°  | 22.5° | 45°  | 67.5° | 90°   |
|--------|-----|-------|------|-------|-------|
| 112.5° | 0.0 | 11.3  | 73.6 | 130.2 | 152.8 |
| 115°   | 0.0 | 11.3  | 62.3 | 113.2 | 135.9 |
| 117.5° | 0.0 | 11.3  | 56.6 | 101.9 | 124.5 |
| 120°   | 0.0 | 11.3  | 50.9 | 90.6  | 107.6 |
| 122.5° | 0.0 | 5.7   | 45.3 | 79.3  | 96.2  |
| 125°   | 0.0 | 5.7   | 39.6 | 73.6  | 84.9  |
| 127.5° | 0.0 | 5.7   | 34.0 | 67.9  | 79.3  |
| 130°   | 0.0 | 5.7   | 34.0 | 62.3  | 73.6  |
| 132.5° | 0.0 | 0.0   | 28.3 | 56.6  | 67.9  |
| 135°   | 0.0 | 0.0   | 22.6 | 45.3  | 56.6  |
| 137.5° | 0.0 | 0.0   | 22.6 | 39.6  | 50.9  |
| 140°   | 0.0 | 0.0   | 17.0 | 39.6  | 45.3  |
| 142.5° | 0.0 | 0.0   | 11.3 | 34.0  | 39.6  |
| 145°   | 0.0 | 0.0   | 11.3 | 28.3  | 34.0  |
| 147.5° | 0.0 | 0.0   | 5.7  | 22.6  | 28.3  |
| 150°   | 0.0 | 0.0   | 5.7  | 17.0  | 22.6  |
| 152.5° | 0.0 | 0.0   | 0.0  | 11.3  | 17.0  |
| 155°   | 0.0 | 0.0   | 0.0  | 5.7   | 11.3  |
| 157.5° | 0.0 | 0.0   | 0.0  | 0.0   | 5.7   |
| 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   |

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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 | 18.63            | 20.16 | 19.10 | 20.62 | 21.11 | 20.69          | 22.22 | 21.16 | 22.68 | 23.17 |
|                 | 3H   | 20.13            | 21.53 | 20.62 | 22.00 | 22.53 | 23.14          | 24.54 | 23.62 | 25.01 | 25.54 |
|                 | 4H   | 20.61            | 21.94 | 21.12 | 22.43 | 22.97 | 24.35          | 25.68 | 24.85 | 26.16 | 26.71 |
|                 | 6H   | 20.89            | 22.12 | 21.41 | 22.62 | 23.18 | 25.62          | 26.86 | 26.14 | 27.36 | 27.92 |
|                 | 8H   | 20.94            | 22.13 | 21.47 | 22.65 | 23.22 | 26.28          | 27.46 | 26.81 | 27.99 | 28.56 |
|                 | 12H  | 20.96            | 22.09 | 21.49 | 22.61 | 23.21 | 27.01          | 28.15 | 27.55 | 28.66 | 29.26 |
| 4H              | 2H   | 19.51            | 20.84 | 20.02 | 21.32 | 21.87 | 21.12          | 22.45 | 21.63 | 22.93 | 23.48 |
|                 | 3H   | 21.25            | 22.38 | 21.77 | 22.91 | 23.48 | 23.80          | 24.93 | 24.32 | 25.46 | 26.03 |
|                 | 4H   | 21.86            | 22.90 | 22.40 | 23.44 | 24.04 | 25.18          | 26.22 | 25.72 | 26.76 | 27.36 |
|                 | 6H   | 22.26            | 23.18 | 22.82 | 23.74 | 24.36 | 26.65          | 27.57 | 27.21 | 28.14 | 28.75 |
|                 | 8H   | 22.36            | 23.22 | 22.92 | 23.79 | 24.41 | 27.42          | 28.28 | 27.98 | 28.85 | 29.47 |
|                 | 12H  | 22.41            | 23.19 | 22.99 | 23.78 | 24.41 | 28.27          | 29.06 | 28.86 | 29.65 | 30.28 |
| 8H              | 4H   | 22.55            | 23.42 | 23.12 | 23.98 | 24.61 | 25.40          | 26.27 | 25.97 | 26.83 | 27.46 |
|                 | 6H   | 23.14            | 23.87 | 23.74 | 24.48 | 25.11 | 27.05          | 27.78 | 27.65 | 28.39 | 29.02 |
|                 | 8H   | 23.33            | 23.99 | 23.94 | 24.61 | 25.25 | 27.96          | 28.62 | 28.57 | 29.24 | 29.88 |
|                 | 12H  | 23.45            | 24.04 | 24.06 | 24.65 | 25.36 | 29.00          | 29.59 | 29.61 | 30.20 | 30.91 |
| 12H             | 4H   | 22.76            | 23.54 | 23.34 | 24.13 | 24.76 | 25.41          | 26.20 | 26.00 | 26.79 | 27.42 |
|                 | 6H   | 23.45            | 24.11 | 24.05 | 24.73 | 25.37 | 27.09          | 27.75 | 27.70 | 28.37 | 29.01 |
|                 | 8H   | 23.73            | 24.32 | 24.34 | 24.93 | 25.64 | 28.07          | 28.66 | 28.68 | 29.27 | 29.98 |

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

Report Prepared for

Cooper Lighting Solutions

Fail-Safe

Report Number: SP1-2511-597-6

Test Date: 11/18/2025

Luminaire Tested: 4ASL-2-65-UNV-OPL-1\_600mA

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

### Test Information

Test Method: LM-79-2019  
 Report Number: SP1-2511-597-6  
 Test Lab: COOPER LIGHTING SOLUTIONS  
 Photometer: SP1 - 76IN SPHERE  
 Measurement Geometry:  $4\pi$   
 Issue Date: 11/18/2025  
 Manufacturer: COOPER LIGHTING SOLUTIONS  
 Product Line: Fail-Safe  
 Catalog Number: **4ASL-2-65-UNV-OPL-1\_600mA**  
 Description: 2foot 4ASL LED LUMINAIRE WITH OPL LENS AND 6500K LEDS with 1 rows at 600mA

### Spectral Parameters

CCT (K): 6972  
 CIE  $u'$ : 0.1979  
 CIE  $v'$ : 0.4612  
 Duv: 0.0005  
 CIE x: 0.3066  
 CIE y: 0.3177  
 CIE z: 0.3758  
 Peak Wavelength (nm): 455  
 Dominant Wavelength (nm): 483  
 Purity: 10.33335  
 R<sub>f</sub>: 88.2  
 R<sub>g</sub>: 97.1

CRI (Ra): 94.3  
 R1: 96.1  
 R2: 98.8  
 R3: 96.4  
 R4: 92.8  
 R5: 92.9  
 R6: 92.2  
 R7: 93.5  
 R8: 91.4  
 R9: 82.6  
 R10: 95.4  
 R11: 95.2  
 R12: 63.5  
 R13: 99.3  
 R14: 98.1  
 R15: 93.7



### Test Conditions

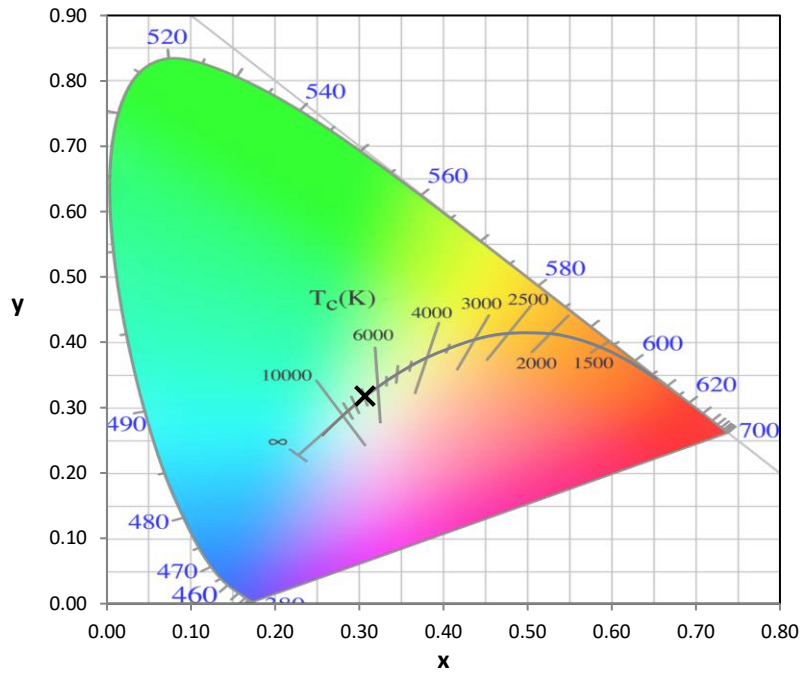
Stabilization Time: 20M  
 Operation Time: 1H 20M  
 Sphere Temperature (°C): 24.1

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| Measurement and Test Equipment |                       |                  |                      |
|--------------------------------|-----------------------|------------------|----------------------|
| Instrument                     | Identification Number | Calibration Date | Calibration Due Date |
| Photometer                     | 76INCH SPHERE IN0058  | 6/16/2025        | 12/16/2025           |
| 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           |

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**CIE 1931 Chromaticity Diagram**



**CIE 1931 Chromaticity Diagram with 2017 ANSI 7-Step and 4-Step Quadrangles**



Point lies inside the ANSI 6500K 7-step quadrangle

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### Photopic Flux vs. Wavelength

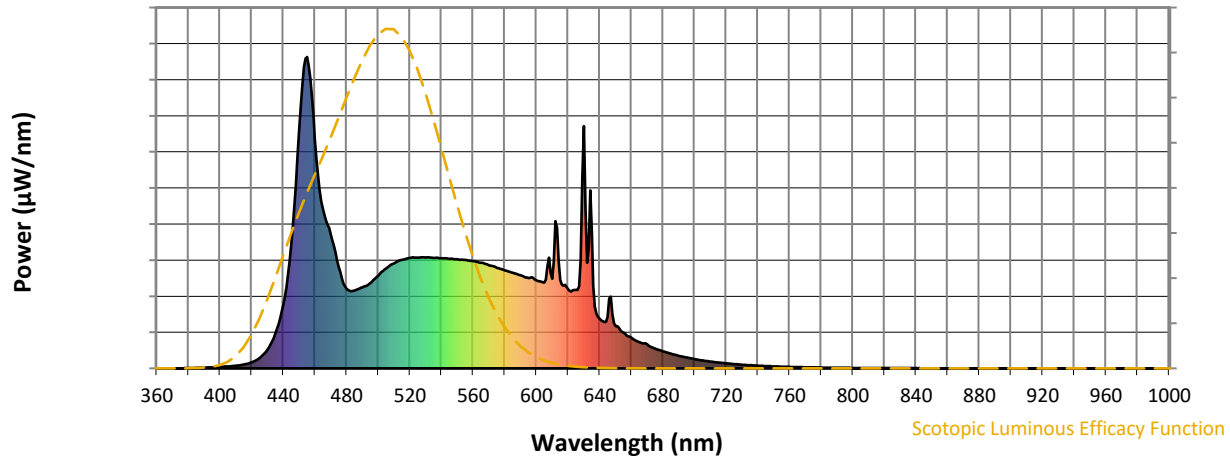


### Photopic Lumens: NR

| λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) |
|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|
| 360       | 0                           | NR               | 490       | 260                         | NR               | 620       | 255                         | NR               | 750       | 6                           | NR               | 880       | 0                           | NR               |
| 365       | 0                           | NR               | 495       | 274                         | NR               | 625       | 252                         | NR               | 755       | 6                           | NR               | 885       | 0                           | NR               |
| 370       | 0                           | NR               | 500       | 297                         | NR               | 630       | 778                         | NR               | 760       | 5                           | NR               | 890       | 0                           | NR               |
| 375       | 0                           | NR               | 505       | 320                         | NR               | 635       | 431                         | NR               | 765       | 4                           | NR               | 895       | 0                           | NR               |
| 380       | 1                           | NR               | 510       | 337                         | NR               | 640       | 160                         | NR               | 770       | 4                           | NR               | 900       | 0                           | NR               |
| 385       | 2                           | NR               | 515       | 349                         | NR               | 645       | 165                         | NR               | 775       | 3                           | NR               | 905       | 0                           | NR               |
| 390       | 2                           | NR               | 520       | 354                         | NR               | 650       | 135                         | NR               | 780       | 3                           | NR               | 910       | 0                           | NR               |
| 395       | 3                           | NR               | 525       | 356                         | NR               | 655       | 115                         | NR               | 785       | 2                           | NR               | 915       | 0                           | NR               |
| 400       | 5                           | NR               | 530       | 356                         | NR               | 660       | 99                          | NR               | 790       | 2                           | NR               | 920       | 0                           | NR               |
| 405       | 6                           | NR               | 535       | 355                         | NR               | 665       | 84                          | NR               | 795       | 2                           | NR               | 925       | 0                           | NR               |
| 410       | 8                           | NR               | 540       | 354                         | NR               | 670       | 77                          | NR               | 800       | 2                           | NR               | 930       | 0                           | NR               |
| 415       | 12                          | NR               | 545       | 351                         | NR               | 675       | 64                          | NR               | 805       | 1                           | NR               | 935       | 0                           | NR               |
| 420       | 19                          | NR               | 550       | 350                         | NR               | 680       | 55                          | NR               | 810       | 1                           | NR               | 940       | 0                           | NR               |
| 425       | 33                          | NR               | 555       | 348                         | NR               | 685       | 47                          | NR               | 815       | 1                           | NR               | 945       | 0                           | NR               |
| 430       | 60                          | NR               | 560       | 344                         | NR               | 690       | 41                          | NR               | 820       | 1                           | NR               | 950       | 0                           | NR               |
| 435       | 113                         | NR               | 565       | 339                         | NR               | 695       | 35                          | NR               | 825       | 1                           | NR               | 955       | 0                           | NR               |
| 440       | 206                         | NR               | 570       | 331                         | NR               | 700       | 30                          | NR               | 830       | 1                           | NR               | 960       | 0                           | NR               |
| 445       | 392                         | NR               | 575       | 323                         | NR               | 705       | 26                          | NR               | 835       | 1                           | NR               | 965       | 0                           | NR               |
| 450       | 764                         | NR               | 580       | 315                         | NR               | 710       | 22                          | NR               | 840       | 1                           | NR               | 970       | 0                           | NR               |
| 455       | 1000                        | NR               | 585       | 307                         | NR               | 715       | 19                          | NR               | 845       | 0                           | NR               | 975       | 0                           | NR               |
| 460       | 736                         | NR               | 590       | 299                         | NR               | 720       | 16                          | NR               | 850       | 0                           | NR               | 980       | 0                           | NR               |
| 465       | 513                         | NR               | 595       | 290                         | NR               | 725       | 14                          | NR               | 855       | 0                           | NR               | 985       | 0                           | NR               |
| 470       | 430                         | NR               | 600       | 282                         | NR               | 730       | 12                          | NR               | 860       | 0                           | NR               | 990       | 0                           | NR               |
| 475       | 325                         | NR               | 605       | 276                         | NR               | 735       | 10                          | NR               | 865       | 0                           | NR               | 995       | 0                           | NR               |
| 480       | 256                         | NR               | 610       | 287                         | NR               | 740       | 9                           | NR               | 870       | 0                           | NR               | 1000      | 0                           | NR               |
| 485       | 250                         | NR               | 615       | 284                         | NR               | 745       | 7                           | NR               | 875       | 0                           | NR               |           |                             |                  |

REPORT NUMBER: SP1-2511-597-6

### Scotopic Flux vs. Wavelength



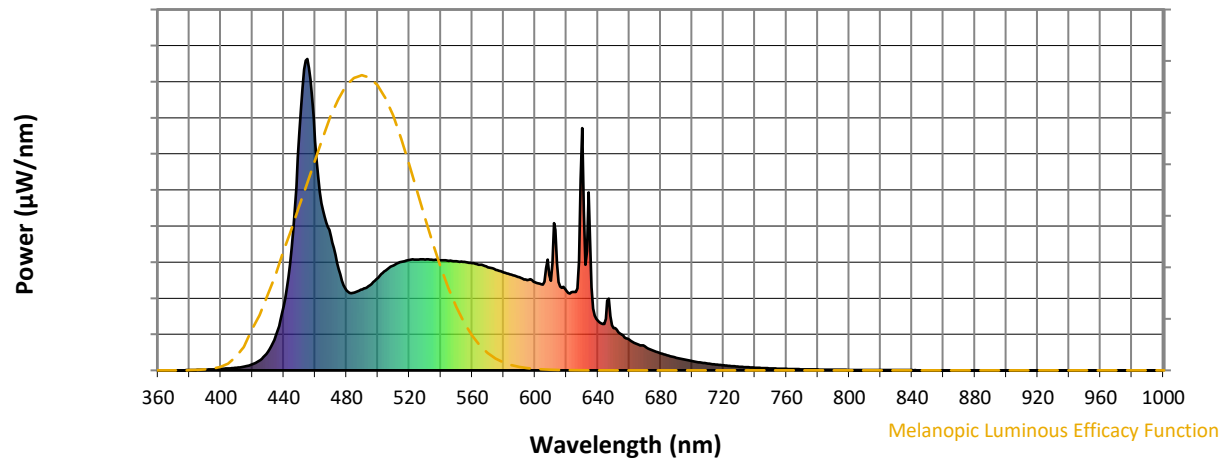
Scotopic Lumens: NR

S/P: 2.48

| $\lambda$<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               | 260                                  | NR                             | 620               | 255                                  | NR                             | 750               | 6                                    | NR                             | 880               | 0                                    | NR                             |
| 365               | 0                                    | NR                             | 495               | 274                                  | NR                             | 625               | 252                                  | NR                             | 755               | 6                                    | NR                             | 885               | 0                                    | NR                             |
| 370               | 0                                    | NR                             | 500               | 297                                  | NR                             | 630               | 778                                  | NR                             | 760               | 5                                    | NR                             | 890               | 0                                    | NR                             |
| 375               | 0                                    | NR                             | 505               | 320                                  | NR                             | 635               | 431                                  | NR                             | 765               | 4                                    | NR                             | 895               | 0                                    | NR                             |
| 380               | 1                                    | NR                             | 510               | 337                                  | NR                             | 640               | 160                                  | NR                             | 770               | 4                                    | NR                             | 900               | 0                                    | NR                             |
| 385               | 2                                    | NR                             | 515               | 349                                  | NR                             | 645               | 165                                  | NR                             | 775               | 3                                    | NR                             | 905               | 0                                    | NR                             |
| 390               | 2                                    | NR                             | 520               | 354                                  | NR                             | 650               | 135                                  | NR                             | 780               | 3                                    | NR                             | 910               | 0                                    | NR                             |
| 395               | 3                                    | NR                             | 525               | 356                                  | NR                             | 655               | 115                                  | NR                             | 785               | 2                                    | NR                             | 915               | 0                                    | NR                             |
| 400               | 5                                    | NR                             | 530               | 356                                  | NR                             | 660               | 99                                   | NR                             | 790               | 2                                    | NR                             | 920               | 0                                    | NR                             |
| 405               | 6                                    | NR                             | 535               | 355                                  | NR                             | 665               | 84                                   | NR                             | 795               | 2                                    | NR                             | 925               | 0                                    | NR                             |
| 410               | 8                                    | NR                             | 540               | 354                                  | NR                             | 670               | 77                                   | NR                             | 800               | 2                                    | NR                             | 930               | 0                                    | NR                             |
| 415               | 12                                   | NR                             | 545               | 351                                  | NR                             | 675               | 64                                   | NR                             | 805               | 1                                    | NR                             | 935               | 0                                    | NR                             |
| 420               | 19                                   | NR                             | 550               | 350                                  | NR                             | 680               | 55                                   | NR                             | 810               | 1                                    | NR                             | 940               | 0                                    | NR                             |
| 425               | 33                                   | NR                             | 555               | 348                                  | NR                             | 685               | 47                                   | NR                             | 815               | 1                                    | NR                             | 945               | 0                                    | NR                             |
| 430               | 60                                   | NR                             | 560               | 344                                  | NR                             | 690               | 41                                   | NR                             | 820               | 1                                    | NR                             | 950               | 0                                    | NR                             |
| 435               | 113                                  | NR                             | 565               | 339                                  | NR                             | 695               | 35                                   | NR                             | 825               | 1                                    | NR                             | 955               | 0                                    | NR                             |
| 440               | 206                                  | NR                             | 570               | 331                                  | NR                             | 700               | 30                                   | NR                             | 830               | 1                                    | NR                             | 960               | 0                                    | NR                             |
| 445               | 392                                  | NR                             | 575               | 323                                  | NR                             | 705               | 26                                   | NR                             | 835               | 1                                    | NR                             | 965               | 0                                    | NR                             |
| 450               | 764                                  | NR                             | 580               | 315                                  | NR                             | 710               | 22                                   | NR                             | 840               | 1                                    | NR                             | 970               | 0                                    | NR                             |
| 455               | 1000                                 | NR                             | 585               | 307                                  | NR                             | 715               | 19                                   | NR                             | 845               | 0                                    | NR                             | 975               | 0                                    | NR                             |
| 460               | 736                                  | NR                             | 590               | 299                                  | NR                             | 720               | 16                                   | NR                             | 850               | 0                                    | NR                             | 980               | 0                                    | NR                             |
| 465               | 513                                  | NR                             | 595               | 290                                  | NR                             | 725               | 14                                   | NR                             | 855               | 0                                    | NR                             | 985               | 0                                    | NR                             |
| 470               | 430                                  | NR                             | 600               | 282                                  | NR                             | 730               | 12                                   | NR                             | 860               | 0                                    | NR                             | 990               | 0                                    | NR                             |
| 475               | 325                                  | NR                             | 605               | 276                                  | NR                             | 735               | 10                                   | NR                             | 865               | 0                                    | NR                             | 995               | 0                                    | NR                             |
| 480               | 256                                  | NR                             | 610               | 287                                  | NR                             | 740               | 9                                    | NR                             | 870               | 0                                    | NR                             | 1000              | 0                                    | NR                             |
| 485               | 250                                  | NR                             | 615               | 284                                  | NR                             | 745               | 7                                    | NR                             | 875               | 0                                    | NR                             |                   |                                      |                                |

REPORT NUMBER: SP1-2511-597-6

### Melanopic Flux vs. Wavelength



Melanopic Lumens: NR

M/P: 5.67

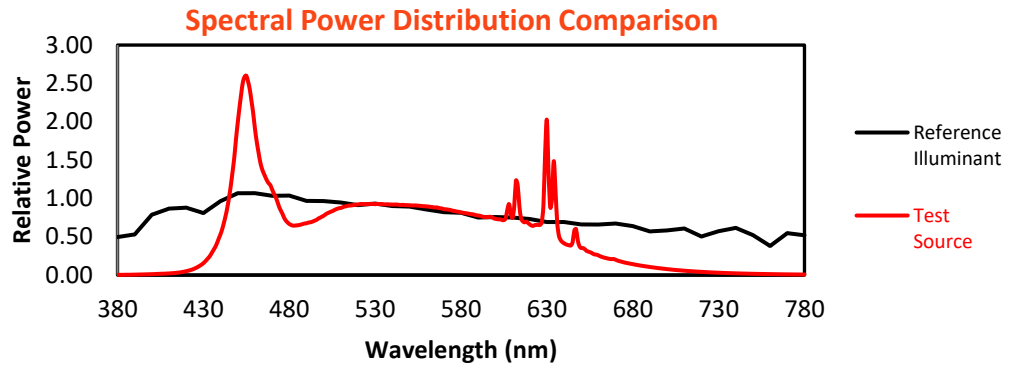
| λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) |
|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|
| 360       | 0                           | NR               | 490       | 260                         | NR               | 620       | 255                         | NR               | 750       | 6                           | NR               | 880       | 0                           | NR               |
| 365       | 0                           | NR               | 495       | 274                         | NR               | 625       | 252                         | NR               | 755       | 6                           | NR               | 885       | 0                           | NR               |
| 370       | 0                           | NR               | 500       | 297                         | NR               | 630       | 778                         | NR               | 760       | 5                           | NR               | 890       | 0                           | NR               |
| 375       | 0                           | NR               | 505       | 320                         | NR               | 635       | 431                         | NR               | 765       | 4                           | NR               | 895       | 0                           | NR               |
| 380       | 1                           | NR               | 510       | 337                         | NR               | 640       | 160                         | NR               | 770       | 4                           | NR               | 900       | 0                           | NR               |
| 385       | 2                           | NR               | 515       | 349                         | NR               | 645       | 165                         | NR               | 775       | 3                           | NR               | 905       | 0                           | NR               |
| 390       | 2                           | NR               | 520       | 354                         | NR               | 650       | 135                         | NR               | 780       | 3                           | NR               | 910       | 0                           | NR               |
| 395       | 3                           | NR               | 525       | 356                         | NR               | 655       | 115                         | NR               | 785       | 2                           | NR               | 915       | 0                           | NR               |
| 400       | 5                           | NR               | 530       | 356                         | NR               | 660       | 99                          | NR               | 790       | 2                           | NR               | 920       | 0                           | NR               |
| 405       | 6                           | NR               | 535       | 355                         | NR               | 665       | 84                          | NR               | 795       | 2                           | NR               | 925       | 0                           | NR               |
| 410       | 8                           | NR               | 540       | 354                         | NR               | 670       | 77                          | NR               | 800       | 2                           | NR               | 930       | 0                           | NR               |
| 415       | 12                          | NR               | 545       | 351                         | NR               | 675       | 64                          | NR               | 805       | 1                           | NR               | 935       | 0                           | NR               |
| 420       | 19                          | NR               | 550       | 350                         | NR               | 680       | 55                          | NR               | 810       | 1                           | NR               | 940       | 0                           | NR               |
| 425       | 33                          | NR               | 555       | 348                         | NR               | 685       | 47                          | NR               | 815       | 1                           | NR               | 945       | 0                           | NR               |
| 430       | 60                          | NR               | 560       | 344                         | NR               | 690       | 41                          | NR               | 820       | 1                           | NR               | 950       | 0                           | NR               |
| 435       | 113                         | NR               | 565       | 339                         | NR               | 695       | 35                          | NR               | 825       | 1                           | NR               | 955       | 0                           | NR               |
| 440       | 206                         | NR               | 570       | 331                         | NR               | 700       | 30                          | NR               | 830       | 1                           | NR               | 960       | 0                           | NR               |
| 445       | 392                         | NR               | 575       | 323                         | NR               | 705       | 26                          | NR               | 835       | 1                           | NR               | 965       | 0                           | NR               |
| 450       | 764                         | NR               | 580       | 315                         | NR               | 710       | 22                          | NR               | 840       | 1                           | NR               | 970       | 0                           | NR               |
| 455       | 1000                        | NR               | 585       | 307                         | NR               | 715       | 19                          | NR               | 845       | 0                           | NR               | 975       | 0                           | NR               |
| 460       | 736                         | NR               | 590       | 299                         | NR               | 720       | 16                          | NR               | 850       | 0                           | NR               | 980       | 0                           | NR               |
| 465       | 513                         | NR               | 595       | 290                         | NR               | 725       | 14                          | NR               | 855       | 0                           | NR               | 985       | 0                           | NR               |
| 470       | 430                         | NR               | 600       | 282                         | NR               | 730       | 12                          | NR               | 860       | 0                           | NR               | 990       | 0                           | NR               |
| 475       | 325                         | NR               | 605       | 276                         | NR               | 735       | 10                          | NR               | 865       | 0                           | NR               | 995       | 0                           | NR               |
| 480       | 256                         | NR               | 610       | 287                         | NR               | 740       | 9                           | NR               | 870       | 0                           | NR               | 1000      | 0                           | NR               |
| 485       | 250                         | NR               | 615       | 284                         | NR               | 745       | 7                           | NR               | 875       | 0                           | NR               |           |                             |                  |

REPORT NUMBER: SP1-2511-597-6

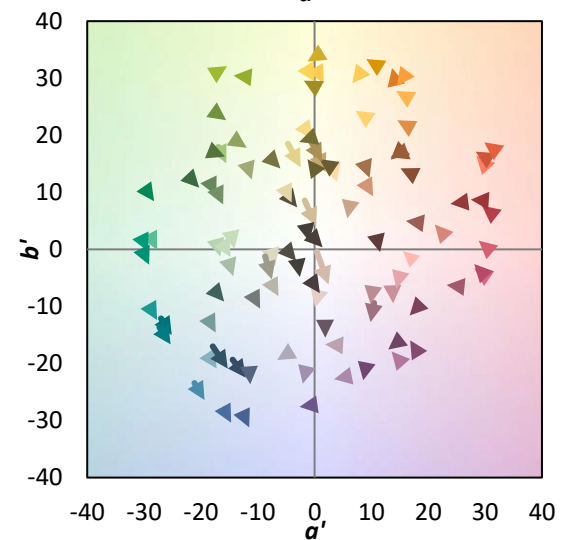
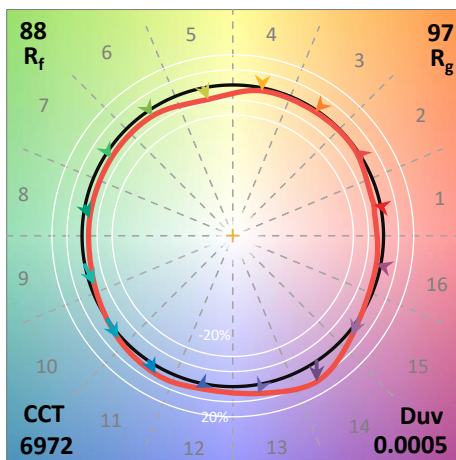
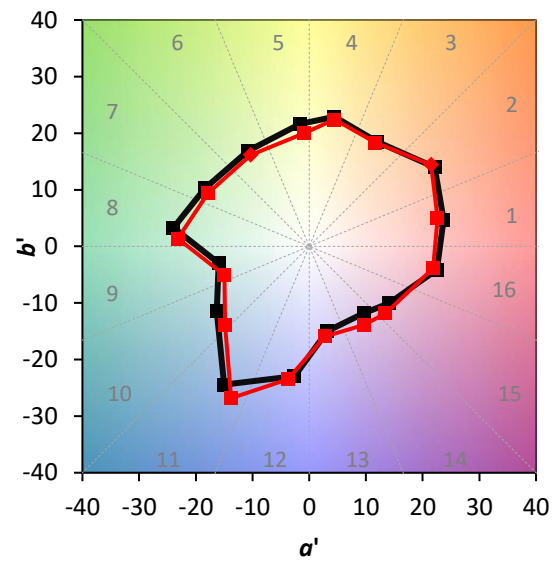
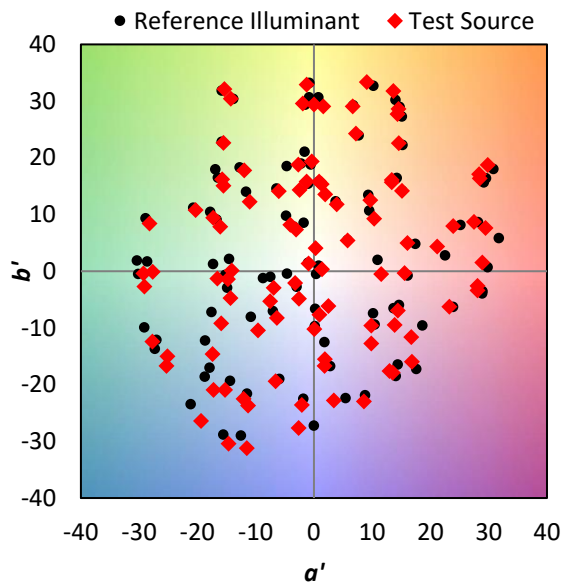
TM-30-18

### Summary

$R_f = 88.2$   
 $R_g = 97.1$   
 $CIE R_a = 94.3$   
 $R_9 = 82.6$

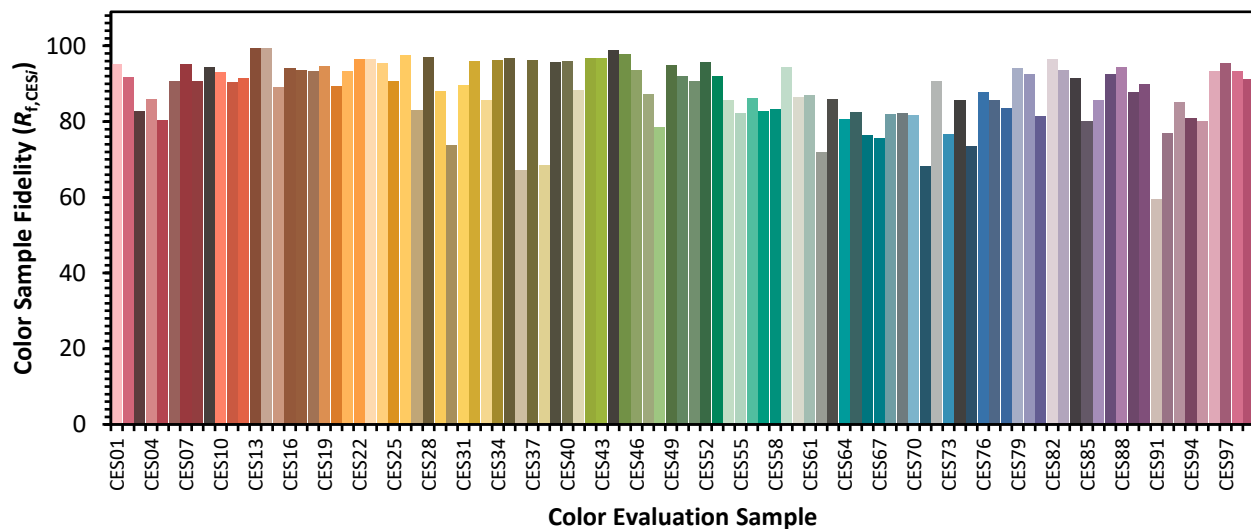


### Color Vector Graphics

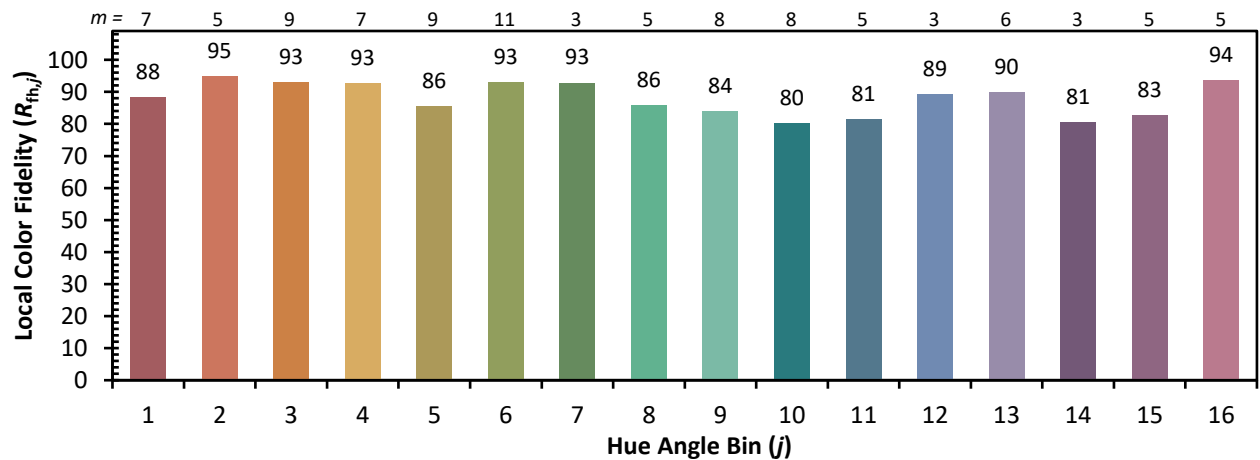


**Individual Sample Fidelity Index ( $R_{f,i}$ )**

|            |            |            |            |
|------------|------------|------------|------------|
| CES01 = 85 | CES26 = 97 | CES51 = 91 | CES76 = 88 |
| CES02 = 60 | CES27 = 83 | CES52 = 96 | CES77 = 86 |
| CES03 = 31 | CES28 = 97 | CES53 = 92 | CES78 = 83 |
| CES04 = 68 | CES29 = 88 | CES54 = 86 | CES79 = 94 |
| CES05 = 47 | CES30 = 74 | CES55 = 82 | CES80 = 93 |
| CES06 = 49 | CES31 = 90 | CES56 = 86 | CES81 = 81 |
| CES07 = 40 | CES32 = 96 | CES57 = 83 | CES82 = 96 |
| CES08 = 39 | CES33 = 86 | CES58 = 83 | CES83 = 94 |
| CES09 = 29 | CES34 = 96 | CES59 = 94 | CES84 = 91 |
| CES10 = 72 | CES35 = 97 | CES60 = 87 | CES85 = 80 |
| CES11 = 55 | CES36 = 67 | CES61 = 87 | CES86 = 86 |
| CES12 = 61 | CES37 = 96 | CES62 = 72 | CES87 = 93 |
| CES13 = 42 | CES38 = 68 | CES63 = 86 | CES88 = 94 |
| CES14 = 74 | CES39 = 96 | CES64 = 81 | CES89 = 88 |
| CES15 = 71 | CES40 = 96 | CES65 = 83 | CES90 = 90 |
| CES16 = 46 | CES41 = 88 | CES66 = 76 | CES91 = 60 |
| CES17 = 48 | CES42 = 97 | CES67 = 76 | CES92 = 77 |
| CES18 = 55 | CES43 = 97 | CES68 = 82 | CES93 = 85 |
| CES19 = 69 | CES44 = 99 | CES69 = 82 | CES94 = 81 |
| CES20 = 64 | CES45 = 98 | CES70 = 82 | CES95 = 80 |
| CES21 = 84 | CES46 = 93 | CES71 = 68 | CES96 = 93 |
| CES22 = 76 | CES47 = 87 | CES72 = 91 | CES97 = 95 |
| CES23 = 91 | CES48 = 79 | CES73 = 77 | CES98 = 93 |
| CES24 = 89 | CES49 = 95 | CES74 = 86 | CES99 = 91 |
| CES25 = 69 | CES50 = 92 | CES75 = 74 |            |



Color Rendition by Hue-Angle Bin



**Measure Comparisons**



(END OF REPORT)