

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: P1356899

Luminaire Tested: 2ASL4-25VHE-3-50-UNV

Issue Date: 2/17/2026

**Test Information**

Test Method: LM-79-2019  
Report Number: P1356899  
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: 2ASL4-25VHE-3-50-UNV  
Description: 2FT 2500 LUMEN PER FOOT 4ASL LED LUMINAIRE WITH OPL LENS AND 5000K LEDS 3 ROW  
Light Source: -  
Ballast/Driver: -

**Summary**

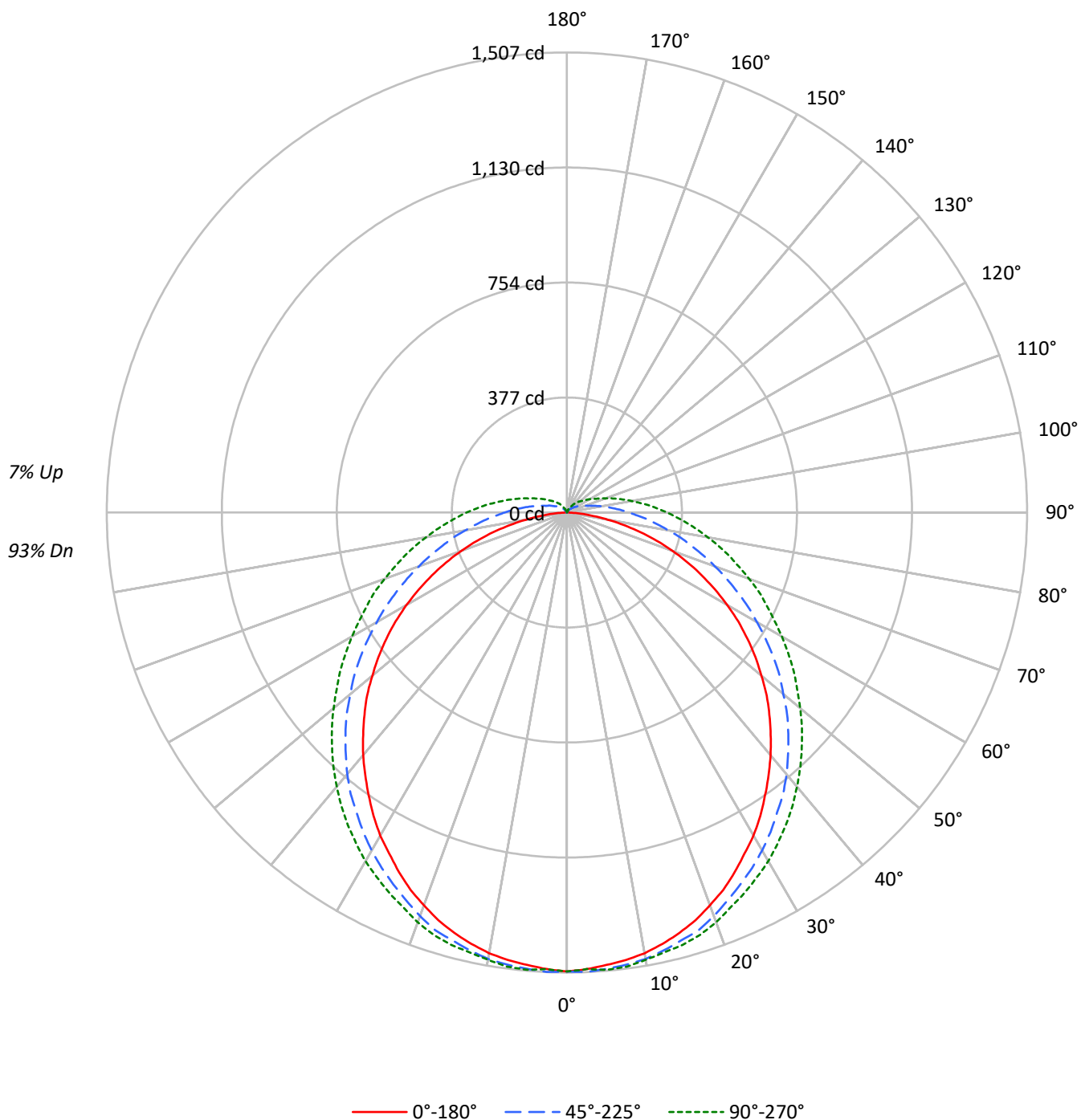
Lumens per Lamp: N/A  
Luminaire Lumens: 5112.0 lumens  
Efficiency: N/A  
Efficacy: 119.4 lumens/watt  
Spacing Criteria (0/90/45): 1.21 / 1.3 / 1.39  
Luminous Opening: Rectangular w/ Sides (W: 0.33' x L: 1.98' x H: 0.1')  
CIE Type: Direct

Input Watts (W): 42.8  
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: 2ASL4-25VHE-3-50-UNV

### Luminous Intensity Polar Plot



TEST NUMBER: P1356899

CATALOG NUMBER: 2ASL4-25VHE-3-50-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 |  | 96 | 96 | 96 | 93 |
| 1   | 105 | 100 | 95  | 91  | 102 | 97  | 92  | 88  | 91  | 88  | 84  |  | 86  | 83  | 80  |  | 81 | 79 | 77 | 74 |
| 2   | 95  | 86  | 79  | 72  | 92  | 84  | 77  | 71  | 79  | 73  | 68  |  | 75  | 70  | 66  |  | 71 | 67 | 63 | 61 |
| 3   | 86  | 75  | 67  | 60  | 83  | 73  | 65  | 59  | 69  | 62  | 57  |  | 65  | 60  | 55  |  | 62 | 57 | 53 | 50 |
| 4   | 79  | 66  | 57  | 50  | 76  | 65  | 56  | 49  | 61  | 54  | 48  |  | 58  | 52  | 47  |  | 55 | 50 | 45 | 43 |
| 5   | 73  | 59  | 50  | 43  | 70  | 58  | 49  | 42  | 55  | 47  | 41  |  | 52  | 45  | 40  |  | 49 | 44 | 39 | 37 |
| 6   | 67  | 53  | 44  | 37  | 64  | 52  | 43  | 37  | 49  | 42  | 36  |  | 47  | 40  | 35  |  | 45 | 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  | 35  | 29  | 41  | 34  | 28  |  | 39  | 32  | 28  |  | 37 | 32 | 27 | 25 |
| 9   | 54  | 40  | 32  | 26  | 52  | 39  | 31  | 26  | 38  | 30  | 25  |  | 36  | 30  | 25  |  | 35 | 29 | 24 | 22 |
| 10  | 50  | 37  | 29  | 24  | 49  | 36  | 29  | 23  | 35  | 28  | 23  |  | 33  | 27  | 23  |  | 32 | 26 | 22 | 20 |

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

|     | 0°    | 45°   | 90°   |
|-----|-------|-------|-------|
| 0°  | 24531 | 24531 | 24531 |
| 5°  | 24258 | 24031 | 23969 |
| 10° | 24065 | 23529 | 23364 |
| 15° | 23742 | 22914 | 22850 |
| 20° | 23325 | 22325 | 22270 |
| 25° | 22848 | 21597 | 21612 |
| 30° | 22347 | 20962 | 21053 |
| 35° | 21736 | 20247 | 20433 |
| 40° | 21169 | 19590 | 19780 |
| 45° | 20555 | 18803 | 19124 |
| 50° | 19860 | 17959 | 18441 |
| 55° | 19105 | 17150 | 17829 |
| 60° | 18135 | 16210 | 17207 |
| 65° | 16915 | 15302 | 16692 |
| 70° | 15371 | 14395 | 16286 |
| 75° | 13178 | 13548 | 16008 |
| 80° | 9950  | 12872 | 15892 |
| 85° | 5482  | 12589 | 16129 |

**MAXIMUM LUMINANCE 45°-90°:**

Horizontal Angle: 0°

Vertical Angle: 45°

Luminance: 20555 cd/sqm

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**ZONAL LUMENS:**

| Zone      | Lumens | % Fixture |
|-----------|--------|-----------|
| 0°-10°    | 142.6  | 2.8       |
| 10°-20°   | 409.4  | 8.0       |
| 20°-30°   | 618.9  | 12.1      |
| 30°-40°   | 749.4  | 14.7      |
| 40°-50°   | 787.1  | 15.4      |
| 50°-60°   | 734.3  | 14.4      |
| 60°-70°   | 606.9  | 11.9      |
| 70°-80°   | 437.0  | 8.5       |
| 80°-90°   | 271.5  | 5.3       |
| 90°-100°  | 159.1  | 3.1       |
| 100°-110° | 91.0   | 1.8       |
| 110°-120° | 51.4   | 1.0       |
| 120°-130° | 29.6   | 0.6       |
| 130°-140° | 15.9   | 0.3       |
| 140°-150° | 6.7    | 0.1       |
| 150°-160° | 1.2    | 0.0       |
| 160°-170° | 0.0    | 0.0       |
| 170°-180° | 0.0    | 0.0       |
| 0°-30°    | 1170.8 | 22.9      |
| 0°-40°    | 1920.2 | 37.6      |
| 0°-60°    | 3441.7 | 67.3      |
| 0°-90°    | 4757.0 | 93.1      |
| 90°-120°  | 301.5  | 5.9       |
| 90°-150°  | 353.7  | 6.9       |
| 90°-180°  | 355.0  | 6.9       |
| 0°-180°   | 5112.0 | 100.0     |

**CANDELA DISTRIBUTION:**

|      | 0°   | 22.5° | 45°  | 67.5° | 90°  | Flux |
|------|------|-------|------|-------|------|------|
| 0°   | 1504 | 1504  | 1504 | 1504  | 1504 |      |
| 5°   | 1488 | 1500  | 1500 | 1500  | 1504 | 141  |
| 15°  | 1425 | 1444  | 1450 | 1460  | 1466 | 402  |
| 25°  | 1300 | 1322  | 1344 | 1363  | 1375 | 599  |
| 35°  | 1132 | 1163  | 1200 | 1235  | 1250 | 708  |
| 45°  | 938  | 972   | 1025 | 1069  | 1088 | 723  |
| 55°  | 722  | 763   | 825  | 885   | 906  | 645  |
| 65°  | 488  | 534   | 616  | 694   | 722  | 482  |
| 75°  | 250  | 313   | 422  | 513   | 550  | 264  |
| 85°  | 47   | 141   | 266  | 360   | 394  | 57   |
| 90°  | 0    | 84    | 203  | 291   | 328  | 2    |
| 95°  | 0    | 53    | 153  | 234   | 269  | 0    |
| 105° | 0    | 19    | 84   | 147   | 172  | 0    |
| 115° | 0    | 9     | 50   | 91    | 106  | 0    |
| 125° | 0    | 6     | 31   | 59    | 69   | 0    |
| 135° | 0    | 0     | 19   | 38    | 47   | 0    |
| 145° | 0    | 0     | 9    | 22    | 25   | 0    |
| 155° | 0    | 0     | 0    | 6     | 9    | 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°     | 1503.5 | 1503.5 | 1503.5 | 1503.5 | 1503.5 |
| 2.5°   | 1497.3 | 1506.6 | 1506.6 | 1497.3 | 1497.3 |
| 5°     | 1487.9 | 1500.4 | 1500.4 | 1500.4 | 1503.5 |
| 7.5°   | 1478.5 | 1494.1 | 1494.1 | 1494.1 | 1500.4 |
| 10°    | 1466.0 | 1481.6 | 1484.8 | 1484.8 | 1487.9 |
| 12.5°  | 1447.2 | 1466.0 | 1469.1 | 1472.2 | 1475.4 |
| 15°    | 1425.4 | 1444.1 | 1450.4 | 1459.7 | 1466.0 |
| 17.5°  | 1400.4 | 1422.2 | 1434.7 | 1444.1 | 1450.4 |
| 20°    | 1369.1 | 1391.0 | 1406.6 | 1419.1 | 1428.5 |
| 22.5°  | 1337.8 | 1356.6 | 1375.4 | 1391.0 | 1400.4 |
| 25°    | 1300.3 | 1322.2 | 1344.1 | 1362.8 | 1375.4 |
| 27.5°  | 1259.7 | 1284.7 | 1312.8 | 1334.7 | 1347.2 |
| 30°    | 1222.2 | 1247.2 | 1278.5 | 1306.6 | 1319.1 |
| 32.5°  | 1178.4 | 1206.6 | 1240.9 | 1269.1 | 1284.7 |
| 35°    | 1131.5 | 1162.8 | 1200.3 | 1234.7 | 1250.3 |
| 37.5°  | 1084.7 | 1115.9 | 1162.8 | 1197.2 | 1212.8 |
| 40°    | 1037.8 | 1069.0 | 1119.0 | 1156.5 | 1172.2 |
| 42.5°  | 987.8  | 1019.0 | 1072.1 | 1112.8 | 1131.5 |
| 45°    | 937.7  | 972.1  | 1025.3 | 1069.0 | 1087.8 |
| 47.5°  | 887.7  | 922.1  | 978.4  | 1025.3 | 1044.0 |
| 50°    | 831.5  | 869.0  | 925.2  | 978.4  | 997.1  |
| 52.5°  | 778.3  | 815.8  | 878.3  | 931.5  | 950.2  |
| 55°    | 722.1  | 762.7  | 825.2  | 884.6  | 906.5  |
| 57.5°  | 665.8  | 706.4  | 772.1  | 834.6  | 859.6  |
| 60°    | 606.4  | 650.2  | 718.9  | 784.6  | 812.7  |
| 62.5°  | 547.0  | 593.9  | 668.9  | 737.7  | 765.8  |
| 65°    | 487.6  | 534.5  | 615.8  | 693.9  | 722.1  |
| 67.5°  | 428.2  | 478.2  | 565.8  | 647.0  | 681.4  |
| 70°    | 368.8  | 422.0  | 515.8  | 600.2  | 634.5  |
| 72.5°  | 309.5  | 365.7  | 468.9  | 556.4  | 590.8  |
| 75°    | 250.1  | 312.6  | 422.0  | 512.6  | 550.1  |
| 77.5°  | 190.7  | 262.6  | 381.3  | 472.0  | 509.5  |
| 80°    | 137.5  | 218.8  | 337.6  | 431.4  | 468.9  |
| 82.5°  | 87.5   | 175.0  | 300.1  | 393.9  | 431.4  |
| 85°    | 46.9   | 140.7  | 265.7  | 359.5  | 393.9  |
| 87.5°  | 15.6   | 109.4  | 231.3  | 325.1  | 359.5  |
| 90°    | 0.0    | 84.4   | 203.2  | 290.7  | 328.2  |
| 92.5°  | 0.0    | 65.6   | 178.2  | 262.6  | 297.0  |
| 95°    | 0.0    | 53.1   | 153.2  | 234.4  | 268.8  |
| 97.5°  | 0.0    | 43.8   | 134.4  | 209.4  | 240.7  |
| 100°   | 0.0    | 34.4   | 115.7  | 187.5  | 215.7  |
| 102.5° | 0.0    | 28.1   | 100.0  | 165.7  | 193.8  |
| 105°   | 0.0    | 18.8   | 84.4   | 146.9  | 171.9  |
| 107.5° | 0.0    | 15.6   | 71.9   | 131.3  | 153.2  |
| 110°   | 0.0    | 12.5   | 65.6   | 112.5  | 134.4  |



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CATALOG NUMBER: 2ASL4-25VHE-3-50-UNV

**CANDELA DISTRIBUTION (continued):**

|        | 0°  | 22.5° | 45°  | 67.5° | 90°   |
|--------|-----|-------|------|-------|-------|
| 112.5° | 0.0 | 9.4   | 59.4 | 100.0 | 121.9 |
| 115°   | 0.0 | 9.4   | 50.0 | 90.6  | 106.3 |
| 117.5° | 0.0 | 9.4   | 43.8 | 81.3  | 96.9  |
| 120°   | 0.0 | 6.3   | 40.6 | 71.9  | 87.5  |
| 122.5° | 0.0 | 6.3   | 34.4 | 65.6  | 78.1  |
| 125°   | 0.0 | 6.3   | 31.3 | 59.4  | 68.8  |
| 127.5° | 0.0 | 3.1   | 28.1 | 53.1  | 62.5  |
| 130°   | 0.0 | 3.1   | 25.0 | 46.9  | 56.3  |
| 132.5° | 0.0 | 3.1   | 21.9 | 43.8  | 53.1  |
| 135°   | 0.0 | 0.0   | 18.8 | 37.5  | 46.9  |
| 137.5° | 0.0 | 0.0   | 15.6 | 34.4  | 40.6  |
| 140°   | 0.0 | 0.0   | 12.5 | 28.1  | 37.5  |
| 142.5° | 0.0 | 0.0   | 9.4  | 25.0  | 31.3  |
| 145°   | 0.0 | 0.0   | 9.4  | 21.9  | 25.0  |
| 147.5° | 0.0 | 0.0   | 6.3  | 15.6  | 21.9  |
| 150°   | 0.0 | 0.0   | 3.1  | 12.5  | 15.6  |
| 152.5° | 0.0 | 0.0   | 0.0  | 9.4   | 12.5  |
| 155°   | 0.0 | 0.0   | 0.0  | 6.3   | 9.4   |
| 157.5° | 0.0 | 0.0   | 0.0  | 0.0   | 3.1   |
| 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: P1356899

CATALOG NUMBER: 2ASL4-25VHE-3-50-UNV

**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 | 20.42            | 21.96 | 20.89 | 22.41 | 22.90 | 22.36          | 23.90 | 22.83 | 24.36 | 24.84 |
|                 | 3H   | 21.92            | 23.32 | 22.40 | 23.79 | 24.31 | 24.79          | 26.19 | 25.27 | 26.66 | 27.18 |
|                 | 4H   | 22.40            | 23.73 | 22.90 | 24.21 | 24.75 | 25.96          | 27.29 | 26.46 | 27.77 | 28.31 |
|                 | 6H   | 22.68            | 23.92 | 23.19 | 24.41 | 24.97 | 27.16          | 28.40 | 27.68 | 28.90 | 29.45 |
|                 | 8H   | 22.73            | 23.92 | 23.26 | 24.44 | 25.00 | 27.77          | 28.96 | 28.30 | 29.48 | 30.04 |
|                 | 12H  | 22.74            | 23.88 | 23.28 | 24.40 | 24.99 | 28.42          | 29.56 | 28.95 | 30.07 | 30.66 |
| 4H              | 2H   | 21.28            | 22.61 | 21.78 | 23.09 | 23.63 | 22.80          | 24.13 | 23.30 | 24.62 | 25.15 |
|                 | 3H   | 23.02            | 24.15 | 23.53 | 24.68 | 25.24 | 25.45          | 26.59 | 25.97 | 27.11 | 27.68 |
|                 | 4H   | 23.62            | 24.66 | 24.16 | 25.20 | 25.79 | 26.79          | 27.83 | 27.33 | 28.37 | 28.96 |
|                 | 6H   | 24.02            | 24.94 | 24.58 | 25.50 | 26.11 | 28.19          | 29.11 | 28.74 | 29.67 | 30.28 |
|                 | 8H   | 24.12            | 24.98 | 24.68 | 25.54 | 26.16 | 28.90          | 29.77 | 29.47 | 30.33 | 30.95 |
|                 | 12H  | 24.16            | 24.94 | 24.74 | 25.53 | 26.16 | 29.68          | 30.46 | 30.26 | 31.05 | 31.68 |
| 8H              | 4H   | 24.28            | 25.15 | 24.84 | 25.71 | 26.33 | 27.01          | 27.88 | 27.57 | 28.44 | 29.06 |
|                 | 6H   | 24.86            | 25.59 | 25.45 | 26.20 | 26.82 | 28.58          | 29.31 | 29.17 | 29.92 | 30.54 |
|                 | 8H   | 25.04            | 25.70 | 25.65 | 26.32 | 26.96 | 29.44          | 30.10 | 30.04 | 30.71 | 31.35 |
|                 | 12H  | 25.16            | 25.75 | 25.77 | 26.35 | 27.06 | 30.40          | 30.99 | 31.00 | 31.59 | 32.29 |
| 12H             | 4H   | 24.47            | 25.25 | 25.05 | 25.84 | 26.47 | 27.02          | 27.81 | 27.60 | 28.40 | 29.02 |
|                 | 6H   | 25.14            | 25.81 | 25.75 | 26.42 | 27.06 | 28.62          | 29.28 | 29.22 | 29.90 | 30.53 |
|                 | 8H   | 25.42            | 26.01 | 26.03 | 26.62 | 27.32 | 29.55          | 30.14 | 30.15 | 30.74 | 31.44 |



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

Report Prepared for

Cooper Lighting Solutions

Fail-Safe

Report Number: SP1-2511-597-5

Test Date: 11/18/2025

Luminaire Tested: 4ASL-2-50-UNV-OPL-1\_600mA

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

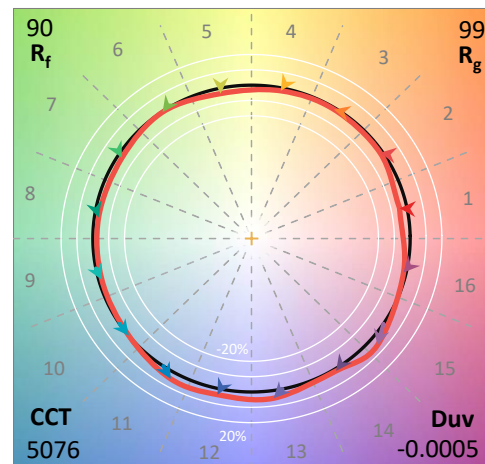
### Test Information

Test Method: LM-79-2019  
 Report Number: SP1-2511-597-5  
 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-2-50-UNV-OPL-1\_600mA**  
 Description: 2foot 4ASL LED LUMINAIRE WITH OPL LENS AND 5000K LEDS with 1 rows at 600mA

### Spectral Parameters

CCT (K): 5076  
 CIE  $u'$ : 0.2110  
 CIE  $v'$ : 0.4830  
 Duv: -0.0005  
 CIE x: 0.3429  
 CIE y: 0.3489  
 CIE z: 0.3082  
 Peak Wavelength (nm): 630  
 Dominant Wavelength (nm): 572  
 Purity: 7.553016  
 R<sub>f</sub>: 90.4  
 R<sub>g</sub>: 99

CRI (Ra): 94.9  
 R1: 96.7  
 R2: 98.2  
 R3: 96.6  
 R4: 95.6  
 R5: 95.1  
 R6: 93.6  
 R7: 94.0  
 R8: 89.6  
 R9: 74.0  
 R10: 93.9  
 R11: 96.2  
 R12: 72.4  
 R13: 98.1  
 R14: 97.8  
 R15: 95.6



### Test Conditions

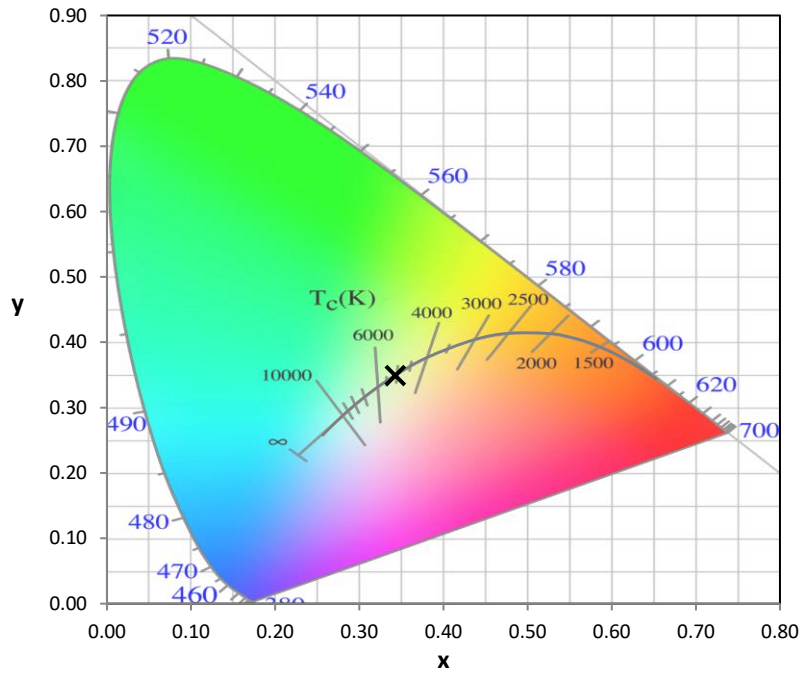
Stabilization Time: 24M  
 Operation Time: 1H 24M  
 Sphere Temperature (°C): 24.1

REPORT NUMBER: SP1-2511-597-5

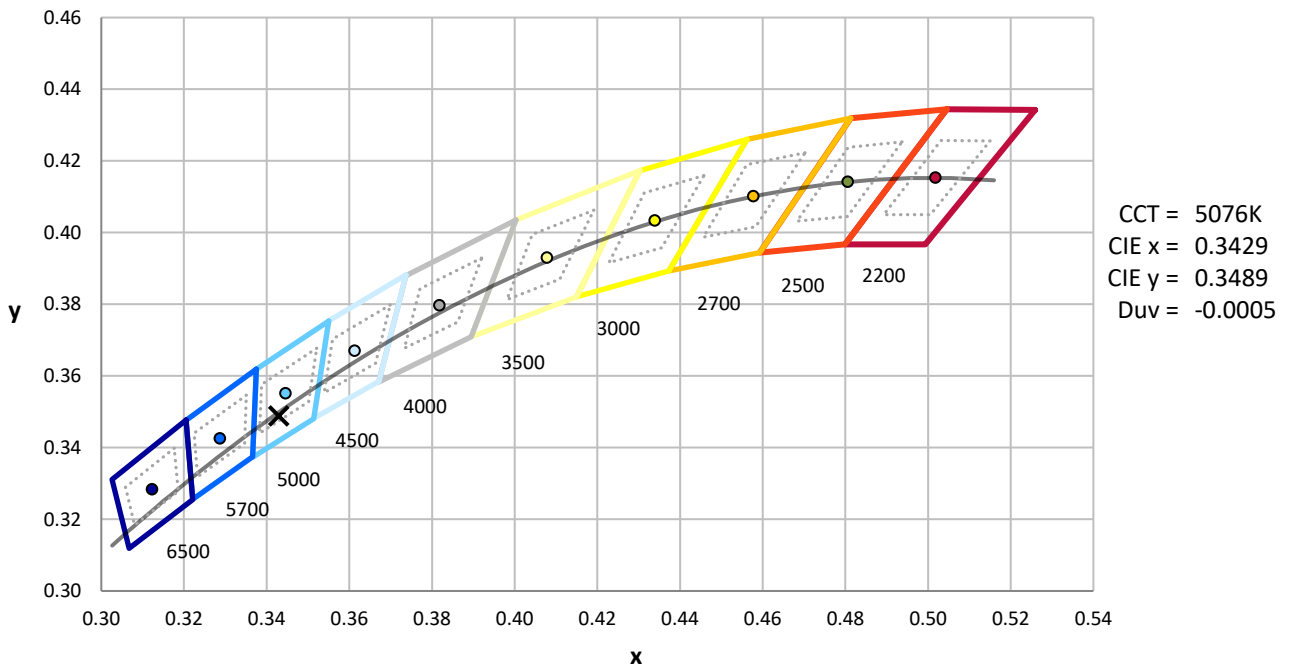
| Measurement and Test Equipment |                       |                  |                      |
|--------------------------------|-----------------------|------------------|----------------------|
| Instrument                     | Identification Number | Calibration Date | Calibration Due Date |
| 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           |

REPORT NUMBER: SP1-2511-597-5

**CIE 1931 Chromaticity Diagram**



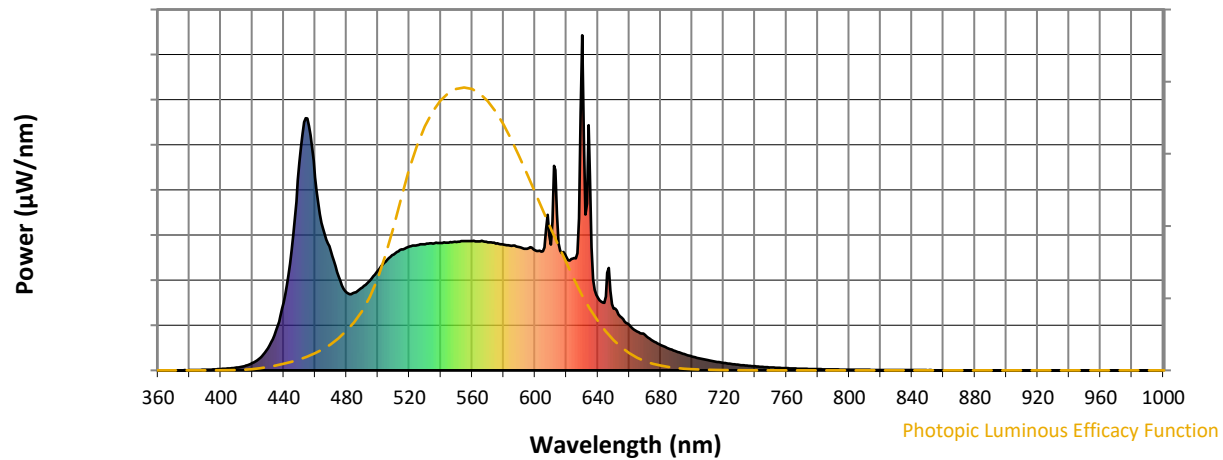
**CIE 1931 Chromaticity Diagram with 2017 ANSI 7-Step and 4-Step Quadrangles**



Point lies inside the ANSI 5000K 4-step quadrangle

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### Photopic Flux vs. Wavelength

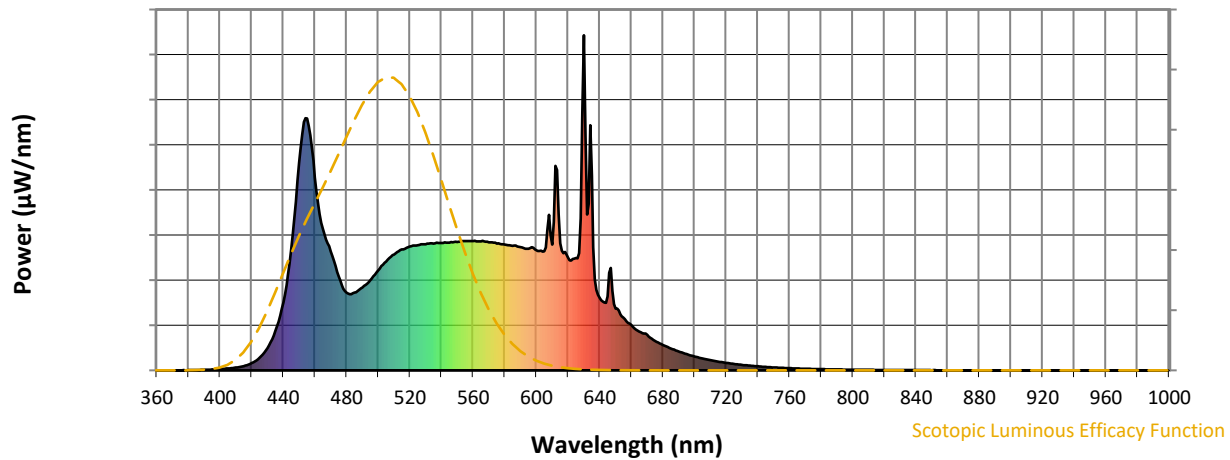


### Photopic Lumens: NR

| 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       | 248                         | NR               | 620       | 337                         | NR               | 750       | 9                           | NR               | 880       | 0                           | NR               |
| 365       | 0                           | NR               | 495       | 269                         | NR               | 625       | 335                         | NR               | 755       | 8                           | NR               | 885       | 0                           | NR               |
| 370       | 0                           | NR               | 500       | 298                         | NR               | 630       | 1000                        | NR               | 760       | 6                           | NR               | 890       | 0                           | NR               |
| 375       | 0                           | NR               | 505       | 325                         | NR               | 635       | 580                         | NR               | 765       | 6                           | NR               | 895       | 0                           | NR               |
| 380       | 1                           | NR               | 510       | 346                         | NR               | 640       | 216                         | NR               | 770       | 5                           | NR               | 900       | 0                           | NR               |
| 385       | 1                           | NR               | 515       | 361                         | NR               | 645       | 221                         | NR               | 775       | 4                           | NR               | 905       | 0                           | NR               |
| 390       | 2                           | NR               | 520       | 369                         | NR               | 650       | 185                         | NR               | 780       | 4                           | NR               | 910       | 0                           | NR               |
| 395       | 3                           | NR               | 525       | 374                         | NR               | 655       | 158                         | NR               | 785       | 3                           | NR               | 915       | 0                           | NR               |
| 400       | 4                           | NR               | 530       | 376                         | NR               | 660       | 136                         | NR               | 790       | 3                           | NR               | 920       | 0                           | NR               |
| 405       | 6                           | NR               | 535       | 379                         | NR               | 665       | 116                         | NR               | 795       | 2                           | NR               | 925       | 0                           | NR               |
| 410       | 8                           | NR               | 540       | 381                         | NR               | 670       | 106                         | NR               | 800       | 2                           | NR               | 930       | 0                           | NR               |
| 415       | 13                          | NR               | 545       | 381                         | NR               | 675       | 88                          | NR               | 805       | 2                           | NR               | 935       | 0                           | NR               |
| 420       | 22                          | NR               | 550       | 383                         | NR               | 680       | 76                          | NR               | 810       | 2                           | NR               | 940       | 0                           | NR               |
| 425       | 37                          | NR               | 555       | 386                         | NR               | 685       | 65                          | NR               | 815       | 1                           | NR               | 945       | 0                           | NR               |
| 430       | 66                          | NR               | 560       | 386                         | NR               | 690       | 56                          | NR               | 820       | 1                           | NR               | 950       | 0                           | NR               |
| 435       | 119                         | NR               | 565       | 385                         | NR               | 695       | 48                          | NR               | 825       | 1                           | NR               | 955       | 0                           | NR               |
| 440       | 203                         | NR               | 570       | 382                         | NR               | 700       | 41                          | NR               | 830       | 1                           | NR               | 960       | 0                           | NR               |
| 445       | 359                         | NR               | 575       | 379                         | NR               | 705       | 35                          | NR               | 835       | 1                           | NR               | 965       | 0                           | NR               |
| 450       | 620                         | NR               | 580       | 376                         | NR               | 710       | 30                          | NR               | 840       | 1                           | NR               | 970       | 0                           | NR               |
| 455       | 752                         | NR               | 585       | 372                         | NR               | 715       | 26                          | NR               | 845       | 1                           | NR               | 975       | 0                           | NR               |
| 460       | 576                         | NR               | 590       | 368                         | NR               | 720       | 22                          | NR               | 850       | 1                           | NR               | 980       | 0                           | NR               |
| 465       | 423                         | NR               | 595       | 363                         | NR               | 725       | 19                          | NR               | 855       | 0                           | NR               | 985       | 0                           | NR               |
| 470       | 354                         | NR               | 600       | 358                         | NR               | 730       | 16                          | NR               | 860       | 0                           | NR               | 990       | 0                           | NR               |
| 475       | 280                         | NR               | 605       | 355                         | NR               | 735       | 14                          | NR               | 865       | 0                           | NR               | 995       | 0                           | NR               |
| 480       | 232                         | NR               | 610       | 375                         | NR               | 740       | 12                          | NR               | 870       | 0                           | NR               | 1000      | 0                           | NR               |
| 485       | 232                         | NR               | 615       | 379                         | NR               | 745       | 10                          | NR               | 875       | 0                           | NR               |           |                             |                  |

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### Scotopic Flux vs. Wavelength



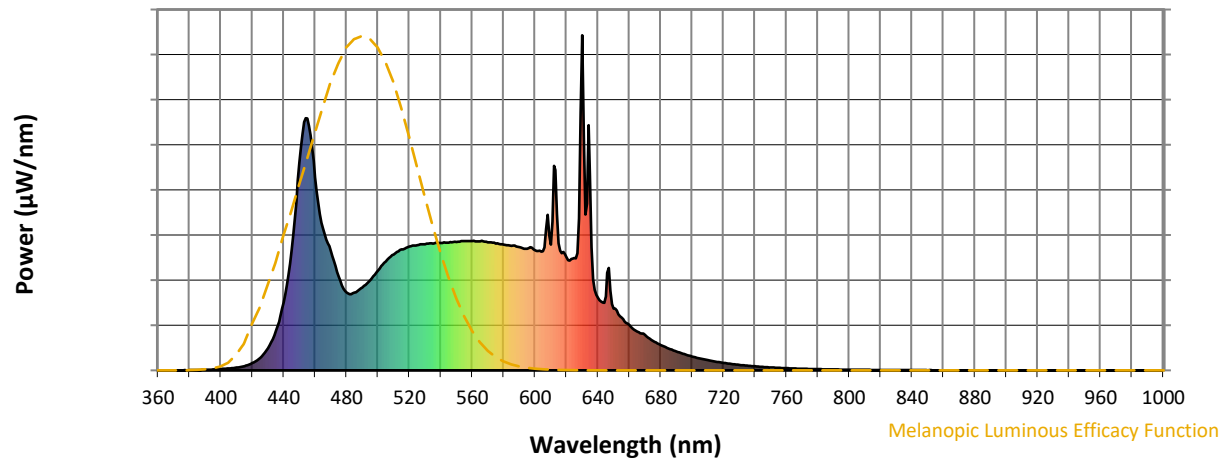
Scotopic Lumens: NR

S/P: 2.12

| 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       | 248                         | NR               | 620       | 337                         | NR               | 750       | 9                           | NR               | 880       | 0                           | NR               |
| 365       | 0                           | NR               | 495       | 269                         | NR               | 625       | 335                         | NR               | 755       | 8                           | NR               | 885       | 0                           | NR               |
| 370       | 0                           | NR               | 500       | 298                         | NR               | 630       | 1000                        | NR               | 760       | 6                           | NR               | 890       | 0                           | NR               |
| 375       | 0                           | NR               | 505       | 325                         | NR               | 635       | 580                         | NR               | 765       | 6                           | NR               | 895       | 0                           | NR               |
| 380       | 1                           | NR               | 510       | 346                         | NR               | 640       | 216                         | NR               | 770       | 5                           | NR               | 900       | 0                           | NR               |
| 385       | 1                           | NR               | 515       | 361                         | NR               | 645       | 221                         | NR               | 775       | 4                           | NR               | 905       | 0                           | NR               |
| 390       | 2                           | NR               | 520       | 369                         | NR               | 650       | 185                         | NR               | 780       | 4                           | NR               | 910       | 0                           | NR               |
| 395       | 3                           | NR               | 525       | 374                         | NR               | 655       | 158                         | NR               | 785       | 3                           | NR               | 915       | 0                           | NR               |
| 400       | 4                           | NR               | 530       | 376                         | NR               | 660       | 136                         | NR               | 790       | 3                           | NR               | 920       | 0                           | NR               |
| 405       | 6                           | NR               | 535       | 379                         | NR               | 665       | 116                         | NR               | 795       | 2                           | NR               | 925       | 0                           | NR               |
| 410       | 8                           | NR               | 540       | 381                         | NR               | 670       | 106                         | NR               | 800       | 2                           | NR               | 930       | 0                           | NR               |
| 415       | 13                          | NR               | 545       | 381                         | NR               | 675       | 88                          | NR               | 805       | 2                           | NR               | 935       | 0                           | NR               |
| 420       | 22                          | NR               | 550       | 383                         | NR               | 680       | 76                          | NR               | 810       | 2                           | NR               | 940       | 0                           | NR               |
| 425       | 37                          | NR               | 555       | 386                         | NR               | 685       | 65                          | NR               | 815       | 1                           | NR               | 945       | 0                           | NR               |
| 430       | 66                          | NR               | 560       | 386                         | NR               | 690       | 56                          | NR               | 820       | 1                           | NR               | 950       | 0                           | NR               |
| 435       | 119                         | NR               | 565       | 385                         | NR               | 695       | 48                          | NR               | 825       | 1                           | NR               | 955       | 0                           | NR               |
| 440       | 203                         | NR               | 570       | 382                         | NR               | 700       | 41                          | NR               | 830       | 1                           | NR               | 960       | 0                           | NR               |
| 445       | 359                         | NR               | 575       | 379                         | NR               | 705       | 35                          | NR               | 835       | 1                           | NR               | 965       | 0                           | NR               |
| 450       | 620                         | NR               | 580       | 376                         | NR               | 710       | 30                          | NR               | 840       | 1                           | NR               | 970       | 0                           | NR               |
| 455       | 752                         | NR               | 585       | 372                         | NR               | 715       | 26                          | NR               | 845       | 1                           | NR               | 975       | 0                           | NR               |
| 460       | 576                         | NR               | 590       | 368                         | NR               | 720       | 22                          | NR               | 850       | 1                           | NR               | 980       | 0                           | NR               |
| 465       | 423                         | NR               | 595       | 363                         | NR               | 725       | 19                          | NR               | 855       | 0                           | NR               | 985       | 0                           | NR               |
| 470       | 354                         | NR               | 600       | 358                         | NR               | 730       | 16                          | NR               | 860       | 0                           | NR               | 990       | 0                           | NR               |
| 475       | 280                         | NR               | 605       | 355                         | NR               | 735       | 14                          | NR               | 865       | 0                           | NR               | 995       | 0                           | NR               |
| 480       | 232                         | NR               | 610       | 375                         | NR               | 740       | 12                          | NR               | 870       | 0                           | NR               | 1000      | 0                           | NR               |
| 485       | 232                         | NR               | 615       | 379                         | NR               | 745       | 10                          | NR               | 875       | 0                           | NR               |           |                             |                  |

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### Melanopic Flux vs. Wavelength



Melanopic Lumens: NR

M/P: 4.65

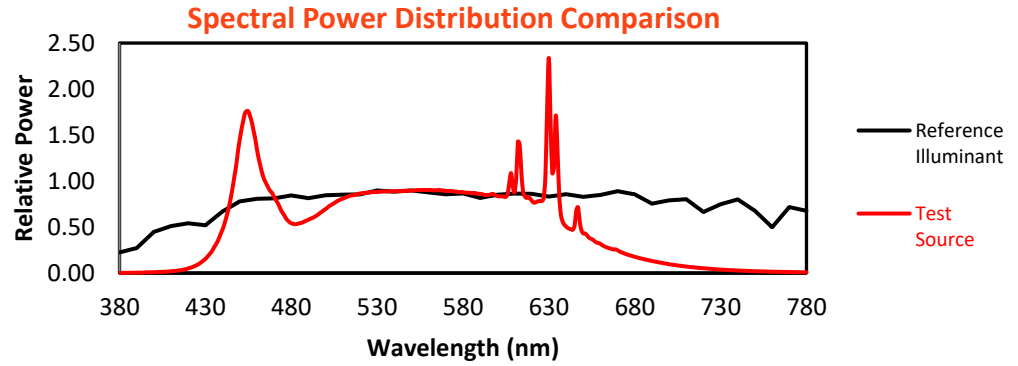
| λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) |
|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|
| 360       | 0                           | NR               | 490       | 248                         | NR               | 620       | 337                         | NR               | 750       | 9                           | NR               | 880       | 0                           | NR               |
| 365       | 0                           | NR               | 495       | 269                         | NR               | 625       | 335                         | NR               | 755       | 8                           | NR               | 885       | 0                           | NR               |
| 370       | 0                           | NR               | 500       | 298                         | NR               | 630       | 1000                        | NR               | 760       | 6                           | NR               | 890       | 0                           | NR               |
| 375       | 0                           | NR               | 505       | 325                         | NR               | 635       | 580                         | NR               | 765       | 6                           | NR               | 895       | 0                           | NR               |
| 380       | 1                           | NR               | 510       | 346                         | NR               | 640       | 216                         | NR               | 770       | 5                           | NR               | 900       | 0                           | NR               |
| 385       | 1                           | NR               | 515       | 361                         | NR               | 645       | 221                         | NR               | 775       | 4                           | NR               | 905       | 0                           | NR               |
| 390       | 2                           | NR               | 520       | 369                         | NR               | 650       | 185                         | NR               | 780       | 4                           | NR               | 910       | 0                           | NR               |
| 395       | 3                           | NR               | 525       | 374                         | NR               | 655       | 158                         | NR               | 785       | 3                           | NR               | 915       | 0                           | NR               |
| 400       | 4                           | NR               | 530       | 376                         | NR               | 660       | 136                         | NR               | 790       | 3                           | NR               | 920       | 0                           | NR               |
| 405       | 6                           | NR               | 535       | 379                         | NR               | 665       | 116                         | NR               | 795       | 2                           | NR               | 925       | 0                           | NR               |
| 410       | 8                           | NR               | 540       | 381                         | NR               | 670       | 106                         | NR               | 800       | 2                           | NR               | 930       | 0                           | NR               |
| 415       | 13                          | NR               | 545       | 381                         | NR               | 675       | 88                          | NR               | 805       | 2                           | NR               | 935       | 0                           | NR               |
| 420       | 22                          | NR               | 550       | 383                         | NR               | 680       | 76                          | NR               | 810       | 2                           | NR               | 940       | 0                           | NR               |
| 425       | 37                          | NR               | 555       | 386                         | NR               | 685       | 65                          | NR               | 815       | 1                           | NR               | 945       | 0                           | NR               |
| 430       | 66                          | NR               | 560       | 386                         | NR               | 690       | 56                          | NR               | 820       | 1                           | NR               | 950       | 0                           | NR               |
| 435       | 119                         | NR               | 565       | 385                         | NR               | 695       | 48                          | NR               | 825       | 1                           | NR               | 955       | 0                           | NR               |
| 440       | 203                         | NR               | 570       | 382                         | NR               | 700       | 41                          | NR               | 830       | 1                           | NR               | 960       | 0                           | NR               |
| 445       | 359                         | NR               | 575       | 379                         | NR               | 705       | 35                          | NR               | 835       | 1                           | NR               | 965       | 0                           | NR               |
| 450       | 620                         | NR               | 580       | 376                         | NR               | 710       | 30                          | NR               | 840       | 1                           | NR               | 970       | 0                           | NR               |
| 455       | 752                         | NR               | 585       | 372                         | NR               | 715       | 26                          | NR               | 845       | 1                           | NR               | 975       | 0                           | NR               |
| 460       | 576                         | NR               | 590       | 368                         | NR               | 720       | 22                          | NR               | 850       | 1                           | NR               | 980       | 0                           | NR               |
| 465       | 423                         | NR               | 595       | 363                         | NR               | 725       | 19                          | NR               | 855       | 0                           | NR               | 985       | 0                           | NR               |
| 470       | 354                         | NR               | 600       | 358                         | NR               | 730       | 16                          | NR               | 860       | 0                           | NR               | 990       | 0                           | NR               |
| 475       | 280                         | NR               | 605       | 355                         | NR               | 735       | 14                          | NR               | 865       | 0                           | NR               | 995       | 0                           | NR               |
| 480       | 232                         | NR               | 610       | 375                         | NR               | 740       | 12                          | NR               | 870       | 0                           | NR               | 1000      | 0                           | NR               |
| 485       | 232                         | NR               | 615       | 379                         | NR               | 745       | 10                          | NR               | 875       | 0                           | NR               |           |                             |                  |

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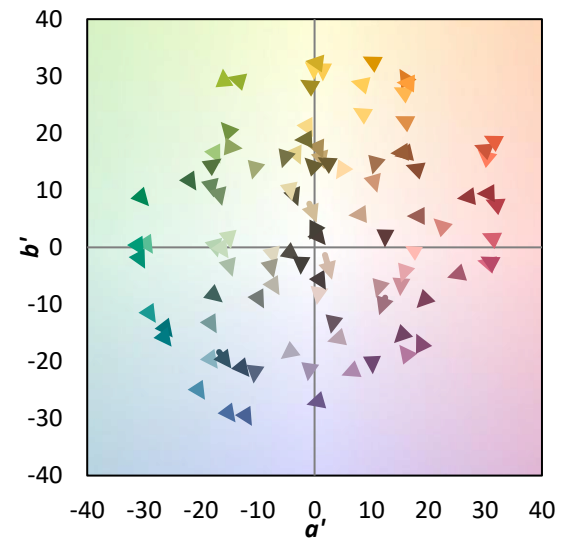
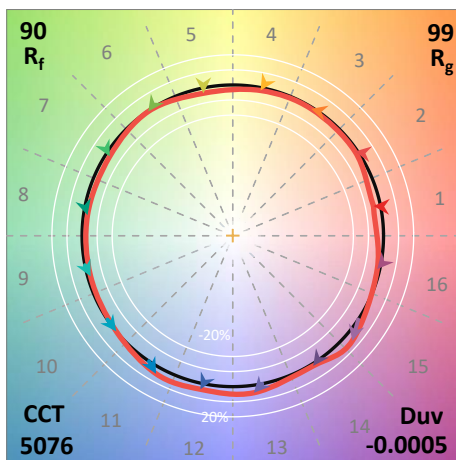
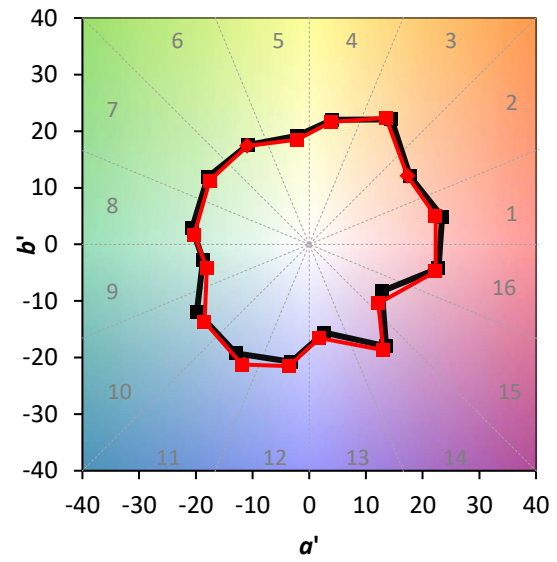
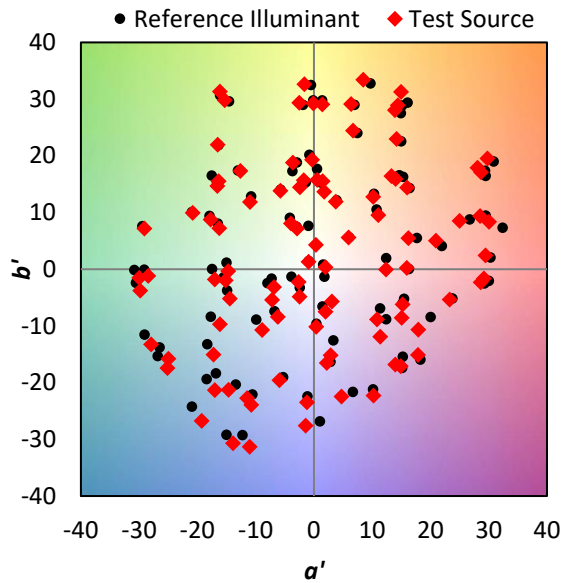
TM-30-18

### Summary

$R_f = 90.4$   
 $R_g = 99$   
 $\text{CIE } R_a = 94.9$   
 $R_9 = 74.0$



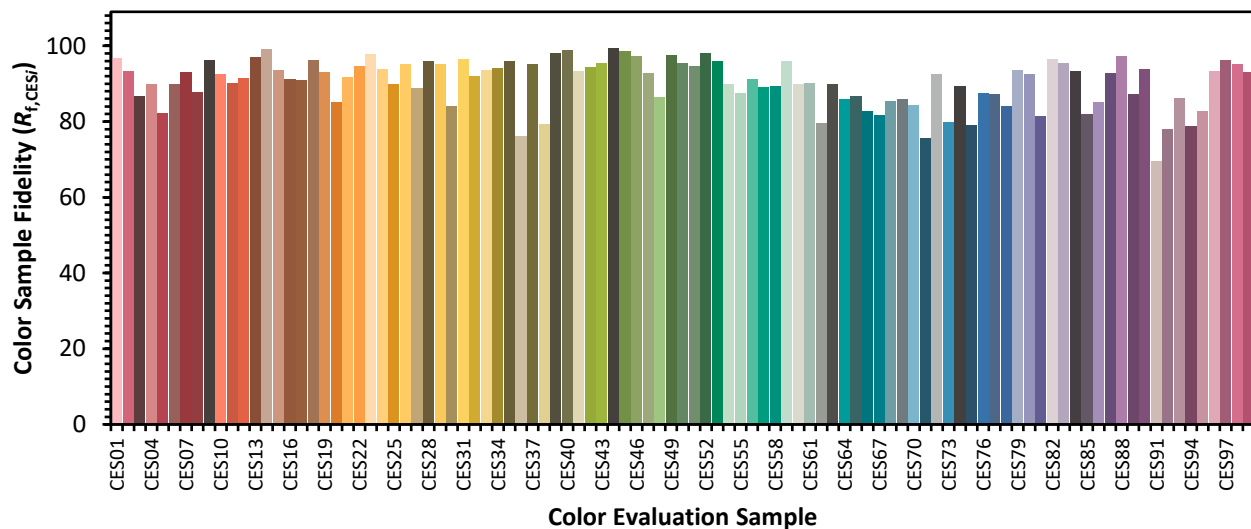
### Color Vector Graphics



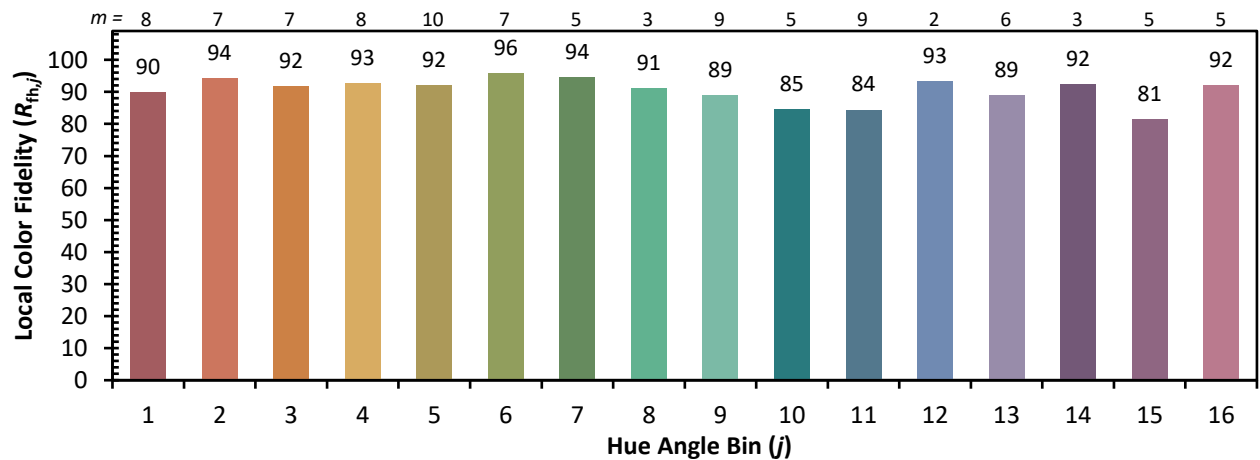
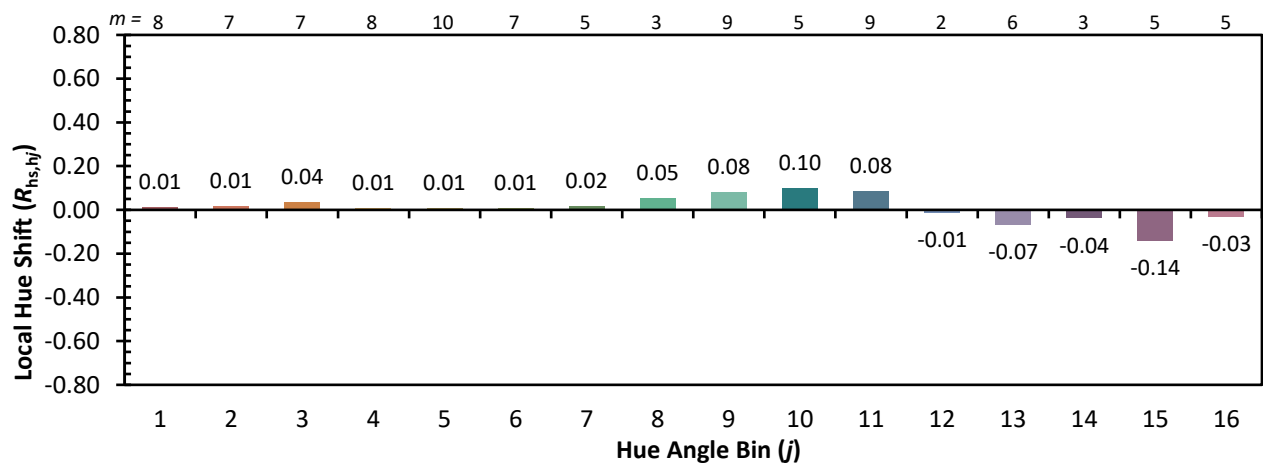
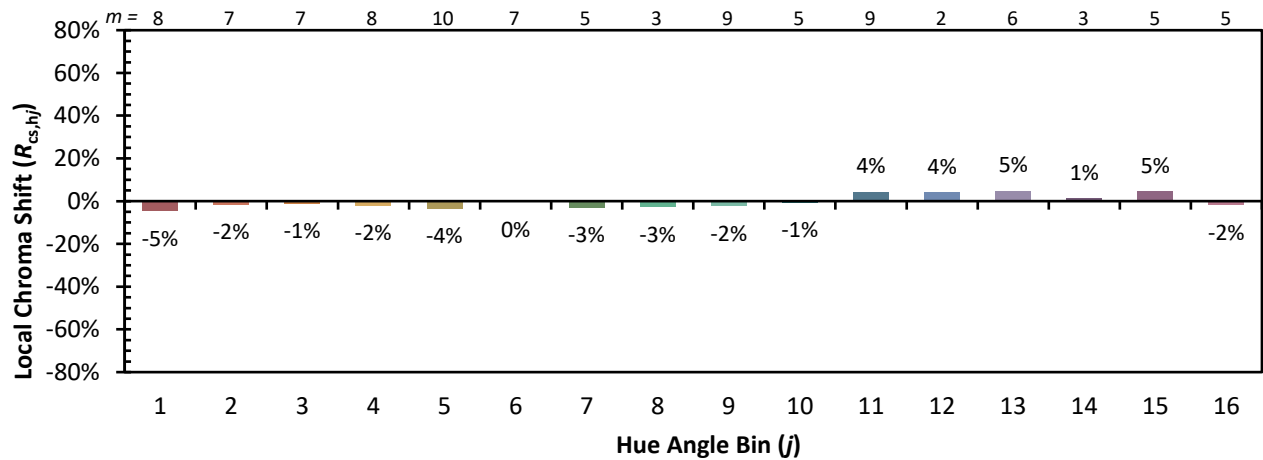


Individual Sample Fidelity Index ( $R_{f,i}$ )

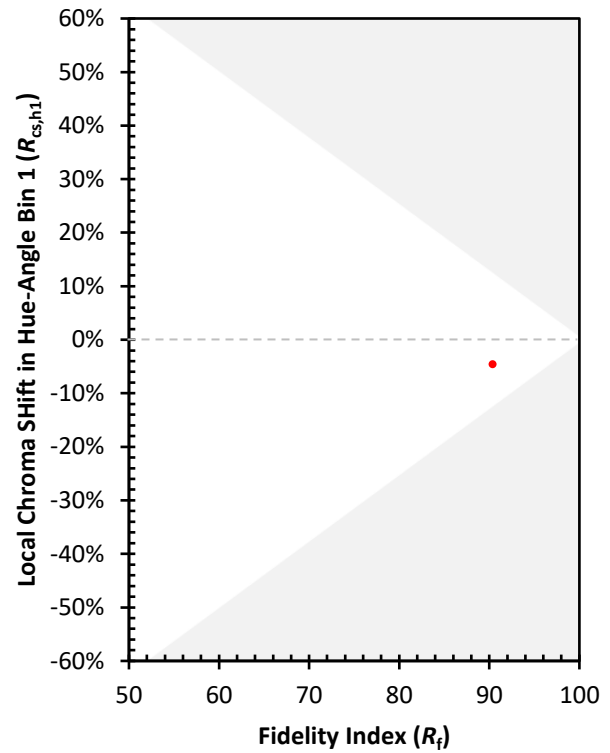
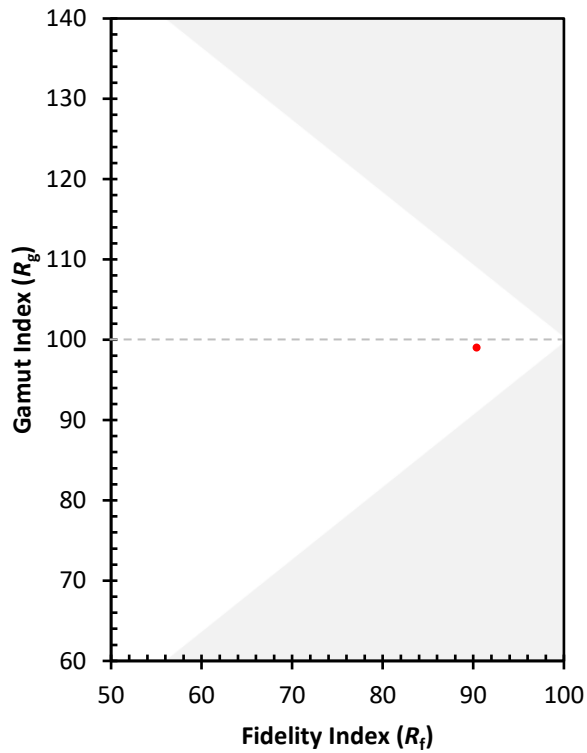
|            |            |            |            |
|------------|------------|------------|------------|
| CES01 = 85 | CES26 = 95 | CES51 = 95 | CES76 = 87 |
| CES02 = 61 | CES27 = 89 | CES52 = 98 | CES77 = 87 |
| CES03 = 31 | CES28 = 96 | CES53 = 96 | CES78 = 84 |
| CES04 = 69 | CES29 = 95 | CES54 = 90 | CES79 = 94 |
| CES05 = 48 | CES30 = 84 | CES55 = 88 | CES80 = 93 |
| CES06 = 50 | CES31 = 96 | CES56 = 91 | CES81 = 81 |
| CES07 = 41 | CES32 = 92 | CES57 = 89 | CES82 = 97 |
| CES08 = 40 | CES33 = 94 | CES58 = 89 | CES83 = 95 |
| CES09 = 29 | CES34 = 94 | CES59 = 96 | CES84 = 93 |
| CES10 = 73 | CES35 = 96 | CES60 = 90 | CES85 = 82 |
| CES11 = 56 | CES36 = 76 | CES61 = 90 | CES86 = 85 |
| CES12 = 62 | CES37 = 95 | CES62 = 80 | CES87 = 93 |
| CES13 = 42 | CES38 = 79 | CES63 = 90 | CES88 = 97 |
| CES14 = 74 | CES39 = 98 | CES64 = 86 | CES89 = 87 |
| CES15 = 71 | CES40 = 99 | CES65 = 87 | CES90 = 94 |
| CES16 = 47 | CES41 = 93 | CES66 = 83 | CES91 = 70 |
| CES17 = 48 | CES42 = 94 | CES67 = 82 | CES92 = 78 |
| CES18 = 56 | CES43 = 95 | CES68 = 85 | CES93 = 86 |
| CES19 = 70 | CES44 = 99 | CES69 = 86 | CES94 = 79 |
| CES20 = 65 | CES45 = 99 | CES70 = 84 | CES95 = 83 |
| CES21 = 85 | CES46 = 97 | CES71 = 76 | CES96 = 93 |
| CES22 = 77 | CES47 = 93 | CES72 = 92 | CES97 = 96 |
| CES23 = 91 | CES48 = 86 | CES73 = 80 | CES98 = 95 |
| CES24 = 90 | CES49 = 98 | CES74 = 89 | CES99 = 93 |
| CES25 = 70 | CES50 = 96 | CES75 = 79 |            |



Color Rendition by Hue-Angle Bin



**Measure Comparisons**



(END OF REPORT)