

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: P1357043

Luminaire Tested: 3ASL4-25VHE-3-30-UNV

Issue Date: 2/17/2026

**Test Information**

Test Method: LM-79-2019  
Report Number: P1357043  
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: 3ASL4-25VHE-3-30-UNV  
Description: 3FT 2500 LUMEN PER FOOT 4ASL LED LUMINAIRE WITH OPL LENS AND 3000K LEDS 3 ROW  
Light Source: -  
Ballast/Driver: -

**Summary**

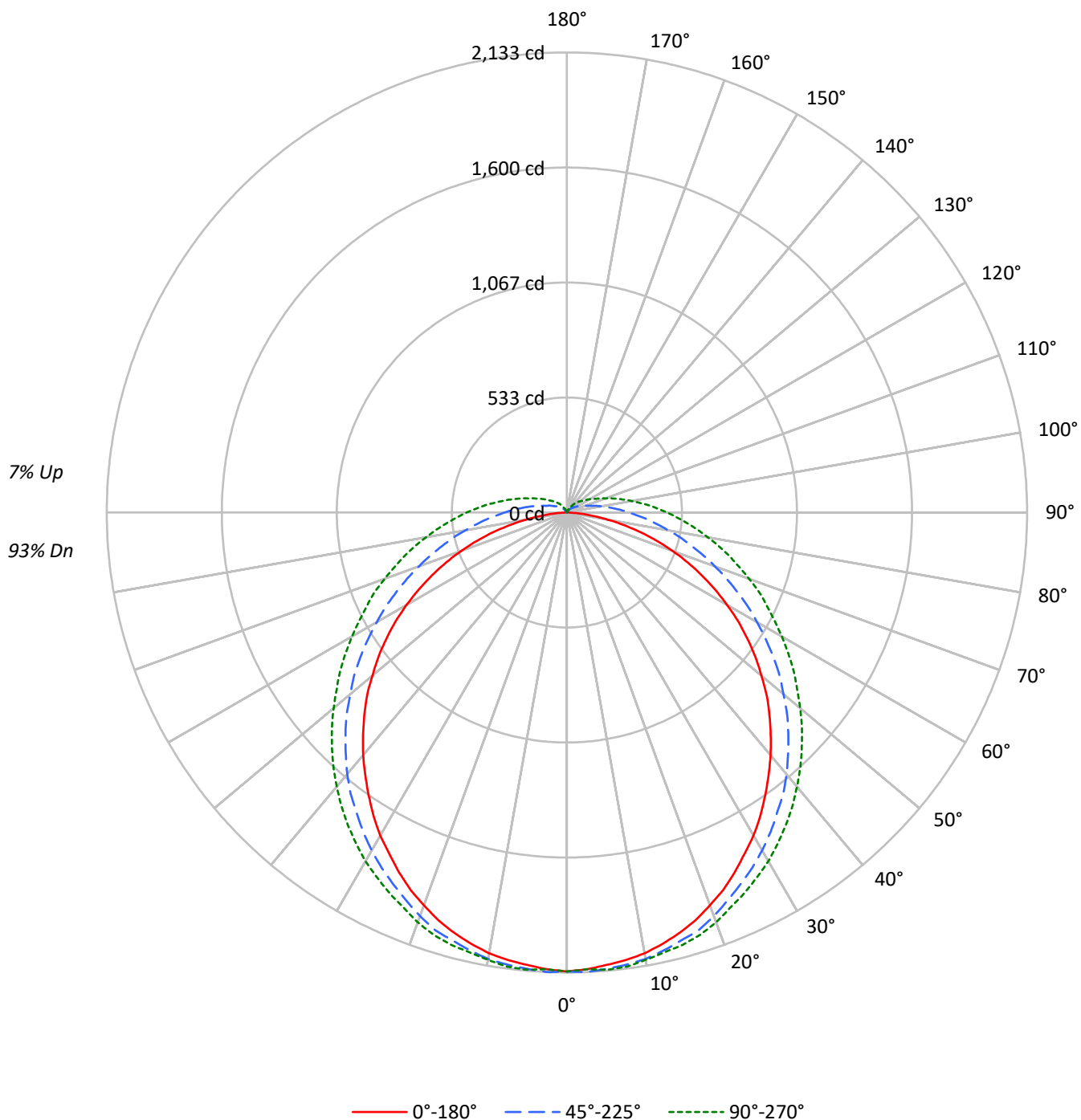
Lumens per Lamp: N/A  
Luminaire Lumens: 7236.0 lumens  
Efficiency: N/A  
Efficacy: 112.7 lumens/watt  
Spacing Criteria (0/90/45): 1.21 / 1.3 / 1.39  
Luminous Opening: Rectangular w/ Sides (W: 0.33' x L: 2.98' x H: 0.1')  
CIE Type: Direct

Input Watts (W): 64.2  
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: 3ASL4-25VHE-3-30-UNV

### Luminous Intensity Polar Plot



TEST NUMBER: P1357043

CATALOG NUMBER: 3ASL4-25VHE-3-30-UNV

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

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

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

|     | 0°    | 45°   | 90°   |
|-----|-------|-------|-------|
| 0°  | 23068 | 23068 | 23068 |
| 5°  | 22846 | 22622 | 22540 |
| 10° | 22700 | 22172 | 21970 |
| 15° | 22431 | 21615 | 21487 |
| 20° | 22073 | 21081 | 20942 |
| 25° | 21660 | 20416 | 20322 |
| 30° | 21224 | 19835 | 19798 |
| 35° | 20688 | 19182 | 19214 |
| 40° | 20192 | 18582 | 18600 |
| 45° | 19660 | 17858 | 17983 |
| 50° | 19052 | 17083 | 17342 |
| 55° | 18397 | 16341 | 16765 |
| 60° | 17546 | 15475 | 16181 |
| 65° | 16467 | 14641 | 15696 |
| 70° | 15096 | 13812 | 15316 |
| 75° | 13114 | 13049 | 15054 |
| 80° | 10142 | 12464 | 14944 |
| 85° | 5900  | 12282 | 15165 |

**MAXIMUM LUMINANCE 45°-90°:**

Horizontal Angle: 0°

Vertical Angle: 45°

Luminance: 19660 cd/sqm

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**ZONAL LUMENS:**

| Zone      | Lumens | % Fixture |
|-----------|--------|-----------|
| 0°-10°    | 201.8  | 2.8       |
| 10°-20°   | 579.4  | 8.0       |
| 20°-30°   | 876.1  | 12.1      |
| 30°-40°   | 1060.8 | 14.7      |
| 40°-50°   | 1114.1 | 15.4      |
| 50°-60°   | 1039.4 | 14.4      |
| 60°-70°   | 859.0  | 11.9      |
| 70°-80°   | 618.5  | 8.5       |
| 80°-90°   | 384.4  | 5.3       |
| 90°-100°  | 225.2  | 3.1       |
| 100°-110° | 128.8  | 1.8       |
| 110°-120° | 72.7   | 1.0       |
| 120°-130° | 41.8   | 0.6       |
| 130°-140° | 22.5   | 0.3       |
| 140°-150° | 9.5    | 0.1       |
| 150°-160° | 1.8    | 0.0       |
| 160°-170° | 0.0    | 0.0       |
| 170°-180° | 0.0    | 0.0       |
| 0°-30°    | 1657.3 | 22.9      |
| 0°-40°    | 2718.1 | 37.6      |
| 0°-60°    | 4871.6 | 67.3      |
| 0°-90°    | 6733.6 | 93.1      |
| 90°-120°  | 426.8  | 5.9       |
| 90°-150°  | 500.7  | 6.9       |
| 90°-180°  | 502.0  | 6.9       |
| 0°-180°   | 7236.0 | 100.0     |

**CANDELA DISTRIBUTION:**

|      | 0°   | 22.5° | 45°  | 67.5° | 90°  | Flux |
|------|------|-------|------|-------|------|------|
| 0°   | 2128 | 2128  | 2128 | 2128  | 2128 |      |
| 5°   | 2106 | 2124  | 2124 | 2124  | 2128 | 200  |
| 15°  | 2018 | 2044  | 2053 | 2066  | 2075 | 569  |
| 25°  | 1841 | 1872  | 1903 | 1929  | 1947 | 848  |
| 35°  | 1602 | 1646  | 1699 | 1748  | 1770 | 1003 |
| 45°  | 1327 | 1376  | 1451 | 1513  | 1540 | 1024 |
| 55°  | 1022 | 1080  | 1168 | 1252  | 1283 | 913  |
| 65°  | 690  | 757   | 872  | 982   | 1022 | 683  |
| 75°  | 354  | 442   | 597  | 726   | 779  | 374  |
| 85°  | 66   | 199   | 376  | 509   | 558  | 81   |
| 90°  | 0    | 120   | 288  | 412   | 465  | 3    |
| 95°  | 0    | 75    | 217  | 332   | 380  | 0    |
| 105° | 0    | 26    | 120  | 208   | 243  | 0    |
| 115° | 0    | 13    | 71   | 128   | 150  | 0    |
| 125° | 0    | 9     | 44   | 84    | 97   | 0    |
| 135° | 0    | 0     | 26   | 53    | 66   | 0    |
| 145° | 0    | 0     | 13   | 31    | 35   | 0    |
| 155° | 0    | 0     | 0    | 9     | 13   | 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°     | 2128.2 | 2128.2 | 2128.2 | 2128.2 | 2128.2 |
| 2.5°   | 2119.4 | 2132.6 | 2132.6 | 2119.4 | 2119.4 |
| 5°     | 2106.1 | 2123.8 | 2123.8 | 2123.8 | 2128.2 |
| 7.5°   | 2092.8 | 2114.9 | 2114.9 | 2114.9 | 2123.8 |
| 10°    | 2075.1 | 2097.2 | 2101.7 | 2101.7 | 2106.1 |
| 12.5°  | 2048.6 | 2075.1 | 2079.5 | 2084.0 | 2088.4 |
| 15°    | 2017.6 | 2044.1 | 2053.0 | 2066.3 | 2075.1 |
| 17.5°  | 1982.2 | 2013.2 | 2030.9 | 2044.1 | 2053.0 |
| 20°    | 1937.9 | 1968.9 | 1991.0 | 2008.7 | 2022.0 |
| 22.5°  | 1893.7 | 1920.3 | 1946.8 | 1968.9 | 1982.2 |
| 25°    | 1840.6 | 1871.6 | 1902.6 | 1929.1 | 1946.8 |
| 27.5°  | 1783.1 | 1818.5 | 1858.3 | 1889.3 | 1907.0 |
| 30°    | 1730.0 | 1765.4 | 1809.6 | 1849.5 | 1867.2 |
| 32.5°  | 1668.1 | 1707.9 | 1756.5 | 1796.4 | 1818.5 |
| 35°    | 1601.7 | 1645.9 | 1699.0 | 1747.7 | 1769.8 |
| 37.5°  | 1535.3 | 1579.6 | 1645.9 | 1694.6 | 1716.7 |
| 40°    | 1468.9 | 1513.2 | 1584.0 | 1637.1 | 1659.2 |
| 42.5°  | 1398.2 | 1442.4 | 1517.6 | 1575.1 | 1601.7 |
| 45°    | 1327.4 | 1376.0 | 1451.2 | 1513.2 | 1539.7 |
| 47.5°  | 1256.6 | 1305.2 | 1384.9 | 1451.2 | 1477.8 |
| 50°    | 1176.9 | 1230.0 | 1309.7 | 1384.9 | 1411.4 |
| 52.5°  | 1101.7 | 1154.8 | 1243.3 | 1318.5 | 1345.1 |
| 55°    | 1022.1 | 1079.6 | 1168.1 | 1252.1 | 1283.1 |
| 57.5°  | 942.4  | 999.9  | 1092.9 | 1181.4 | 1216.7 |
| 60°    | 858.4  | 920.3  | 1017.6 | 1110.6 | 1150.4 |
| 62.5°  | 774.3  | 840.7  | 946.9  | 1044.2 | 1084.0 |
| 65°    | 690.2  | 756.6  | 871.6  | 982.2  | 1022.1 |
| 67.5°  | 606.2  | 677.0  | 800.8  | 915.9  | 964.6  |
| 70°    | 522.1  | 597.3  | 730.0  | 849.5  | 898.2  |
| 72.5°  | 438.0  | 517.7  | 663.7  | 787.6  | 836.2  |
| 75°    | 354.0  | 442.5  | 597.3  | 725.6  | 778.7  |
| 77.5°  | 269.9  | 371.7  | 539.8  | 668.1  | 721.2  |
| 80°    | 194.7  | 309.7  | 477.9  | 610.6  | 663.7  |
| 82.5°  | 123.9  | 247.8  | 424.8  | 557.5  | 610.6  |
| 85°    | 66.4   | 199.1  | 376.1  | 508.8  | 557.5  |
| 87.5°  | 22.1   | 154.9  | 327.4  | 460.2  | 508.8  |
| 90°    | 0.0    | 119.5  | 287.6  | 411.5  | 464.6  |
| 92.5°  | 0.0    | 92.9   | 252.2  | 371.7  | 420.3  |
| 95°    | 0.0    | 75.2   | 216.8  | 331.8  | 380.5  |
| 97.5°  | 0.0    | 61.9   | 190.3  | 296.4  | 340.7  |
| 100°   | 0.0    | 48.7   | 163.7  | 265.5  | 305.3  |
| 102.5° | 0.0    | 39.8   | 141.6  | 234.5  | 274.3  |
| 105°   | 0.0    | 26.5   | 119.5  | 208.0  | 243.3  |
| 107.5° | 0.0    | 22.1   | 101.8  | 185.8  | 216.8  |
| 110°   | 0.0    | 17.7   | 92.9   | 159.3  | 190.3  |

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CATALOG NUMBER: 3ASL4-25VHE-3-30-UNV

**CANDELA DISTRIBUTION (continued):**

|        | 0°  | 22.5° | 45°  | 67.5° | 90°   |
|--------|-----|-------|------|-------|-------|
| 112.5° | 0.0 | 13.3  | 84.1 | 141.6 | 172.6 |
| 115°   | 0.0 | 13.3  | 70.8 | 128.3 | 150.4 |
| 117.5° | 0.0 | 13.3  | 61.9 | 115.0 | 137.2 |
| 120°   | 0.0 | 8.8   | 57.5 | 101.8 | 123.9 |
| 122.5° | 0.0 | 8.8   | 48.7 | 92.9  | 110.6 |
| 125°   | 0.0 | 8.8   | 44.2 | 84.1  | 97.3  |
| 127.5° | 0.0 | 4.4   | 39.8 | 75.2  | 88.5  |
| 130°   | 0.0 | 4.4   | 35.4 | 66.4  | 79.6  |
| 132.5° | 0.0 | 4.4   | 31.0 | 61.9  | 75.2  |
| 135°   | 0.0 | 0.0   | 26.5 | 53.1  | 66.4  |
| 137.5° | 0.0 | 0.0   | 22.1 | 48.7  | 57.5  |
| 140°   | 0.0 | 0.0   | 17.7 | 39.8  | 53.1  |
| 142.5° | 0.0 | 0.0   | 13.3 | 35.4  | 44.2  |
| 145°   | 0.0 | 0.0   | 13.3 | 31.0  | 35.4  |
| 147.5° | 0.0 | 0.0   | 8.8  | 22.1  | 31.0  |
| 150°   | 0.0 | 0.0   | 4.4  | 17.7  | 22.1  |
| 152.5° | 0.0 | 0.0   | 0.0  | 13.3  | 17.7  |
| 155°   | 0.0 | 0.0   | 0.0  | 8.8   | 13.3  |
| 157.5° | 0.0 | 0.0   | 0.0  | 0.0   | 4.4   |
| 160°   | 0.0 | 0.0   | 0.0  | 0.0   | 0.0   |
| 162.5° | 0.0 | 0.0   | 0.0  | 0.0   | 0.0   |
| 165°   | 0.0 | 0.0   | 0.0  | 0.0   | 0.0   |
| 167.5° | 0.0 | 0.0   | 0.0  | 0.0   | 0.0   |
| 170°   | 0.0 | 0.0   | 0.0  | 0.0   | 0.0   |
| 172.5° | 0.0 | 0.0   | 0.0  | 0.0   | 0.0   |
| 175°   | 0.0 | 0.0   | 0.0  | 0.0   | 0.0   |
| 177.5° | 0.0 | 0.0   | 0.0  | 0.0   | 0.0   |
| 180°   | 0.0 | 0.0   | 0.0  | 0.0   | 0.0   |

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CATALOG NUMBER: 3ASL4-25VHE-3-30-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 | 20.23            | 21.77 | 20.69 | 22.22 | 22.70 | 22.23          | 23.77 | 22.69 | 24.22 | 24.70 |
|                 | 3H   | 21.72            | 23.13 | 22.21 | 23.59 | 24.12 | 24.68          | 26.08 | 25.16 | 26.55 | 27.07 |
|                 | 4H   | 22.21            | 23.54 | 22.71 | 24.02 | 24.56 | 25.86          | 27.19 | 26.36 | 27.68 | 28.21 |
|                 | 6H   | 22.48            | 23.72 | 23.00 | 24.22 | 24.77 | 27.10          | 28.34 | 27.61 | 28.83 | 29.39 |
|                 | 8H   | 22.53            | 23.72 | 23.06 | 24.24 | 24.80 | 27.73          | 28.92 | 28.26 | 29.44 | 30.00 |
|                 | 12H  | 22.55            | 23.69 | 23.08 | 24.20 | 24.79 | 28.42          | 29.56 | 28.95 | 30.07 | 30.66 |
| 4H              | 2H   | 21.10            | 22.43 | 21.60 | 22.91 | 23.45 | 22.66          | 23.99 | 23.16 | 24.47 | 25.01 |
|                 | 3H   | 22.83            | 23.97 | 23.35 | 24.49 | 25.05 | 25.34          | 26.47 | 25.85 | 27.00 | 27.56 |
|                 | 4H   | 23.44            | 24.48 | 23.97 | 25.01 | 25.61 | 26.70          | 27.73 | 27.23 | 28.27 | 28.86 |
|                 | 6H   | 23.84            | 24.75 | 24.39 | 25.32 | 25.92 | 28.12          | 29.04 | 28.68 | 29.60 | 30.21 |
|                 | 8H   | 23.93            | 24.79 | 24.49 | 25.36 | 25.97 | 28.86          | 29.73 | 29.42 | 30.29 | 30.91 |
|                 | 12H  | 23.98            | 24.76 | 24.56 | 25.35 | 25.97 | 29.68          | 30.46 | 30.26 | 31.05 | 31.67 |
| 8H              | 4H   | 24.11            | 24.98 | 24.67 | 25.54 | 26.16 | 26.91          | 27.78 | 27.47 | 28.34 | 28.96 |
|                 | 6H   | 24.69            | 25.42 | 25.28 | 26.03 | 26.65 | 28.51          | 29.24 | 29.10 | 29.85 | 30.47 |
|                 | 8H   | 24.87            | 25.53 | 25.48 | 26.15 | 26.79 | 29.39          | 30.05 | 30.00 | 30.67 | 31.30 |
|                 | 12H  | 24.99            | 25.58 | 25.60 | 26.18 | 26.89 | 30.39          | 30.98 | 31.00 | 31.58 | 32.29 |
| 12H             | 4H   | 24.30            | 25.09 | 24.88 | 25.68 | 26.30 | 26.92          | 27.71 | 27.50 | 28.30 | 28.92 |
|                 | 6H   | 24.98            | 25.64 | 25.59 | 26.26 | 26.89 | 28.55          | 29.21 | 29.15 | 29.82 | 30.46 |
|                 | 8H   | 25.26            | 25.85 | 25.87 | 26.45 | 27.16 | 29.50          | 30.09 | 30.10 | 30.69 | 31.40 |



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

Report Prepared for

Cooper Lighting Solutions

Fail-Safe

Report Number: SP1-2511-597-3

Test Date: 11/18/2025

Luminaire Tested: 4ASL-2-30-UNV-OPL-1\_600mA

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

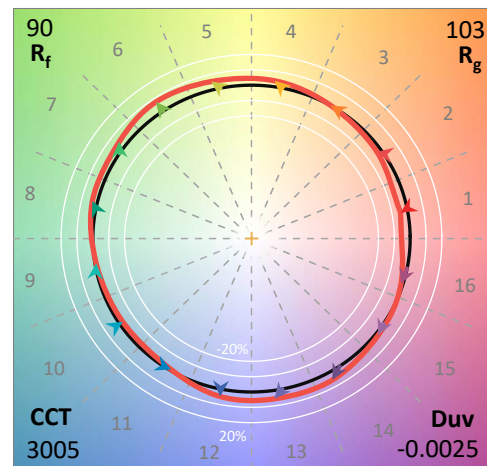
### Test Information

Test Method: LM-79-2019  
 Report Number: SP1-2511-597-3  
 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-2-30-UNV-OPL-1\_600mA**  
 Description: 2foot 4ASL LED LUMINAIRE WITH OPL LENS AND 3000K LEDS with 1 rows at 600mA

### Spectral Parameters

CCT (K): 3005  
 CIE  $u'$ : 0.2513  
 CIE  $v'$ : 0.5178  
 Duv: -0.0025  
 CIE x: 0.4330  
 CIE y: 0.3966  
 CIE z: 0.1704  
 Peak Wavelength (nm): 630  
 Dominant Wavelength (nm): 583  
 Purity: 49.00645  
 R<sub>f</sub>: 90.1  
 R<sub>g</sub>: 103.3

CRI (Ra): 93.9  
 R1: 96.5  
 R2: 96.6  
 R3: 95.5  
 R4: 94.4  
 R5: 96.0  
 R6: 96.4  
 R7: 91.7  
 R8: 84.0  
 R9: 62.0  
 R10: 90.8  
 R11: 94.1  
 R12: 88.9  
 R13: 96.4  
 R14: 96.3  
 R15: 91.9



### Test Conditions

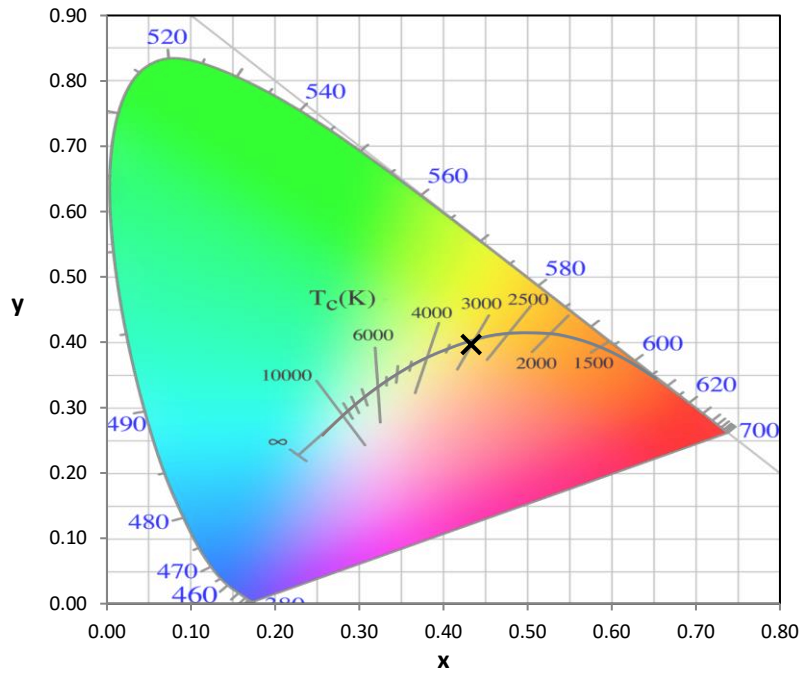
Stabilization Time: 32M  
 Operation Time: 1H 32M  
 Sphere Temperature (°C): 24.1

REPORT NUMBER: SP1-2511-597-3

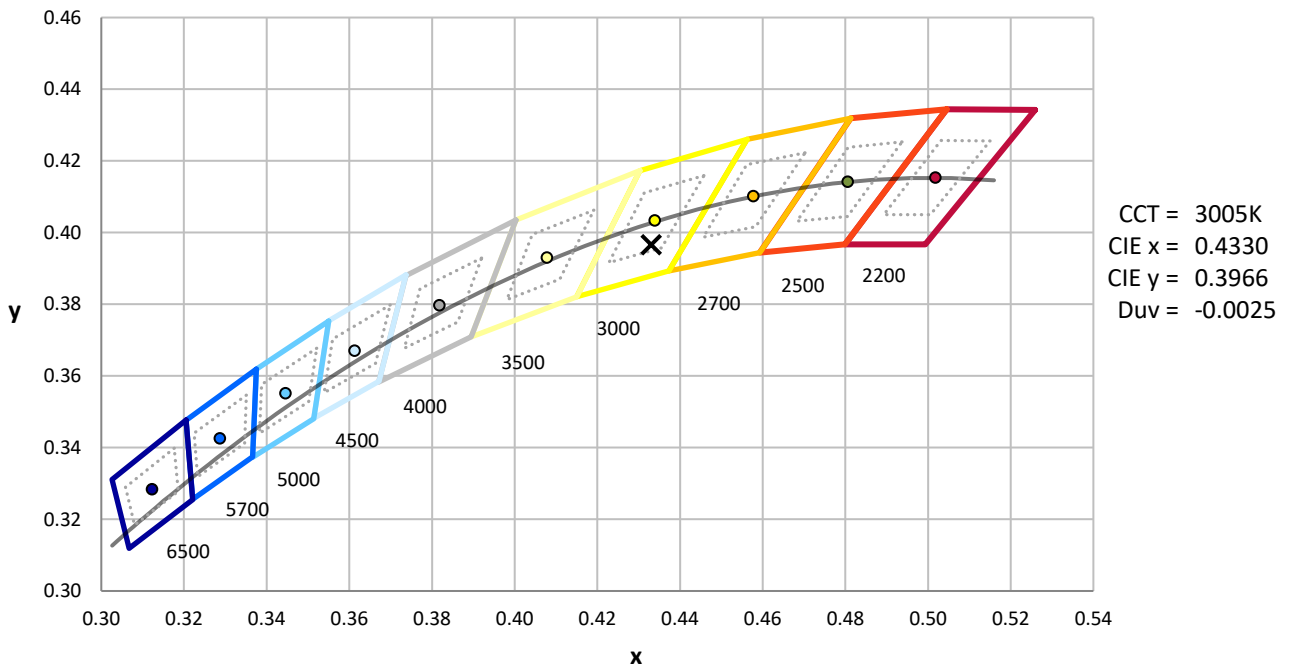
| Measurement and Test Equipment |                       |                  |                      |
|--------------------------------|-----------------------|------------------|----------------------|
| Instrument                     | Identification Number | Calibration Date | Calibration Due Date |
| 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: SP1-2511-597-3

**CIE 1931 Chromaticity Diagram**



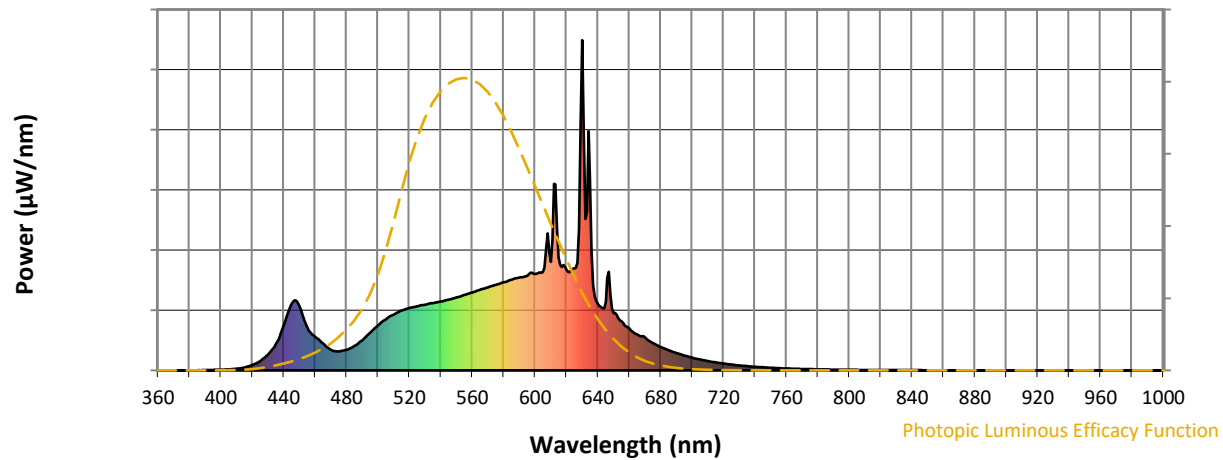
**CIE 1931 Chromaticity Diagram with 2017 ANSI 7-Step and 4-Step Quadrangles**



Point lies inside the ANSI 3000K 4-step quadrangle

REPORT NUMBER: SP1-2511-597-3

### Photopic Flux vs. Wavelength

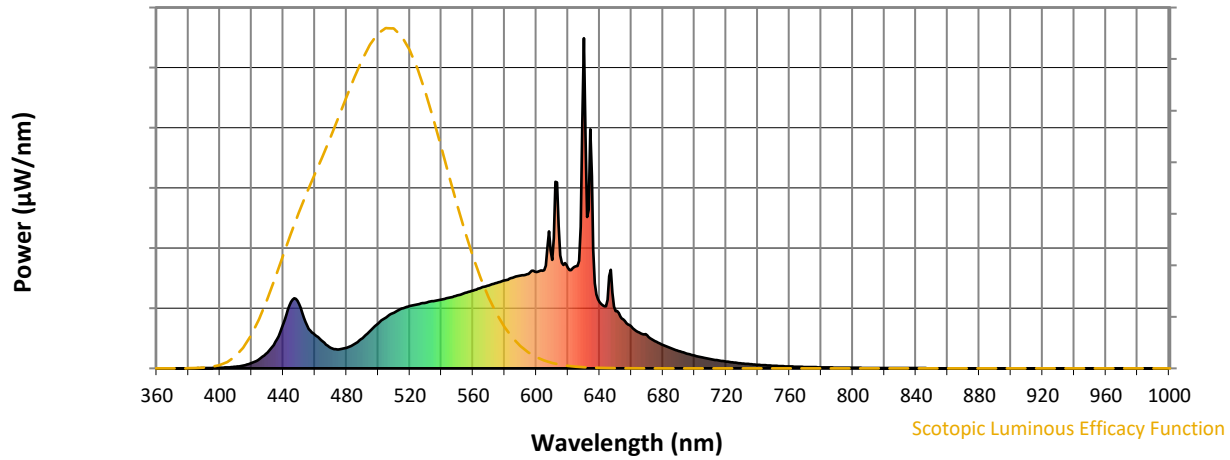


### Photopic Lumens: NR

| λ (nm) | Power W <sup>^</sup> /nm | Lumens (φ/nm) | λ (nm) | Power W <sup>^</sup> /nm | Lumens (φ/nm) | λ (nm) | Power W <sup>^</sup> /nm | Lumens (φ/nm) | λ (nm) | Power W <sup>^</sup> /nm | Lumens (φ/nm) | λ (nm) | Power W <sup>^</sup> /nm | Lumens (φ/nm) |
|--------|--------------------------|---------------|--------|--------------------------|---------------|--------|--------------------------|---------------|--------|--------------------------|---------------|--------|--------------------------|---------------|
| 360    | 0                        | NR            | 490    | 92                       | NR            | 620    | 304                      | NR            | 750    | 8                        | NR            | 880    | 0                        | NR            |
| 365    | 0                        | NR            | 495    | 114                      | NR            | 625    | 309                      | NR            | 755    | 7                        | NR            | 885    | 0                        | NR            |
| 370    | 0                        | NR            | 500    | 136                      | NR            | 630    | 1000                     | NR            | 760    | 6                        | NR            | 890    | 0                        | NR            |
| 375    | 0                        | NR            | 505    | 154                      | NR            | 635    | 582                      | NR            | 765    | 5                        | NR            | 895    | 0                        | NR            |
| 380    | 0                        | NR            | 510    | 169                      | NR            | 640    | 200                      | NR            | 770    | 4                        | NR            | 900    | 0                        | NR            |
| 385    | 0                        | NR            | 515    | 181                      | NR            | 645    | 207                      | NR            | 775    | 4                        | NR            | 905    | 0                        | NR            |
| 390    | 1                        | NR            | 520    | 189                      | NR            | 650    | 174                      | NR            | 780    | 3                        | NR            | 910    | 0                        | NR            |
| 395    | 1                        | NR            | 525    | 194                      | NR            | 655    | 148                      | NR            | 785    | 3                        | NR            | 915    | 0                        | NR            |
| 400    | 2                        | NR            | 530    | 199                      | NR            | 660    | 127                      | NR            | 790    | 2                        | NR            | 920    | 0                        | NR            |
| 405    | 3                        | NR            | 535    | 203                      | NR            | 665    | 108                      | NR            | 795    | 2                        | NR            | 925    | 0                        | NR            |
| 410    | 5                        | NR            | 540    | 208                      | NR            | 670    | 100                      | NR            | 800    | 2                        | NR            | 930    | 0                        | NR            |
| 415    | 9                        | NR            | 545    | 214                      | NR            | 675    | 83                       | NR            | 805    | 2                        | NR            | 935    | 0                        | NR            |
| 420    | 16                       | NR            | 550    | 221                      | NR            | 680    | 71                       | NR            | 810    | 1                        | NR            | 940    | 0                        | NR            |
| 425    | 28                       | NR            | 555    | 228                      | NR            | 685    | 61                       | NR            | 815    | 1                        | NR            | 945    | 0                        | NR            |
| 430    | 48                       | NR            | 560    | 236                      | NR            | 690    | 53                       | NR            | 820    | 1                        | NR            | 950    | 0                        | NR            |
| 435    | 80                       | NR            | 565    | 244                      | NR            | 695    | 45                       | NR            | 825    | 1                        | NR            | 955    | 0                        | NR            |
| 440    | 135                      | NR            | 570    | 251                      | NR            | 700    | 38                       | NR            | 830    | 1                        | NR            | 960    | 0                        | NR            |
| 445    | 202                      | NR            | 575    | 259                      | NR            | 705    | 33                       | NR            | 835    | 1                        | NR            | 965    | 0                        | NR            |
| 450    | 195                      | NR            | 580    | 266                      | NR            | 710    | 28                       | NR            | 840    | 1                        | NR            | 970    | 0                        | NR            |
| 455    | 130                      | NR            | 585    | 274                      | NR            | 715    | 24                       | NR            | 845    | 1                        | NR            | 975    | 0                        | NR            |
| 460    | 101                      | NR            | 590    | 281                      | NR            | 720    | 20                       | NR            | 850    | 0                        | NR            | 980    | 0                        | NR            |
| 465    | 82                       | NR            | 595    | 286                      | NR            | 725    | 17                       | NR            | 855    | 0                        | NR            | 985    | 0                        | NR            |
| 470    | 62                       | NR            | 600    | 292                      | NR            | 730    | 15                       | NR            | 860    | 0                        | NR            | 990    | 0                        | NR            |
| 475    | 58                       | NR            | 605    | 298                      | NR            | 735    | 13                       | NR            | 865    | 0                        | NR            | 995    | 0                        | NR            |
| 480    | 62                       | NR            | 610    | 328                      | NR            | 740    | 11                       | NR            | 870    | 0                        | NR            | 1000   | 0                        | NR            |
| 485    | 74                       | NR            | 615    | 342                      | NR            | 745    | 9                        | NR            | 875    | 0                        | NR            |        |                          |               |

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### Scotopic Flux vs. Wavelength



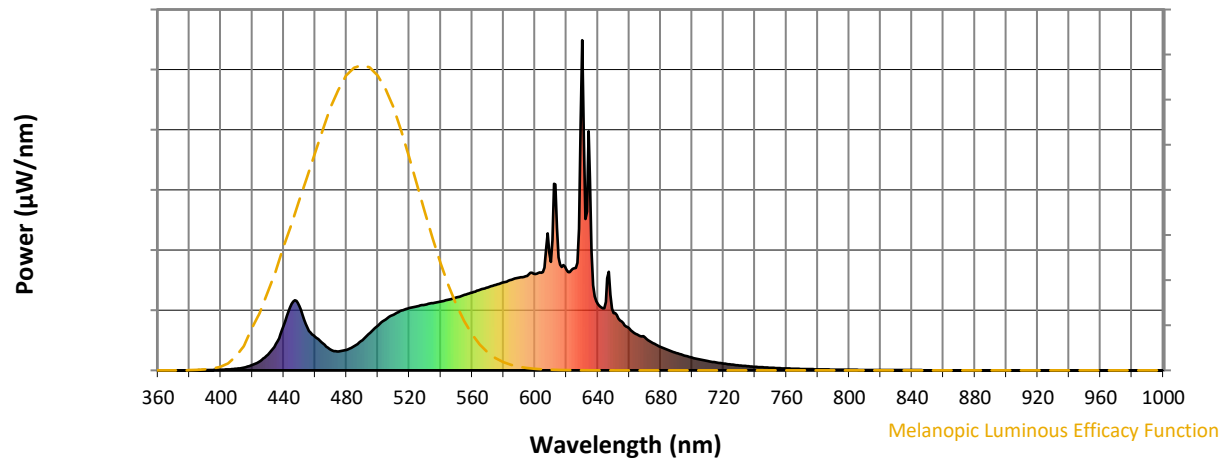
Scotopic Lumens: NR

S/P: 1.42

| 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       | 92                          | NR               | 620       | 304                         | NR               | 750       | 8                           | NR               | 880       | 0                           | NR               |
| 365       | 0                           | NR               | 495       | 114                         | NR               | 625       | 309                         | NR               | 755       | 7                           | NR               | 885       | 0                           | NR               |
| 370       | 0                           | NR               | 500       | 136                         | NR               | 630       | 1000                        | NR               | 760       | 6                           | NR               | 890       | 0                           | NR               |
| 375       | 0                           | NR               | 505       | 154                         | NR               | 635       | 582                         | NR               | 765       | 5                           | NR               | 895       | 0                           | NR               |
| 380       | 0                           | NR               | 510       | 169                         | NR               | 640       | 200                         | NR               | 770       | 4                           | NR               | 900       | 0                           | NR               |
| 385       | 0                           | NR               | 515       | 181                         | NR               | 645       | 207                         | NR               | 775       | 4                           | NR               | 905       | 0                           | NR               |
| 390       | 1                           | NR               | 520       | 189                         | NR               | 650       | 174                         | NR               | 780       | 3                           | NR               | 910       | 0                           | NR               |
| 395       | 1                           | NR               | 525       | 194                         | NR               | 655       | 148                         | NR               | 785       | 3                           | NR               | 915       | 0                           | NR               |
| 400       | 2                           | NR               | 530       | 199                         | NR               | 660       | 127                         | NR               | 790       | 2                           | NR               | 920       | 0                           | NR               |
| 405       | 3                           | NR               | 535       | 203                         | NR               | 665       | 108                         | NR               | 795       | 2                           | NR               | 925       | 0                           | NR               |
| 410       | 5                           | NR               | 540       | 208                         | NR               | 670       | 100                         | NR               | 800       | 2                           | NR               | 930       | 0                           | NR               |
| 415       | 9                           | NR               | 545       | 214                         | NR               | 675       | 83                          | NR               | 805       | 2                           | NR               | 935       | 0                           | NR               |
| 420       | 16                          | NR               | 550       | 221                         | NR               | 680       | 71                          | NR               | 810       | 1                           | NR               | 940       | 0                           | NR               |
| 425       | 28                          | NR               | 555       | 228                         | NR               | 685       | 61                          | NR               | 815       | 1                           | NR               | 945       | 0                           | NR               |
| 430       | 48                          | NR               | 560       | 236                         | NR               | 690       | 53                          | NR               | 820       | 1                           | NR               | 950       | 0                           | NR               |
| 435       | 80                          | NR               | 565       | 244                         | NR               | 695       | 45                          | NR               | 825       | 1                           | NR               | 955       | 0                           | NR               |
| 440       | 135                         | NR               | 570       | 251                         | NR               | 700       | 38                          | NR               | 830       | 1                           | NR               | 960       | 0                           | NR               |
| 445       | 202                         | NR               | 575       | 259                         | NR               | 705       | 33                          | NR               | 835       | 1                           | NR               | 965       | 0                           | NR               |
| 450       | 195                         | NR               | 580       | 266                         | NR               | 710       | 28                          | NR               | 840       | 1                           | NR               | 970       | 0                           | NR               |
| 455       | 130                         | NR               | 585       | 274                         | NR               | 715       | 24                          | NR               | 845       | 1                           | NR               | 975       | 0                           | NR               |
| 460       | 101                         | NR               | 590       | 281                         | NR               | 720       | 20                          | NR               | 850       | 0                           | NR               | 980       | 0                           | NR               |
| 465       | 82                          | NR               | 595       | 286                         | NR               | 725       | 17                          | NR               | 855       | 0                           | NR               | 985       | 0                           | NR               |
| 470       | 62                          | NR               | 600       | 292                         | NR               | 730       | 15                          | NR               | 860       | 0                           | NR               | 990       | 0                           | NR               |
| 475       | 58                          | NR               | 605       | 298                         | NR               | 735       | 13                          | NR               | 865       | 0                           | NR               | 995       | 0                           | NR               |
| 480       | 62                          | NR               | 610       | 328                         | NR               | 740       | 11                          | NR               | 870       | 0                           | NR               | 1000      | 0                           | NR               |
| 485       | 74                          | NR               | 615       | 342                         | NR               | 745       | 9                           | NR               | 875       | 0                           | NR               |           |                             |                  |

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### Melanopic Flux vs. Wavelength



Melanopic Lumens: NR

M/P: 2.76

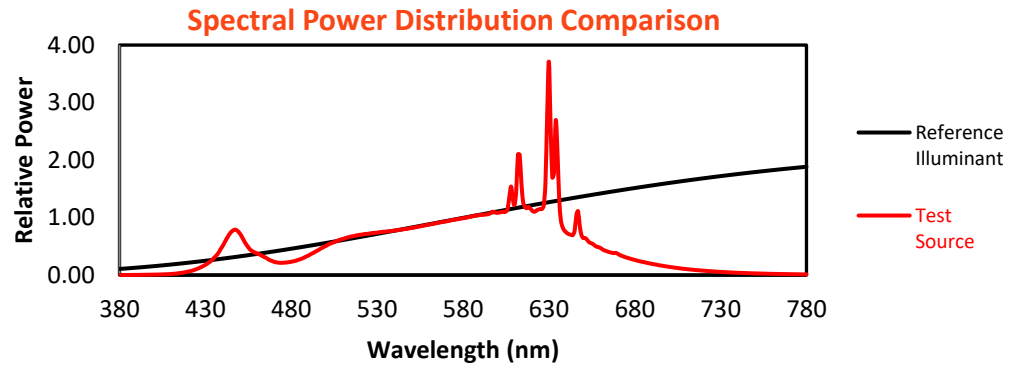
| λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) |
|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|
| 360       | 0                           | NR               | 490       | 92                          | NR               | 620       | 304                         | NR               | 750       | 8                           | NR               | 880       | 0                           | NR               |
| 365       | 0                           | NR               | 495       | 114                         | NR               | 625       | 309                         | NR               | 755       | 7                           | NR               | 885       | 0                           | NR               |
| 370       | 0                           | NR               | 500       | 136                         | NR               | 630       | 1000                        | NR               | 760       | 6                           | NR               | 890       | 0                           | NR               |
| 375       | 0                           | NR               | 505       | 154                         | NR               | 635       | 582                         | NR               | 765       | 5                           | NR               | 895       | 0                           | NR               |
| 380       | 0                           | NR               | 510       | 169                         | NR               | 640       | 200                         | NR               | 770       | 4                           | NR               | 900       | 0                           | NR               |
| 385       | 0                           | NR               | 515       | 181                         | NR               | 645       | 207                         | NR               | 775       | 4                           | NR               | 905       | 0                           | NR               |
| 390       | 1                           | NR               | 520       | 189                         | NR               | 650       | 174                         | NR               | 780       | 3                           | NR               | 910       | 0                           | NR               |
| 395       | 1                           | NR               | 525       | 194                         | NR               | 655       | 148                         | NR               | 785       | 3                           | NR               | 915       | 0                           | NR               |
| 400       | 2                           | NR               | 530       | 199                         | NR               | 660       | 127                         | NR               | 790       | 2                           | NR               | 920       | 0                           | NR               |
| 405       | 3                           | NR               | 535       | 203                         | NR               | 665       | 108                         | NR               | 795       | 2                           | NR               | 925       | 0                           | NR               |
| 410       | 5                           | NR               | 540       | 208                         | NR               | 670       | 100                         | NR               | 800       | 2                           | NR               | 930       | 0                           | NR               |
| 415       | 9                           | NR               | 545       | 214                         | NR               | 675       | 83                          | NR               | 805       | 2                           | NR               | 935       | 0                           | NR               |
| 420       | 16                          | NR               | 550       | 221                         | NR               | 680       | 71                          | NR               | 810       | 1                           | NR               | 940       | 0                           | NR               |
| 425       | 28                          | NR               | 555       | 228                         | NR               | 685       | 61                          | NR               | 815       | 1                           | NR               | 945       | 0                           | NR               |
| 430       | 48                          | NR               | 560       | 236                         | NR               | 690       | 53                          | NR               | 820       | 1                           | NR               | 950       | 0                           | NR               |
| 435       | 80                          | NR               | 565       | 244                         | NR               | 695       | 45                          | NR               | 825       | 1                           | NR               | 955       | 0                           | NR               |
| 440       | 135                         | NR               | 570       | 251                         | NR               | 700       | 38                          | NR               | 830       | 1                           | NR               | 960       | 0                           | NR               |
| 445       | 202                         | NR               | 575       | 259                         | NR               | 705       | 33                          | NR               | 835       | 1                           | NR               | 965       | 0                           | NR               |
| 450       | 195                         | NR               | 580       | 266                         | NR               | 710       | 28                          | NR               | 840       | 1                           | NR               | 970       | 0                           | NR               |
| 455       | 130                         | NR               | 585       | 274                         | NR               | 715       | 24                          | NR               | 845       | 1                           | NR               | 975       | 0                           | NR               |
| 460       | 101                         | NR               | 590       | 281                         | NR               | 720       | 20                          | NR               | 850       | 0                           | NR               | 980       | 0                           | NR               |
| 465       | 82                          | NR               | 595       | 286                         | NR               | 725       | 17                          | NR               | 855       | 0                           | NR               | 985       | 0                           | NR               |
| 470       | 62                          | NR               | 600       | 292                         | NR               | 730       | 15                          | NR               | 860       | 0                           | NR               | 990       | 0                           | NR               |
| 475       | 58                          | NR               | 605       | 298                         | NR               | 735       | 13                          | NR               | 865       | 0                           | NR               | 995       | 0                           | NR               |
| 480       | 62                          | NR               | 610       | 328                         | NR               | 740       | 11                          | NR               | 870       | 0                           | NR               | 1000      | 0                           | NR               |
| 485       | 74                          | NR               | 615       | 342                         | NR               | 745       | 9                           | NR               | 875       | 0                           | NR               |           |                             |                  |

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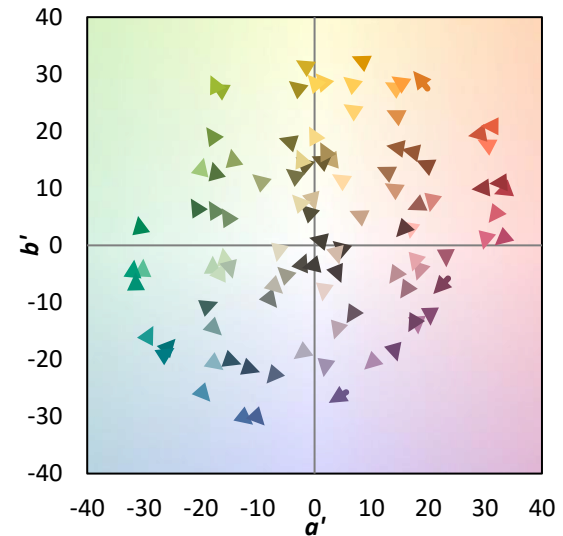
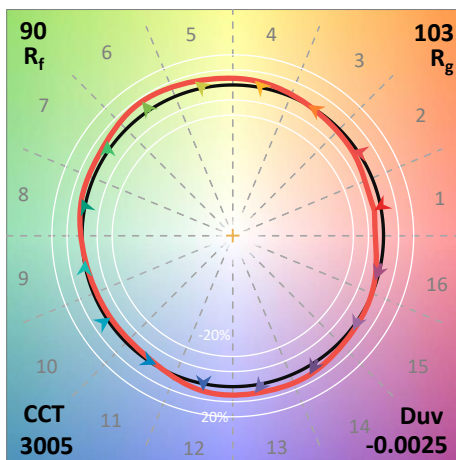
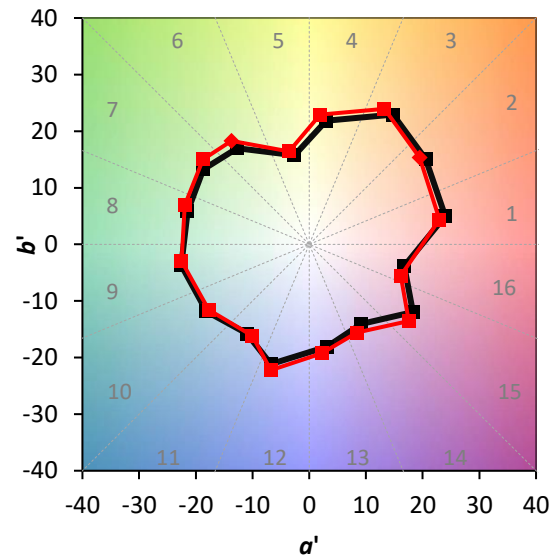
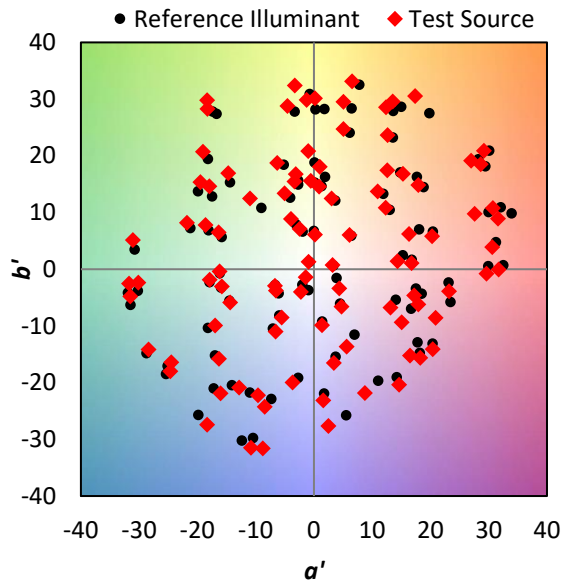
TM-30-18

### Summary

$R_f = 90.1$   
 $R_g = 103.3$   
 $\text{CIE } R_a = 93.9$   
 $R_9 = 62.0$



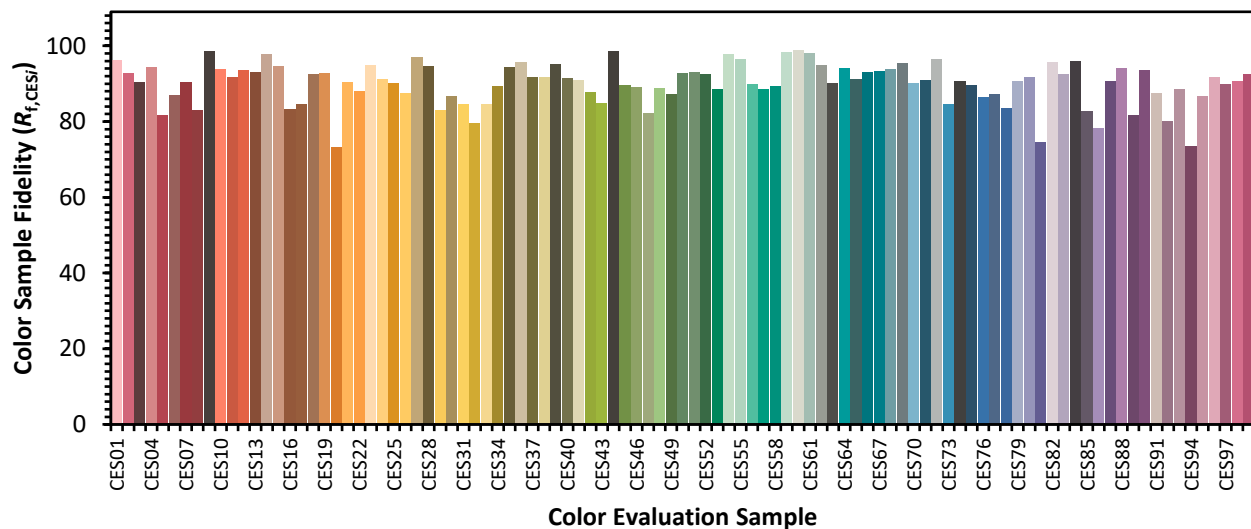
### Color Vector Graphics



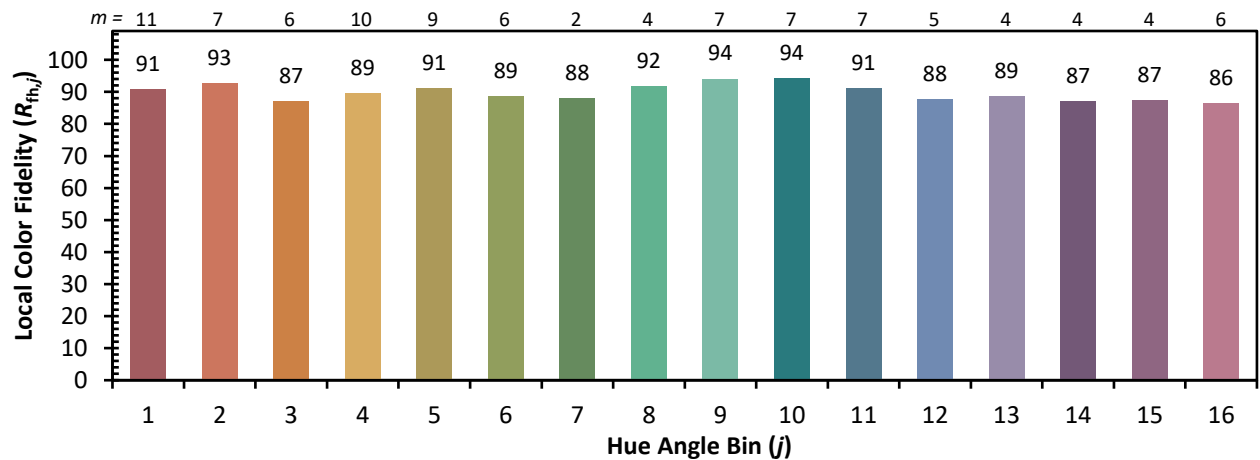
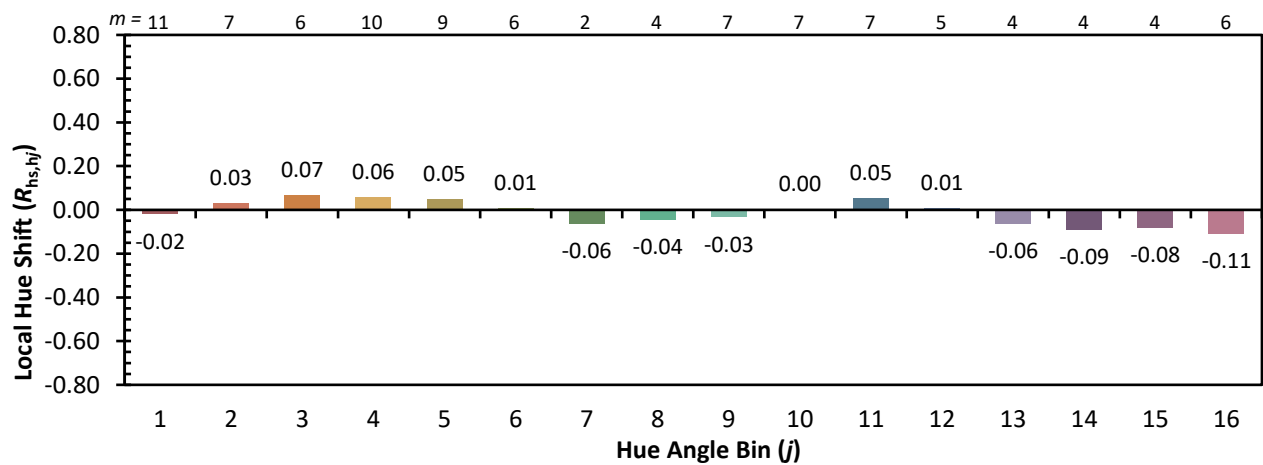
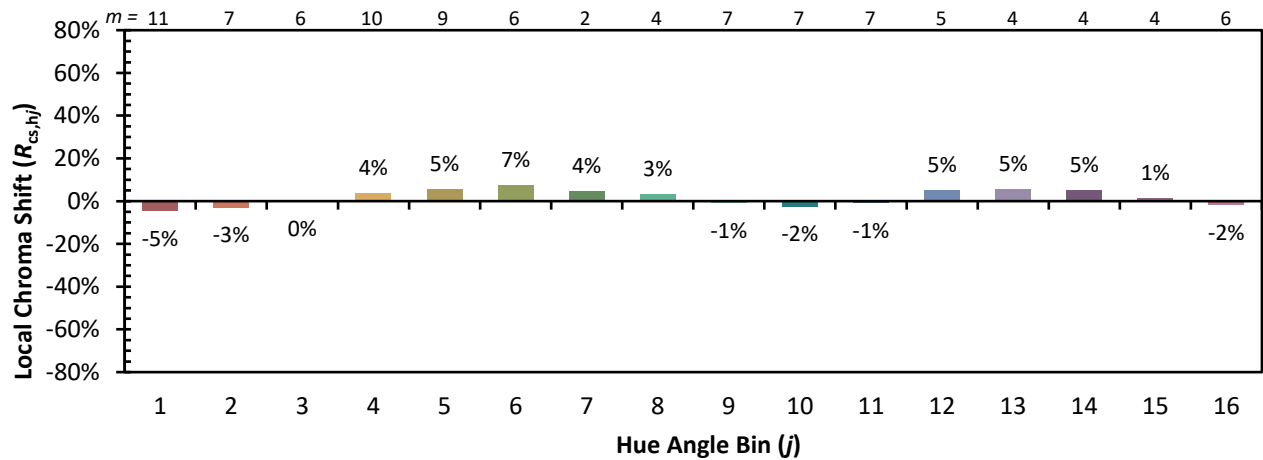


**Individual Sample Fidelity Index ( $R_{f,i}$ )**

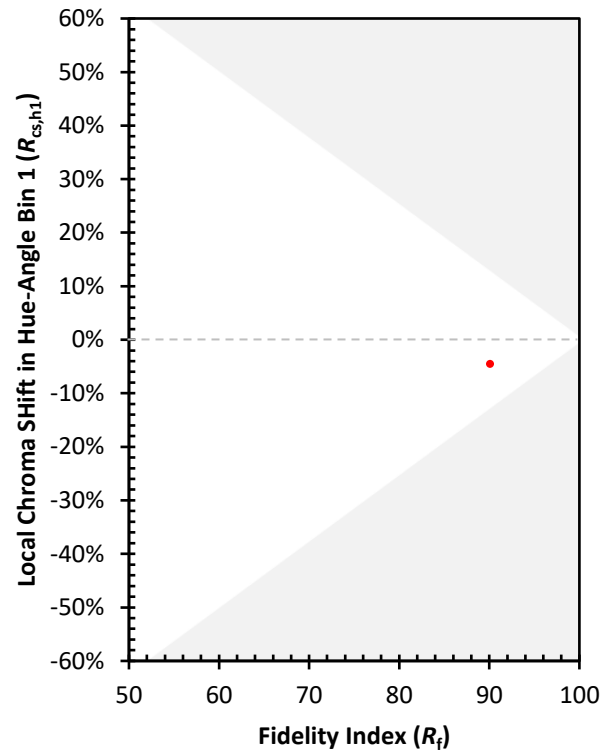
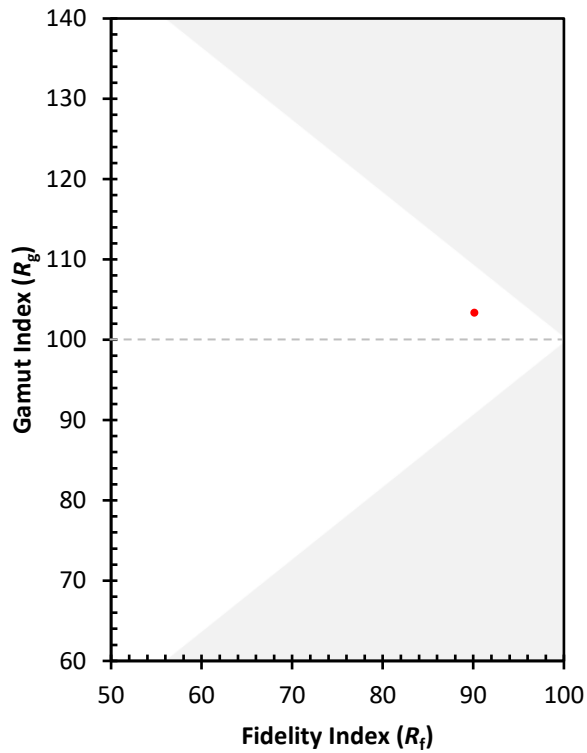
|            |            |            |            |
|------------|------------|------------|------------|
| CES01 = 86 | CES26 = 88 | CES51 = 93 | CES76 = 86 |
| CES02 = 63 | CES27 = 97 | CES52 = 93 | CES77 = 87 |
| CES03 = 32 | CES28 = 95 | CES53 = 89 | CES78 = 83 |
| CES04 = 70 | CES29 = 83 | CES54 = 98 | CES79 = 91 |
| CES05 = 51 | CES30 = 87 | CES55 = 97 | CES80 = 92 |
| CES06 = 51 | CES31 = 85 | CES56 = 90 | CES81 = 75 |
| CES07 = 44 | CES32 = 80 | CES57 = 89 | CES82 = 96 |
| CES08 = 42 | CES33 = 85 | CES58 = 89 | CES83 = 92 |
| CES09 = 29 | CES34 = 89 | CES59 = 98 | CES84 = 96 |
| CES10 = 76 | CES35 = 94 | CES60 = 99 | CES85 = 83 |
| CES11 = 59 | CES36 = 96 | CES61 = 98 | CES86 = 78 |
| CES12 = 65 | CES37 = 92 | CES62 = 95 | CES87 = 91 |
| CES13 = 44 | CES38 = 92 | CES63 = 90 | CES88 = 94 |
| CES14 = 74 | CES39 = 95 | CES64 = 94 | CES89 = 82 |
| CES15 = 72 | CES40 = 91 | CES65 = 91 | CES90 = 94 |
| CES16 = 48 | CES41 = 91 | CES66 = 93 | CES91 = 87 |
| CES17 = 50 | CES42 = 88 | CES67 = 93 | CES92 = 80 |
| CES18 = 57 | CES43 = 85 | CES68 = 94 | CES93 = 89 |
| CES19 = 72 | CES44 = 99 | CES69 = 96 | CES94 = 74 |
| CES20 = 67 | CES45 = 90 | CES70 = 90 | CES95 = 87 |
| CES21 = 86 | CES46 = 89 | CES71 = 91 | CES96 = 92 |
| CES22 = 79 | CES47 = 82 | CES72 = 96 | CES97 = 90 |
| CES23 = 92 | CES48 = 89 | CES73 = 85 | CES98 = 91 |
| CES24 = 91 | CES49 = 87 | CES74 = 91 | CES99 = 93 |
| CES25 = 72 | CES50 = 93 | CES75 = 90 |            |



Color Rendition by Hue-Angle Bin



**Measure Comparisons**



(END OF REPORT)