

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: P1356769

Luminaire Tested: 1ASL4-5-1-A59-UNV

Issue Date: 2/17/2026

**Test Information**

Test Method: LM-79-2019  
Report Number: P1356769  
TEST IS SCALED FROM IESNA LM-79-08 TEST DATA (G2-2511-597-6)  
Test Lab: INNOVATION CENTER  
Issue Date: 2/17/2026  
Manufacturer: COOPER LIGHTING SOLUTIONS  
Product Line: FAIL-SAFE  
Catalog Number: 1ASL4-5-1-A59-UNV  
Description: 1FT 500 LUMEN PER FOOT 4ASL LED LUMINAIRE WITH OPL LENS AND A59 LEDS 1 ROW  
Light Source: -  
Ballast/Driver: -

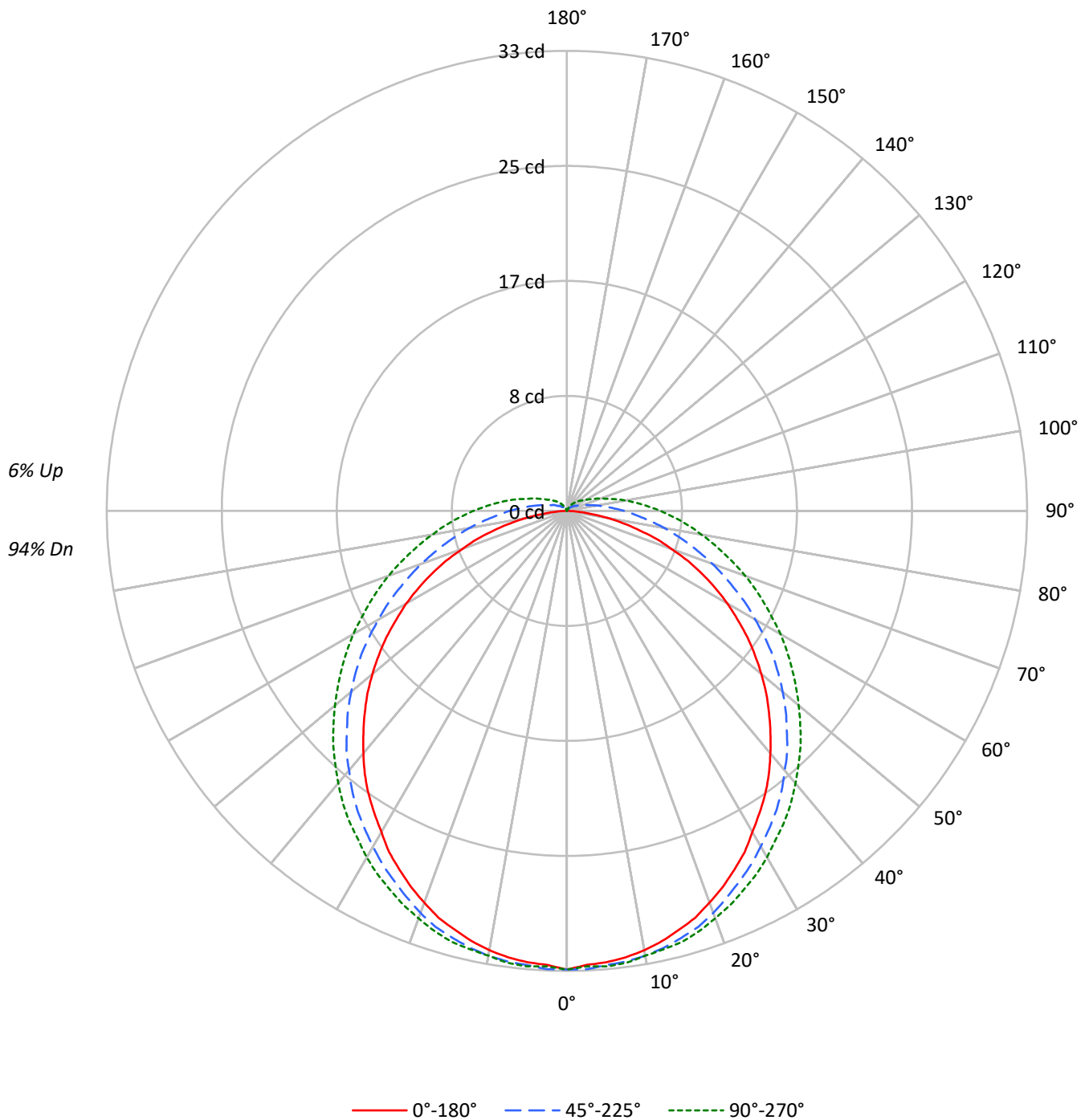
**Summary**

Lumens per Lamp: N/A  
Luminaire Lumens: 110.0 lumens  
Efficiency: N/A  
Efficacy: 35.5 lumens/watt  
Spacing Criteria (0/90/45): 1.21 / 1.29 / 1.39  
Luminous Opening: Rectangular w/ Sides (W: 0.33' x L: 0.98' x H: 0.1')  
CIE Type: Direct

Input Watts (W): 3.1  
Input Voltage (V): NR  
Input Current (Ain): NR  
Voltage Rise (V): NR  
Power Factor: NR  
Total Harmonic Distortion (THDi): NR  
Frequency (hertz): 60  
Stabilization Time: NR  
Operation Time: NR  
Ambient Temperature (°C): NR  
Test Distance: 24 FT

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CATALOG NUMBER: 1ASL4-5-1-A59-UNV

### Luminous Intensity Polar Plot



TEST NUMBER: P1356769

CATALOG NUMBER: 1ASL4-5-1-A59-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   | 118 | 118 | 118 | 118 | 114 | 114 | 114 | 114 | 108 | 108 | 108 |  | 102 | 102 | 102 |  | 96 | 96 | 96 | 94 |
| 1   | 106 | 100 | 95  | 91  | 102 | 97  | 93  | 89  | 92  | 88  | 85  |  | 87  | 84  | 81  |  | 82 | 80 | 78 | 75 |
| 2   | 95  | 87  | 79  | 73  | 92  | 84  | 77  | 71  | 79  | 74  | 69  |  | 75  | 70  | 66  |  | 71 | 67 | 64 | 61 |
| 3   | 87  | 76  | 67  | 60  | 84  | 73  | 65  | 59  | 70  | 63  | 57  |  | 66  | 60  | 55  |  | 62 | 58 | 54 | 51 |
| 4   | 79  | 67  | 57  | 50  | 76  | 65  | 56  | 50  | 62  | 54  | 48  |  | 58  | 52  | 47  |  | 56 | 50 | 46 | 43 |
| 5   | 73  | 59  | 50  | 43  | 70  | 58  | 49  | 43  | 55  | 47  | 42  |  | 52  | 46  | 41  |  | 50 | 44 | 40 | 37 |
| 6   | 67  | 53  | 44  | 38  | 65  | 52  | 43  | 37  | 50  | 42  | 36  |  | 47  | 41  | 35  |  | 45 | 39 | 35 | 32 |
| 7   | 62  | 48  | 39  | 33  | 60  | 47  | 39  | 33  | 45  | 37  | 32  |  | 43  | 36  | 31  |  | 41 | 35 | 31 | 29 |
| 8   | 58  | 44  | 35  | 29  | 56  | 43  | 35  | 29  | 41  | 34  | 29  |  | 39  | 33  | 28  |  | 38 | 32 | 27 | 25 |
| 9   | 54  | 40  | 32  | 26  | 52  | 39  | 32  | 26  | 38  | 31  | 26  |  | 36  | 30  | 25  |  | 35 | 29 | 25 | 23 |
| 10  | 51  | 37  | 29  | 24  | 49  | 36  | 29  | 24  | 35  | 28  | 23  |  | 34  | 27  | 23  |  | 32 | 27 | 22 | 21 |

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

|     | 0°   | 45°  | 90°  |
|-----|------|------|------|
| 0°  | 1085 | 1085 | 1085 |
| 5°  | 1066 | 1055 | 1057 |
| 10° | 1052 | 1031 | 1028 |
| 15° | 1032 | 1003 | 1008 |
| 20° | 1010 | 973  | 980  |
| 25° | 985  | 937  | 953  |
| 30° | 954  | 904  | 926  |
| 35° | 929  | 874  | 898  |
| 40° | 897  | 838  | 870  |
| 45° | 864  | 802  | 842  |
| 50° | 829  | 766  | 811  |
| 55° | 789  | 727  | 783  |
| 60° | 741  | 680  | 757  |
| 65° | 680  | 635  | 729  |
| 70° | 597  | 590  | 706  |
| 75° | 493  | 545  | 682  |
| 80° | 355  | 503  | 671  |
| 85° | 171  | 466  | 679  |

**MAXIMUM LUMINANCE 45°-90°:**

Horizontal Angle: 0°

Vertical Angle: 45°

Luminance: 864 cd/sqm

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CATALOG NUMBER: 1ASL4-5-1-A59-UNV

**ZONAL LUMENS:**

| Zone      | Lumens | % Fixture |
|-----------|--------|-----------|
| 0°-10°    | 3.1    | 2.8       |
| 10°-20°   | 8.9    | 8.1       |
| 20°-30°   | 13.5   | 12.3      |
| 30°-40°   | 16.3   | 14.8      |
| 40°-50°   | 17.2   | 15.6      |
| 50°-60°   | 16.0   | 14.5      |
| 60°-70°   | 13.1   | 11.9      |
| 70°-80°   | 9.3    | 8.5       |
| 80°-90°   | 5.6    | 5.1       |
| 90°-100°  | 3.2    | 2.9       |
| 100°-110° | 1.7    | 1.6       |
| 110°-120° | 1.0    | 0.9       |
| 120°-130° | 0.6    | 0.5       |
| 130°-140° | 0.3    | 0.3       |
| 140°-150° | 0.1    | 0.1       |
| 150°-160° | 0.0    | 0.0       |
| 160°-170° | 0.0    | 0.0       |
| 170°-180° | 0.0    | 0.0       |
| 0°-30°    | 25.5   | 23.2      |
| 0°-40°    | 41.9   | 38.1      |
| 0°-60°    | 75.0   | 68.2      |
| 0°-90°    | 103.1  | 93.8      |
| 90°-120°  | 5.9    | 5.3       |
| 90°-150°  | 6.9    | 6.2       |
| 90°-180°  | 7.0    | 6.4       |
| 0°-180°   | 110.0  | 100.0     |

**CANDELA DISTRIBUTION:**

|      | 0° | 22.5° | 45° | 67.5° | 90° | Flux |
|------|----|-------|-----|-------|-----|------|
| 0°   | 33 | 33    | 33  | 33    | 33  |      |
| 5°   | 32 | 33    | 33  | 33    | 33  | 3    |
| 15°  | 31 | 32    | 32  | 32    | 32  | 9    |
| 25°  | 28 | 29    | 29  | 30    | 30  | 13   |
| 35°  | 25 | 25    | 26  | 27    | 27  | 15   |
| 45°  | 20 | 21    | 22  | 23    | 24  | 16   |
| 55°  | 16 | 17    | 18  | 19    | 20  | 14   |
| 65°  | 11 | 12    | 13  | 15    | 16  | 11   |
| 75°  | 5  | 7     | 9   | 11    | 12  | 6    |
| 85°  | 1  | 3     | 5   | 7     | 8   | 1    |
| 90°  | 0  | 2     | 4   | 6     | 7   | 0    |
| 95°  | 0  | 1     | 3   | 5     | 5   | 0    |
| 105° | 0  | 0     | 2   | 3     | 3   | 0    |
| 115° | 0  | 0     | 1   | 2     | 2   | 0    |
| 125° | 0  | 0     | 1   | 1     | 1   | 0    |
| 135° | 0  | 0     | 0   | 1     | 1   | 0    |
| 145° | 0  | 0     | 0   | 0     | 0   | 0    |
| 155° | 0  | 0     | 0   | 0     | 0   | 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°     | 32.9 | 32.9  | 32.9 | 32.9  | 32.9 |
| 2.5°   | 32.6 | 32.9  | 32.9 | 32.7  | 32.7 |
| 5°     | 32.5 | 32.8  | 32.7 | 32.7  | 32.8 |
| 7.5°   | 32.3 | 32.6  | 32.6 | 32.6  | 32.7 |
| 10°    | 32.0 | 32.4  | 32.4 | 32.4  | 32.4 |
| 12.5°  | 31.6 | 32.0  | 32.1 | 32.1  | 32.2 |
| 15°    | 31.1 | 31.6  | 31.7 | 31.9  | 32.0 |
| 17.5°  | 30.6 | 31.0  | 31.3 | 31.4  | 31.6 |
| 20°    | 29.9 | 30.4  | 30.7 | 30.9  | 31.1 |
| 22.5°  | 29.2 | 29.7  | 30.0 | 30.3  | 30.6 |
| 25°    | 28.4 | 28.9  | 29.3 | 29.7  | 30.0 |
| 27.5°  | 27.6 | 28.1  | 28.6 | 29.1  | 29.4 |
| 30°    | 26.6 | 27.2  | 27.8 | 28.4  | 28.7 |
| 32.5°  | 25.7 | 26.3  | 27.0 | 27.6  | 27.9 |
| 35°    | 24.8 | 25.4  | 26.2 | 26.8  | 27.2 |
| 37.5°  | 23.8 | 24.4  | 25.3 | 26.0  | 26.4 |
| 40°    | 22.7 | 23.4  | 24.3 | 25.1  | 25.5 |
| 42.5°  | 21.6 | 22.3  | 23.4 | 24.2  | 24.6 |
| 45°    | 20.5 | 21.3  | 22.3 | 23.3  | 23.7 |
| 47.5°  | 19.4 | 20.1  | 21.3 | 22.3  | 22.7 |
| 50°    | 18.2 | 19.0  | 20.2 | 21.3  | 21.7 |
| 52.5°  | 17.0 | 17.8  | 19.1 | 20.2  | 20.7 |
| 55°    | 15.8 | 16.7  | 18.0 | 19.1  | 19.7 |
| 57.5°  | 14.5 | 15.4  | 16.8 | 18.1  | 18.7 |
| 60°    | 13.3 | 14.2  | 15.6 | 17.0  | 17.7 |
| 62.5°  | 12.0 | 12.9  | 14.5 | 15.9  | 16.6 |
| 65°    | 10.7 | 11.7  | 13.3 | 14.9  | 15.6 |
| 67.5°  | 9.4  | 10.4  | 12.2 | 13.8  | 14.6 |
| 70°    | 8.0  | 9.2   | 11.1 | 12.8  | 13.6 |
| 72.5°  | 6.8  | 8.0   | 10.0 | 11.8  | 12.6 |
| 75°    | 5.4  | 6.8   | 9.0  | 10.9  | 11.6 |
| 77.5°  | 4.2  | 5.7   | 8.0  | 9.9   | 10.7 |
| 80°    | 3.0  | 4.6   | 7.1  | 9.0   | 9.8  |
| 82.5°  | 1.9  | 3.7   | 6.2  | 8.2   | 9.0  |
| 85°    | 1.0  | 2.9   | 5.4  | 7.4   | 8.2  |
| 87.5°  | 0.3  | 2.2   | 4.7  | 6.7   | 7.4  |
| 90°    | 0.0  | 1.7   | 4.1  | 5.9   | 6.7  |
| 92.5°  | 0.0  | 1.3   | 3.5  | 5.3   | 6.0  |
| 95°    | 0.0  | 1.0   | 3.0  | 4.7   | 5.4  |
| 97.5°  | 0.0  | 0.8   | 2.6  | 4.1   | 4.8  |
| 100°   | 0.0  | 0.6   | 2.2  | 3.6   | 4.3  |
| 102.5° | 0.0  | 0.5   | 1.9  | 3.2   | 3.8  |
| 105°   | 0.0  | 0.4   | 1.6  | 2.8   | 3.3  |
| 107.5° | 0.0  | 0.3   | 1.4  | 2.5   | 2.9  |
| 110°   | 0.0  | 0.2   | 1.2  | 2.2   | 2.6  |



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CATALOG NUMBER: 1ASL4-5-1-A59-UNV

**CANDELA DISTRIBUTION (continued):**

|        | 0°  | 22.5° | 45° | 67.5° | 90° |
|--------|-----|-------|-----|-------|-----|
| 112.5° | 0.0 | 0.2   | 1.1 | 1.9   | 2.3 |
| 115°   | 0.0 | 0.2   | 1.0 | 1.7   | 2.0 |
| 117.5° | 0.0 | 0.1   | 0.8 | 1.5   | 1.8 |
| 120°   | 0.0 | 0.1   | 0.7 | 1.4   | 1.6 |
| 122.5° | 0.0 | 0.1   | 0.7 | 1.2   | 1.5 |
| 125°   | 0.0 | 0.1   | 0.6 | 1.1   | 1.3 |
| 127.5° | 0.0 | 0.1   | 0.5 | 1.0   | 1.2 |
| 130°   | 0.0 | 0.1   | 0.5 | 0.9   | 1.1 |
| 132.5° | 0.0 | 0.0   | 0.4 | 0.8   | 1.0 |
| 135°   | 0.0 | 0.0   | 0.4 | 0.7   | 0.9 |
| 137.5° | 0.0 | 0.0   | 0.3 | 0.6   | 0.8 |
| 140°   | 0.0 | 0.0   | 0.3 | 0.6   | 0.7 |
| 142.5° | 0.0 | 0.0   | 0.2 | 0.5   | 0.6 |
| 145°   | 0.0 | 0.0   | 0.1 | 0.4   | 0.5 |
| 147.5° | 0.0 | 0.0   | 0.1 | 0.3   | 0.4 |
| 150°   | 0.0 | 0.0   | 0.1 | 0.2   | 0.3 |
| 152.5° | 0.0 | 0.0   | 0.0 | 0.1   | 0.2 |
| 155°   | 0.0 | 0.0   | 0.0 | 0.1   | 0.1 |
| 157.5° | 0.0 | 0.0   | 0.0 | 0.0   | 0.1 |
| 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 |

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**CIE UGR TABLE:**

| Reflectances:   |      |                  |       |       |       |       |                |       |       |       |       |
|-----------------|------|------------------|-------|-------|-------|-------|----------------|-------|-------|-------|-------|
| Ceiling         |      | 0.7              | 0.7   | 0.5   | 0.5   | 0.3   | 0.7            | 0.7   | 0.5   | 0.5   | 0.3   |
| Wall            |      | 0.5              | 0.3   | 0.5   | 0.3   | 0.3   | 0.5            | 0.3   | 0.5   | 0.3   | 0.3   |
| Reference plane |      | 0.2              | 0.2   | 0.2   | 0.2   | 0.2   | 0.2            | 0.2   | 0.2   | 0.2   | 0.2   |
| Room dimensions |      | Viewed crosswise |       |       |       |       | Viewed endwise |       |       |       |       |
| X=2H            | Y=2H | 9.58             | 11.13 | 10.04 | 11.58 | 12.04 | 11.34          | 12.89 | 11.80 | 13.33 | 13.80 |
|                 | 3H   | 11.09            | 12.50 | 11.56 | 12.95 | 13.46 | 13.65          | 15.06 | 14.12 | 15.51 | 16.02 |
|                 | 4H   | 11.57            | 12.91 | 12.06 | 13.38 | 13.90 | 14.73          | 16.07 | 15.22 | 16.54 | 17.07 |
|                 | 6H   | 11.85            | 13.10 | 12.36 | 13.58 | 14.12 | 15.81          | 17.06 | 16.32 | 17.55 | 18.08 |
|                 | 8H   | 11.90            | 13.10 | 12.42 | 13.60 | 14.15 | 16.34          | 17.54 | 16.86 | 18.05 | 18.59 |
|                 | 12H  | 11.91            | 13.06 | 12.44 | 13.56 | 14.14 | 16.89          | 18.04 | 17.42 | 18.54 | 19.12 |
| 4H              | 2H   | 10.40            | 11.74 | 10.89 | 12.21 | 12.73 | 11.78          | 13.12 | 12.27 | 13.59 | 14.11 |
|                 | 3H   | 12.14            | 13.28 | 12.65 | 13.80 | 14.34 | 14.32          | 15.46 | 14.82 | 15.97 | 16.52 |
|                 | 4H   | 12.75            | 13.79 | 13.27 | 14.32 | 14.89 | 15.57          | 16.62 | 16.10 | 17.14 | 17.72 |
|                 | 6H   | 13.14            | 14.07 | 13.69 | 14.62 | 15.21 | 16.84          | 17.76 | 17.39 | 18.31 | 18.91 |
|                 | 8H   | 13.24            | 14.10 | 13.79 | 14.65 | 15.26 | 17.48          | 18.34 | 18.03 | 18.89 | 19.50 |
|                 | 12H  | 13.28            | 14.07 | 13.85 | 14.65 | 15.26 | 18.14          | 18.93 | 18.71 | 19.51 | 20.12 |
| 8H              | 4H   | 13.35            | 14.21 | 13.90 | 14.76 | 15.37 | 15.79          | 16.66 | 16.35 | 17.21 | 17.82 |
|                 | 6H   | 13.91            | 14.64 | 14.49 | 15.24 | 15.85 | 17.23          | 17.97 | 17.81 | 18.56 | 19.17 |
|                 | 8H   | 14.08            | 14.75 | 14.68 | 15.35 | 15.97 | 18.00          | 18.66 | 18.60 | 19.27 | 19.89 |
|                 | 12H  | 14.19            | 14.78 | 14.79 | 15.38 | 16.07 | 18.85          | 19.44 | 19.44 | 20.03 | 20.72 |
| 12H             | 4H   | 13.50            | 14.29 | 14.07 | 14.87 | 15.48 | 15.80          | 16.59 | 16.38 | 17.17 | 17.78 |
|                 | 6H   | 14.15            | 14.81 | 14.75 | 15.42 | 16.04 | 17.27          | 17.93 | 17.86 | 18.54 | 19.16 |
|                 | 8H   | 14.42            | 15.01 | 15.01 | 15.60 | 16.29 | 18.11          | 18.70 | 18.71 | 19.29 | 19.98 |

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

Report Prepared for

Cooper Lighting Solutions

Fail-Safe

Report Number: SP1-2511-597-9

Test Date: 01/22/2026

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

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

### Test Information

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

### Spectral Parameters

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



### Test Conditions

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

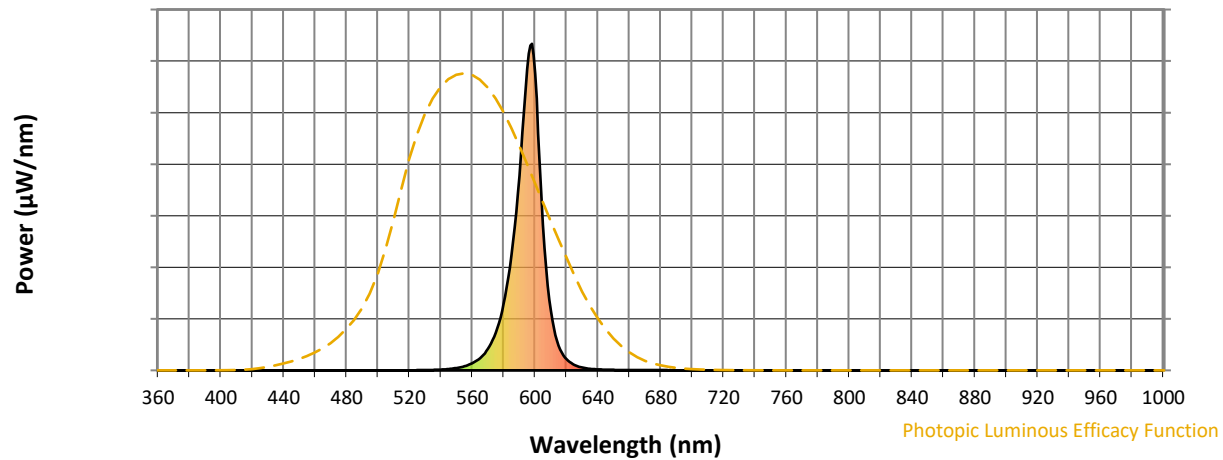
REPORT NUMBER: SP1-2511-597-9

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



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### Photopic Flux vs. Wavelength

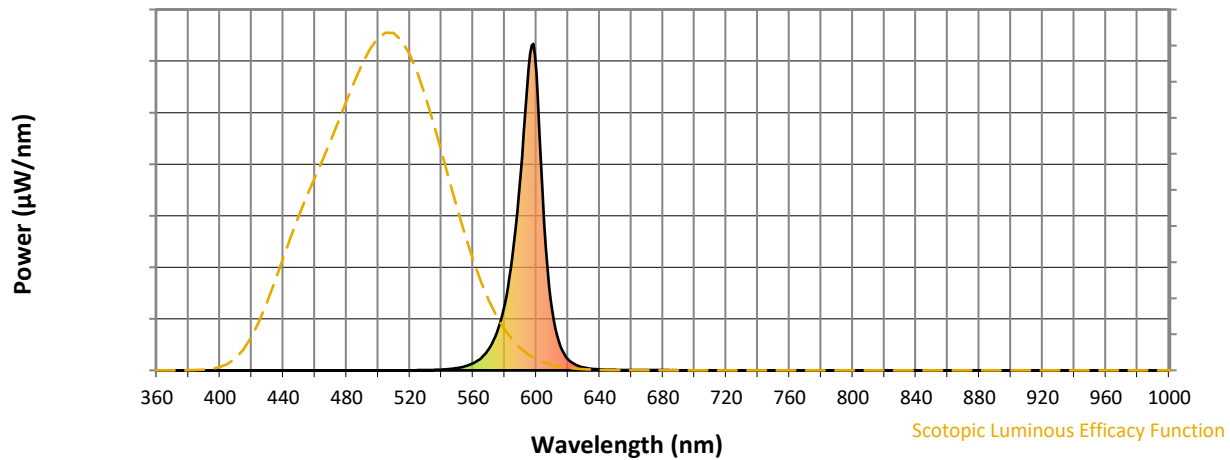


### Photopic Lumens: NR

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

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### Scotopic Flux vs. Wavelength



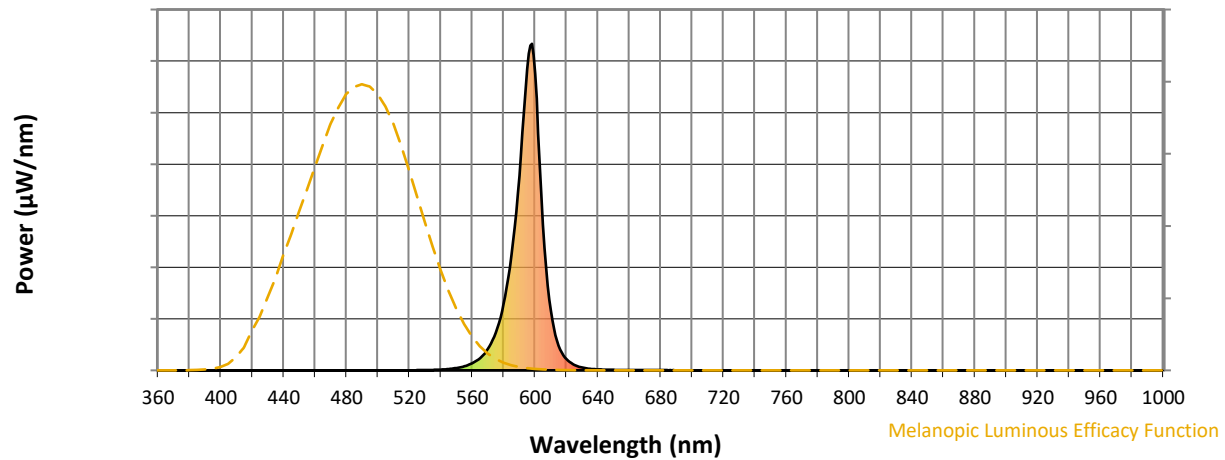
Scotopic Lumens: NR

S/P: 0.22

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

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### Melanopic Flux vs. Wavelength



Melanopic Lumens: NR

M/P: 0.12

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

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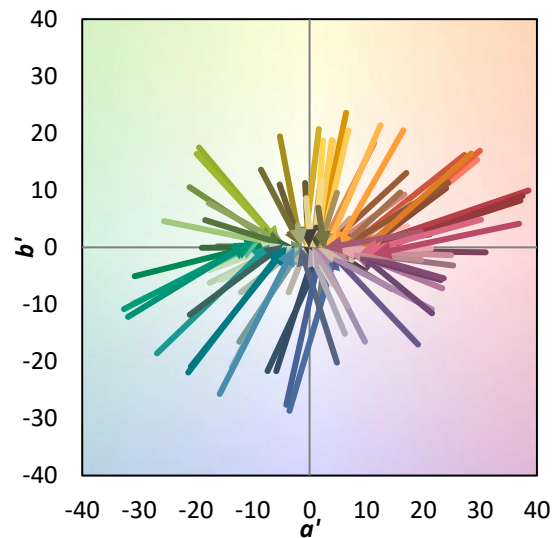
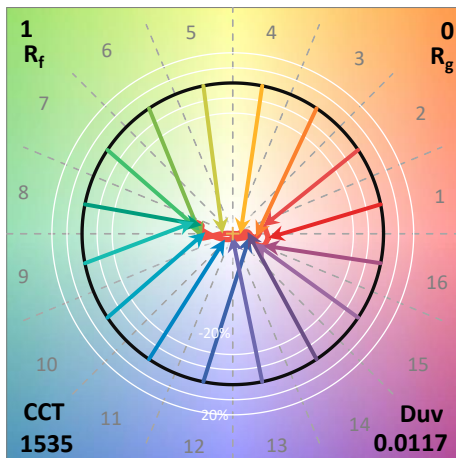
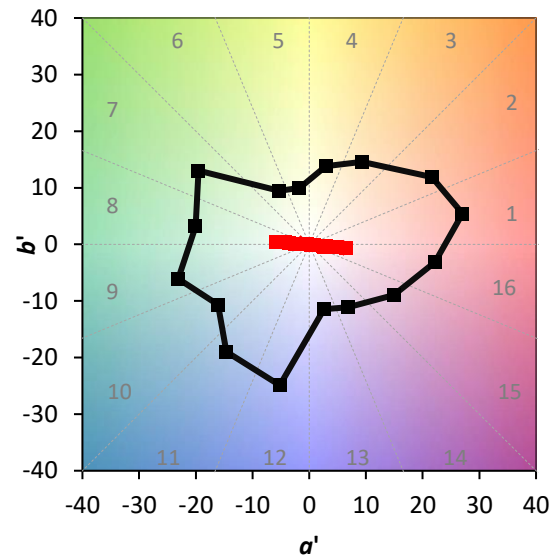
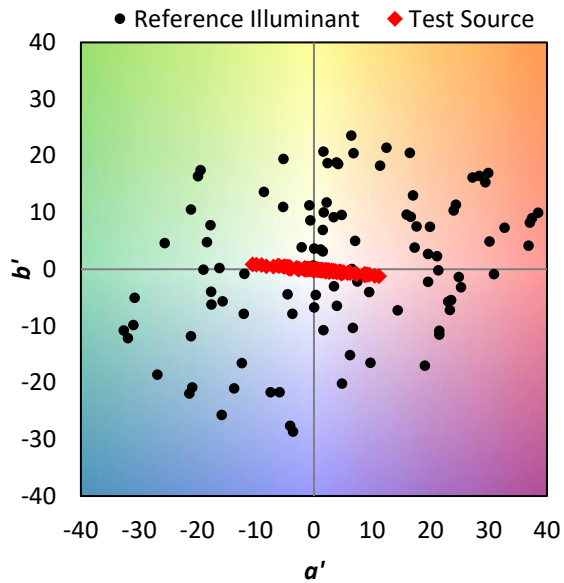
TM-30-18

### Summary

$R_f = 1.3$   
 $R_g = 0.1$   
 $CIE R_a = -20.0$   
 $R_g = -380.5$

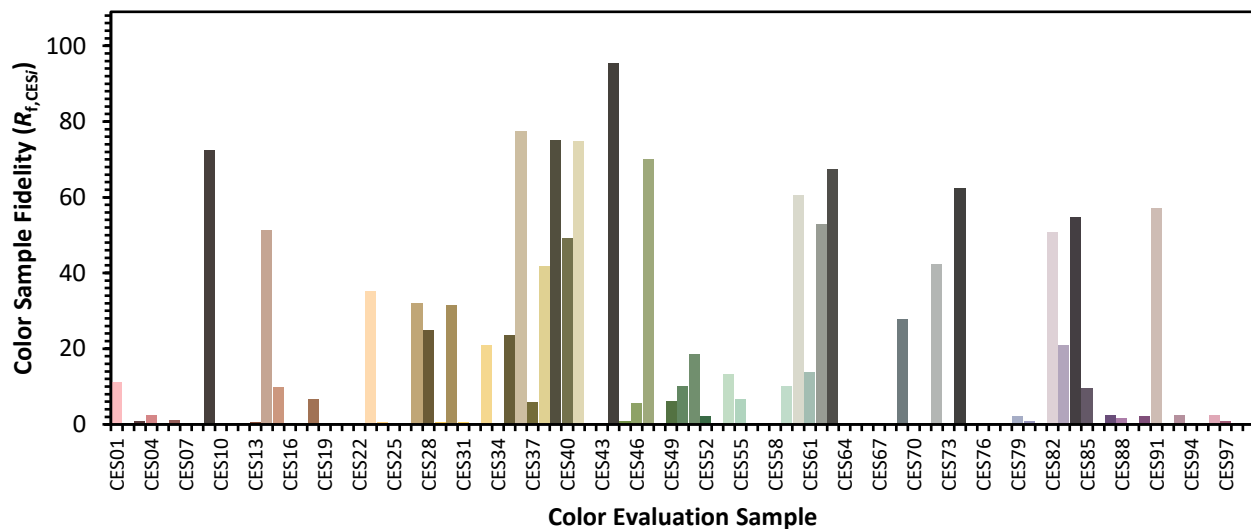


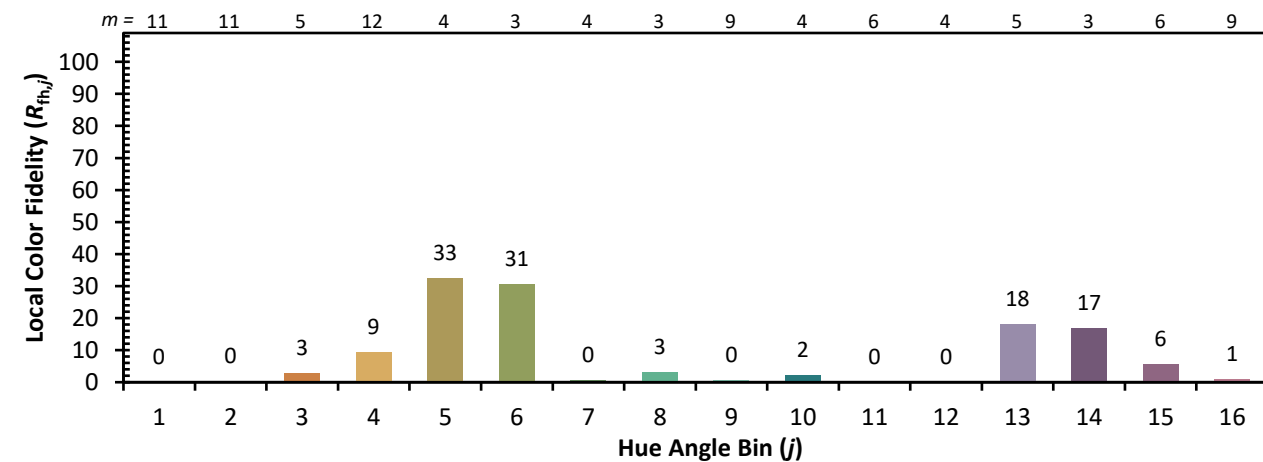
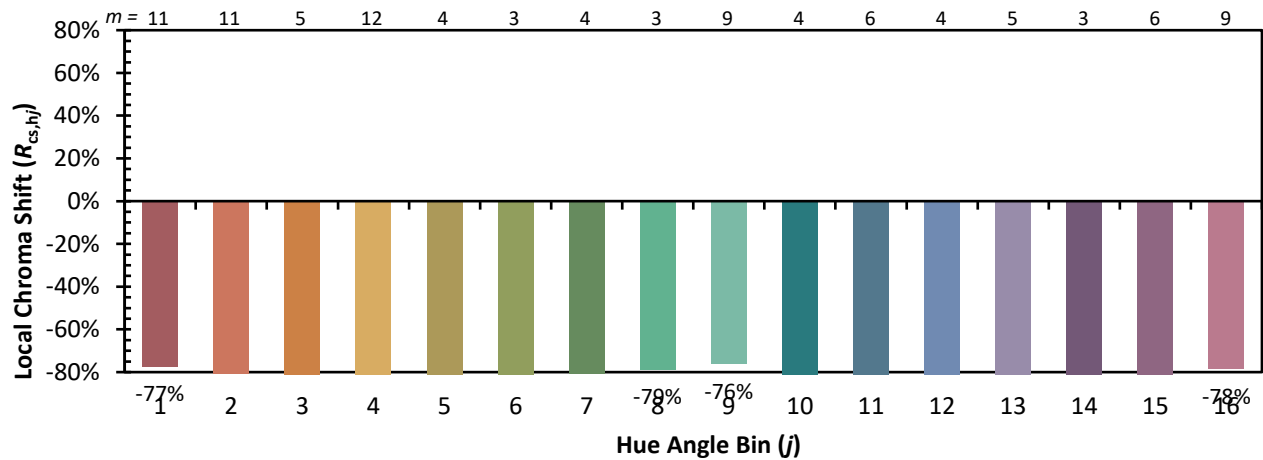
### Color Vector Graphics



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

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



**Color Rendition by Hue-Angle Bin**


**Measure Comparisons**



(END OF REPORT)