

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: P1356877

Luminaire Tested: 2ASL4-20HE-2-A59-UNV

Issue Date: 2/17/2026

**Test Information**

Test Method: LM-79-2019  
Report Number: P1356877  
TEST IS SCALED FROM IESNA LM-79-08 TEST DATA (G2-2511-597-7)  
Test Lab: INNOVATION CENTER  
Issue Date: 2/17/2026  
Manufacturer: COOPER LIGHTING SOLUTIONS  
Product Line: FAIL-SAFE  
Catalog Number: 2ASL4-20HE-2-A59-UNV  
Description: 2FT 2000 LUMEN PER FOOT 4ASL LED LUMINAIRE WITH OPL LENS AND A59 LEDS 2 ROW  
Light Source: -  
Ballast/Driver: -

**Summary**

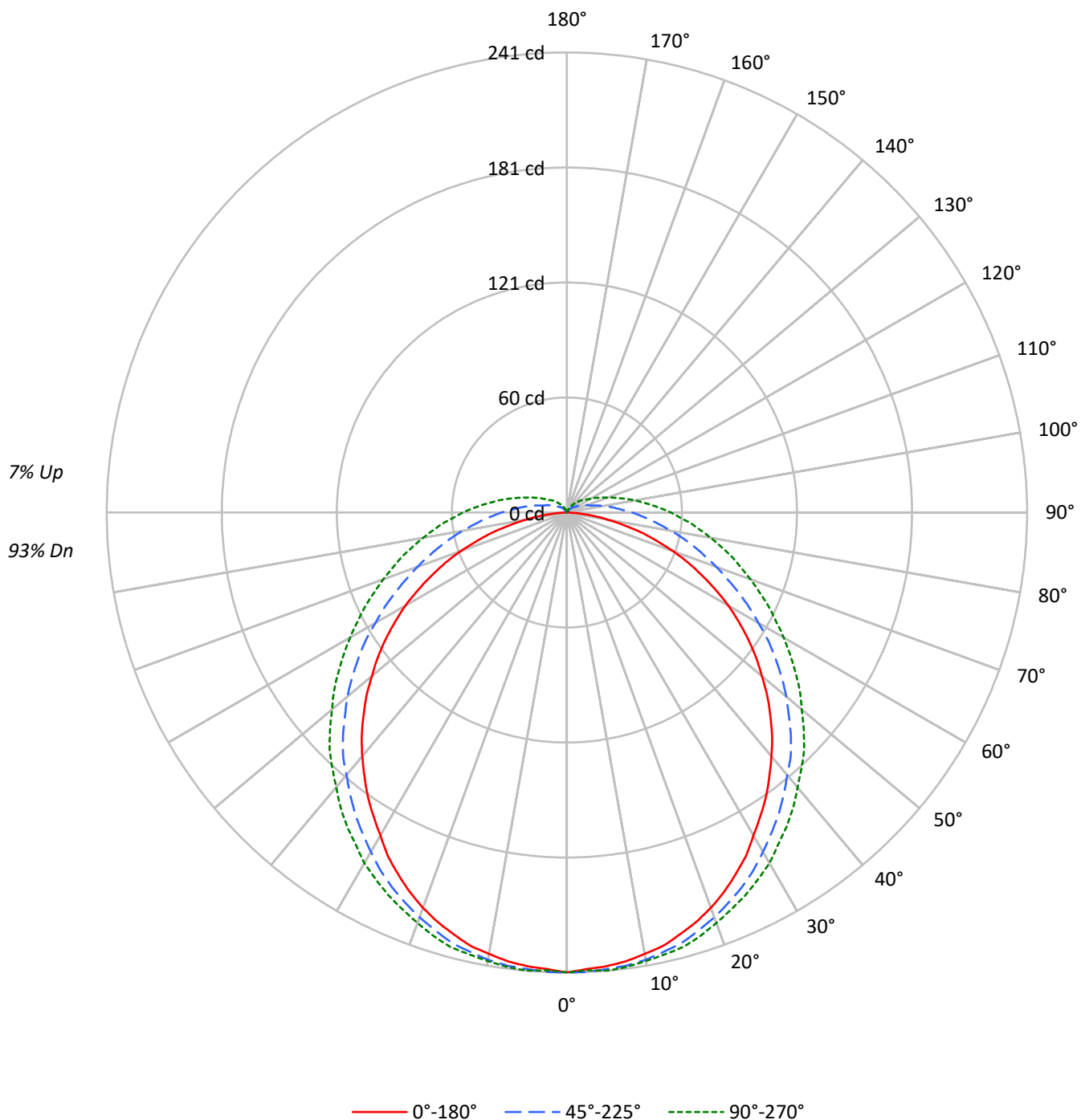
Lumens per Lamp: N/A  
Luminaire Lumens: 827.0 lumens  
Efficiency: N/A  
Efficacy: 33.3 lumens/watt  
Spacing Criteria (0/90/45): 1.21 / 1.3 / 1.4  
Luminous Opening: Rectangular w/ Sides (W: 0.33' x L: 1.98' x H: 0.1')  
CIE Type: Direct

Input Watts (W): 24.8  
Input Voltage (V): NR  
Input Current (Ain): NR  
Voltage Rise (V): NR  
Power Factor: NR  
Total Harmonic Distortion (THDi): NR  
Frequency (hertz): 60  
Stabilization Time: NR  
Operation Time: NR  
Ambient Temperature (°C): NR  
Test Distance: 24 FT

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CATALOG NUMBER: 2ASL4-20HE-2-A59-UNV

### Luminous Intensity Polar Plot



TEST NUMBER: P1356877

CATALOG NUMBER: 2ASL4-20HE-2-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 | 50 | 30 | 10 |
| RCR |     |     |     |     |     |     |     |     |     |     |     |     |     |     |    |    |    |    |    |    |
| 0   | 117 | 117 | 117 | 117 | 114 | 114 | 114 | 114 | 107 | 107 | 107 | 101 | 101 | 101 | 95 | 95 | 95 | 95 | 95 | 93 |
| 1   | 105 | 100 | 95  | 90  | 102 | 97  | 92  | 88  | 91  | 87  | 84  | 86  | 83  | 80  | 81 | 79 | 77 | 74 | 74 | 74 |
| 2   | 95  | 86  | 79  | 72  | 92  | 84  | 77  | 71  | 79  | 73  | 68  | 74  | 70  | 65  | 70 | 66 | 63 | 60 | 60 | 60 |
| 3   | 86  | 75  | 66  | 59  | 83  | 73  | 65  | 58  | 69  | 62  | 56  | 65  | 59  | 55  | 62 | 57 | 53 | 50 | 50 | 50 |
| 4   | 79  | 66  | 57  | 50  | 76  | 64  | 56  | 49  | 61  | 54  | 48  | 58  | 51  | 46  | 55 | 49 | 45 | 42 | 42 | 42 |
| 5   | 72  | 59  | 50  | 43  | 70  | 57  | 49  | 42  | 54  | 47  | 41  | 52  | 45  | 40  | 49 | 43 | 39 | 36 | 36 | 36 |
| 6   | 67  | 53  | 44  | 37  | 64  | 52  | 43  | 37  | 49  | 41  | 36  | 47  | 40  | 35  | 44 | 39 | 34 | 32 | 32 | 32 |
| 7   | 62  | 48  | 39  | 33  | 60  | 47  | 38  | 32  | 45  | 37  | 32  | 43  | 36  | 31  | 41 | 35 | 30 | 28 | 28 | 28 |
| 8   | 58  | 44  | 35  | 29  | 56  | 43  | 34  | 29  | 41  | 33  | 28  | 39  | 32  | 28  | 37 | 31 | 27 | 25 | 25 | 25 |
| 9   | 54  | 40  | 32  | 26  | 52  | 39  | 31  | 26  | 37  | 30  | 25  | 36  | 29  | 25  | 34 | 29 | 24 | 22 | 22 | 22 |
| 10  | 50  | 37  | 29  | 24  | 49  | 36  | 28  | 23  | 35  | 28  | 23  | 33  | 27  | 22  | 32 | 26 | 22 | 20 | 20 | 20 |

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

|     | 0°   | 45°  | 90°  |
|-----|------|------|------|
| 0°  | 3931 | 3931 | 3931 |
| 5°  | 3890 | 3846 | 3841 |
| 10° | 3854 | 3770 | 3747 |
| 15° | 3811 | 3686 | 3672 |
| 20° | 3755 | 3582 | 3567 |
| 25° | 3674 | 3482 | 3476 |
| 30° | 3573 | 3366 | 3385 |
| 35° | 3492 | 3259 | 3280 |
| 40° | 3400 | 3142 | 3171 |
| 45° | 3303 | 3042 | 3089 |
| 50° | 3184 | 2912 | 2970 |
| 55° | 3066 | 2770 | 2875 |
| 60° | 2922 | 2613 | 2776 |
| 65° | 2706 | 2465 | 2698 |
| 70° | 2463 | 2325 | 2626 |
| 75° | 2113 | 2212 | 2602 |
| 80° | 1592 | 2109 | 2593 |
| 85° | 888  | 2080 | 2666 |

**MAXIMUM LUMINANCE 45°-90°:**

Horizontal Angle: 0°

Vertical Angle: 45°

Luminance: 3303 cd/sqm

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**ZONAL LUMENS:**

| Zone      | Lumens | % Fixture |
|-----------|--------|-----------|
| 0°-10°    | 22.8   | 2.8       |
| 10°-20°   | 65.7   | 7.9       |
| 20°-30°   | 99.5   | 12.0      |
| 30°-40°   | 120.4  | 14.6      |
| 40°-50°   | 126.9  | 15.3      |
| 50°-60°   | 118.4  | 14.3      |
| 60°-70°   | 97.8   | 11.8      |
| 70°-80°   | 70.9   | 8.6       |
| 80°-90°   | 44.8   | 5.4       |
| 90°-100°  | 26.7   | 3.2       |
| 100°-110° | 15.3   | 1.9       |
| 110°-120° | 8.7    | 1.1       |
| 120°-130° | 5.0    | 0.6       |
| 130°-140° | 2.7    | 0.3       |
| 140°-150° | 1.2    | 0.1       |
| 150°-160° | 0.2    | 0.0       |
| 160°-170° | 0.0    | 0.0       |
| 170°-180° | 0.0    | 0.0       |
| 0°-30°    | 188.0  | 22.7      |
| 0°-40°    | 308.4  | 37.3      |
| 0°-60°    | 553.7  | 66.9      |
| 0°-90°    | 767.2  | 92.8      |
| 90°-120°  | 50.8   | 6.1       |
| 90°-150°  | 59.6   | 7.2       |
| 90°-180°  | 60.0   | 7.3       |
| 0°-180°   | 827.0  | 100.0     |

**CANDELA DISTRIBUTION:**

|      | 0°  | 22.5° | 45° | 67.5° | 90° | Flux |
|------|-----|-------|-----|-------|-----|------|
| 0°   | 241 | 241   | 241 | 241   | 241 |      |
| 5°   | 239 | 241   | 240 | 240   | 241 | 23   |
| 15°  | 229 | 232   | 233 | 234   | 236 | 65   |
| 25°  | 209 | 212   | 217 | 220   | 221 | 96   |
| 35°  | 182 | 186   | 193 | 198   | 201 | 114  |
| 45°  | 151 | 157   | 166 | 173   | 176 | 116  |
| 55°  | 116 | 123   | 133 | 142   | 146 | 104  |
| 65°  | 78  | 86    | 99  | 111   | 117 | 77   |
| 75°  | 40  | 51    | 69  | 83    | 89  | 42   |
| 85°  | 8   | 24    | 44  | 59    | 65  | 9    |
| 90°  | 0   | 14    | 34  | 48    | 54  | 0    |
| 95°  | 0   | 9     | 26  | 39    | 45  | 0    |
| 105° | 0   | 3     | 14  | 25    | 29  | 0    |
| 115° | 0   | 2     | 8   | 15    | 18  | 0    |
| 125° | 0   | 1     | 5   | 10    | 11  | 0    |
| 135° | 0   | 0     | 3   | 6     | 8   | 0    |
| 145° | 0   | 0     | 2   | 4     | 4   | 0    |
| 155° | 0   | 0     | 0   | 1     | 2   | 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°     | 240.9 | 240.9 | 240.9 | 240.9 | 240.9 |
| 2.5°   | 239.4 | 241.7 | 240.9 | 240.1 | 240.1 |
| 5°     | 238.6 | 240.9 | 240.1 | 240.1 | 240.9 |
| 7.5°   | 237.1 | 239.4 | 239.4 | 239.4 | 240.1 |
| 10°    | 234.8 | 237.9 | 237.9 | 237.9 | 238.6 |
| 12.5°  | 232.6 | 234.8 | 235.6 | 236.4 | 237.1 |
| 15°    | 228.8 | 231.8 | 233.3 | 234.1 | 235.6 |
| 17.5°  | 225.0 | 227.3 | 229.5 | 231.8 | 232.6 |
| 20°    | 220.4 | 223.5 | 225.7 | 228.0 | 228.8 |
| 22.5°  | 215.1 | 218.2 | 221.2 | 223.5 | 225.0 |
| 25°    | 209.1 | 212.1 | 216.7 | 219.7 | 221.2 |
| 27.5°  | 203.0 | 206.0 | 211.4 | 215.1 | 216.7 |
| 30°    | 195.4 | 200.0 | 205.3 | 209.8 | 212.1 |
| 32.5°  | 188.6 | 193.2 | 199.2 | 204.5 | 206.0 |
| 35°    | 181.8 | 186.4 | 193.2 | 198.5 | 200.7 |
| 37.5°  | 174.2 | 179.5 | 186.4 | 192.4 | 194.7 |
| 40°    | 166.7 | 172.0 | 179.5 | 186.4 | 187.9 |
| 42.5°  | 159.1 | 164.4 | 173.5 | 179.5 | 181.8 |
| 45°    | 150.7 | 156.8 | 165.9 | 172.7 | 175.7 |
| 47.5°  | 142.4 | 148.5 | 157.6 | 165.1 | 168.2 |
| 50°    | 133.3 | 140.1 | 150.0 | 157.6 | 160.6 |
| 52.5°  | 125.0 | 131.8 | 141.7 | 150.0 | 153.8 |
| 55°    | 115.9 | 122.7 | 133.3 | 142.4 | 146.2 |
| 57.5°  | 106.8 | 113.6 | 125.0 | 134.8 | 138.6 |
| 60°    | 97.7  | 104.5 | 115.9 | 127.3 | 131.1 |
| 62.5°  | 87.9  | 95.4  | 107.6 | 118.9 | 123.5 |
| 65°    | 78.0  | 86.4  | 99.2  | 111.4 | 116.7 |
| 67.5°  | 68.9  | 77.3  | 90.9  | 104.5 | 109.1 |
| 70°    | 59.1  | 68.2  | 83.3  | 97.0  | 102.3 |
| 72.5°  | 49.2  | 59.1  | 75.8  | 90.1  | 95.4  |
| 75°    | 40.1  | 50.8  | 68.9  | 83.3  | 89.4  |
| 77.5°  | 30.3  | 43.2  | 62.1  | 77.3  | 82.6  |
| 80°    | 22.0  | 35.6  | 55.3  | 71.2  | 76.5  |
| 82.5°  | 14.4  | 28.8  | 49.2  | 65.1  | 70.5  |
| 85°    | 7.6   | 23.5  | 43.9  | 59.1  | 65.1  |
| 87.5°  | 2.3   | 18.2  | 38.6  | 53.8  | 59.1  |
| 90°    | 0.0   | 14.4  | 34.1  | 48.5  | 54.5  |
| 92.5°  | 0.0   | 11.4  | 29.5  | 43.9  | 49.2  |
| 95°    | 0.0   | 9.1   | 25.8  | 39.4  | 44.7  |
| 97.5°  | 0.0   | 7.6   | 22.7  | 35.6  | 40.1  |
| 100°   | 0.0   | 6.1   | 19.7  | 31.8  | 36.4  |
| 102.5° | 0.0   | 4.5   | 16.7  | 28.0  | 32.6  |
| 105°   | 0.0   | 3.0   | 14.4  | 25.0  | 28.8  |
| 107.5° | 0.0   | 2.3   | 12.1  | 22.0  | 25.8  |
| 110°   | 0.0   | 2.3   | 11.4  | 18.9  | 22.7  |

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**CANDELA DISTRIBUTION (continued):**

|        | 0°  | 22.5° | 45° | 67.5° | 90°  |
|--------|-----|-------|-----|-------|------|
| 112.5° | 0.0 | 1.5   | 9.8 | 17.4  | 20.5 |
| 115°   | 0.0 | 1.5   | 8.3 | 15.2  | 18.2 |
| 117.5° | 0.0 | 1.5   | 7.6 | 13.6  | 16.7 |
| 120°   | 0.0 | 1.5   | 6.8 | 12.1  | 14.4 |
| 122.5° | 0.0 | 0.8   | 6.1 | 10.6  | 12.9 |
| 125°   | 0.0 | 0.8   | 5.3 | 9.8   | 11.4 |
| 127.5° | 0.0 | 0.8   | 4.5 | 9.1   | 10.6 |
| 130°   | 0.0 | 0.8   | 4.5 | 8.3   | 9.8  |
| 132.5° | 0.0 | 0.0   | 3.8 | 7.6   | 9.1  |
| 135°   | 0.0 | 0.0   | 3.0 | 6.1   | 7.6  |
| 137.5° | 0.0 | 0.0   | 3.0 | 5.3   | 6.8  |
| 140°   | 0.0 | 0.0   | 2.3 | 5.3   | 6.1  |
| 142.5° | 0.0 | 0.0   | 1.5 | 4.5   | 5.3  |
| 145°   | 0.0 | 0.0   | 1.5 | 3.8   | 4.5  |
| 147.5° | 0.0 | 0.0   | 0.8 | 3.0   | 3.8  |
| 150°   | 0.0 | 0.0   | 0.8 | 2.3   | 3.0  |
| 152.5° | 0.0 | 0.0   | 0.0 | 1.5   | 2.3  |
| 155°   | 0.0 | 0.0   | 0.0 | 0.8   | 1.5  |
| 157.5° | 0.0 | 0.0   | 0.0 | 0.0   | 0.8  |
| 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 | 14.03            | 15.57 | 14.51 | 16.03 | 16.52 | 16.01          | 17.55 | 16.48 | 18.01 | 18.50 |
|                 | 3H   | 15.54            | 16.94 | 16.03 | 17.41 | 17.94 | 18.43          | 19.83 | 18.91 | 20.30 | 20.83 |
|                 | 4H   | 16.02            | 17.35 | 16.53 | 17.84 | 18.38 | 19.61          | 20.93 | 20.11 | 21.42 | 21.97 |
|                 | 6H   | 16.30            | 17.53 | 16.82 | 18.03 | 18.60 | 20.83          | 22.07 | 21.35 | 22.57 | 23.13 |
|                 | 8H   | 16.35            | 17.54 | 16.88 | 18.06 | 18.63 | 21.45          | 22.64 | 21.98 | 23.16 | 23.73 |
|                 | 12H  | 16.37            | 17.50 | 16.90 | 18.02 | 18.62 | 22.12          | 23.26 | 22.66 | 23.77 | 24.37 |
| 4H              | 2H   | 14.90            | 16.23 | 15.41 | 16.71 | 17.26 | 16.45          | 17.77 | 16.95 | 18.26 | 18.81 |
|                 | 3H   | 16.64            | 17.78 | 17.16 | 18.31 | 18.87 | 19.09          | 20.23 | 19.61 | 20.76 | 21.32 |
|                 | 4H   | 17.25            | 18.29 | 17.79 | 18.83 | 19.43 | 20.45          | 21.48 | 20.99 | 22.02 | 22.62 |
|                 | 6H   | 17.66            | 18.57 | 18.21 | 19.14 | 19.75 | 21.87          | 22.78 | 22.43 | 23.35 | 23.96 |
|                 | 8H   | 17.75            | 18.62 | 18.32 | 19.18 | 19.81 | 22.60          | 23.46 | 23.16 | 24.03 | 24.65 |
|                 | 12H  | 17.80            | 18.58 | 18.39 | 19.18 | 19.81 | 23.39          | 24.17 | 23.98 | 24.77 | 25.40 |
| 8H              | 4H   | 17.93            | 18.79 | 18.49 | 19.36 | 19.98 | 20.67          | 21.53 | 21.24 | 22.10 | 22.73 |
|                 | 6H   | 18.52            | 19.25 | 19.11 | 19.86 | 20.49 | 22.27          | 23.00 | 22.86 | 23.61 | 24.24 |
|                 | 8H   | 18.70            | 19.36 | 19.31 | 19.98 | 20.63 | 23.14          | 23.80 | 23.75 | 24.42 | 25.06 |
|                 | 12H  | 18.83            | 19.42 | 19.44 | 20.02 | 20.73 | 24.12          | 24.71 | 24.73 | 25.32 | 26.03 |
| 12H             | 4H   | 18.12            | 18.90 | 18.71 | 19.50 | 20.13 | 20.68          | 21.46 | 21.27 | 22.06 | 22.69 |
|                 | 6H   | 18.81            | 19.47 | 19.42 | 20.09 | 20.73 | 22.31          | 22.97 | 22.92 | 23.59 | 24.23 |
|                 | 8H   | 19.09            | 19.68 | 19.70 | 20.29 | 21.00 | 23.25          | 23.84 | 23.86 | 24.45 | 25.16 |

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

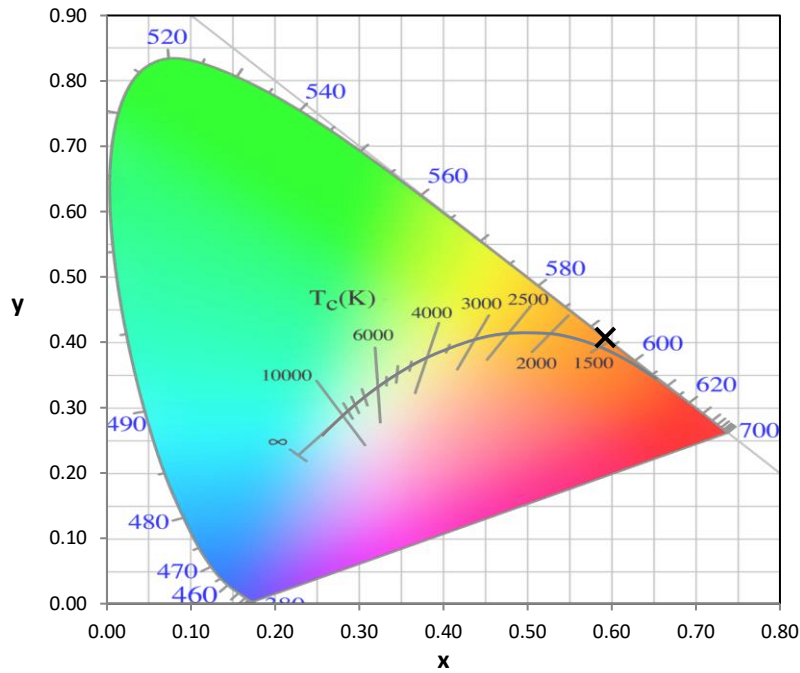
Stabilization Time: 77M  
 Operation Time: 2H 17M  
 Sphere Temperature (°C): 25.1

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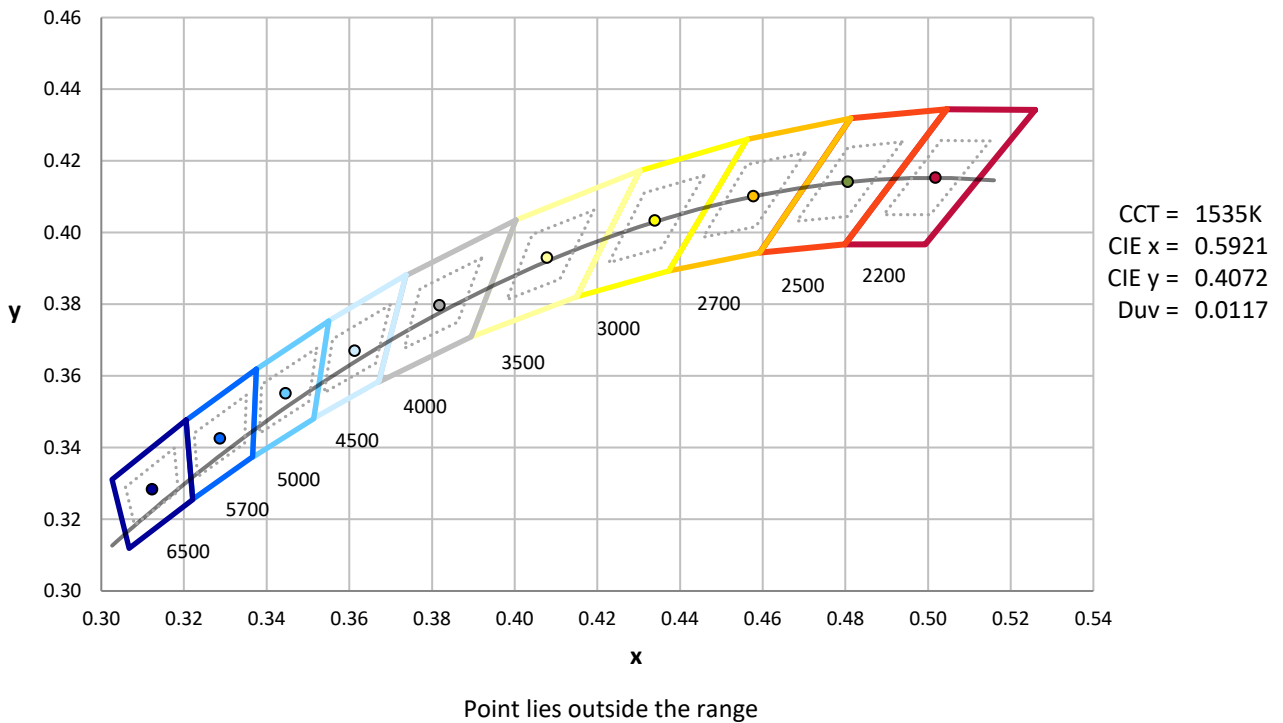
| Measurement and Test Equipment |                       |                  |                      |
|--------------------------------|-----------------------|------------------|----------------------|
| Instrument                     | Identification Number | Calibration Date | Calibration Due Date |
| 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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**CIE 1931 Chromaticity Diagram**

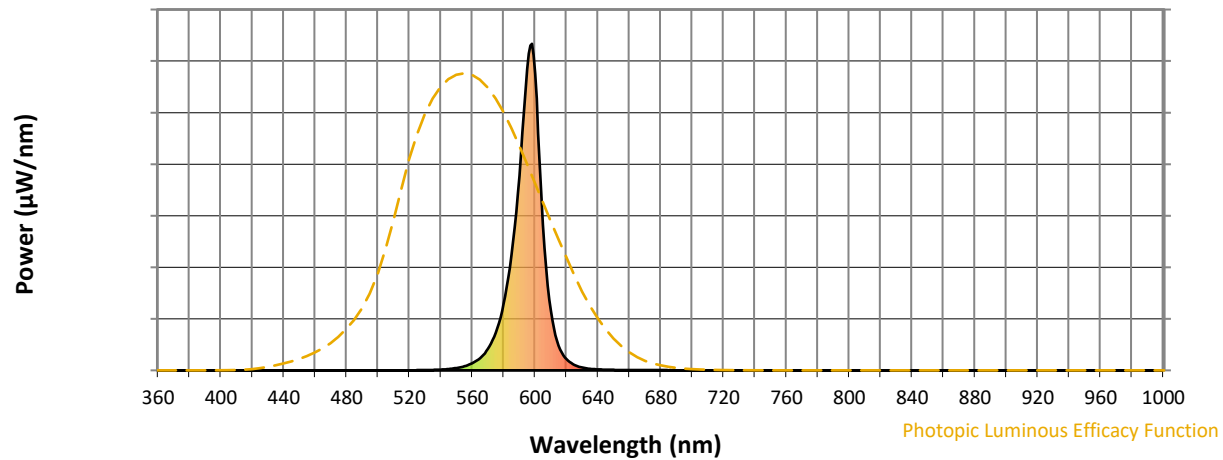


**CIE 1931 Chromaticity Diagram with 2017 ANSI 7-Step and 4-Step Quadrangles**



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### Photopic Flux vs. Wavelength

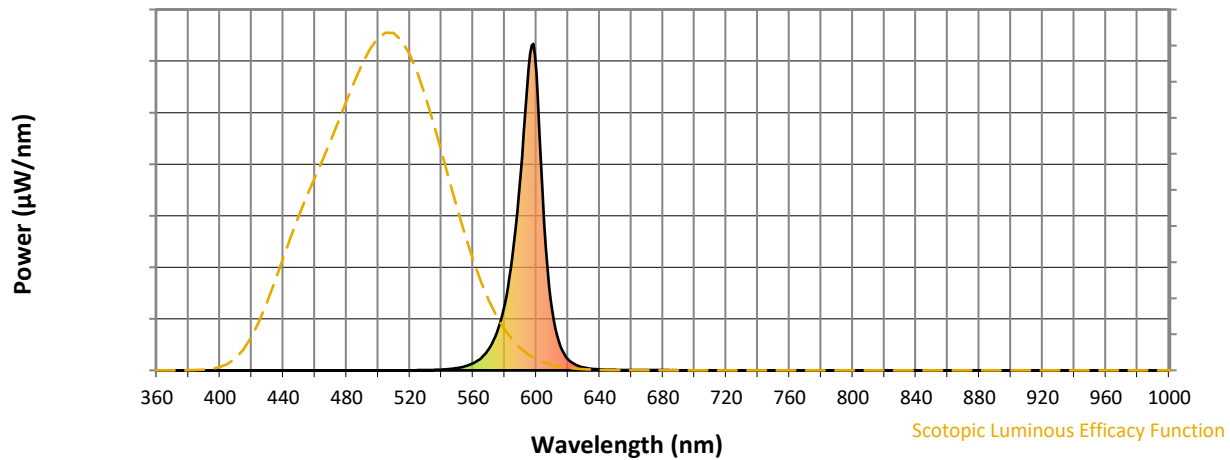


### Photopic Lumens: NR

| $\lambda$<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



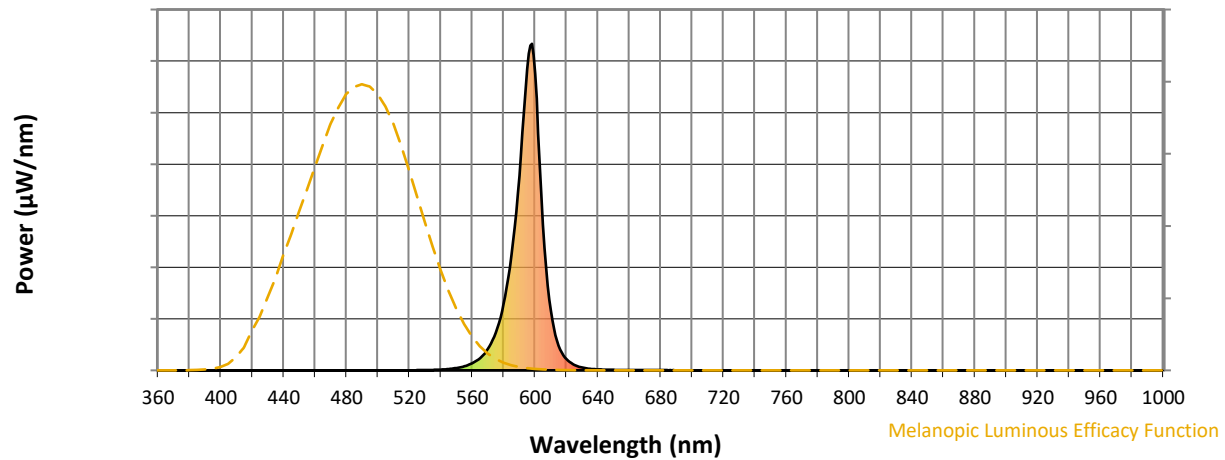
Scotopic Lumens: NR

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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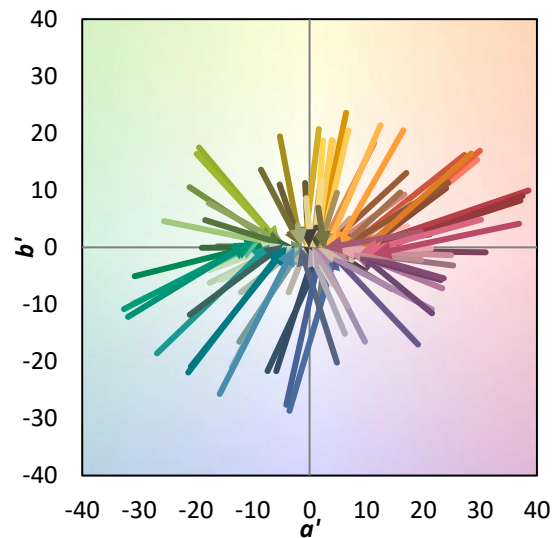
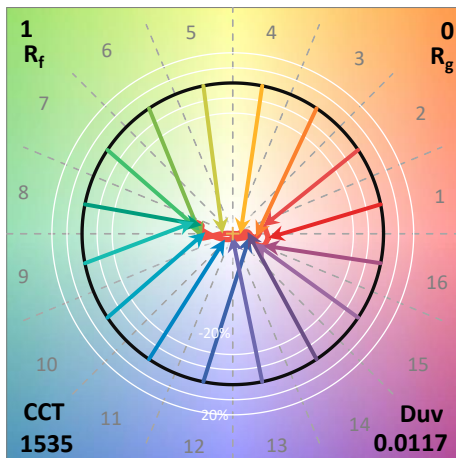
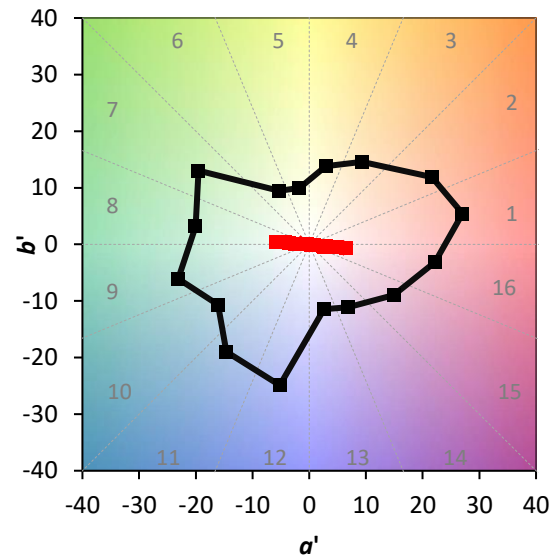
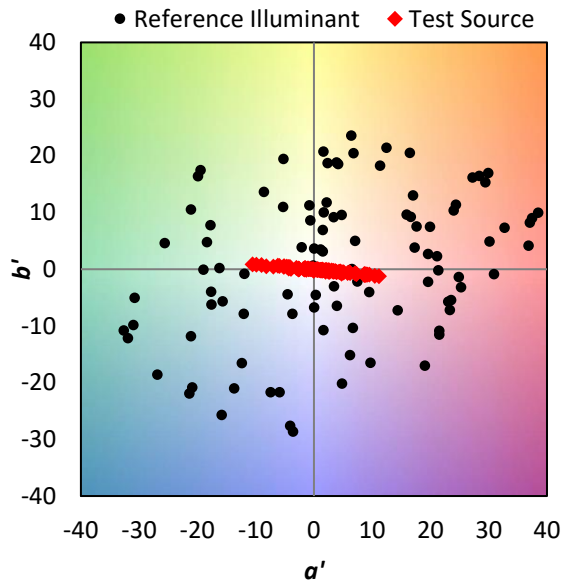
### Melanopic Flux vs. Wavelength


**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                             |                   |                                        |                                |

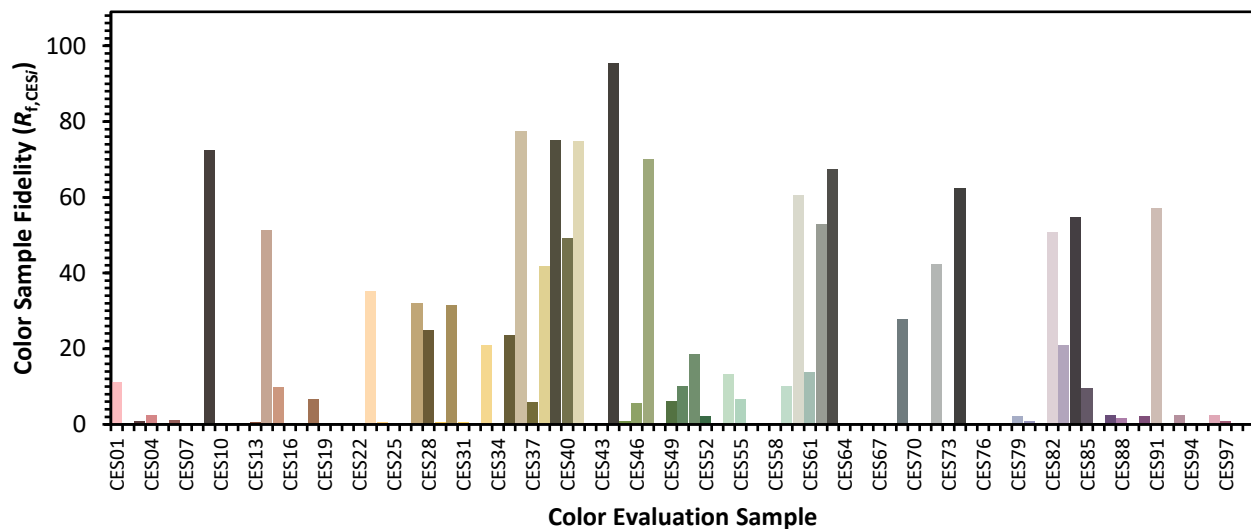
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**TM-30-18**
**Summary**
 $R_f = 1.3$   
 $R_g = 0.1$   
 $CIE\ R_a = -20.0$   
 $R_g = -380.5$ 

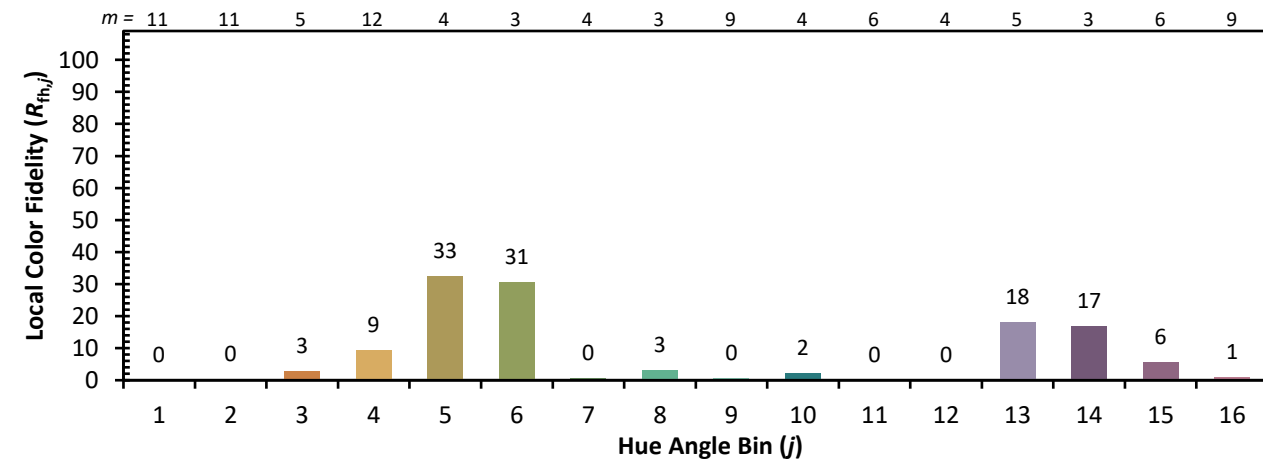
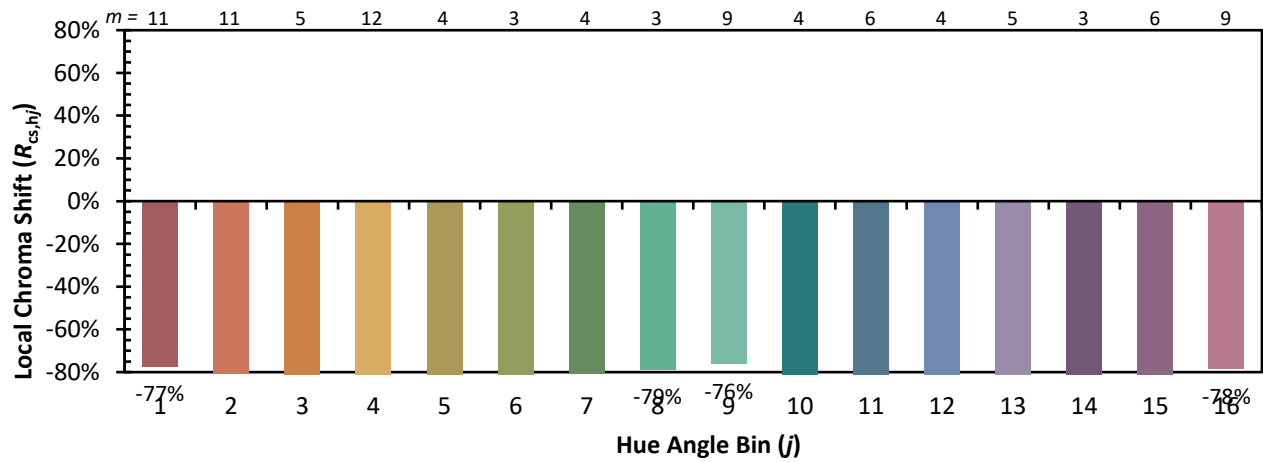
**Color Vector Graphics**


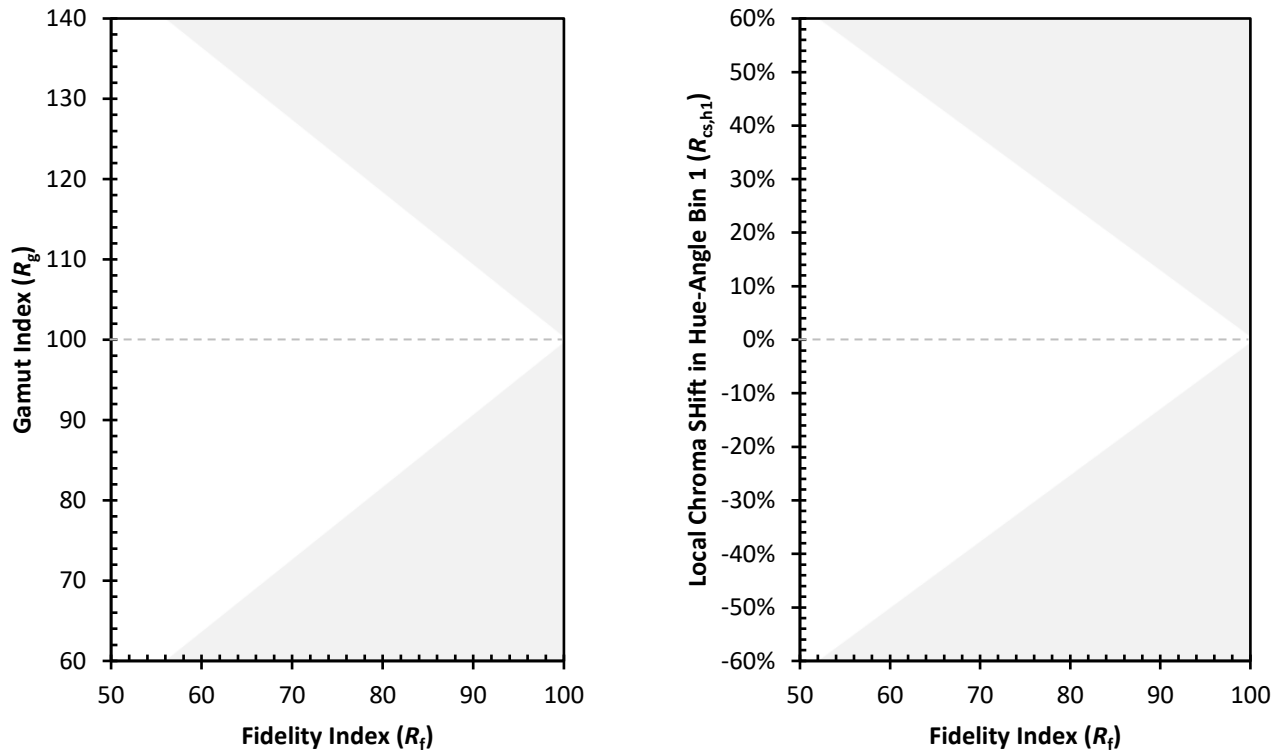
**Individual Sample Fidelity Index ( $R_{f,i}$ )**

|            |            |            |            |
|------------|------------|------------|------------|
| 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)