

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: P1357078

Luminaire Tested: 3ASL4-5HE-2-27-UNV

Issue Date: 2/17/2026

**Test Information**

Test Method: LM-79-2019  
Report Number: P1357078  
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: 3ASL4-5HE-2-27-UNV  
Description: 3FT 500 LUMEN PER FOOT 4ASL LED LUMINAIRE WITH OPL LENS AND 2700K LEDS 2 ROW  
Light Source: -  
Ballast/Driver: -

**Summary**

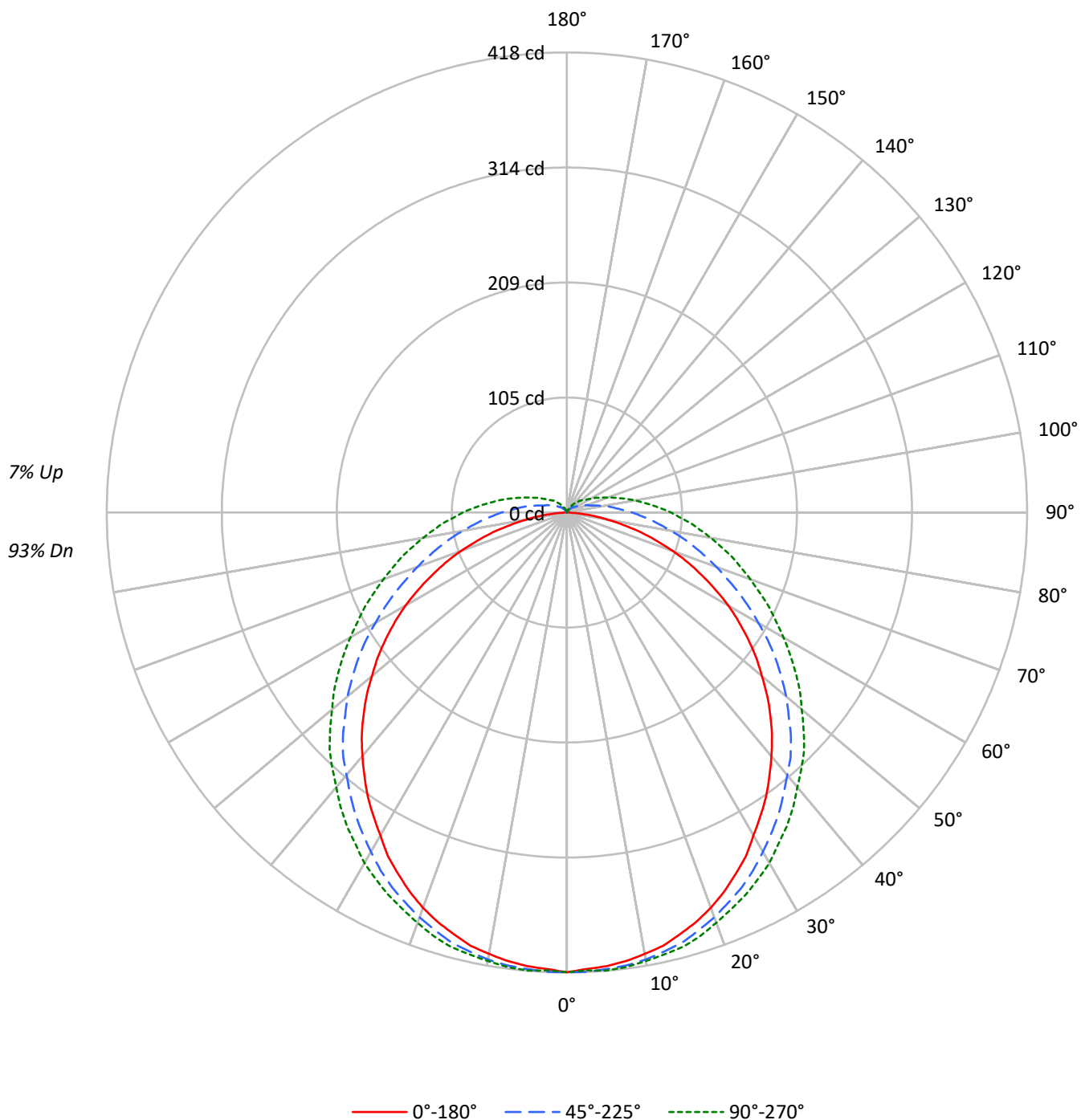
Lumens per Lamp: N/A  
Luminaire Lumens: 1434.0 lumens  
Efficiency: N/A  
Efficacy: 116.6 lumens/watt  
Spacing Criteria (0/90/45): 1.21 / 1.3 / 1.4  
Luminous Opening: Rectangular w/ Sides (W: 0.33' x L: 2.98' x H: 0.1')  
CIE Type: Direct

Input Watts (W): 12.3  
Input Voltage (V): NR  
Input Current (Ain): NR  
Voltage Rise (V): NR  
Power Factor: NR  
Total Harmonic Distortion (THDi): NR  
Frequency (hertz): 60  
Stabilization Time: NR  
Operation Time: NR  
Ambient Temperature (°C): NR  
Test Distance: 24 FT

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CATALOG NUMBER: 3ASL4-5HE-2-27-UNV

### Luminous Intensity Polar Plot



TEST NUMBER: P1357078

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

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

|     | 0°   | 45°  | 90°  |
|-----|------|------|------|
| 0°  | 4528 | 4528 | 4528 |
| 5°  | 4489 | 4435 | 4424 |
| 10° | 4454 | 4352 | 4317 |
| 15° | 4410 | 4260 | 4230 |
| 20° | 4353 | 4144 | 4109 |
| 25° | 4266 | 4031 | 4004 |
| 30° | 4158 | 3902 | 3900 |
| 35° | 4072 | 3782 | 3779 |
| 40° | 3973 | 3652 | 3652 |
| 45° | 3872 | 3540 | 3559 |
| 50° | 3743 | 3393 | 3422 |
| 55° | 3618 | 3234 | 3312 |
| 60° | 3463 | 3057 | 3196 |
| 65° | 3228 | 2891 | 3107 |
| 70° | 2964 | 2734 | 3023 |
| 75° | 2578 | 2611 | 2997 |
| 80° | 1985 | 2501 | 2988 |
| 85° | 1164 | 2488 | 3074 |

**MAXIMUM LUMINANCE 45°-90°:**

Horizontal Angle: 0°

Vertical Angle: 45°

Luminance: 3872 cd/sqm

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**ZONAL LUMENS:**

| Zone      | Lumens | % Fixture |
|-----------|--------|-----------|
| 0°-10°    | 39.6   | 2.8       |
| 10°-20°   | 113.9  | 7.9       |
| 20°-30°   | 172.5  | 12.0      |
| 30°-40°   | 208.7  | 14.6      |
| 40°-50°   | 220.0  | 15.3      |
| 50°-60°   | 205.3  | 14.3      |
| 60°-70°   | 169.5  | 11.8      |
| 70°-80°   | 123.0  | 8.6       |
| 80°-90°   | 77.7   | 5.4       |
| 90°-100°  | 46.4   | 3.2       |
| 100°-110° | 26.6   | 1.9       |
| 110°-120° | 15.1   | 1.1       |
| 120°-130° | 8.6    | 0.6       |
| 130°-140° | 4.7    | 0.3       |
| 140°-150° | 2.0    | 0.1       |
| 150°-160° | 0.4    | 0.0       |
| 160°-170° | 0.0    | 0.0       |
| 170°-180° | 0.0    | 0.0       |
| 0°-30°    | 326.0  | 22.7      |
| 0°-40°    | 534.7  | 37.3      |
| 0°-60°    | 960.0  | 66.9      |
| 0°-90°    | 1330.3 | 92.8      |
| 90°-120°  | 88.1   | 6.1       |
| 90°-150°  | 103.4  | 7.2       |
| 90°-180°  | 104.0  | 7.3       |
| 0°-180°   | 1434.0 | 100.0     |

**CANDELA DISTRIBUTION:**

|      | 0°  | 22.5° | 45° | 67.5° | 90° | Flux |
|------|-----|-------|-----|-------|-----|------|
| 0°   | 418 | 418   | 418 | 418   | 418 |      |
| 5°   | 414 | 418   | 416 | 416   | 418 | 39   |
| 15°  | 397 | 402   | 405 | 406   | 408 | 112  |
| 25°  | 362 | 368   | 376 | 381   | 384 | 167  |
| 35°  | 315 | 323   | 335 | 344   | 348 | 197  |
| 45°  | 261 | 272   | 288 | 300   | 305 | 202  |
| 55°  | 201 | 213   | 231 | 247   | 254 | 180  |
| 65°  | 135 | 150   | 172 | 193   | 202 | 134  |
| 75°  | 70  | 88    | 120 | 144   | 155 | 73   |
| 85°  | 13  | 41    | 76  | 102   | 113 | 16   |
| 90°  | 0   | 25    | 59  | 84    | 95  | 1    |
| 95°  | 0   | 16    | 45  | 68    | 78  | 0    |
| 105° | 0   | 5     | 25  | 43    | 50  | 0    |
| 115° | 0   | 3     | 14  | 26    | 32  | 0    |
| 125° | 0   | 1     | 9   | 17    | 20  | 0    |
| 135° | 0   | 0     | 5   | 10    | 13  | 0    |
| 145° | 0   | 0     | 3   | 7     | 8   | 0    |
| 155° | 0   | 0     | 0   | 1     | 3   | 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°     | 417.7 | 417.7 | 417.7 | 417.7 | 417.7 |
| 2.5°   | 415.1 | 419.0 | 417.7 | 416.4 | 416.4 |
| 5°     | 413.8 | 417.7 | 416.4 | 416.4 | 417.7 |
| 7.5°   | 411.1 | 415.1 | 415.1 | 415.1 | 416.4 |
| 10°    | 407.2 | 412.5 | 412.5 | 412.5 | 413.8 |
| 12.5°  | 403.3 | 407.2 | 408.5 | 409.8 | 411.1 |
| 15°    | 396.7 | 401.9 | 404.6 | 405.9 | 408.5 |
| 17.5°  | 390.1 | 394.1 | 398.0 | 401.9 | 403.3 |
| 20°    | 382.2 | 387.5 | 391.4 | 395.4 | 396.7 |
| 22.5°  | 373.0 | 378.3 | 383.6 | 387.5 | 390.1 |
| 25°    | 362.5 | 367.8 | 375.7 | 380.9 | 383.6 |
| 27.5°  | 352.0 | 357.3 | 366.5 | 373.0 | 375.7 |
| 30°    | 338.9 | 346.8 | 356.0 | 363.9 | 367.8 |
| 32.5°  | 327.1 | 335.0 | 345.5 | 354.7 | 357.3 |
| 35°    | 315.3 | 323.1 | 335.0 | 344.2 | 348.1 |
| 37.5°  | 302.1 | 311.3 | 323.1 | 333.6 | 337.6 |
| 40°    | 289.0 | 298.2 | 311.3 | 323.1 | 325.8 |
| 42.5°  | 275.8 | 285.0 | 300.8 | 311.3 | 315.3 |
| 45°    | 261.4 | 271.9 | 287.7 | 299.5 | 304.7 |
| 47.5°  | 246.9 | 257.5 | 273.2 | 286.4 | 291.6 |
| 50°    | 231.2 | 243.0 | 260.1 | 273.2 | 278.5 |
| 52.5°  | 216.7 | 228.6 | 245.6 | 260.1 | 266.7 |
| 55°    | 201.0 | 212.8 | 231.2 | 246.9 | 253.5 |
| 57.5°  | 185.2 | 197.0 | 216.7 | 233.8 | 240.4 |
| 60°    | 169.4 | 181.3 | 201.0 | 220.7 | 227.2 |
| 62.5°  | 152.4 | 165.5 | 186.5 | 206.2 | 214.1 |
| 65°    | 135.3 | 149.7 | 172.1 | 193.1 | 202.3 |
| 67.5°  | 119.5 | 134.0 | 157.6 | 181.3 | 189.2 |
| 70°    | 102.5 | 118.2 | 144.5 | 168.1 | 177.3 |
| 72.5°  | 85.4  | 102.5 | 131.4 | 156.3 | 165.5 |
| 75°    | 69.6  | 88.0  | 119.5 | 144.5 | 155.0 |
| 77.5°  | 52.5  | 74.9  | 107.7 | 134.0 | 143.2 |
| 80°    | 38.1  | 61.7  | 95.9  | 123.5 | 132.7 |
| 82.5°  | 25.0  | 49.9  | 85.4  | 113.0 | 122.2 |
| 85°    | 13.1  | 40.7  | 76.2  | 102.5 | 113.0 |
| 87.5°  | 3.9   | 31.5  | 67.0  | 93.3  | 102.5 |
| 90°    | 0.0   | 25.0  | 59.1  | 84.1  | 94.6  |
| 92.5°  | 0.0   | 19.7  | 51.2  | 76.2  | 85.4  |
| 95°    | 0.0   | 15.8  | 44.7  | 68.3  | 77.5  |
| 97.5°  | 0.0   | 13.1  | 39.4  | 61.7  | 69.6  |
| 100°   | 0.0   | 10.5  | 34.2  | 55.2  | 63.1  |
| 102.5° | 0.0   | 7.9   | 28.9  | 48.6  | 56.5  |
| 105°   | 0.0   | 5.3   | 25.0  | 43.3  | 49.9  |
| 107.5° | 0.0   | 3.9   | 21.0  | 38.1  | 44.7  |
| 110°   | 0.0   | 3.9   | 19.7  | 32.8  | 39.4  |



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**CANDELA DISTRIBUTION (continued):**

|        | 0°  | 22.5° | 45°  | 67.5° | 90°  |
|--------|-----|-------|------|-------|------|
| 112.5° | 0.0 | 2.6   | 17.1 | 30.2  | 35.5 |
| 115°   | 0.0 | 2.6   | 14.4 | 26.3  | 31.5 |
| 117.5° | 0.0 | 2.6   | 13.1 | 23.6  | 28.9 |
| 120°   | 0.0 | 2.6   | 11.8 | 21.0  | 25.0 |
| 122.5° | 0.0 | 1.3   | 10.5 | 18.4  | 22.3 |
| 125°   | 0.0 | 1.3   | 9.2  | 17.1  | 19.7 |
| 127.5° | 0.0 | 1.3   | 7.9  | 15.8  | 18.4 |
| 130°   | 0.0 | 1.3   | 7.9  | 14.4  | 17.1 |
| 132.5° | 0.0 | 0.0   | 6.6  | 13.1  | 15.8 |
| 135°   | 0.0 | 0.0   | 5.3  | 10.5  | 13.1 |
| 137.5° | 0.0 | 0.0   | 5.3  | 9.2   | 11.8 |
| 140°   | 0.0 | 0.0   | 3.9  | 9.2   | 10.5 |
| 142.5° | 0.0 | 0.0   | 2.6  | 7.9   | 9.2  |
| 145°   | 0.0 | 0.0   | 2.6  | 6.6   | 7.9  |
| 147.5° | 0.0 | 0.0   | 1.3  | 5.3   | 6.6  |
| 150°   | 0.0 | 0.0   | 1.3  | 3.9   | 5.3  |
| 152.5° | 0.0 | 0.0   | 0.0  | 2.6   | 3.9  |
| 155°   | 0.0 | 0.0   | 0.0  | 1.3   | 2.6  |
| 157.5° | 0.0 | 0.0   | 0.0  | 0.0   | 1.3  |
| 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 | 14.55            | 16.08 | 15.02 | 16.54 | 17.03 | 16.58          | 18.12 | 17.05 | 18.58 | 19.07 |
|                 | 3H   | 16.05            | 17.45 | 16.54 | 17.92 | 18.45 | 19.02          | 20.42 | 19.50 | 20.89 | 21.42 |
|                 | 4H   | 16.53            | 17.86 | 17.04 | 18.35 | 18.89 | 20.22          | 21.55 | 20.72 | 22.03 | 22.58 |
|                 | 6H   | 16.81            | 18.04 | 17.33 | 18.54 | 19.10 | 21.47          | 22.71 | 21.99 | 23.21 | 23.77 |
|                 | 8H   | 16.86            | 18.05 | 17.39 | 18.57 | 19.14 | 22.12          | 23.30 | 22.65 | 23.83 | 24.39 |
|                 | 12H  | 16.88            | 18.01 | 17.41 | 18.53 | 19.13 | 22.83          | 23.96 | 23.36 | 24.48 | 25.08 |
| 4H              | 2H   | 15.42            | 16.75 | 15.93 | 17.24 | 17.78 | 17.01          | 18.34 | 17.52 | 18.83 | 19.37 |
|                 | 3H   | 17.17            | 18.30 | 17.69 | 18.83 | 19.40 | 19.68          | 20.81 | 20.20 | 21.34 | 21.91 |
|                 | 4H   | 17.77            | 18.81 | 18.31 | 19.35 | 19.95 | 21.06          | 22.09 | 21.59 | 22.63 | 23.23 |
|                 | 6H   | 18.18            | 19.09 | 18.73 | 19.66 | 20.27 | 22.51          | 23.42 | 23.07 | 23.99 | 24.60 |
|                 | 8H   | 18.27            | 19.14 | 18.84 | 19.70 | 20.33 | 23.26          | 24.12 | 23.83 | 24.69 | 25.32 |
|                 | 12H  | 18.32            | 19.10 | 18.91 | 19.70 | 20.33 | 24.09          | 24.88 | 24.68 | 25.47 | 26.10 |
| 8H              | 4H   | 18.46            | 19.32 | 19.03 | 19.89 | 20.52 | 21.28          | 22.14 | 21.84 | 22.71 | 23.33 |
|                 | 6H   | 19.05            | 19.78 | 19.65 | 20.39 | 21.02 | 22.90          | 23.64 | 23.50 | 24.24 | 24.88 |
|                 | 8H   | 19.24            | 19.90 | 19.85 | 20.52 | 21.16 | 23.80          | 24.46 | 24.41 | 25.08 | 25.73 |
|                 | 12H  | 19.36            | 19.95 | 19.97 | 20.56 | 21.27 | 24.82          | 25.41 | 25.43 | 26.02 | 26.73 |
| 12H             | 4H   | 18.66            | 19.44 | 19.25 | 20.04 | 20.67 | 21.29          | 22.07 | 21.87 | 22.66 | 23.29 |
|                 | 6H   | 19.35            | 20.01 | 19.96 | 20.63 | 21.27 | 22.94          | 23.60 | 23.55 | 24.22 | 24.87 |
|                 | 8H   | 19.64            | 20.23 | 20.25 | 20.83 | 21.54 | 23.91          | 24.50 | 24.52 | 25.11 | 25.82 |

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

Report Prepared for

Cooper Lighting Solutions

Fail-Safe

Report Number: SP1-2511-597-2

Test Date: 11/17/2025

Luminaire Tested: 4ASL-2-27-UNV-OPL-1\_600mA

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

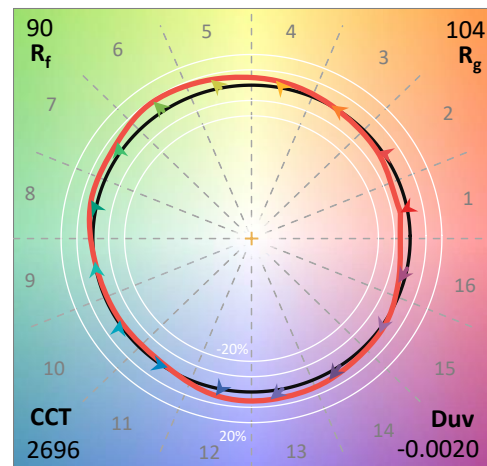
### Test Information

Test Method: LM-79-2019  
 Report Number: SP1-2511-597-2  
 Test Lab: COOPER LIGHTING SOLUTIONS  
 Photometer: SP1 - 76IN SPHERE  
 Measurement Geometry:  $4\pi$   
 Issue Date: 11/18/2025  
 Manufacturer: COOPER LIGHTING SOLUTIONS  
 Product Line: Fail-Safe  
 Catalog Number: **4ASL-2-27-UNV-OPL-1\_600mA**  
 Description: 2foot 4ASL LED LUMINAIRE WITH OPL LENS AND 2700K LEDS with 1 rows at 600mA

### Spectral Parameters

CCT (K): 2696  
 CIE  $u'$ : 0.2632  
 CIE  $v'$ : 0.5245  
 Duv: -0.0020  
 CIE x: 0.4568  
 CIE y: 0.4045  
 CIE z: 0.1387  
 Peak Wavelength (nm): 630  
 Dominant Wavelength (nm): 584  
 Purity: 58.52757  
 R<sub>f</sub>: 90.1  
 R<sub>g</sub>: 103.5

CRI (Ra): 94.4  
 R1: 97.5  
 R2: 97.8  
 R3: 96.9  
 R4: 95.3  
 R5: 97.2  
 R6: 96.5  
 R7: 91.2  
 R8: 83.2  
 R9: 61.8  
 R10: 93.6  
 R11: 93.7  
 R12: 94.1  
 R13: 97.6  
 R14: 96.8  
 R15: 91.9



### Test Conditions

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

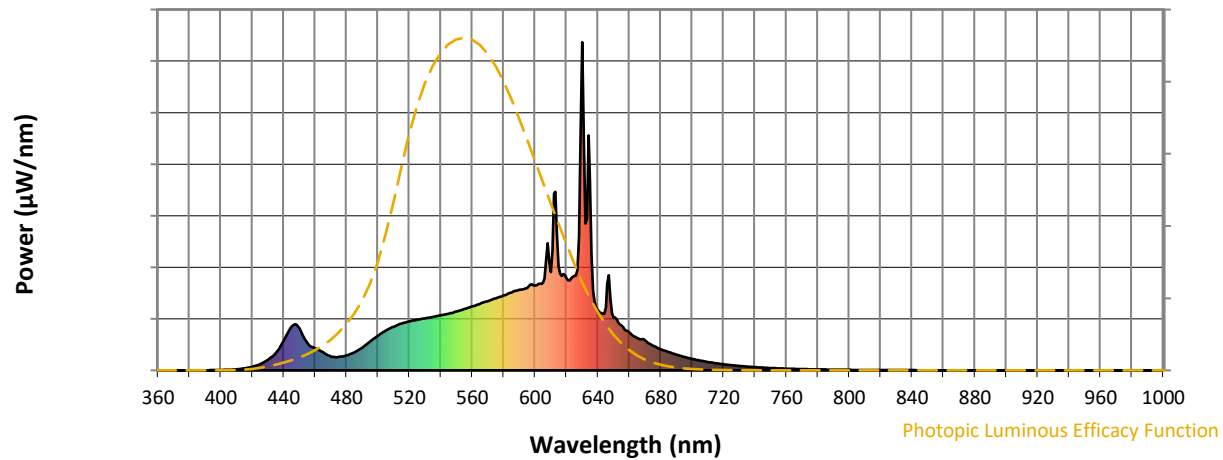
REPORT NUMBER: SP1-2511-597-2

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



REPORT NUMBER: SP1-2511-597-2

### Photopic Flux vs. Wavelength

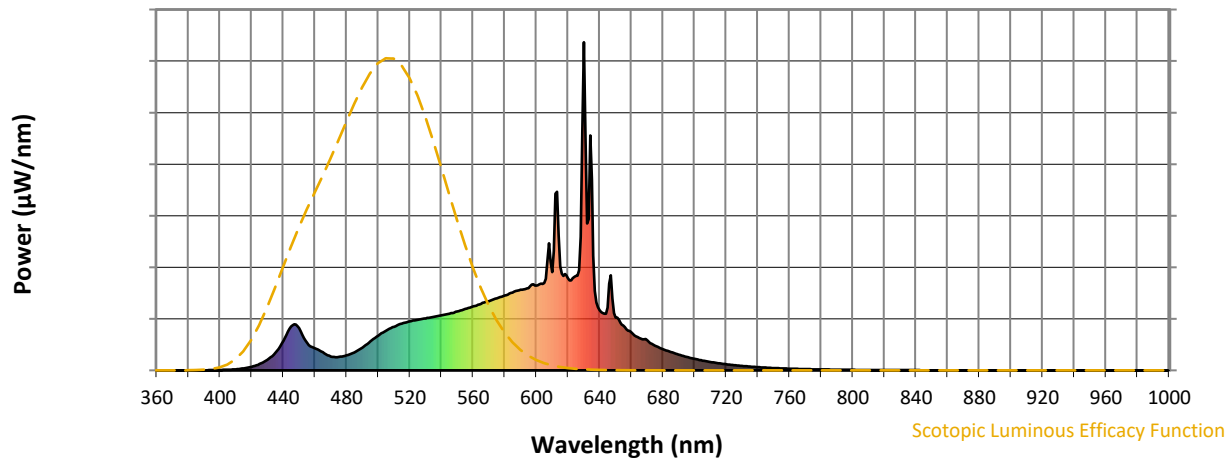


### Photopic Lumens: NR

| λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>λ</sup> /nm | Lumens<br>(φ/nm) |
|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|
| 360       | 0                           | NR               | 490       | 70                          | NR               | 620       | 281                         | NR               | 750       | 7                           | NR               | 880       | 0                           | NR               |
| 365       | 0                           | NR               | 495       | 88                          | NR               | 625       | 288                         | NR               | 755       | 6                           | NR               | 885       | 0                           | NR               |
| 370       | 0                           | NR               | 500       | 106                         | NR               | 630       | 1000                        | NR               | 760       | 5                           | NR               | 890       | 0                           | NR               |
| 375       | 0                           | NR               | 505       | 121                         | NR               | 635       | 581                         | NR               | 765       | 5                           | NR               | 895       | 0                           | NR               |
| 380       | 0                           | NR               | 510       | 133                         | NR               | 640       | 184                         | NR               | 770       | 4                           | NR               | 900       | 0                           | NR               |
| 385       | 0                           | NR               | 515       | 143                         | NR               | 645       | 191                         | NR               | 775       | 3                           | NR               | 905       | 0                           | NR               |
| 390       | 0                           | NR               | 520       | 149                         | NR               | 650       | 161                         | NR               | 780       | 3                           | NR               | 910       | 0                           | NR               |
| 395       | 1                           | NR               | 525       | 155                         | NR               | 655       | 136                         | NR               | 785       | 2                           | NR               | 915       | 0                           | NR               |
| 400       | 1                           | NR               | 530       | 158                         | NR               | 660       | 116                         | NR               | 790       | 2                           | NR               | 920       | 0                           | NR               |
| 405       | 2                           | NR               | 535       | 163                         | NR               | 665       | 99                          | NR               | 795       | 2                           | NR               | 925       | 0                           | NR               |
| 410       | 3                           | NR               | 540       | 168                         | NR               | 670       | 92                          | NR               | 800       | 2                           | NR               | 930       | 0                           | NR               |
| 415       | 6                           | NR               | 545       | 173                         | NR               | 675       | 75                          | NR               | 805       | 1                           | NR               | 935       | 0                           | NR               |
| 420       | 11                          | NR               | 550       | 179                         | NR               | 680       | 65                          | NR               | 810       | 1                           | NR               | 940       | 0                           | NR               |
| 425       | 19                          | NR               | 555       | 187                         | NR               | 685       | 56                          | NR               | 815       | 1                           | NR               | 945       | 0                           | NR               |
| 430       | 32                          | NR               | 560       | 195                         | NR               | 690       | 48                          | NR               | 820       | 1                           | NR               | 950       | 0                           | NR               |
| 435       | 54                          | NR               | 565       | 203                         | NR               | 695       | 41                          | NR               | 825       | 1                           | NR               | 955       | 0                           | NR               |
| 440       | 90                          | NR               | 570       | 211                         | NR               | 700       | 35                          | NR               | 830       | 1                           | NR               | 960       | 0                           | NR               |
| 445       | 134                         | NR               | 575       | 219                         | NR               | 705       | 30                          | NR               | 835       | 1                           | NR               | 965       | 0                           | NR               |
| 450       | 128                         | NR               | 580       | 228                         | NR               | 710       | 26                          | NR               | 840       | 1                           | NR               | 970       | 0                           | NR               |
| 455       | 83                          | NR               | 585       | 237                         | NR               | 715       | 22                          | NR               | 845       | 0                           | NR               | 975       | 0                           | NR               |
| 460       | 67                          | NR               | 590       | 246                         | NR               | 720       | 19                          | NR               | 850       | 0                           | NR               | 980       | 0                           | NR               |
| 465       | 55                          | NR               | 595       | 251                         | NR               | 725       | 16                          | NR               | 855       | 0                           | NR               | 985       | 0                           | NR               |
| 470       | 42                          | NR               | 600       | 259                         | NR               | 730       | 13                          | NR               | 860       | 0                           | NR               | 990       | 0                           | NR               |
| 475       | 41                          | NR               | 605       | 266                         | NR               | 735       | 11                          | NR               | 865       | 0                           | NR               | 995       | 0                           | NR               |
| 480       | 46                          | NR               | 610       | 299                         | NR               | 740       | 10                          | NR               | 870       | 0                           | NR               | 1000      | 0                           | NR               |
| 485       | 55                          | NR               | 615       | 317                         | NR               | 745       | 8                           | NR               | 875       | 0                           | NR               |           |                             |                  |

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### Scotopic Flux vs. Wavelength



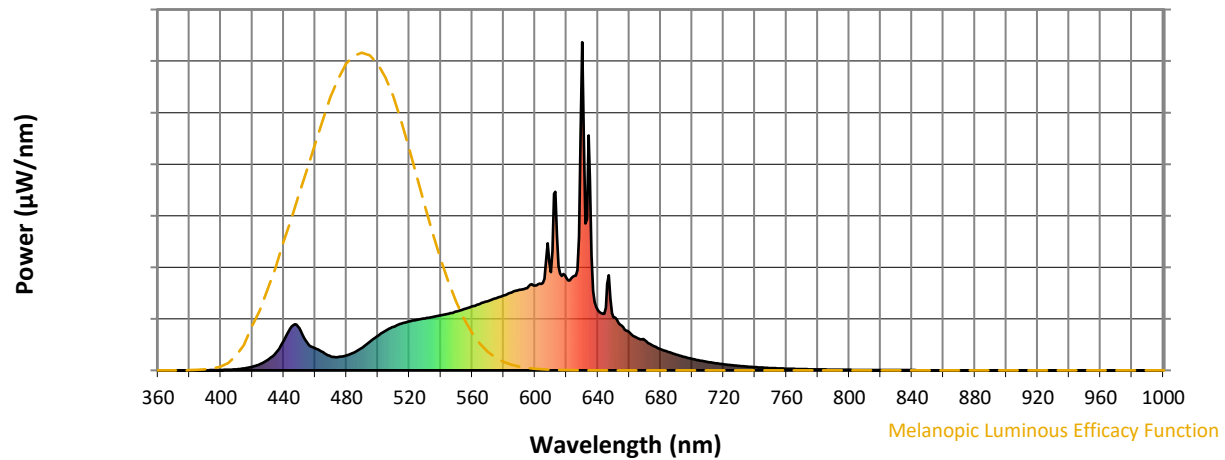
Scotopic Lumens: NR

S/P: 1.29

| λ (nm) | Power W <sup>^</sup> /nm | Lumens (Φ/nm) | λ (nm) | Power W <sup>^</sup> /nm | Lumens (Φ/nm) | λ (nm) | Power W <sup>^</sup> /nm | Lumens (Φ/nm) | λ (nm) | Power W <sup>^</sup> /nm | Lumens (Φ/nm) | λ (nm) | Power W <sup>^</sup> /nm | Lumens (Φ/nm) |
|--------|--------------------------|---------------|--------|--------------------------|---------------|--------|--------------------------|---------------|--------|--------------------------|---------------|--------|--------------------------|---------------|
| 360    | 0                        | NR            | 490    | 70                       | NR            | 620    | 281                      | NR            | 750    | 7                        | NR            | 880    | 0                        | NR            |
| 365    | 0                        | NR            | 495    | 88                       | NR            | 625    | 288                      | NR            | 755    | 6                        | NR            | 885    | 0                        | NR            |
| 370    | 0                        | NR            | 500    | 106                      | NR            | 630    | 1000                     | NR            | 760    | 5                        | NR            | 890    | 0                        | NR            |
| 375    | 0                        | NR            | 505    | 121                      | NR            | 635    | 581                      | NR            | 765    | 5                        | NR            | 895    | 0                        | NR            |
| 380    | 0                        | NR            | 510    | 133                      | NR            | 640    | 184                      | NR            | 770    | 4                        | NR            | 900    | 0                        | NR            |
| 385    | 0                        | NR            | 515    | 143                      | NR            | 645    | 191                      | NR            | 775    | 3                        | NR            | 905    | 0                        | NR            |
| 390    | 0                        | NR            | 520    | 149                      | NR            | 650    | 161                      | NR            | 780    | 3                        | NR            | 910    | 0                        | NR            |
| 395    | 1                        | NR            | 525    | 155                      | NR            | 655    | 136                      | NR            | 785    | 2                        | NR            | 915    | 0                        | NR            |
| 400    | 1                        | NR            | 530    | 158                      | NR            | 660    | 116                      | NR            | 790    | 2                        | NR            | 920    | 0                        | NR            |
| 405    | 2                        | NR            | 535    | 163                      | NR            | 665    | 99                       | NR            | 795    | 2                        | NR            | 925    | 0                        | NR            |
| 410    | 3                        | NR            | 540    | 168                      | NR            | 670    | 92                       | NR            | 800    | 2                        | NR            | 930    | 0                        | NR            |
| 415    | 6                        | NR            | 545    | 173                      | NR            | 675    | 75                       | NR            | 805    | 1                        | NR            | 935    | 0                        | NR            |
| 420    | 11                       | NR            | 550    | 179                      | NR            | 680    | 65                       | NR            | 810    | 1                        | NR            | 940    | 0                        | NR            |
| 425    | 19                       | NR            | 555    | 187                      | NR            | 685    | 56                       | NR            | 815    | 1                        | NR            | 945    | 0                        | NR            |
| 430    | 32                       | NR            | 560    | 195                      | NR            | 690    | 48                       | NR            | 820    | 1                        | NR            | 950    | 0                        | NR            |
| 435    | 54                       | NR            | 565    | 203                      | NR            | 695    | 41                       | NR            | 825    | 1                        | NR            | 955    | 0                        | NR            |
| 440    | 90                       | NR            | 570    | 211                      | NR            | 700    | 35                       | NR            | 830    | 1                        | NR            | 960    | 0                        | NR            |
| 445    | 134                      | NR            | 575    | 219                      | NR            | 705    | 30                       | NR            | 835    | 1                        | NR            | 965    | 0                        | NR            |
| 450    | 128                      | NR            | 580    | 228                      | NR            | 710    | 26                       | NR            | 840    | 1                        | NR            | 970    | 0                        | NR            |
| 455    | 83                       | NR            | 585    | 237                      | NR            | 715    | 22                       | NR            | 845    | 0                        | NR            | 975    | 0                        | NR            |
| 460    | 67                       | NR            | 590    | 246                      | NR            | 720    | 19                       | NR            | 850    | 0                        | NR            | 980    | 0                        | NR            |
| 465    | 55                       | NR            | 595    | 251                      | NR            | 725    | 16                       | NR            | 855    | 0                        | NR            | 985    | 0                        | NR            |
| 470    | 42                       | NR            | 600    | 259                      | NR            | 730    | 13                       | NR            | 860    | 0                        | NR            | 990    | 0                        | NR            |
| 475    | 41                       | NR            | 605    | 266                      | NR            | 735    | 11                       | NR            | 865    | 0                        | NR            | 995    | 0                        | NR            |
| 480    | 46                       | NR            | 610    | 299                      | NR            | 740    | 10                       | NR            | 870    | 0                        | NR            | 1000   | 0                        | NR            |
| 485    | 55                       | NR            | 615    | 317                      | NR            | 745    | 8                        | NR            | 875    | 0                        | NR            |        |                          |               |

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### Melanopic Flux vs. Wavelength


**Melanopic Lumens: NR**
**M/P: 2.45**

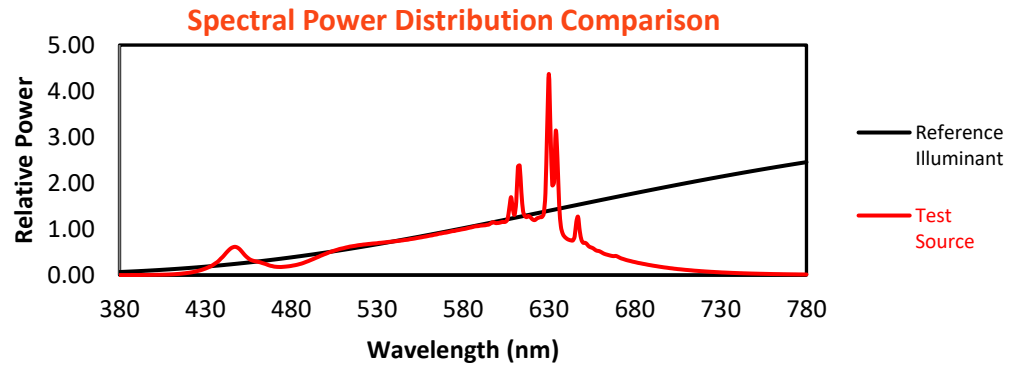
| λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) | λ<br>(nm) | Power<br>W <sup>^</sup> /nm | Lumens<br>(φ/nm) |
|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|-----------|-----------------------------|------------------|
| 360       | 0                           | NR               | 490       | 70                          | NR               | 620       | 281                         | NR               | 750       | 7                           | NR               | 880       | 0                           | NR               |
| 365       | 0                           | NR               | 495       | 88                          | NR               | 625       | 288                         | NR               | 755       | 6                           | NR               | 885       | 0                           | NR               |
| 370       | 0                           | NR               | 500       | 106                         | NR               | 630       | 1000                        | NR               | 760       | 5                           | NR               | 890       | 0                           | NR               |
| 375       | 0                           | NR               | 505       | 121                         | NR               | 635       | 581                         | NR               | 765       | 5                           | NR               | 895       | 0                           | NR               |
| 380       | 0                           | NR               | 510       | 133                         | NR               | 640       | 184                         | NR               | 770       | 4                           | NR               | 900       | 0                           | NR               |
| 385       | 0                           | NR               | 515       | 143                         | NR               | 645       | 191                         | NR               | 775       | 3                           | NR               | 905       | 0                           | NR               |
| 390       | 0                           | NR               | 520       | 149                         | NR               | 650       | 161                         | NR               | 780       | 3                           | NR               | 910       | 0                           | NR               |
| 395       | 1                           | NR               | 525       | 155                         | NR               | 655       | 136                         | NR               | 785       | 2                           | NR               | 915       | 0                           | NR               |
| 400       | 1                           | NR               | 530       | 158                         | NR               | 660       | 116                         | NR               | 790       | 2                           | NR               | 920       | 0                           | NR               |
| 405       | 2                           | NR               | 535       | 163                         | NR               | 665       | 99                          | NR               | 795       | 2                           | NR               | 925       | 0                           | NR               |
| 410       | 3                           | NR               | 540       | 168                         | NR               | 670       | 92                          | NR               | 800       | 2                           | NR               | 930       | 0                           | NR               |
| 415       | 6                           | NR               | 545       | 173                         | NR               | 675       | 75                          | NR               | 805       | 1                           | NR               | 935       | 0                           | NR               |
| 420       | 11                          | NR               | 550       | 179                         | NR               | 680       | 65                          | NR               | 810       | 1                           | NR               | 940       | 0                           | NR               |
| 425       | 19                          | NR               | 555       | 187                         | NR               | 685       | 56                          | NR               | 815       | 1                           | NR               | 945       | 0                           | NR               |
| 430       | 32                          | NR               | 560       | 195                         | NR               | 690       | 48                          | NR               | 820       | 1                           | NR               | 950       | 0                           | NR               |
| 435       | 54                          | NR               | 565       | 203                         | NR               | 695       | 41                          | NR               | 825       | 1                           | NR               | 955       | 0                           | NR               |
| 440       | 90                          | NR               | 570       | 211                         | NR               | 700       | 35                          | NR               | 830       | 1                           | NR               | 960       | 0                           | NR               |
| 445       | 134                         | NR               | 575       | 219                         | NR               | 705       | 30                          | NR               | 835       | 1                           | NR               | 965       | 0                           | NR               |
| 450       | 128                         | NR               | 580       | 228                         | NR               | 710       | 26                          | NR               | 840       | 1                           | NR               | 970       | 0                           | NR               |
| 455       | 83                          | NR               | 585       | 237                         | NR               | 715       | 22                          | NR               | 845       | 0                           | NR               | 975       | 0                           | NR               |
| 460       | 67                          | NR               | 590       | 246                         | NR               | 720       | 19                          | NR               | 850       | 0                           | NR               | 980       | 0                           | NR               |
| 465       | 55                          | NR               | 595       | 251                         | NR               | 725       | 16                          | NR               | 855       | 0                           | NR               | 985       | 0                           | NR               |
| 470       | 42                          | NR               | 600       | 259                         | NR               | 730       | 13                          | NR               | 860       | 0                           | NR               | 990       | 0                           | NR               |
| 475       | 41                          | NR               | 605       | 266                         | NR               | 735       | 11                          | NR               | 865       | 0                           | NR               | 995       | 0                           | NR               |
| 480       | 46                          | NR               | 610       | 299                         | NR               | 740       | 10                          | NR               | 870       | 0                           | NR               | 1000      | 0                           | NR               |
| 485       | 55                          | NR               | 615       | 317                         | NR               | 745       | 8                           | NR               | 875       | 0                           | NR               |           |                             |                  |

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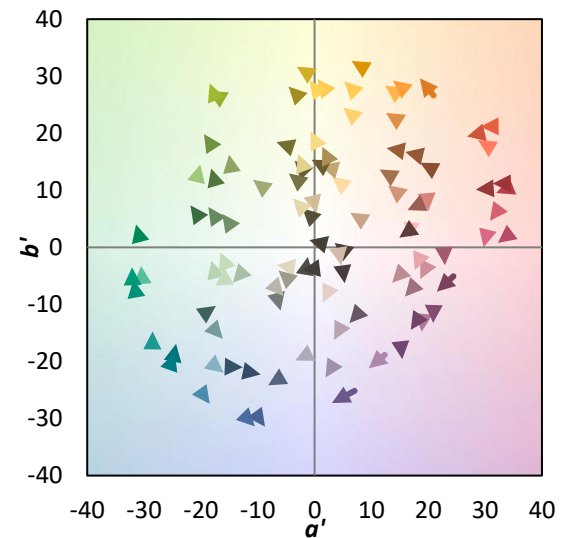
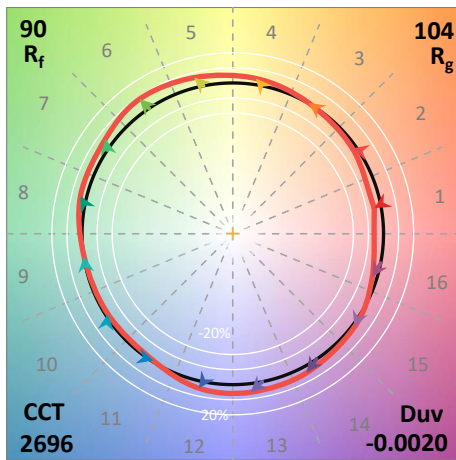
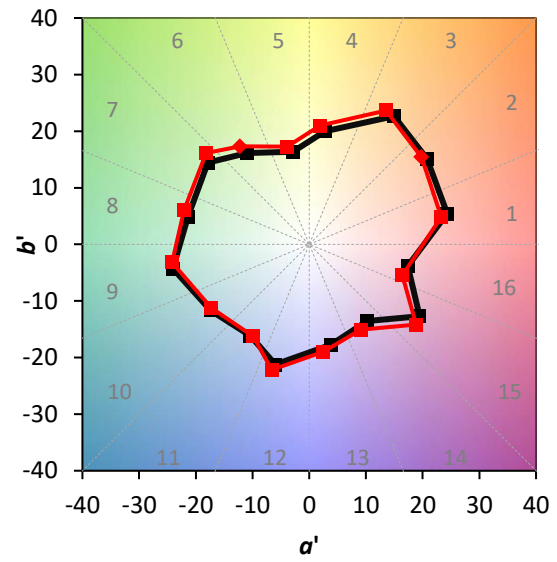
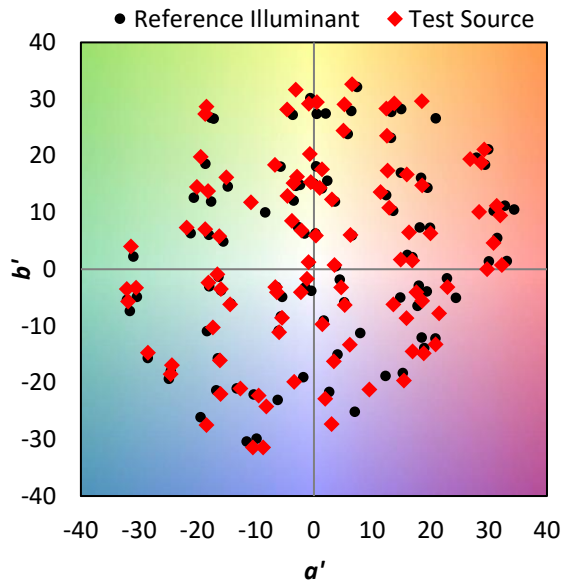
TM-30-18

### Summary

$R_f = 90.1$   
 $R_g = 103.5$   
 $CIE R_a = 94.4$   
 $R_9 = 61.8$

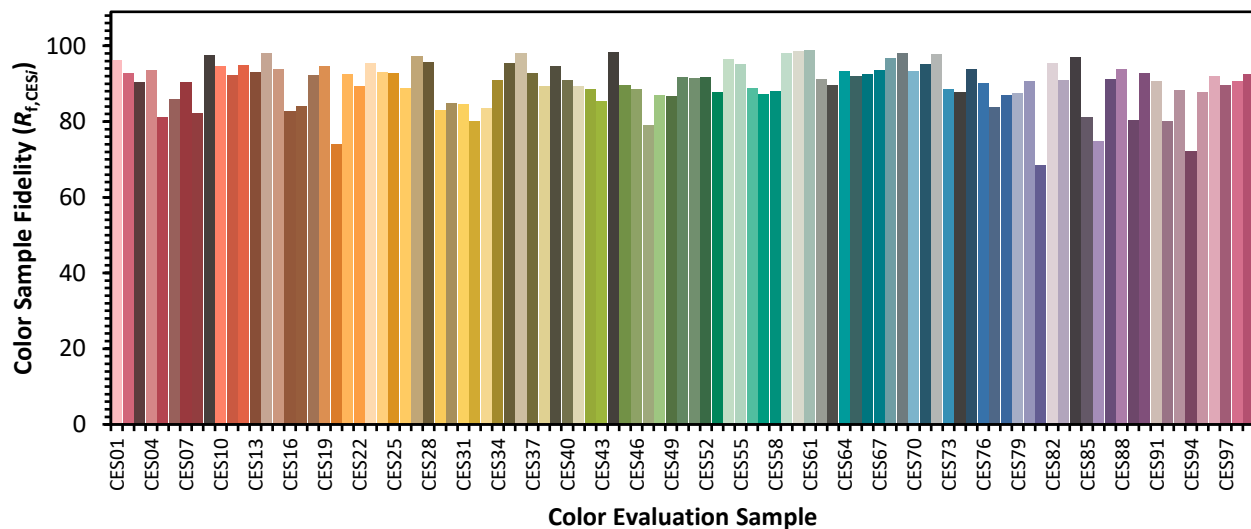


### Color Vector Graphics

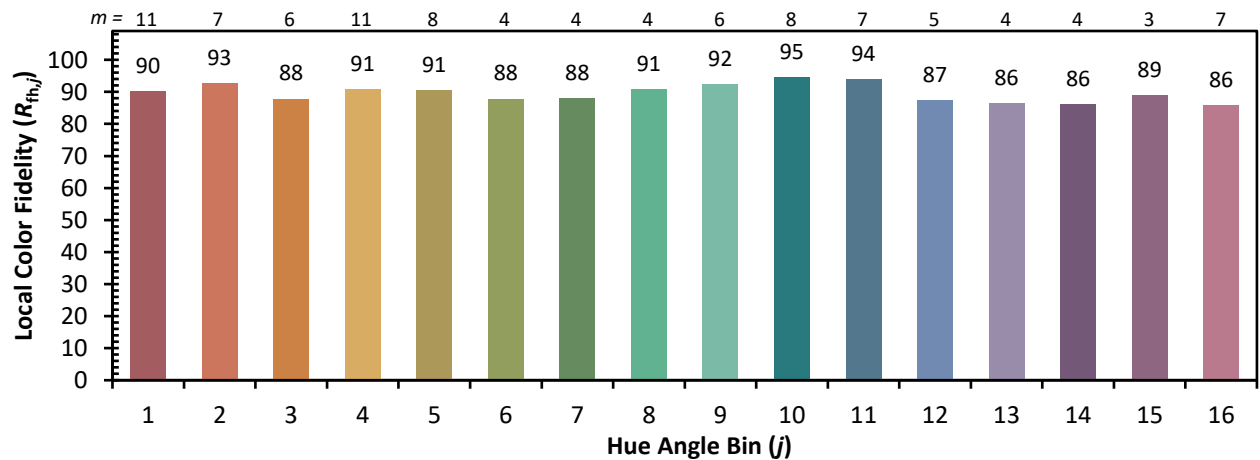
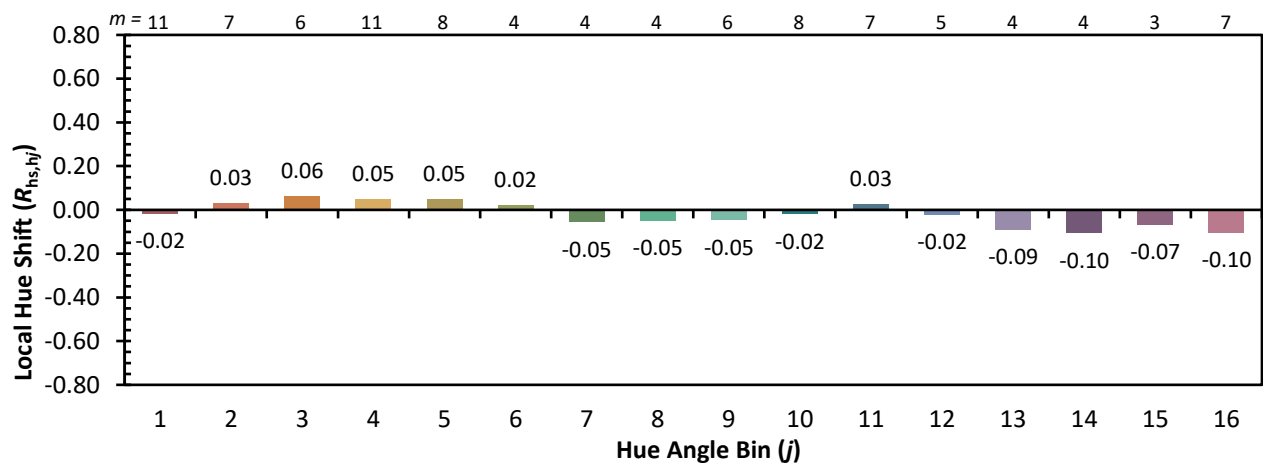
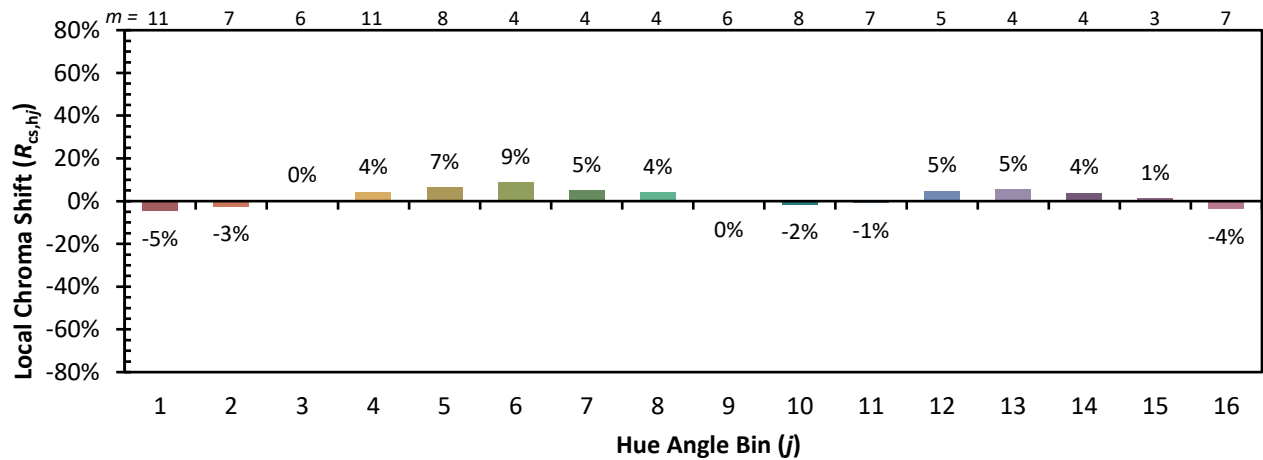


**Individual Sample Fidelity Index ( $R_{f,i}$ )**

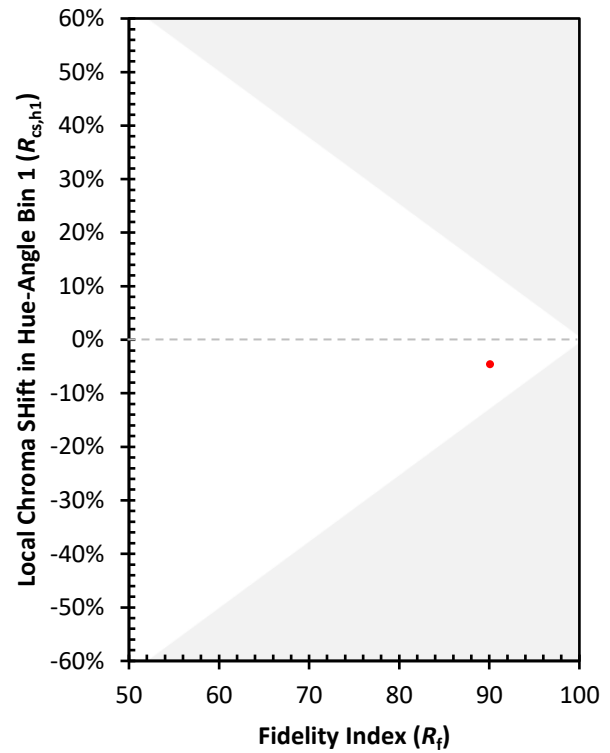
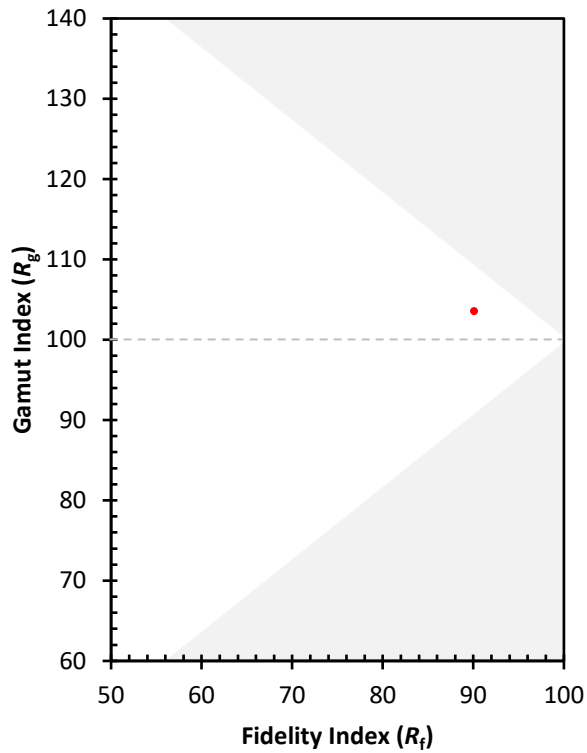
|            |            |            |            |
|------------|------------|------------|------------|
| CES01 = 86 | CES26 = 89 | CES51 = 92 | CES76 = 90 |
| CES02 = 64 | CES27 = 97 | CES52 = 92 | CES77 = 84 |
| CES03 = 32 | CES28 = 96 | CES53 = 88 | CES78 = 87 |
| CES04 = 71 | CES29 = 83 | CES54 = 97 | CES79 = 88 |
| CES05 = 51 | CES30 = 85 | CES55 = 95 | CES80 = 91 |
| CES06 = 51 | CES31 = 85 | CES56 = 89 | CES81 = 69 |
| CES07 = 44 | CES32 = 80 | CES57 = 87 | CES82 = 95 |
| CES08 = 43 | CES33 = 84 | CES58 = 88 | CES83 = 91 |
| CES09 = 29 | CES34 = 91 | CES59 = 98 | CES84 = 97 |
| CES10 = 77 | CES35 = 96 | CES60 = 99 | CES85 = 81 |
| CES11 = 59 | CES36 = 98 | CES61 = 99 | CES86 = 75 |
| CES12 = 66 | CES37 = 93 | CES62 = 91 | CES87 = 91 |
| CES13 = 45 | CES38 = 89 | CES63 = 90 | CES88 = 94 |
| CES14 = 74 | CES39 = 95 | CES64 = 93 | CES89 = 80 |
| CES15 = 72 | CES40 = 91 | CES65 = 92 | CES90 = 93 |
| CES16 = 48 | CES41 = 89 | CES66 = 92 | CES91 = 91 |
| CES17 = 50 | CES42 = 89 | CES67 = 93 | CES92 = 80 |
| CES18 = 57 | CES43 = 85 | CES68 = 97 | CES93 = 88 |
| CES19 = 72 | CES44 = 98 | CES69 = 98 | CES94 = 72 |
| CES20 = 68 | CES45 = 90 | CES70 = 93 | CES95 = 88 |
| CES21 = 87 | CES46 = 89 | CES71 = 95 | CES96 = 92 |
| CES22 = 79 | CES47 = 79 | CES72 = 98 | CES97 = 90 |
| CES23 = 92 | CES48 = 87 | CES73 = 89 | CES98 = 91 |
| CES24 = 91 | CES49 = 87 | CES74 = 88 | CES99 = 92 |
| CES25 = 72 | CES50 = 92 | CES75 = 94 |            |



### Color Rendition by Hue-Angle Bin



**Measure Comparisons**



(END OF REPORT)