NVLAP Lab Code 500077-0

**Report Number:** PL08598-001A

**Model:** ZR14M-40L-35K-10V-FD

**Date:** 6/22/2016

# Cree Engineering Services Testing Laboratory (CESTL) Photometric Testing and Evaluation Report

**Prepared For:**

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**Approved By:**

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This report contains data that are not covered by the NVLAP accreditation. This report also contains goniometric data that was produced under subcontract by Cree Durham Technology Center, NVLAP Lab Code 500070-0.

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| Product Information | |
|---|---|
| **Manufacturer** | Cree Inc |
| **Model Number (SKU)** | ZR14M-40L-35K-10V-FD |
| **Serial Number** | WK191A02839 |
| **LED Type** | XH-G2 |

## Product Description

1 x 4 Troffer with a white painted aluminum reflector and body, and curved diffuse lens.

## Driver Information (Where Applicable)

Integral

| Length | Width |
|---|---|
| 48” | 12” |

## Sample

The following sample was submitted for evaluation

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| Key Photometric Data | Sphere Output | Goniophotometer | |
|---|---|---|---|
| Luminous Flux | 4018.0 | 3976.0 | lm |
| Efficacy | 131.39 | 130.10 | lm/W |
| Correlated Color Temperature (CCT) | 3429 | | K |
| Color Rendering Index (CRI) | 83 | | |
| $R_9$ | 15 | | |
| Duv | 0.000245 | | |
| S/P Ratio* | 1.46 | | |

| | Sphere | | Goniophotometer | | |
|---|---|---|---|---|---|
| **Electrical Measurements** | **120V** | **277V** | **120V** | **277V** | |
| Input Wattage | 30.58 | 30.31 | 30.56 | 30.23 | W |
| Input Current | 0.26 | 0.12 | 0.26 | 0.12 | A |
| Input Voltage | 119.98 | 277.01 | 119.99 | 277.06 | V |
| Power Factor | 0.990 | 0.927 | 0.989 | 0.923 | |
| Off-State Power | 0 | 0 | 0 | 0 | W |
| Total Harmonic Distortion (Voltage) | 0.06 | 0.06 | 0.07 | 0.07 | % |
| Total Harmonic Distortion (Amperage) | 7.73 | 16.91 | 7.46 | 16.77 | % |

**Note:** All photometric measurements taken at 120VAC.

| Luminous Intensity Distribution | Goniophotometer | |
|---|---|---|
| Maximum Candela | 1373.3 | Cd |
| Horizontal Angle of Max Candela | 67.5 | ˚ |
| Vertical Angle of Max Candela | 2.5 | ˚ |
| Zonal Lumens (0˚ – 30˚) | 1056.5 (26.6) | lm (%) |
| Zonal Lumens (0˚ – 40˚) | 1735.4 (43.6) | lm (%) |
| Zonal Lumens (0˚ – 60˚) | 3099.2 (77.9) | lm (%) |
| Zonal Lumens (60˚ – 90˚) | 876.7 (22.1) | lm (%) |
| Color Angular Uniformity | NA | |

| Key Test Parameters | Sphere Output | Goniophotometer | |
|---|---|---|---|
| Stabilization Time | 32 | 60 | min |
| Total Operating Time (Stabilization + Test) | 32 | 80 | min |
| Ambient Temperature | 25.0 | 24.9 | ˚C |

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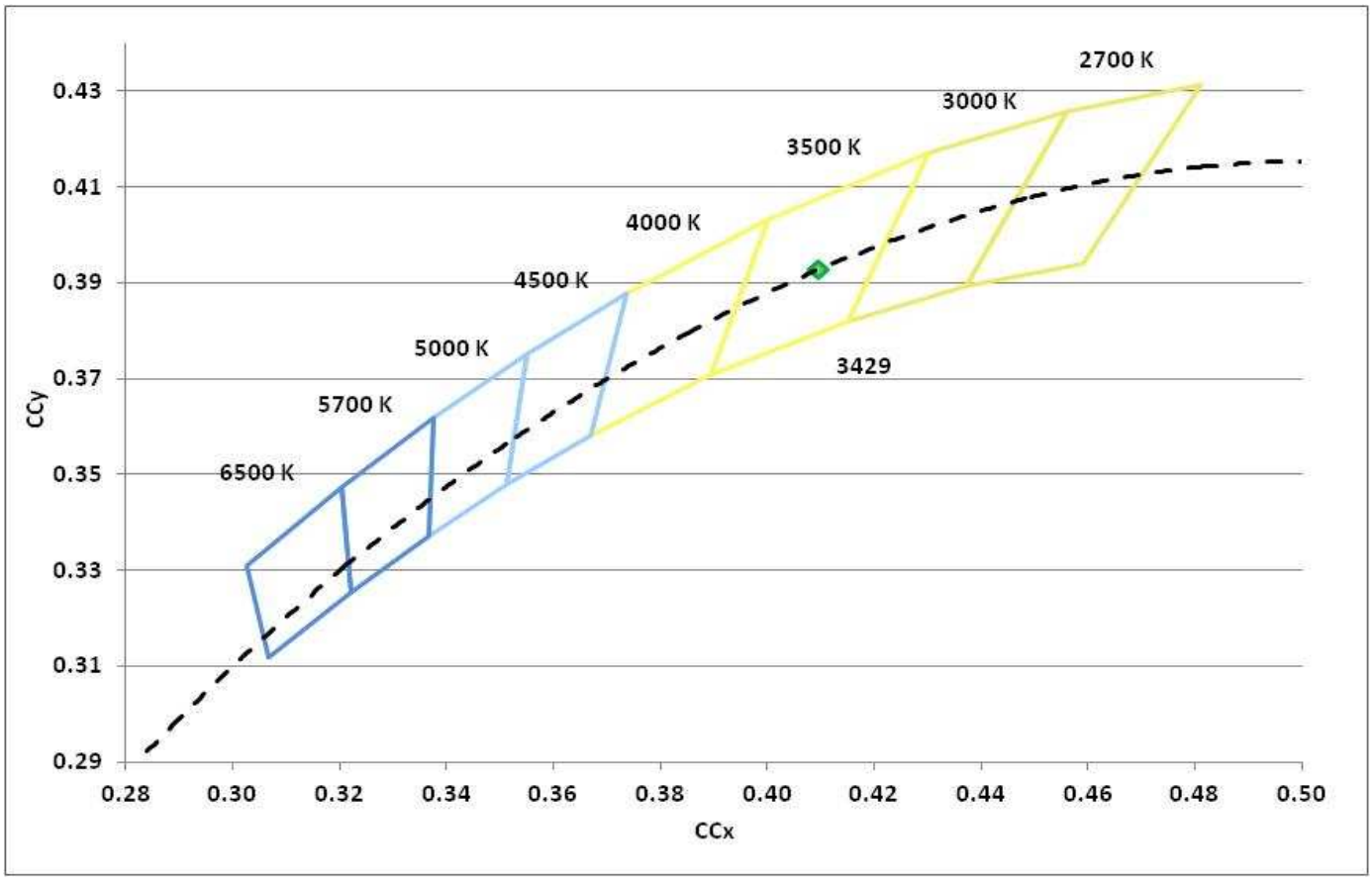
## Chromaticity Coordinates

| x | y | u | v | u' | v' | Duv |
|---|---|---|---|---|---|---|
| 0.4094 | 0.3931 | 0.2374 | 0.3420 | 0.2374 | 0.5129 | 0.000245 |

## Color Rendering Index Details

| Ra | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 | R11 | R12 | R13 | R14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 83 | 81 | 88 | 93 | 82 | 81 | 83 | 86 | 66 | 15 | 71 | 81 | 62 | 83 | 96 |

## Chromaticity Diagram



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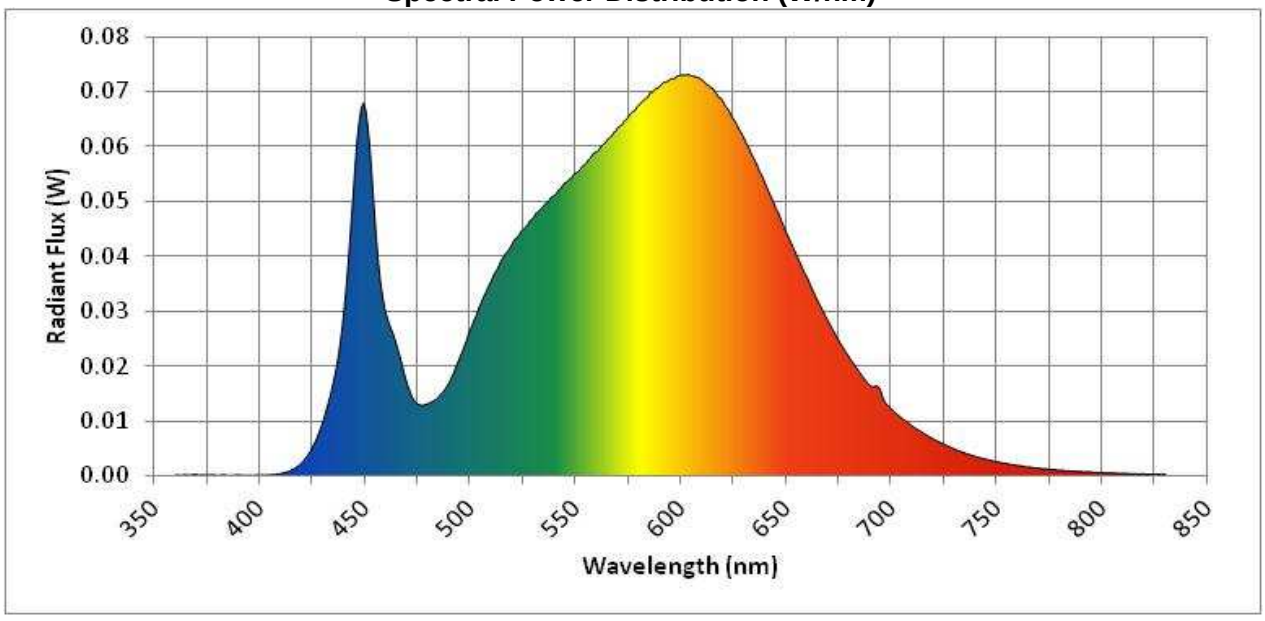
## Spectral Distribution

| λ(nm) | W/nm | λ(nm) | W/nm | λ(nm) | W/nm |
|---|---|---|---|---|---|
| 360 | 0.000164 | 530 | 0.047184 | 700 | 0.012182 |
| 370 | 0.000220 | 540 | 0.051263 | 710 | 0.009079 |
| 380 | 0.000042 | 550 | 0.055284 | 720 | 0.006715 |
| 390 | 0.000151 | 560 | 0.059173 | 730 | 0.004889 |
| 400 | 0.000129 | 570 | 0.063602 | 740 | 0.003549 |
| 410 | 0.000450 | 580 | 0.067655 | 750 | 0.002588 |
| 420 | 0.002531 | 590 | 0.071118 | 760 | 0.001871 |
| 430 | 0.010152 | 600 | 0.073163 | 770 | 0.001432 |
| 440 | 0.030837 | 610 | 0.072181 | 780 | 0.001058 |
| 450 | 0.066871 | 620 | 0.068216 | 790 | 0.000837 |
| 460 | 0.029224 | 630 | 0.061524 | 800 | 0.000610 |
| 470 | 0.016548 | 640 | 0.053315 | 810 | 0.000462 |
| 480 | 0.013214 | 650 | 0.044417 | 820 | 0.000366 |
| 490 | 0.017212 | 660 | 0.036135 | 830 | 0.000371 |
| 500 | 0.026826 | 670 | 0.028177 | | |
| 510 | 0.035684 | 680 | 0.021578 | | |
| 520 | 0.042562 | 690 | 0.016498 | | |

| | | |
|---|---|---|
| **Dominant Wavelength** | 581 | nm |
| **Peak Wavelength:** | 603 | nm |

## Spectral Power Distribution (W/nm)



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**Zonal Lumen Summary ****

| Zone | Lumens | % of Total | Zone | Lumens | % of Total |
|---|---|---|---|---|---|
| 0-5 | 32.4 | 0.8% | 90-95 | 0 | 0% |
| 5-10 | 96.0 | 2.4% | 95-100 | 0 | 0% |
| 10-15 | 156.3 | 3.9% | 100-105 | 0 | 0% |
| 15-20 | 211.7 | 5.3% | 105-110 | 0 | 0% |
| 20-25 | 260.2 | 6.5% | 110-115 | 0 | 0% |
| 25-30 | 300.0 | 7.5% | 115-120 | 0 | 0% |
| 30-35 | 329.9 | 8.3% | 120-125 | 0 | 0% |
| 35-40 | 349.0 | 8.8% | 125-130 | 0 | 0% |
| 40-45 | 356.7 | 9.0% | 130-135 | 0 | 0% |
| 45-50 | 353.2 | 8.9% | 135-140 | 0 | 0% |
| 50-55 | 339.1 | 8.5% | 140-145 | 0 | 0% |
| 55-60 | 314.9 | 7.9% | 145-150 | 0 | 0% |
| 60-65 | 279.4 | 7.0% | 150-155 | 0 | 0% |
| 65-70 | 232.1 | 5.8% | 155-160 | 0 | 0% |
| 70-75 | 175.7 | 4.4% | 160-165 | 0 | 0% |
| 75-80 | 115.9 | 2.9% | 165-170 | 0 | 0% |
| 80-85 | 59.3 | 1.5% | 170-175 | 0 | 0% |
| 85-90 | 14.3 | 0.4% | 175-180 | 0 | 0% |
| | | | **Total** | **3976 lm** | **100%** |

**Spacing Criteria ****

| | |
|---|---|
| **Spacing Criterion (0 - 180)** | 1.24 |
| **Spacing Criterion (90 - 270)** | 1.30 |
| **Spacing Criterion (Diagonal)** | 1.40 |

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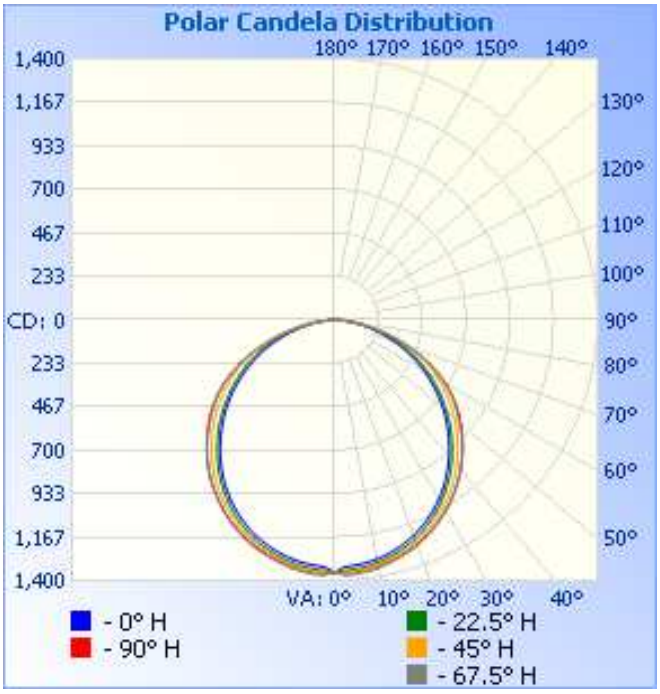
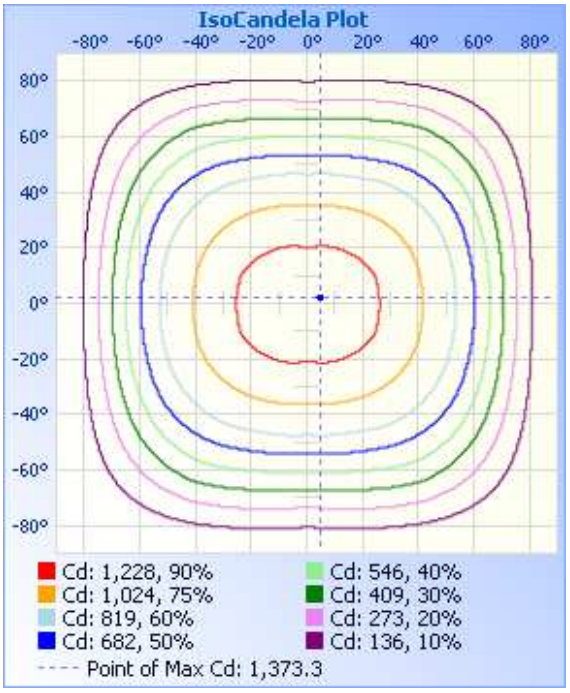
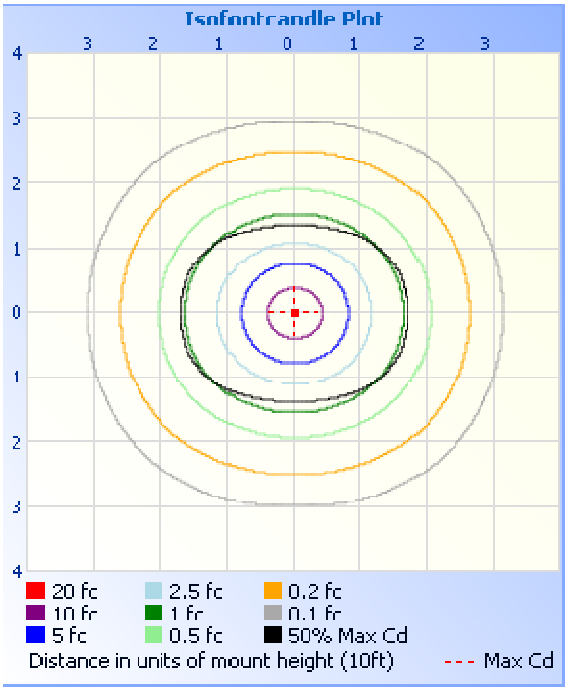
## Candela Plots **




## Isofootcandle Plot **



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## Candela Tabulations **

| | 0 | 22.5 | 45 | 67.5 | 90 |
|---|---|---|---|---|---|
| 0 | 1354 | 1354 | 1354 | 1354 | 1354 |
| 2.5 | 1326 | 1347 | 1358 | 1373 | 1361 |
| 5 | 1322 | 1342 | 1353 | 1370 | 1358 |
| 7.5 | 1314 | 1334 | 1345 | 1362 | 1350 |
| 10 | 1304 | 1322 | 1335 | 1352 | 1340 |
| 12.5 | 1290 | 1309 | 1322 | 1338 | 1328 |
| 15 | 1273 | 1292 | 1306 | 1323 | 1314 |
| 17.5 | 1254 | 1273 | 1288 | 1307 | 1298 |
| 20 | 1231 | 1251 | 1267 | 1288 | 1280 |
| 22.5 | 1205 | 1226 | 1245 | 1266 | 1258 |
| 25 | 1177 | 1198 | 1219 | 1241 | 1235 |
| 27.5 | 1146 | 1167 | 1190 | 1214 | 1209 |
| 30 | 1111 | 1133 | 1158 | 1184 | 1181 |
| 32.5 | 1074 | 1096 | 1125 | 1153 | 1150 |
| 35 | 1035 | 1057 | 1090 | 1119 | 1118 |
| 37.5 | 993 | 1016 | 1052 | 1082 | 1082 |
| 40 | 949 | 973 | 1012 | 1044 | 1045 |
| 42.5 | 904 | 928 | 971 | 1004 | 1006 |
| 45 | 857 | 881 | 928 | 962 | 965 |
| 47.5 | 809 | 833 | 883 | 918 | 922 |
| 50 | 760 | 784 | 837 | 872 | 878 |
| 52.5 | 710 | 735 | 789 | 826 | 834 |
| 55 | 658 | 684 | 742 | 780 | 788 |
| 57.5 | 606 | 633 | 692 | 732 | 737 |
| 60 | 553 | 582 | 642 | 678 | 682 |
| 62.5 | 500 | 530 | 592 | 620 | 622 |
| 65 | 447 | 477 | 538 | 558 | 558 |
| 67.5 | 393 | 423 | 480 | 492 | 489 |
| 70 | 339 | 370 | 419 | 424 | 417 |
| 72.5 | 285 | 319 | 357 | 354 | 345 |
| 75 | 234 | 268 | 294 | 284 | 275 |
| 77.5 | 185 | 216 | 232 | 219 | 211 |
| 80 | 139 | 164 | 172 | 158 | 150 |
| 82.5 | 96 | 115 | 117 | 103 | 97 |
| 85 | 58 | 69 | 66 | 55 | 52 |
| 87.5 | 24 | 27 | 22 | 17 | 16 |
| 90 | 0 | 0 | 0 | 0 | 0 |

## Candela Tabulations (Continued) **

| | 0 | 22.5 | 45 | 67.5 | 90 |
|---|---|---|---|---|---|
| 92.5 | 0 | 0 | 0 | 0 | 0 |
| 95 | 0 | 0 | 0 | 0 | 0 |
| 97.5 | 0 | 0 | 0 | 0 | 0 |
| 100 | 0 | 0 | 0 | 0 | 0 |
| 102.5 | 0 | 0 | 0 | 0 | 0 |
| 105 | 0 | 0 | 0 | 0 | 0 |
| 107.5 | 0 | 0 | 0 | 0 | 0 |
| 110 | 0 | 0 | 0 | 0 | 0 |
| 112.5 | 0 | 0 | 0 | 0 | 0 |
| 115 | 0 | 0 | 0 | 0 | 0 |
| 117.5 | 0 | 0 | 0 | 0 | 0 |
| 120 | 0 | 0 | 0 | 0 | 0 |
| 122.5 | 0 | 0 | 0 | 0 | 0 |
| 125 | 0 | 0 | 0 | 0 | 0 |
| 127.5 | 0 | 0 | 0 | 0 | 0 |
| 130 | 0 | 0 | 0 | 0 | 0 |
| 132.5 | 0 | 0 | 0 | 0 | 0 |
| 135 | 0 | 0 | 0 | 0 | 0 |
| 137.5 | 0 | 0 | 0 | 0 | 0 |
| 140 | 0 | 0 | 0 | 0 | 0 |
| 142.5 | 0 | 0 | 0 | 0 | 0 |
| 145 | 0 | 0 | 0 | 0 | 0 |
| 147.5 | 0 | 0 | 0 | 0 | 0 |
| 150 | 0 | 0 | 0 | 0 | 0 |
| 152.5 | 0 | 0 | 0 | 0 | 0 |
| 155 | 0 | 0 | 0 | 0 | 0 |
| 157.5 | 0 | 0 | 0 | 0 | 0 |
| 160 | 0 | 0 | 0 | 0 | 0 |
| 162.5 | 0 | 0 | 0 | 0 | 0 |
| 165 | 0 | 0 | 0 | 0 | 0 |
| 167.5 | 0 | 0 | 0 | 0 | 0 |
| 170 | 0 | 0 | 0 | 0 | 0 |
| 172.5 | 0 | 0 | 0 | 0 | 0 |
| 175 | 0 | 0 | 0 | 0 | 0 |
| 177.5 | 0 | 0 | 0 | 0 | 0 |
| 180 | 0 | 0 | 0 | 0 | 0 |

### Integrating Sphere Equipment List

| Description | Manufacturer | Model | Serial Number |
|---|---|---|---|
| 3M Sphere | Labsphere | CSTM-CSLMS-3M98-HDS | 82456 |
| CCD Array Spectrometer | Otsuka | MC-9801 | 98010165 |
| Programmable AC Source | Chroma | 61603 | 616030000761 |
| Single Channel Power Analyzer | Xitron | 2801 | 28011110008 |
| Aux Lamp Power Supply | Labsphere | LPS-100-0833 | 1002104538 |

### Goniophotometer Equipment List

| Description | Manufacturer | Model | Serial Number |
|---|---|---|---|
| AC Power Source | Adaptive | FC210 | 2300229 |
| AC Power Source | Elgar | CW1251 | 1126A06399 |
| Type C Goniophotometer | LSI / UL | 6440T | 6440TE0192T |
| Spectroradiometer | Gooch & Housego | 770VIS/NIR | 11414155 |
| Power Meter | Yokogawa | WT210 | 91L220953 |

### Test Methods Used:

| Title | Description |
|---|---|
| ANSI C82.77:2002 | Harmonic Emission Limits- Related Power Quality Reqt's for Lighting Equipment |
| CIE Pub. 13.3:1995 | Method of Measuring and Specifying Color Rendering of Light Sources |
| CIE Pub. 15:2004 | Colorimetry |
| IES LM-58:1994 | Spectroradiometric Measurements |
| IES LM-65:2001 | Single-Ended Compact Fluorescent Lamps – Life Test Performance |
| IES LM-79:2008 | Electrical and Photometric Measurements of Solid-State Lighting Products |

### Reference Standard Used:

| Equipment | Description |
|---|---|
| 3m Sphere | Tungsten Halogen Omni-Directional 75W Calibration Lamp, Serial Number K142 |
| Type C Goniophotometer | Tungsten Halogen Omni-Directional 500W Calibration Lamp, Serial Number 97A |

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The results contained in this report pertain only to the tested sample.

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* Items marked with a single asterisk are not covered by the NVLAP accreditation.

In the event that the recorded temperature is outside of 25 ± 1˚C, this is considered a non-standard condition.

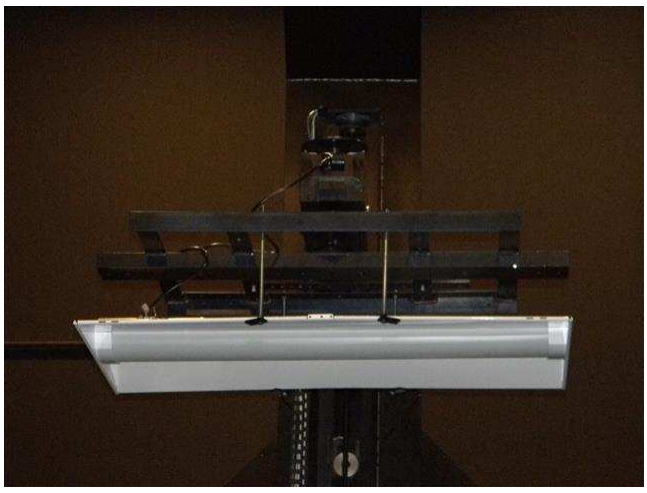
** In the event that testing is subcontracted, test results in this report marked with the symbol **, or noted as "Goniophotometer", were performed by the subcontracted laboratory identified in the footer on the first page of this report. Subcontracted testing is strictly goniophotometer based. All other tests are performed using an integrating sphere.

The goniophotometer information in the equipment list, report items marked with **, or results specifically identified as "Goniophotometer", are the actual equipment used, and test results produced, by the subcontracted laboratory.

**Additional Comments:** This luminaire was tested in the base up orientation.

**Sphere picture**

**Goniophotometer Picture**



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**Document Revision History:**

Each subsequent revision of this report replaces the preceding report.

| Date | Rev | DCN # | Change at the time of this test | By | Approval |
|---|---|---|---|---|---|
| 06/22/16 | A | DMS | Origination | A. Gressel | C. McLaurin |