

Goniophotometry Report

1_PHOT_NINETY-NINE-2000lmChip-2700K-38Deg_2303
www.factorylux.com



Tested Light Source - 1_PHOT_NINETY-NINE-2000lmChip-2700K-38Deg_2303

Laboratory and Equipment

Laboratory Owner and Location
Goniospectrometer System and Type
Spectrometer Manufacturer and Model

Factorylux, Greenhill Mills, Hebden Bridge, HX7 5QF, UK
BaseSpion – Type C, horizontal
Ibsen Photonics, Denmark – Freedom VIS (Custom Viso)

Measurement Conditions

Number of C-planes and Resolution
 γ (gamma)-Resolution
Test Distance
Input Power, Power and Displ. Factors
Input RMS Voltage and Current
Frequency of Input Power

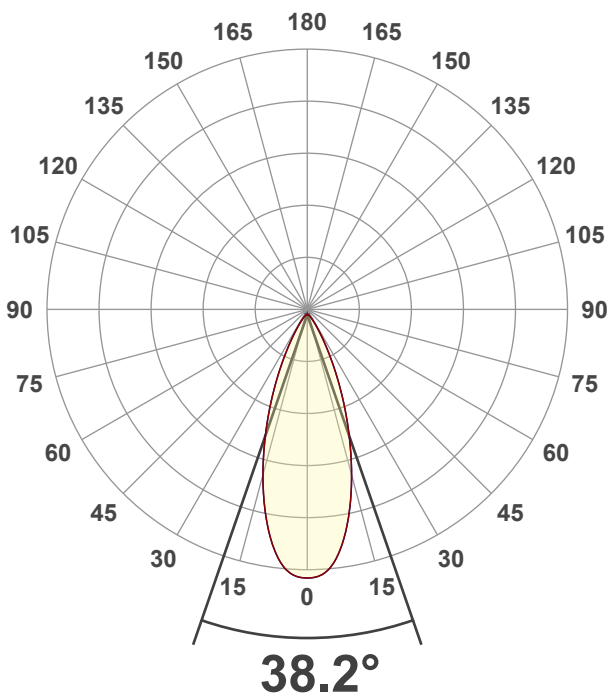
32 planes – 11.25°
1.5°
1.50 m
15.9 W – PF 0.98 – DPF 0.98
239 V – 0.068 A
50 Hz

Main Light Measurement Results

Output
Efficiency
Peak Intensity and Beam Angle
Color Rendering Index

1462 lm
92 lm/W
2871 cd – 38.2°
CRI 92.7

Light Intensity Distribution



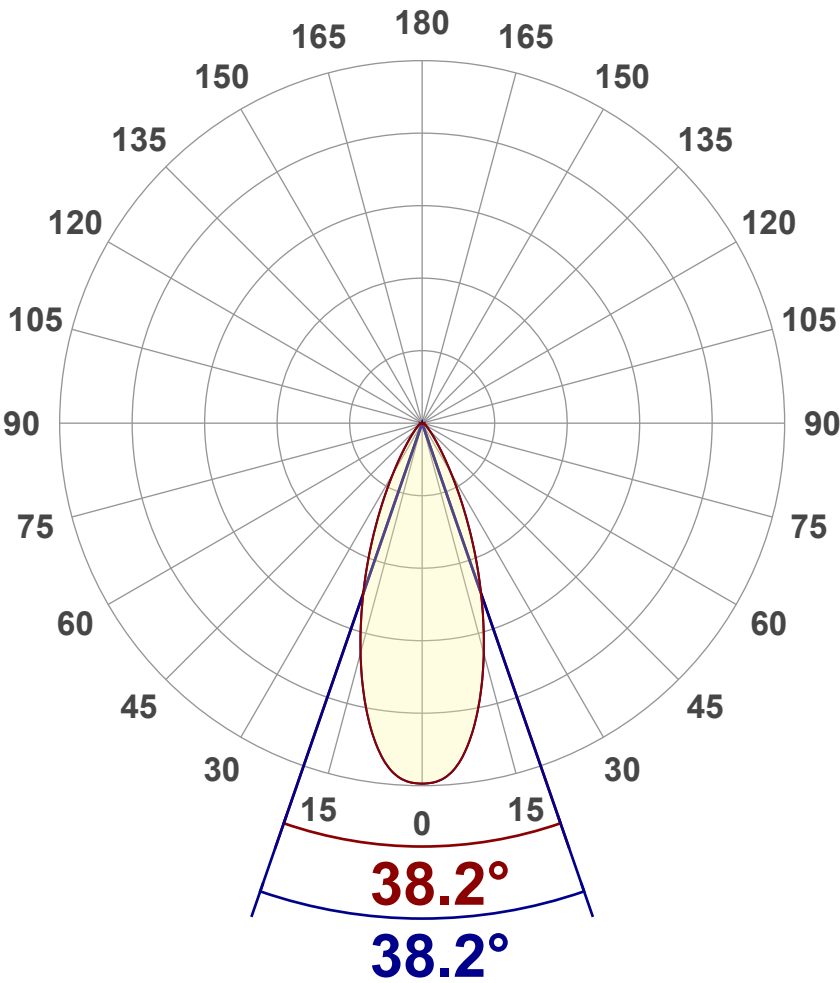
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Luminous Intensity diagram

Unit: 0-100% of peak intensity



Main Values

| | |
|----------------------|---------|
| Output (total Lumen) | 1462 lm |
| Peak Intensity | 2871 cd |
| Beam Angle (50%) | 38.2° |
| Beam Angle (90%) | 38.2° |
| Beam Angle (10%) | 38.2° |

Cut-off Angle

| | |
|--------------|-----|
| Average 2,5% | 94° |
|--------------|-----|

Field Angle

| | |
|-------------|-------|
| Average 10% | 67.6° |
|-------------|-------|

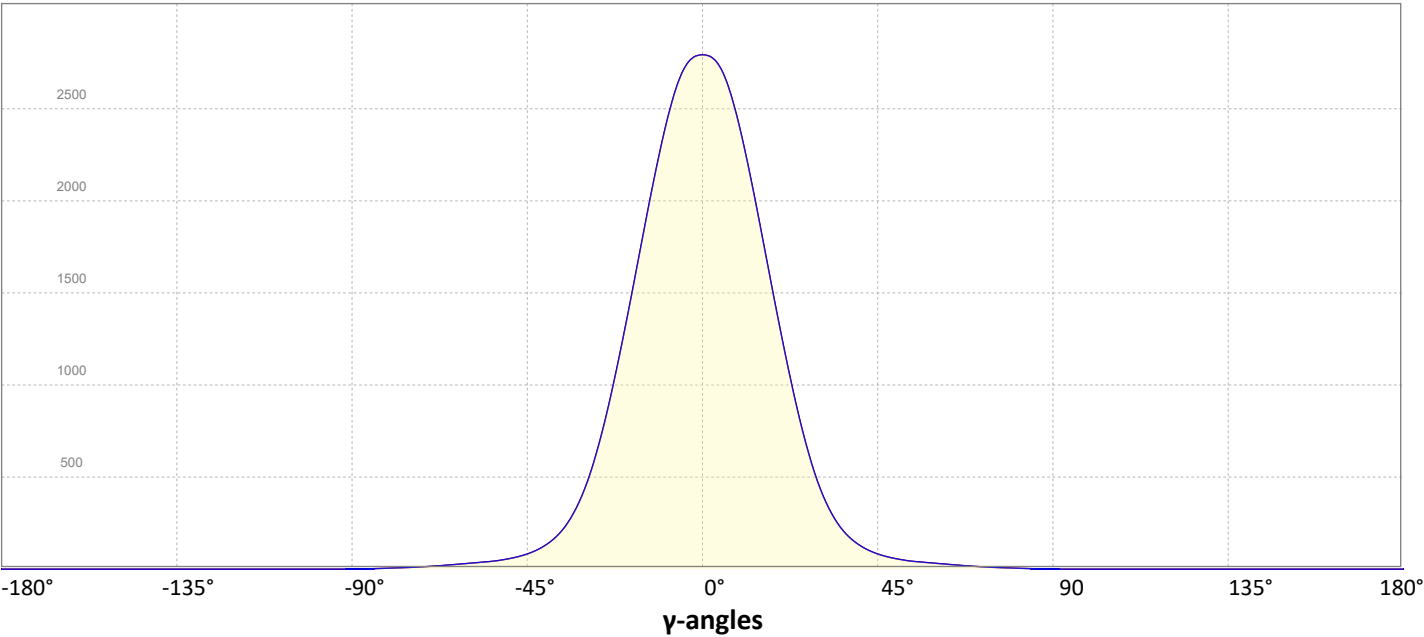
Intensity Ratio

| | |
|--------------|-------|
| In 120° cone | 97.5% |
| In 90° cone | 92.9% |

C000-C180

C090-C270

Linear distribution diagram - Intensity (candela) vs γ-angle

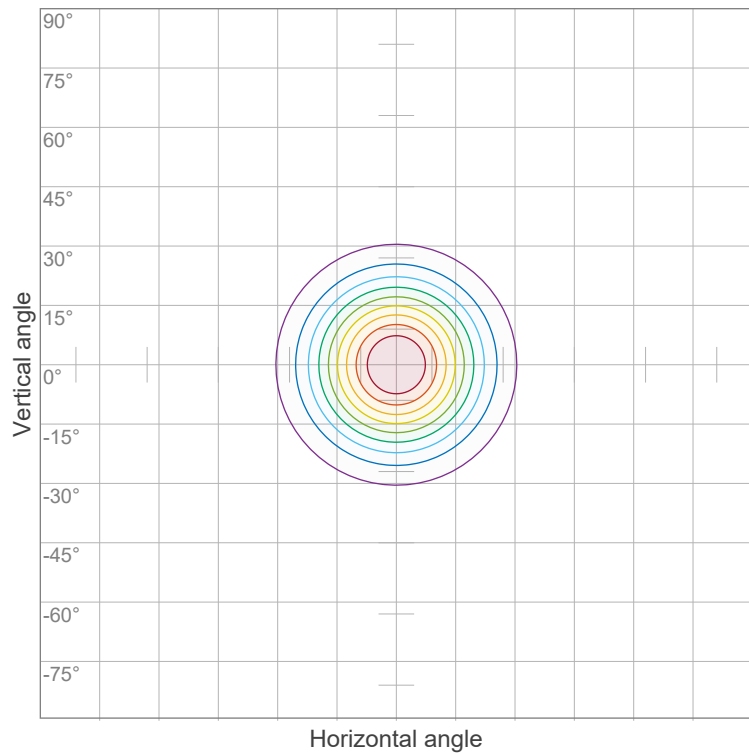


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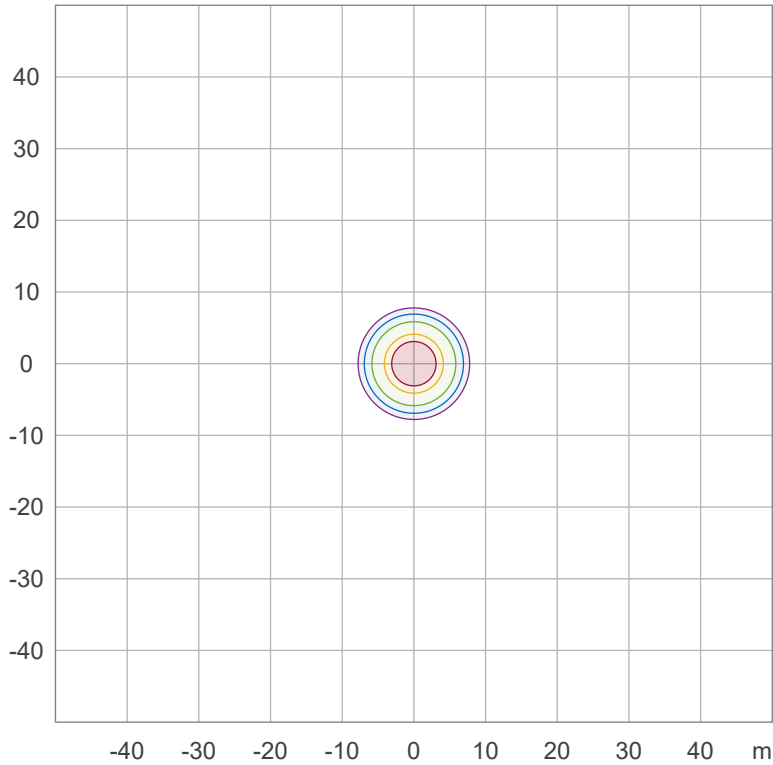
Iso-intensity Diagram (Iso-candela)



| | |
|------|-----------|
| 90 % | 2583.7 cd |
| 80 % | 2296.6 cd |
| 70 % | 2009.5 cd |
| 60 % | 1722.5 cd |
| 50 % | 1435.4 cd |
| 40 % | 1148.3 cd |
| 30 % | 861.2 cd |
| 20 % | 574.2 cd |
| 10 % | 287.1 cd |

Peak intensity: 2870.8 cd
Number of c-planes: 32

Iso-illuminance Diagram (Iso-lux)



| | |
|--------|---------|
| 50.0 % | 14.4 lx |
| 30.0 % | 8.6 lx |
| 10.0 % | 2.9 lx |
| 5.0 % | 1.4 lx |
| 3.0 % | 0.9 lx |

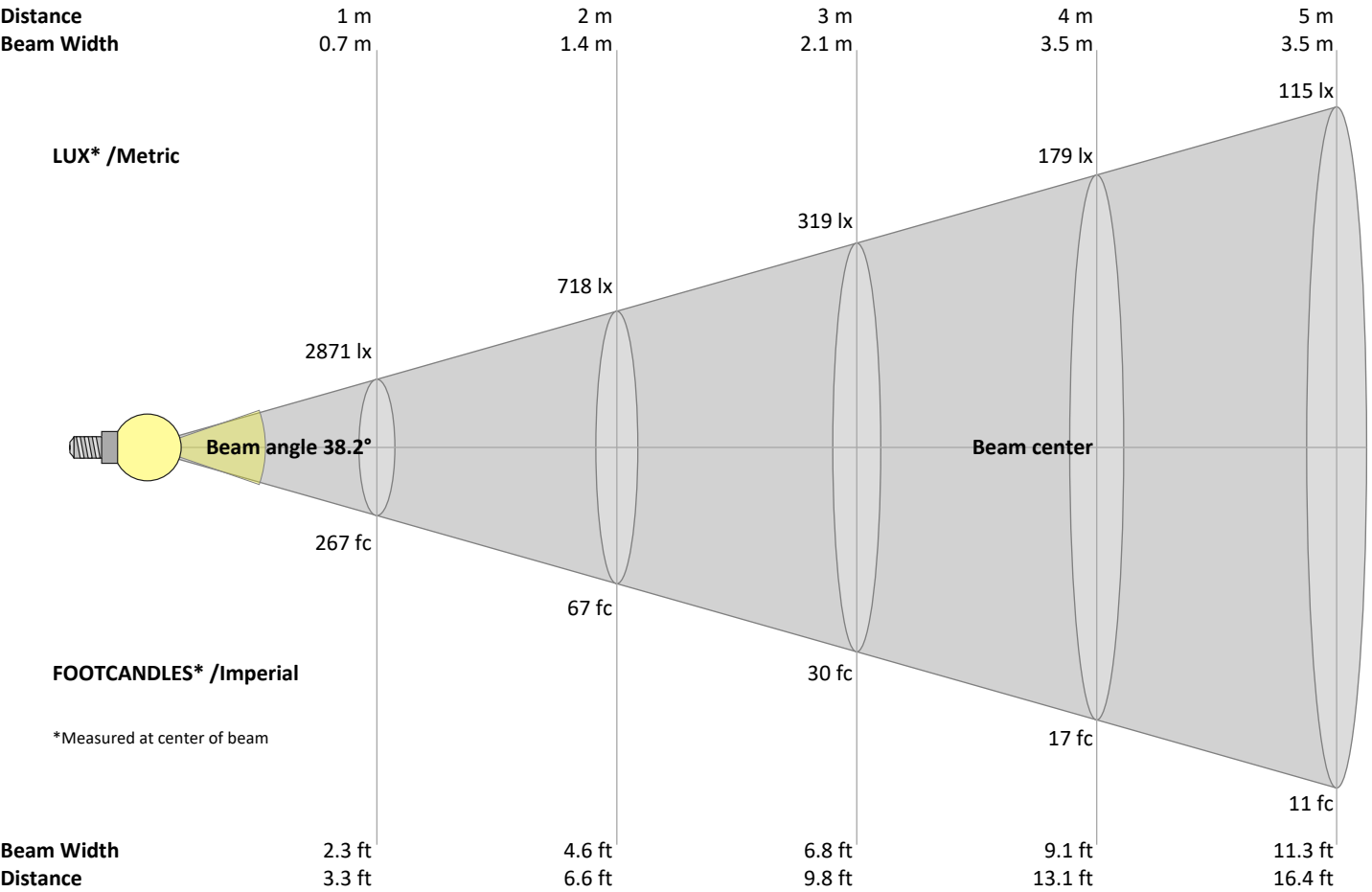
Peak illuminance: 28.7 lx
Mounting height: 10.0 m
Number of c-planes: 32

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Beam Details



Beam intensities from 1 – 20 m

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | m |
|-------|------|------|------|------|------|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|
| 3.3 | 6.6 | 9.8 | 13.1 | 16.4 | 19.7 | 23 | 26.2 | 29.5 | 32.8 | 36.1 | 39.4 | 42.7 | 45.9 | 49.2 | 52.5 | 55.8 | 59.1 | 62.3 | 65.6 | ft |
| 2871 | 718 | 319 | 179 | 115 | 80 | 59 | 45 | 35 | 29 | 24 | 20 | 17 | 15 | 13 | 11 | 10 | 9 | 8 | 7 | lux |
| 266.7 | 66.7 | 29.6 | 16.7 | 10.7 | 7.4 | 5.4 | 4.2 | 3.3 | 2.7 | 2.2 | 1.9 | 1.6 | 1.4 | 1.2 | 1 | 0.9 | 0.8 | 0.7 | 0.7 | fc |

Intensities in 0° c-plane

| 0° | 2° | 4° | 6° | 8° | 10° | 12° | 14° | 16° | 18° | 20° | 22° | 24° | 26° | 28° | 30° | 32° | 34° | 36° | 38° | γ |
|------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|----------|
| 2871 | 2861 | 2818 | 2730 | 2596 | 2423 | 2224 | 2008 | 1782 | 1555 | 1335 | 1124 | 926 | 748 | 594 | 464 | 361 | 281 | 218 | 173 | cd |
| 100% | 100% | 98% | 95% | 90% | 84% | 77% | 70% | 62% | 54% | 46% | 39% | 32% | 26% | 21% | 16% | 13% | 10% | 8% | 6% | of 0°val |

Intensities in 90° c-plane

| 0° | 2° | 4° | 6° | 8° | 10° | 12° | 14° | 16° | 18° | 20° | 22° | 24° | 26° | 28° | 30° | 32° | 34° | 36° | 38° | γ |
|------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|----------|
| 2871 | 2861 | 2818 | 2730 | 2596 | 2423 | 2224 | 2008 | 1782 | 1555 | 1335 | 1124 | 926 | 748 | 594 | 464 | 361 | 281 | 218 | 173 | cd |
| 100% | 100% | 98% | 95% | 90% | 84% | 77% | 70% | 62% | 54% | 46% | 39% | 32% | 26% | 21% | 16% | 13% | 10% | 8% | 6% | of 0°val |

Intensities in 180° c-plane

| 0° | 2° | 4° | 6° | 8° | 10° | 12° | 14° | 16° | 18° | 20° | 22° | 24° | 26° | 28° | 30° | 32° | 34° | 36° | 38° | γ |
|------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|----------|
| 2871 | 2861 | 2818 | 2730 | 2596 | 2423 | 2224 | 2008 | 1782 | 1555 | 1335 | 1124 | 926 | 748 | 594 | 464 | 361 | 281 | 218 | 173 | cd |
| 100% | 100% | 98% | 95% | 90% | 84% | 77% | 70% | 62% | 54% | 46% | 39% | 32% | 26% | 21% | 16% | 13% | 10% | 8% | 6% | of 0°val |

Intensities in 270° c-plane

| 0° | 2° | 4° | 6° | 8° | 10° | 12° | 14° | 16° | 18° | 20° | 22° | 24° | 26° | 28° | 30° | 32° | 34° | 36° | 38° | γ |
|------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|----------|
| 2871 | 2861 | 2818 | 2730 | 2596 | 2423 | 2224 | 2008 | 1782 | 1555 | 1335 | 1124 | 926 | 748 | 594 | 464 | 361 | 281 | 218 | 173 | cd |
| 100% | 100% | 98% | 95% | 90% | 84% | 77% | 70% | 62% | 54% | 46% | 39% | 32% | 26% | 21% | 16% | 13% | 10% | 8% | 6% | of 0°val |

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Light Planning – UGR table

Uncorrected, comprehensive UGR table according to 117-1995

| Reflectances | | | | | | | | | | | |
|-------------------------------------|-----------|--|------|------|------|------|--|------|------|------|------|
| | p Ceiling | 70 | 70 | 50 | 50 | 30 | 70 | 70 | 50 | 50 | 30 |
| | p Walls | 50 | 30 | 50 | 30 | 30 | 50 | 30 | 50 | 30 | 30 |
| | p Floor | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Room size | | Viewed Crosswise | | | | | Viewed Endwise | | | | |
| H = mounting height above eye level | | (Viewing direction orthogonal to lamp length axis) | | | | | (Viewing direction parallel to lamp length axis) | | | | |
| X | Y | | | | | | | | | | |
| 2H | 2H | 19.0 | 19.6 | 19.1 | 19.8 | 20.0 | 19.0 | 19.6 | 19.1 | 19.8 | 20.0 |
| | 3H | 19.3 | 20.0 | 19.7 | 20.2 | 20.4 | 19.3 | 20.0 | 19.7 | 20.2 | 20.4 |
| | 4H | 19.4 | 20.1 | 19.8 | 20.4 | 20.6 | 19.4 | 20.1 | 19.8 | 20.4 | 20.6 |
| | 6H | 19.6 | 20.2 | 19.9 | 20.5 | 20.8 | 19.6 | 20.2 | 19.9 | 20.5 | 20.8 |
| | 8H | 19.6 | 20.2 | 20.0 | 20.5 | 20.9 | 19.6 | 20.2 | 20.0 | 20.5 | 20.9 |
| | 12H | 19.6 | 20.2 | 20.0 | 20.5 | 21.0 | 19.6 | 20.2 | 20.0 | 20.5 | 21.0 |
| 4H | 2H | 19.0 | 19.7 | 19.4 | 19.9 | 20.2 | 19.0 | 19.7 | 19.4 | 19.9 | 20.2 |
| | 3H | 19.6 | 20.2 | 20.0 | 20.5 | 21.0 | 19.6 | 20.2 | 20.0 | 20.5 | 21.0 |
| | 4H | 19.8 | 20.3 | 20.2 | 20.7 | 21.3 | 19.8 | 20.3 | 20.2 | 20.7 | 21.3 |
| | 6H | 20.0 | 20.5 | 20.5 | 20.9 | 21.2 | 20.0 | 20.5 | 20.5 | 20.9 | 21.2 |
| | 8H | 20.0 | 20.5 | 20.5 | 20.9 | 21.2 | 20.0 | 20.5 | 20.5 | 20.9 | 21.2 |
| | 12H | 20.0 | 20.4 | 20.5 | 20.8 | 21.3 | 20.0 | 20.4 | 20.5 | 20.8 | 21.3 |
| 8H | 4H | 19.8 | 20.3 | 20.4 | 20.7 | 21.0 | 19.8 | 20.3 | 20.4 | 20.7 | 21.0 |
| | 6H | 20.1 | 20.5 | 20.6 | 20.9 | 21.4 | 20.1 | 20.5 | 20.6 | 20.9 | 21.4 |
| | 8H | 20.3 | 20.5 | 20.8 | 21.0 | 21.7 | 20.3 | 20.5 | 20.8 | 21.0 | 21.7 |
| | 12H | 20.3 | 20.5 | 20.9 | 21.1 | 21.7 | 20.3 | 20.5 | 20.9 | 21.1 | 21.7 |
| 12H | 4H | 19.8 | 20.2 | 20.3 | 20.6 | 21.1 | 19.8 | 20.2 | 20.3 | 20.6 | 21.1 |
| | 6H | 20.2 | 20.4 | 20.7 | 20.9 | 21.6 | 20.2 | 20.4 | 20.7 | 20.9 | 21.6 |
| | 8H | 20.3 | 20.5 | 20.9 | 21.0 | 21.6 | 20.3 | 20.5 | 20.9 | 21.0 | 21.6 |

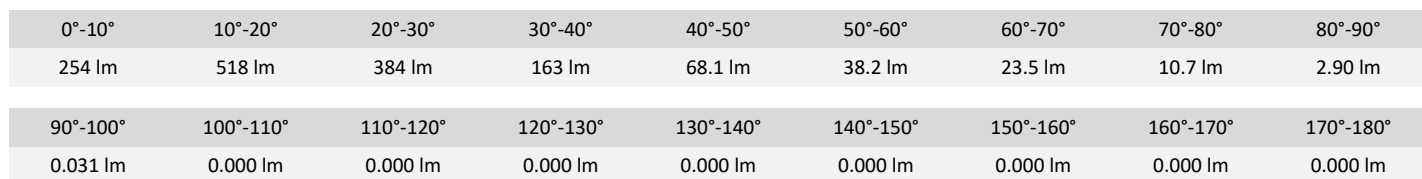
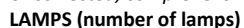
Variations with the observer position for the luminaire spacings, S:

| | | |
|----------|------------|------------|
| S = 1.0H | 2.0 / -1.2 | 2.0 / -1.2 |
| S = 1.5H | 3.9 / -1.6 | 3.9 / -1.6 |
| S = 2.0H | 5.5 / -2.2 | 5.5 / -2.2 |

Coefficients of Utilization

| Ceiling reflectance | 80 | | | 70 | | | 50 | | | 30 | | | 10 | | | 0 | | |
|---------------------|-----|--------------------------|-----|-----|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Wall reflectance | 70 | 50 | 30 | 10 | 70 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 50 | 30 | 10 | 0 |
| Floor reflectance | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 0 |
| RCR | | (RCR: Room Cavity Ratio) | | | Room Values are expressed as percentage of Lumen delivered to the task surface | | | | | | | | | | | | | |
| 0 | 119 | 119 | 119 | 119 | 116 | 116 | 116 | 116 | 111 | 111 | 111 | 106 | 106 | 106 | 102 | 102 | 102 | 100 |
| 1 | 114 | 111 | 108 | 106 | 111 | 109 | 107 | 105 | 105 | 103 | 101 | 101 | 100 | 98 | 98 | 97 | 96 | 94 |
| 2 | 108 | 104 | 100 | 96 | 106 | 102 | 98 | 95 | 99 | 96 | 93 | 96 | 93 | 91 | 93 | 91 | 89 | 88 |
| 3 | 103 | 97 | 92 | 89 | 101 | 96 | 91 | 88 | 93 | 90 | 87 | 91 | 88 | 85 | 89 | 86 | 84 | 82 |
| 4 | 99 | 91 | 86 | 82 | 97 | 90 | 86 | 82 | 88 | 84 | 81 | 86 | 83 | 80 | 84 | 81 | 79 | 78 |
| 5 | 94 | 86 | 81 | 77 | 93 | 85 | 80 | 77 | 84 | 79 | 76 | 82 | 78 | 75 | 81 | 77 | 75 | 73 |
| 6 | 90 | 82 | 76 | 72 | 89 | 81 | 76 | 72 | 80 | 75 | 72 | 78 | 74 | 71 | 77 | 73 | 71 | 69 |
| 7 | 86 | 78 | 72 | 68 | 85 | 77 | 72 | 68 | 76 | 71 | 68 | 75 | 71 | 67 | 74 | 70 | 67 | 66 |
| 8 | 83 | 74 | 69 | 65 | 82 | 74 | 68 | 65 | 72 | 68 | 64 | 71 | 67 | 64 | 71 | 67 | 64 | 63 |
| 9 | 80 | 71 | 65 | 62 | 78 | 70 | 65 | 62 | 69 | 65 | 61 | 68 | 64 | 61 | 68 | 64 | 61 | 60 |
| 10 | 76 | 68 | 62 | 59 | 75 | 67 | 62 | 59 | 66 | 62 | 59 | 66 | 61 | 58 | 65 | 61 | 58 | 57 |

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Outdoor Light Planning

Lumen per Zone

| Zone (γ) | Lumen | % Total |
|----------|---------|---------|
| 0-10° | 254 lm | 17.4% |
| 10-20° | 518 lm | 35.5% |
| 20-30° | 384 lm | 26.2% |
| 30-40° | 163 lm | 11.1% |
| 40-50° | 68 lm | 4.7% |
| 50-60° | 38 lm | 2.6% |
| 60-70° | 23 lm | 1.6% |
| 70-80° | 11 lm | 0.7% |
| 80-90° | 3 lm | 0.2% |
| 90-100° | 0 lm | 0.0% |
| 100-110° | 0 lm | 0.0% |
| 110-120° | 0 lm | 0.0% |
| 120-130° | 0 lm | 0.0% |
| 130-140° | 0 lm | 0.0% |
| 140-150° | 0 lm | 0.0% |
| 150-160° | 0 lm | 0.0% |
| 160-170° | 0 lm | 0.0% |
| 170-180° | 0 lm | 0.0% |
| Total | 1462 lm | 100.0% |

Intensity peaks

| | |
|----------------|---------|
| Max intensity | 2871 cd |
| Intensity, 90° | 0 cd |
| Intensity, 0° | 2871 cd |

Zonal Lumen summary

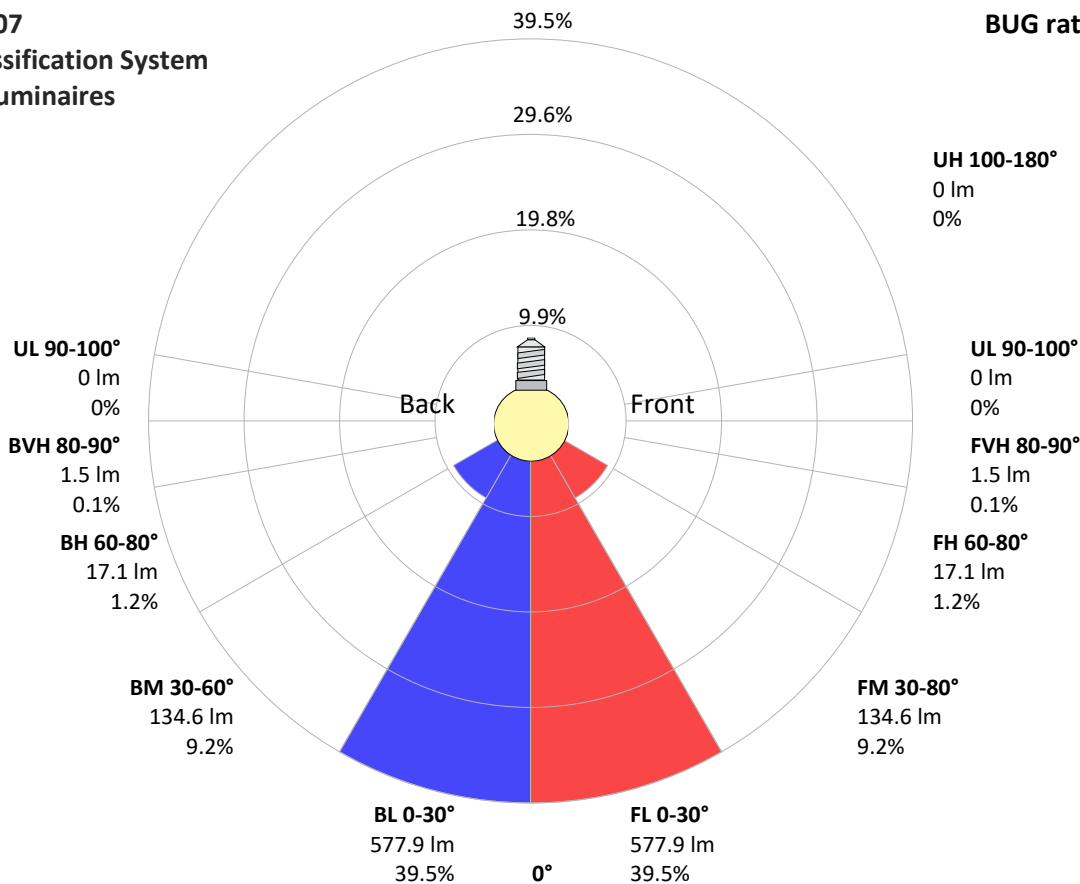
| Zone (γ) | Lumen | % Total |
|----------|---------|---------|
| 0-30° | 1156 lm | 79.1% |
| 0-40° | 1319 lm | 90.2% |
| 0-60° | 1425 lm | 97.5% |
| 60-90° | 37 lm | 2.5% |
| 70-100° | 14 lm | 0.9% |
| 90-120° | 0 lm | 0.0% |
| 0-90° | 1462 lm | 100.0% |
| 90-180° | 0 lm | 0.0% |
| 0-180° | 1462 lm | 100.0% |

BUG rating

| | Lumen | % Total |
|----------------------|--------|---------|
| Forward light | | |
| Low(0-30°) | 578 lm | 39.5% |
| Medium(30-60°) | 135 lm | 9.2% |
| High(60-80°) | 17 lm | 1.2% |
| Very high(80-90°) | 1 lm | 0.1% |
| Back light | | |
| Low(0-30°) | 578 lm | 39.5% |
| Medium(30-60°) | 135 lm | 9.2% |
| High(60-80°) | 17 lm | 1.2% |
| Very high(80-90°) | 1 lm | 0.1% |
| Uplight | | |
| Low(90-100°) | 0 lm | 0.0% |
| High(100-180°) | 0 lm | 0.0% |

IESNA TM-15-07 Luminaire Classification System For Outdoor Luminaires

BUG rating B2 U1 G0



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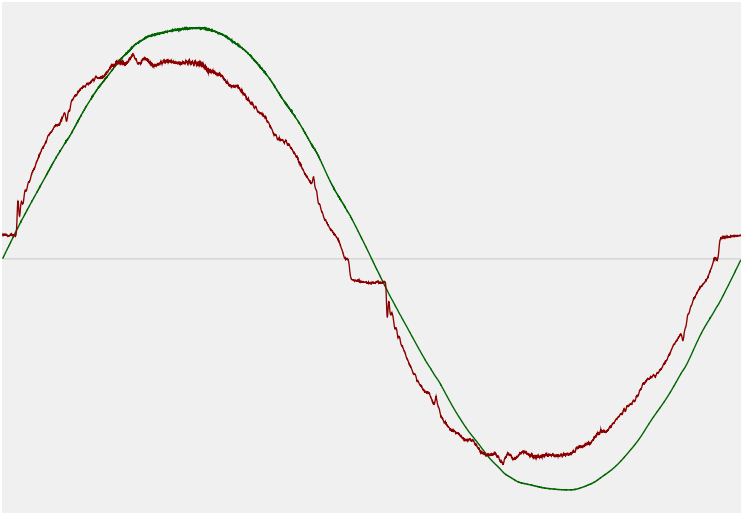


Power Details

Input Power

| | |
|---|----------|
| Power feed to light source | 15.9 W |
| Frequency of input power | 50 Hz |
| RMS Input voltage feed, V_{RMS} | 239 V |
| RMS Input current feed, I_{RMS} | 0.068 A |
| Volt-Ampere or apparent power = $V_{RMS} * I_{RMS}$ | 16.19 VA |
| Displacement factor of AC power feed | 0.98 |
| Power factor of AC current feed | 0.98 |
| Total harmonic distortion of the current | 6.21% |
| Total harmonic distortion of the voltage | 1.09% |

Input Power Curve



Efficiency

| | |
|---------------------------|---------|
| Radiated power efficiency | 33.7% |
| Lumen efficiency | 92 lm/W |

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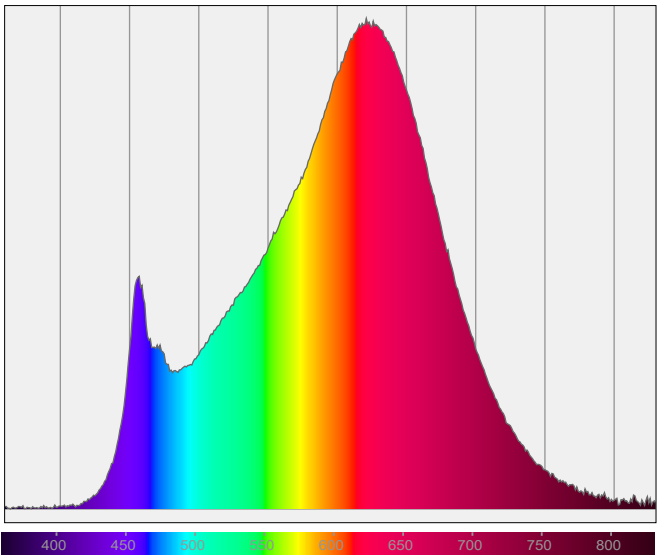
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Color Measurements

| | |
|------------------------------|---|
| Correlated Color Temperature | CCT = 2700 K |
| Color Rendering TM30-18 | R _f 91.3 — R _g 98.9 |
| Color Shift, CIE duv | Duv ±0.0003 |

Spectral distribution



Color details

| | | | |
|---|---|-------------------------------------|-------------------------|
| Correlated Color Temperature | CCT = 2700 K | Color coordinates CIE 1931 | (x;y) = (0.460;0.411) |
| Color Rendering Index | CRI 92.7 | Color coordinate CIEs 1960 | (u;v) = (0.263;0.352) |
| Color Rendering Index, R9 (red component) | R9 = 66.5 | Color deviation from BBL | Duv = ±0.0003 |
| Color Rendering TM30-18 | R _f 91.3 — R _g 98.9 | Color coordinate CIEs 1976 (CIELUV) | (u';v') = (0.263;0.263) |
| Color Quality Scale | CQS = 90.6 | | |

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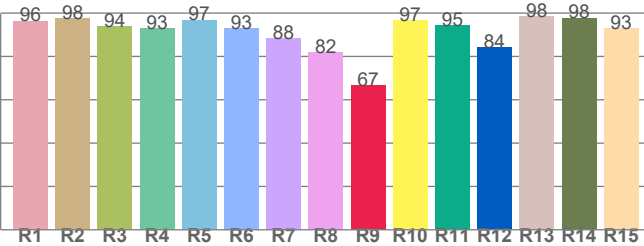
CIE 1931



CIE 1931 – zoomed on Planckian locus



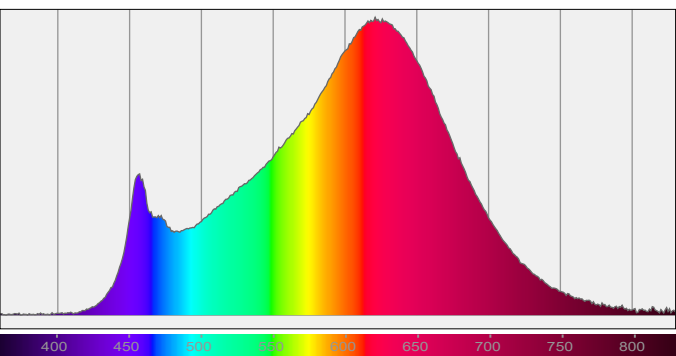
Color Rendering Index per reference color (CIE 1995)



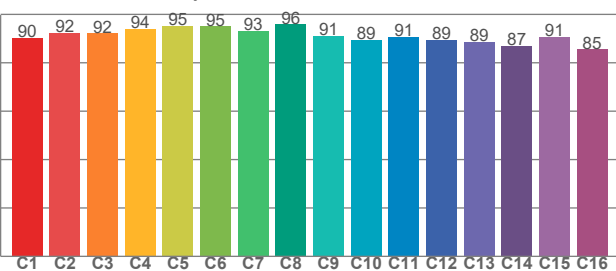
CRI R values, only R1-R8 are used to calculate final CRI value

| R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 | R11 | R12 | R13 | R14 | R15 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 96.4 | 97.6 | 94.0 | 93.1 | 96.9 | 93.1 | 88.3 | 82.0 | 66.5 | 96.5 | 94.5 | 84.0 | 98.4 | 97.8 | 93.0 |

Spectral power distribution (SPD) / W/nm – 0-100%



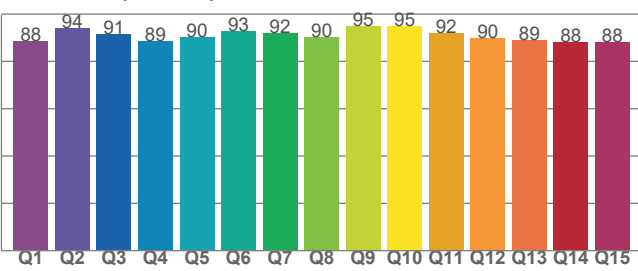
TM30-18 Rf-values per hue bin



TM30 C values, 16 binned values out of total of 99 C values

| C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 | C15 | C16 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 90.3 | 92.3 | 92.1 | 93.9 | 95.1 | 95.0 | 93.2 | 95.8 | 91.1 | 89.5 | 90.6 | 89.5 | 88.7 | 86.9 | 90.7 | 85.5 |

Color Quality Scale by reference color



CQS Q values

| Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 88.5 | 93.9 | 91.4 | 88.6 | 90.1 | 93.0 | 91.9 | 90.1 | 94.7 | 95.1 | 92.1 | 89.8 | 89.1 | 88.1 | 88.1 |