

Goniophotometry Report

1_PHOT_SKIN+BONES-4750lmChip-4000K-21Deg_2303
www.factorylux.com



Tested Light Source - 1_PHOT_SKIN+BONES-4750lmChip-4000K-21Deg_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

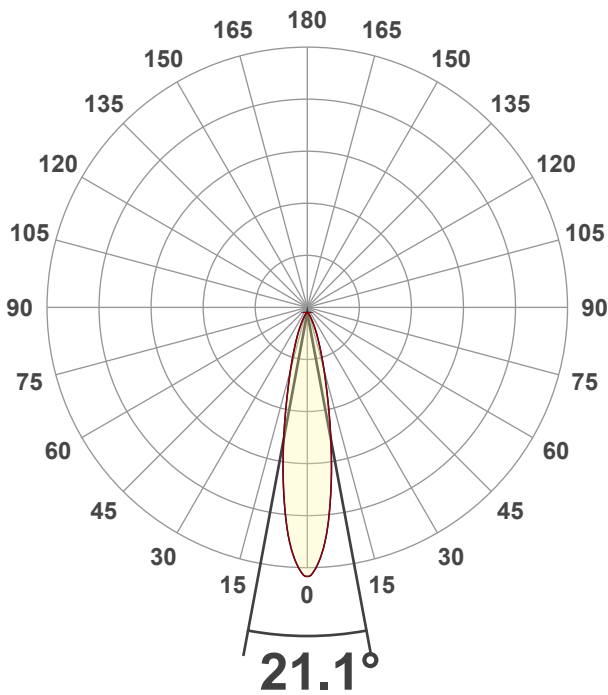
4 planes – 90°
1°
1.50 m
41.4 W – PF 0.97 – DPF 0.97
242 V – 0.177 A
50 Hz

Main Light Measurement Results

Output
Efficiency
Peak Intensity and Beam Angle
Color Rendering Index

4198 lm
101 lm/W
18682 cd – 21.1°
CRI 92.7

Light Intensity Distribution



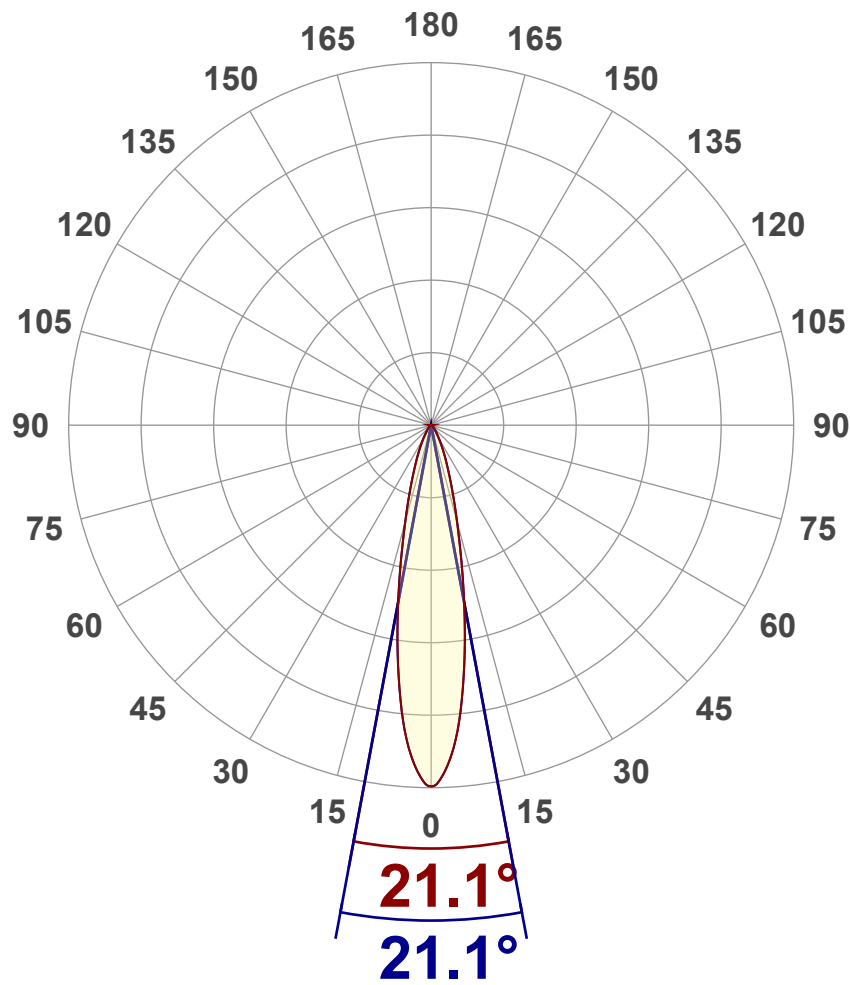
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Luminous Intensity diagram

Unit: 0-100% of peak intensity



Main Values

| | |
|----------------------|----------|
| Output (total Lumen) | 4198 lm |
| Peak Intensity | 18682 cd |
| Beam Angle (50%) | 21.1° |
| Beam Angle (90%) | 21.1° |
| Beam Angle (10%) | 21.1° |

Cut-off Angle

| | |
|--------------|-------|
| Average 2,5% | 69.8° |
|--------------|-------|

Field Angle

| | |
|-------------|-------|
| Average 10% | 46.4° |
|-------------|-------|

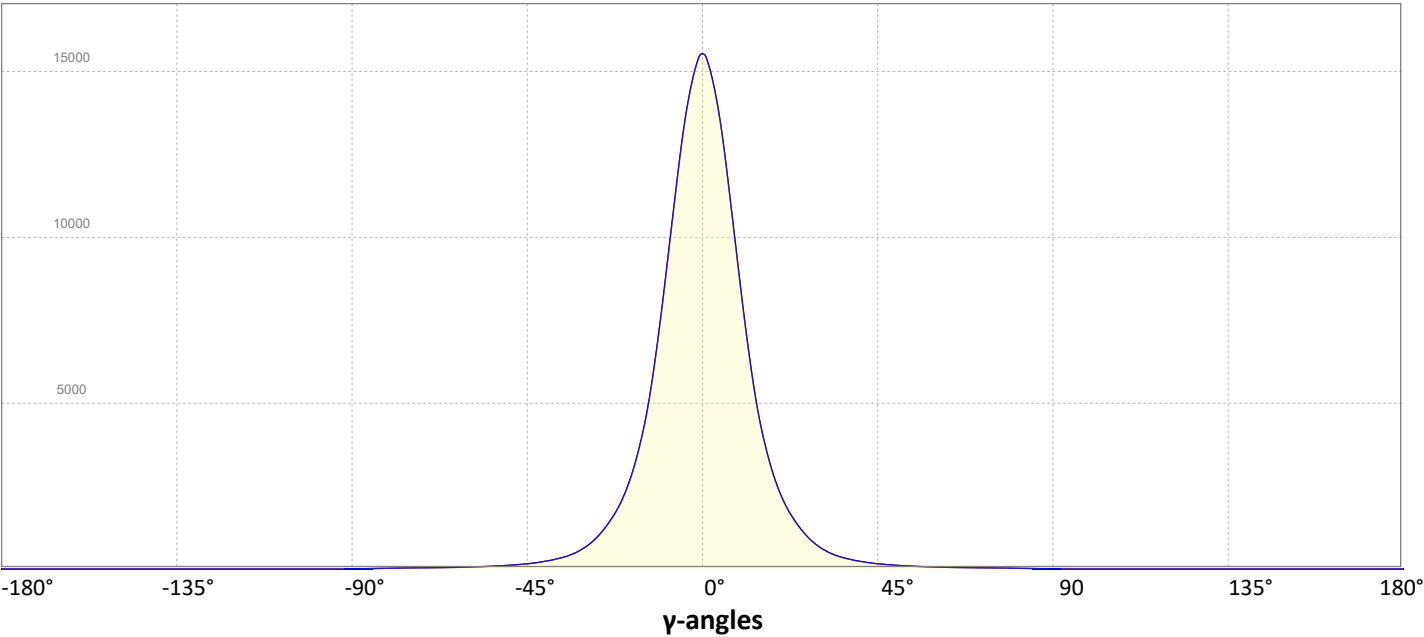
Intensity Ratio

| | |
|--------------|-------|
| In 120° cone | 96.5% |
| In 90° cone | 92.7% |

C000-C180

C090-C270

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

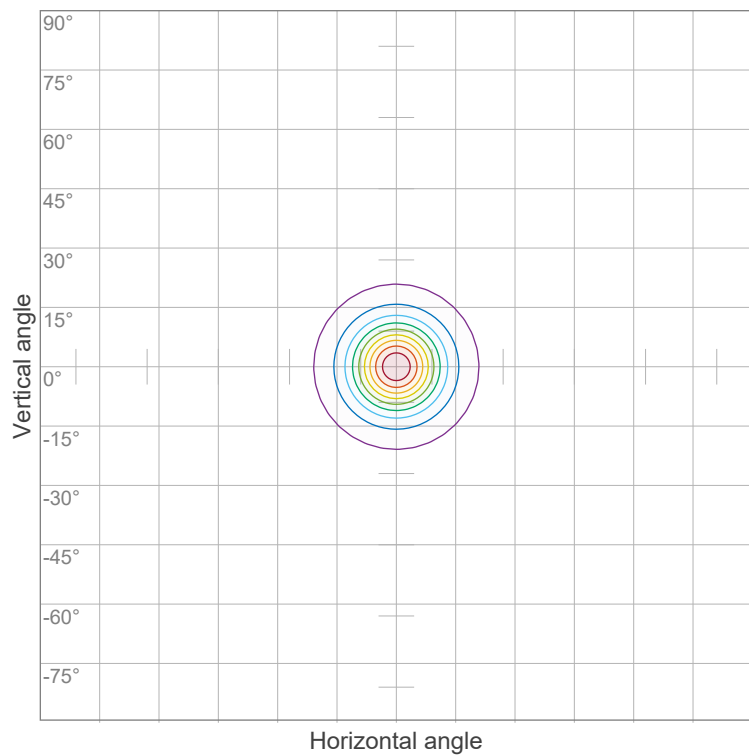


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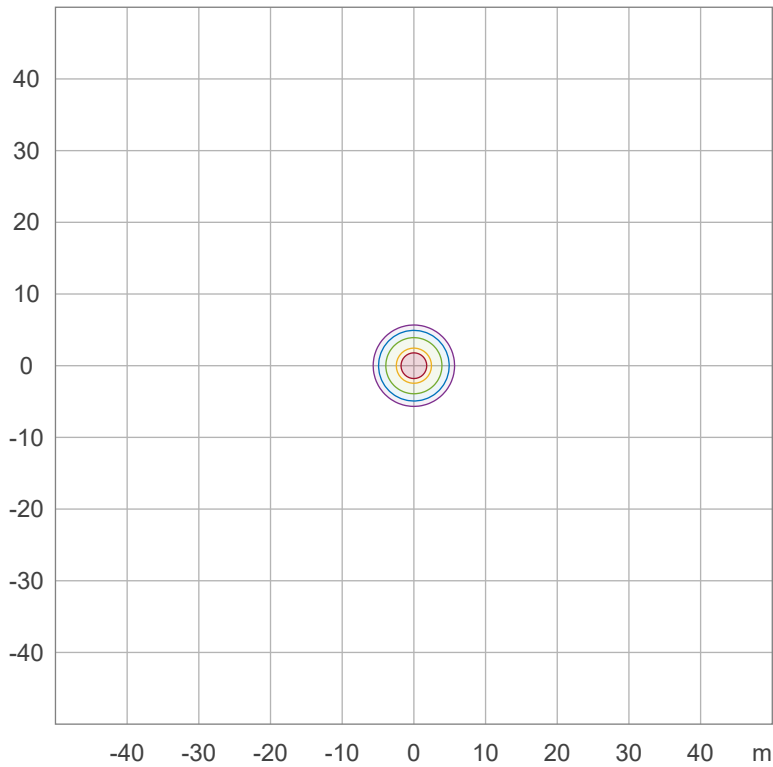
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Iso-intensity Diagram (Iso-candela)



Iso-illuminance Diagram (Iso-lux)

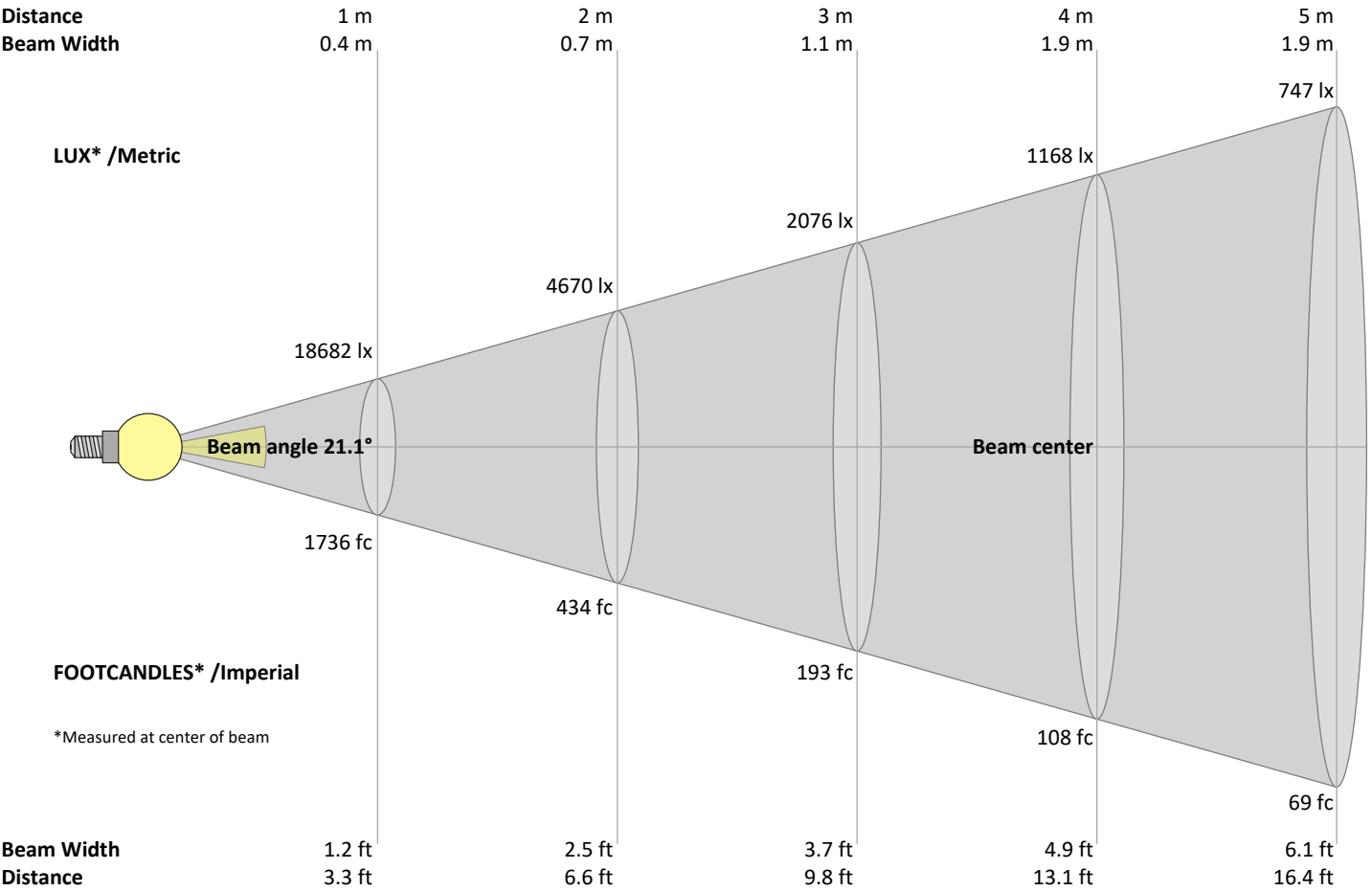


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Beam Details



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 |
| 18682 | 4670 | 2076 | 1168 | 747 | 519 | 381 | 292 | 231 | 187 | 154 | 130 | 111 | 95 | 83 | 73 | 65 | 58 | 52 | 47 | lux |
| 1735.6 | 433.9 | 192.8 | 108.5 | 69.4 | 48.2 | 35.4 | 27.1 | 21.4 | 17.4 | 14.3 | 12.1 | 10.3 | 8.9 | 7.7 | 6.8 | 6 | 5.4 | 4.8 | 4.3 | 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 |
|-------|-------|-------|-------|-------|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|----------|
| 18.7K | 18.1K | 16.7K | 14.7K | 12.4K | 10.0K | 7.8K | 5.9K | 4.6K | 3.5K | 2.7K | 2.1K | 1.7K | 1.3K | 1.0K | 0.8K | 0.6K | 0.5K | 0.4K | 0.4K | cd |
| 100% | 97% | 90% | 79% | 66% | 53% | 42% | 32% | 24% | 19% | 15% | 11% | 9% | 7% | 6% | 4% | 3% | 3% | 2% | 2% | 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 |
|-------|-------|-------|-------|-------|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|----------|
| 18.7K | 18.1K | 16.7K | 14.7K | 12.4K | 10.0K | 7.8K | 5.9K | 4.6K | 3.5K | 2.7K | 2.1K | 1.7K | 1.3K | 1.0K | 0.8K | 0.6K | 0.5K | 0.4K | 0.4K | cd |
| 100% | 97% | 90% | 79% | 66% | 53% | 42% | 32% | 24% | 19% | 15% | 11% | 9% | 7% | 6% | 4% | 3% | 3% | 2% | 2% | 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 |
|-------|-------|-------|-------|-------|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|----------|
| 18.7K | 18.1K | 16.7K | 14.7K | 12.4K | 10.0K | 7.8K | 5.9K | 4.6K | 3.5K | 2.7K | 2.1K | 1.7K | 1.3K | 1.0K | 0.8K | 0.6K | 0.5K | 0.4K | 0.4K | cd |
| 100% | 97% | 90% | 79% | 66% | 53% | 42% | 32% | 24% | 19% | 15% | 11% | 9% | 7% | 6% | 4% | 3% | 3% | 2% | 2% | 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 |
|-------|-------|-------|-------|-------|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|----------|
| 18.7K | 18.1K | 16.7K | 14.7K | 12.4K | 10.0K | 7.8K | 5.9K | 4.6K | 3.5K | 2.7K | 2.1K | 1.7K | 1.3K | 1.0K | 0.8K | 0.6K | 0.5K | 0.4K | 0.4K | cd |
| 100% | 97% | 90% | 79% | 66% | 53% | 42% | 32% | 24% | 19% | 15% | 11% | 9% | 7% | 6% | 4% | 3% | 3% | 2% | 2% | 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 | 20.1 | 20.6 | 20.2 | 20.8 | 21.0 | 20.1 | 20.6 | 20.2 | 20.8 | 21.0 |
| | 3H | 20.7 | 21.3 | 21.0 | 21.5 | 21.7 | 20.7 | 21.3 | 21.0 | 21.5 | 21.7 |
| | 4H | 21.1 | 21.7 | 21.5 | 22.0 | 22.2 | 21.1 | 21.7 | 21.5 | 22.0 | 22.2 |
| | 6H | 21.6 | 22.1 | 21.9 | 22.4 | 22.8 | 21.6 | 22.1 | 21.9 | 22.4 | 22.8 |
| | 8H | 21.8 | 22.3 | 22.1 | 22.6 | 23.0 | 21.8 | 22.3 | 22.1 | 22.6 | 23.0 |
| | 12H | 21.9 | 22.4 | 22.3 | 22.8 | 23.2 | 21.9 | 22.4 | 22.3 | 22.8 | 23.2 |
| 4H | 2H | 20.2 | 20.8 | 20.6 | 21.1 | 21.3 | 20.2 | 20.8 | 20.6 | 21.1 | 21.3 |
| | 3H | 21.2 | 21.7 | 21.5 | 22.0 | 22.4 | 21.2 | 21.7 | 21.5 | 22.0 | 22.4 |
| | 4H | 21.7 | 22.2 | 22.1 | 22.6 | 23.1 | 21.7 | 22.2 | 22.1 | 22.6 | 23.1 |
| | 6H | 22.3 | 22.8 | 22.8 | 23.2 | 23.5 | 22.3 | 22.8 | 22.8 | 23.2 | 23.5 |
| | 8H | 22.6 | 23.1 | 23.1 | 23.4 | 23.8 | 22.6 | 23.1 | 23.1 | 23.4 | 23.8 |
| | 12H | 22.8 | 23.2 | 23.3 | 23.6 | 24.0 | 22.8 | 23.2 | 23.3 | 23.6 | 24.0 |
| 8H | 4H | 21.9 | 22.4 | 22.4 | 22.7 | 23.1 | 21.9 | 22.4 | 22.4 | 22.7 | 23.1 |
| | 6H | 22.7 | 23.0 | 23.2 | 23.5 | 24.0 | 22.7 | 23.0 | 23.2 | 23.5 | 24.0 |
| | 8H | 23.2 | 23.4 | 23.7 | 23.9 | 24.6 | 23.2 | 23.4 | 23.7 | 23.9 | 24.6 |
| | 12H | 23.5 | 23.7 | 24.1 | 24.2 | 24.8 | 23.5 | 23.7 | 24.1 | 24.2 | 24.8 |
| 12H | 4H | 21.9 | 22.3 | 22.4 | 22.7 | 23.2 | 21.9 | 22.3 | 22.4 | 22.7 | 23.2 |
| | 6H | 22.9 | 23.1 | 23.4 | 23.6 | 24.2 | 22.9 | 23.1 | 23.4 | 23.6 | 24.2 |
| | 8H | 23.3 | 23.5 | 23.9 | 24.0 | 24.6 | 23.3 | 23.5 | 23.9 | 24.0 | 24.6 |
| Variations with the observer position for the luminaire spacings, S: | | | | | | | | | | | |
| S = 1.0H | | 0.8 / -0.5 | | | | | 0.8 / -0.5 | | | | |
| S = 1.5H | | 1.8 / -0.7 | | | | | 1.8 / -0.7 | | | | |
| S = 2.0H | | 2.9 / -1.0 | | | | | 2.9 / -1.0 | | | | |

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 | 99 |
| 1 | 114 | 111 | 109 | 107 | 111 | 109 | 107 | 105 | 105 | 103 | 102 | 101 | 100 | 99 | 98 | 97 | 96 | 94 |
| 2 | 109 | 105 | 101 | 98 | 107 | 103 | 100 | 97 | 100 | 97 | 95 | 97 | 95 | 93 | 94 | 92 | 91 | 89 |
| 3 | 105 | 99 | 95 | 91 | 103 | 98 | 94 | 91 | 95 | 92 | 89 | 93 | 90 | 88 | 91 | 88 | 86 | 85 |
| 4 | 101 | 94 | 90 | 86 | 99 | 93 | 89 | 86 | 91 | 87 | 85 | 89 | 86 | 84 | 87 | 85 | 83 | 81 |
| 5 | 97 | 90 | 85 | 82 | 96 | 89 | 85 | 81 | 87 | 84 | 81 | 86 | 82 | 80 | 84 | 81 | 79 | 78 |
| 6 | 94 | 86 | 81 | 78 | 92 | 86 | 81 | 78 | 84 | 80 | 77 | 83 | 79 | 77 | 82 | 78 | 76 | 75 |
| 7 | 91 | 83 | 78 | 75 | 89 | 82 | 78 | 74 | 81 | 77 | 74 | 80 | 76 | 74 | 79 | 76 | 73 | 72 |
| 8 | 88 | 80 | 75 | 72 | 87 | 79 | 75 | 72 | 78 | 74 | 71 | 77 | 74 | 71 | 77 | 73 | 71 | 70 |
| 9 | 85 | 77 | 72 | 69 | 84 | 77 | 72 | 69 | 76 | 72 | 69 | 75 | 71 | 69 | 74 | 71 | 68 | 67 |
| 10 | 82 | 75 | 70 | 67 | 82 | 74 | 70 | 67 | 74 | 69 | 67 | 73 | 69 | 67 | 72 | 69 | 66 | 65 |

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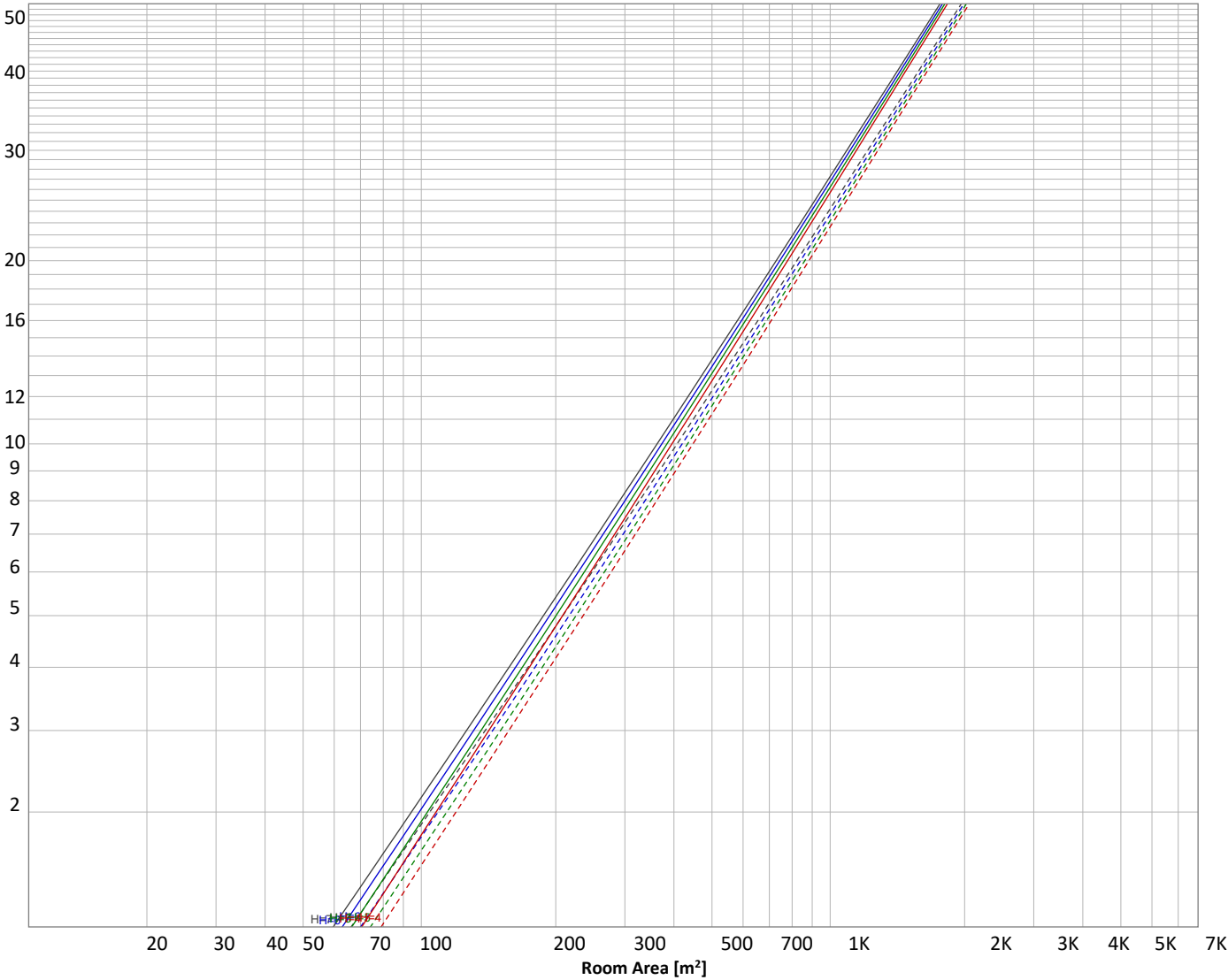
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Luminaire budgetary diagram

Uncorrected, comprehensive UGR table according to 117-1995

LAMPS (number of lamps)



Conditions

| | | | | |
|---|----------------|-----------|---------------------|-------------------|
| H = Room height | Flux = 4198 lm | p(%) | | |
| H _{down} = Lamp distance from ceiling = | 0.00 m | Line type | Ceiling reflectance | Wall reflectance |
| H _{work} = Work area height from floor = | 0.00 m | ----- | 70 | 50 |
| E _{work} = Average lux on work area = | 100 lx | ----- | 50 | 30 |
| | | | | Floor reflectance |
| | | | | 20 |

Zonal Lumen Summary

| 0°-10° | 10°-20° | 20°-30° | 30°-40° | 40°-50° | 50°-60° | 60°-70° | 70°-80° | 80°-90° |
|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1314 lm | 1477 lm | 708 lm | 303 lm | 157 lm | 91.1 lm | 60.2 lm | 43.8 lm | 22.5 lm |
| 90°-100° | 100°-110° | 110°-120° | 120°-130° | 130°-140° | 140°-150° | 150°-160° | 160°-170° | 170°-180° |
| 4.40 lm | 3.51 lm | 3.29 lm | 2.97 lm | 2.57 lm | 2.08 lm | 1.53 lm | 0.939 lm | 0.316 lm |

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Outdoor Light Planning

Lumen per Zone

| Zone (°) | Lumen | % Total |
|----------|---------|---------|
| 0-10° | 1314 lm | 31.3% |
| 10-20° | 1477 lm | 35.2% |
| 20-30° | 708 lm | 16.9% |
| 30-40° | 303 lm | 7.2% |
| 40-50° | 157 lm | 3.8% |
| 50-60° | 91 lm | 2.2% |
| 60-70° | 60 lm | 1.4% |
| 70-80° | 44 lm | 1.0% |
| 80-90° | 23 lm | 0.5% |
| 90-100° | 4 lm | 0.1% |
| 100-110° | 4 lm | 0.1% |
| 110-120° | 3 lm | 0.1% |
| 120-130° | 3 lm | 0.1% |
| 130-140° | 3 lm | 0.1% |
| 140-150° | 2 lm | 0.0% |
| 150-160° | 2 lm | 0.0% |
| 160-170° | 1 lm | 0.0% |
| 170-180° | 0 lm | 0.0% |
| Total | 4198 lm | 100.0% |

Intensity peaks

| | |
|----------------|----------|
| Max intensity | 18682 cd |
| Intensity, 90° | 7 cd |
| Intensity, 0° | 18682 cd |

Zonal Lumen summary

| Zone (°) | Lumen | % Total |
|----------|---------|---------|
| 0-30° | 3499 lm | 83.3% |
| 0-40° | 3801 lm | 90.6% |
| 0-60° | 4050 lm | 96.5% |
| 60-90° | 127 lm | 3.0% |
| 70-100° | 71 lm | 1.7% |
| 90-120° | 11 lm | 0.3% |
| 0-90° | 4176 lm | 99.5% |
| 90-180° | 22 lm | 0.5% |
| 0-180° | 4198 lm | 100.0% |

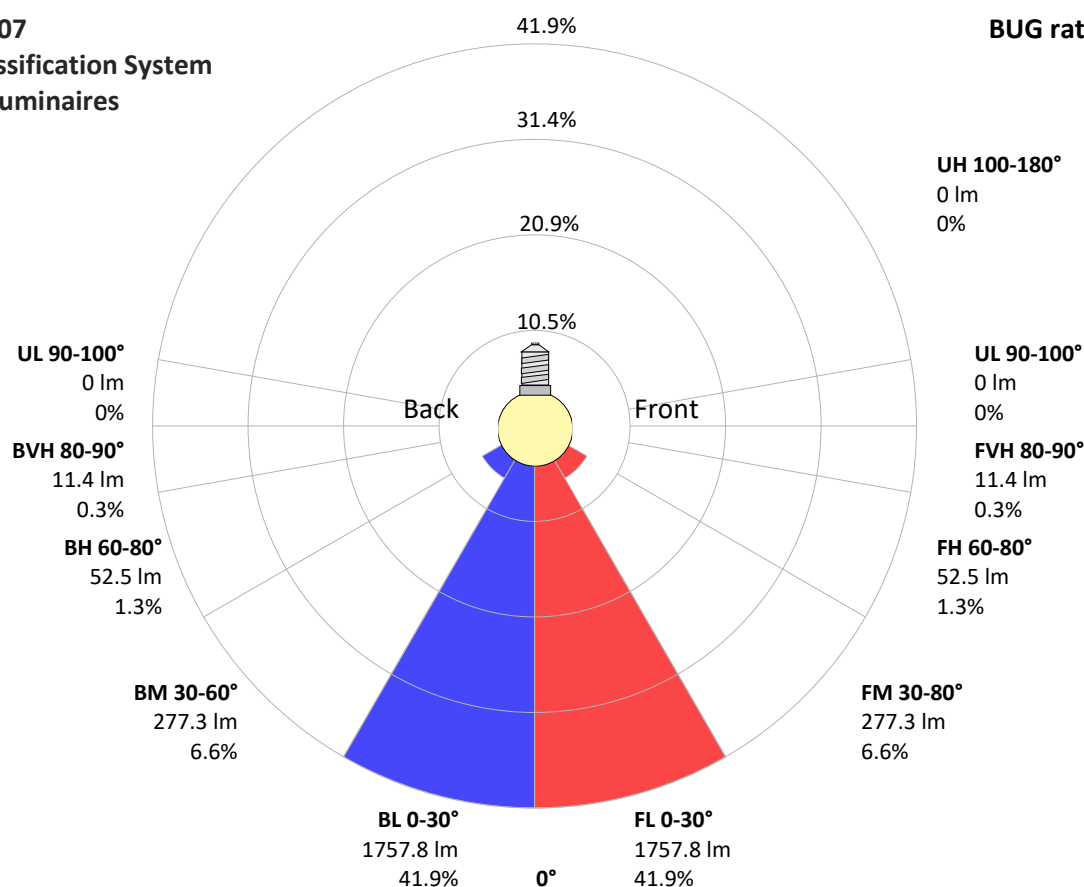
BUG rating

| | Lumen | % Total |
|----------------------|---------|---------|
| Forward light | | |
| Low(0-30°) | 1758 lm | 41.9% |
| Medium(30-60°) | 277 lm | 6.6% |
| High(60-80°) | 53 lm | 1.3% |
| Very high(80-90°) | 11 lm | 0.3% |
| Back light | | |
| Low(0-30°) | 1758 lm | 41.9% |
| Medium(30-60°) | 277 lm | 6.6% |
| High(60-80°) | 53 lm | 1.3% |
| Very high(80-90°) | 11 lm | 0.3% |
| 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 B3 U1 G1



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Power Details

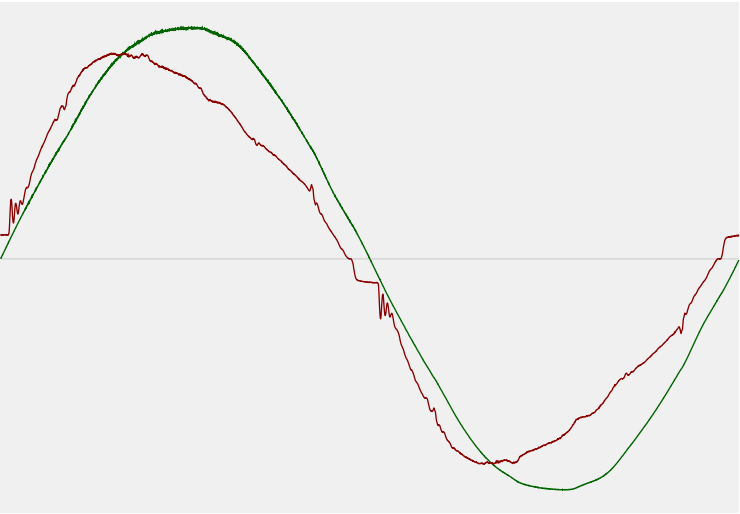
Input Power

| | |
|---|----------|
| Power feed to light source | 41.4 W |
| Frequency of input power | 50 Hz |
| RMS Input voltage feed, V_{RMS} | 242 V |
| RMS Input current feed, I_{RMS} | 0.177 A |
| Volt-Ampere or apparent power = $V_{RMS} * I_{RMS}$ | 42.86 VA |
| Displacement factor of AC power feed | 0.97 |
| Power factor of AC current feed | 0.97 |
| Total harmonic distortion of the current | 10.87% |
| Total harmonic distortion of the voltage | 1.24% |

Efficiency

| | |
|---------------------------|----------|
| Radiated power efficiency | 36.6% |
| <div><div></div></div> | |
| Lumen efficiency | 101 lm/W |
| <div><div></div></div> | |

Input Power Curve



Goniophotometry Report

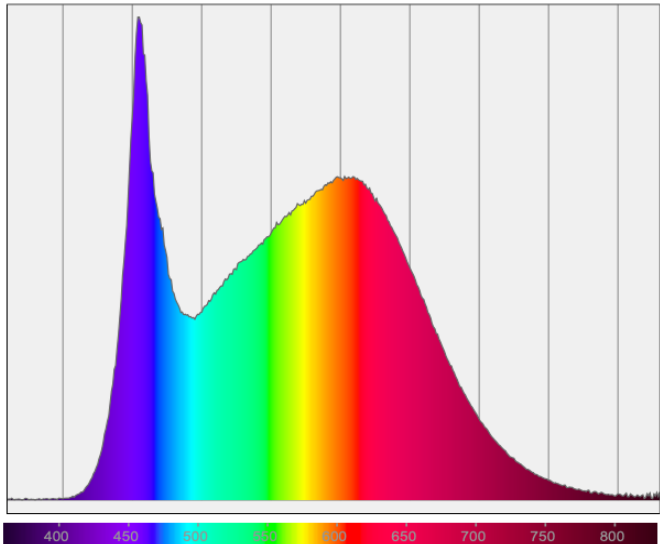
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Color Measurements

| | |
|------------------------------|---|
| Correlated Color Temperature | CCT = 4000 K |
| Color Rendering TM30-18 | R _f 88.9 – R _g 98.5 |
| Color Shift, CIE duv | Duv ±0.0003 |

Spectral distribution



Color details

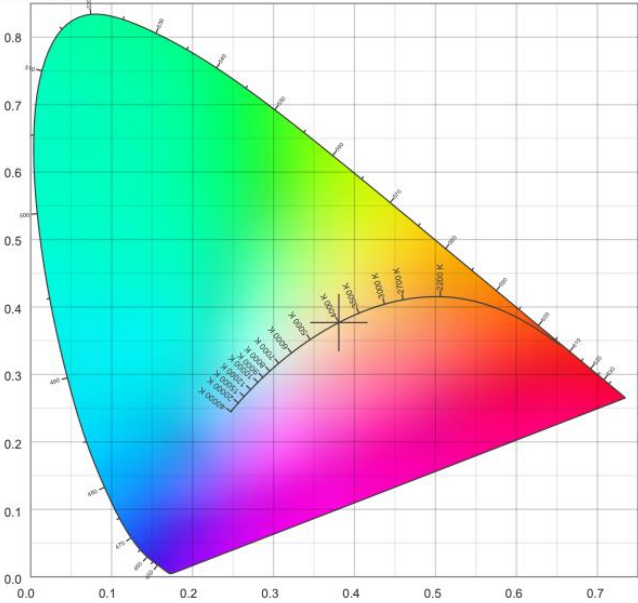
| | | | |
|---|---|-------------------------------------|-------------------------|
| Correlated Color Temperature | CCT = 4000 K | Color coordinates CIE 1931 | (x;y) = (0.381;0.377) |
| Color Rendering Index | CRI 92.6 | Color coordinate CIEs 1960 | (u;v) = (0.225;0.334) |
| Color Rendering Index, R9 (red component) | R9 = 72.2 | Color deviation from BBL | Duv = ±0.0003 |
| Color Rendering TM30-18 | R _f 88.9 – R _g 98.5 | Color coordinate CIEs 1976 (CIELUV) | (u';v') = (0.225;0.225) |
| Color Quality Scale | CQS = 88.9 | | |

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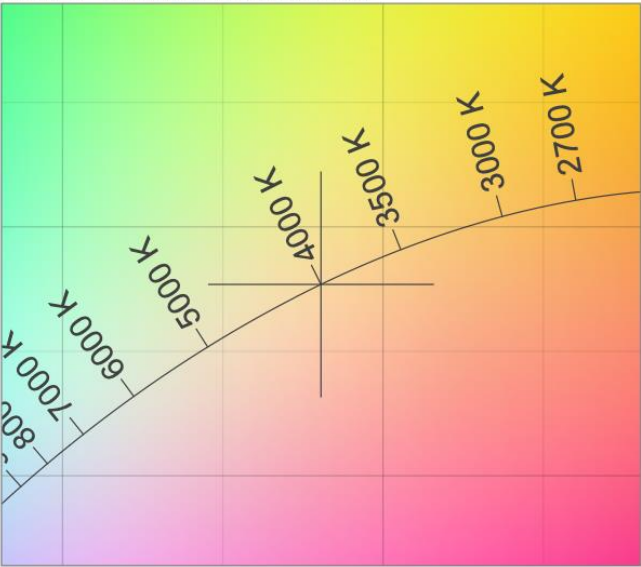
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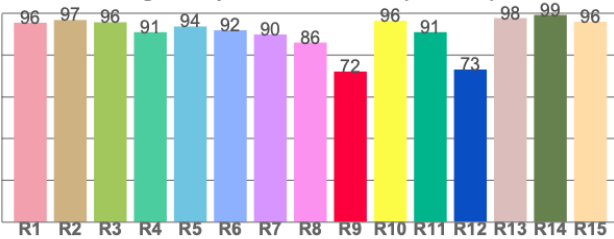
CIE 1931



CIE 1931 – zoomed on Planckian locus



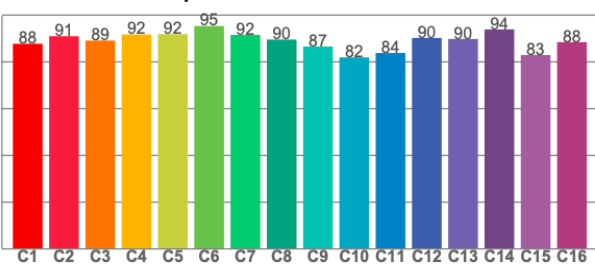
Color Rendering Index per reference color (CIE 1995)



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 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 95.5 | 96.8 | 95.7 | 91.0 | 93.7 | 91.9 | 89.9 | 86.0 | 72.2 | 96.4 | 91.0 | 73.1 | 97.7 | 99.2 | 96.0 |

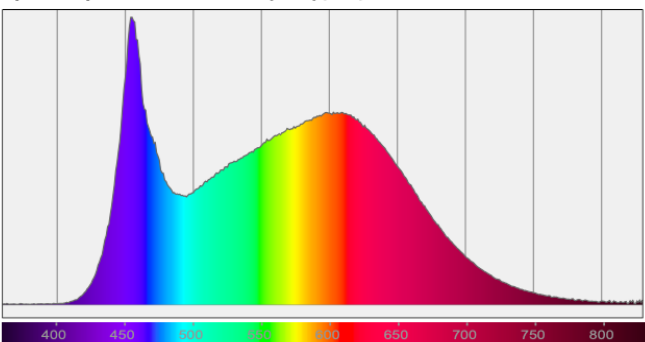
TM30-18 Rf-values per hue bin



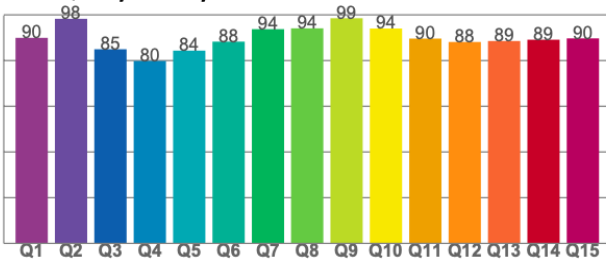
TM30 C values, 16 binned values out of total of 99 C values

| C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 | C15 | C16 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 87.8 | 91.0 | 89.1 | 91.7 | 91.9 | 95.3 | 91.5 | 89.6 | 86.6 | 81.9 | 83.8 | 90.3 | 89.8 | 93.9 | 83.0 | 88.4 |

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



Color Quality Scale by reference color



CQS Q values

| Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 89.9 | 98.3 | 84.9 | 79.8 | 84.3 | 88.3 | 93.7 | 94.1 | 98.5 | 94.0 | 89.6 | 88.1 | 88.6 | 89.1 | 89.7 |