

# Goniophotometry Report

1\_PHOT\_SKIN+BONES-4750lmChip-4000K-38Deg\_2303  
www.factorylux.com



Tested Light Source - 1\_PHOT\_SKIN+BONES-4750lmChip-4000K-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  
 $\gamma$  (gamma)-Resolution  
Test Distance  
Input Power, Power and Displ. Factors  
Input RMS Voltage and Current  
Frequency of Input Power

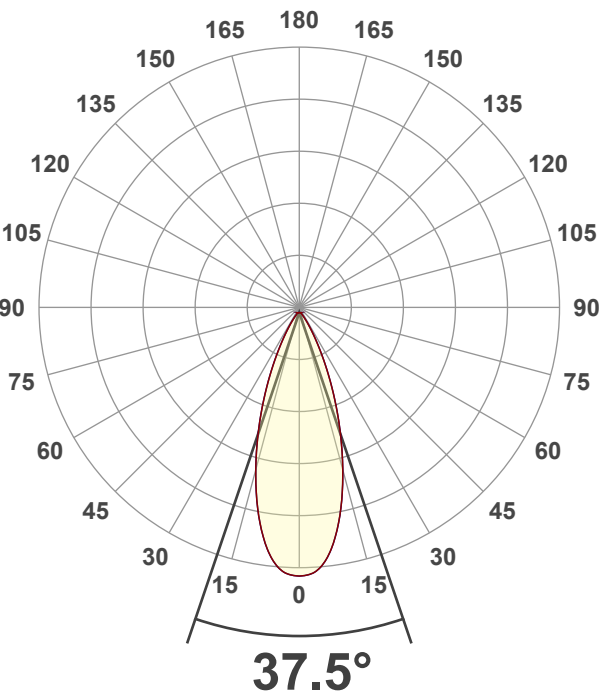
4 planes – 90°  
1.5°  
1.50 m  
41.4 W – PF 0.97 – DPF 0.97  
243 V – 0.176 A  
50 Hz

## Main Light Measurement Results

Output  
Efficiency  
Peak Intensity and Beam Angle  
Color Rendering Index

4102 lm  
99 lm/W  
8125 cd – 37.5°  
CRI 92.6

## Light Intensity Distribution



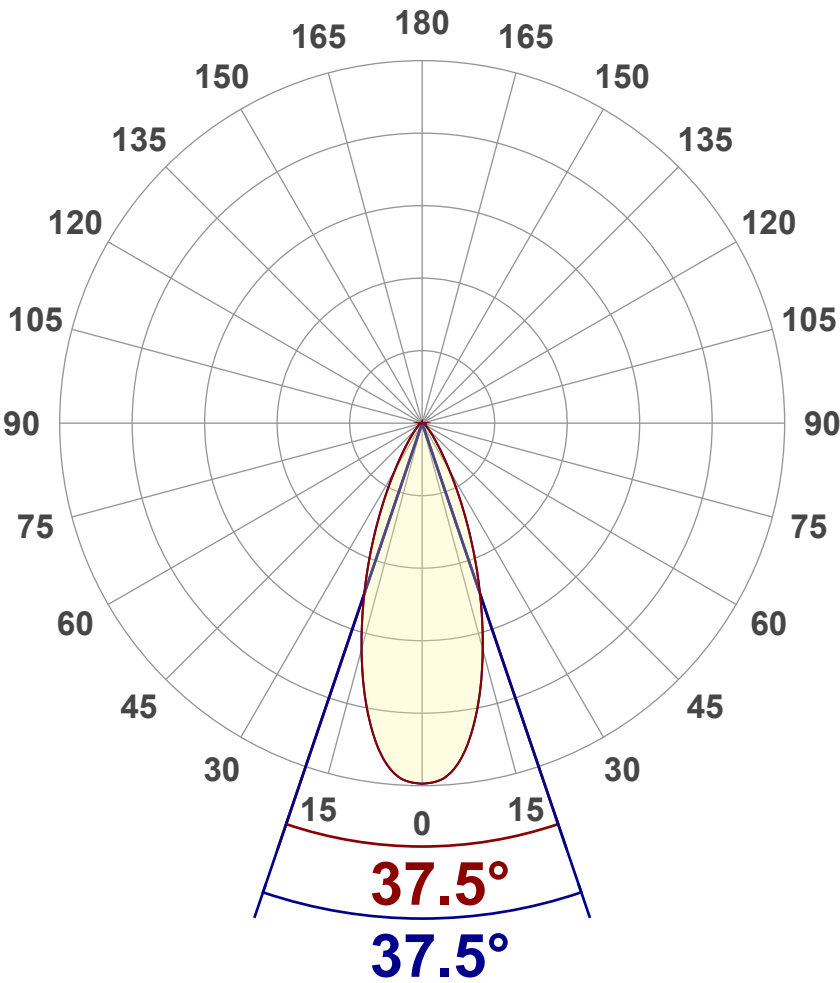
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Luminous Intensity diagram

Unit: 0-100% of peak intensity



Main Values

|                      |         |
|----------------------|---------|
| Output (total Lumen) | 4102 lm |
| Peak Intensity       | 8125 cd |
| Beam Angle (50%)     | 37.5°   |
| Beam Angle (90%)     | 37.5°   |
| Beam Angle (10%)     | 37.5°   |

Cut-off Angle

|              |       |
|--------------|-------|
| Average 2,5% | 92.4° |
|--------------|-------|

Field Angle

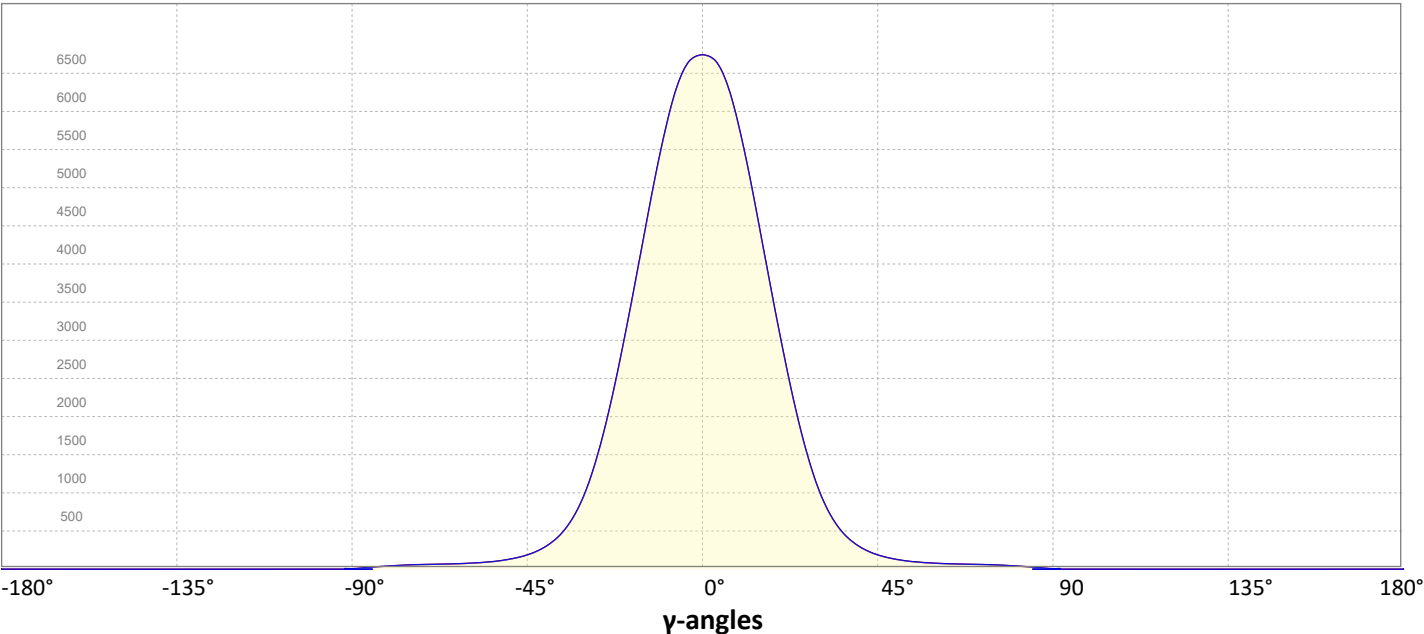
|             |       |
|-------------|-------|
| Average 10% | 66.6° |
|-------------|-------|

Intensity Ratio

|              |       |
|--------------|-------|
| In 120° cone | 95.5% |
| In 90° cone  | 91.1% |

C000-C180  
C090-C270

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

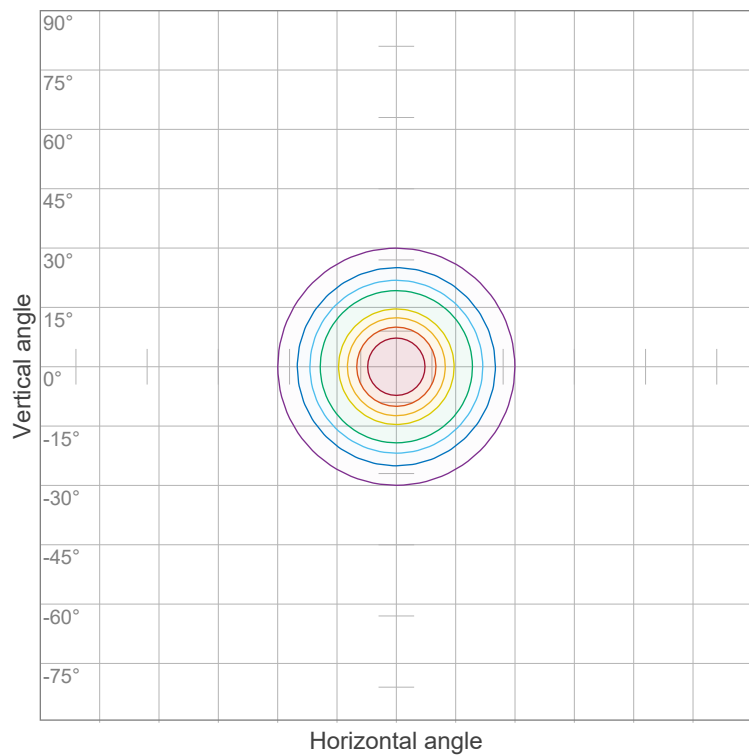


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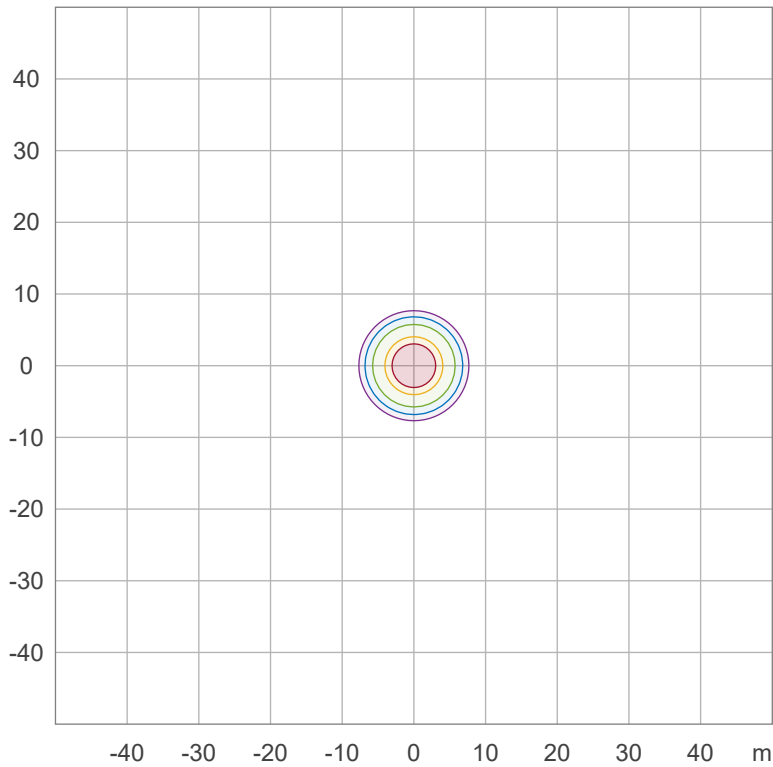
## Iso-intensity Diagram (Iso-candela)



|      |           |
|------|-----------|
| 90 % | 7312.6 cd |
| 80 % | 6500.1 cd |
| 70 % | 5687.6 cd |
| 60 % | 4875.1 cd |
| 50 % | 4062.6 cd |
| 40 % | 3250.1 cd |
| 30 % | 2437.6 cd |
| 20 % | 1625.0 cd |
| 10 % | 812.5 cd  |

Peak intensity: 8125.2 cd  
Number of c-planes: 4

## Iso-illuminance Diagram (Iso-lux)



|        |         |
|--------|---------|
| 50.0 % | 40.6 lx |
| 30.0 % | 24.4 lx |
| 10.0 % | 8.1 lx  |
| 5.0 %  | 4.1 lx  |
| 3.0 %  | 2.4 lx  |

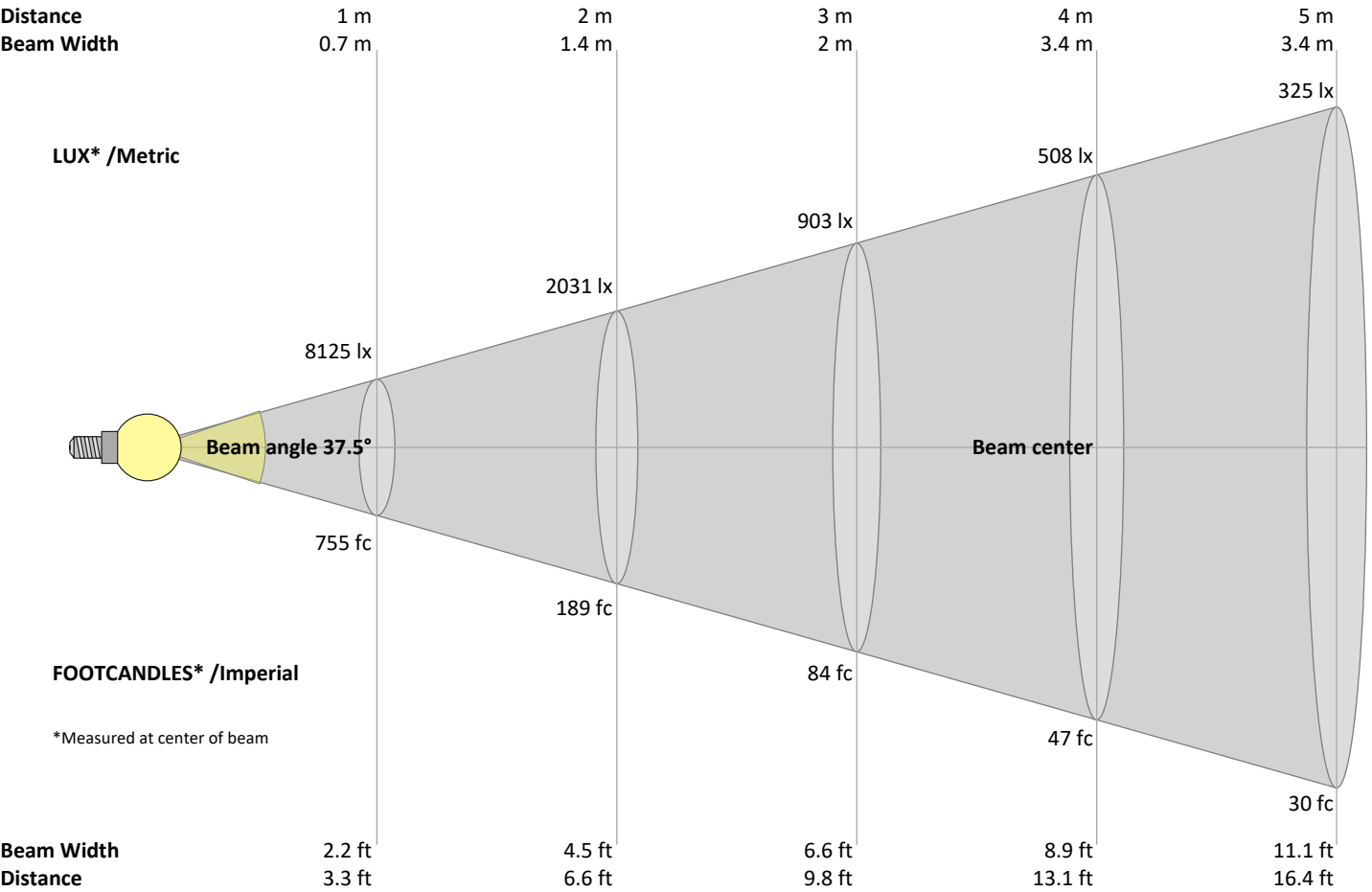
Peak illuminance: 81.3 lx  
Mounting height: 10.0 m  
Number of c-planes: 4

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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  |
| 8125  | 2031  | 903  | 508  | 325  | 226  | 166  | 127  | 100  | 81   | 67   | 56   | 48   | 41   | 36   | 32   | 28   | 25   | 23   | 20   | lux |
| 754.9 | 188.7 | 83.9 | 47.2 | 30.2 | 21   | 15.4 | 11.8 | 9.3  | 7.5  | 6.2  | 5.2  | 4.5  | 3.9  | 3.4  | 2.9  | 2.6  | 2.3  | 2.1  | 1.9  | 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        |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|-----|-----|----------|
| 8125 | 8095 | 7969 | 7714 | 7325 | 6815 | 6239 | 5604 | 4950 | 4297 | 3668 | 3067 | 2509 | 2018 | 1590 | 1235 | 960 | 744 | 581 | 461 | cd       |
| 100% | 100% | 98%  | 95%  | 90%  | 84%  | 77%  | 69%  | 61%  | 53%  | 45%  | 38%  | 31%  | 25%  | 20%  | 15%  | 12% | 9%  | 7%  | 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        |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|-----|-----|----------|
| 8125 | 8095 | 7969 | 7714 | 7325 | 6815 | 6239 | 5604 | 4950 | 4297 | 3668 | 3067 | 2509 | 2018 | 1590 | 1235 | 960 | 744 | 581 | 461 | cd       |
| 100% | 100% | 98%  | 95%  | 90%  | 84%  | 77%  | 69%  | 61%  | 53%  | 45%  | 38%  | 31%  | 25%  | 20%  | 15%  | 12% | 9%  | 7%  | 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        |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|-----|-----|----------|
| 8125 | 8095 | 7969 | 7714 | 7325 | 6815 | 6239 | 5604 | 4950 | 4297 | 3668 | 3067 | 2509 | 2018 | 1590 | 1235 | 960 | 744 | 581 | 461 | cd       |
| 100% | 100% | 98%  | 95%  | 90%  | 84%  | 77%  | 69%  | 61%  | 53%  | 45%  | 38%  | 31%  | 25%  | 20%  | 15%  | 12% | 9%  | 7%  | 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        |
|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|-----|-----|-----|----------|
| 8125 | 8095 | 7969 | 7714 | 7325 | 6815 | 6239 | 5604 | 4950 | 4297 | 3668 | 3067 | 2509 | 2018 | 1590 | 1235 | 960 | 744 | 581 | 461 | cd       |
| 100% | 100% | 98%  | 95%  | 90%  | 84%  | 77%  | 69%  | 61%  | 53%  | 45%  | 38%  | 31%  | 25%  | 20%  | 15%  | 12% | 9%  | 7%  | 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        | 21.7   | 22.4 | 21.9 | 22.6 | 22.8 | 21.7   | 22.4 | 21.9 | 22.6 | 22.8 |
|                                     | 3H        | 22.5   | 23.3 | 22.9 | 23.5 | 23.7 | 22.5   | 23.3 | 22.9 | 23.5 | 23.7 |
|                                     | 4H        | 23.2   | 23.9 | 23.6 | 24.2 | 24.4 | 23.2   | 23.9 | 23.6 | 24.2 | 24.4 |
|                                     | 6H        | 23.9   | 24.5 | 24.2 | 24.8 | 25.2 | 23.9   | 24.5 | 24.2 | 24.8 | 25.2 |
|                                     | 8H        | 24.1   | 24.7 | 24.5 | 25.1 | 25.4 | 24.1   | 24.7 | 24.5 | 25.1 | 25.4 |
|                                     | 12H       | 24.3   | 24.9 | 24.7 | 25.2 | 25.7 | 24.3   | 24.9 | 24.7 | 25.2 | 25.7 |
| 4H                                  | 2H        | 21.9   | 22.6 | 22.2 | 22.8 | 23.0 | 21.9   | 22.6 | 22.2 | 22.8 | 23.0 |
|                                     | 3H        | 23.2   | 23.8 | 23.5 | 24.1 | 24.5 | 23.2   | 23.8 | 23.5 | 24.1 | 24.5 |
|                                     | 4H        | 24.0   | 24.5 | 24.4 | 24.9 | 25.4 | 24.0   | 24.5 | 24.4 | 24.9 | 25.4 |
|                                     | 6H        | 24.8   | 25.4 | 25.3 | 25.7 | 26.0 | 24.8   | 25.4 | 25.3 | 25.7 | 26.0 |
|                                     | 8H        | 25.1   | 25.6 | 25.6 | 26.0 | 26.3 | 25.1   | 25.6 | 25.6 | 26.0 | 26.3 |
|                                     | 12H       | 25.3   | 25.8 | 25.8 | 26.2 | 26.6 | 25.3   | 25.8 | 25.8 | 26.2 | 26.6 |
| 8H                                  | 4H        | 24.3   | 24.8 | 24.8 | 25.2 | 25.5 | 24.3   | 24.8 | 24.8 | 25.2 | 25.5 |
|                                     | 6H        | 25.3   | 25.7 | 25.8 | 26.2 | 26.7 | 25.3   | 25.7 | 25.8 | 26.2 | 26.7 |
|                                     | 8H        | 25.8   | 26.1 | 26.3 | 26.6 | 27.2 | 25.8   | 26.1 | 26.3 | 26.6 | 27.2 |
|                                     | 12H       | 26.2   | 26.4 | 26.7 | 26.9 | 27.5 | 26.2   | 26.4 | 26.7 | 26.9 | 27.5 |
| 12H                                 | 4H        | 24.3   | 24.7 | 24.8 | 25.1 | 25.6 | 24.3   | 24.7 | 24.8 | 25.1 | 25.6 |
|                                     | 6H        | 25.5   | 25.8 | 26.0 | 26.3 | 26.9 | 25.5   | 25.8 | 26.0 | 26.3 | 26.9 |
|                                     | 8H        | 25.9   | 26.2 | 26.5 | 26.7 | 27.3 | 25.9   | 26.2 | 26.5 | 26.7 | 27.3 |

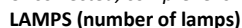
### Variations with the observer position for the luminaire spacings, S:

|          |            |            |
|----------|------------|------------|
| S = 1.0H | 0.9 / -0.4 | 0.9 / -0.4 |
| S = 1.5H | 2.0 / -0.5 | 2.0 / -0.5 |
| S = 2.0H | 3.2 / -0.7 | 3.2 / -0.7 |

## 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                   | 113 | 110                      | 108 | 105 | 111  | 108 | 106 | 104 | 104 | 102 | 100 | 100 | 99  | 97  | 97  | 96  | 95  | 93  |
| 2                   | 108 | 103                      | 99  | 95  | 105  | 101 | 97  | 94  | 98  | 95  | 92  | 95  | 92  | 90  | 92  | 90  | 88  | 87  |
| 3                   | 103 | 96                       | 91  | 87  | 101  | 95  | 90  | 87  | 92  | 88  | 85  | 90  | 87  | 84  | 88  | 85  | 83  | 81  |
| 4                   | 98  | 91                       | 85  | 81  | 96   | 89  | 84  | 81  | 87  | 83  | 80  | 85  | 82  | 79  | 83  | 80  | 78  | 76  |
| 5                   | 94  | 86                       | 80  | 76  | 92   | 85  | 79  | 75  | 83  | 78  | 75  | 81  | 77  | 74  | 80  | 76  | 73  | 72  |
| 6                   | 89  | 81                       | 75  | 71  | 88   | 80  | 75  | 71  | 79  | 74  | 71  | 77  | 73  | 70  | 76  | 72  | 70  | 68  |
| 7                   | 86  | 77                       | 71  | 67  | 84   | 76  | 71  | 67  | 75  | 70  | 67  | 74  | 70  | 67  | 73  | 69  | 66  | 65  |
| 8                   | 82  | 73                       | 68  | 64  | 81   | 73  | 68  | 64  | 72  | 67  | 64  | 71  | 66  | 63  | 70  | 66  | 63  | 62  |
| 9                   | 79  | 70                       | 65  | 61  | 78   | 70  | 64  | 61  | 69  | 64  | 61  | 68  | 63  | 60  | 67  | 63  | 60  | 59  |
| 10                  | 76  | 67                       | 62  | 58  | 75   | 67  | 61  | 58  | 66  | 61  | 58  | 65  | 61  | 58  | 64  | 60  | 58  | 56  |

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### Zonal Lumen Summary

[illegible]

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Outdoor Light Planning

Lumen per Zone

| Zone (γ) | Lumen   | % Total |
|----------|---------|---------|
| 0-10°    | 718 lm  | 17.5%   |
| 10-20°   | 1443 lm | 35.2%   |
| 20-30°   | 1038 lm | 25.3%   |
| 30-40°   | 432 lm  | 10.5%   |
| 40-50°   | 181 lm  | 4.4%    |
| 50-60°   | 104 lm  | 2.5%    |
| 60-70°   | 82 lm   | 2.0%    |
| 70-80°   | 69 lm   | 1.7%    |
| 80-90°   | 33 lm   | 0.8%    |
| 90-100°  | 2 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    | 4102 lm | 100.0%  |

Intensity peaks

|                |         |
|----------------|---------|
| Max intensity  | 8125 cd |
| Intensity, 90° | 9 cd    |
| Intensity, 0°  | 8125 cd |

Zonal Lumen summary

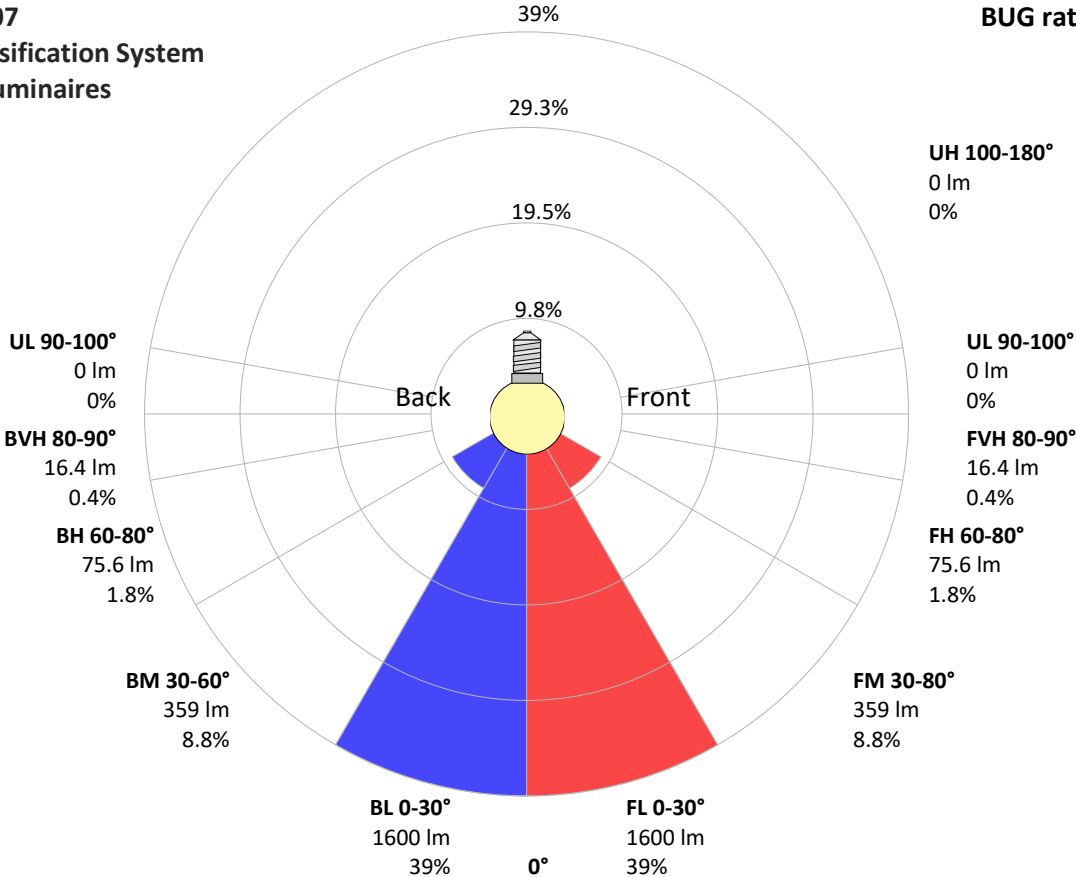
| Zone (γ) | Lumen   | % Total |
|----------|---------|---------|
| 0-30°    | 3199 lm | 78.0%   |
| 0-40°    | 3631 lm | 88.5%   |
| 0-60°    | 3916 lm | 95.5%   |
| 60-90°   | 184 lm  | 4.5%    |
| 70-100°  | 104 lm  | 2.5%    |
| 90-120°  | 2 lm    | 0.0%    |
| 0-90°    | 4100 lm | 100.0%  |
| 90-180°  | 2 lm    | 0.0%    |
| 0-180°   | 4102 lm | 100.0%  |

BUG rating

|                      | Lumen   | % Total |
|----------------------|---------|---------|
| <b>Forward light</b> |         |         |
| Low(0-30°)           | 1600 lm | 39.0%   |
| Medium(30-60°)       | 359 lm  | 8.8%    |
| High(60-80°)         | 76 lm   | 1.8%    |
| Very high(80-90°)    | 16 lm   | 0.4%    |
| <b>Back light</b>    |         |         |
| Low(0-30°)           | 1600 lm | 39.0%   |
| Medium(30-60°)       | 359 lm  | 8.8%    |
| High(60-80°)         | 76 lm   | 1.8%    |
| Very high(80-90°)    | 16 lm   | 0.4%    |
| <b>Uplight</b>       |         |         |
| 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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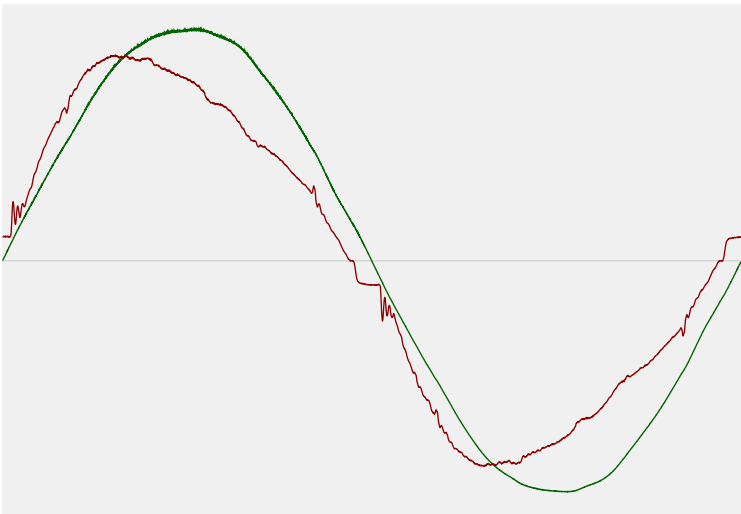


## Power Details

### Input Power

|   |          |
|---|----------|
| Power feed to light source                          | 41.4 W   |
| Frequency of input power                            | 50 Hz    |
| RMS Input voltage feed, $V_{RMS}$                   | 243 V    |
| RMS Input current feed, $I_{RMS}$                   | 0.176 A  |
| Volt-Ampere or apparent power = $V_{RMS} * I_{RMS}$ | 42.84 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            | 1.14%    |

### Input Power Curve



### Efficiency

|                           |         |
|---------------------------|---------|
| Radiated power efficiency | 35.8%   |
| Lumen efficiency          | 99 lm/W |



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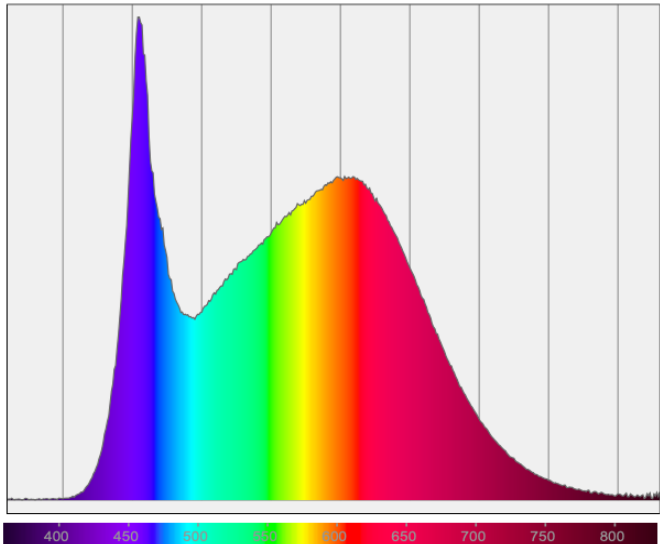
1\_PHOT\_SKIN+BONES-4750lmChip-4000K-38Deg\_2303  
www.factorylux.com



## Color Measurements

|                              |   |
|------------------------------|---|
| Correlated Color Temperature | CCT = 4000 K                              |
| Color Rendering TM30-18      | R <sub>f</sub> 88.9 – R <sub>g</sub> 98.5 |
| Color Shift, CIE duv         | Duv ±0.0003                               |

## Spectral distribution



## Color details

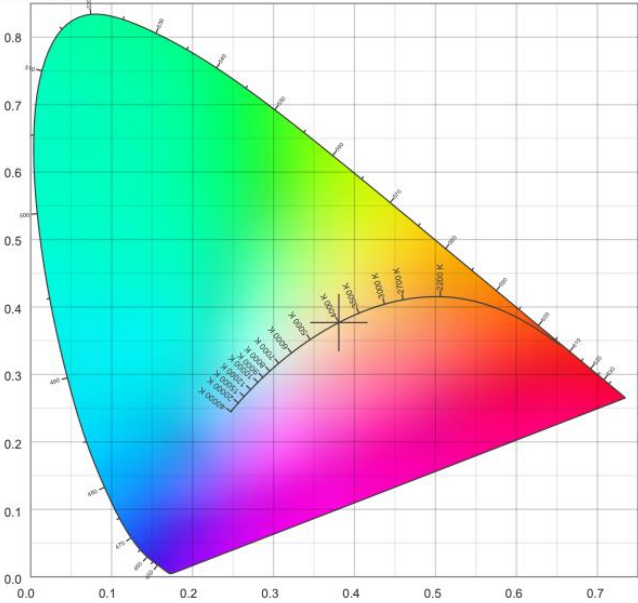
|   |   |                                     |                         |
|---|---|-------------------------------------|-------------------------|
| Correlated Color Temperature              | CCT = 4000 K                              | Color coordinates CIE 1931          | (x;y) = (0.381;0.377)   |
| 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 <sub>f</sub> 88.9 – R <sub>g</sub> 98.5 | Color coordinate CIEs 1976 (CIELUV) | (u';v') = (0.225;0.225) |
| Color Quality Scale                       | CQS = 88.9                                |                                     |                         |

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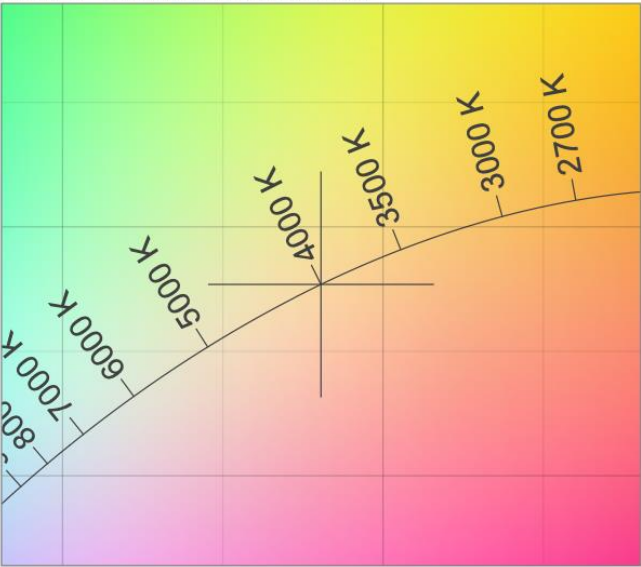
1\_PHOT\_SKIN+BONES-4750lmChip-4000K-38Deg\_2303  
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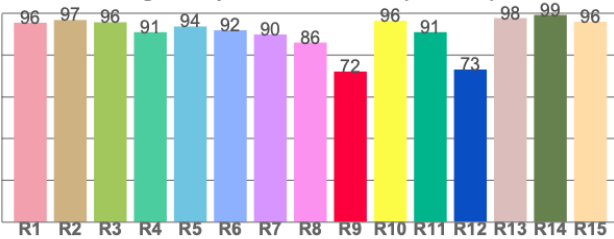
CIE 1931



CIE 1931 – zoomed on Planckian locus



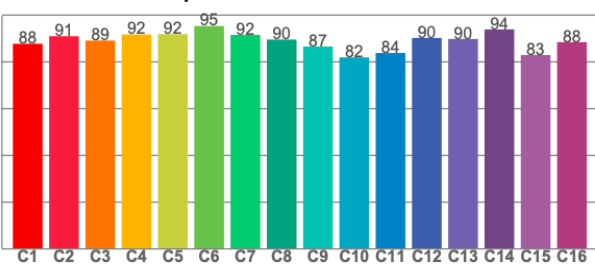
Color Rendering Index per reference color (CIE 1995)



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 |

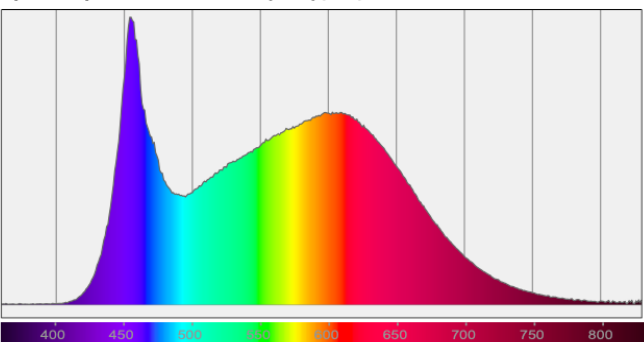
TM30-18 Rf-values per hue bin



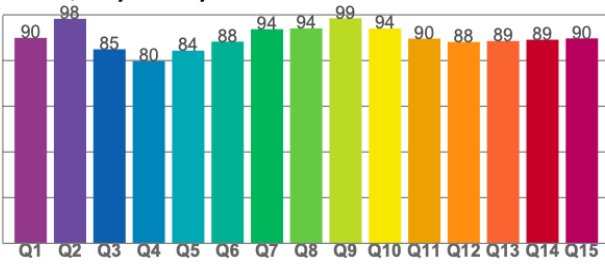
TM30 C values, 16 binned values out of total of 99 C values

| 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 |