Lamp measurement report - 15 July 2021

VL4 Super HO module 24V DC

by

SloanLED

Lamp measurement report - 15 July 2021

Summary measurement data dated 2021-07-15

parameter	meas. result	remark
Color temperature	6751 K	cold white
Luminous intensity I_v	14.0 Cd	Measured straight underneath the lamp.
Illuminance modulation index	1 %	Measured with a light sensor looking at the lamp (angle not defined). Is a measure for the amount of flickering.
SVM	0.0	Stroboscopic Visibility Measure, and must be ? 0.9 (from September 1, 2024 ? 0.4) at full-load for certain (O)LEDs per EU regulation 2019/2020.
Beam angle	178 deg	178 deg is the beam angle for the C0-C180-plane (perpendicular to the length direction of the lamp) and 168 deg is the beam angle for the C90-C270 plane, which is along the length direction of the lamp. Flux code: 14 39 85 98 100 0 1 16 2.
Power P	1.5 W	The net power consumed.
Power Factor	1.00	The tests were done with a DC power supply. This results in no blind power and as a result the power factor is always 1.0 but not relevant to mention.
THD	NaN %	Total Harmonic Distortion, is not present as a DC voltage was used to power the lamp so a DC current resulted which has no THD.
Luminous flux	232 lm	Measured with photogoniometer, calculation done as described in LM79-08.
Luminous efficacy	158 lm/W	This efficiency is for the LED / lamp only and is without any power supply that must convert the 230 V to DC current.
EU2021-label classification	D	The energy class, from A (more efficient) to G (least efficient). This label is an update of the previous version, and compulsory from Sept 2021.
EU2013-label classification	A++	The energy class, from A++ (more efficient) to E (least efficient). This energy label will be replaced on September 21, 2021.
CRI_Ra	75	Color Rendering Index.
Rf_TM30	71	TM30-15 is an improved indicator (over CRI) of how well colors are rendered.
Rg_TM30	93	Gamut Area Ratio.
Coordinates chromaticity diagram	x=0.3092 en y=0.3234	
Fitting	24V DC	

Lamp measurement report - 15 July 2021

parameter	meas. result	remark
Luminous flux for chicken	422 cLm	Total radiant flux adjusted by color sensitivity curve (from 350 - 780 nm) of chickens (Gallus domesticus).
S/P ratio	2.1	This factor indicates the amount of times more efficient the light of this light bulb is perceived under scotopic circumstances (low environmental light level).
L x W x H external dimensions	100 mm x 18 mm x 9 mm	External dimensions of the lamp.
L x W x H luminous area	80 mm x 12 mm x 5 mm	Dimensions of the luminous area (used in Eulumdat file). It is the surface of the smallest rectangle around all LEDs.
General remarks		The ambient temperature during the whole set of illuminance measurements was 25.1 - 25.2 deg C. The temperature of the lamp gets maximally about 13 degrees hotter than ambient temperature. Warm up effect: During the warmup time the illuminance doesn't vary significantly (< 5 %). During the warmup time the power doesn't vary significantly (< 5 %). The variation in efficacy (calculated as indication by simply dividing the illuminance by the power) during the warming up is -2 %. A very high negative value indicates a significant decrease for instance due to heating up of the lamp (decrease of lifetime). Voltage dependency: There is a constant dependency of the illuminance when the power voltage varies between 22 - 25 V . There is a constant dependency of the consumed power when the power voltage varies between 22 - 25 V . At the end of the article an additional photo.
Eff-variation	-2 %	This is the variation in efficacy (calculated as indication by simply dividing the illuminance by the power) during the warming up. A very high negative value indicates a significant decrease for instance due to heating up of the lamp (decrease of lifetime).
Dimmable	no/not known	Info from manufacturer.
Melanopic effect factor	0.738	According to norm DIN SPEC 5031-100:2015-08.
Melanopic Ratio	0.61	This ratio multiplied with the lux value gives the EML-value (Equivalent Melanopic Value), used in table L2 of WELL std 2019-Q3.

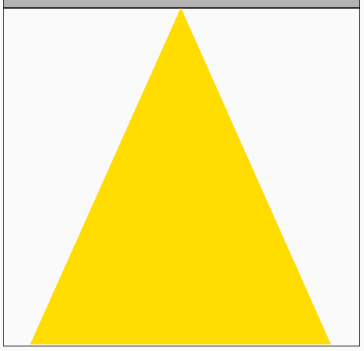
Lamp measurement report - 15 July 2021

parameter	meas. result	remark
Blue Light Hazard risk group	0	0=exempt, 1=low, 2 = moderate, 3=high risk. Indication value only for straight underneath the lamp.
form factor	module	

Overview table

m.	Ø 50%	
	C0-180	C90-270
0.5	47.6	9.5
0.75	71.5	14.3
1	95.3	19
1.25	119.1	23.8
1.5	142.9	28.5
1.75	166.7	33.3
2	190.5	38

C0-180: 178°
C90-270: 168°



E (lux)
56
25
14
9
6
5
3

Luminaire Efficacy	
158	(lumen per Watt)
Half-peak diam C_{0-180}	
47.64	x diameter(m)
Half-peak diam C_{90-270}	
9.51	x diameter(m)
Illuminance	
14	/ distance^2(lux)
Total Output	
232	(lumen)

Please note that this overview table makes use of calculations, use this data with care as explained on the OliNo site.

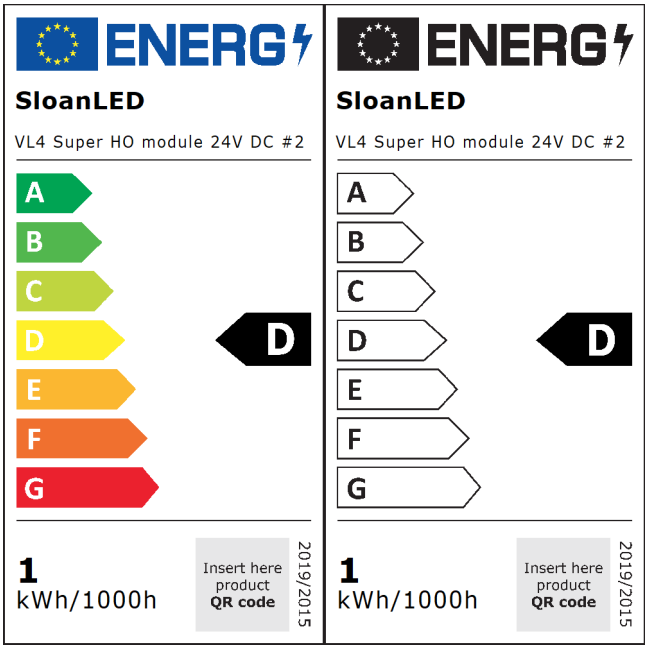
Lamp measurement report - 15 July 2021

EU 2021 Energy label classification

These energy labels are in force since Sept 2021. They have been drawn up in accordance with the Commission Delegated Regulation (EU) 2019/2015.

It applies to light sources, with requirements for the x, y chromaticity coordinates (is fulfilled), the luminous flux (is fulfilled) and colour rendering index CRI (is fulfilled).These requirements are fulfilled.

The energy efficiency class of light sources shall be determined on the basis of the total mains efficacy eta_TM. This is calculated by dividing the declared useful luminous flux (232 lm, flux in a sphere (360°)) by the declared on-mode power consumption P_on (1.5 W) and multiplying by the applicable factor F_TM that depends on the light source type (0.926, type: Non-directional (NDLS) not operating on mains (NMLS)). The result is the total mains efficacy eta_TM = 146 (lm/W).



EU energy label for this light source

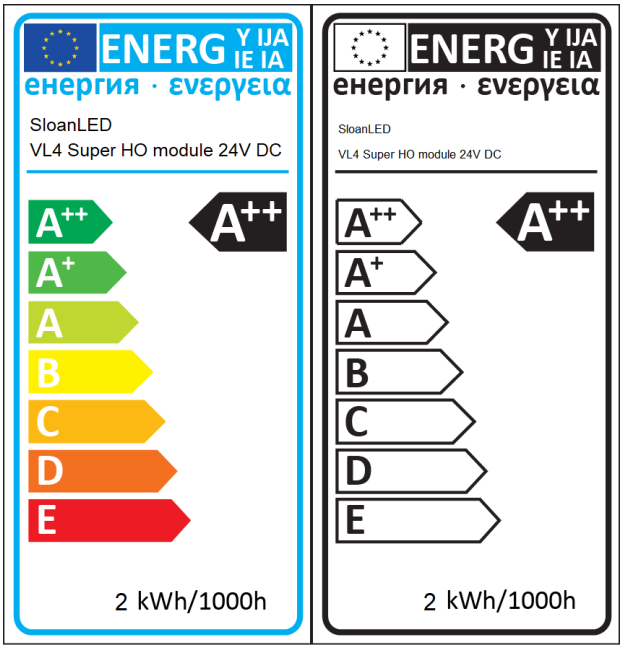
Lamp measurement report - 15 July 2021

EU 2013 Energy label classification

Since Sept 2013 these labels will be needed.

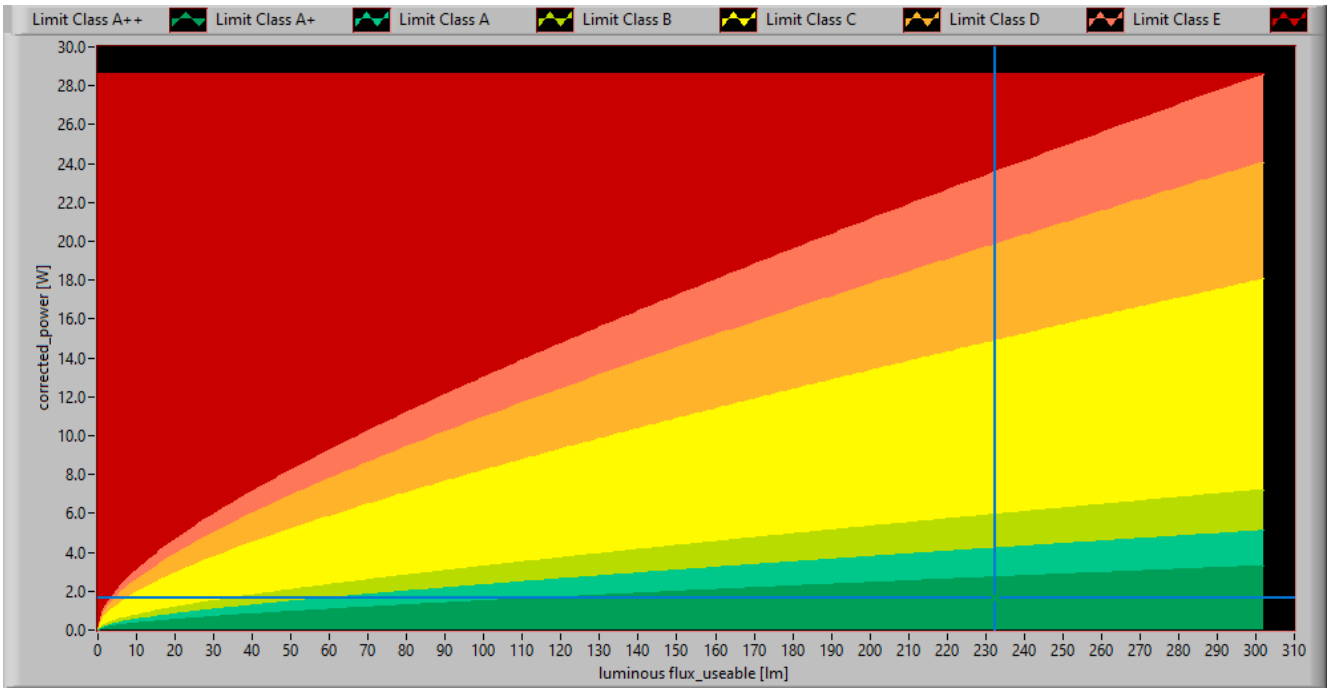
Important for the energy classification are the corrected rated power and the useful luminous flux.
The measured rated power is 1.5 W and might need to be corrected. The correction is dependent from the lamp type and whether or not the lamp control gear is included or not. The choice for this lamp is the following classification: **Lamps operating on external LED lamp control gear**. As a result the corrected rated power becomes: 1.6 W.
The luminous flux measured is 232 lm. The classification of this lamp needed to determine the useful flux is: **Non-directional lamps**. Then the useful flux becomes 232 lm. Now a reference power can be calculated.

The energy efficiency coefficient is P_corr / P_ref = 0.07.



EU energy label for this lamp

Lamp measurement report - 15 July 2021

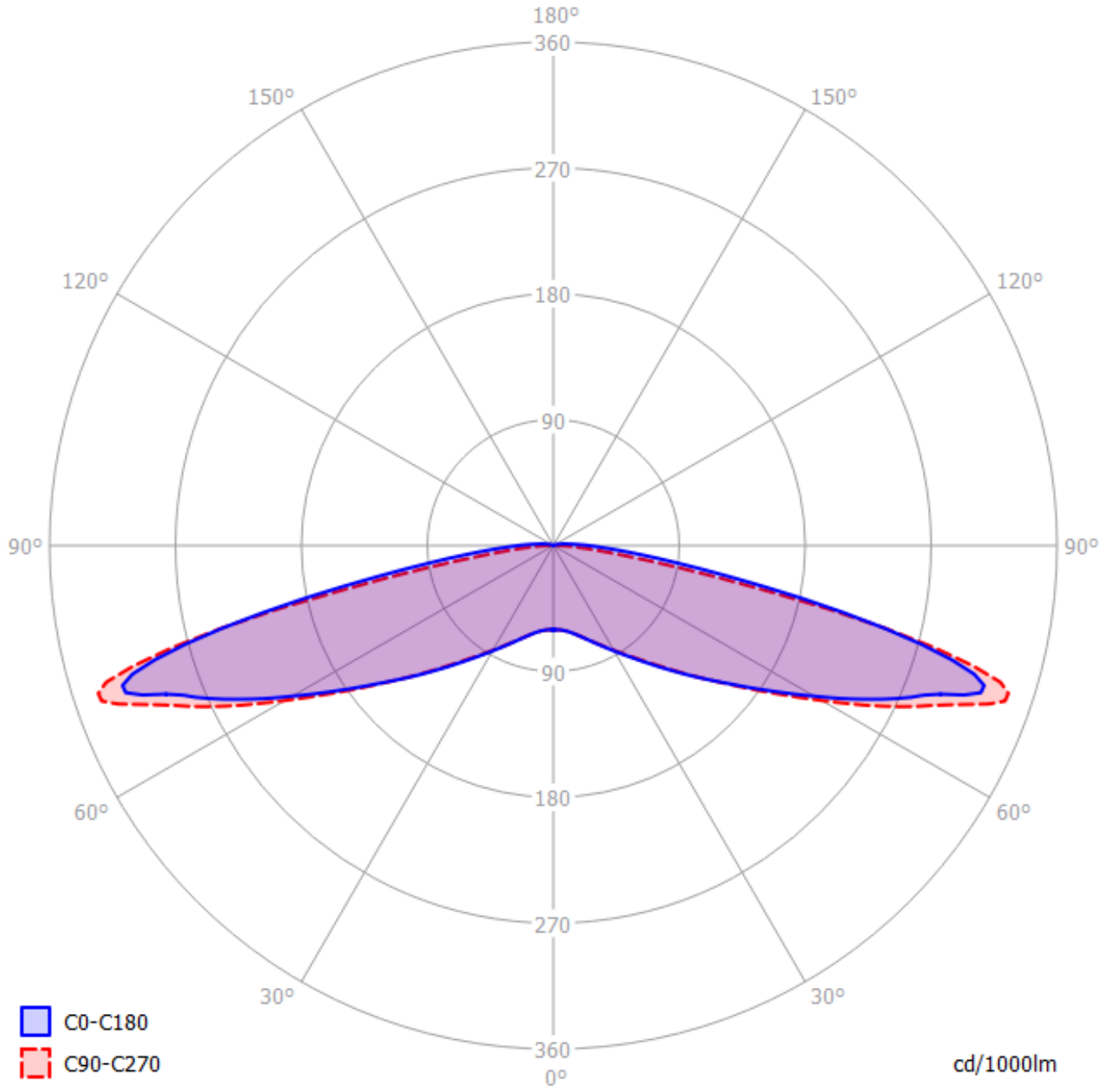


The lamp's performance in the lumen-Watt field, with the energy efficacy fields indicated.

Lamp measurement report - 15 July 2021

Eulumdat light diagram

This light diagram below comes from the program Qlumedit, that extracts these diagrams from an Eulumdat file.



The light diagram giving the radiation pattern.

The light diagram indicates the beam in the C0-C180 plane (perpendicular to the length direction of the lamp) and in the plane perpendicular to that, the C90-C270 plane (along the length direction of the lamp).

When using the Ev or Iv values per inclination angle, the beam angle can be computed, being 178 deg for the C0-C180 plane and 168 deg for the C90-C270 plane.

Lamp measurement report - 15 July 2021

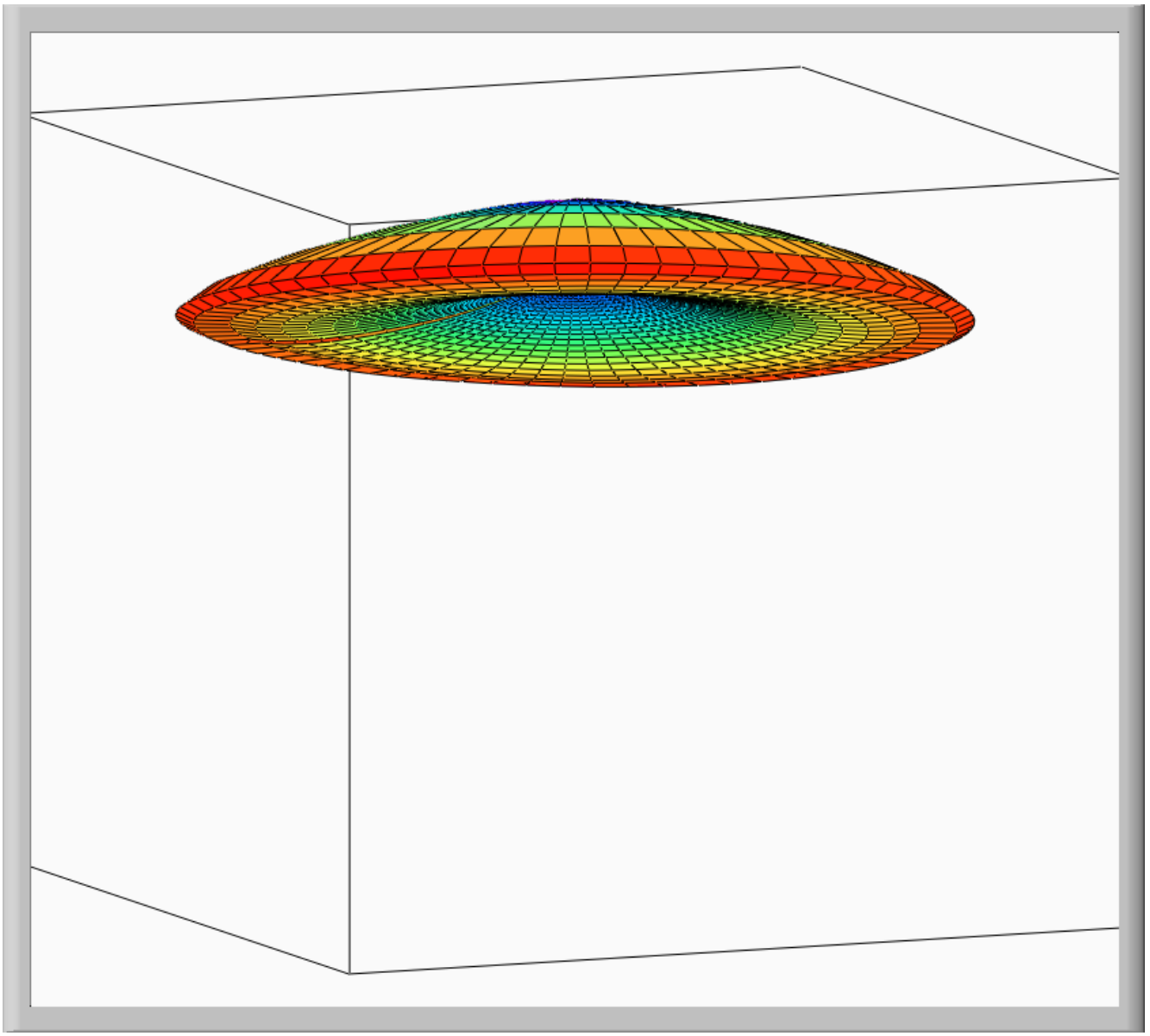
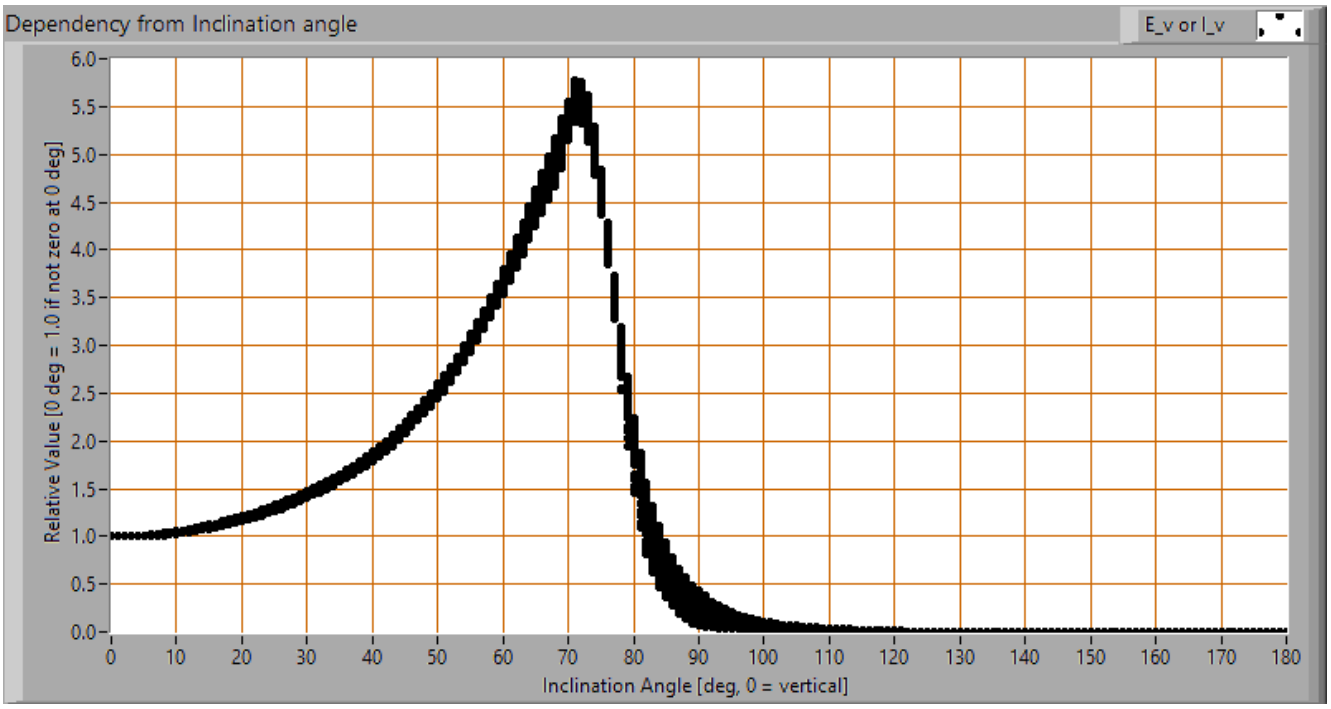


Image of the light distribution pattern in 3D.

Lamp measurement report - 15 July 2021



Intensity data of every measured turn angle at each inclination angle.

This plot shows per inclination angle the intensity measurement results for each turn angle at that inclination angle. There normally are differences in illuminance values for different turn angles. However for further calculations the averaged values will be used.

Luminous flux

With the averaged illuminance data at 1 m distance, taken from the graph showing the averaged radiation pattern, it is possible to compute the luminous flux.

The result of this computation for this light spot is a luminous flux of 232 lm.

Luminous efficacy

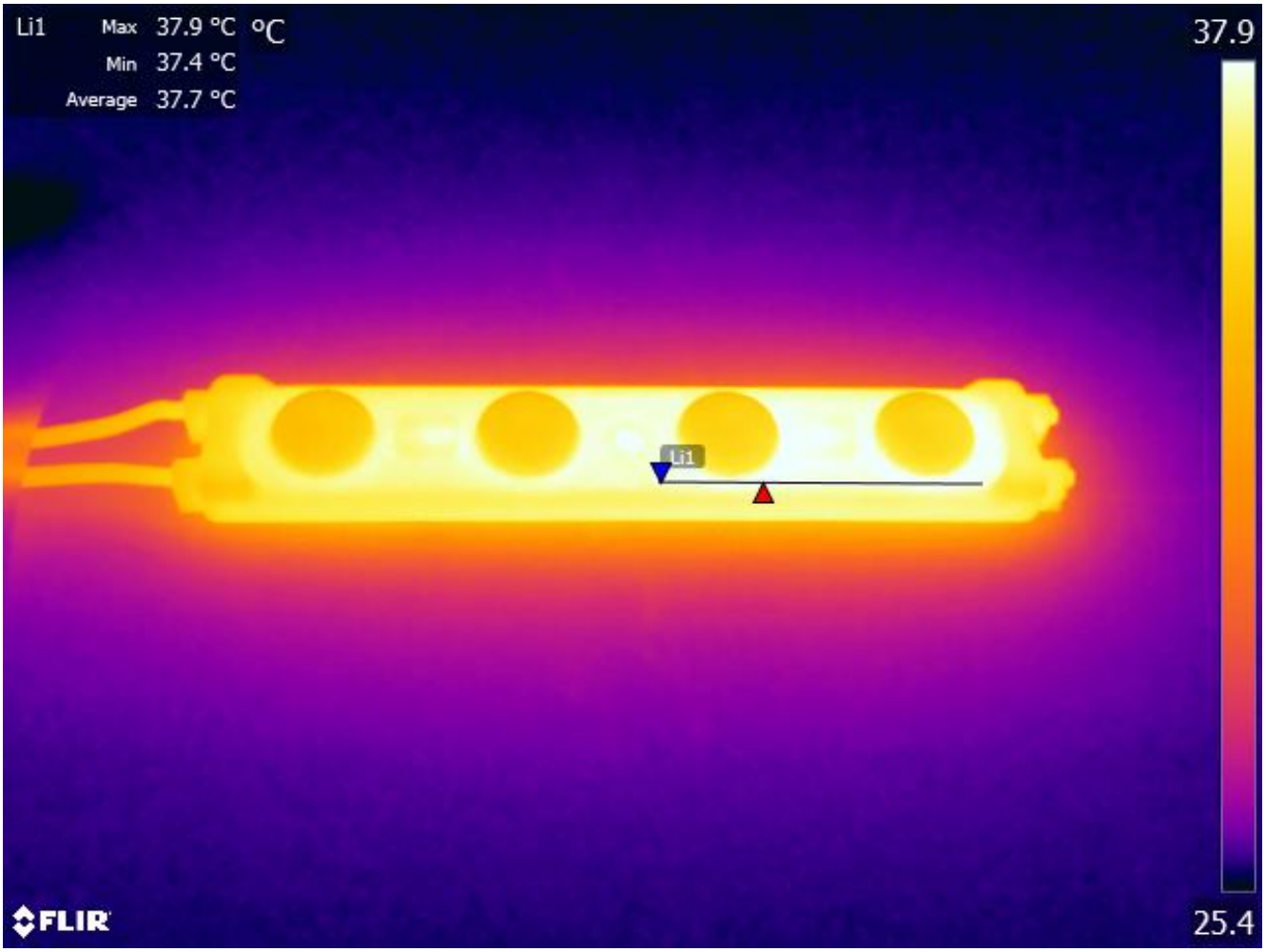
The luminous flux being 232 lm, and the consumed power of the lamp being 1.5 Watt, results in a luminous efficacy of 158 lm/Watt.

Lamp measurement report - 15 July 2021

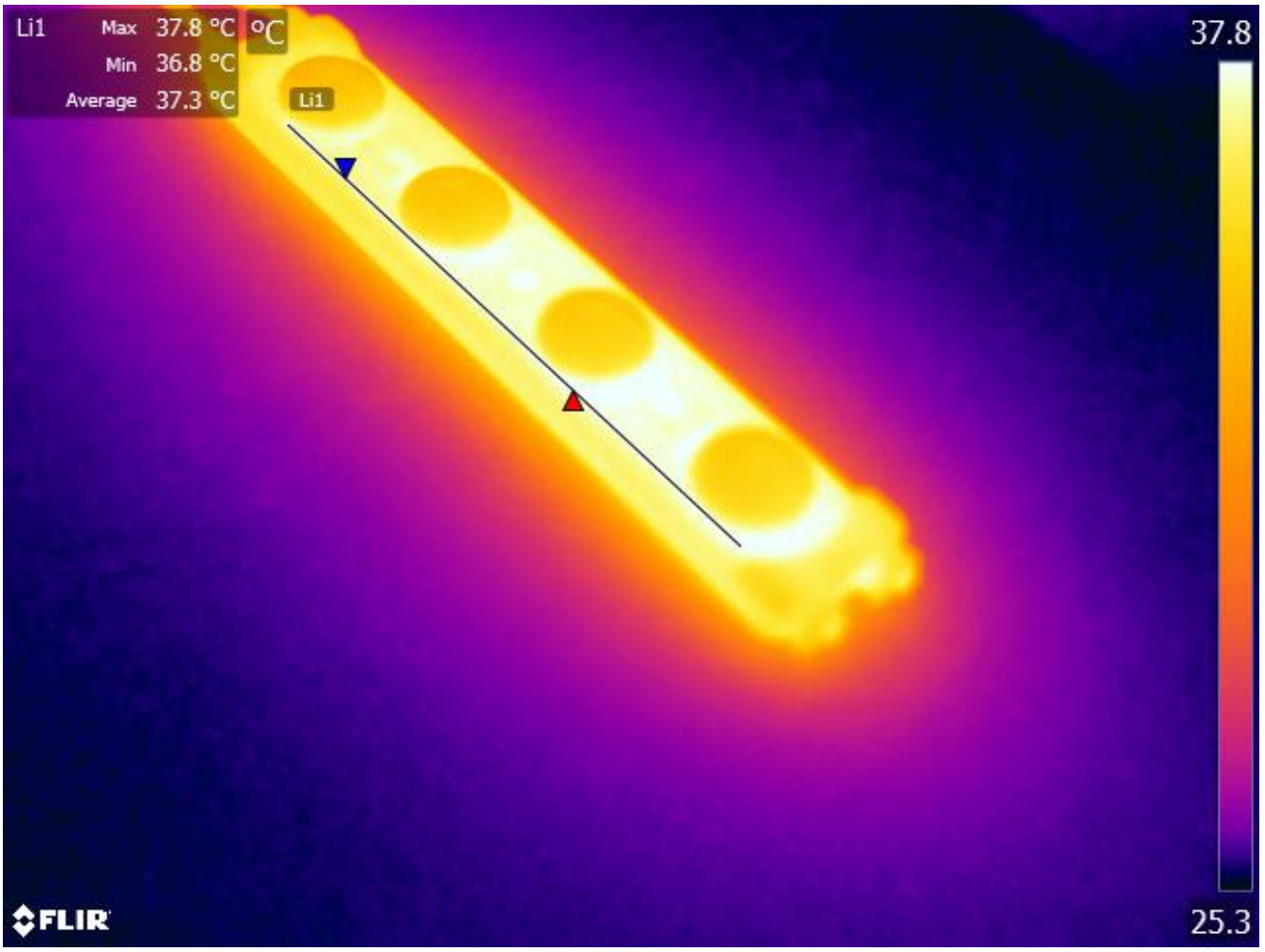
Electrical properties

Lamp voltage	24.00 V DC
Lamp current	0.061 A
Power P	1.5 W
Apparent power S	1.5 VA
Power factor	1.00

Temperature measurements lamp



Lamp measurement report - 15 July 2021

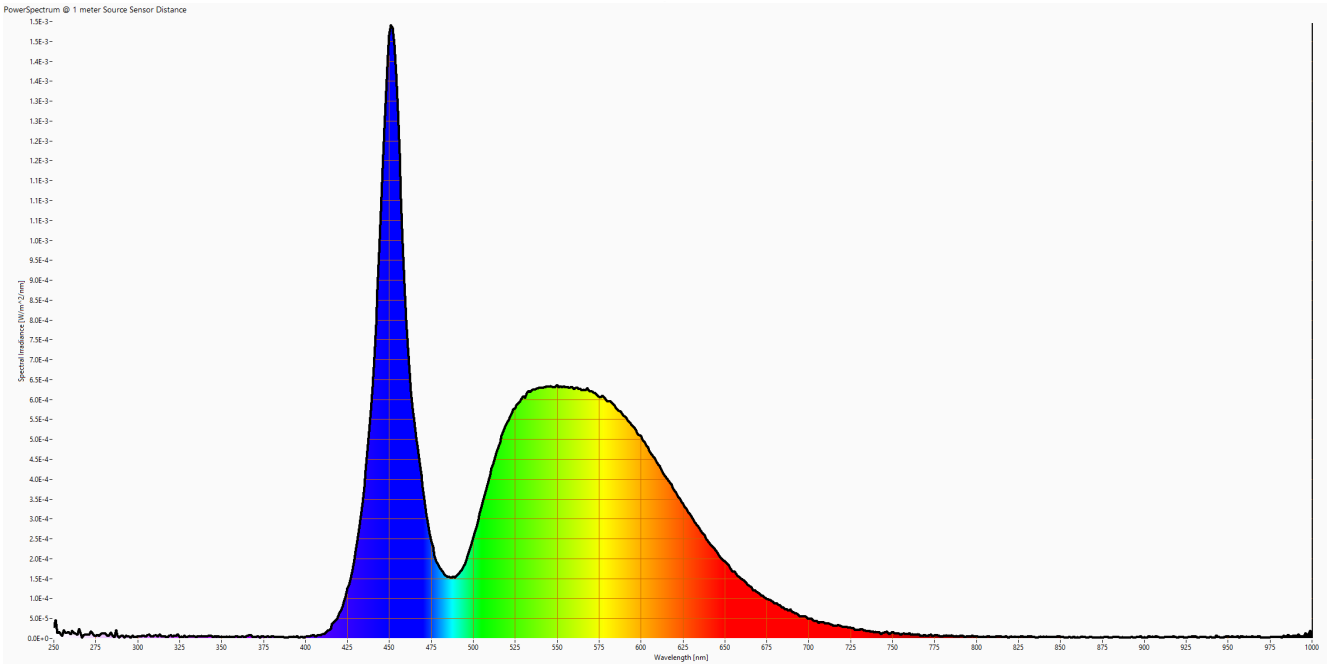


Temperature image(s).

status lamp	> 2 hours on
ambient temperature	25 deg C
reflected background temperature	25 deg C
camera	Flir T335
emissivity	0.95
measurement distance	0.3 m
IFOV_geometric	0.136 mm per 0.1 m distance
NETD (thermal sensitivity)	50 mK

Lamp measurement report - 15 July 2021

Color temperature and Spectral power distribution

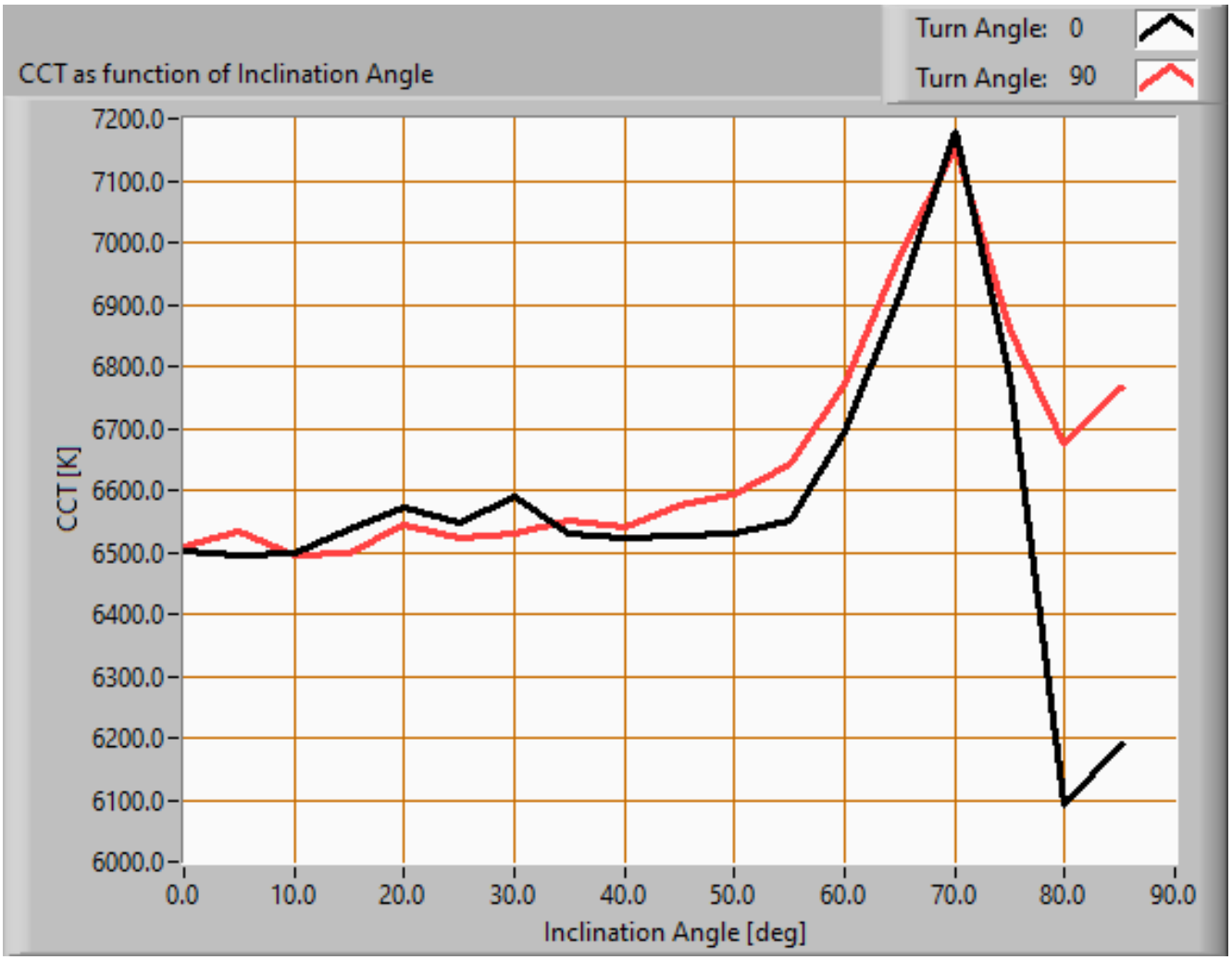


The spectral power distribution of this light bulb, energies on y-axis valid at 1 m distance.

The measured color temperature is 6751 K which is cold white.

This color temperature is measured straight underneath the light bulb. Below a graph showing the color temperature for different inclination angles.

Lamp measurement report - 15 July 2021



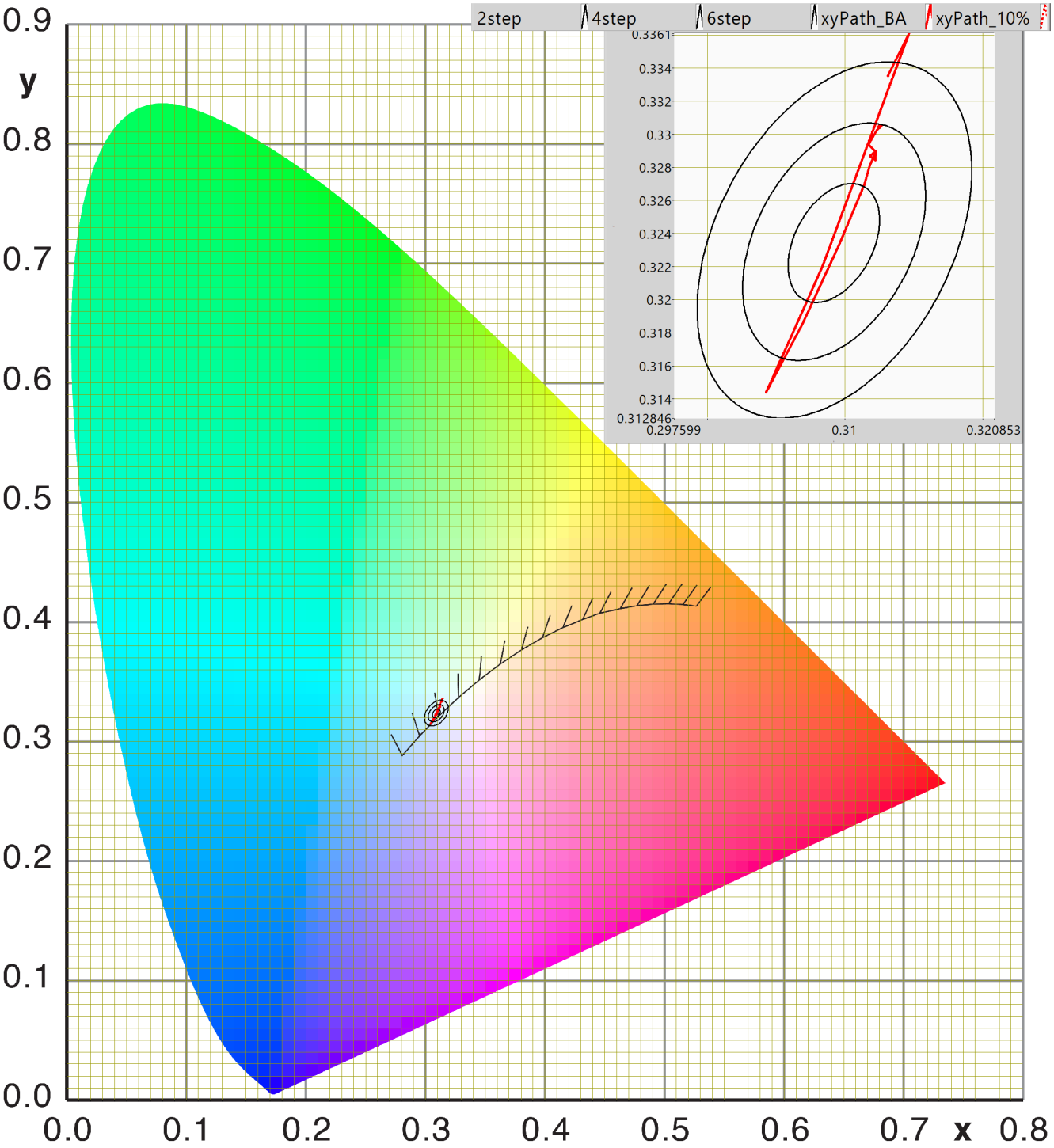
Color temperature as a function of inclination angle.

The color temperature is given for inclination angles up to 85 deg. Beyond that value the illuminance is lower than 10%% of Ev straight underneath the lamp, that it has not been used for color determination of the light.

For the C0-C180 plane: the beam angle of 178 deg is equivalent to 88.8 deg inclination angle,which is the area where most of the light falls within. The maximum variation of color temperature in this inclination area is about 10 %.

For the C90-C270 plane: the beam angle of 168 deg is equivalent to 84.0 deg inclination angle,which is the area where most of the light falls within. The maximum variation of color temperature in this inclination area is about 10 %.

Lamp measurement report - 15 July 2021

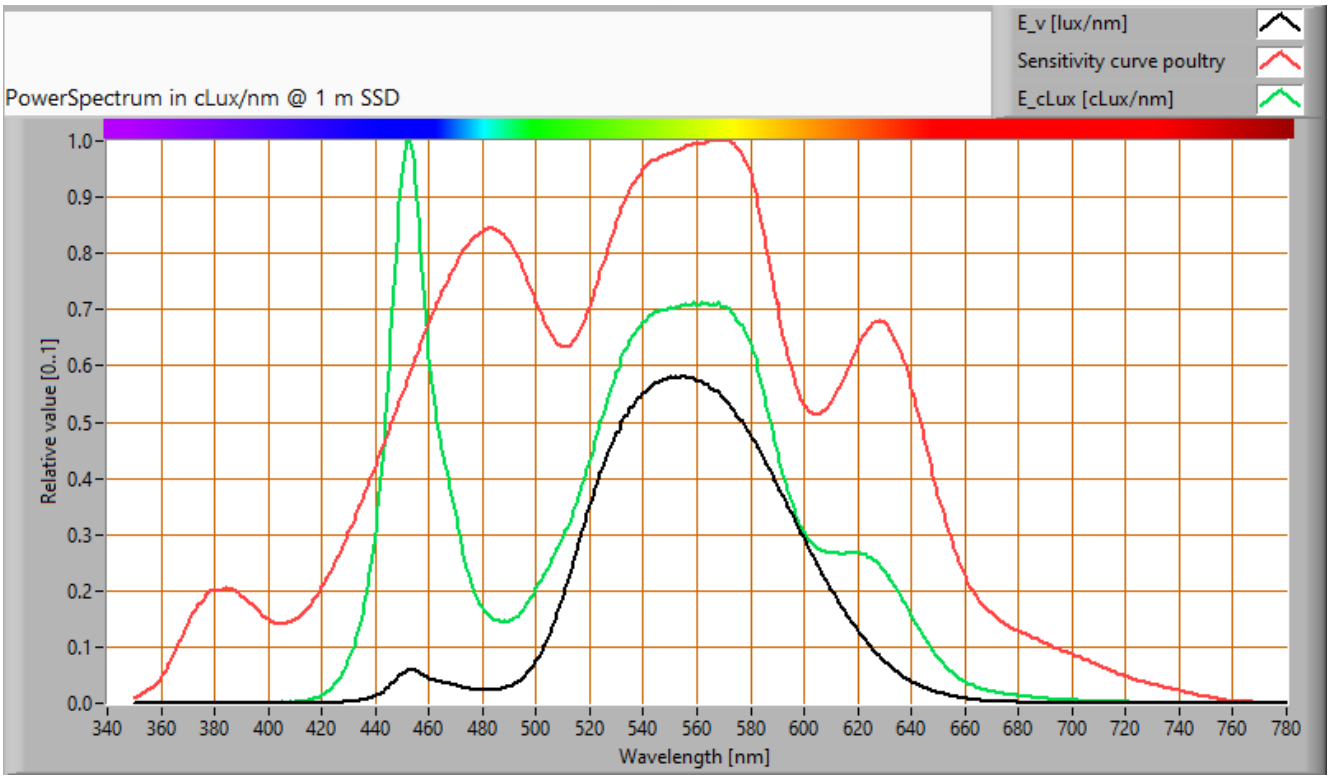


Color point dependent on inclination angle related to 2, 4 and 6 step MacAdam ellipse, for all angles within the beam angle (solid line) and for all angles where Ev dropped to 10 % value (dotted line)

Lamp measurement report - 15 July 2021

Luminous flux for chicken

The energy in the spectrum of the light of the lamp can be evaluated by the spectral sensitivity of the eye of chicken (N.B. Prescott and C.M. Wathes, 1999 and J. E. Saunders, J. R. Jarvis and C. M. Wathes, 2008).

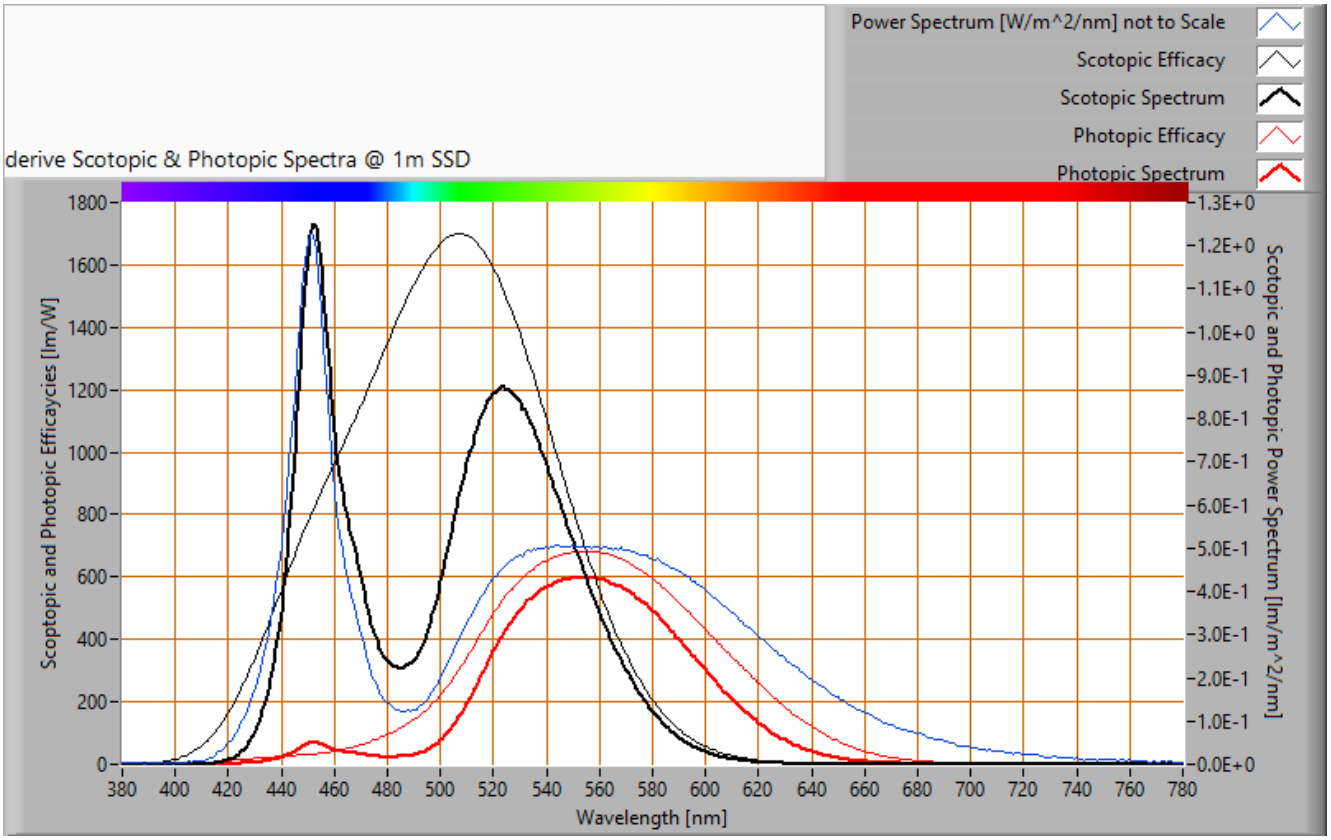


The spectrum of the light, multiplied by the spectral sensitivity of the human eye and the eye of a chicken.

parameter [unit]	value	explanation
Luminous flux [lm]	232	The light of the lamp evaluated for a human eye.
Luminous flux chicken [cLm]	422	The light of the lamp evaluated for the eye of a chicken.
Factor from lux to cLux	1.82	With this factor, the lux value of this light can be converted to the cLux value.

Lamp measurement report - 15 July 2021

S/P ratio

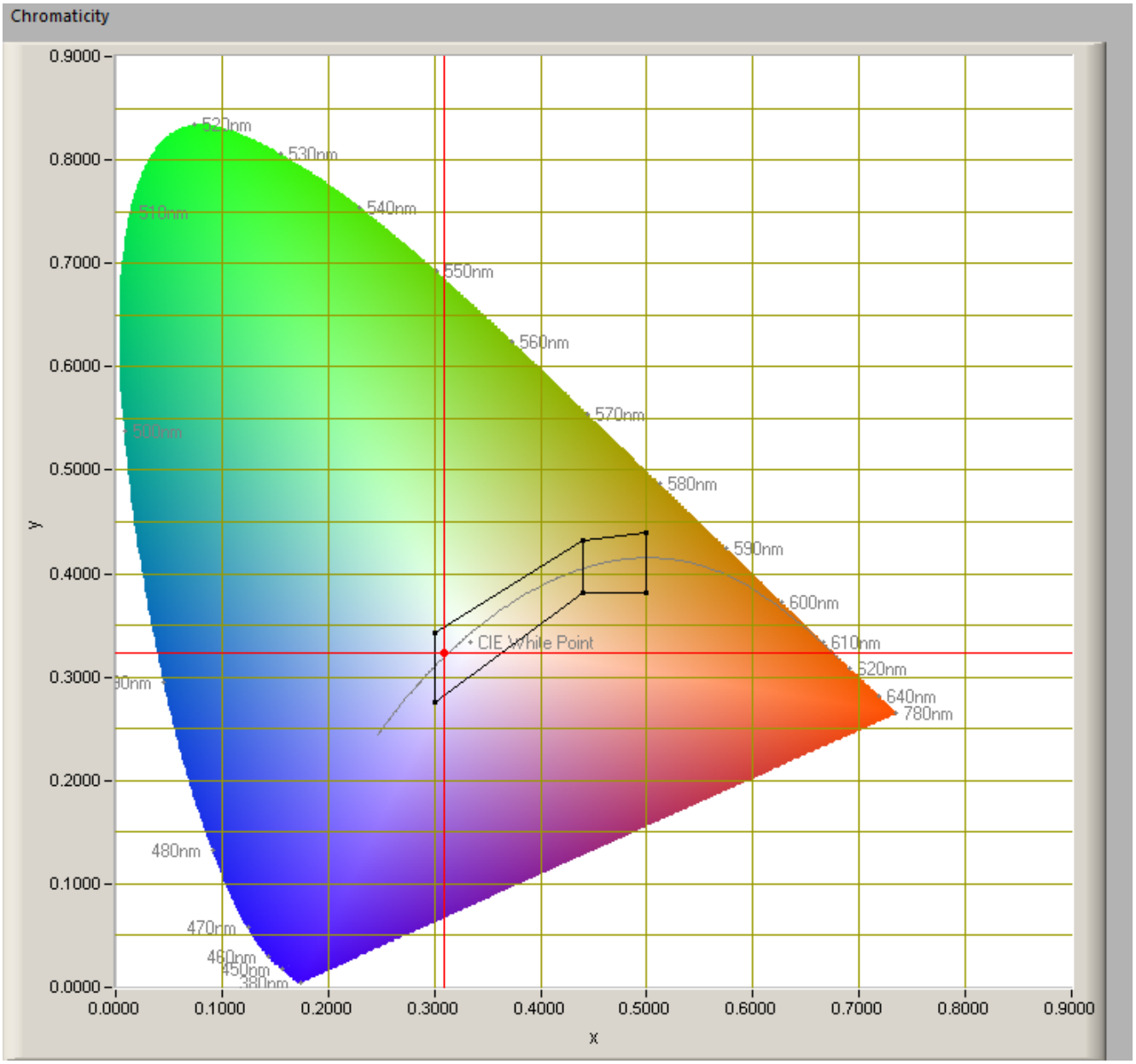


The power spectrum, sensitivity curves and resulting scotopic and photopic spectra (spectra energy content defined at 1 m distance).

The S/P ratio of the light coming from this lamp is 2.1.

Lamp measurement report - 15 July 2021

Chromaticity diagram



The chromaticity space and the position of the lamp's color coordinates in it.

The point of the light in this diagram is inside the area indicated with class A. The areas A and B indicate areas for signal lamps.

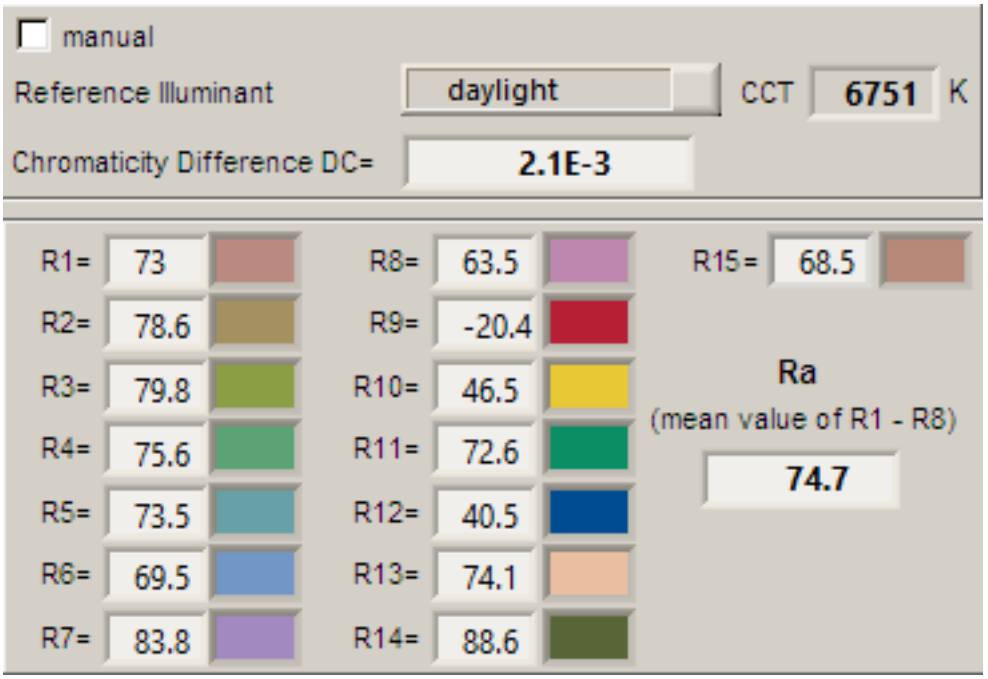
The color coordinates are x=0.3092 and y=0.3234.

Lamp measurement report - 15 July 2021

Color Rendering Index (CRI) or also Ra

Herewith the image showing the CRI as well as how well different colors are represented (rendered). The higher the number, the better the resemblance with the color when a black body radiator would have been used (the sun, or an incandescent lamp)

Each color has an index Rx, and the first 8 indexes (R1 .. R8) are averaged to compute the Ra which is equivalent to the CRI.



CRI of the light of this lightbulb.

This value of 75 indicates how well the light of this lamp can render well a set of reference colors, this in comparison with the light of a reference source (for color temperatures < 5000K a black radiator is used as reference and for color temperatures > 5000K the sun or the light outside during the day).

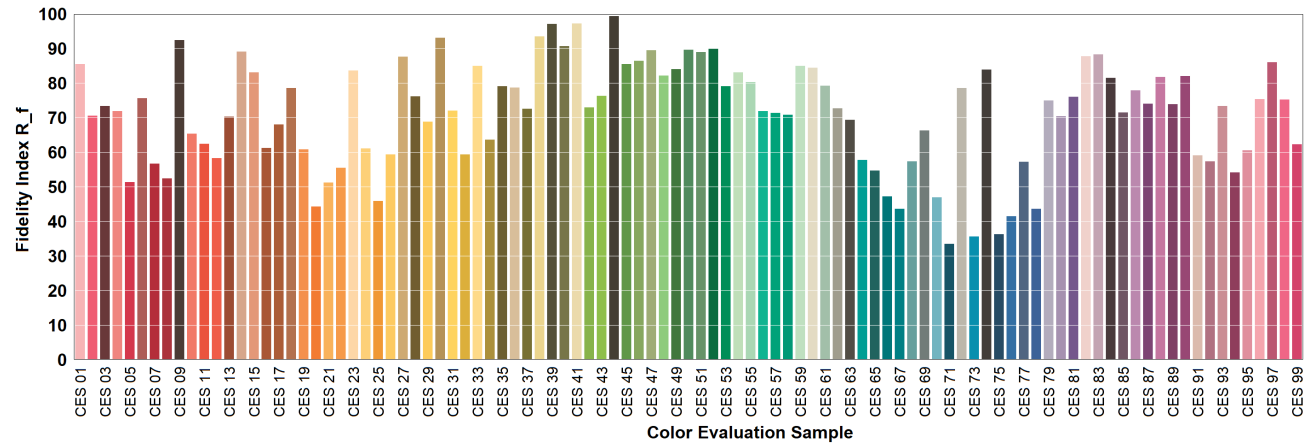
The value of 75 is smaller than the value of 80 that is considered as a minimum for working areas in general.

Note: the chromaticity difference is 0.0021 and indicates the distance to the Planckian Locus. There is a value mentioned of max 5.4E-3 in section 5.3 of CIE 13.3-1995 however no further explanation of it.
An other reference with signal lights as a reference is given in the chromaticity diagram.

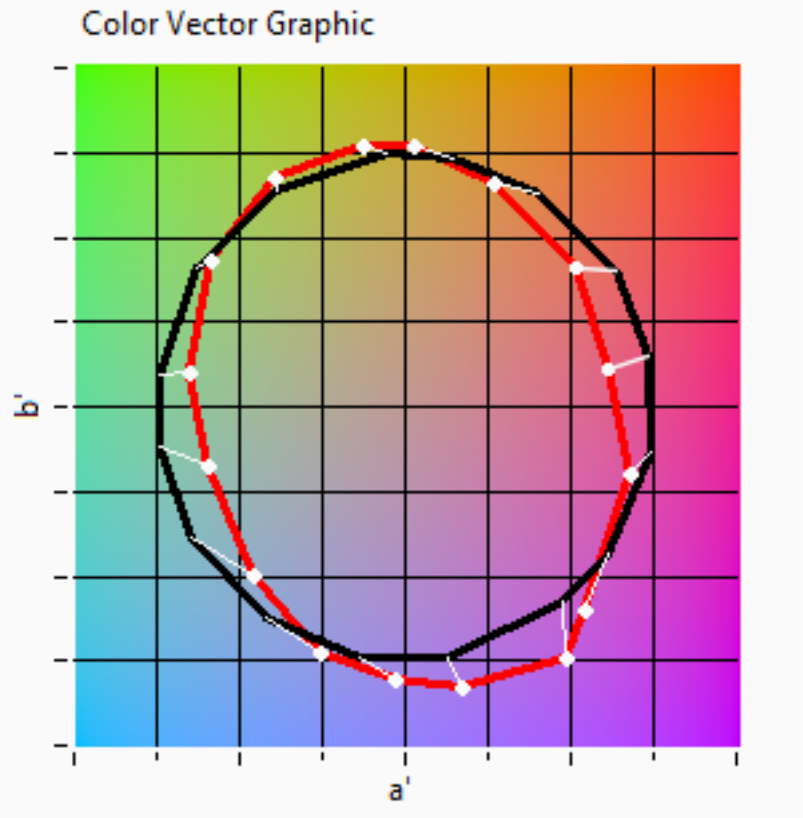
Lamp measurement report - 15 July 2021

Color quality scale TM-30-15

TM-30-15 is an improved indicator (over CRI) of how well colors are rendered.
TM30-15 Rf = 71, Rg = 93.



TM-30-15-values for 99 samples for the light of this light bulb. The closer the value for a testcolor comes to 100, the more its rendition resembles that of a reference lightsource.

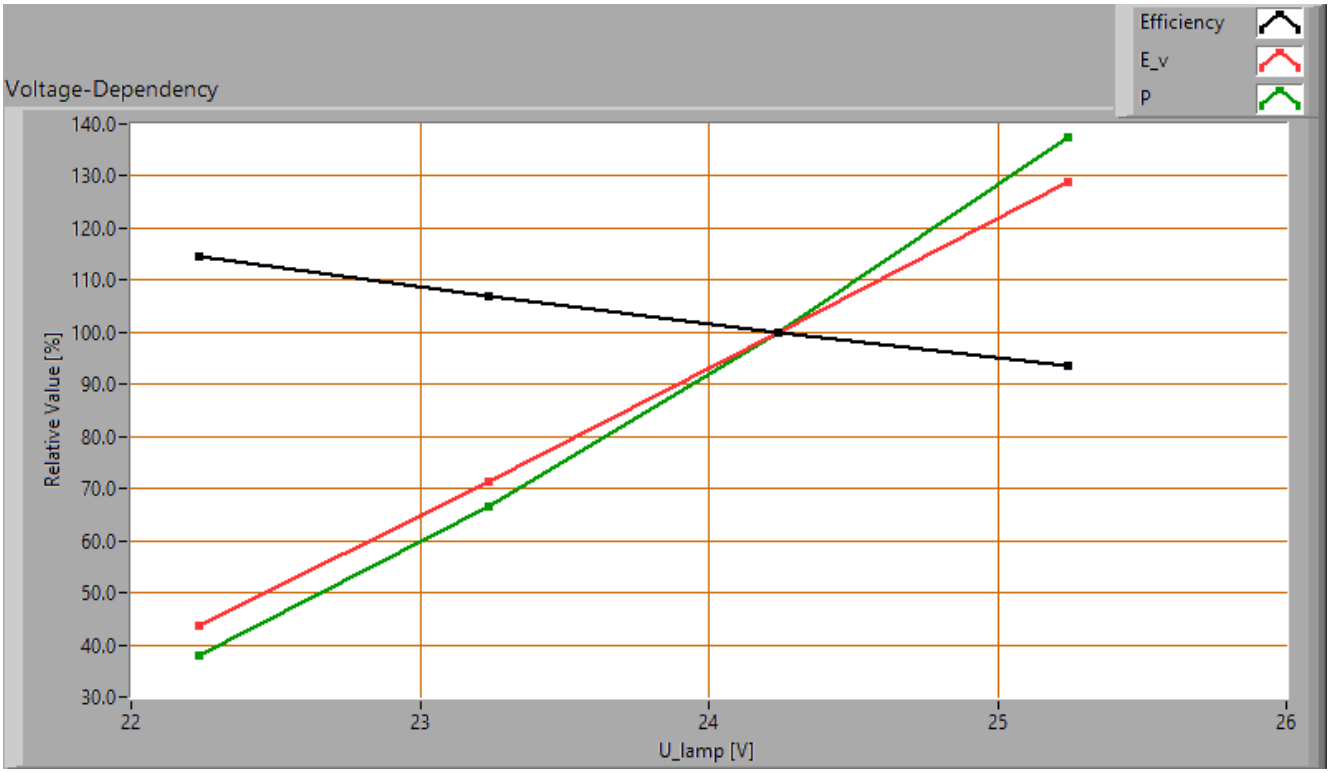


Graphical view of averaged color points for this light bulb compared to a reference source with the same color temperature.

Lamp measurement report - 15 July 2021

Voltage dependency

The dependency of a number of lamp parameters on the lamp voltage is determined. For this, the lamp voltage has been varied and its effect on the following light bulb parameters measured: illuminance E_v [lx], the lamppower P [W] and the luminous efficacy [lm/W] (this latter is estimated here by dividing the found E_v value by P).



Lamp voltage dependencies of certain light bulb parameters

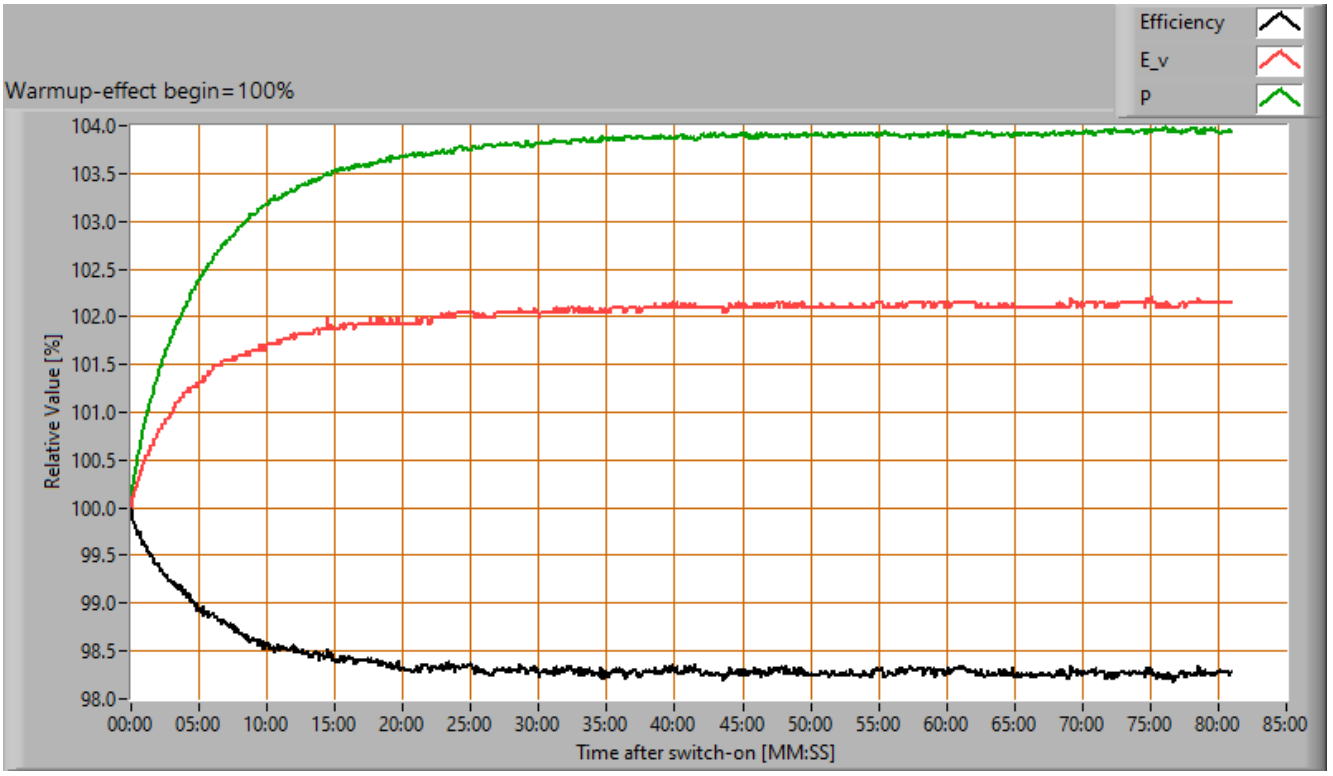
There is a constant dependency of the illuminance when the power voltage varies between 22 - 25 V .
There is a constant dependency of the consumed power when the power voltage varies between 22 - 25 V .

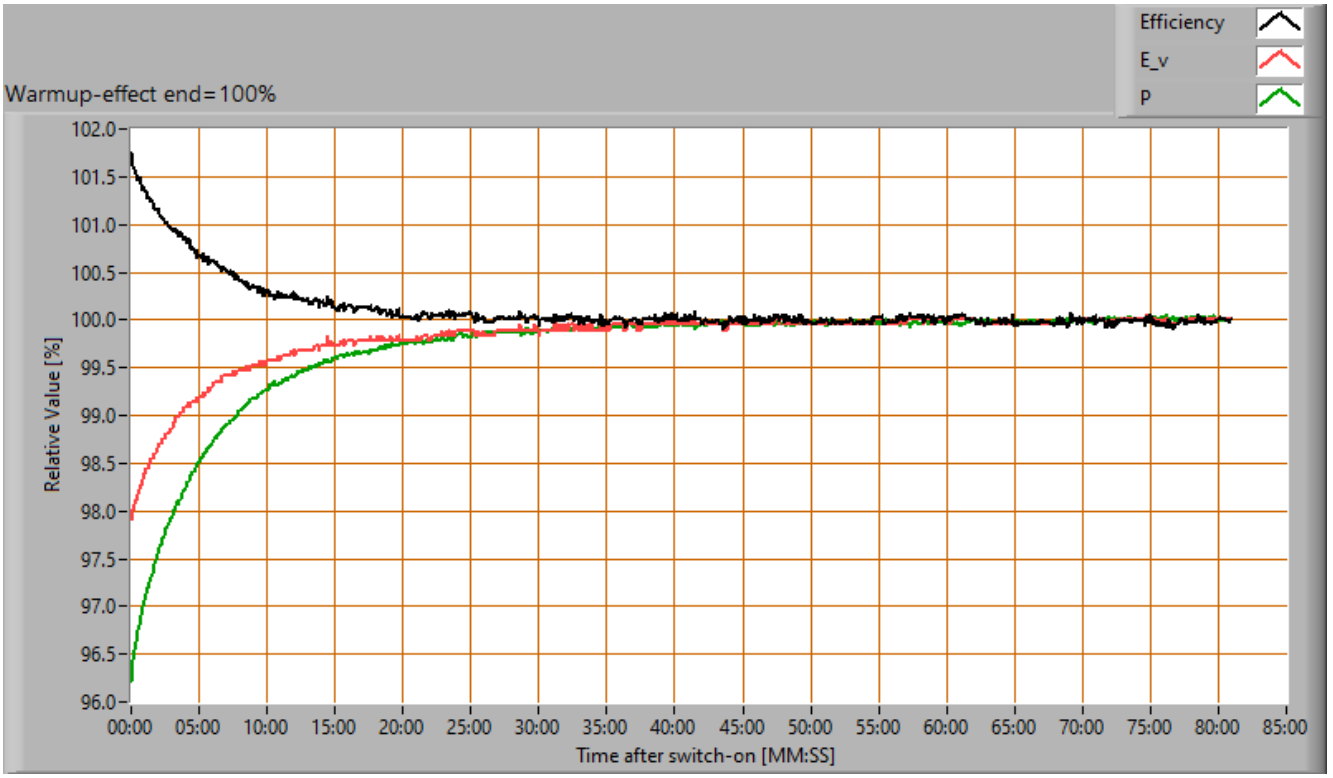
When the voltage varies abruptly with + or - 0.5 V then this results in a variation of the illuminance of maximally 15.4 %. This difference in illuminance is possibly visible (when it occurs abruptly).

Lamp measurement report - 15 July 2021

Warm up effects

After switch on of a cold lamp, the effect of heating up of the lamp is measured on illuminance E_v [lx], the lamppower P [W] and the luminous efficacy [lm/W].





Effect of warming up on different light bulb parameters. In the first graph the 100 % level is put at begin, and in the last graph the 100 % level is put at the end.

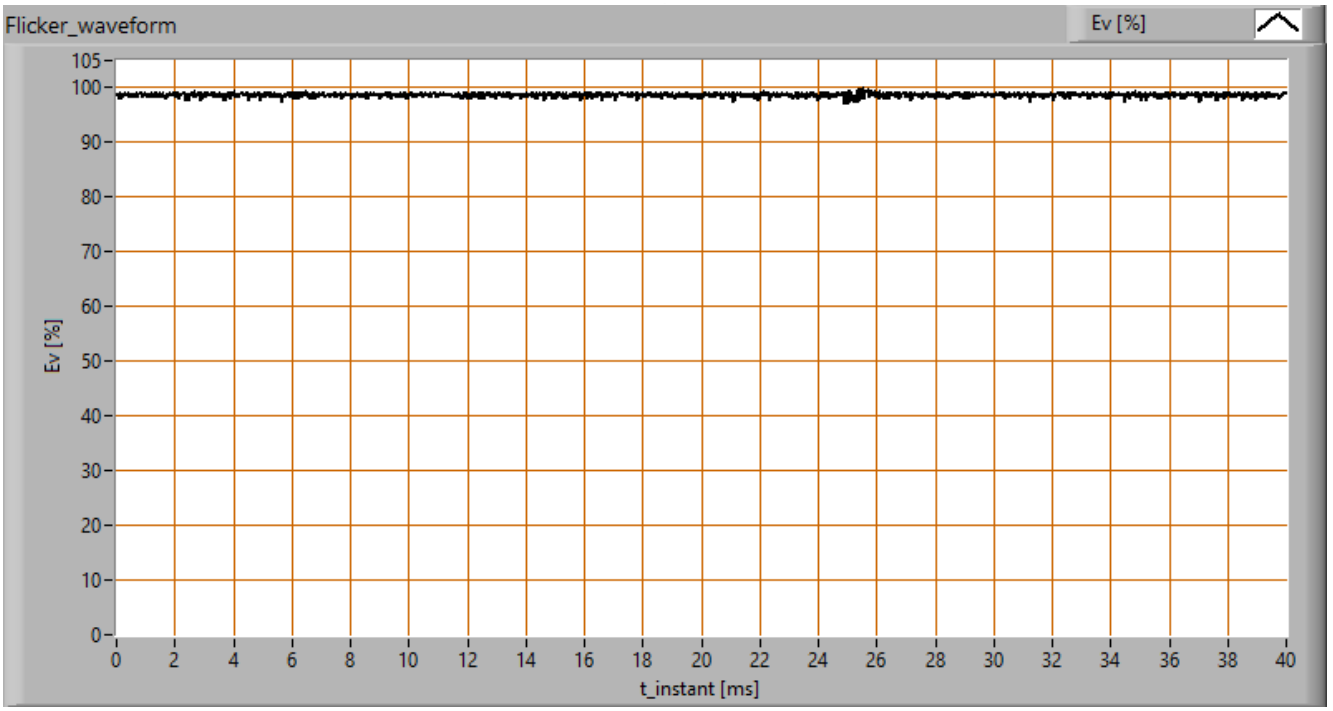
Lamp measurement report - 15 July 2021

During the warmup time the illuminance doesn't vary significantly (< 5 %).

During the warmup time the power doesn't vary significantly (< 5 %).
The variation in efficacy (calculated as indication by simply dividing the illuminance by the power) during the warming up is -2 %. A very high negative value indicates a significant decrease for instance due to heating up of the lamp (decrease of lifetime).

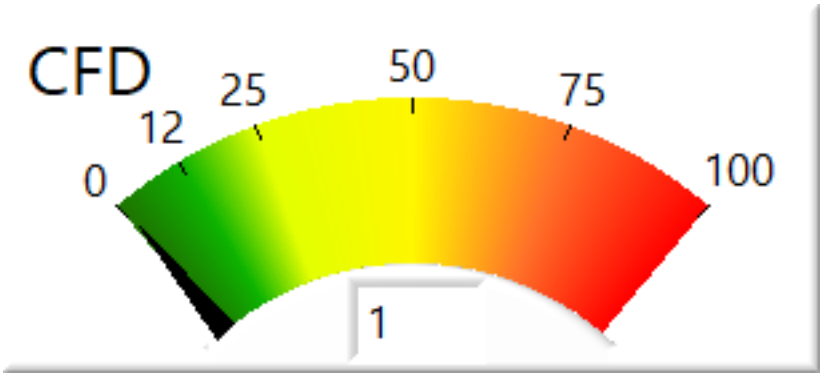
Measure of flickering

An analysis is done on the measure of flickering of the light output by this light bulb.



The measure of fast illuminance variation of the light of the light bulb

parameter	value	unit
Flicker frequency	5814.5	Hz
Illuminance modulation index	1	%
Flicker index	0.001	[-]
SVM	0.0	[-]
Compact Flicker Degree	1	%



Lamp measurement report - 15 July 2021

The illuminance modulation index is computed as: (max_Ev - min_Ev) / (max_Ev + min_Ev).

Melanopic effect

The melanopic effect shows the level of impact the light of this lamp can have on the day-night rhythm of human beings (as well as the suppression of melatonin production).
The important parameters (according to norm DIN SPEC 5031-100:2015-08):

melanopic effect factor	0.738
k_mel trans (25 years)	1.055
k_mel trans (32 years)	1.000
k_mel trans (50 years)	0.827
k_mel trans(75 years)	0.572
k_mel trans(90 years)	0.441
k_pupil(25 years)	1.088
k_pupil(32 years)	1.000
k_pupil(50 years)	0.792
k_pupil(75 years)	0.543
k_pupil(90 years)	0.416

Lamp measurement report - 15 July 2021

Circadian Stimulus (CS)

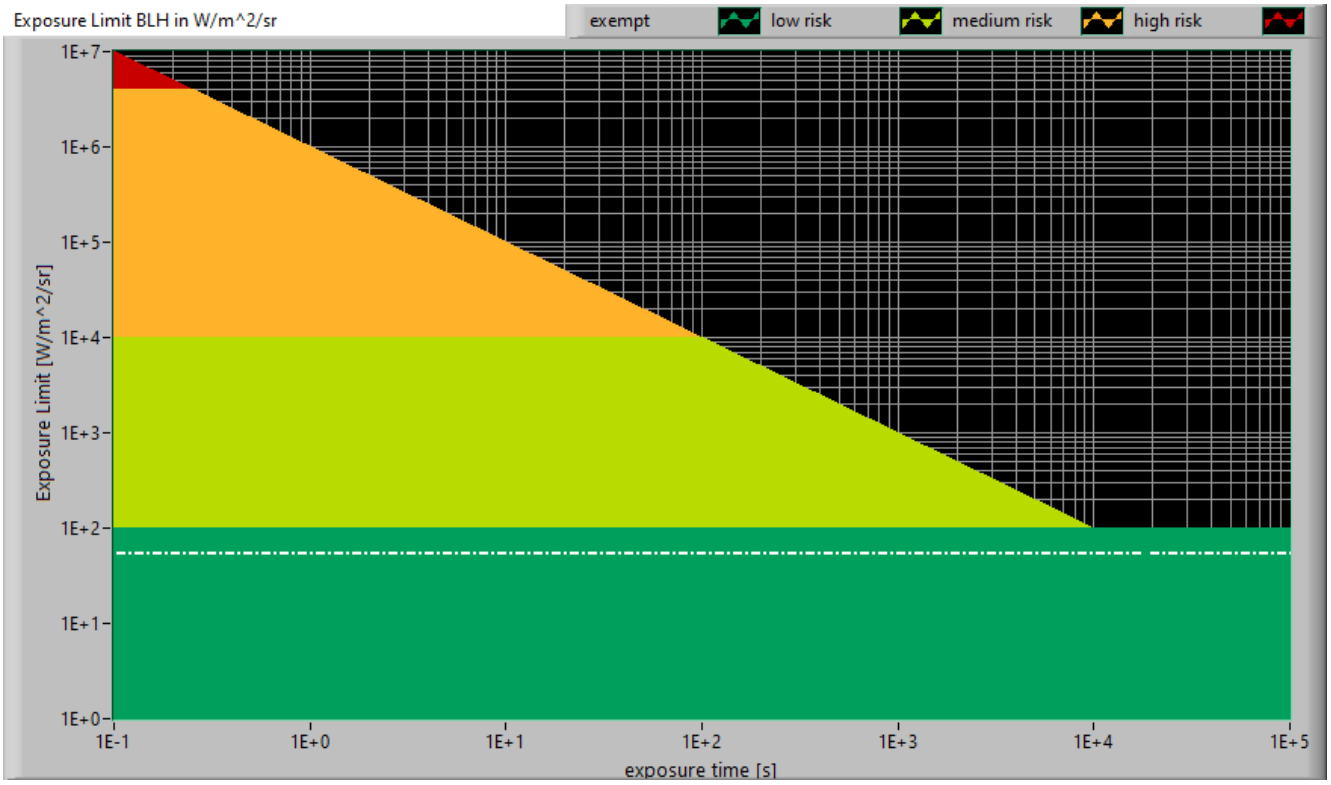
The circadian stimulus indicates the degree of influence that the light of this lamp has on the human circadian rhythm. In addition to the melanopic effect of Ganglion cells, the contributions of S-cones and rods are also included. A CS value of 0.1 has hardly any effect and a value > 0.3 has an effect (0.7 is the maximum, saturated, value). The CS value depends on the spectrum of the light and also on the amount of it (received on the eye).

Ev [lux]	CL__A	CS
20.0	26.4	0.04
30.0	39.7	0.06
50.0	66.2	0.09
75.0	99.5	0.14
100.0	132.8	0.18
150.0	200.0	0.24
300.0	403.9	0.37
500.0	682.0	0.47
750.0	1039.1	0.54
1000.0	1406.1	0.57
1500.0	2168.4	0.62
2000.0	2965.4	0.64

Lamp measurement report - 15 July 2021

Blue Light Hazard

The amount of blue light and the harm it can cause on the retina has been determined. Herewith the results.



The level of blue light of this lamp related to the exposure limit and the different classification areas.

L_lum0 [mm]	17	Dimension of brightest part of lamp in C0-C180 direction.
L_lum90 [mm]	17	Dimension of brightest part of lamp in C90-C270 direction.
SSD_500lx [mm]	400	Calculated distance where Ev = 500 lux. This computation is valid when it is in the far field of the lamp. Note: if this value 200 mm then the distance of 200 mm is taken as proposed in the norm IEC 62471:2006.
Start of far field [mm]	122	Minimum distance at which the lamp can be seen as a point source. In this area the Ev is linearly dependent from (1/distance)^2.
300-350 nm values stuffed with 0s	no	In the event OliNo has measured with a SpB1211 spectrometer without UV option then the irradiance data of 300-349 nm is missing. For lamps where there is already no energy content near 350 nm, the values 300-349 can also be set at zero then.
alpha_C0-C180 [rad]	0.100	(Apparent) source angle in C0-C180 direction.
alpha_C90-C270 [rad]	0.100	(Apparent) source angle in C90-C270 direction.

Lamp measurement report - 15 July 2021

alpha_AVG [rad]	0.100	Average (apparent) source angle. If average >= 0.011 rad then the exposure limit is computed with radiance Lb. Otherwise with irradiance Eb.
Exposure value [W/m^2/sr]	5.39E+1	Blue Light Hazard value for this lamp, measured straight underneath the lamp. Computation is referenced to Lb.
Blue Light Hazard risk group	0	0=exempt, 1=low, 2 = moderate, 3=high risk.

Extra

Additional photos.

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