Lamp measurement report – 3 May 2010

High Bay Led Lamp

by

Glo

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Summary measurement data

parameter	meas. result	remark
Color temperature	5266 K	Cold white
Luminous intensity I_v	2869 Cd	Measured straight underneath the lamp.
Illuminance modulation index	0 %	Measured straight underneath the lamp. Is a measure for the amount of flickering.
Beam angle	114 deg	114° for all C-planes as this lamp is symmetrical along its first axis.
Power P	99.9 W	
Power Factor	0.97	For every 1 kWh net power consumed, there has been 0.2 kVAhr for reactive power.
THD	15 %	Total Harmonic Distortion
Luminous flux	7081 Lm	
Luminous efficacy	71 Lm/W	
CRI_Ra	69	Color Rendering Index.
Coordinates chromaticity diagram	x=0.3406 and y=0.3786	
Fitting	230V	This lamp is connected to their 230 V rail system.
PAR-value	23.2 µMol/s/m^2	The number of photons seen by an average plant when it is lit by the light of this light bulb. Value valid at 1 m distance from light bulb.
PAR-photon efficacy	0.6 µMol/s/W_e	The toal emitted number of photons by this light, divided by its consumption in W. It indicates a kind of efficacy in generating photons.
S/P ratio	1.8	This factor indicates the amount of times more efficient the light of this light bulb is perceived under scotopic circumstances (ow environmental light level).

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H x D external dimensions	365 x 500 mm	External dimensions of the lamp; this is the diameter of the reflector and the total height of the reflector and power supply housing.
D luminous area	500 mm	Dimensions of the luminous area (used in Eulumdat file). This is the diameter of the reflector at the front of the lamp.
General remarks		The ambient temperature during the whole set of measurements was 26 deg C. The temperature of the glass around the chip gets 28 degrees hotter, the area between the fins of the heatsink gets about 38 degrees hotter, and the back side of the power supply housing gets about 22 deg hotter than ambient. Warm up effect: during the warm up time the illuminance decreases with 8 %. Voltage dependency: the power consumption and illuminance was upon request not tested in a wide range. At the end an additional photo.

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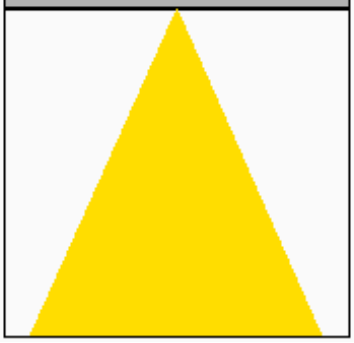
Overview table

m.	Ø 50%	
	C0-180	C90-270
0.25	0.77	0.77
0.5	1.54	1.54
1	3.09	3.09
1.5	4.63	4.63
3	9.26	9.26
4	12.35	12.35
5	15.44	15.44

C0-180: 114°
C90-270: 114°



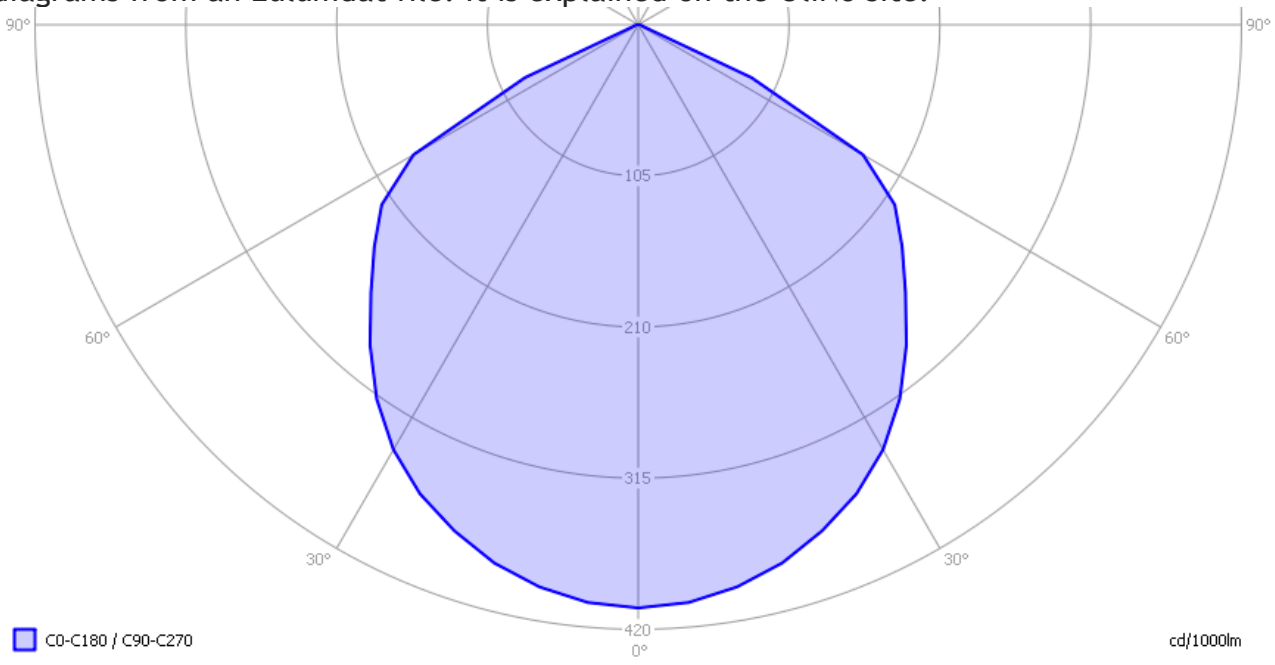
E (lux)
45904
11476
2869
1275
319
179
115

Luminaire Efficacy
71 (lumens per Watt)
Half-peak diam C_{0-180}
3.09 x diameter(m)
Half-peak diam C_{90-270}
3.09 x diameter(m)
Illuminance
2869 / distance² (lux)
Total Output
7081 (lumens)

The overview table is explained on the OliNo website. Please note that this overview table makes use of calculations, use this data with care as explained on the OliNo site. E (lux) values are not accurate, when within 5 x 500 mm ≈ 2500 mm. Within this distance from the lamp, the measured lux values willl be less than the computed values in this overview as the measurements are then within the near field of the lamp.

Eulumdat light diagram

This light diagram below comes from the program Qlumedit, that extracts these diagrams from an Eulumdat file. It is explained on the OliNo site.

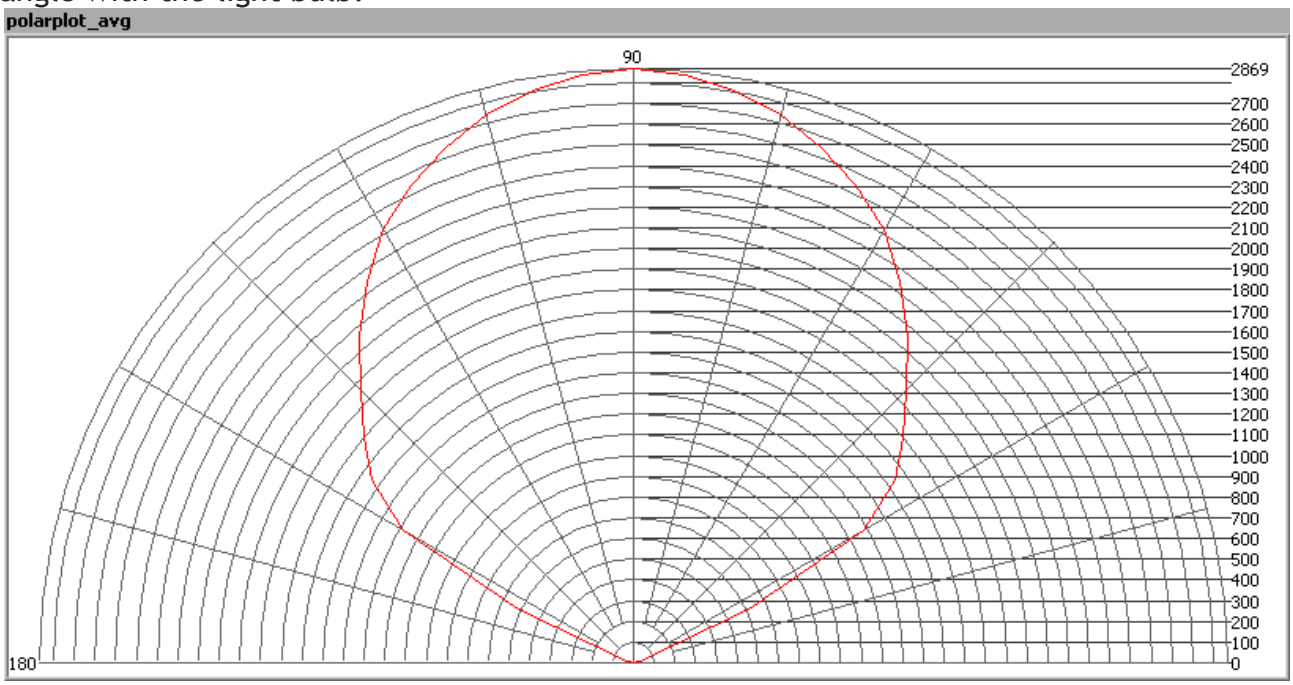


The light diagram giving the radiation pattern.

It indicates the luminous intensity around the light bulb. The plane C90-C270 has the same beam as the C0-C180 due to the symmetry around the 1st axis.

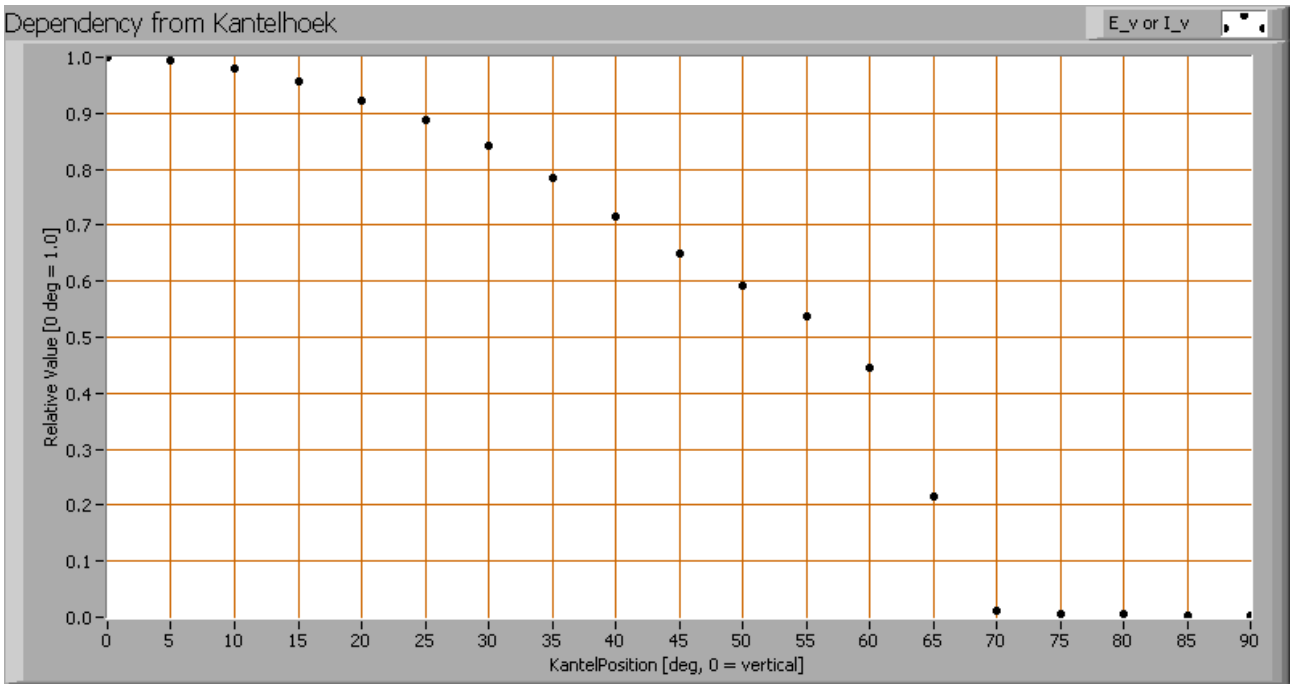
Illuminance Ev at 1 m distance, or luminous intensity Iv

Herewith the plot of the *averaged* luminous intensity Iv as a function of the inclination angle with the light bulb.



The radiation pattern of the light bulb.

This radiation pattern is the average of the light output of the light diagram given earlier. Also, in this graph the luminous intensity is given in Cd.
These averaged values are used (later) to compute the lumen output.



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. When using the average values per inclination angle, the beam angle can be computed, being 114°.

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 7081 Lm.

Luminous efficacy

The luminous flux being 7081 Lm, and the power of the light bulb being 99.9 W, yields a luminous efficacy of 71 Lm/W.

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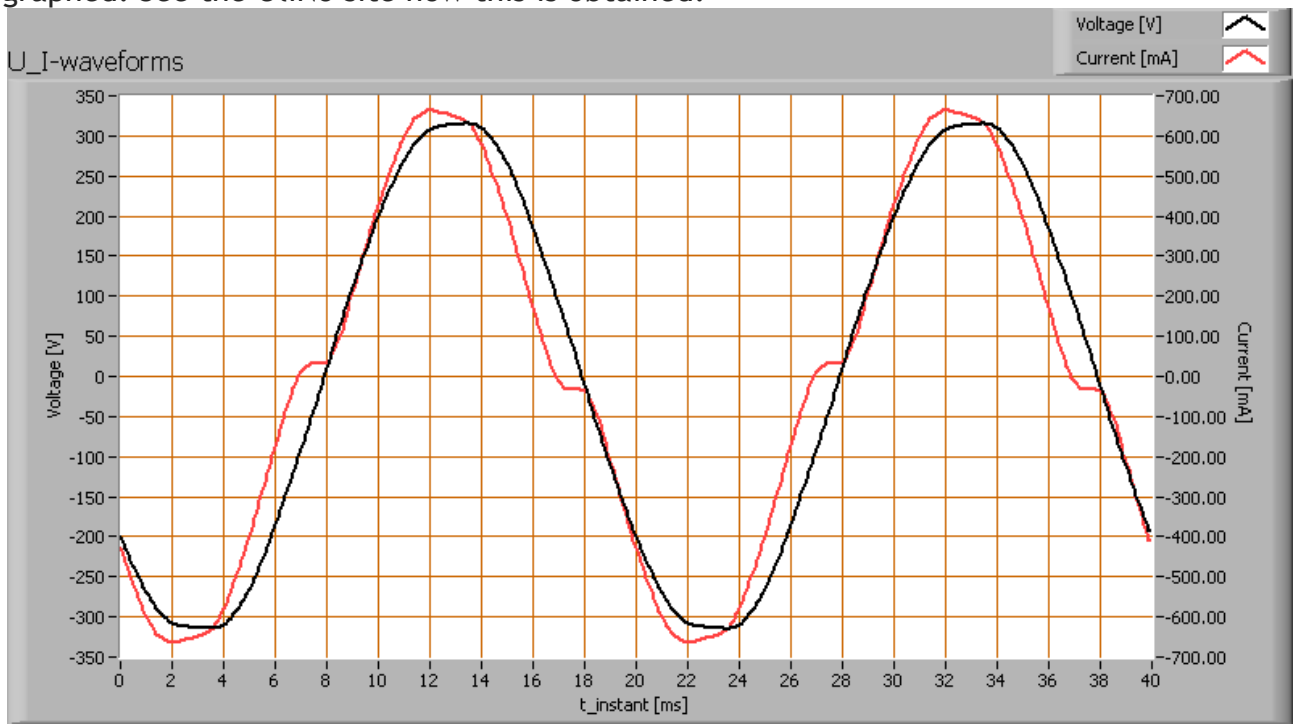
Electrical properties

A power factor of 0.97 means that for every 1 kWh net power consumed, a reactive component of 0.2 kVAr was needed.

Lamp voltage	230 VAC
Lamp current	446 mA
Power P	99.9 W
Apparent power S	102 VA
Power factor	0.97

Of this light bulb the voltage across ad the resulting current through it are measured and graphed. See the OliNo site how this is obtained.



Voltage across and current through the lightbulb

This waveforms have been checked on requirements posed by the norm IEC 61000-3-2:2006 (including up to A2:2009). See also the explanation on the OliNo website.

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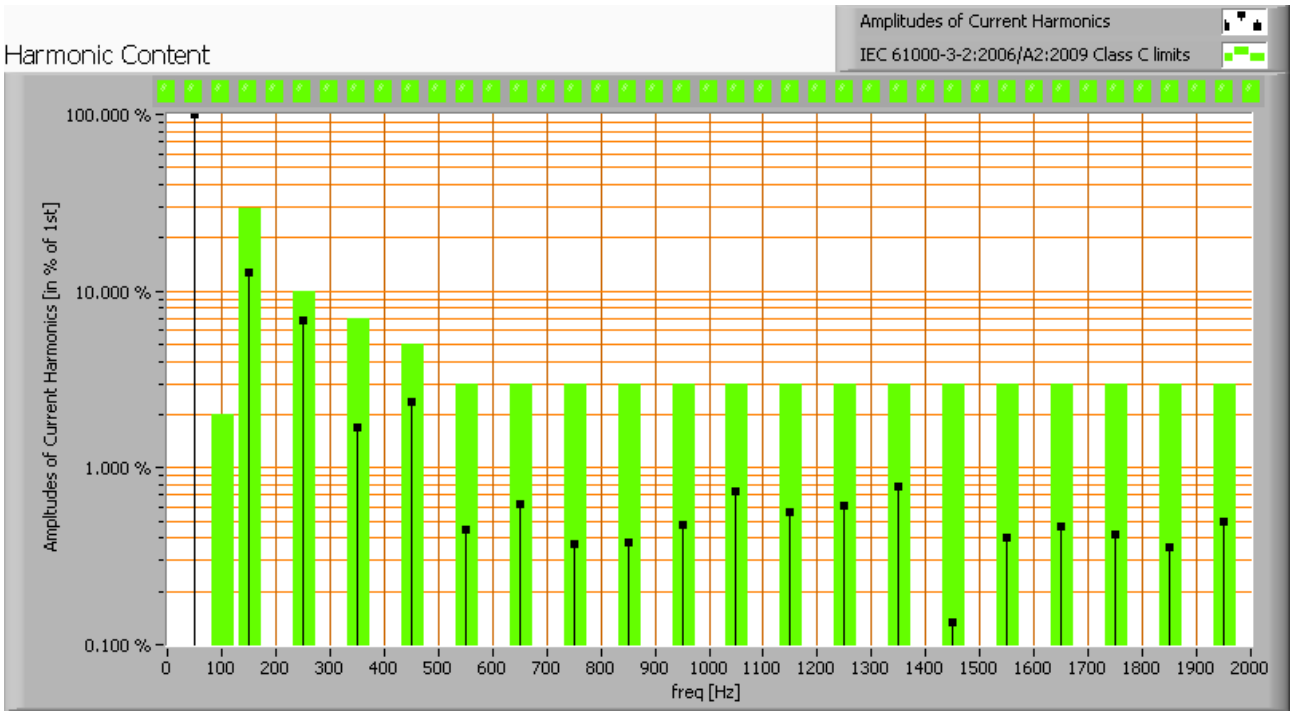

Harmonics in in the current waveform and checked against IEC61000-3-2:2006

There are limits for the harmonics for lighting equipment > 25 W and these limits are fulfilled.
The Total Harmonic Distortion of the current is computed as 15 %.

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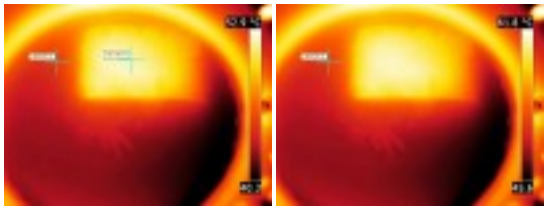
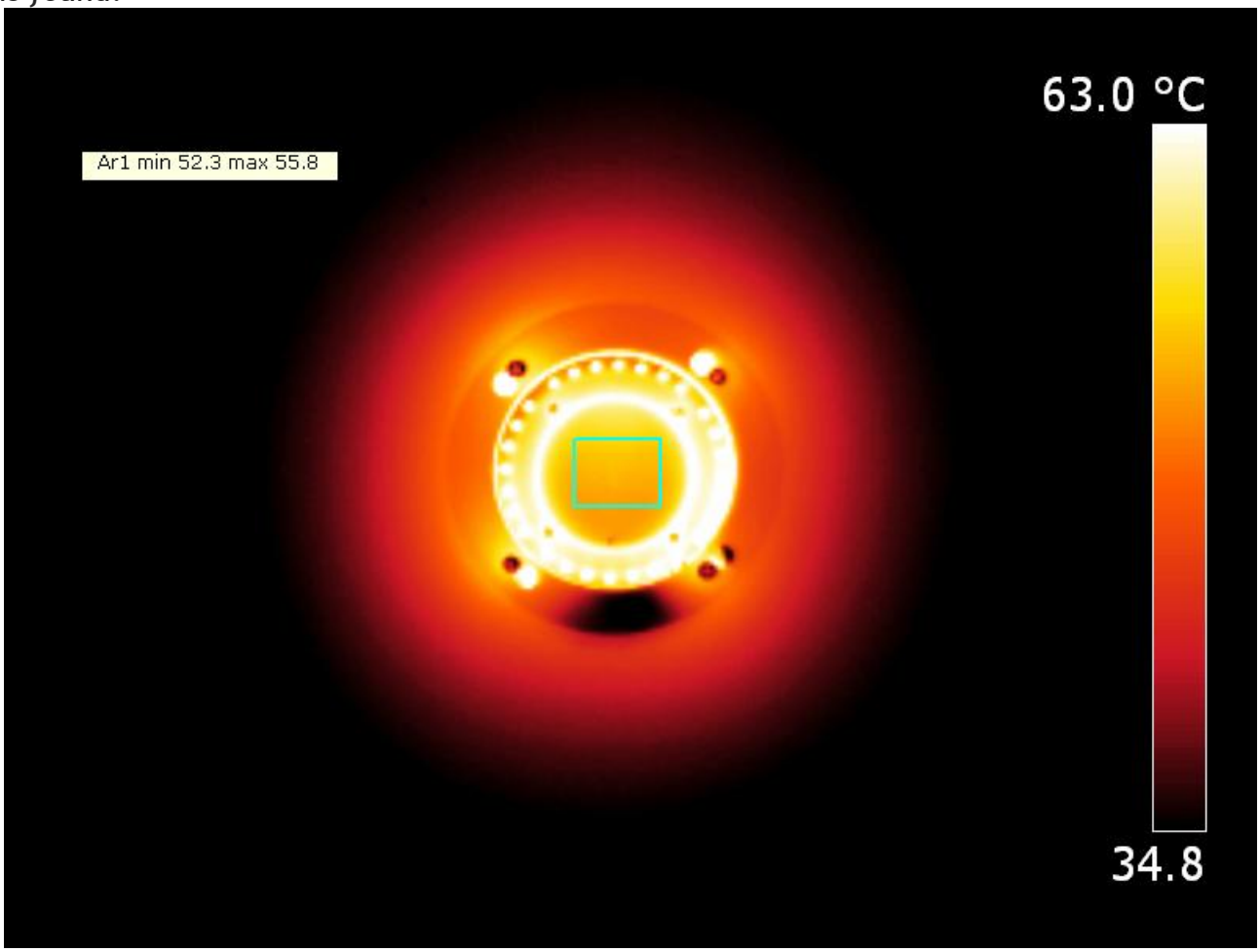
Temperature measurements lamp



Temperature image of the glass around the chip. The top image is taken with an emissivity of 0.95, equal to the tape. The temperature found must then also be on the rest of the glass, and with a setting of 0.70 for emissivity this temperature on the glass is found.



The resulting temperature image of the glass around the chip, getting to about 54 deg C (ambient was 26 deg C).

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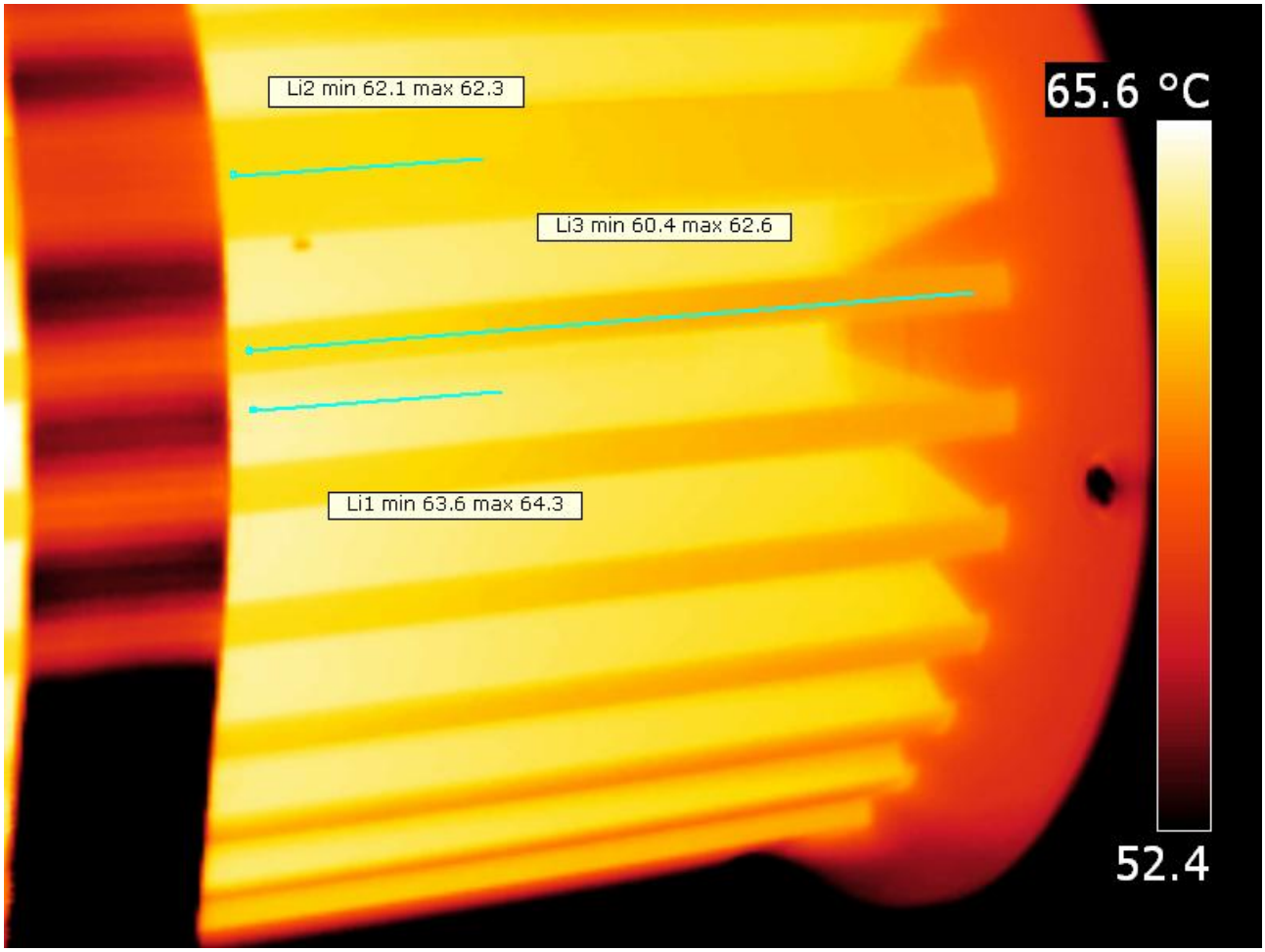
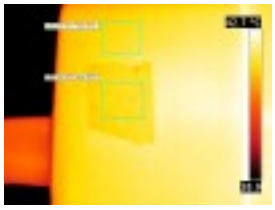
Temperature image of the heatsink. The emissivity of the black material of the heatsink is about 0.98.



Heatsink temperatures, the hottest closer to the led chip. Maximum temp is 38 deg C hotter than ambient.



Temperature image of the back side, seems to be 0.95.

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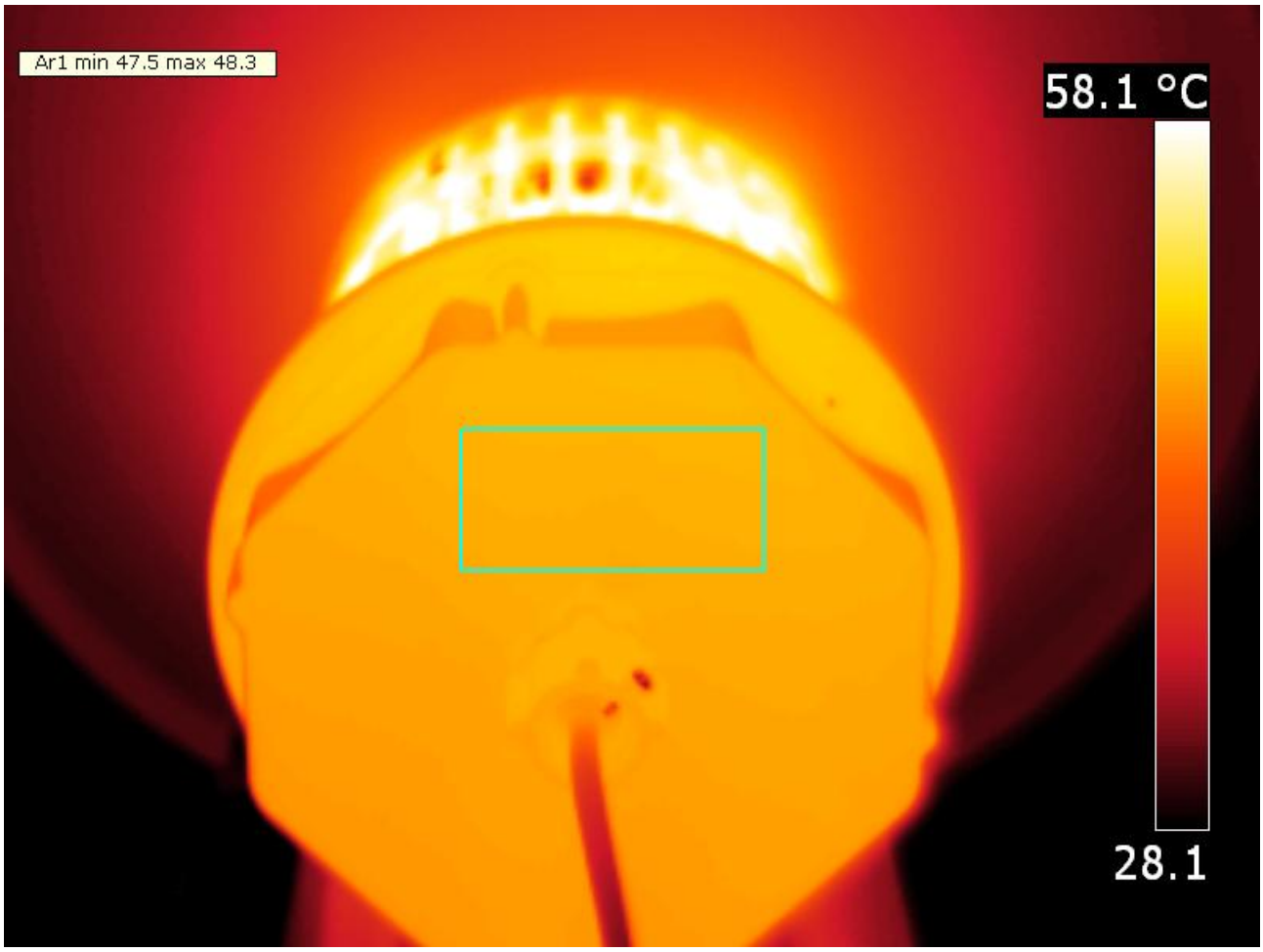

Back side of the power supply housing, getting 22 deg C hotter than ambient

status lamp	> 2 hours on
ambient temperature	26 deg C
reflected background temperature	26 deg C
camera	Flir T335
emissivity	0.7, 0.98 and 0.95
measurement distance	0.2 m (heatsink)
$IFOV_{geometric}$	0.3 mm
NETD (thermal sensitivity)	50 mK

The hottest temperature on the lamp is at the heatsink, between the blades.

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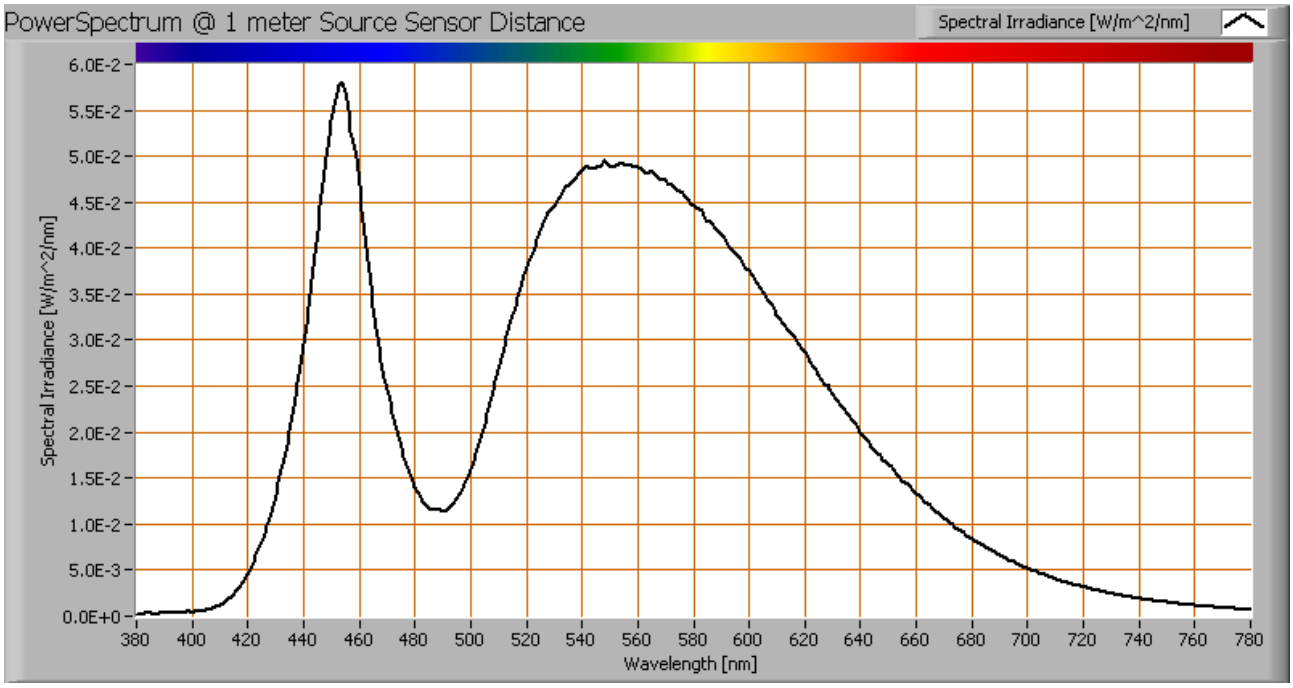
Color temperature and Spectral power distribution



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

The measured color temperature is about 5250 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.

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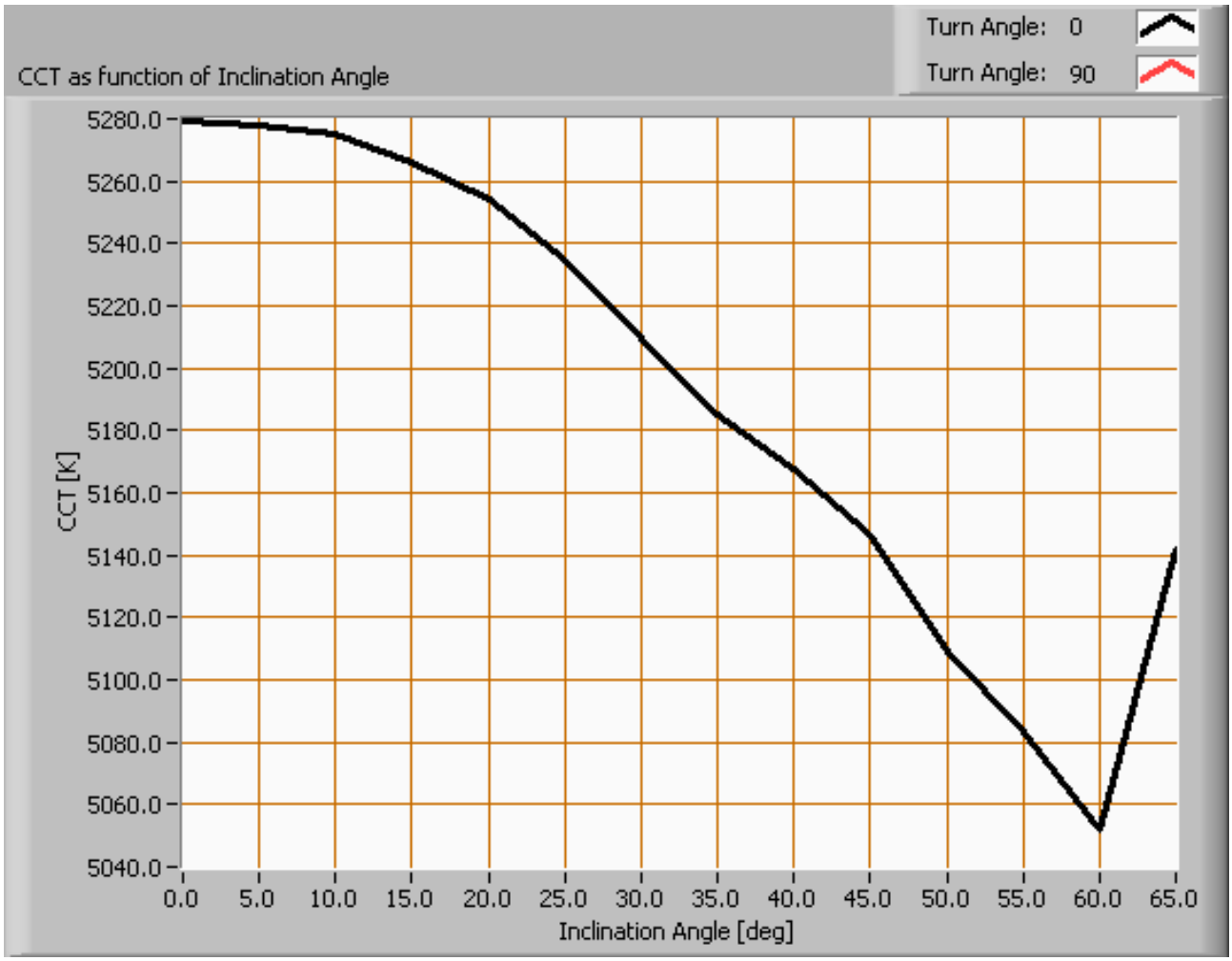

Color temperature as a function of inclination angle.

The measurement of CCT is measured for inclination angles up to 65° and beyond the illuminance value gets very low (< 5 lux).
The beam angle is 114°, meaning a 57° inclination angle. In this area most of the light is present. The variation in correlated color temperature in this area is about 4 %.

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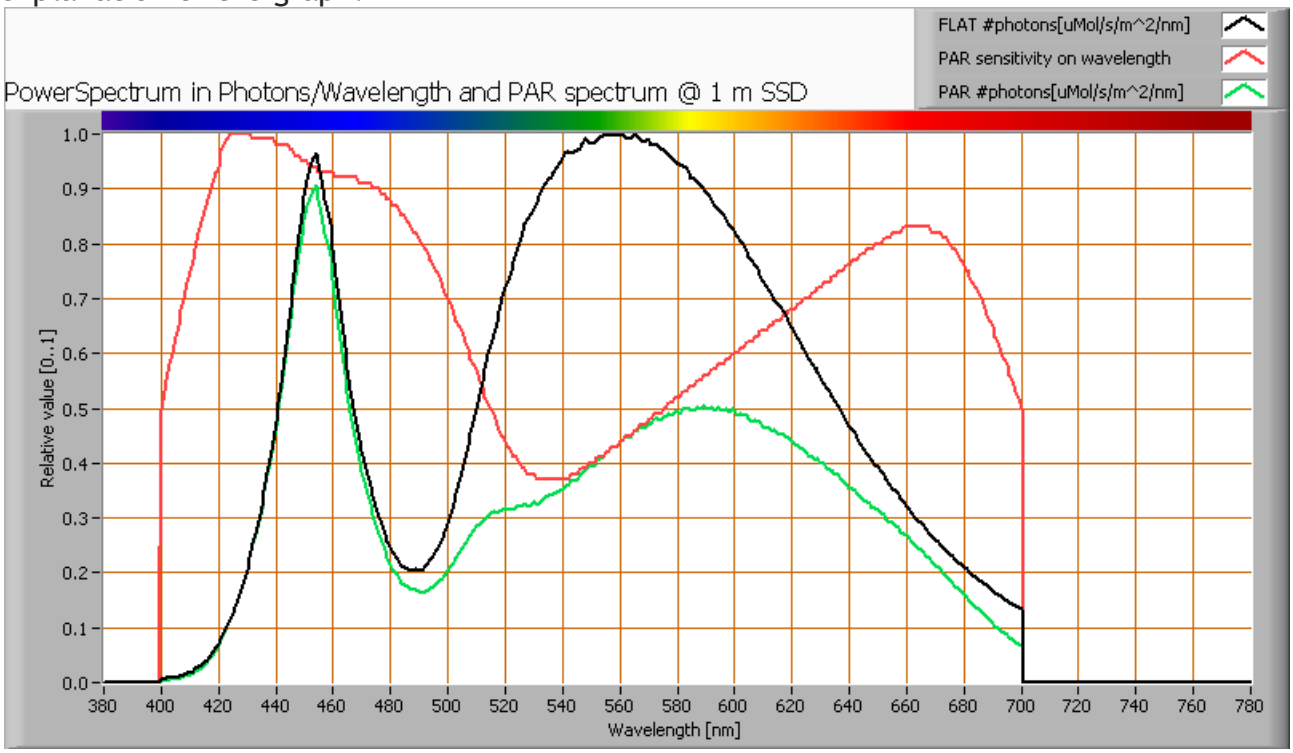
PAR value and PAR spectrum

To make a statement how well the light of this light bulb is for growing plants, the PAR-area needs to be determined. See the OliNo website how this all is determined and the explanation of the graph.



The photon spectrum, then the sensitivity curve and as result the final PAR spectrum of the light of this light bulb

parameter	value	unit
PAR-number	57.2	µMol/s/m²
PAR-photon current	23.2	µMol/s
PAR-photon efficacy	0.6	µMol/s/W

The PAR efficiency is 63 % (valid for the PAR wave length range of 400 - 700 nm). So maximally 63 % of the total of photons in the light is effectively used by the average plant (since the plant might not take 100 % of the photons at the frequency where its relative sensitivity is 100 %).

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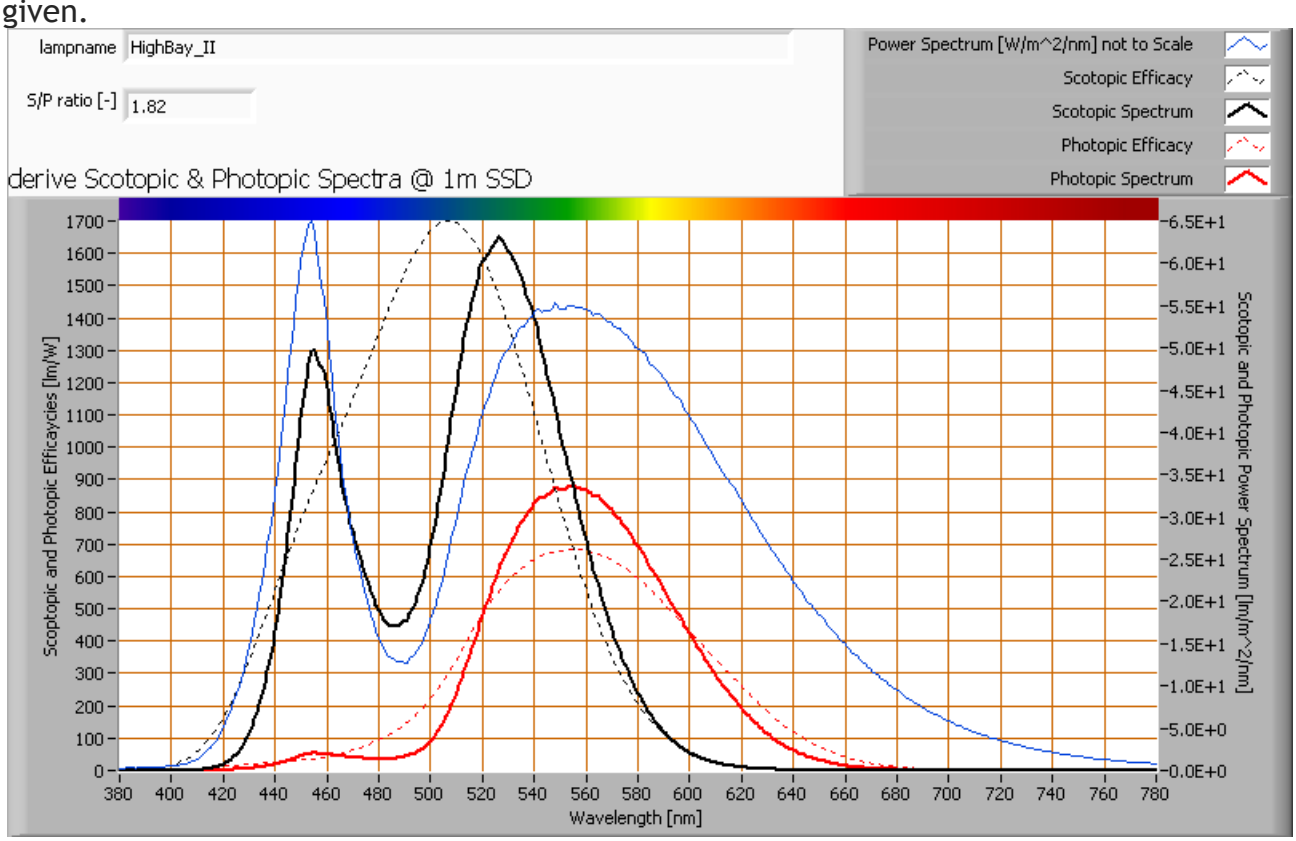
S/P ratio

The S/P ratio and measurement is explained on the OliNo website. Here the results are given.



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

The S/P ratio is 1.8.
More info on S/P ratio can be found on the OliNo website.

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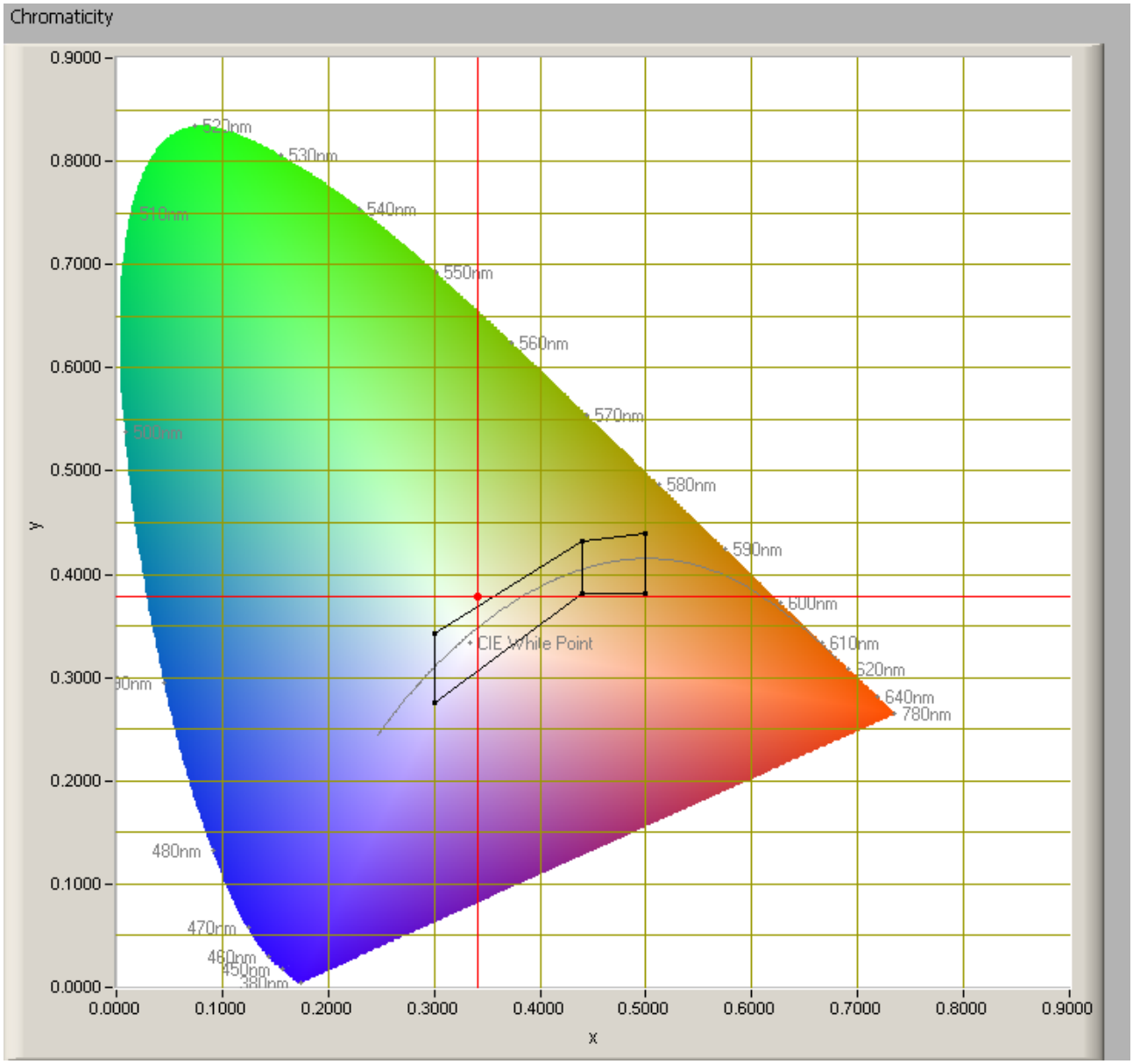
Chromaticity diagram

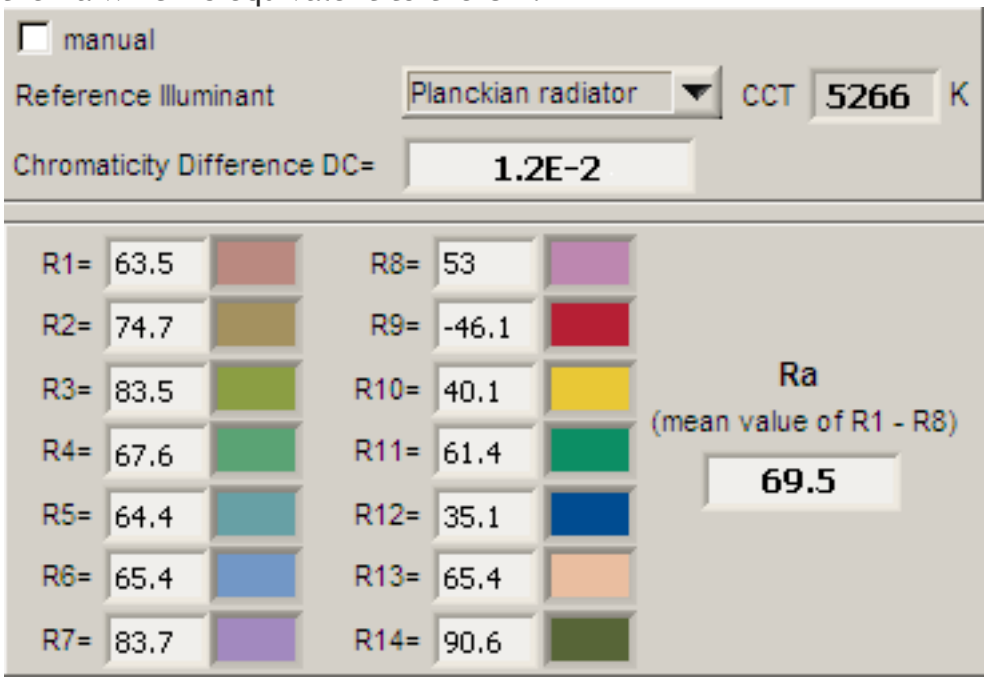


The chromaticity space and the position of the lamp's color coordinates in it.

The light coming from this lamp is just outside the area designated with class A. This class A is an area that is defined for signal lamps, see also the OliNo website.
Its coordinates are x=0.3406 and y=0.3786.

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). Practical information and also some critics about the CRI can be found on the OliNo website.
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.

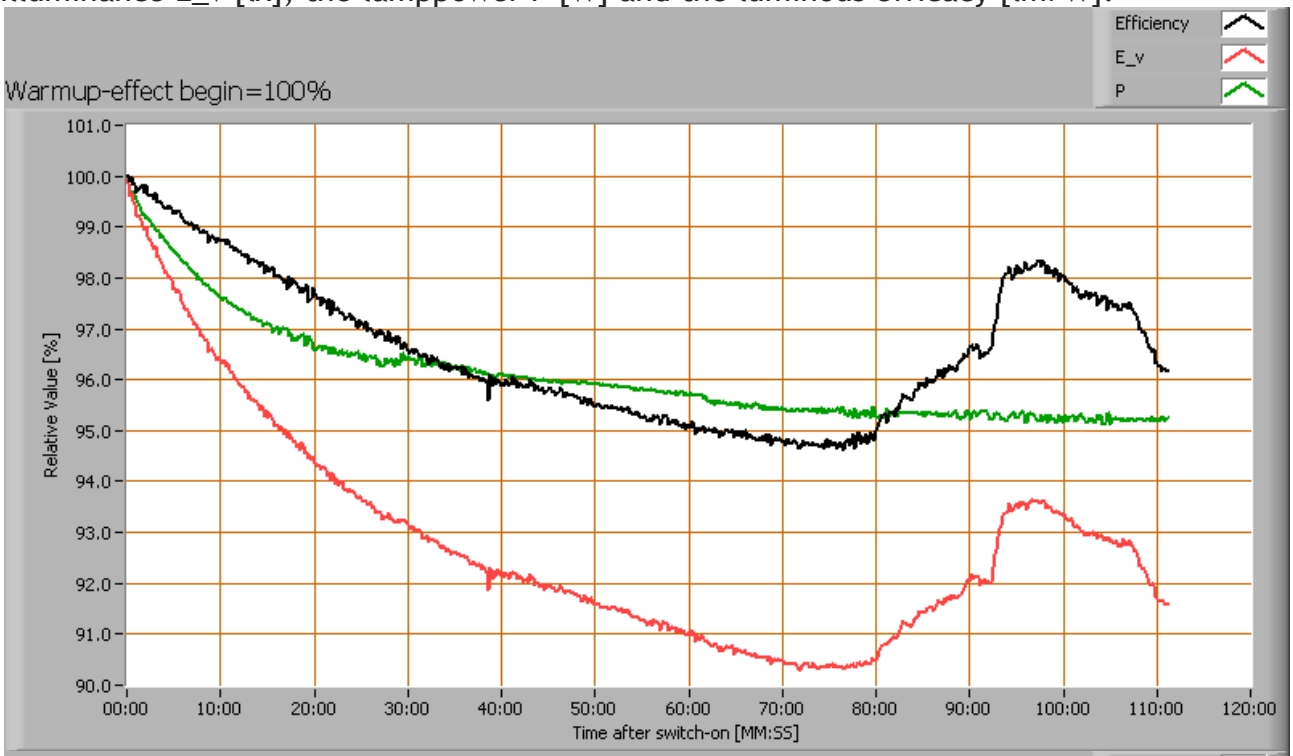
The value of 70 is lower than 80 which is considered a minimum value for indoor usage.
Note: the chromaticity difference is 0.012 indicates the distance to the Planckian Locus. There is no norm yet that states what the max deviation from white light is allowed to be. A reference with signal lights as a reference is given in the chromaticity diagram.

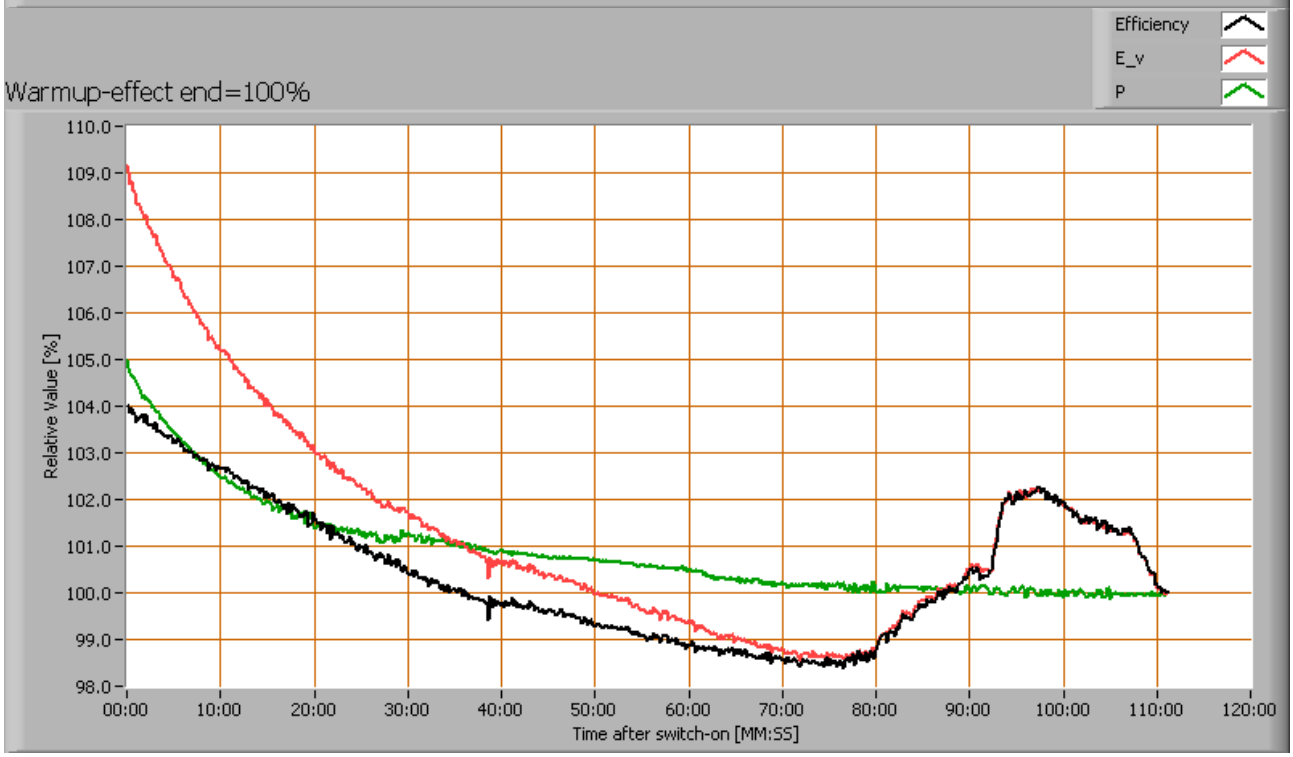
Voltage dependency

The dependency of a number of lamp parameters on the lamp voltage is not determined.

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].



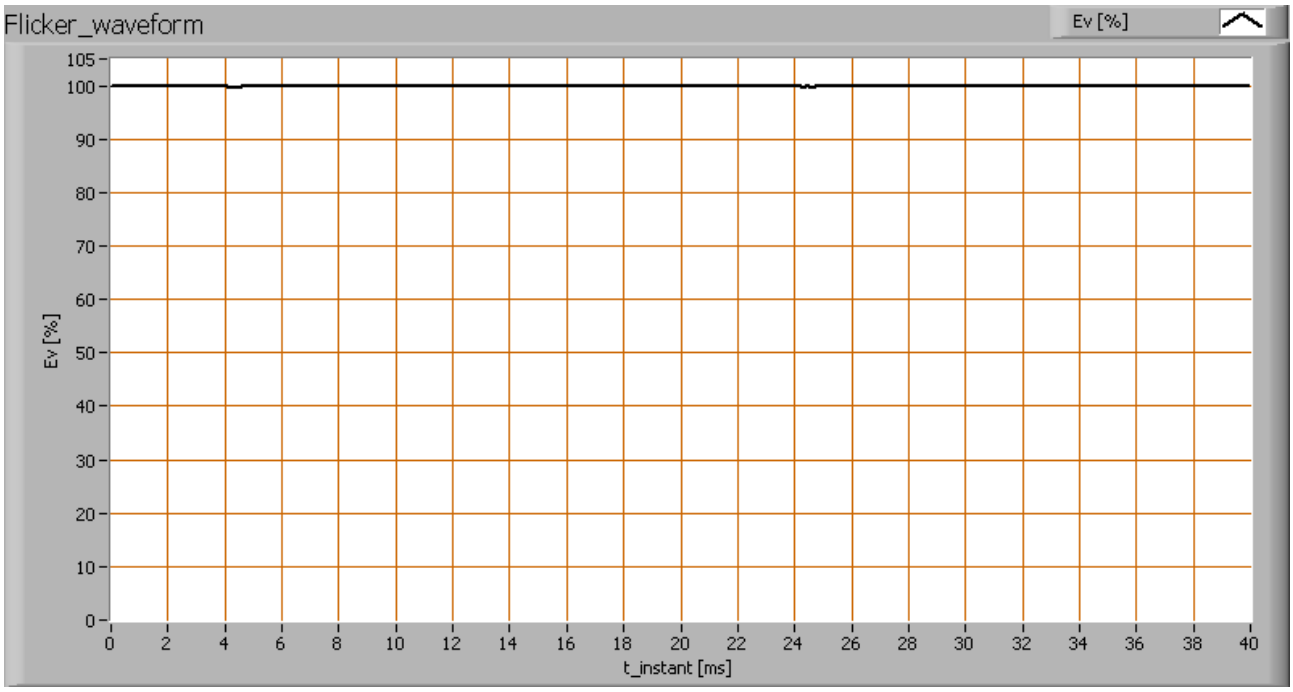


Effect of warming up on different light bulb parameters. At top the 100 % level is put at begin, and at bottom at the end.

The warm up time is about 40 minutes. During that time the illuminance decreases with 8 %.

Measure of flickering

An analysis is done on the measure of flickering of the light output by this light bulb. See the OliNo site for more information.

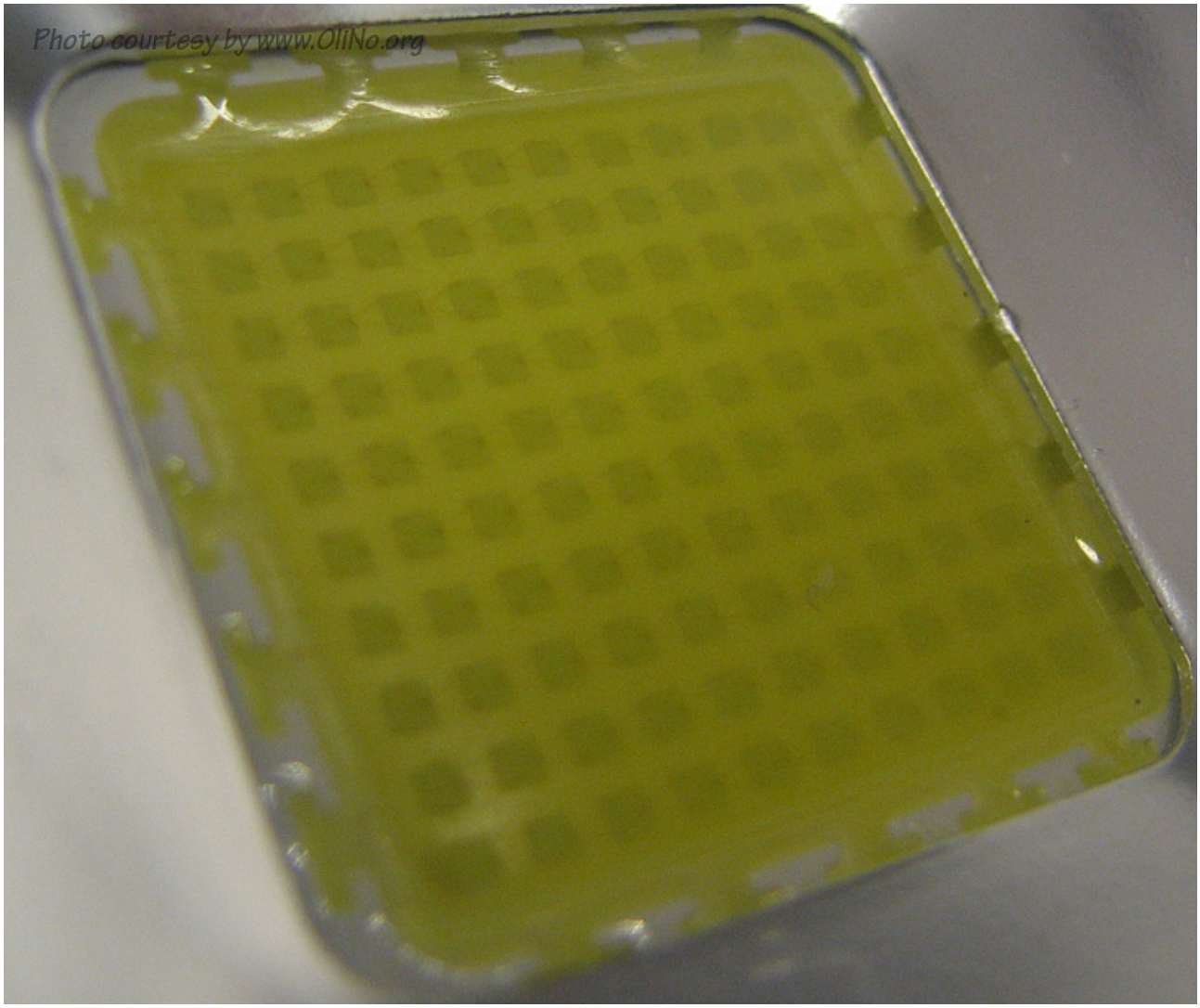


The measure of fast illuminance variartion of the light of the light bulb

parameter	waarde	eenheid
Flicker frequency	n.a.	Hz
Illuminance modulation index	0	%

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

Additional photo



Close up of the led chip.

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