Lamp measurement report – 13 July 2010

Quadro 60W

by

Ledverlichting Soest

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Summary measurement data

parameter	meas. result	remark
Color temperature	3229 K	warm white
Luminous intensity I_v	6920 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	26 deg	26° for the C0-C180-plane (dividing he lamp by putting two spots on each side). In the C90-C270 plane (perpendicular to the C0-C180 plane) the angle is 26°. This is the result when putting the spots in one straight direction. By varying the direction of the spots different spread of the light is obtained.
Power P	56.2 W	
Power Factor	0.70	For every 1 kWh net power consumed, there has been 1.0 kVAhr for reactive power.
THD	94 %	Total Harmonic Distortion
Luminous flux	1988 Lm	
Luminous efficacy	35 Lm/W	
CRI_Ra	80	Color Rendering Index.
Coordinates chromaticity diagram	x=0.4255 y=0.4082	
Fitting	230V	This lamp is connected to the 230 V grid voltage.
PAR-value	65.3 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.

Lamp measurement report – 13 July 2010

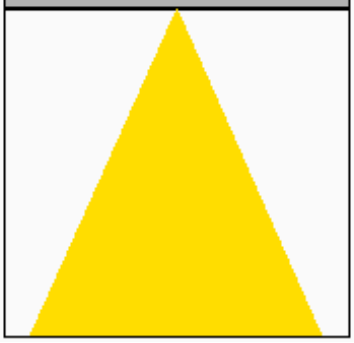
PAR-photon efficacy	0.3 µMol/s/W_e	The toal emitted number of photons by this light, divided by its consumption in W. It indicates a kind of efficacy in generating photons.
S/P ratio	1.3	This factor indicates the amount of times more efficient the light of this light bulb is perceived under scotopic circumstances (ow environmental light level).
L x W x H external dimensions	320 x 320 x 50 mm	External dimensions of the lamp.
L x W luminous area	250 x 250 mm	Dimensions of the luminous area (used in Eulumdat file). This is the surface of an imaginary smallest rectangle around the 4 spots at the front.
General remarks		The ambient temperature during the whole set of measurements was 26 deg C. The temperature of the lam between the fins of the heatsink at the back side of each spot gets about 29 degrees hotter. Warm up effect: during the warm up time the illuminance decreases with 9 % and the consumed power with 4 %. Voltage dependency: the power consumption and illuminance do not vary considerably when the power voltage varies between 200-250 V.

Lamp measurement report – 13 July 2010

Overview table

m.	Ø 50% C0-180	Ø 50% C90-270
0.25	0.11	0.11
0.5	0.23	0.23
1	0.46	0.46
1.5	0.69	0.69
3	1.37	1.38
4	1.83	1.84
5	2.29	2.3

C0-180: 26°
C90-270: 26°



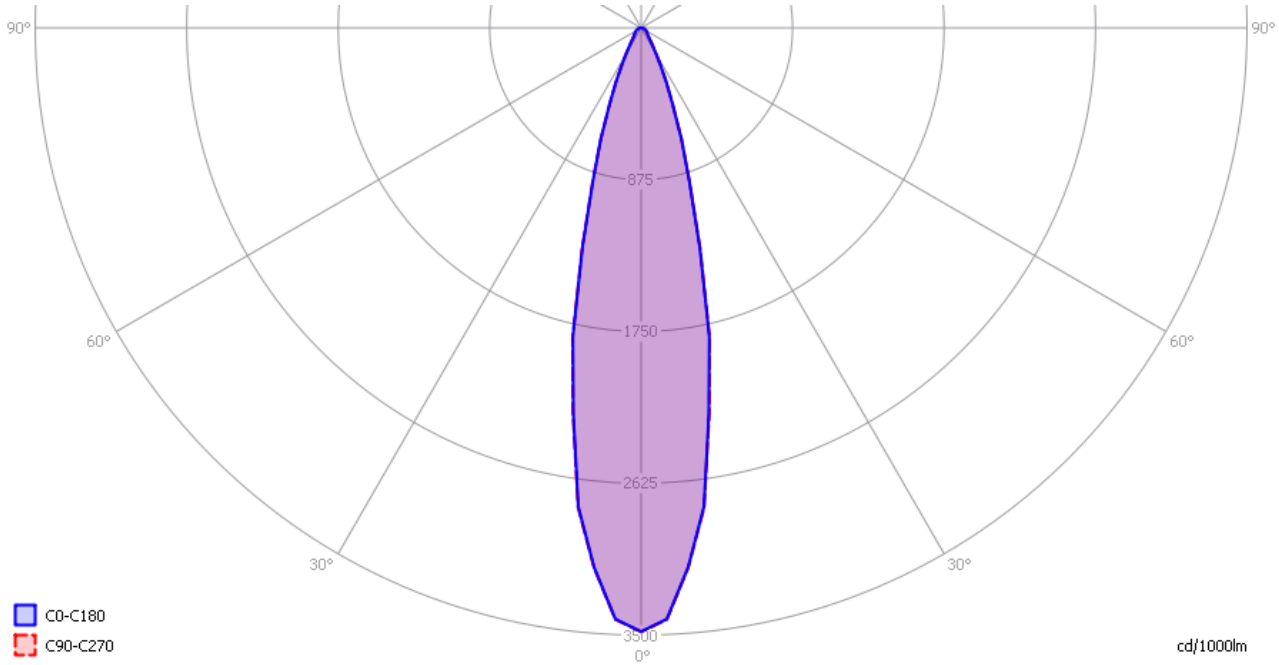
E (lux)
110720
27680
6920
3076
769
433
277

Luminaire Efficacy
35 (lumens per Watt)
Half-peak diam C_{0-180}
0.46 x diameter(m)
Half-peak diam C_{90-270}
0.46 x diameter(m)
Illuminance
6920 / distance² (lux)
Total Output
1988 (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 350 mm (diagonal length) ≈ 1750 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.

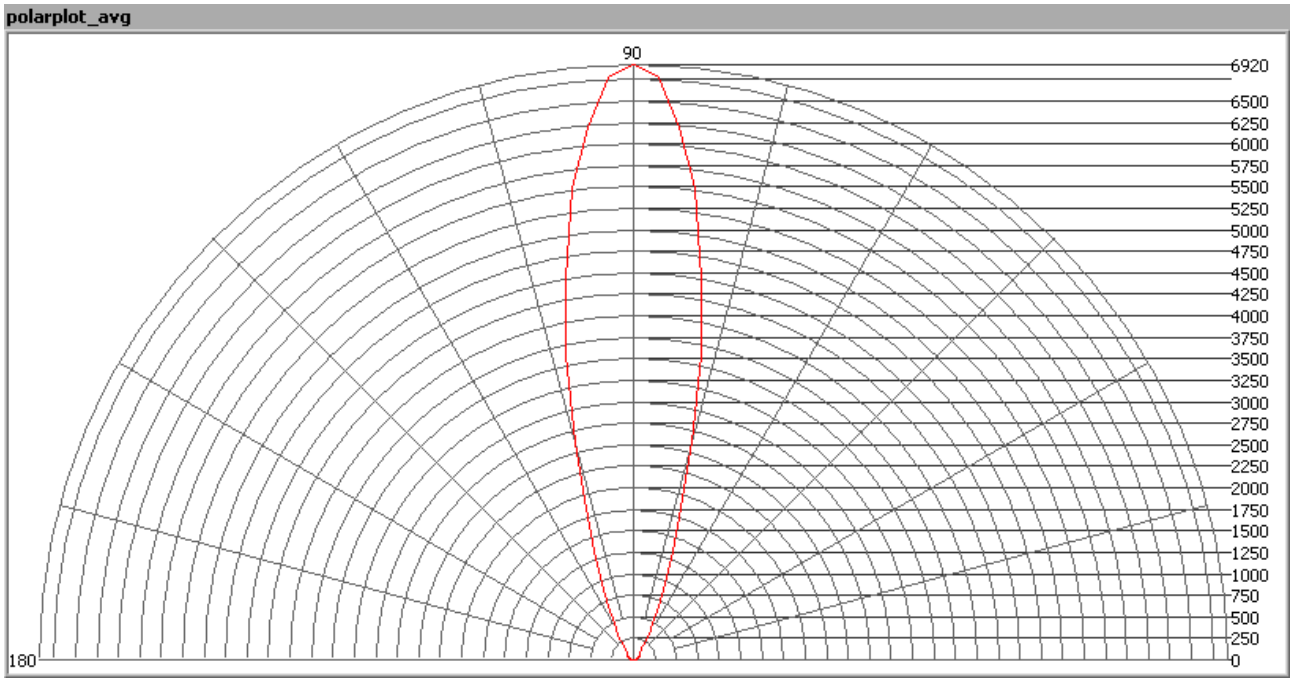


The light diagram giving the radiation pattern.

It indicates the luminous intensity around the light bulb. All the planes give the same results as the lamp is symmetrical along its 1st axis.

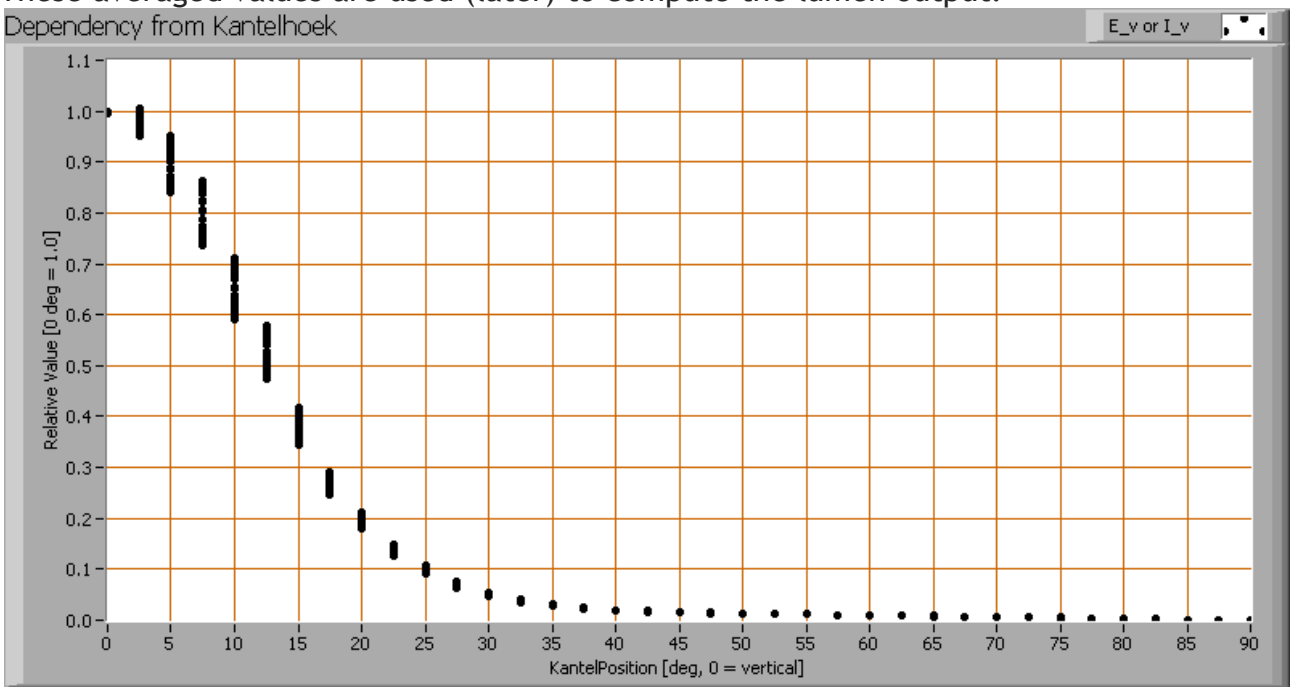
Illuminance Ev at 1 m distance, or luminous intensity Iv

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 26° for the C-planes C0-C180 and C90-C270 looked at.

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 1988 Lm.

Luminous efficacy

The luminous flux being 1988 Lm, and the power of the light bulb being 56.2 W, yields a luminous efficacy of 35 Lm/W.

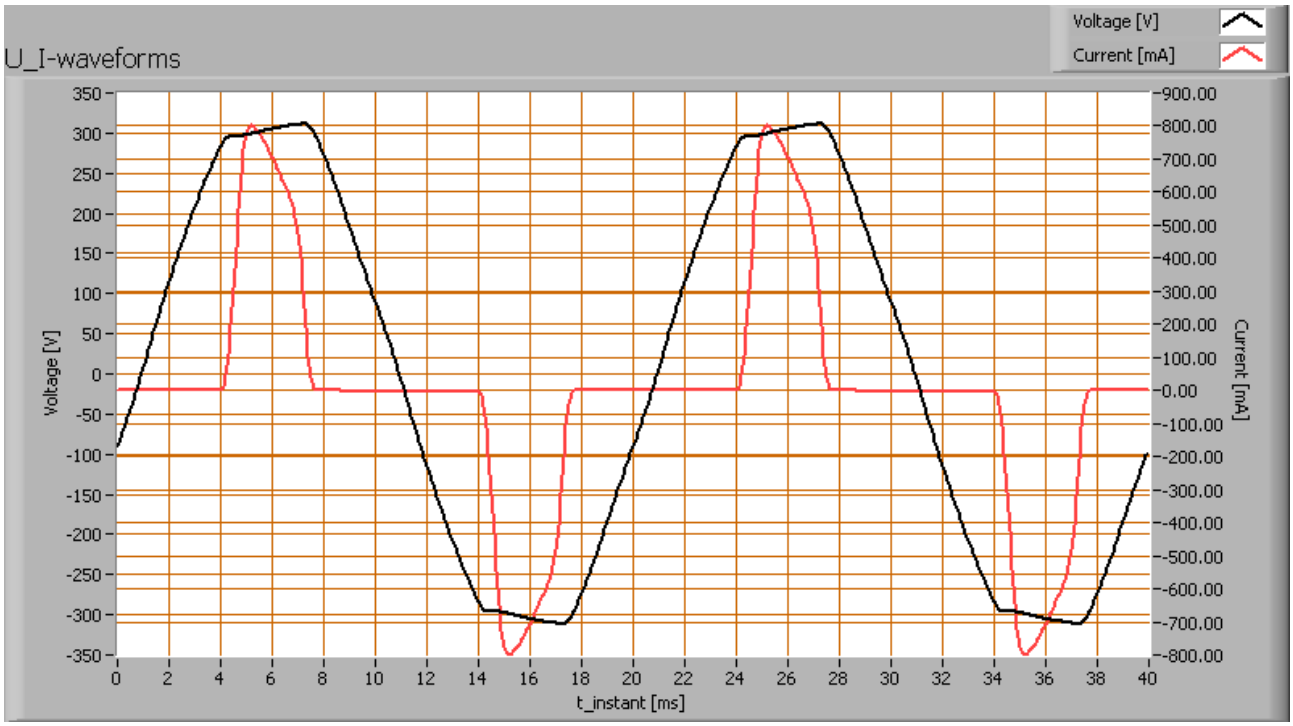
Electrical properties

A power factor of 0.70 means that for every 1 kWh net power consumed, a reactive component of 1.0 kVAr was needed.

Lamp voltage	230 VAC
Lamp current	349 mA
Power P	56.2 W
Apparent power S	80.2 VA
Power factor	0.70

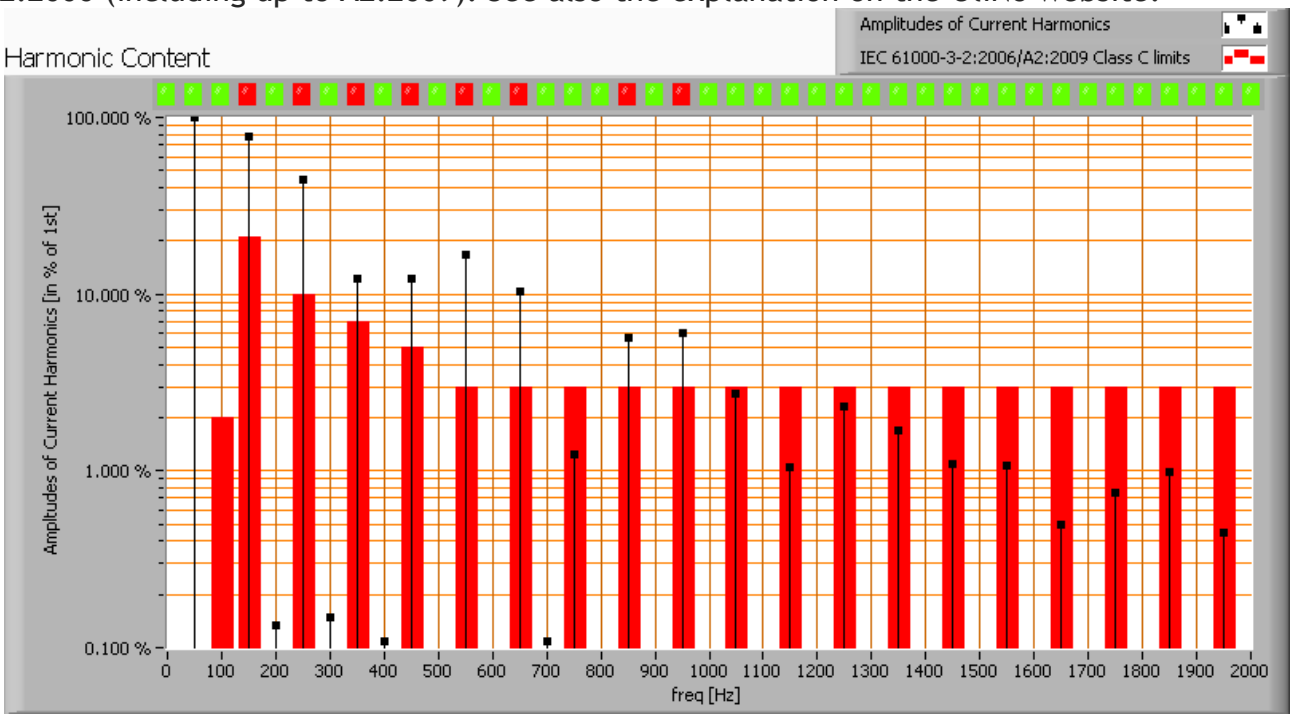
Of this light bulb the voltage across ad the resulting current through it are measured and graphed. See the OliNo site how this is obtained.

Lamp measurement report – 13 July 2010



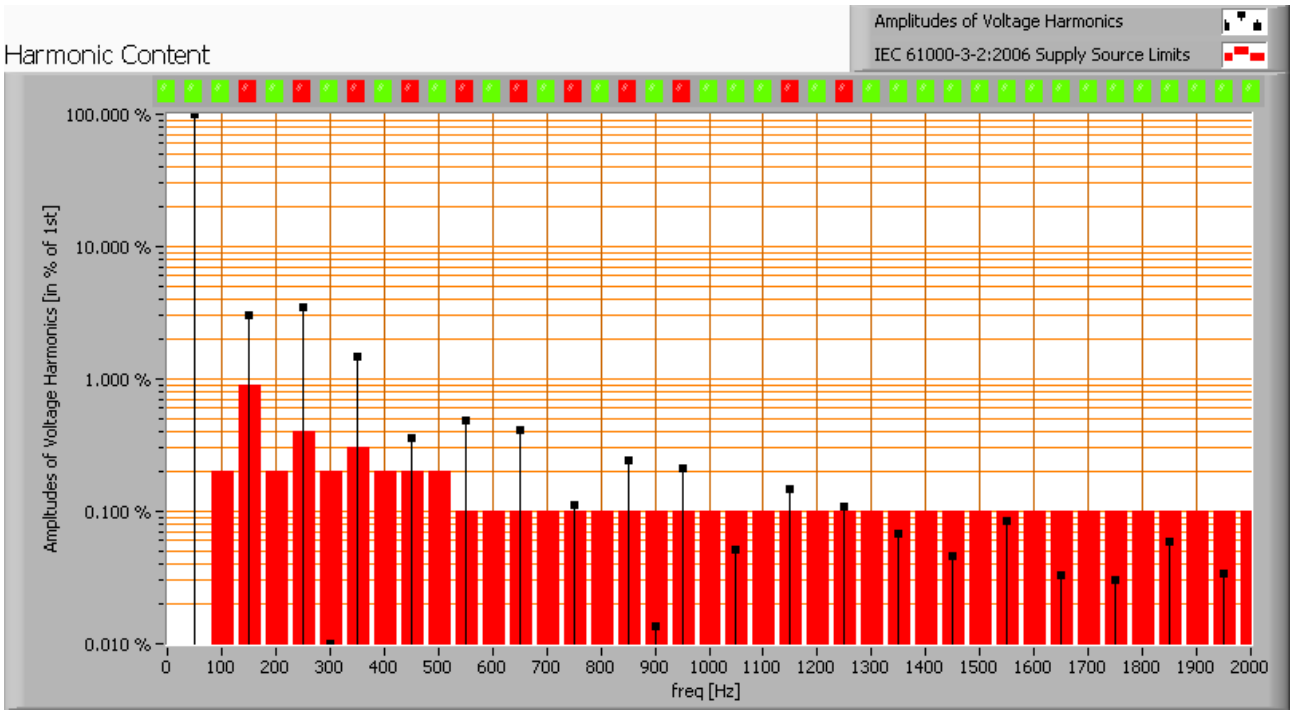
Voltage across and current through the lightbulb

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.



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

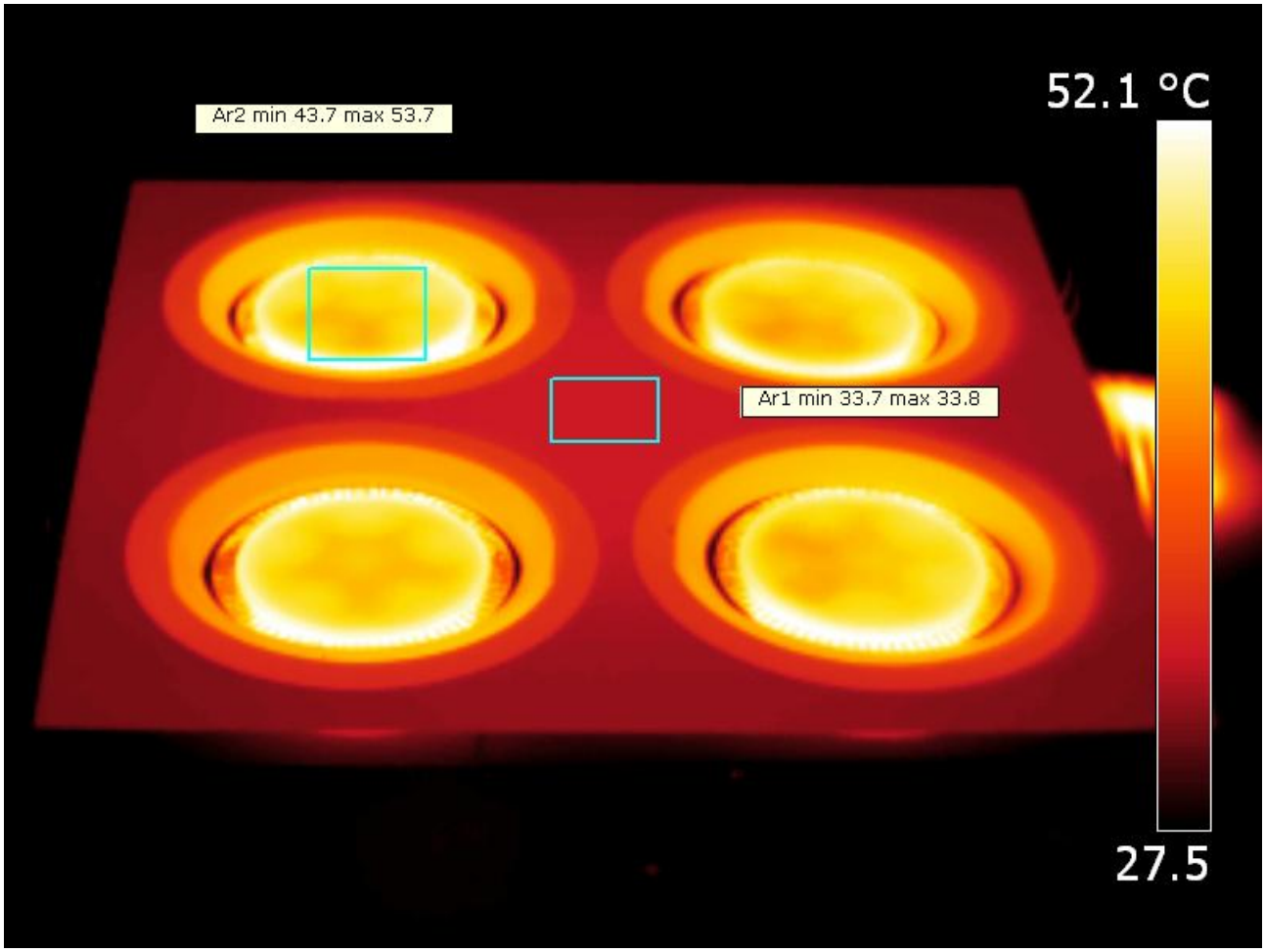
There are limits for the harmonics for lighting equipment > 25 W which are not fulfilled. One sidenote: the used voltage is not according to the specs, and has somewhat more harmonic content than allowed. This negatively affects the results of the harmonic content of the current that results.



The harmonic content of the voltage used.

If the used voltage would have fulfilled the requirements of the norm then the results for the harmonic content for the current would have been better. How much is unknown. Therefore the harmonic content of the current must be seen as an indication. The Total Harmonic Distortion of the current is computed as 94 %.

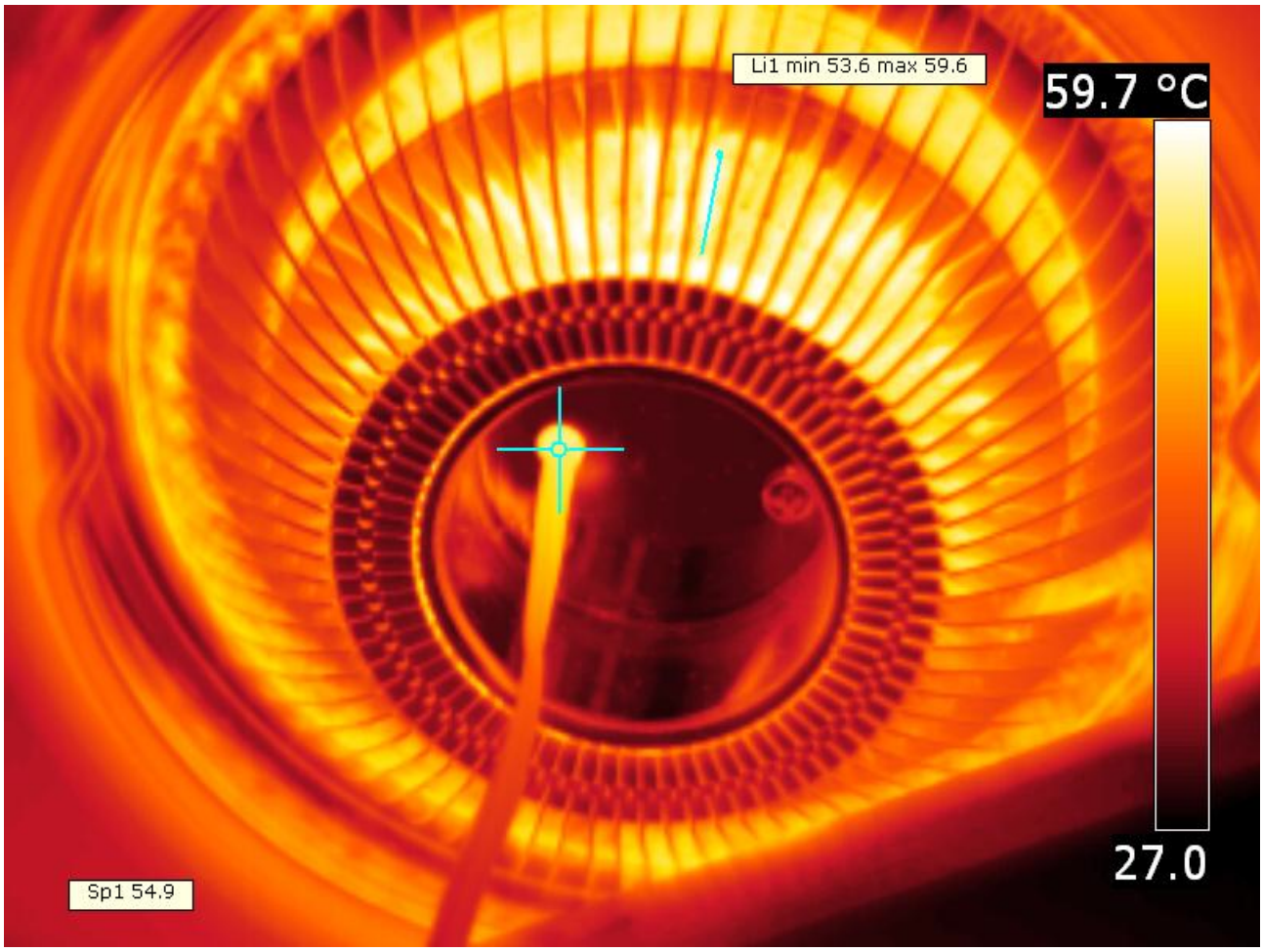
Temperature measurements lamp



Overview image with the temperatures on some relevant spots

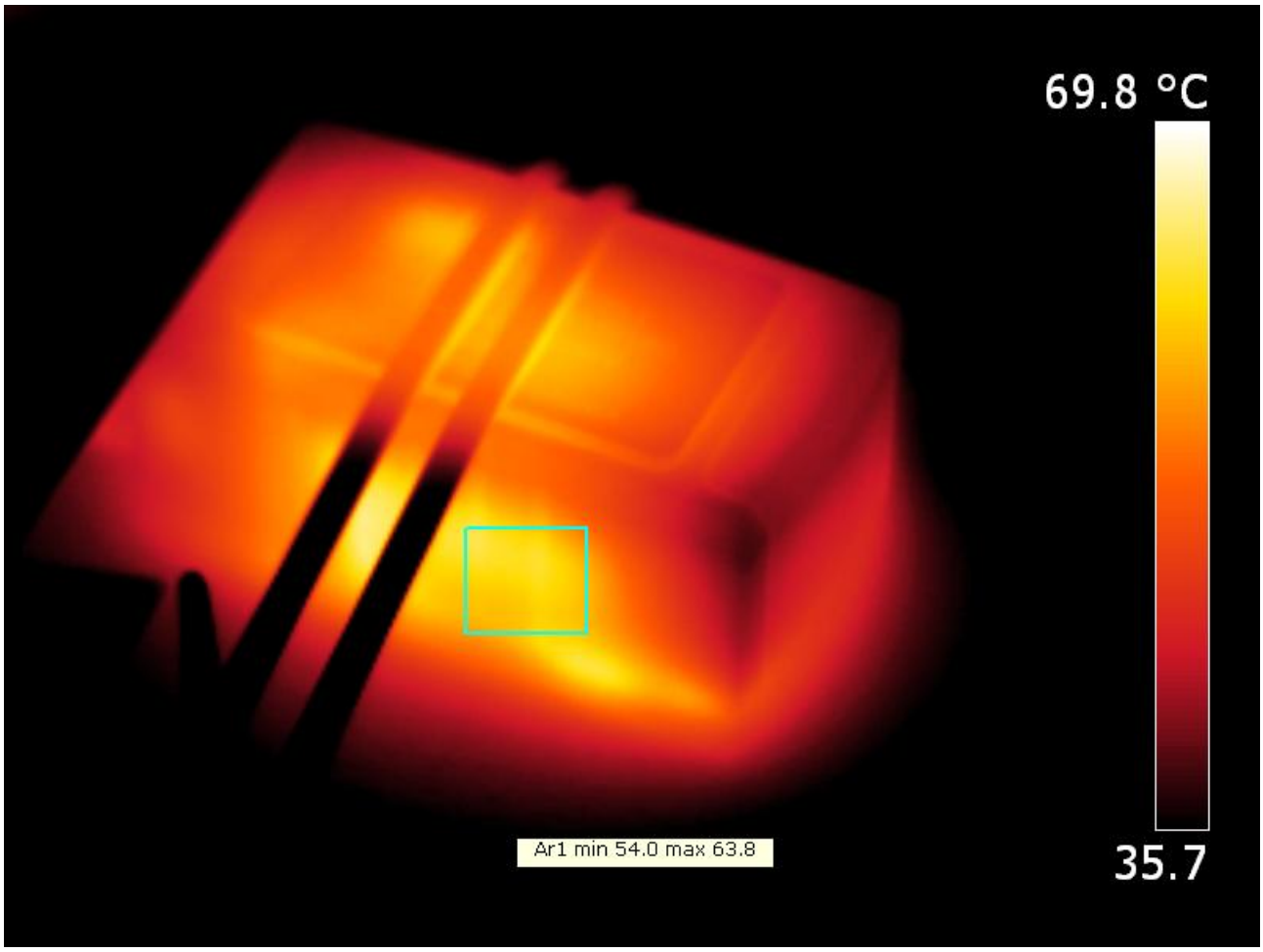
The emissivity for the indicated areas shows comparable with that of masking tape, being about 0.95.

Lamp measurement report – 13 July 2010



Temperature measurement at the back side, on the feeding cable.

Lamp measurement report – 13 July 2010



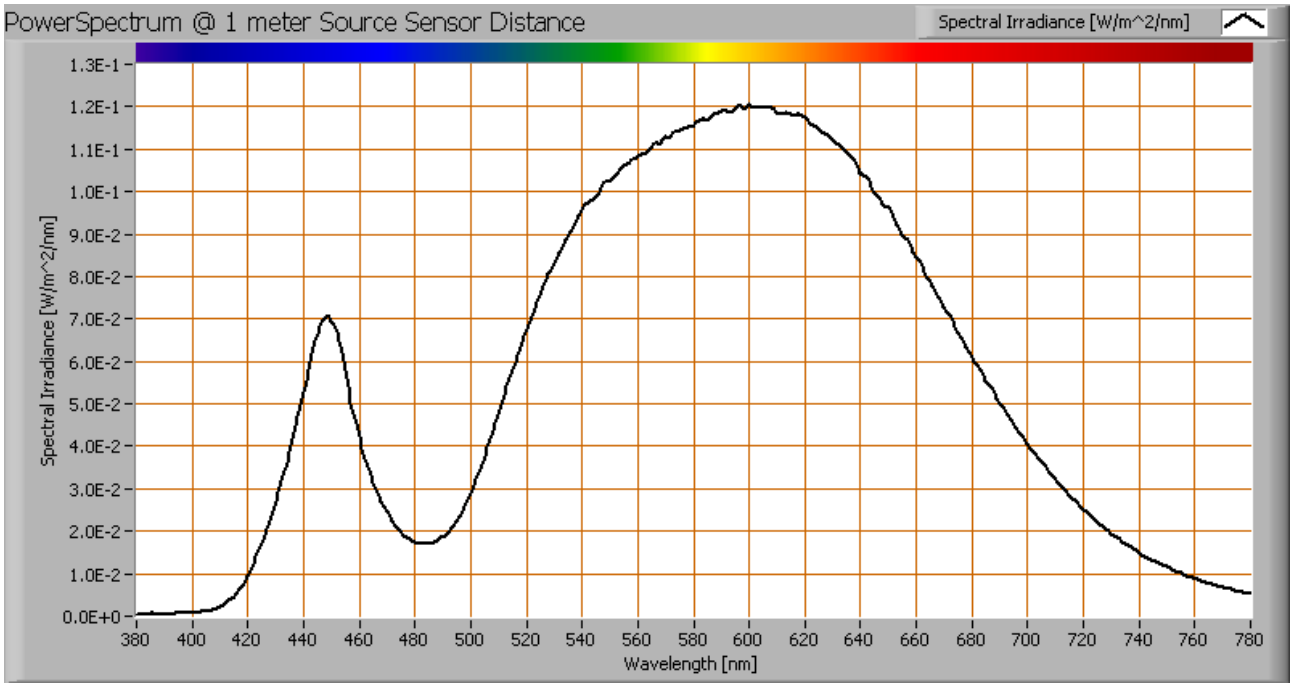
One of the 4 power supplies used.

status lamp	> 2 hours on
ambient temperature	26 deg C
reflected background temperature	26 deg C
camera	Flir T335
emissivity	0.95[1]
measurement distance	zoom is at 0.2 m
$IFOV_{geometric}$	0.3 mm
NETD (thermal sensitivity)	50 mK

[1] See the text for expanation.

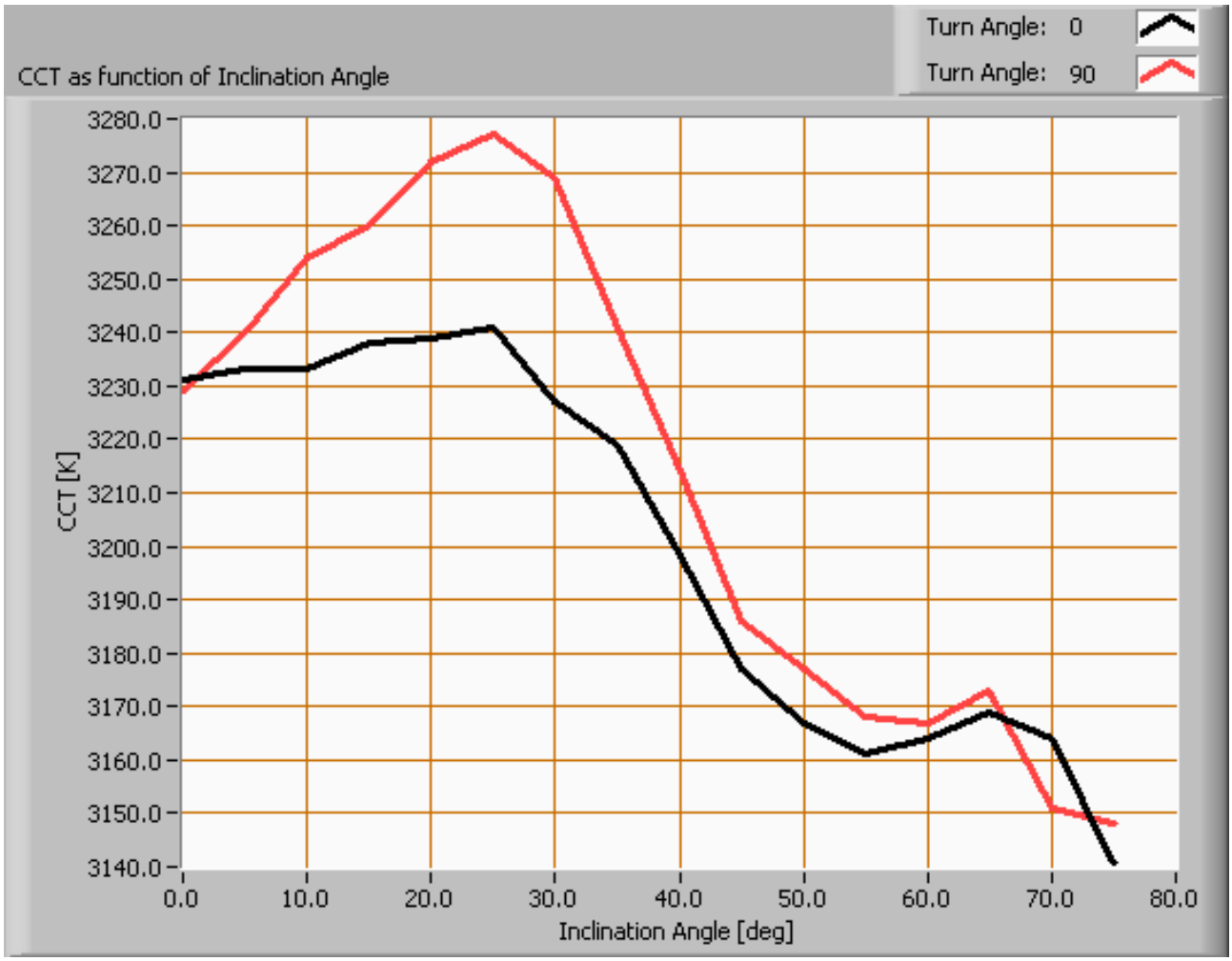
Lamp measurement report – 13 July 2010

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 3225 K which is warm white.
This color temperature is measured straight underneath the light bulb. Below a graph showing the color temperature for different inclination angles.



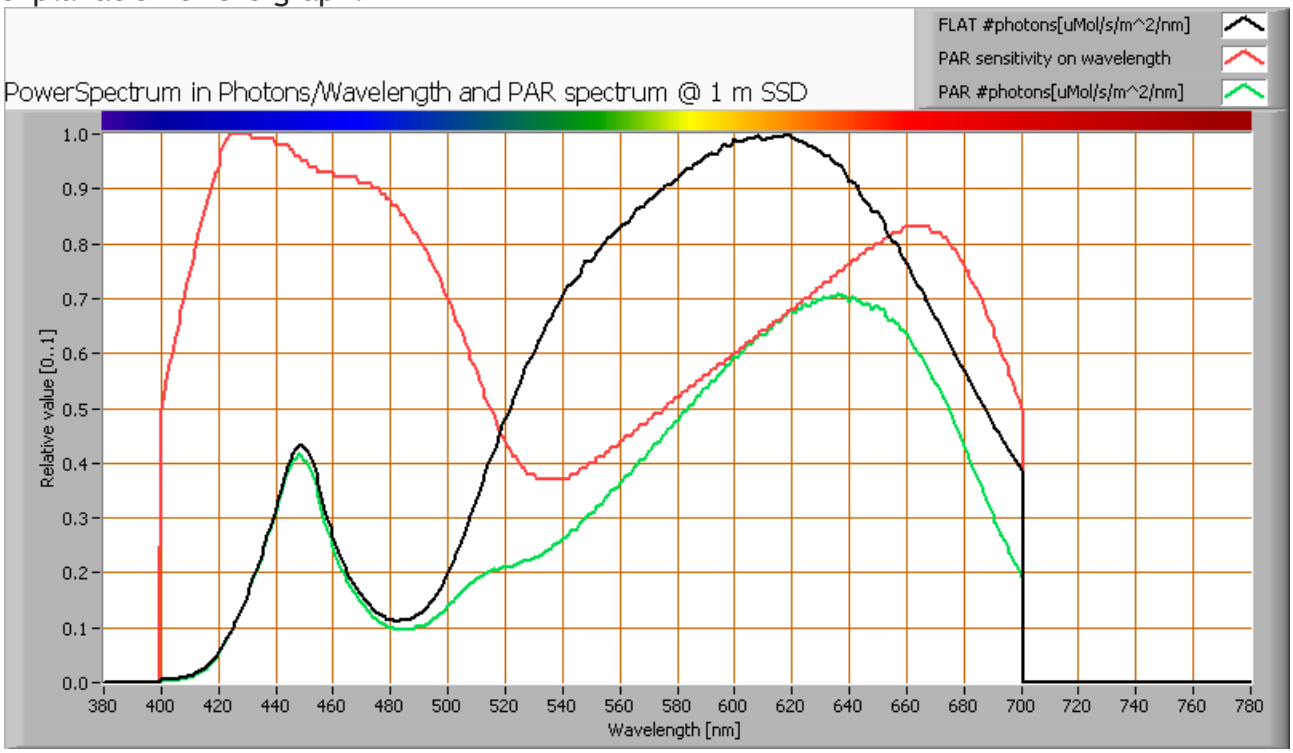
Color temperature as a function of inclination angle.

The measurement of CCT is measured for inclination angles up to 75°.
The maximum beam angle is 26°, meaning a 13° inclination angle. In this area most of the light is present. The variation in correlated color temperature in this area is about 1 %.

Lamp measurement report – 13 July 2010

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.



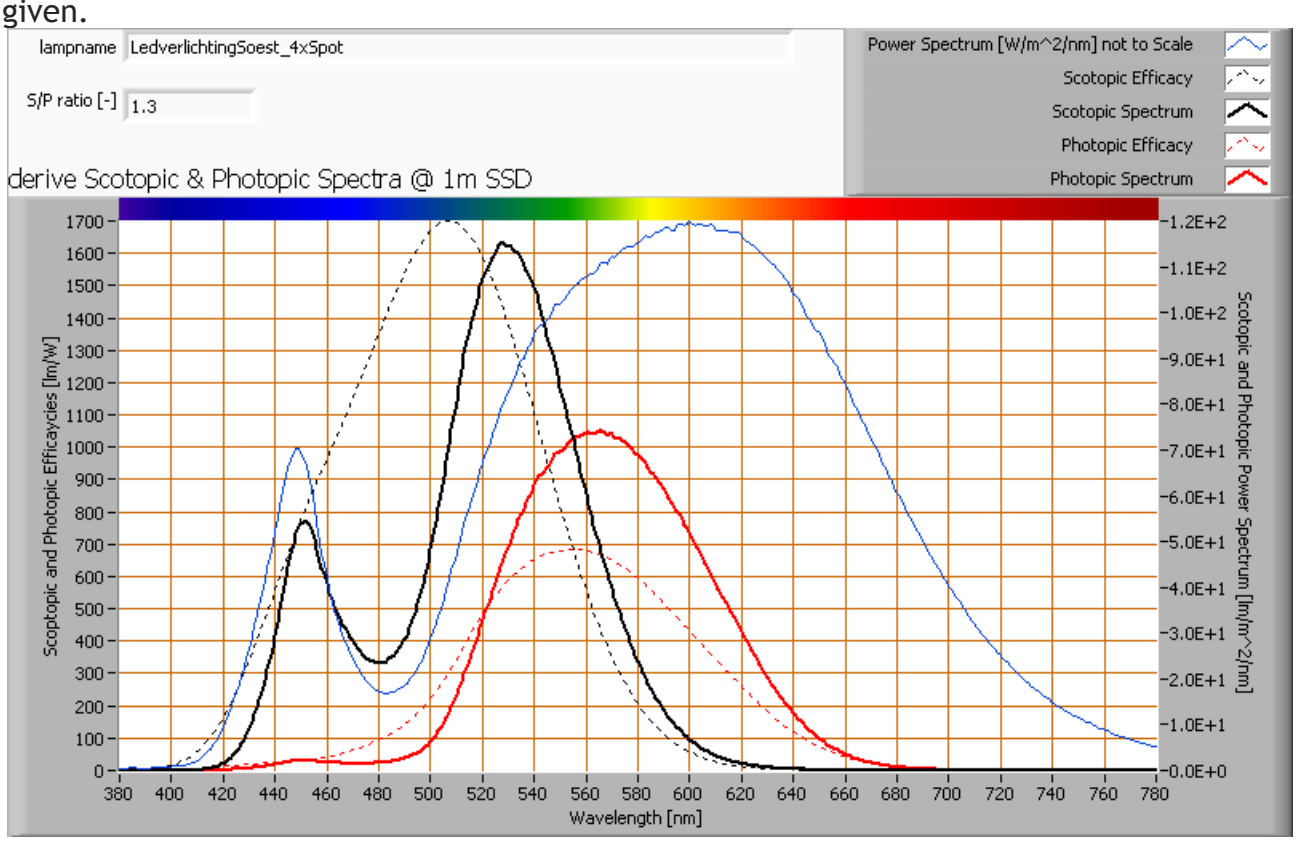
The photon spectrum, then the sensitivity curve and as result the final PAR spectrum of the light of this light bulb

parameter	value	unit
PAR-number	65.3	µMol/s/m²
PAR-photon current	18.8	µMol/s
PAR-photon efficacy	0.3	µMol/s/W

The PAR efficiency is 64 % (valid for the PAR wave length range of 400 - 700 nm). So maximally 64 % 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 %).

S/P ratio

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

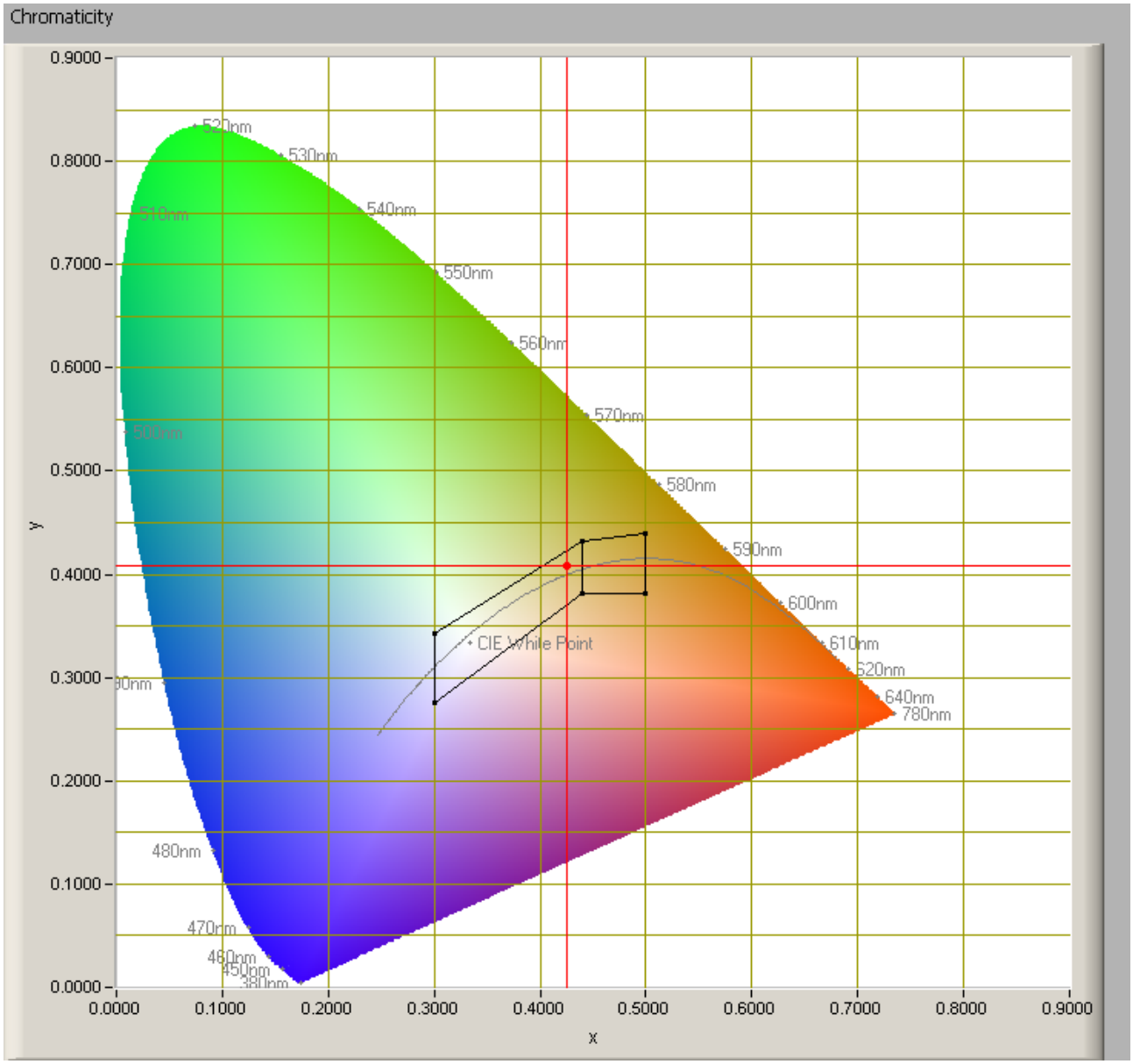


The power spectrum, sensitivity curves and resulting scotopic and photopic spectra (spectra energy content defined at 1 m distance).

The S/P ratio is 1.3.
More info on S/P ratio can be found on the OliNo website.

Lamp measurement report – 13 July 2010

Chromaticity diagram

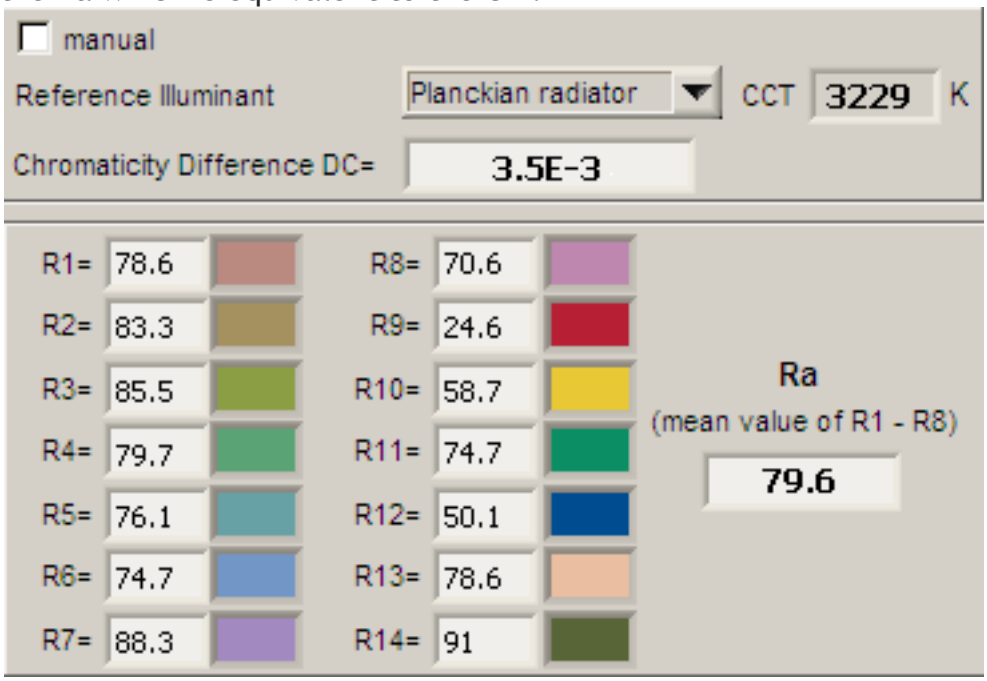


The chromaticity space and the position of the lamp's color coordinates in it.

The light coming from this lamp is inside 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=0.4255 and y=0.4o82.

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.



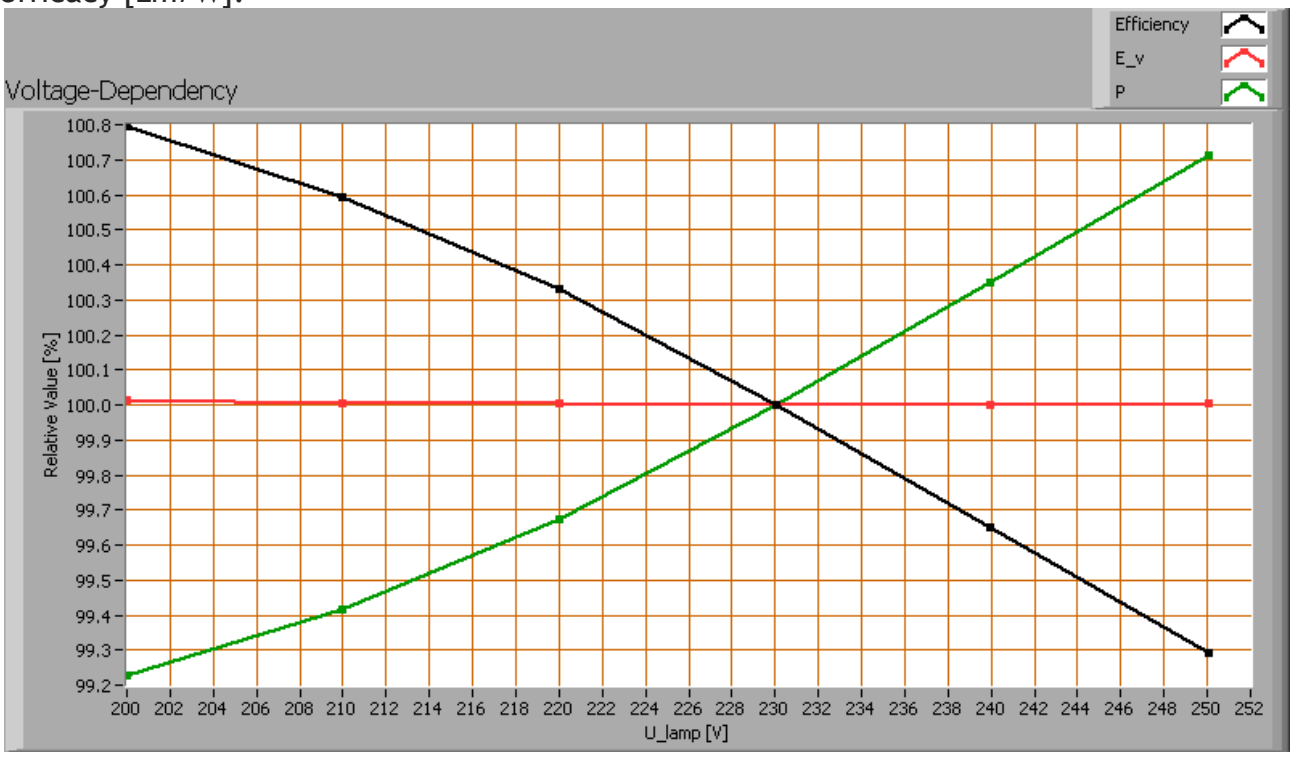
CRI of the light of this lightbulb.

The value of 80 is equal to 80 which is considered a minimum value for indoor usage. Note: the chromaticity difference is 0.0035 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 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].



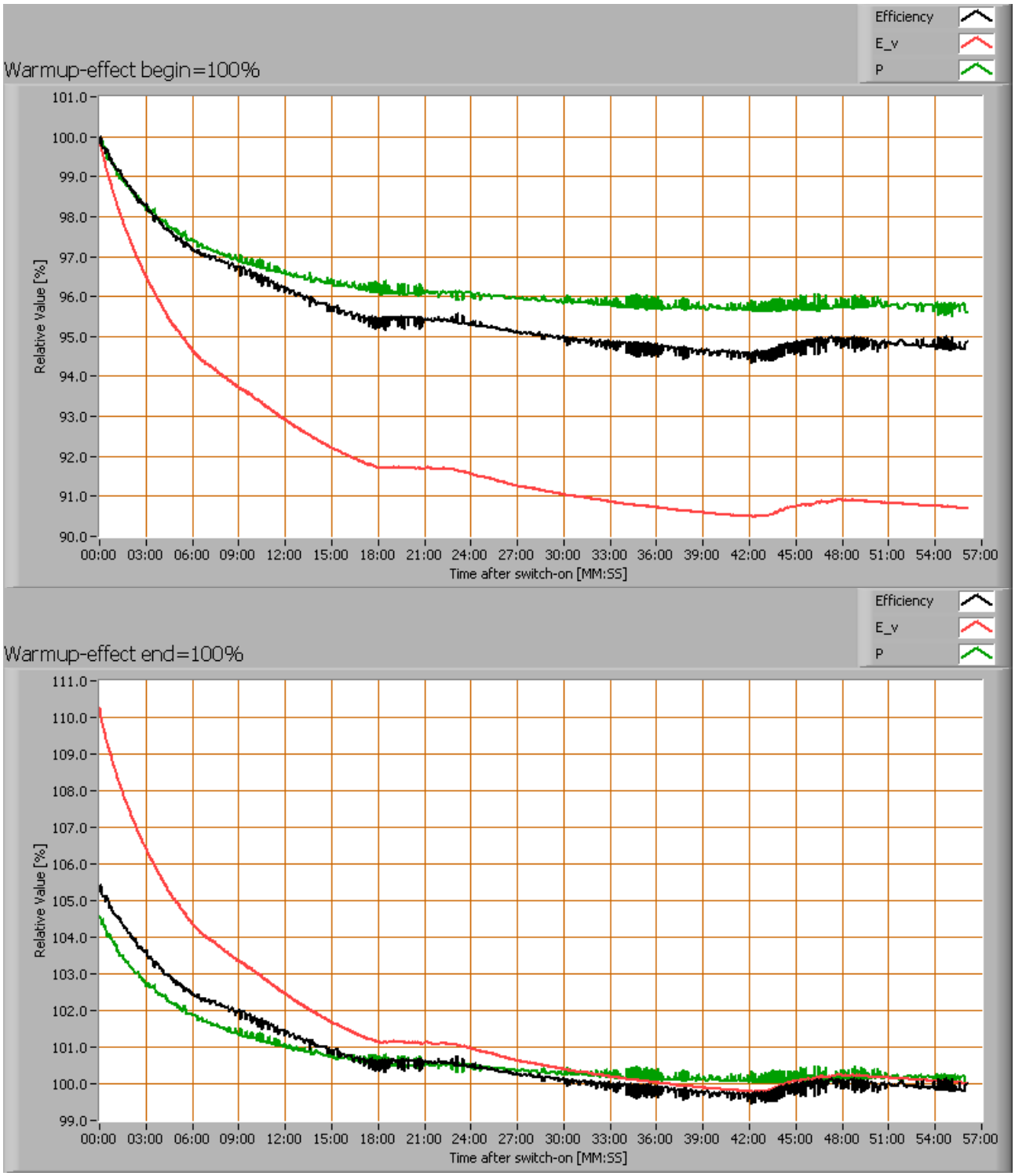
Lamp voltage dependencies of certain light bulb parameters, where the value at 230 V is taken as 100 %.

The illuminance and consumed power do not vary significantly when the voltage is varied.
When the voltage at 230 V varies with + and - 5 V, then the illuminance varies < 0.1 %, so when abrupt voltage changes occur this effect is not visible in the illuminance output.

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].

Lamp measurement report – 13 July 2010

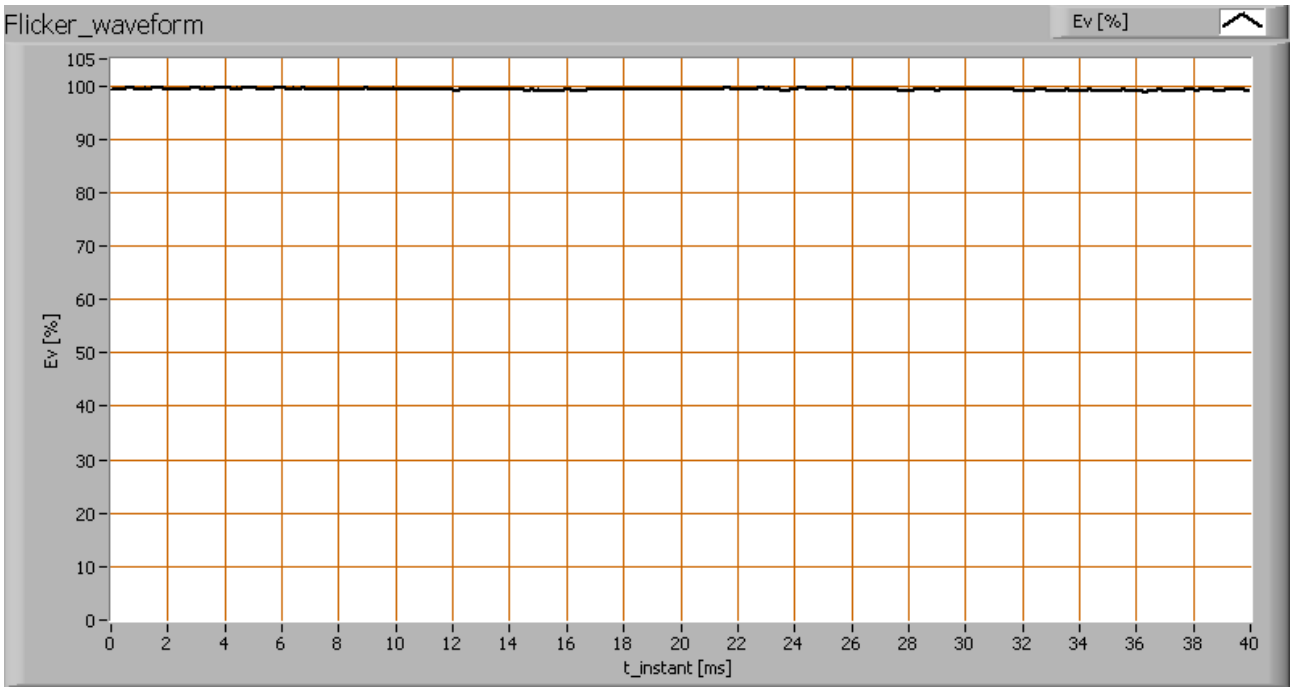


Effect of warming up on different light bulb parameters. At top the 100 % level is put at begin, and at bottom at the end.

The warm up time is about 20 minutes. During that time the illuminance decreases with 9 % and the consumed power with about 4 %.

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).

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