Lamp measurement report – 9 Nov 2010

LVS PP 120 WW

by

Ledverlichting Soest

Lamp measurement report – 9 Nov 2010

Summary measurement data

parameter	meas. result	remark
Color temperature	3357 K	Warm white
Luminous intensity I_v	612 Cd	Measured straight underneath the lamp.
Illuminance modulation index	12 %	Measured straight underneath the lamp. Is a measure for the amount of flickering.
Beam angle	114 deg	114° for all the C0-C180-plane (perpendicular to the length direction of the lamp) and 106° for the C90-C270 plane, which is along the length direction of the lamp.
Power P	23.0 W	
Power Factor	0.88	For every 1 kWh net power consumed, there has been 0.5 kVAhr for reactive power.
THD	40 %	Total Harmonic Distortion
Luminous flux	1841 Lm	
Luminous efficacy	80 Lm/W	
EU-label classification	A	The energy class, from A (more efficient) to G (least efficient).
CRI_Ra	79	Color Rendering Index.
Coordinates chromaticity diagram	x=0.4114 and y=0.3913	
Fitting	FL-tube	This lamp is connected directly to the 230 V grid voltage.
PAR-value	5.5 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.

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PAR-photon efficacy	0.7 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	1.4	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 D external dimensions	1198 x 27 mm	External dimensions of the lamp.
L x W x H luminous area	1105 x 23 x 7 mm	Dimensions of the luminous area (used in Eulumdat file). This is the surface of the prismatic cover.
General remarks		The ambient temperature during the whole set of measurements was 23.6-25.6 deg C. The temperature of the housing gets about 25 degrees hotter than ambient temperature. Warm up effect: during the warm up time the illuminance and consumed power decrease about 5.5 %. Voltage dependency: the power consumption and illuminance vary insignificantly, when the power voltage varies between 200-250 V. At the end of the article there is a additional photo.

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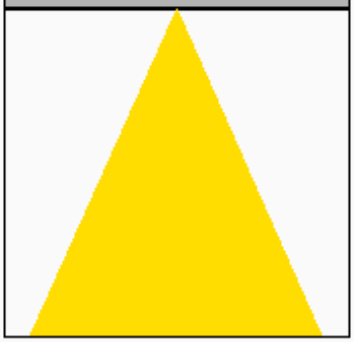
Overview table

m.	Ø 50% C0-180	Ø 50% C90-270
0.25	0.77	0.67
0.5	1.54	1.33
1	3.07	2.66
1.5	4.61	3.99
3	9.21	7.99
4	12.28	10.65
5	15.35	13.31

C0-180: 114°
C90-270: 106°



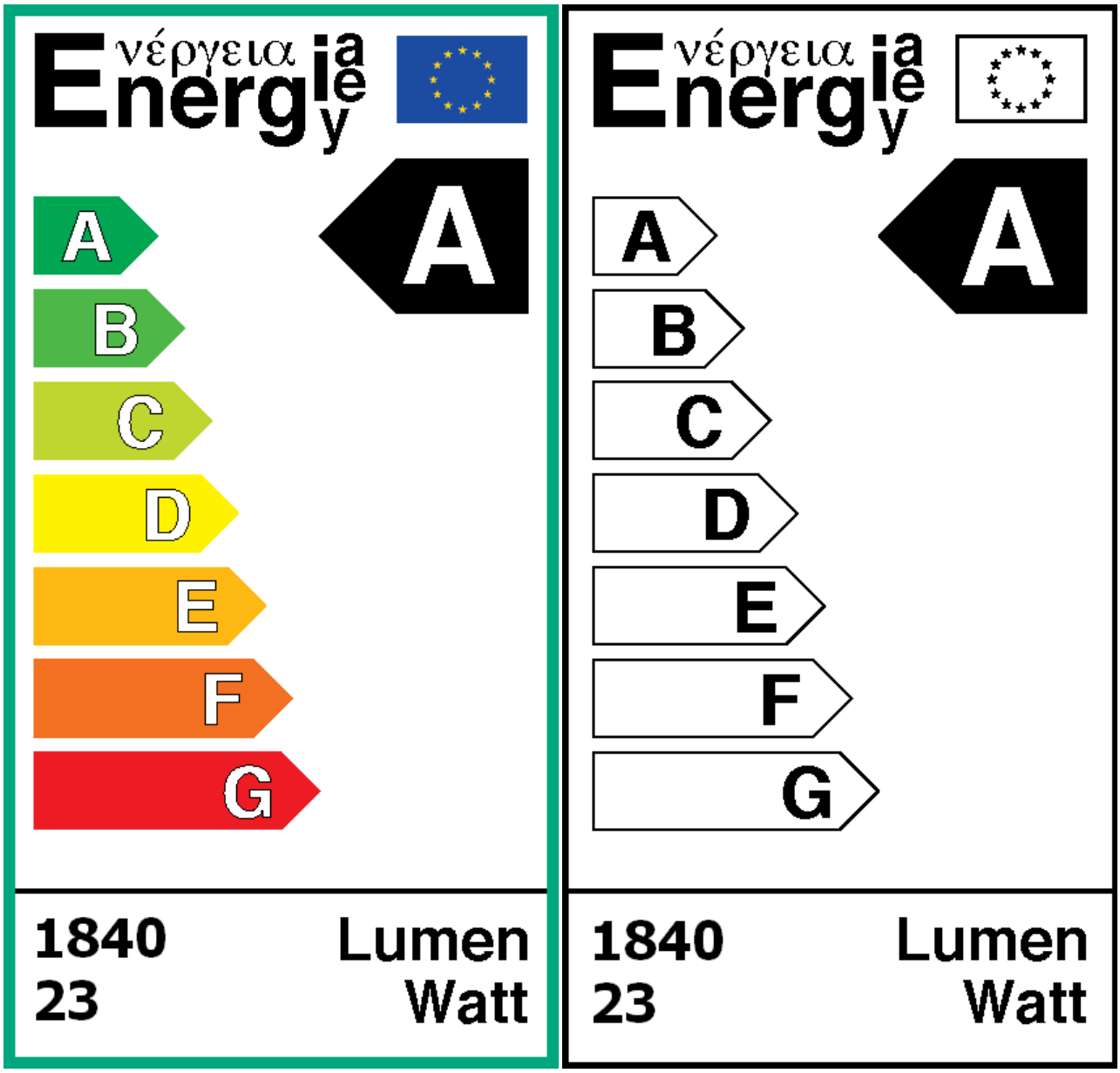
E (lux)
9796
2449
612
272
68
38
24

Luminaire Efficacy	
80	(lumen per Watt)
Half-peak diam C_{0-180}	
3.07	x diameter(m)
Half-peak diam C_{90-270}	
2.66	x diameter(m)
Illuminance	
612	/ distance² (lux)
Total Output	
1841	(lumen)

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 1105 mm ≈ 5600 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.

EU Energy label classfication

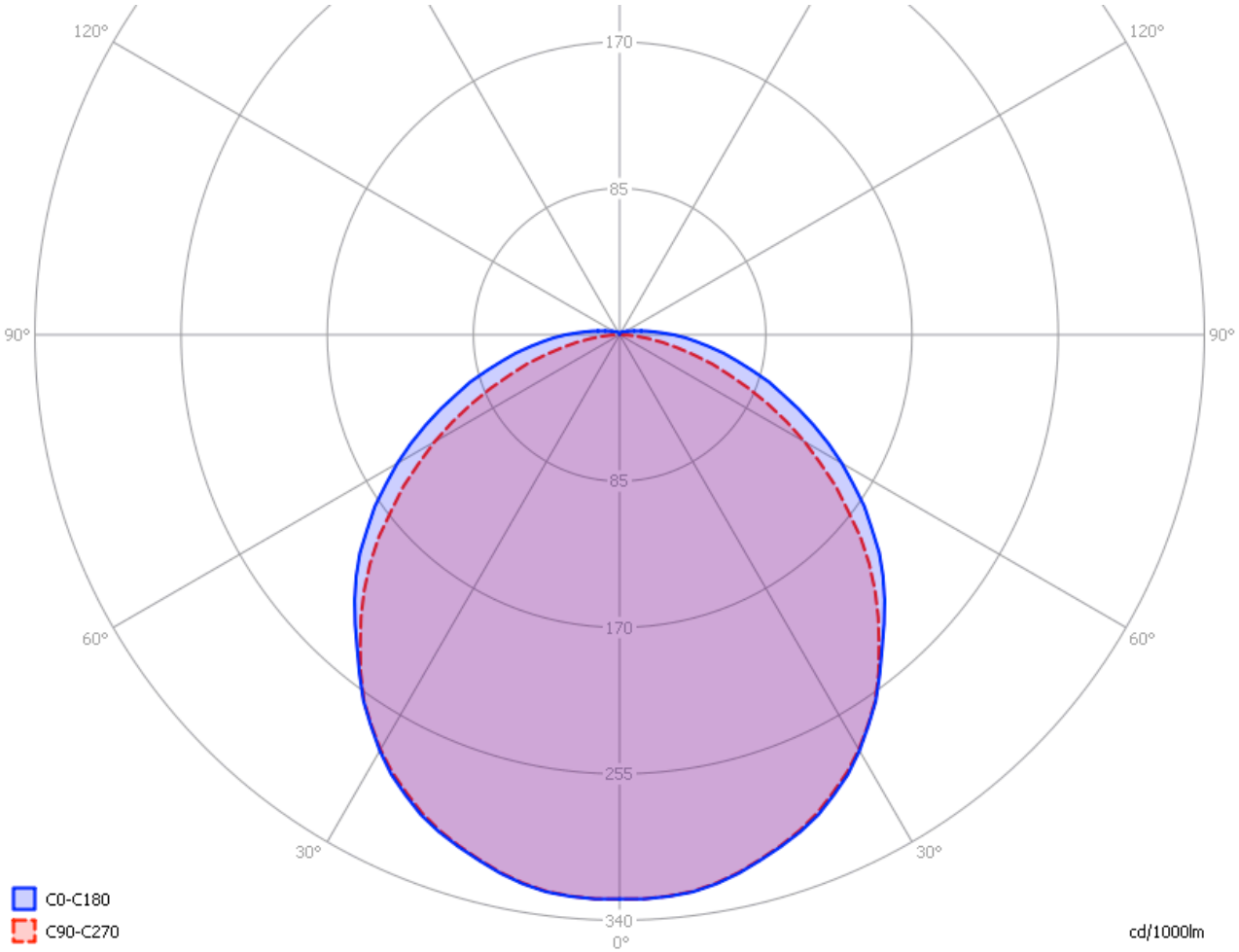
With the measurement results of the luminous flux and the consumed power the classification on energy of this lamp is calculated. This information is requested in the EU for certain household lamps, see also the OliNo site that explains for which lamps it is requested, how the label looks like and what information it needs to contain.
Herewith the labels for this lamp in color and black and white.



EU energy label of this 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 C0-C180 plane is along the width direction of the lamp) and is somewhat wider than the C90-C270 plane (along the length direction of the lamp) since the tube ends block the light towards the length direction.

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.

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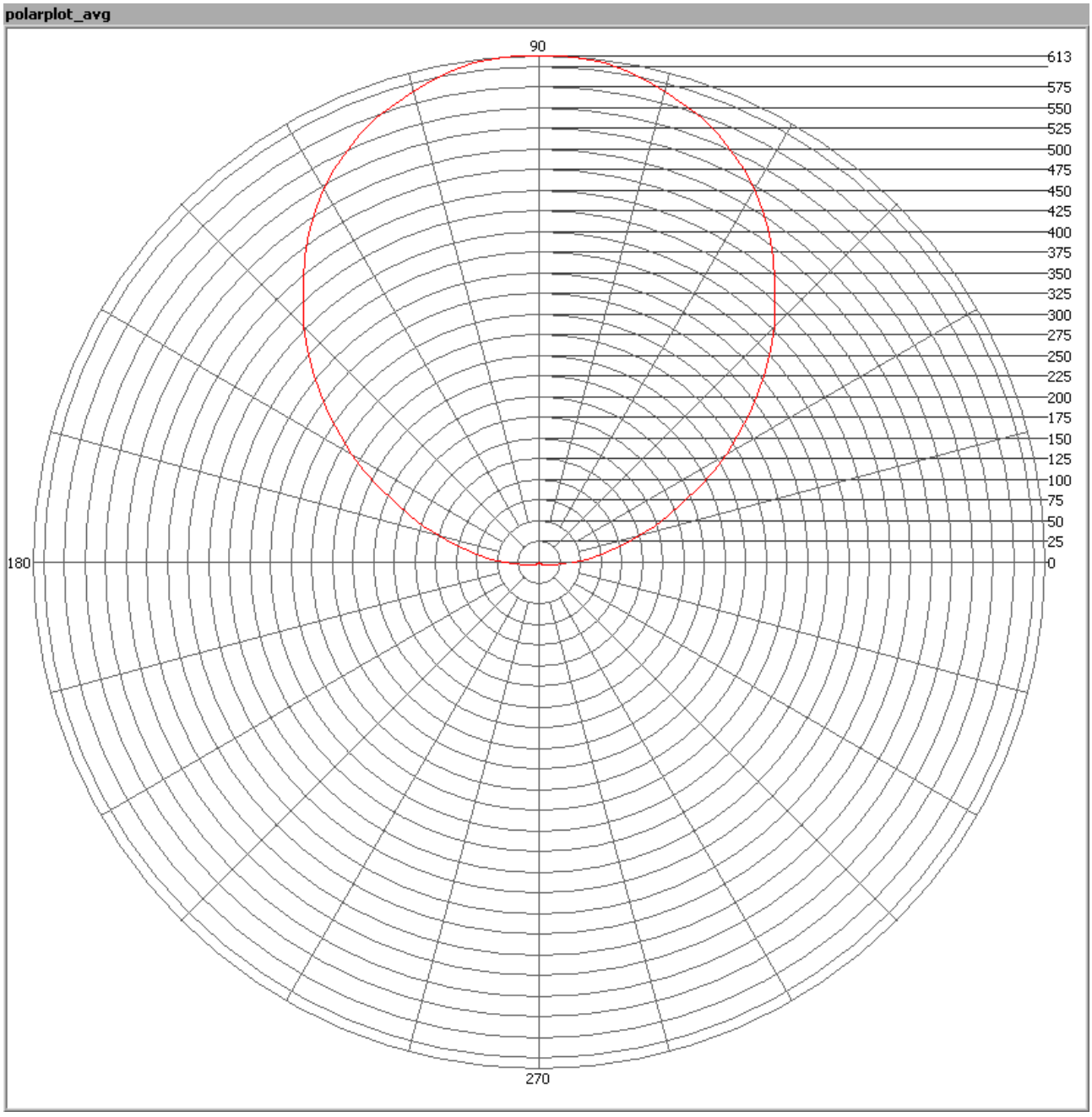
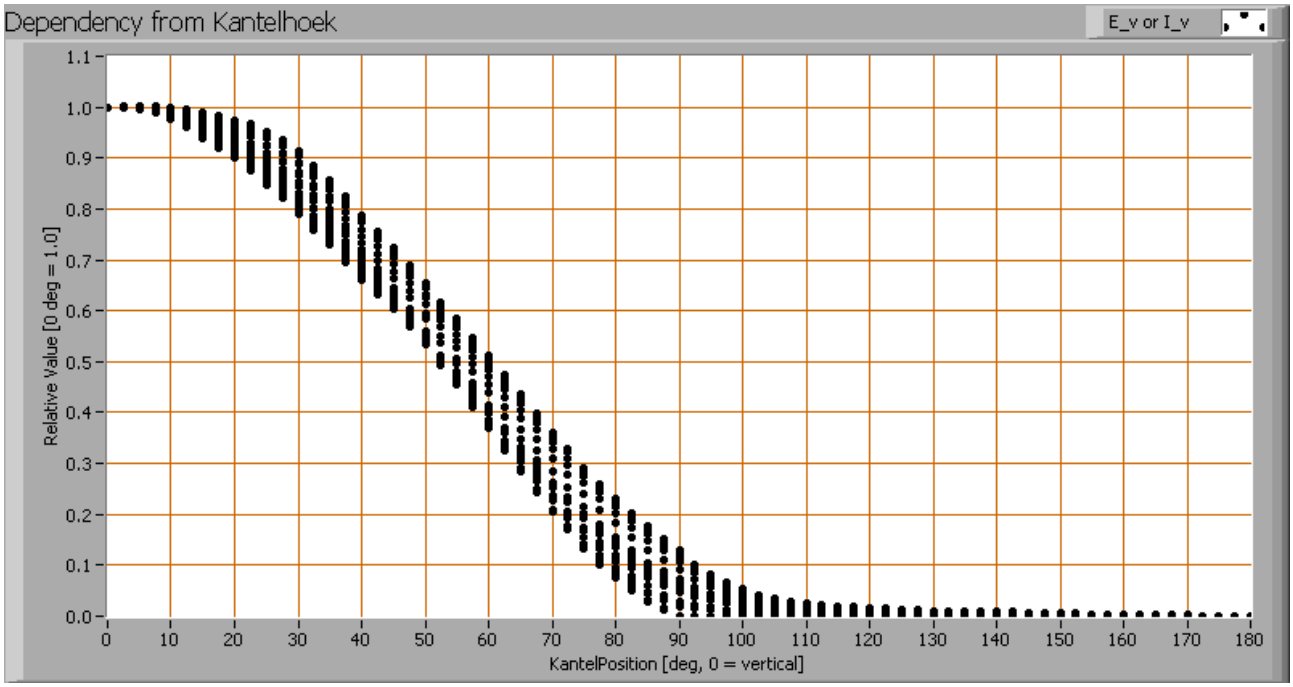


The radiation pattern of the light bulb.

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° for the C0-C180 and 106° for the C90-C270 plane.

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 1841 Lm.

Luminous efficacy

The luminous flux being 1841 Lm, and the power of the light bulb being 23.0 W, yields a luminous efficacy of 80 Lm/W.

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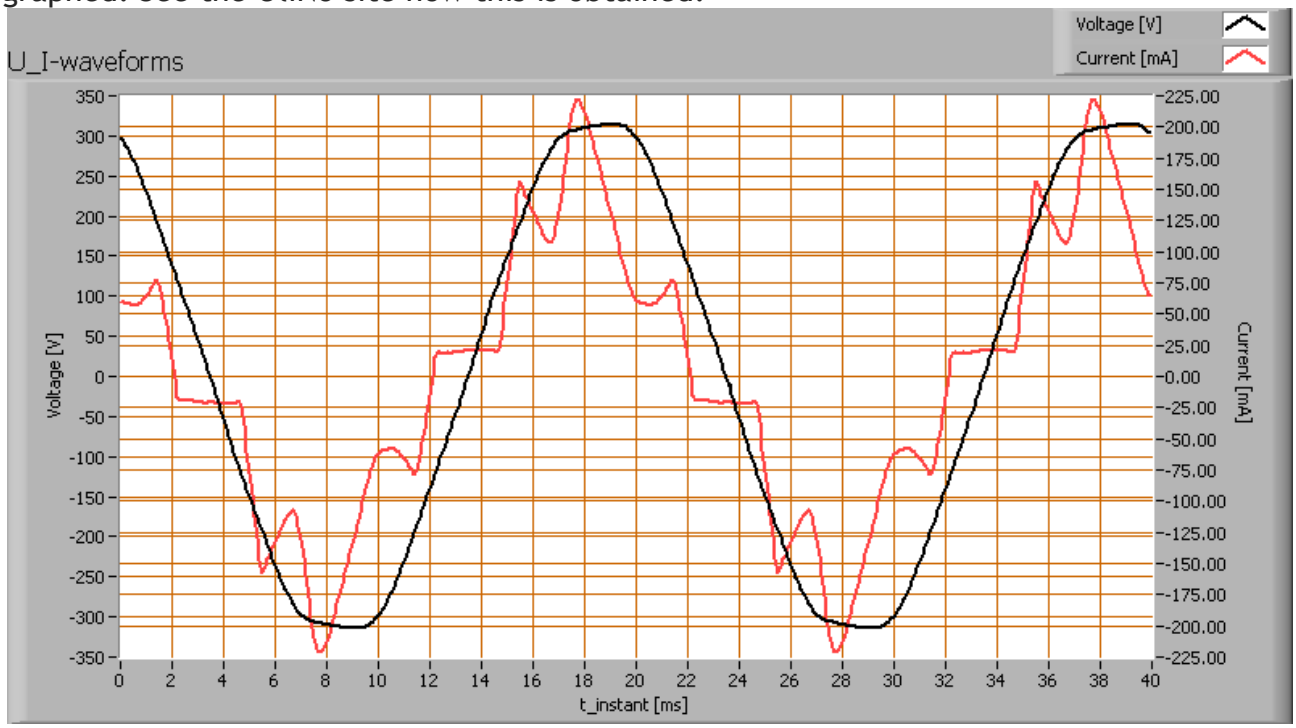
Electrical properties

A power factor of 0.88 means that for every 1 kWh net power consumed, a reactive component of 0.5 kVAr was needed.

Lamp voltage	230 VAC
Lamp current	113 mA
Power P	23.0 W
Apparent power S	26.0 VA
Power factor	0.88

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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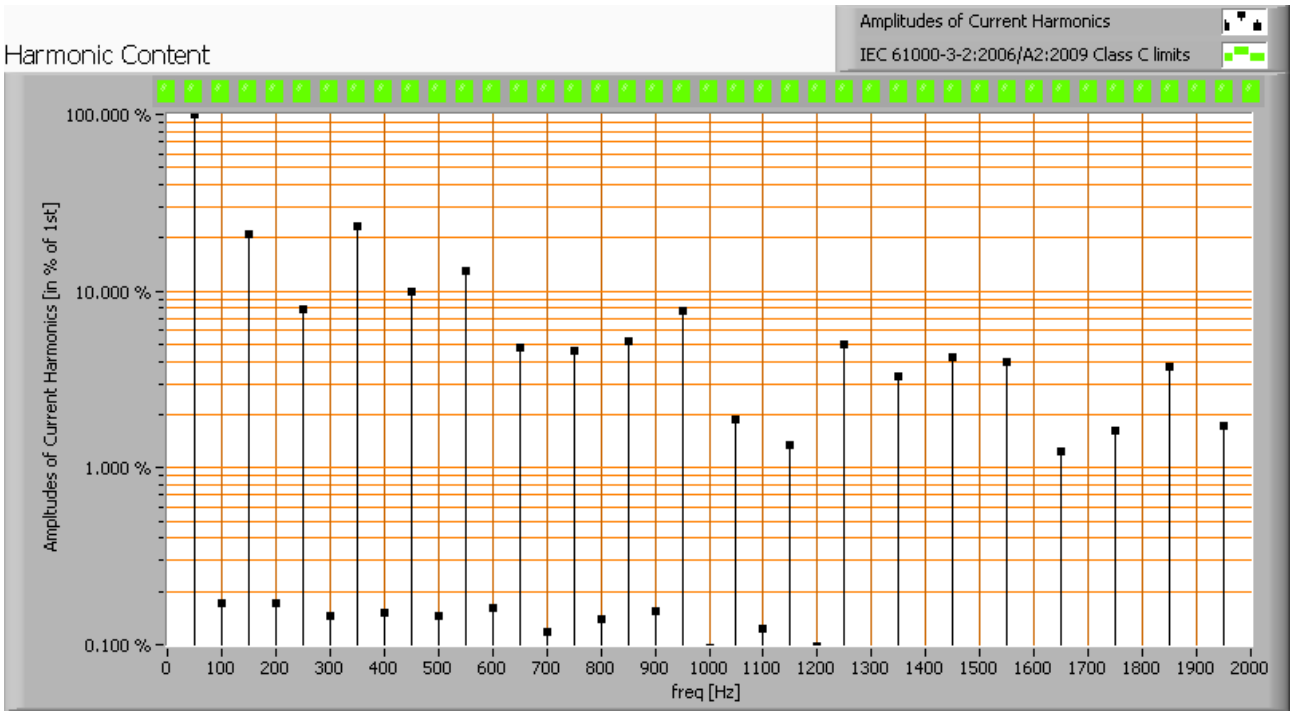

Harmonics in the current waveform and checked against IEC61000-3-2:2006 and A2:2009

There are no limits for the harmonics for lighting equipment <= 25 W.
The Total Harmonic Distortion of the current is computed as 40 %.

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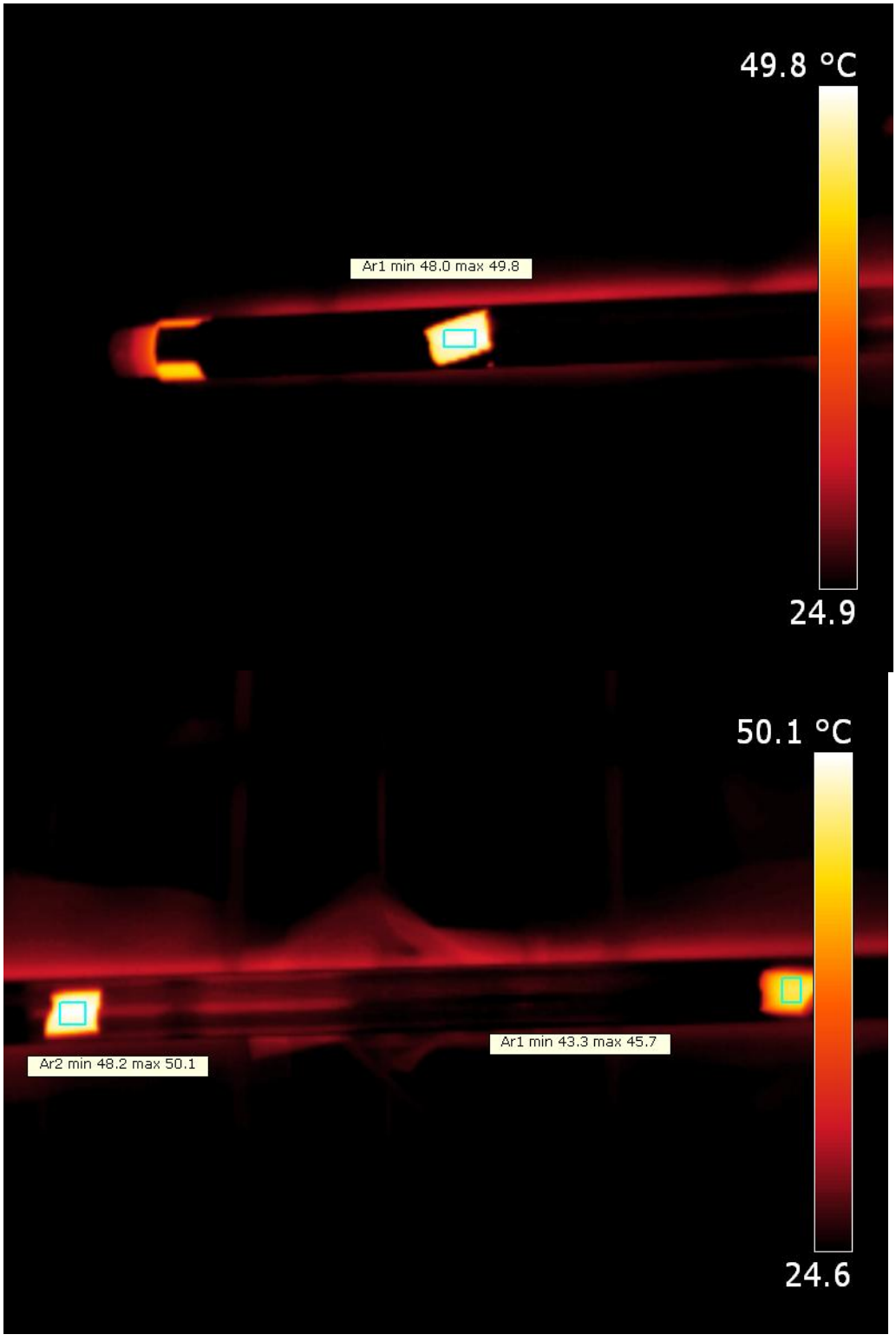
Temperature measurements lamp



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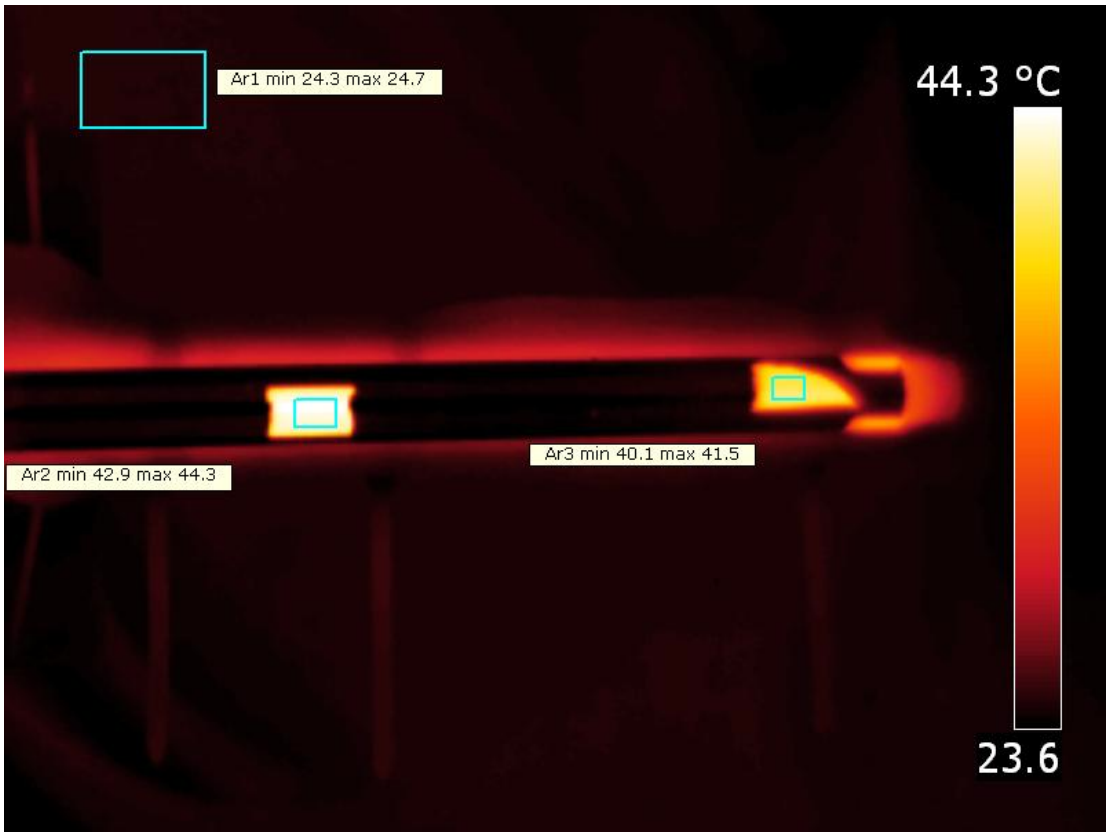


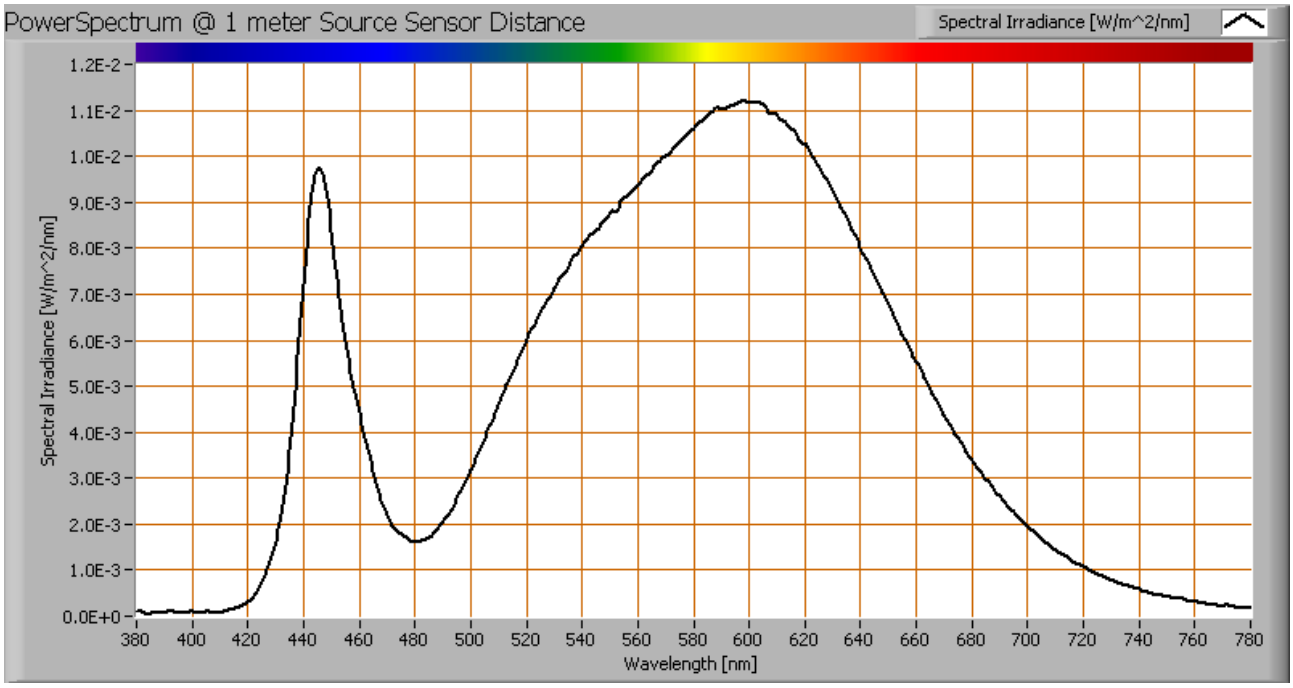
The metal side of the tube with the temperature measurements done on masking tape.

The aluminum on the back side of the tube is not capable of radiating the heat away: the emissivity is very low and the temperature measurements directly on the aluminum give the temperature readings reflected from ambient temperature. For a reliable temperature measurement the measurements were done on masking tape that does hardly reflect the temperatures from the surroundings.
The tube ends have a 8 – 9 degrees difference.

status lamp	> 2 hours on
ambient temperature	24.5 deg C
reflected background temperature	24.5 deg C
camera	Flir T335
emissivity	0.95(1)
measurement distance	1 m
$IFOV_{geometric}$	0.136 mm per 0.1 m distance
NETD (thermal sensitivity)	50 mK

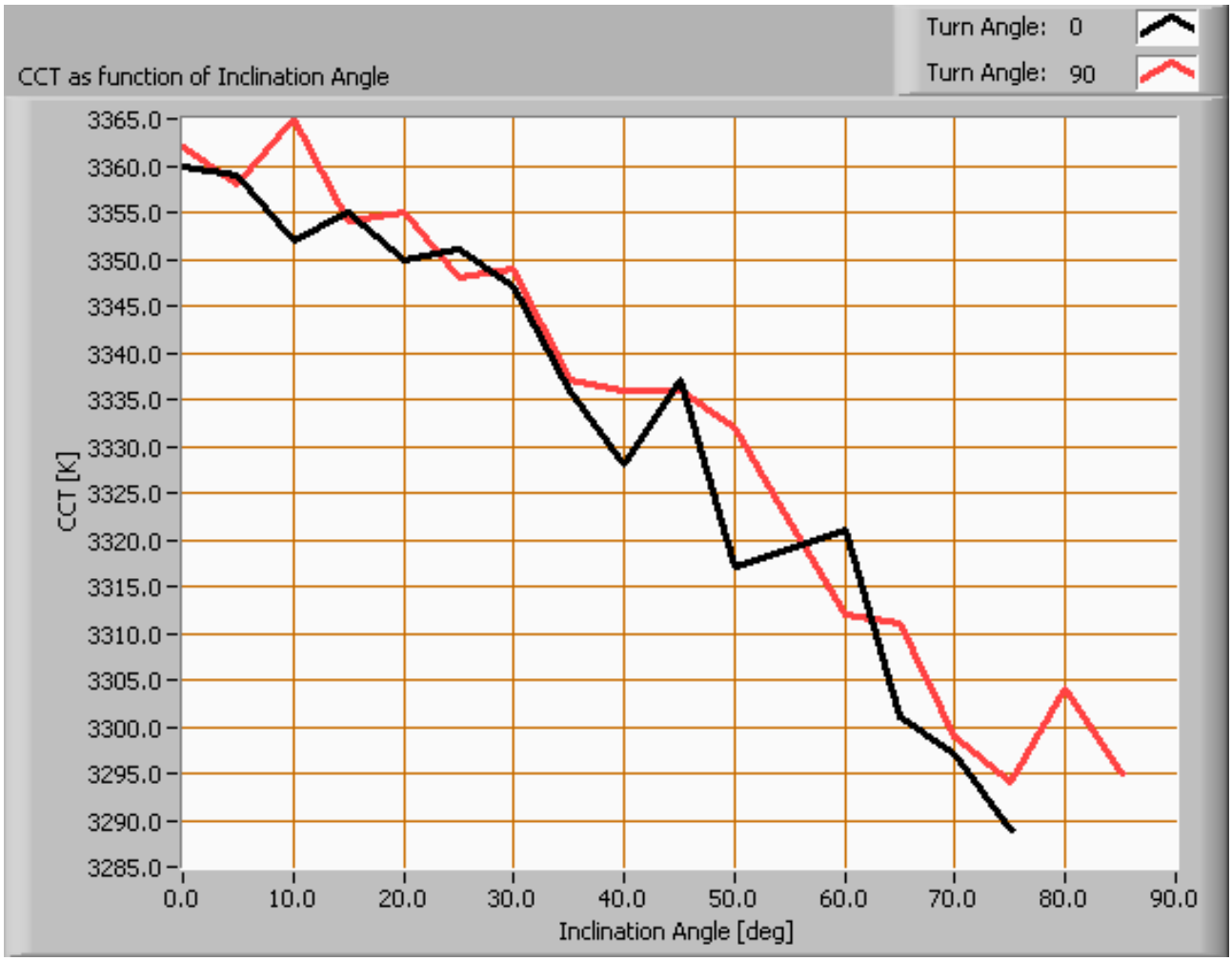
(1) See the text for explanation.

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 3350 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°. Beyond this angle the illuminance is 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 1 %.

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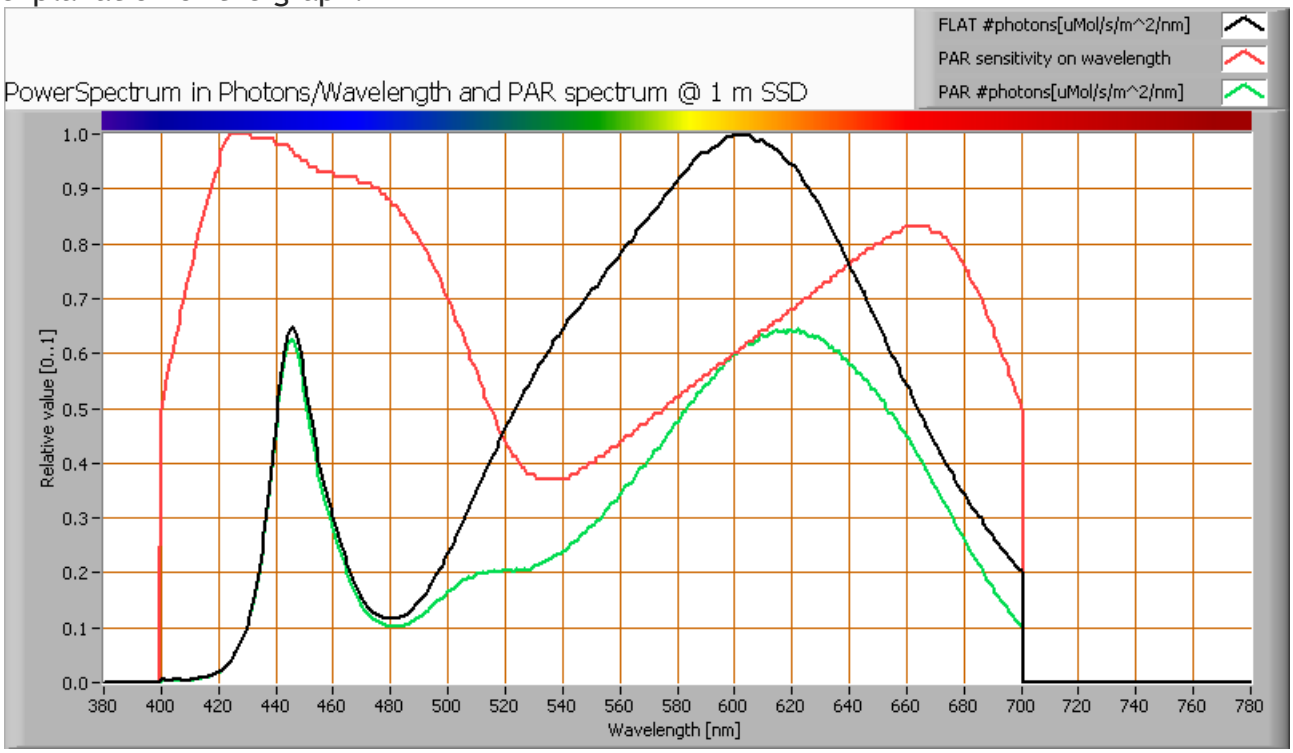
PAR value and PAR spectrum

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	5.5	µMol/s/m²
PAR-photon current	16.5	µMol/s
PAR-photon efficacy	0.7	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 %).

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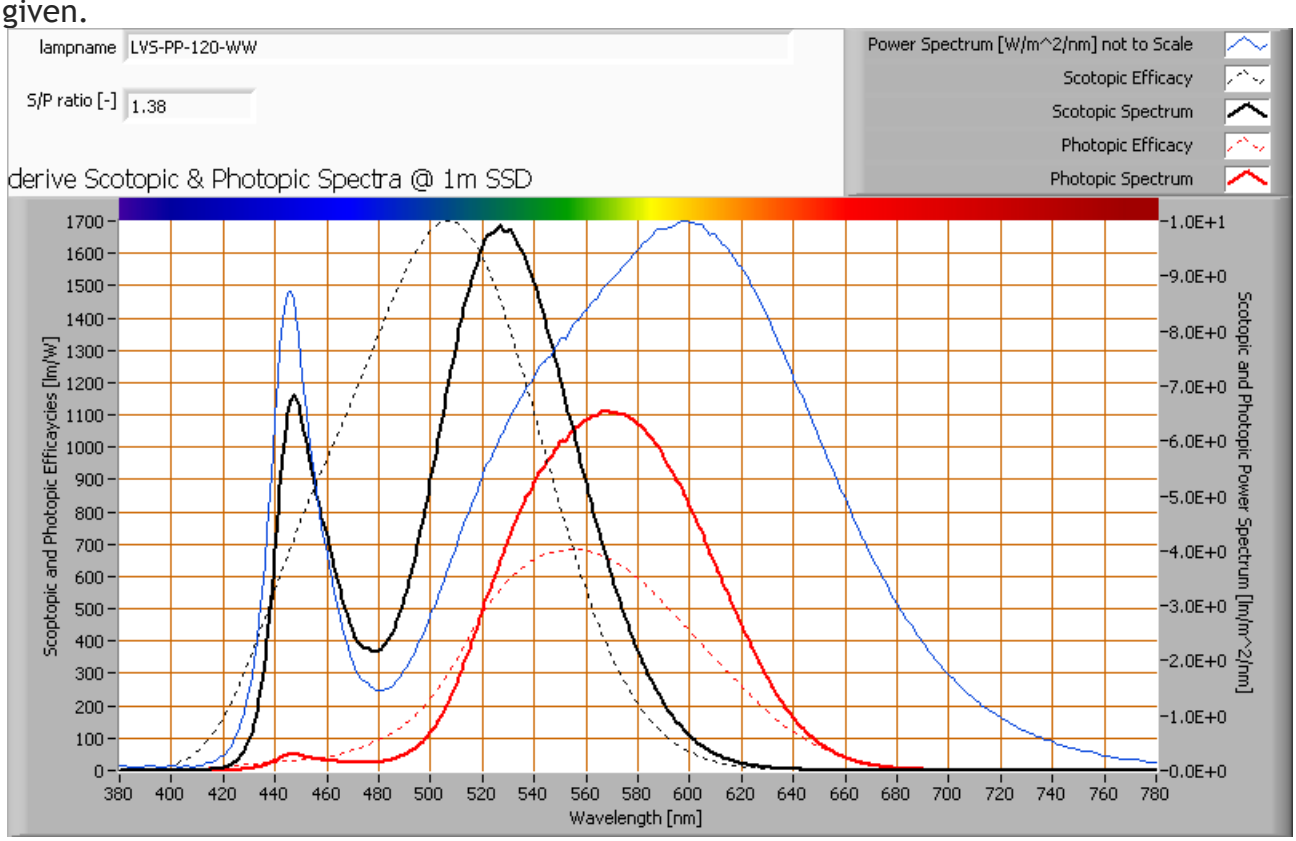
S/P ratio

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 1.4.
More info on S/P ratio can be found on the OliNo website.

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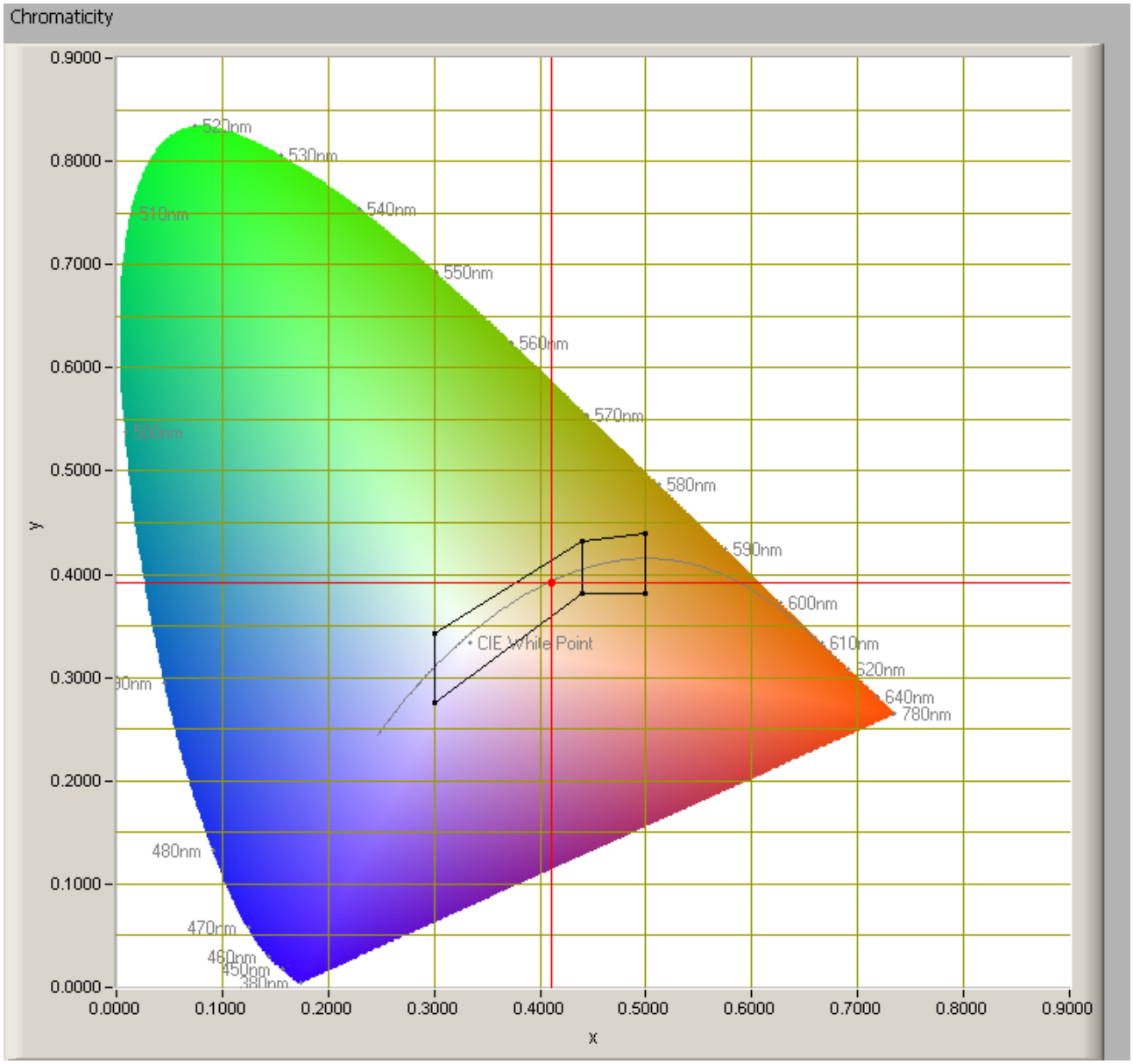
Chromaticity diagram

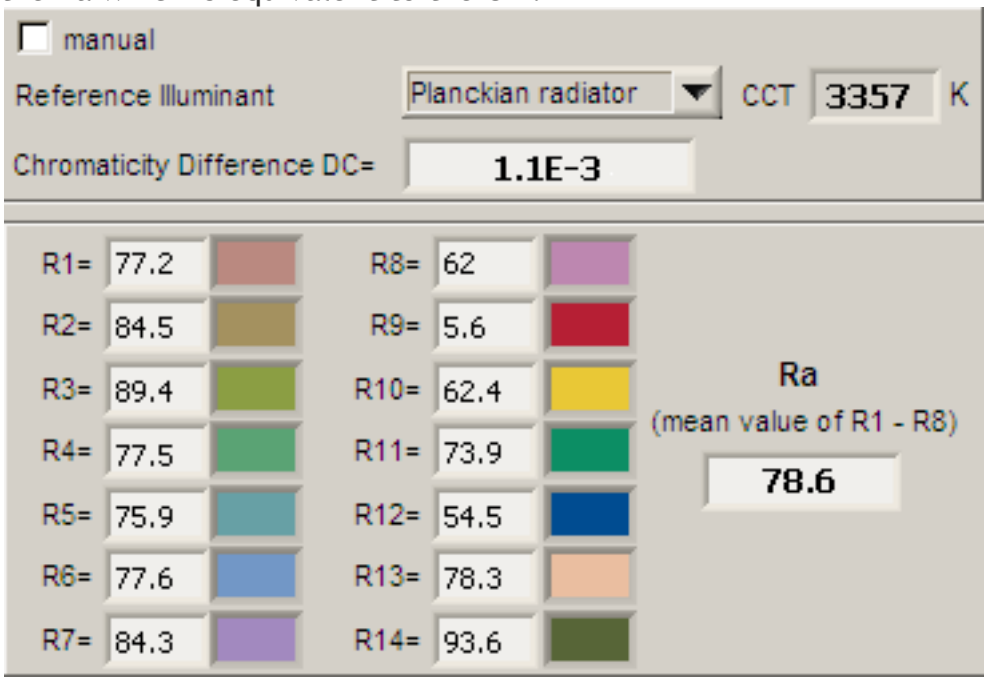


The chromaticity space and the position of the lamp's color coordinates in it.

The light coming from this lamp is inside the area of class A. This is an area defined for signal lamps, see also the OliNo website.
Its coordinates are x=0.4114 and y=0.3913.

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.



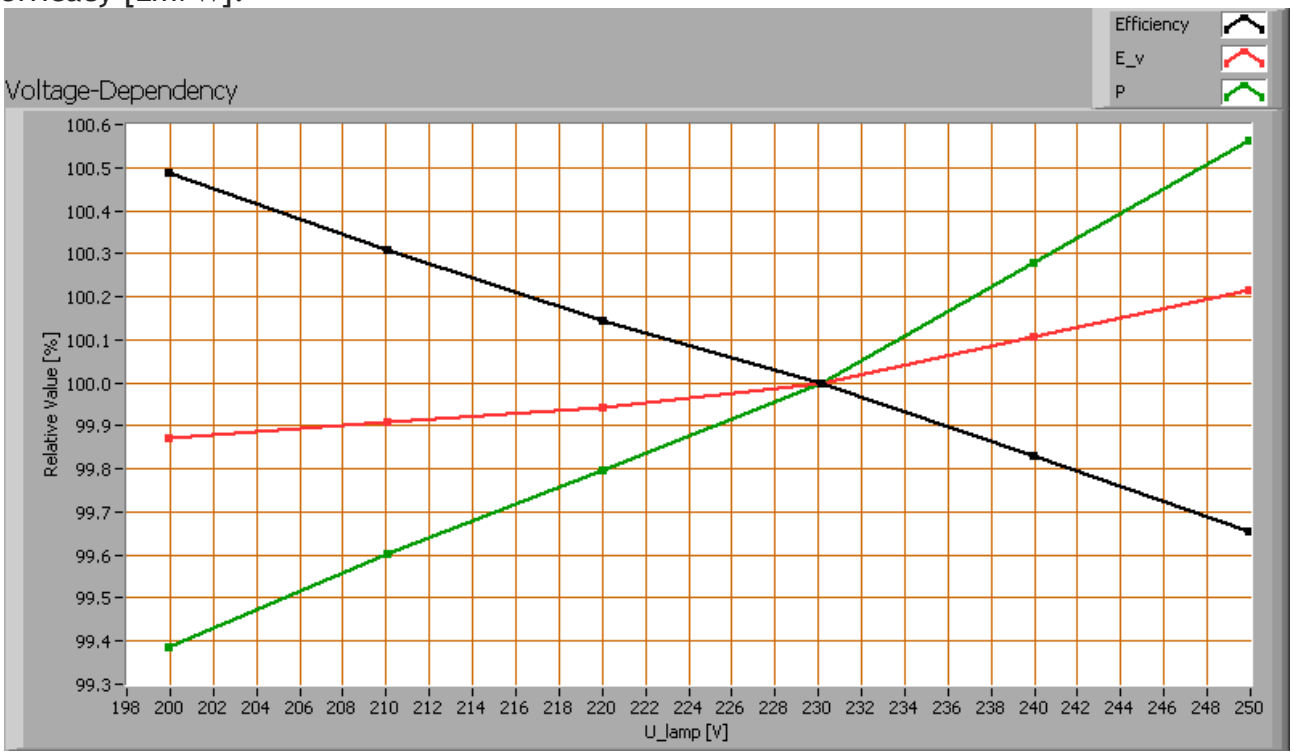
CRI of the light of this lightbulb.

The value of 79 is (minimally) lower than to the value 80 which is considered a minimum value for indoor usage.
Note: the chromaticity difference is 0.0011 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 vary insignificantly 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].

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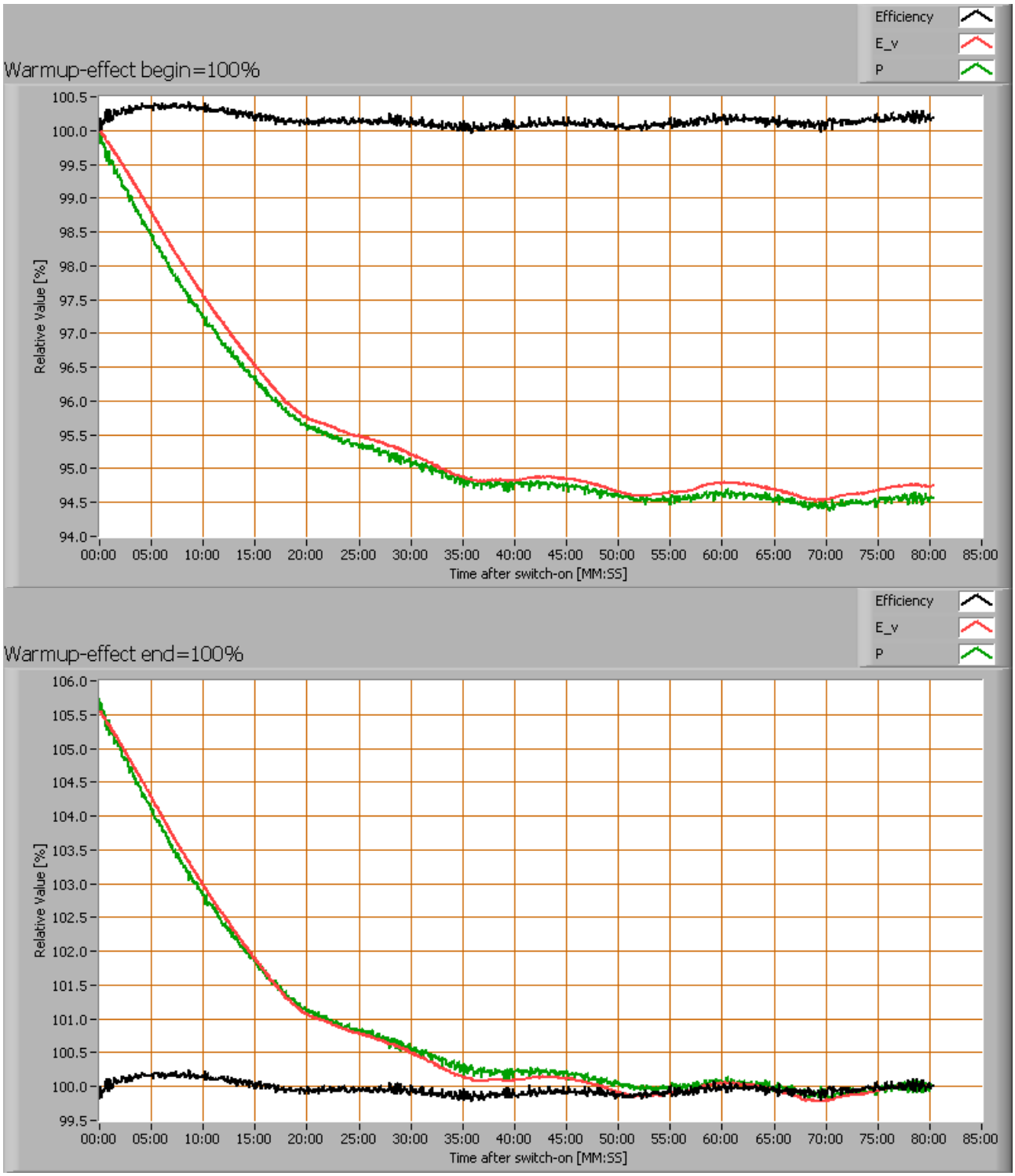
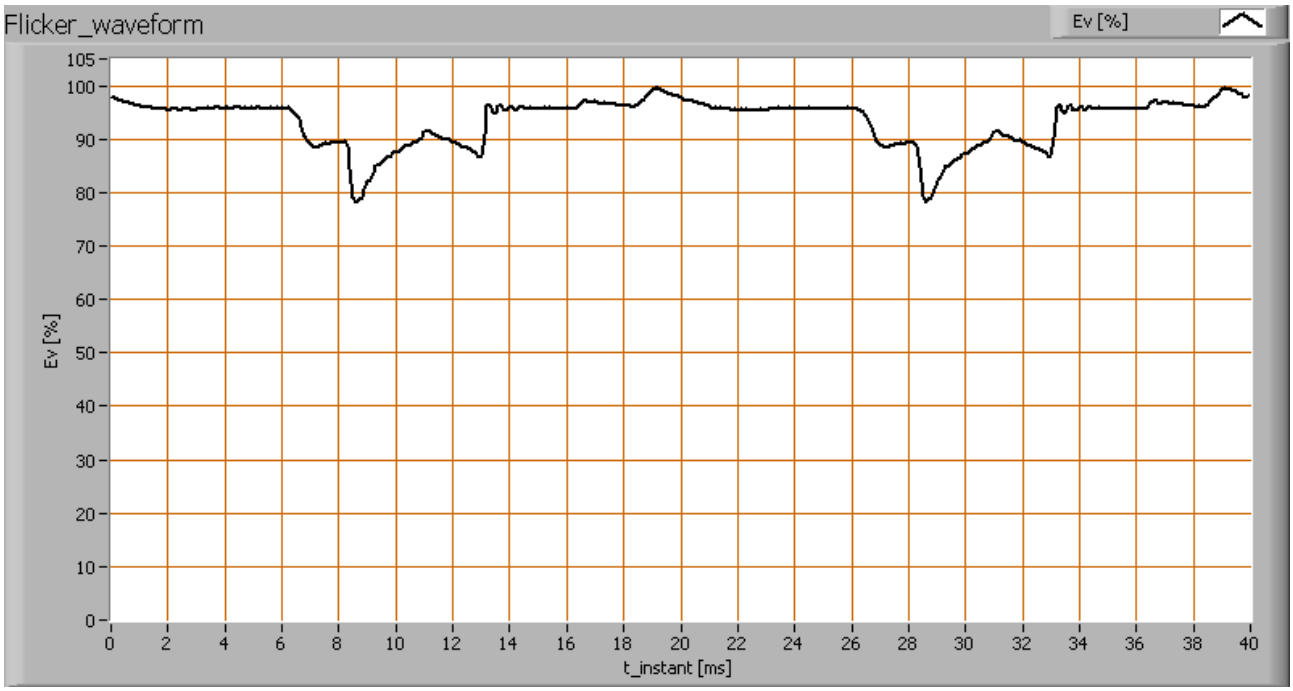


Effect of warming up on different light bulb parameters. At top the 100 % level is put at begin, and at bottom at the end.

The warm up time is about 40 minutes and during that time the illuminance decreases with 5 % and also the consumed power with about 5 %.

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.

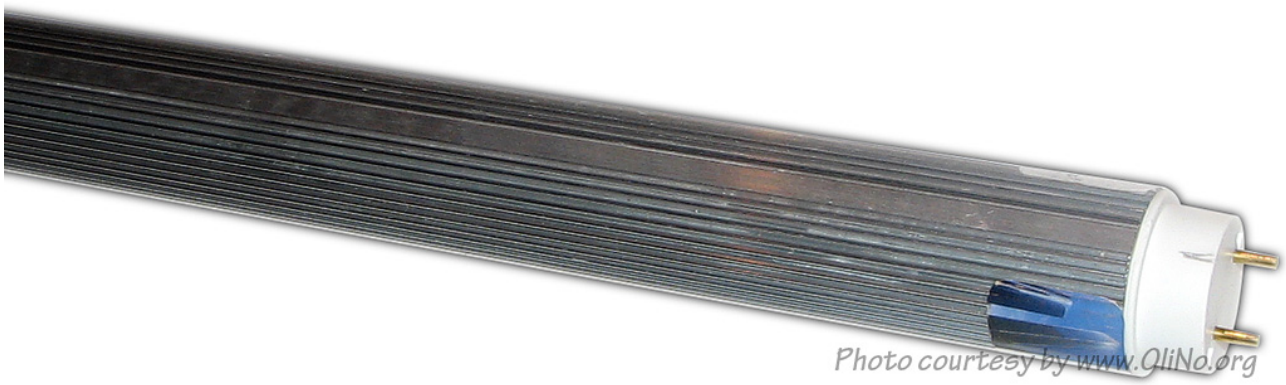


The measure of fast illuminance variation of the light of the light bulb

parameter	value	unit
Flicker frequency	42	Hz
Illuminance modulation index	12	%

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

Additional photo



Back side of the tube, the aluminum heatsink.

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