

**Lamp measurement report – 18 Aug 2010**

1x led tube 150cm in IP65 luminaire

ARM1x1500-IP65-G3-NW

by

Led Light Europe



*Photo courtesy by [www.OLiNo.org](http://www.OLiNo.org)*

## Lamp measurement report – 18 Aug 2010

### Summary measurement data

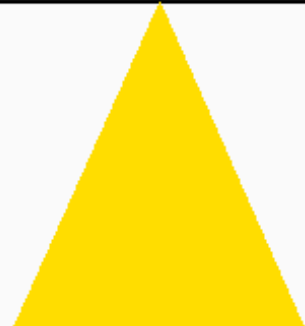
parameter	meas. result	remark
Color temperature	6088 K	Cold white
Luminous intensity $I_v$	397 Cd	Measured straight underneath the lamp
Illuminance modulation index	12 %	Measured straight underneath the lamp. Is a measure for the amount of flickering.
Beam angle	193 deg	193° for the C0-C180 plane (crossing length direction of the tube) and 109° for the C90-C270 plane (length direction).
Power P	29.1 W	
Power Factor	0.96	For every 1 kWh net power consumed, there has been 0.3 kVAhr for reactive power.
THD	16 %	Total Harmonic Distortion
Luminous flux	1684 Lm	
Luminous efficacy	58 Lm/W	
CRI_Ra	74	Color Rendering Index.
Coordinates chromaticity diagram	x=0.3207 and y=0.3266	
Fitting	FL-tube	This Tube Light is connected directly to the grid voltage of 230 V AC.
PAR-value	3.4 $\mu\text{Mol/s/m}^2$	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	0.5 $\mu\text{Mol/s/W}_e$	The total emitted number of photons by this light, divided by its consumption in W. It indicates a kind of efficacy in generating photons.

## Lamp measurement report – 18 Aug 2010

S/P ratio	1.9	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	1575 x 85 x 95 mm	External dimensions of the luminaire.
L x W x H luminous area	1560 x 75 x 40 mm	Dimensions of the luminous area (used in Eulumdat file). This is equal to the dimensions of the prismatic cover behind which the led tube emits light.
General remarks		<p>The ambient temperature during the whole set of measurements was 26.5-27 deg C. The hottest temperature of the luminaire, there where the powersupply is seated, gets about 13 degrees hotter than ambient.</p> <p>Warm up effect: during the warm up time the illuminance decreases with 6 %.</p> <p>Voltage dependency: the power consumption and illuminance do not depend significantly when the voltage is varied from 200 - 250 V.</p>

## Lamp measurement report – 18 Aug 2010

### Overview table

m.	Ø 50%		C0-180: 193° C90-270: 109° 	E (lux)	Luminaire Efficacy
	C0-180	C90-270			58 (lumens per Watt)
0.25	-4.24	0.71		6350	Half-peak diam C0-180
0.5	-8.48	1.41		1588	-16.96 x diameter(m)
1	-16.96	2.83		397	Half-peak diam C90-270
1.5	-25.45	4.24		176	2.83 x diameter(m)
3	-50.89	8.49		44	Illuminance
4	-67.86	11.31		25	397 / distance <sup>2</sup> (lux)
5	-84.82	14.14		16	Total Output
					1684 (lumens)

The overview table is explained on the OLiNo website.

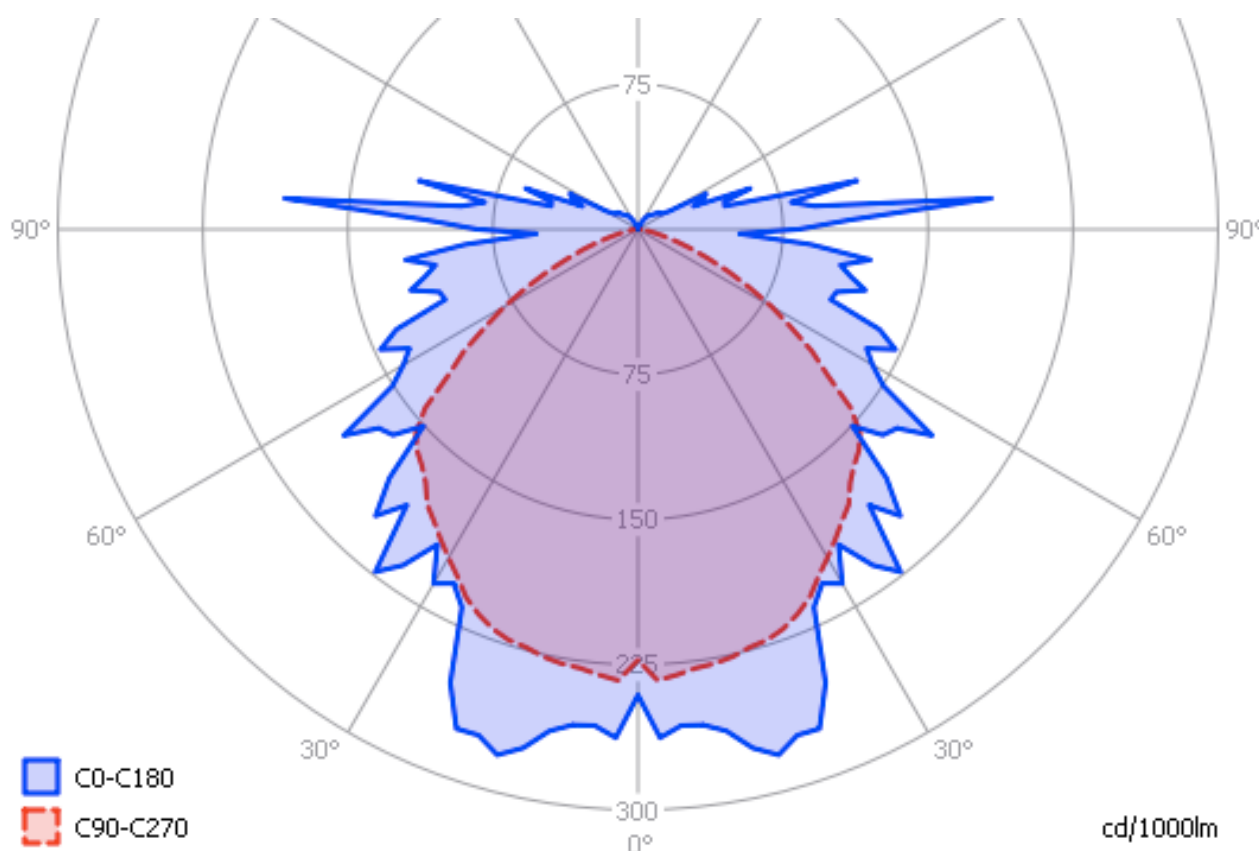
Please note that this overview table makes use of calculations, use this data with care as explained on the OLiNo site. E (lux) values are not accurate, when within 5 x 1560 mm ≈ 7800 mm. Within this distance from the lamp, the measured lux values will be less than the computed values in this overview as the measurements are then within the near field of the lamp.

Note II: the 50 % level for the C0-C180 plane is not valid, as the beamangle > 180 degrees. So do not consider the negative values in the table.

### 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.

## Lamp measurement report – 18 Aug 2010



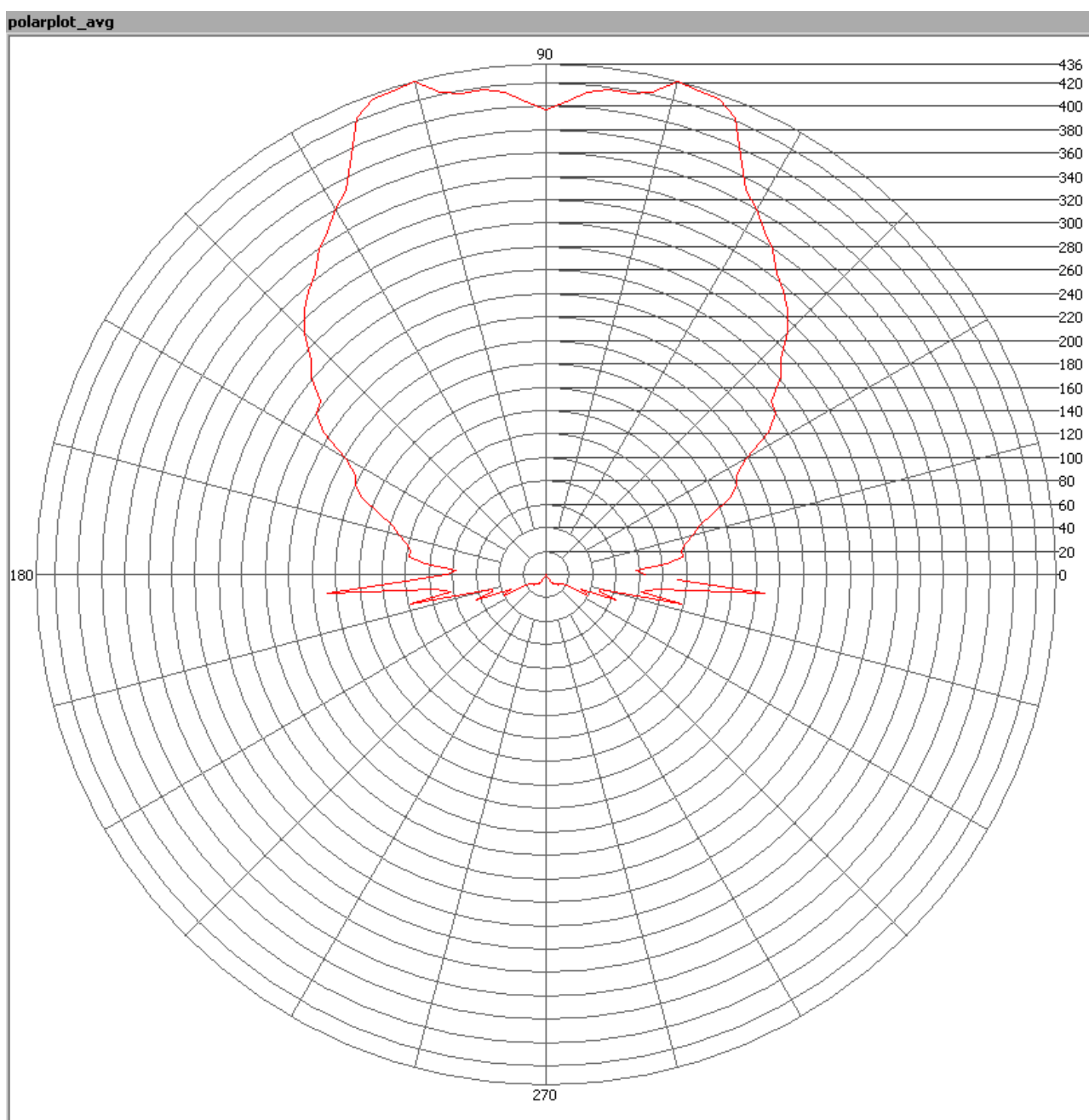
*The light diagram giving the radiation pattern.*

It indicates the luminous intensity around the light bulb. The direction or plane C0-C180 cuts the lamp in the direction crossing the length direction of the tube, and the C90-C270 plane cuts the lamp in the length direction.

### Illuminance $E_v$ at 1 m distance, or luminous intensity $I_v$

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

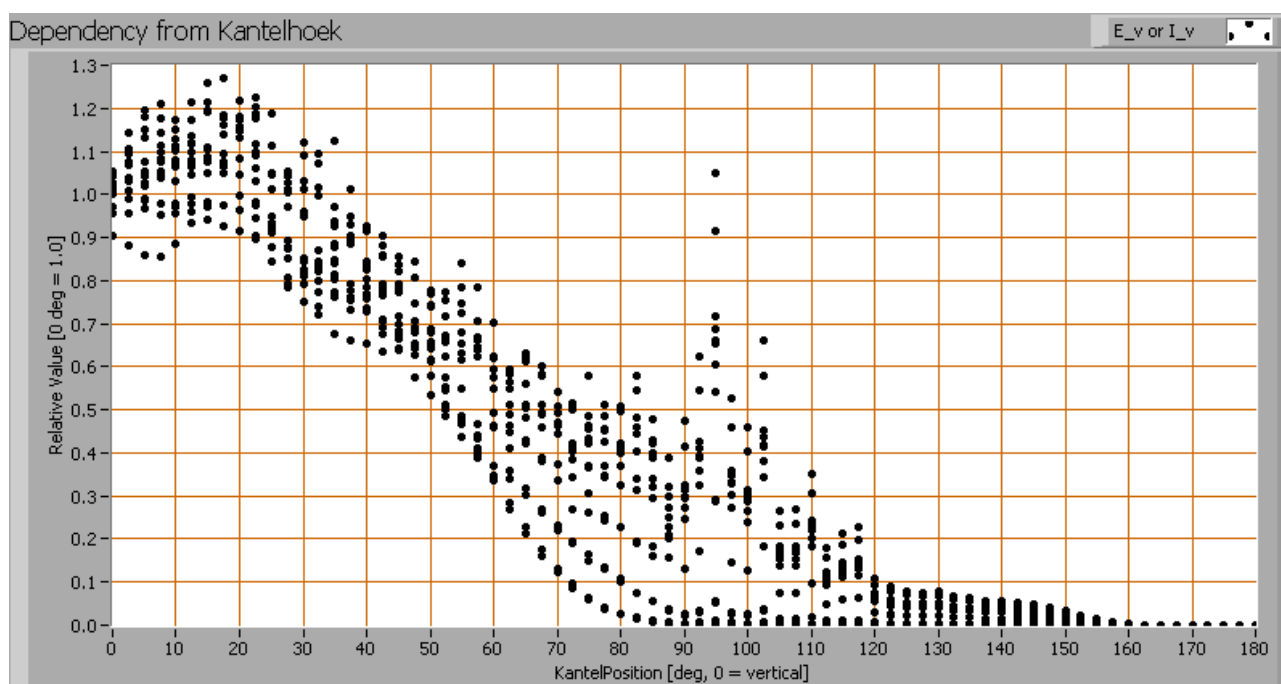
## Lamp measurement report – 18 Aug 2010



*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.

## Lamp measurement report – 18 Aug 2010



*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 193° in the C0-C180 plane and 109° in 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 1684 Lm.

### Luminous efficacy

The luminous flux being 1684 Lm, and the power of the light bulb being 29.1 W, yields a luminous efficacy of 58 Lm/W.



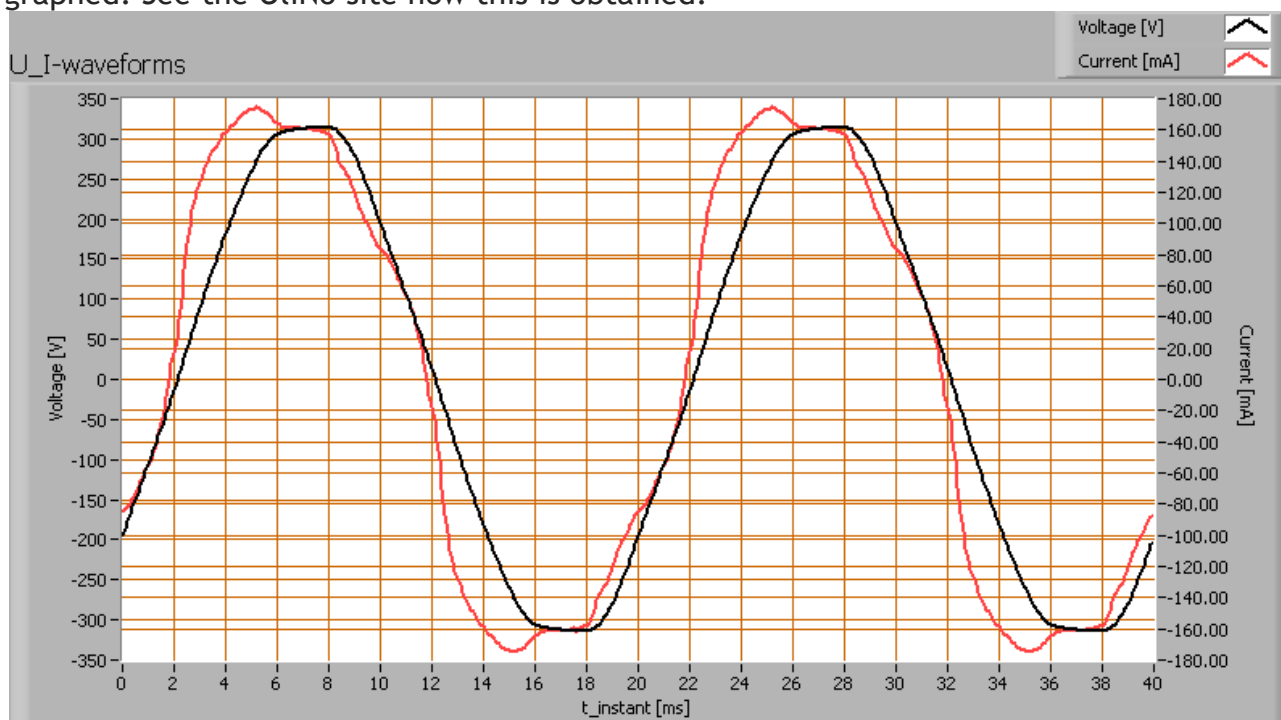
## Lamp measurement report – 18 Aug 2010

### Electrical properties

A power factor of 0.96 means that for every 1 kWh net power consumed, a reactive component of 0.3 kVAr was needed.

Lamp voltage	230 VAC
Lamp current	132 mA
Power P	29.1 W
Apparent power S	30.3 VA
Power factor	0.96

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

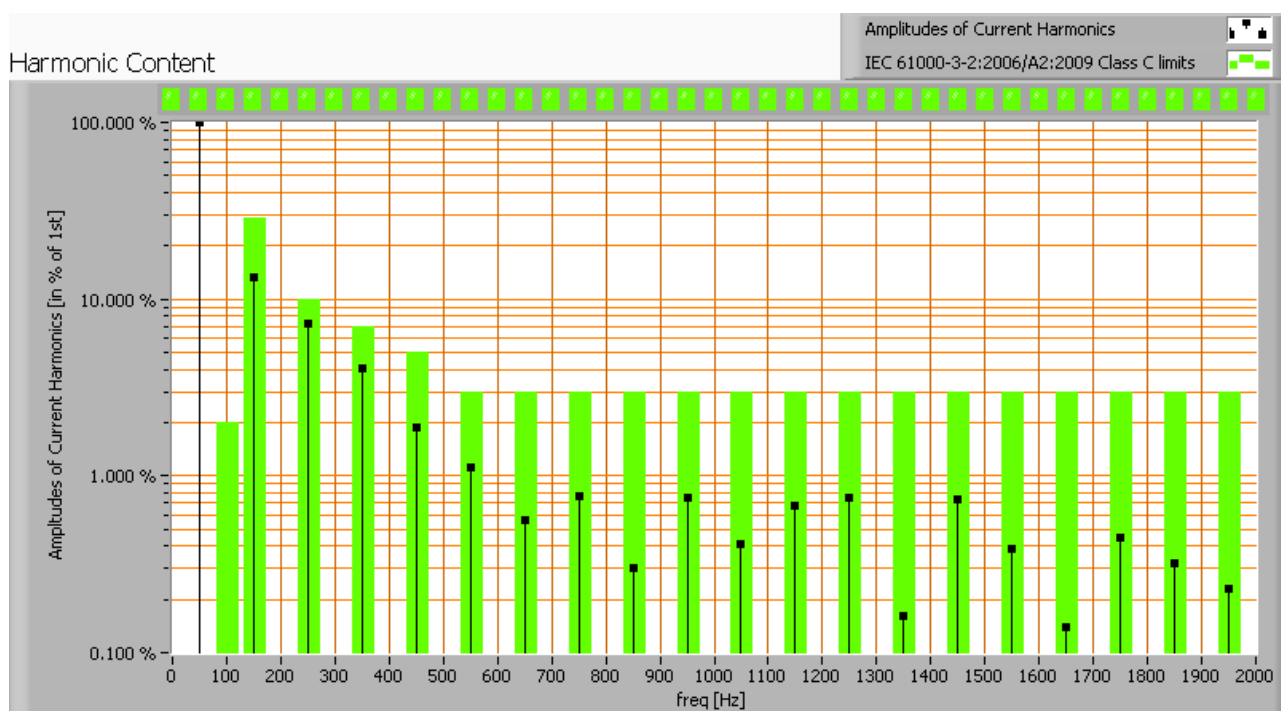


*Voltage across and current through the lightbulb*

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.



## Lamp measurement report – 18 Aug 2010

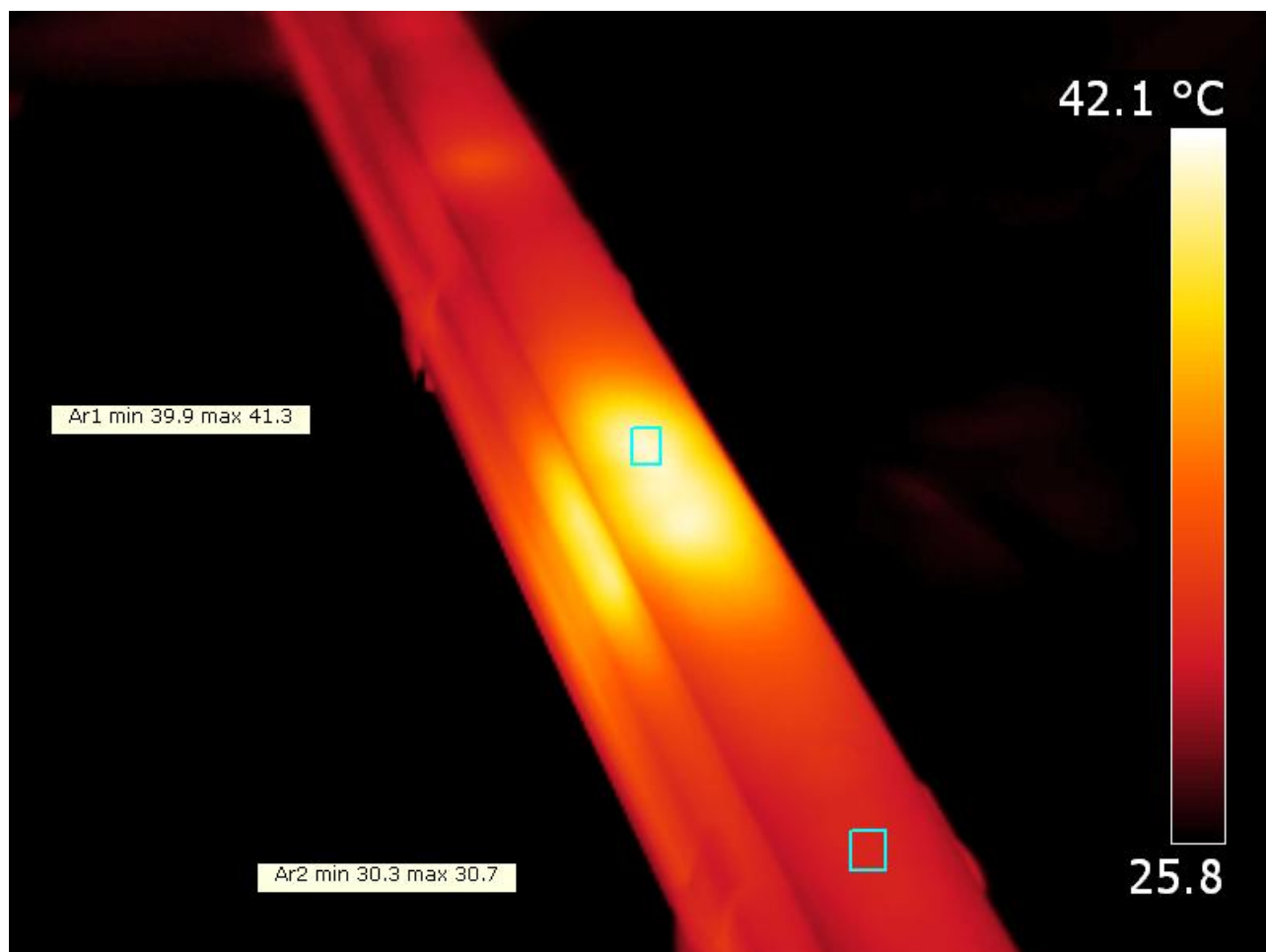


*Harmonics in the current waveform and checked against IEC61000-3-2:2006*

There are limits for the harmonics for lighting equipment > 25 W which are fulfilled.  
The Total Harmonic Distortion of the current is computed as 16 %.

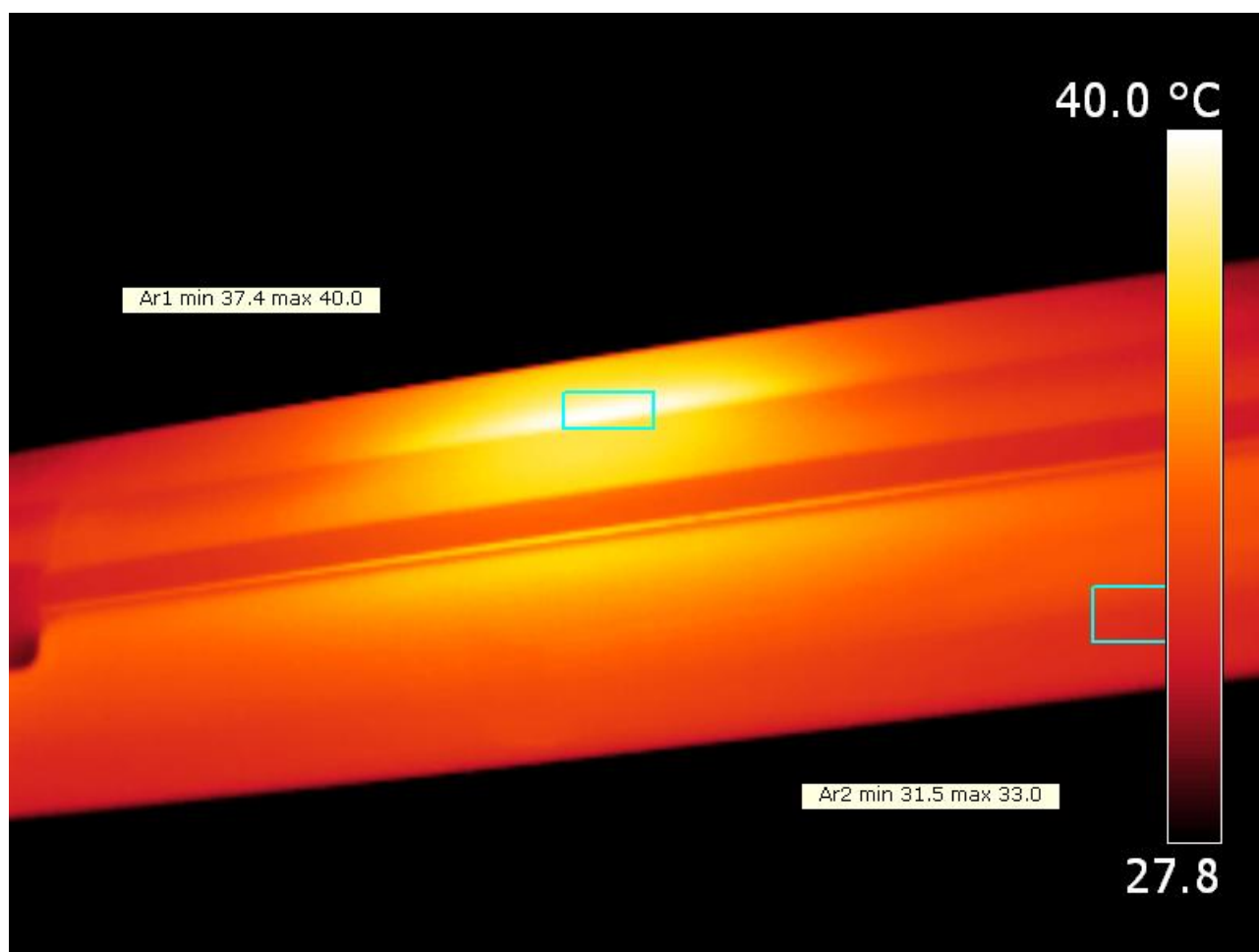
## Lamp measurement report – 18 Aug 2010

### Temperature measurements lamp



*The place of the power supplies is well visible*

## Lamp measurement report – 18 Aug 2010



*Seen from the side of the armature.*

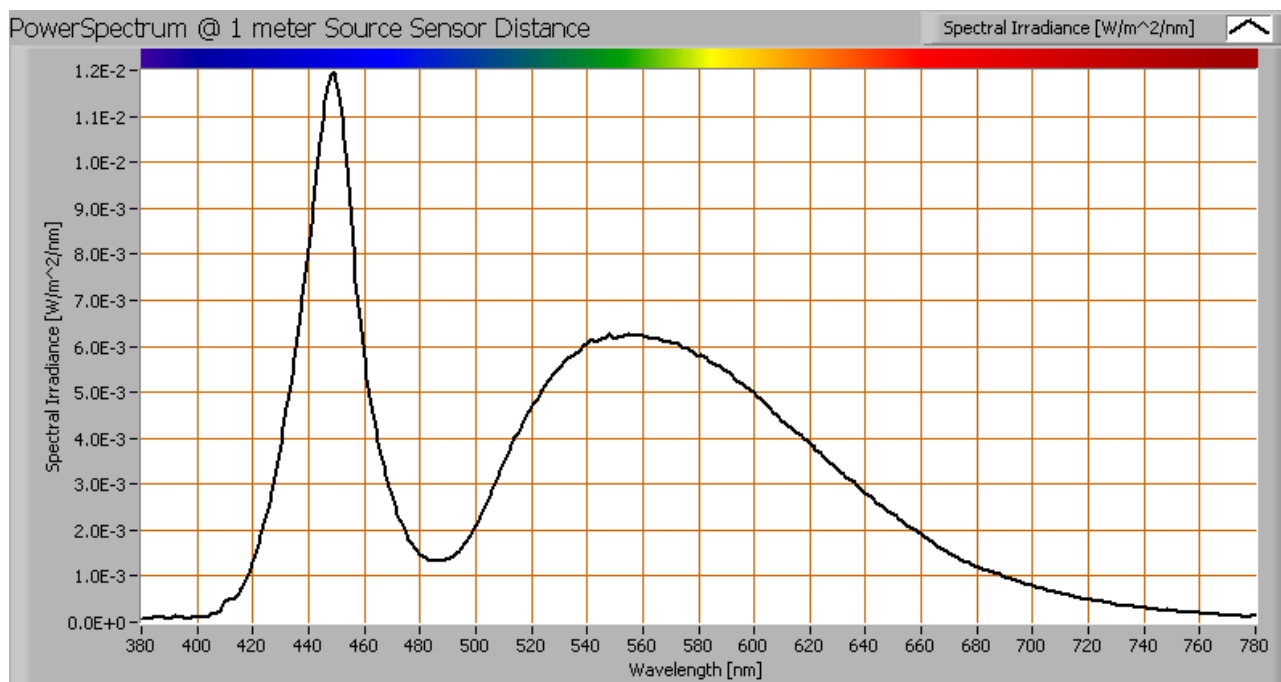
For the temperature measurement a piece of masking tape was not needed as the outer surface of the armature had a high emissivity.

status lamp	> 2 hours on
ambient temperature	27 deg C
reflected background temperature	27 deg C
camera	Flir T335
emissivity	0.95 <sup>(1)</sup>
measurement distance	0.5 m
IFOV <sub>geometric</sub>	0.7 mm
NETD (thermal sensitivity)	50 mK

<sup>(1)</sup> The outside of the luminaire has a high emissivity.

## Lamp measurement report – 18 Aug 2010

### Color temperature and Spectral power distribution

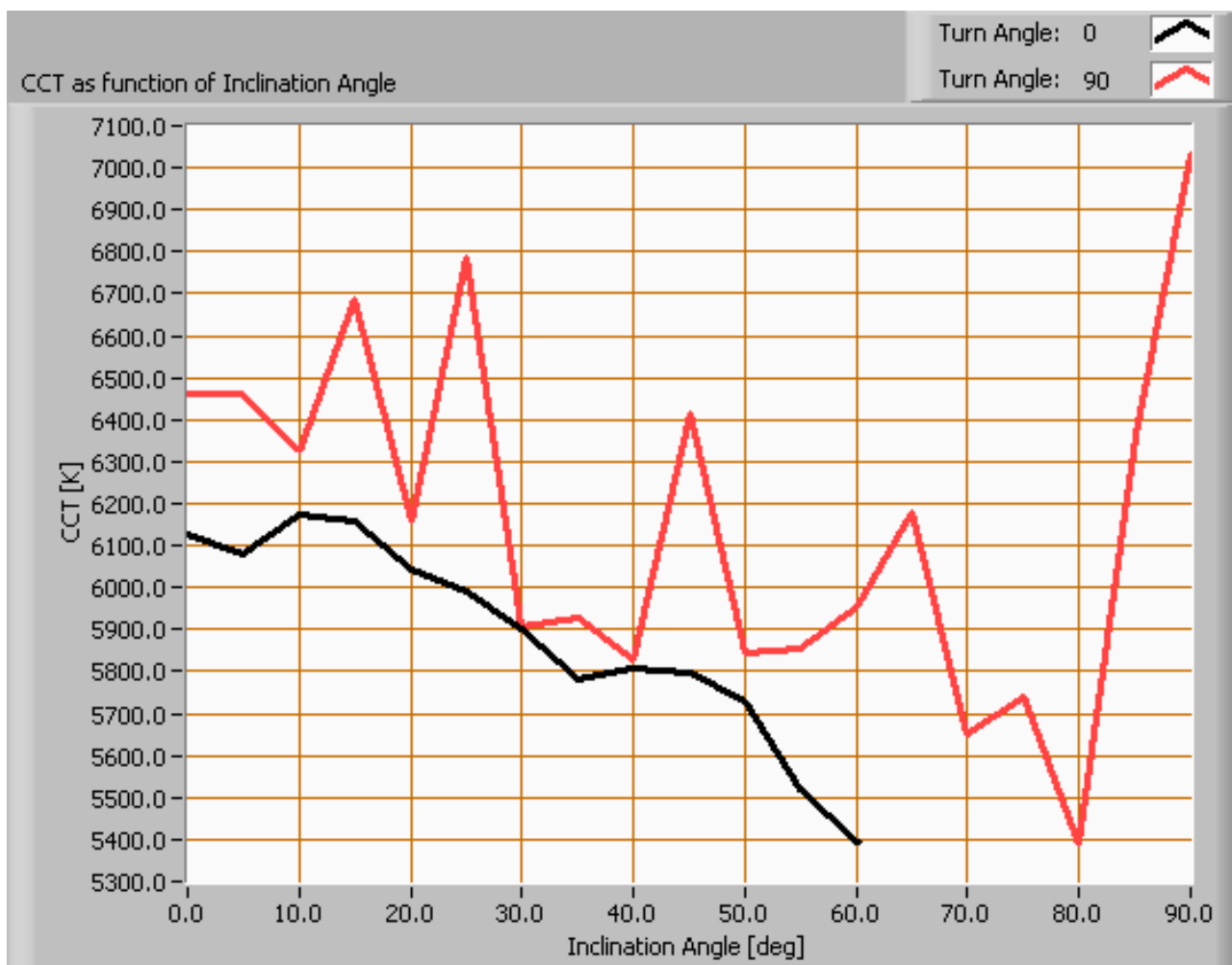


*The spectral power distribution of this light bulb, energies on y-axis valid at 1 m distance.*

The measured color temperature is about 6100 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 – 18 Aug 2010



*Color temperature as a function of inclination angle.*

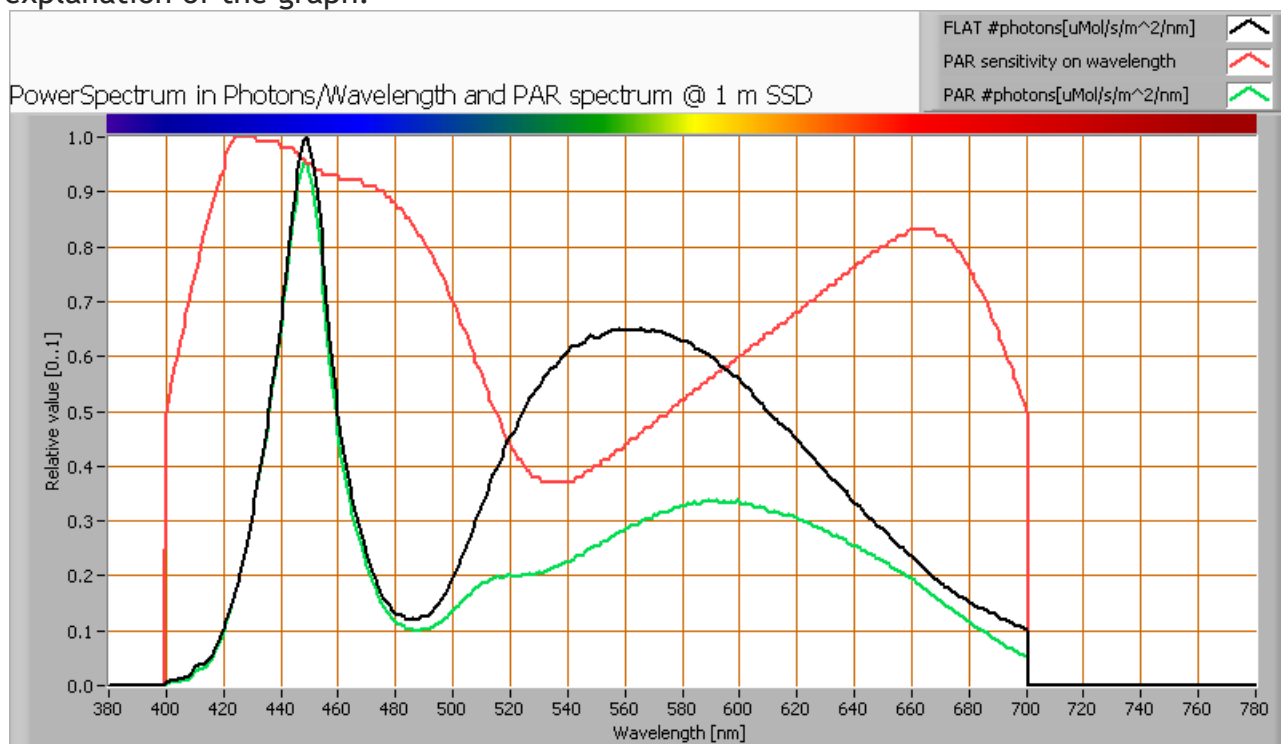
The measurement of CCT is measured for inclination angles up to 60° (for the C90-C270 plane) as beyond that angle the illuminance values are very low (< 5 lux). The C0-C180 plane has been measured up to 90° inclination angle

The beam angle is maximally 193°, meaning a 96.5° inclination angle. In this area most of the light is present. The variation in correlated color temperature in the first 90° is ≈ 17 %.

## Lamp measurement report – 18 Aug 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*

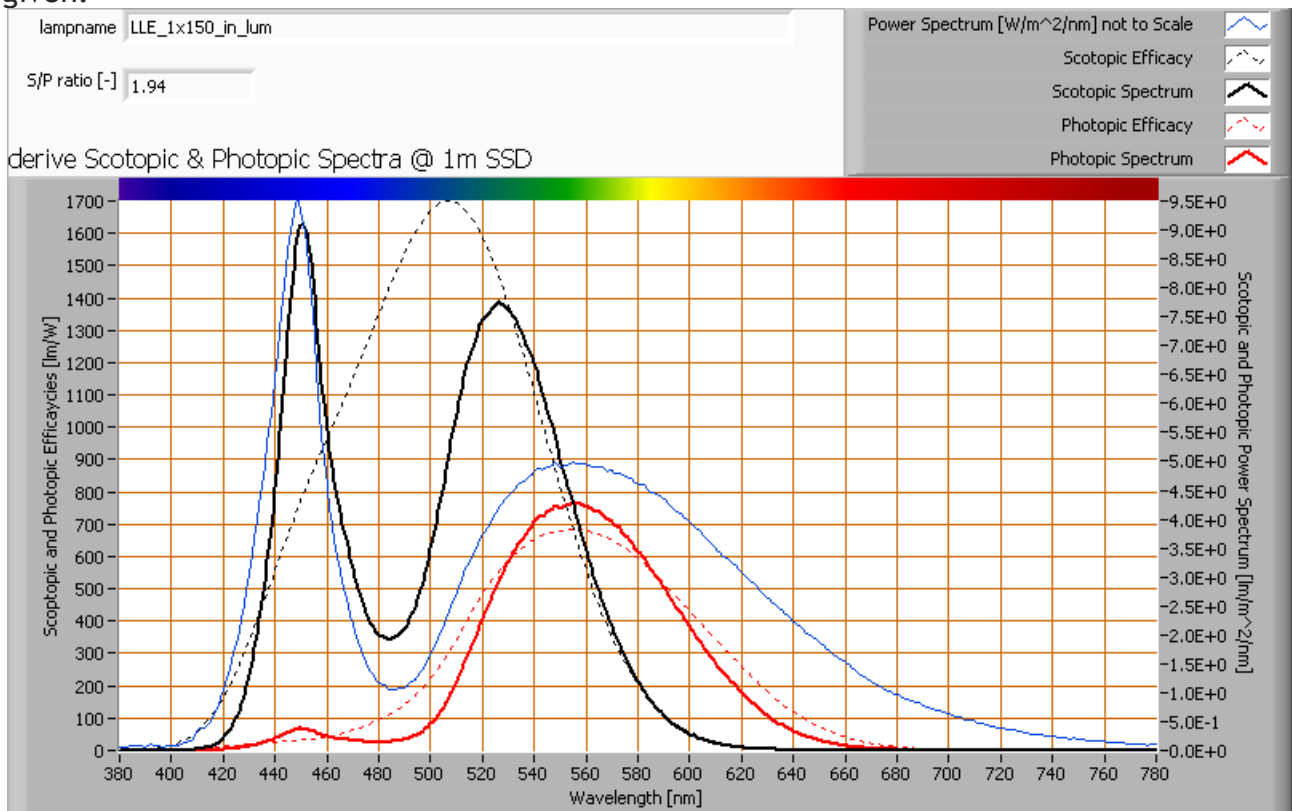
parameter	value	unit
PAR-number	3.4	μMol/s/m <sup>2</sup>
PAR-photon current	14.6	μMol/s
PAR-photon efficacy	0.5	μMol/s/W

The PAR efficiency is 66 % (valid for the PAR wave length range of 400 - 700 nm). So maximally 66 % 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 %).

## Lamp measurement report – 18 Aug 2010

### 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).*

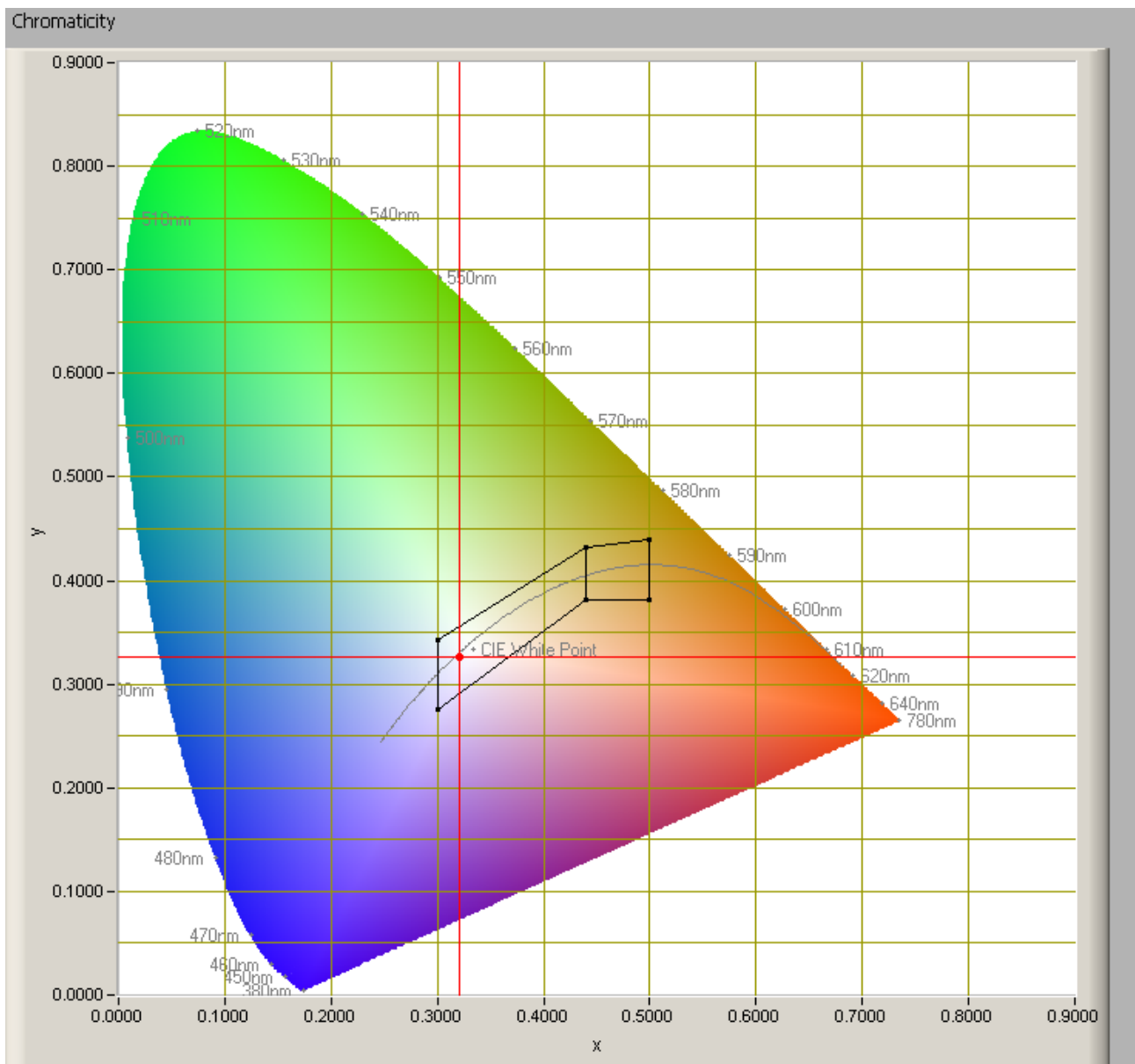
The S/P ratio is 1.9.

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



## Lamp measurement report – 18 Aug 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  $x=0.3207$  and  $y=0.3266$ .

## Lamp measurement report – 18 Aug 2010















### 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  $R_x$ , and the first 8 indexes ( $R_1 \dots R_8$ ) are averaged to compute the  $R_a$  which is equivalent to the CRI.

☐ manual

Reference Illuminant: Planckian radiator CCT: 6088 K

Chromaticity Difference DC= 5.1E-3

R1= 73.7		R8= 66.1	
R2= 76.7		R9= -8	
R3= 75.5		R10= 41.5	
R4= 75.6		R11= 72.7	
R5= 73.9		R12= 44	
R6= 66.9		R13= 73.3	
R7= 81.1		R14= 85.8	

**Ra**  
 (mean value of  $R_1 - R_8$ )  
**73.7**

*CRI of the light of this lightbulb.*

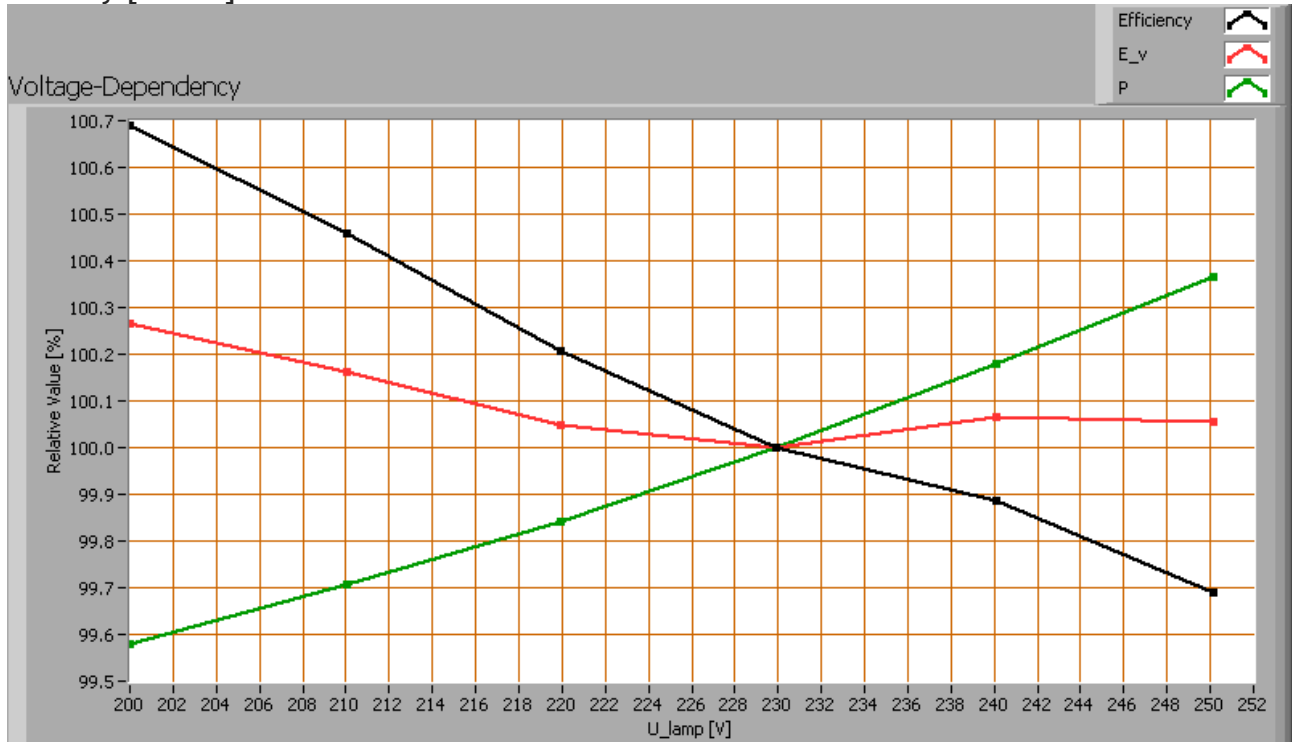
The value of 74 is lower than 80 which is considered a minimum value for indoor usage. Note: the chromaticity difference is 0.0051 indicates the distance to the Planckian Locus. There is no norm yet that states what the max deviation from white light is allowed to be. A reference with signal lights as 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 lamp power  $P$  [W] and the luminous

## Lamp measurement report – 18 Aug 2010

efficacy [lm/W].



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

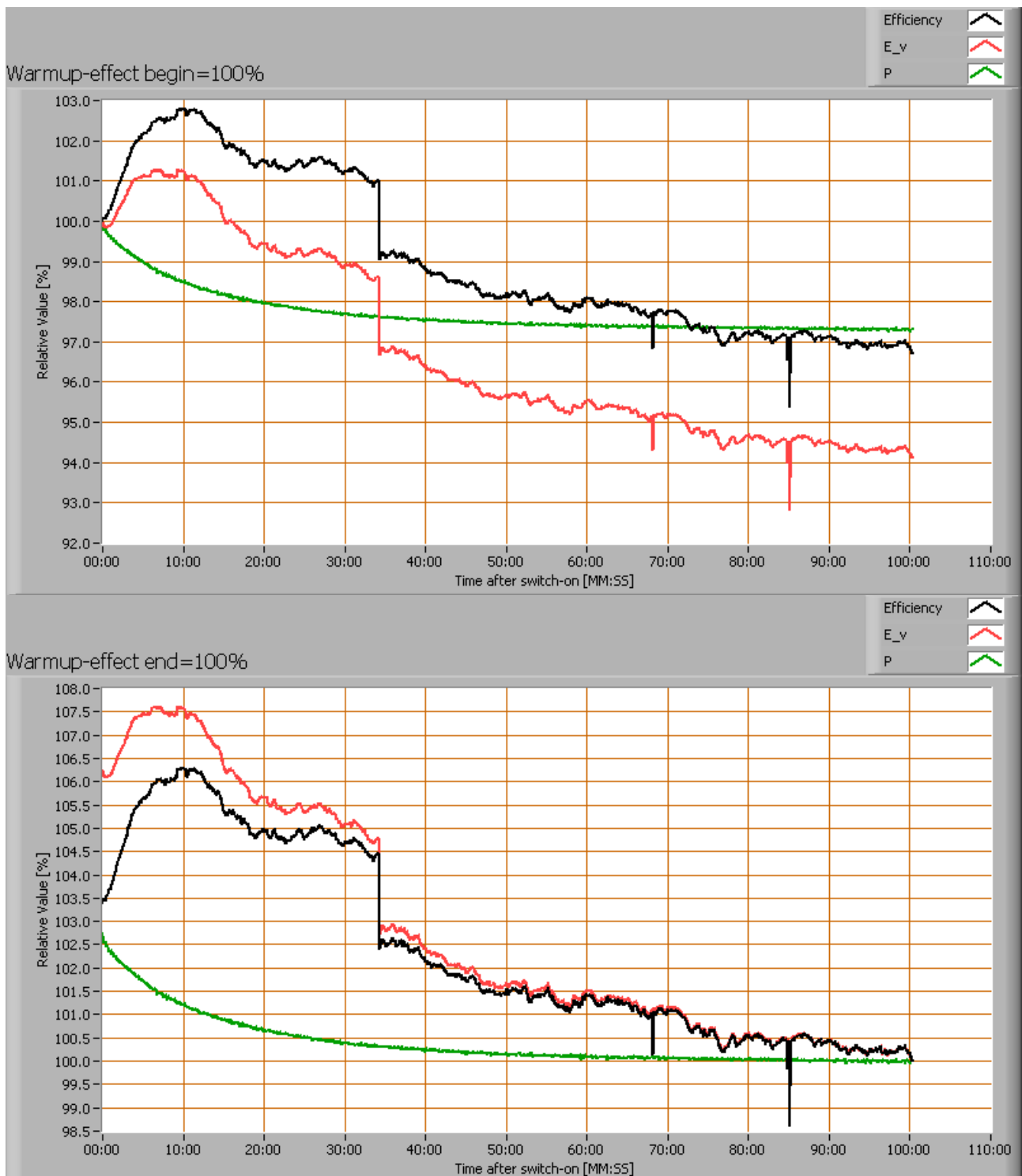
The illuminance and consumed power do not vary significantly when the voltage is varied.

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<sub>v</sub> [lx], the lamp power P [W] and the luminous efficacy [lm/W].

## Lamp measurement report – 18 Aug 2010



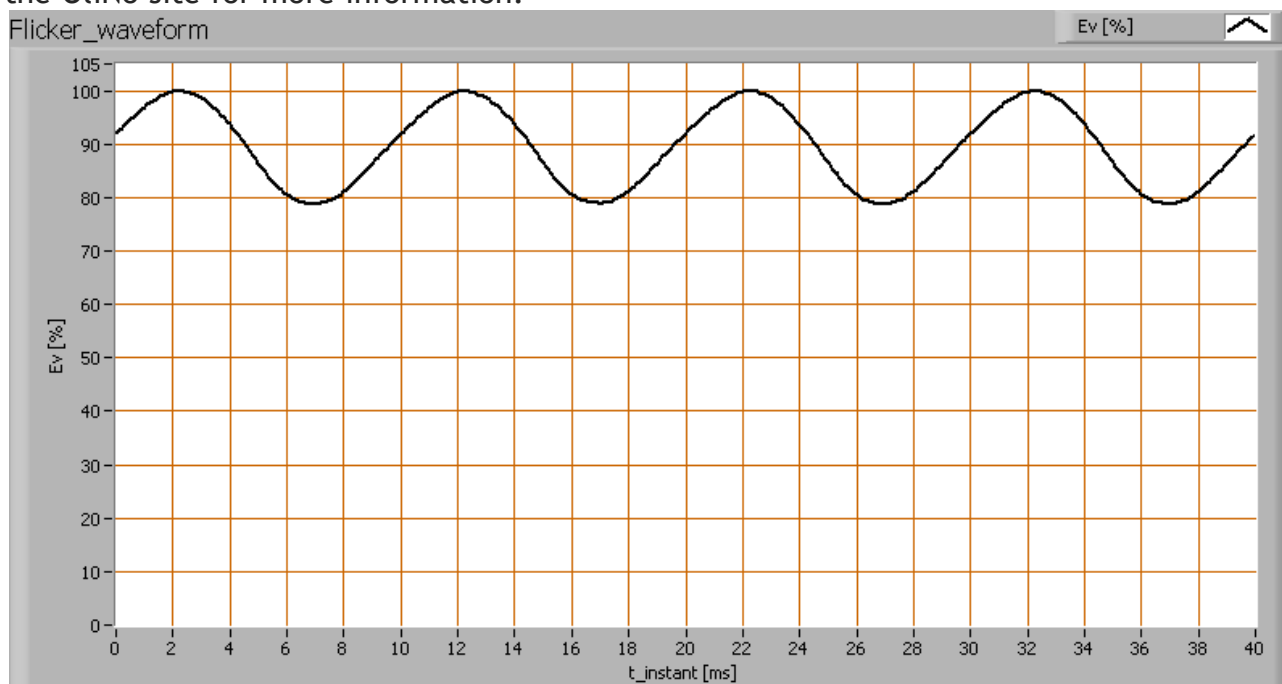
Effect of warming up on different light bulb parameters. At top the 100 % level is put at begin, and at bottom at the end.

## Lamp measurement report – 18 Aug 2010

The warm up time is about one hour. During that time the the illuminance decreases with 6 %.

### 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	waarde	eenheid
Flicker frequency	100.0	Hz
Illuminance modulation index	12	%

The illuminance modulation index is computed as:  $(\max\_Ev - \min\_Ev) / (\max\_Ev + \min\_Ev)$ .

### Disclaimer

The information in this OliNo report is created with the utmost care. Despite this, the information could contain inaccuracies. OliNo cannot be held liable in this instance nor can the data in this



## **Lamp measurement report – 18 Aug 2010**

report be legally binding.

### **License**

It is permitted ONLY to use or publish this report in its entirety and in unaltered form via internet or other digital or written media in any form. To guarantee the reliability and accuracy of the report, it is strictly probited to change or alter parts of the report and/or republish it in a modified content.