

**Lamp measurement report – 8 June 2009 for Line Lite
International BV**

Line Lite International BV Led TL 60 cm WW

Photo courtesy by www.OliNo.org



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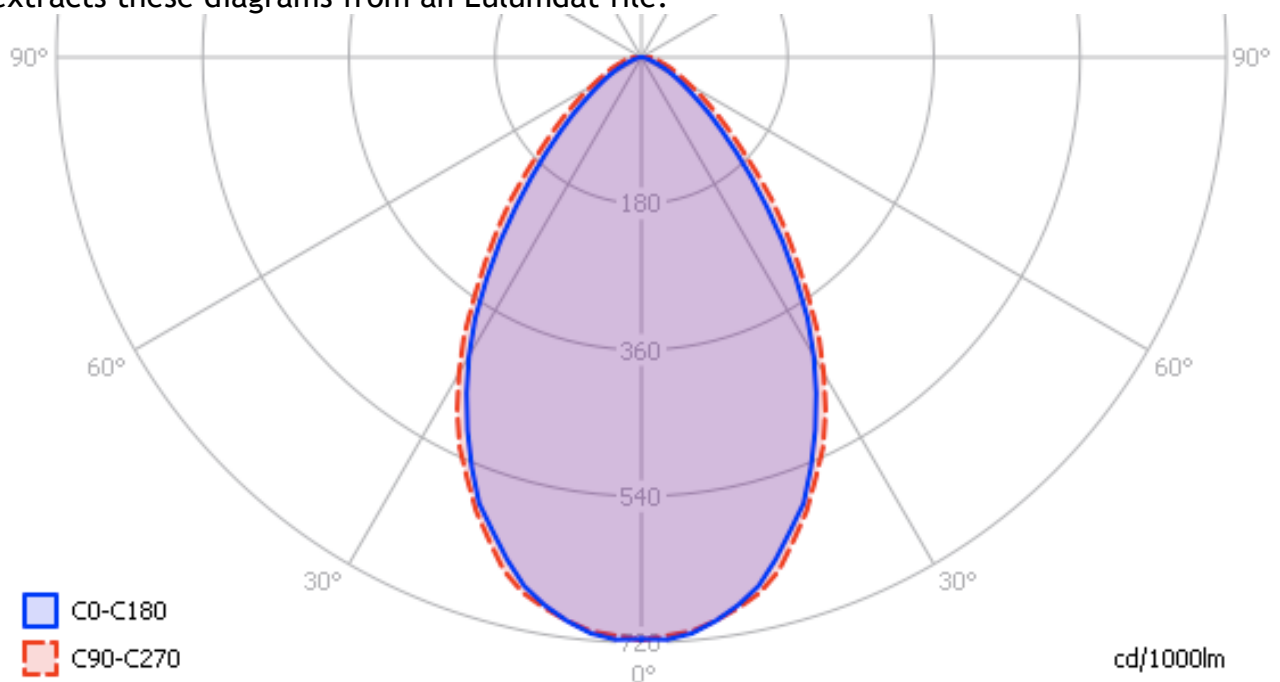
Summary measurement data

parameter	meas. result	remark
Color temperature	3232 K	Close to warm white
Luminous intensity I_v	393 Cd	
Beam angle	69 deg	
Power P	8.4 W	
Power Factor	0.63	For every 1 kWh net power consumed, there has been 1.2 kVAhr for reactive power..
Luminous flux	548 lm	
Luminous efficacy	65 lm/W	
CRI_Ra	70	Color Rendering Index.
Coordinates chromaticity diagram	x=0.4154 and y=0.3860	
Fitting	FL-tube	Direct connection to the mains voltage.
D x L external dimensions	33 x 590 mm	External dimensions of the light bulb.
W x L luminous area	22 x 482 mm	Dimensions of the luminous area (used in Eulumdat file). This is equal to the surface of the area on which the leds are mounted.
General remarks		<p>The ambient temperature during the whole set of measurements was 22.5-23 deg C.</p> <p>Warm up effect: during the warm up time the illuminance dropped with 10 %.</p> <p>Voltage dependency: the power consumption nor illuminance are not significantly dependent on variation of the input voltage.</p> <p>An additional close up photo can be found at the end of this article.</p>

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Eulumdat light diagram

An interesting graph is the light diagram, indicating the intensity in the C0-C180 and the C90-C270 plane. 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 C0-C180 plane goes along the length of the tube. The C90-C270 perpendicular to that.

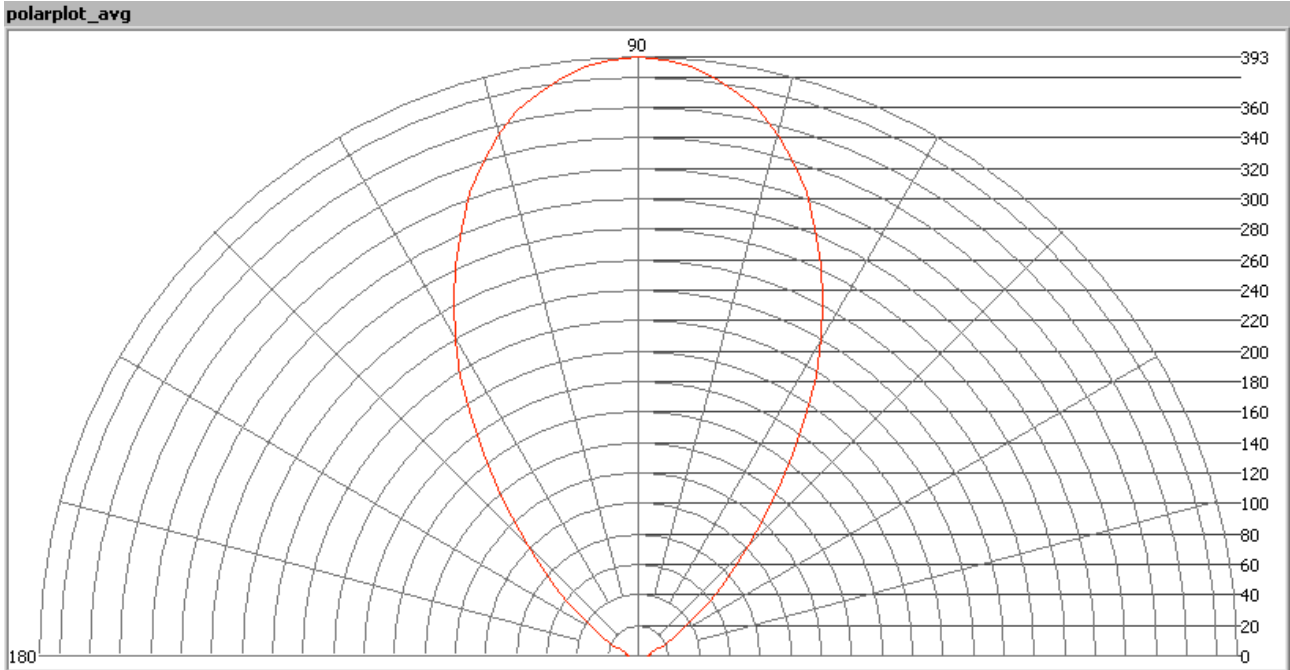
The light diagram indicates the luminous intensity around the light bulb. There is no significant difference between the two planes.

The unit is Cd/1000lm, meaning the intensity in Cd assuming there would be 1000 lumen in the measured light bulb. This enables comparing different types of light bulbs.

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.

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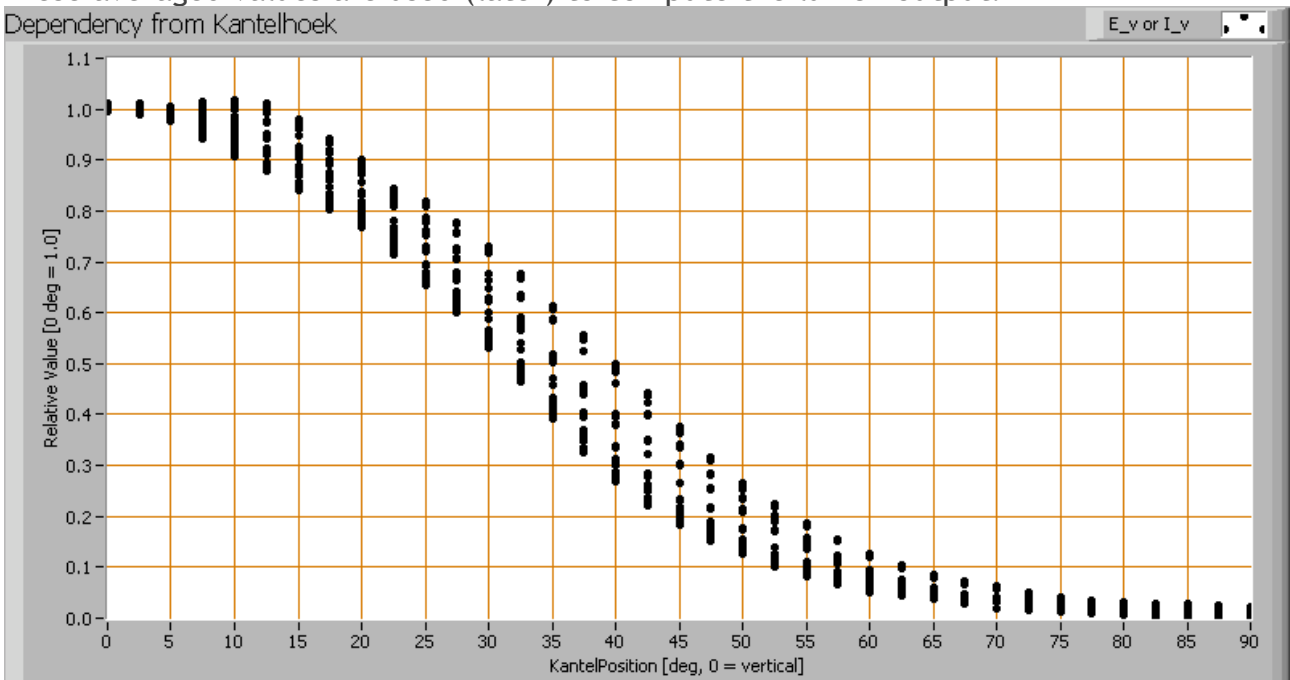


The radiation pattern of the light bulb.

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.

Dependency from Kantelhoek



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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 are small 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 69 degrees. This is the average value for all C-planes on average. There is almost no difference between the C-planes so this beam angle is accurate for most C-planes.

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 548 lm.

Luminous efficacy

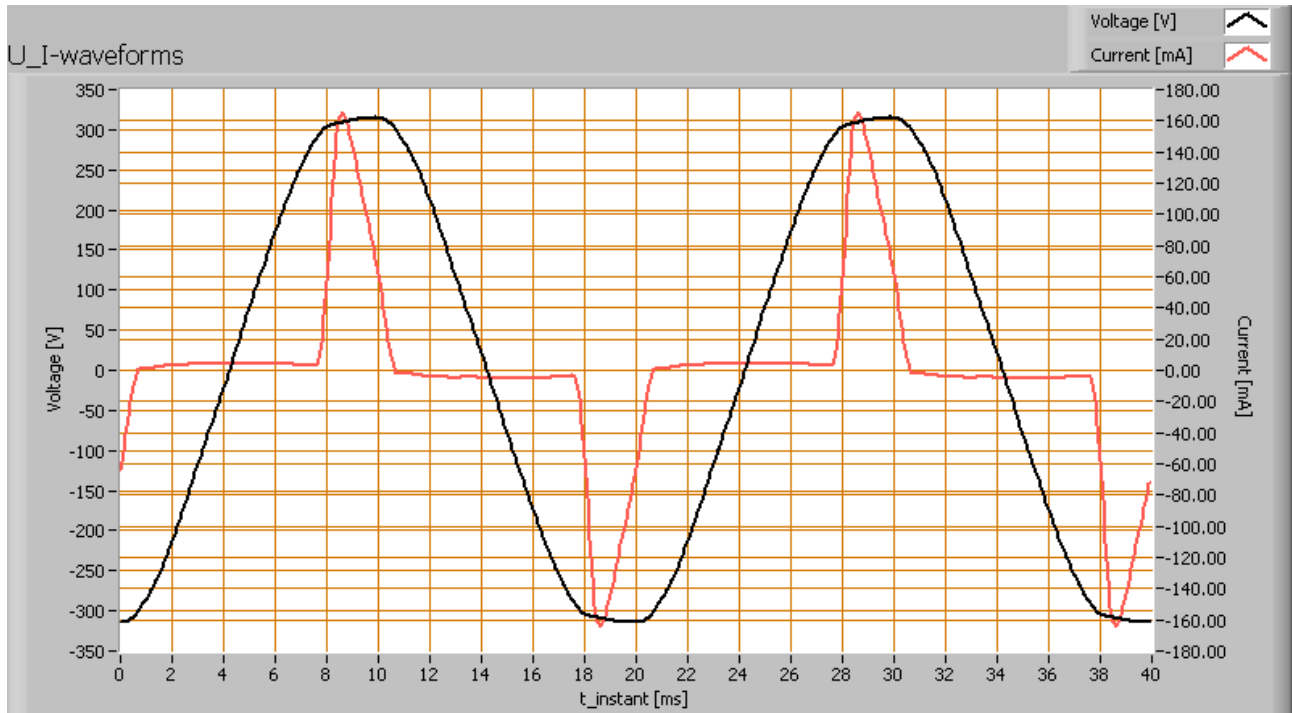
The luminous flux being 548, and the power of the light bulb 8.4 W, yields a luminous efficacy of 65 lm/W.

A power factor of 0.63 means that for every 1 kWh net power consumed, a reactive component of 1.2 kVAr was needed.

Light bulb voltage	230 VAC
Light bulb current	58 mA
Power P	8.4 W
Apparent power S	13.4 VA
Power factor	0.63

Of this light bulb the voltage across and the resulting current through it are measured and graphed.

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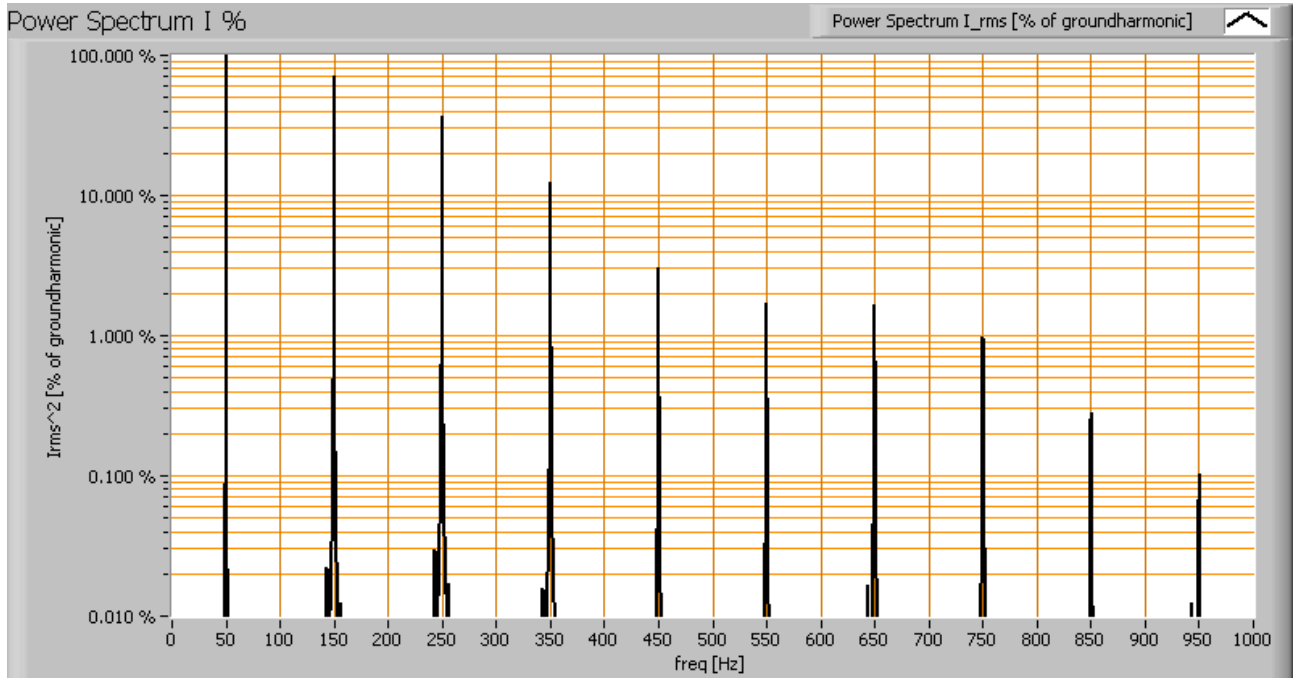


Voltage across and current through the light bulb

There are peaks in current just before the voltage hits its maximum value. This results in a waveform for the current that is different from the sine form of the voltage, resulting in a power factor less than 1. The peak is also not symmetrical, resulting in a further decrease of the power factor.

Also the power spectrum of the current is determined.

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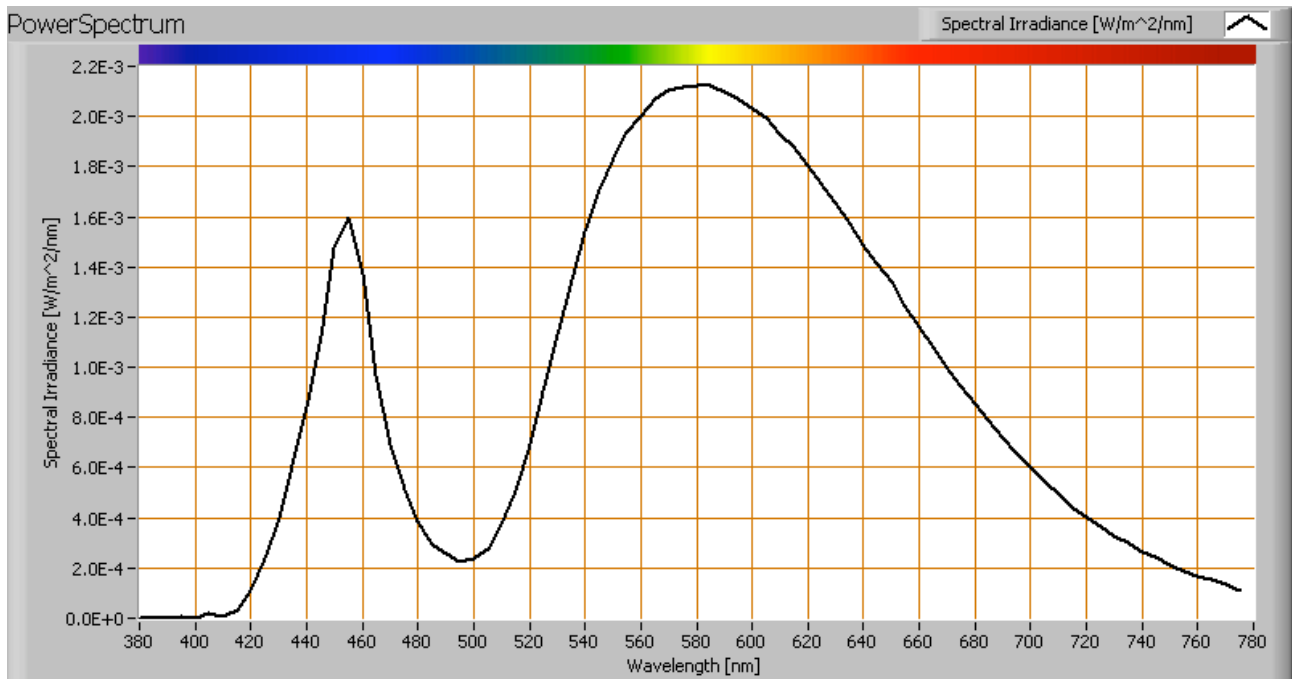


Current power spectrum in % of the first harmonic (50 Hz).

The current peaks result in a current power spectrum with a considerable amount of higher harmonics.

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Color temperature and Spectral power distribution

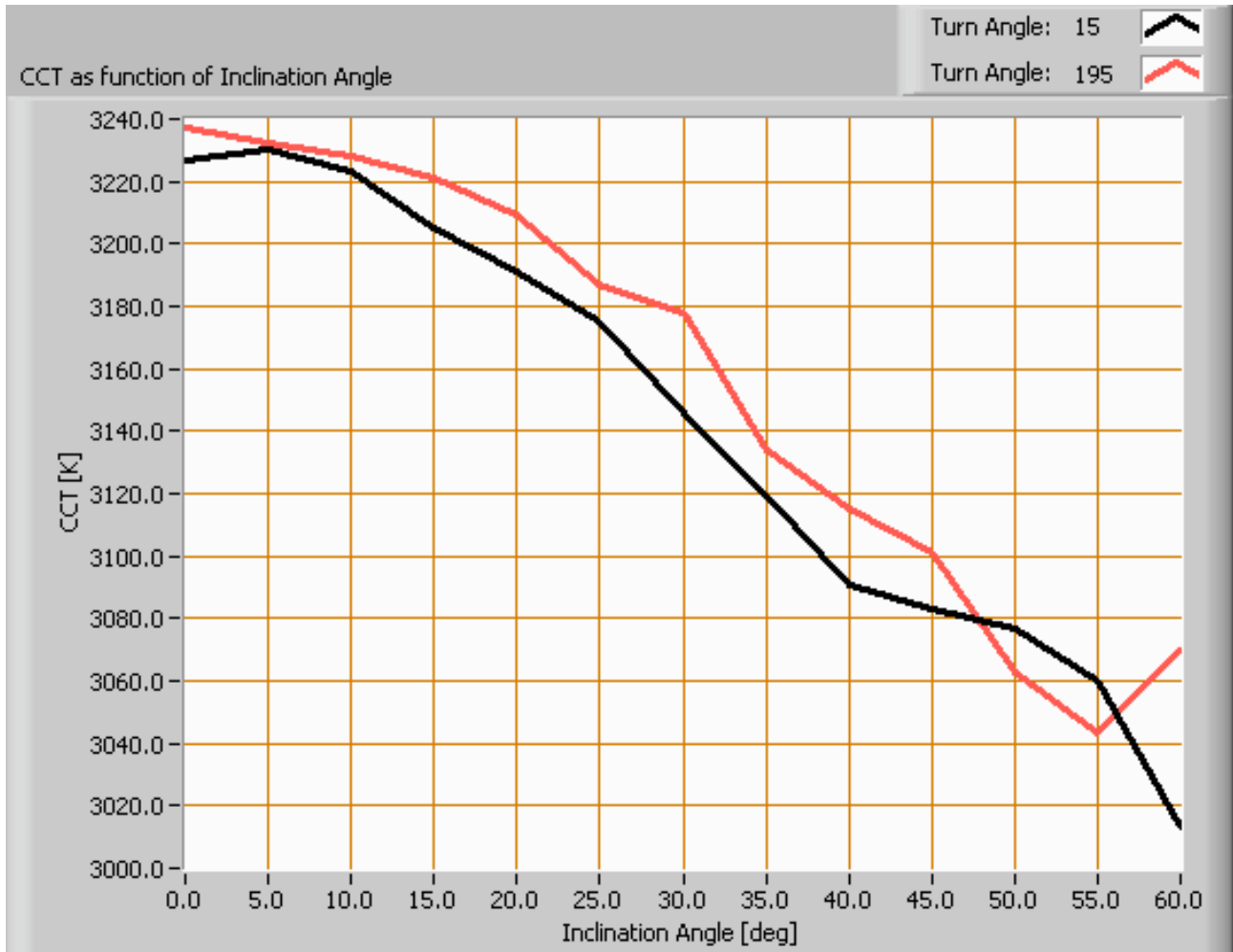


The spectral power distribution of this light bulb.

The measured color temperature is about 3232 K which is close to warm 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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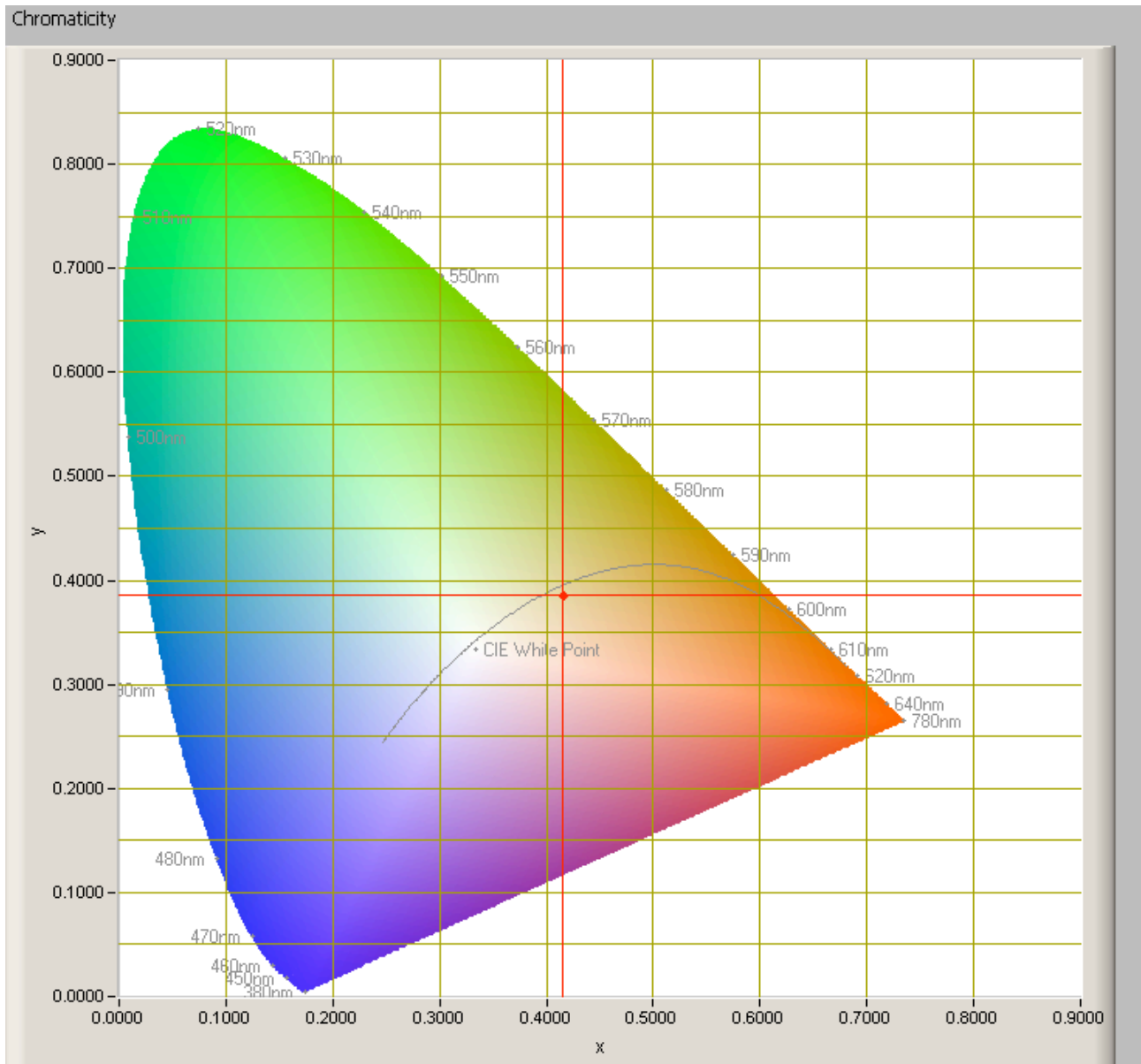
Color temperature as a function of inclination angle.

The color temperature is given for inclination angles up to 60 degrees, since at higher angles there is almost no light output anymore.

The value drops about 6 %.

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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 below the Planckian Locus (the black path in the graph). Its coordinates are $x=0.4154$ and $y=0.3860$.

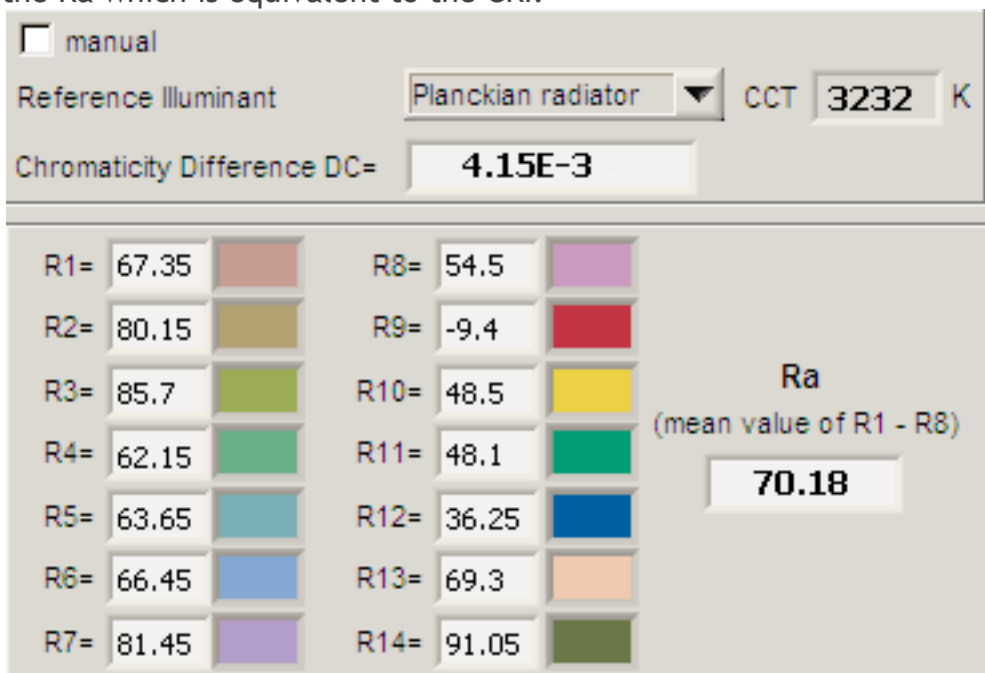


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Color Rendering Index (CRI) or also Ra

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 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.



CRI of the light of this lightbulb.

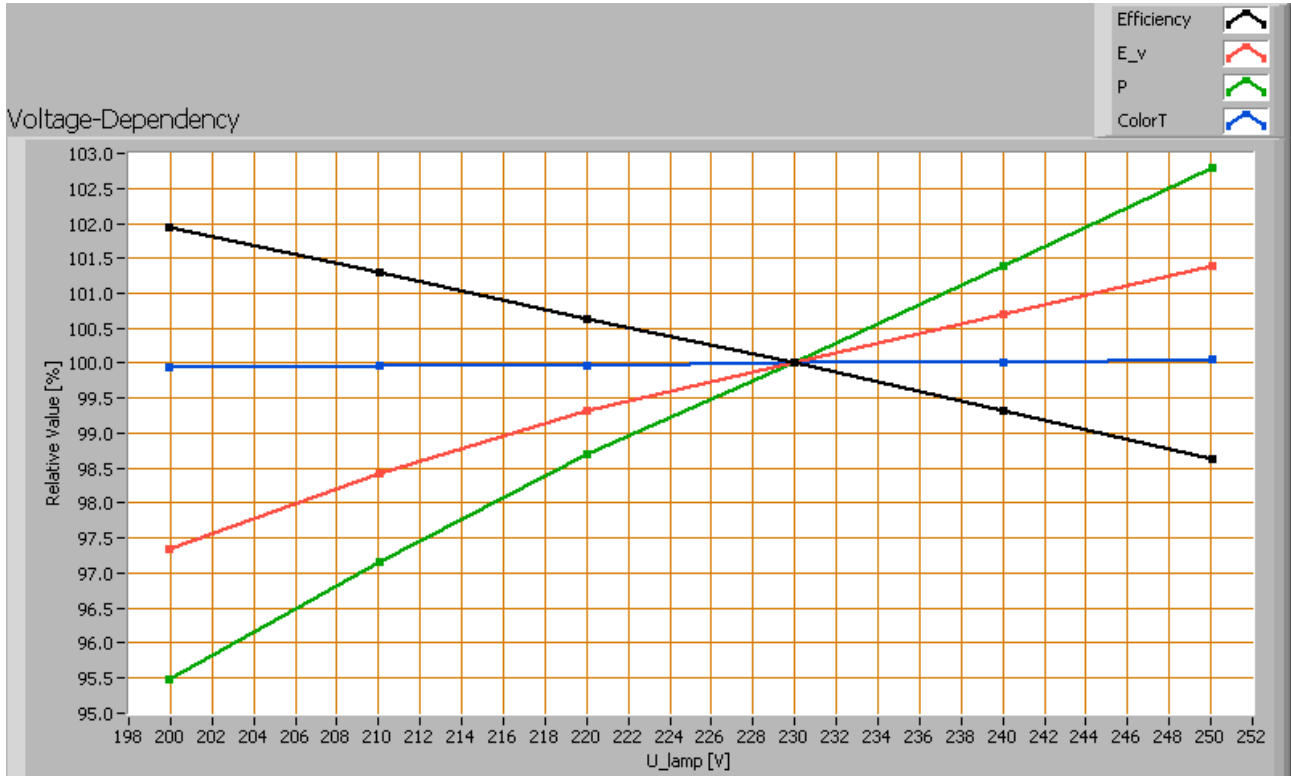
The value of 70 is lower than 80 which is considered a minimum value for indoor usage.

Note: the chromaticity difference is 0.0042 indicates the distance to the Planckian Locus. Its value is lower than 0.0054, which means that the calculated CRI result is meaningful.

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], the (Correlated) Color Temperature [K] and the luminous efficacy [lm/W].

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

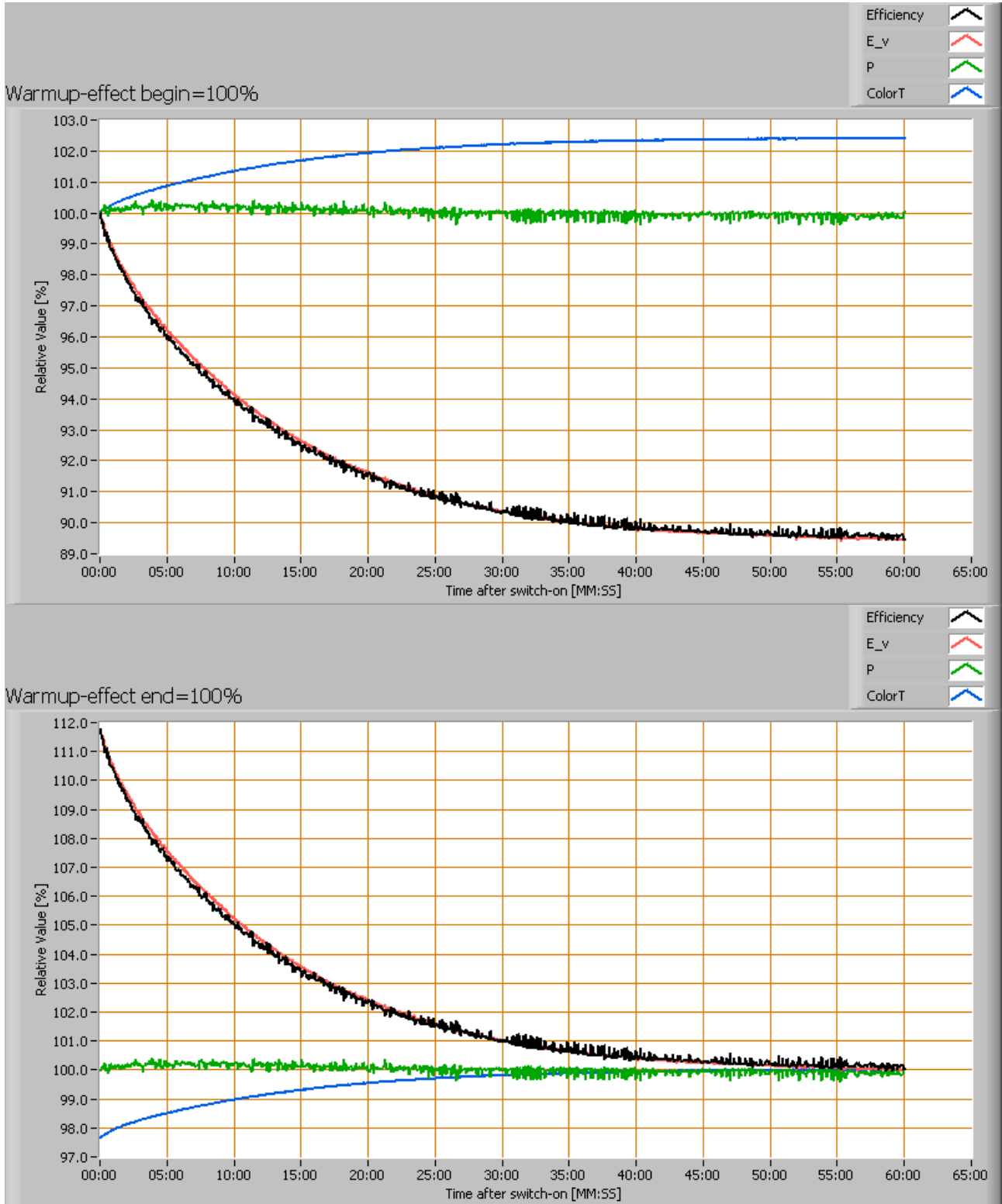
The consumed power nor illuminance vary insignificantly (< 5 %) when the voltage is varied between 200-250 V.

When the voltage at 230 V varies with + and - 5 V, then the illuminance varies within 0.5 %, 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], color temperature CT or correlated color temperature CCT [K], the lamp power 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.

After 35 minutes of warm up time, the illumination level dropped about 10 %.

Close up photo



Close up of the used leds.

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