

**Lamp measurement report – 25 March 09 for LedNed**

**LedNed Spot E27 WW**





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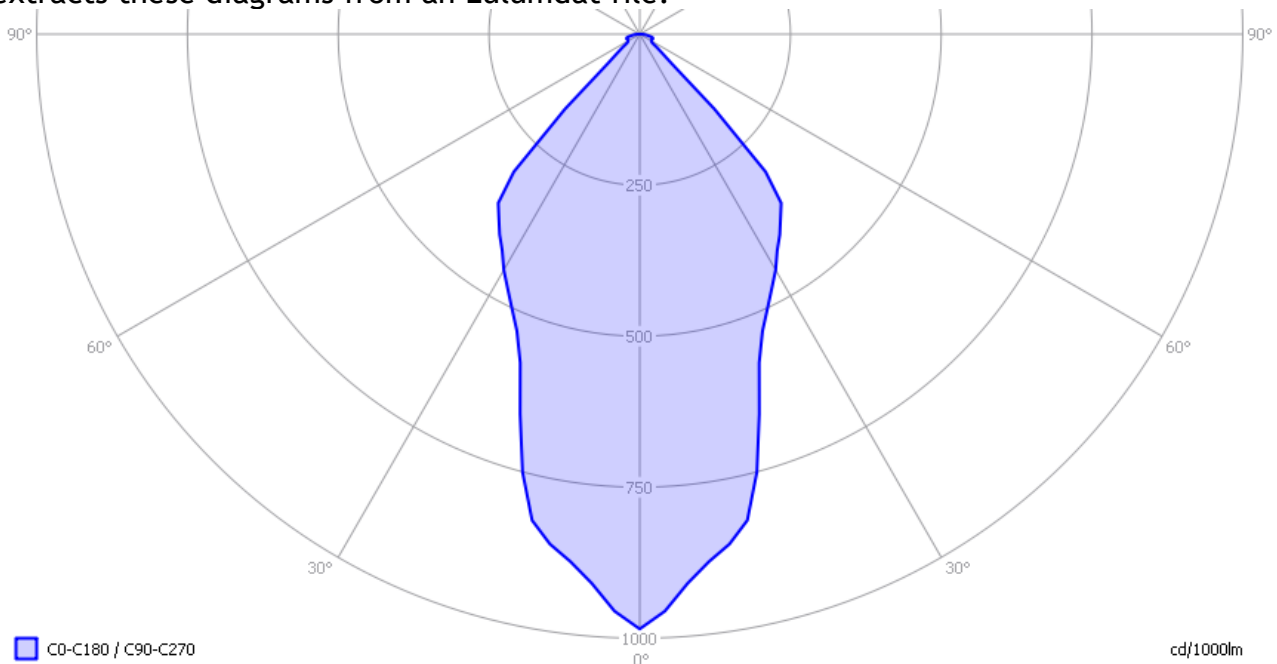
### Summary measurement data

| parameter                        | meas. result          | remark                                                                                                                                                                                                                                                                                         |
|----------------------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Color temperature                | 2944 K                | Warm white                                                                                                                                                                                                                                                                                     |
| Luminous intensity $I_v$         | 91 Cd                 |                                                                                                                                                                                                                                                                                                |
| Beam angle                       | 52 deg                |                                                                                                                                                                                                                                                                                                |
| Power P                          | 3.1 W                 |                                                                                                                                                                                                                                                                                                |
| Power Factor                     | 0.73                  | For every 1 kWh net power consumed, there has been 0.9 kVAhr for reactive power.                                                                                                                                                                                                               |
| Luminous flux                    | 93 lm                 |                                                                                                                                                                                                                                                                                                |
| Luminous efficacy                | 30 lm/W               |                                                                                                                                                                                                                                                                                                |
| CRI_Ra                           | 81                    | Color Rendering Index.                                                                                                                                                                                                                                                                         |
| Coordinates chromaticity diagram | x=0.4336 and y=0.3912 |                                                                                                                                                                                                                                                                                                |
| Fitting                          | E27                   |                                                                                                                                                                                                                                                                                                |
| D x H external dimensions        | 50 x 75 mm            | External dimensions of the lightbulb.                                                                                                                                                                                                                                                          |
| D luminous area                  | 28 mm                 | Dimensions of the luminous area (used in Eulumdat file). This is equal to the size of the frontglass.                                                                                                                                                                                          |
| General remarks                  |                       | <p>The ambient temperature during the whole set of measurements was 24-28 deg C.</p> <p>Warm up effect: during the warming up the illuminance and consumed power reduce with 18 %.</p> <p>Voltage dependency: the illuminance and power consumption are almost independent on the voltage.</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.*

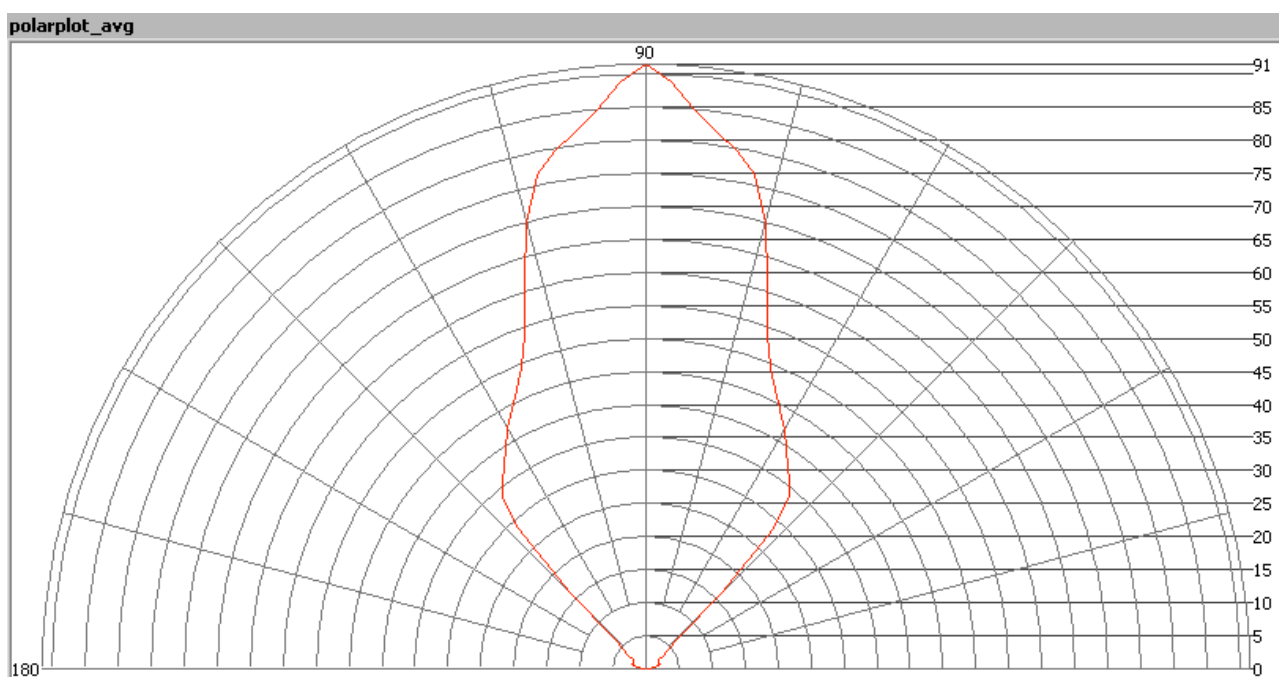
It indicates the luminous intensity around the light bulb. This light bulb has symmetry over the z-axis, so the C0-C180 and C90-C270 planes show the same radiation pattern result.

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.

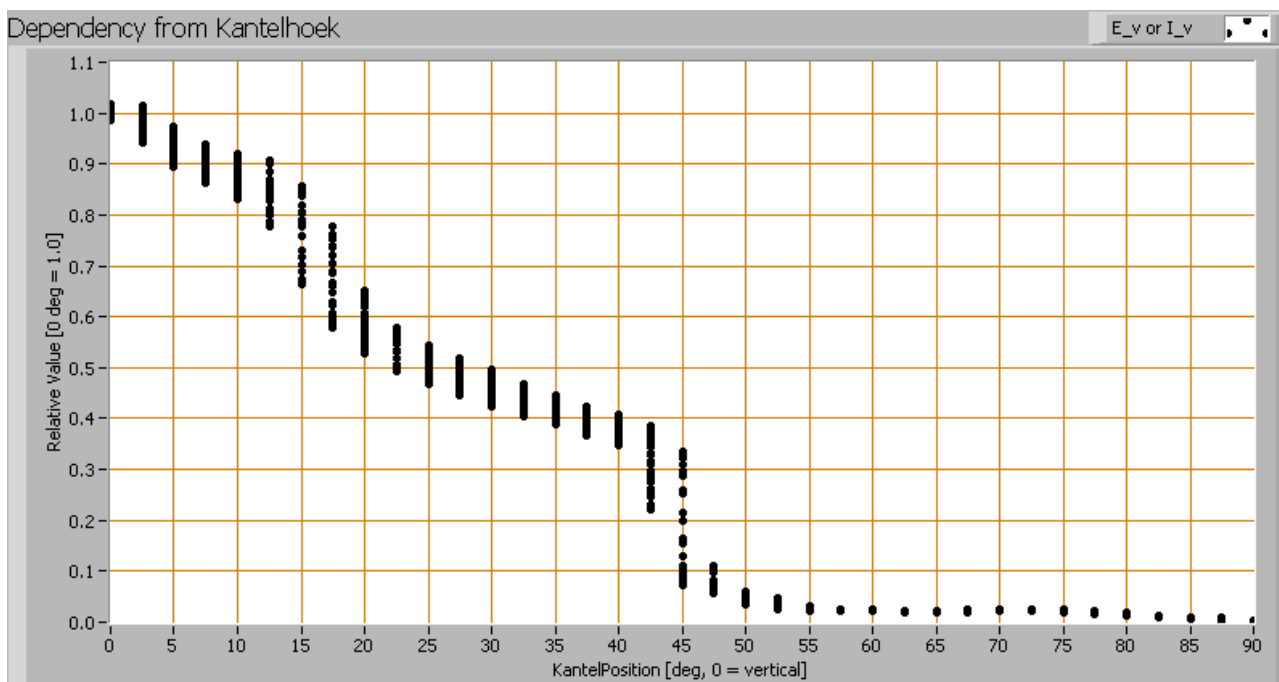
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*The radiation pattern of the light bulb.*

This radiation pattern is not the same as the one given earlier. This is because of the (small) differences of beam angles in the different planes. In this graph the luminous intensity is given in Cd.

These averaged values are used (later) to compute the lumen output.





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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 is some more spread in intensity results at low inclination angles, when the illuminance is varying depending on the inclination angle. When using the average values per inclination angle, the beam angle can be computed, being 52 degrees.

### 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 93 lm.

### Luminous efficacy

The luminous flux being 93 lm, and the power of the lightbulb being 3.1 W, yields a luminous efficacy of 30 lm/W.

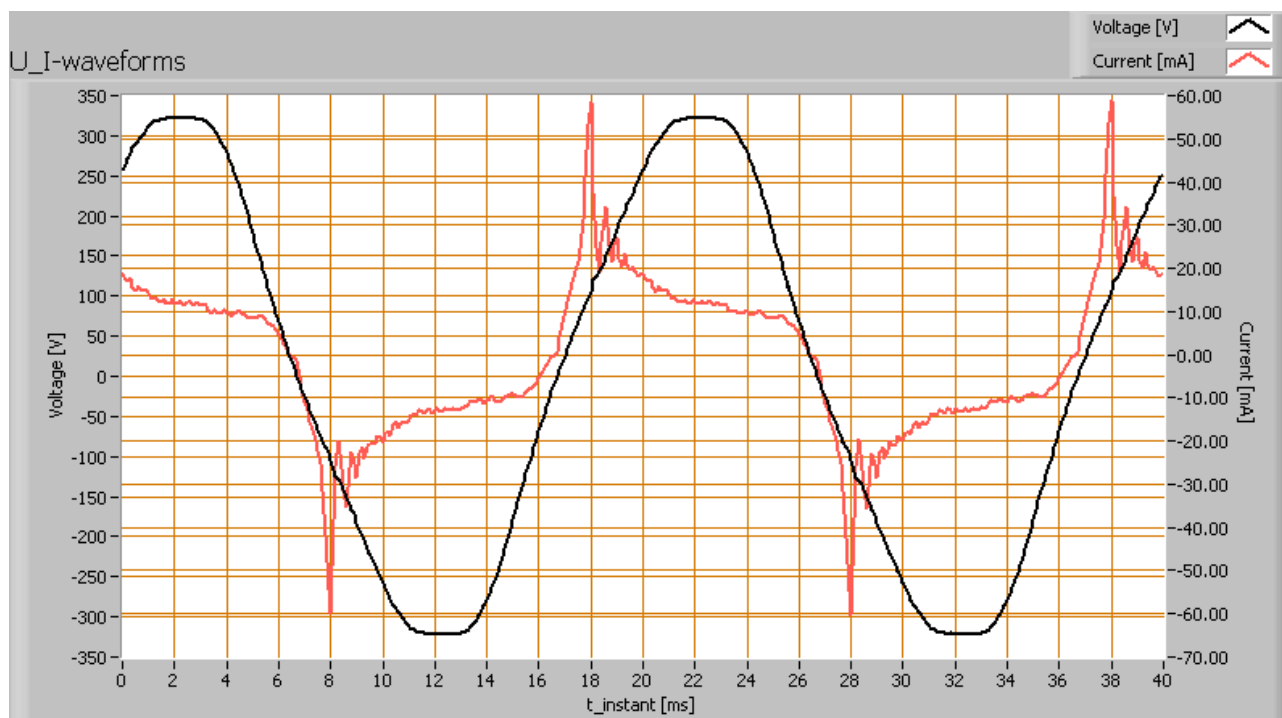
A power factor of 0.73 means that for every 1 kWh net power consumed, a reactive component of 0.9 kVAr was needed.

|                    |        |
|--------------------|--------|
| Light bulb voltage | 230 V  |
| Light bulb current | 18 mA  |
| Power P            | 3.1 W  |
| Apparent power S   | 4.2 VA |
| Power factor       | 0.73   |

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

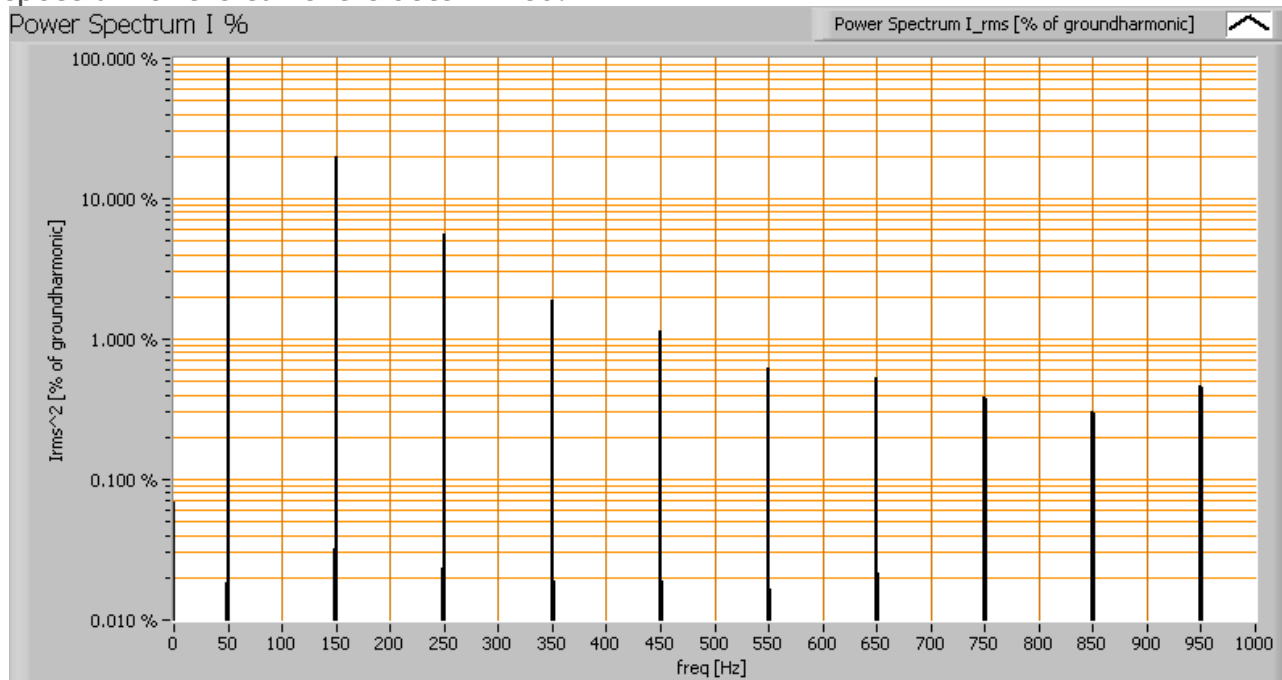


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### Voltage across and current through the lightbulb

The current has peaks and already very early when the voltage rises. Also the power spectrum of the current is determined.

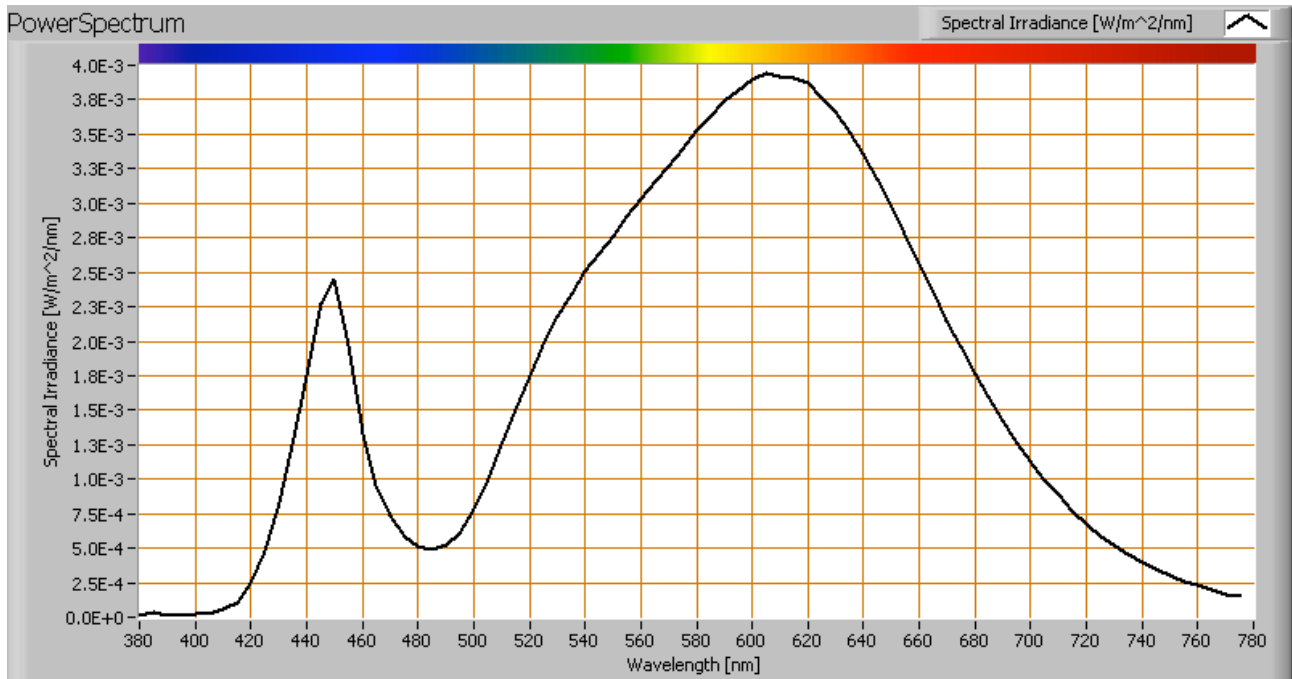


### The powerspectrum of the current through the light bulb.

There are higher harmonics apparent in the spectrum.

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### Color temperature and Spectral power distribution

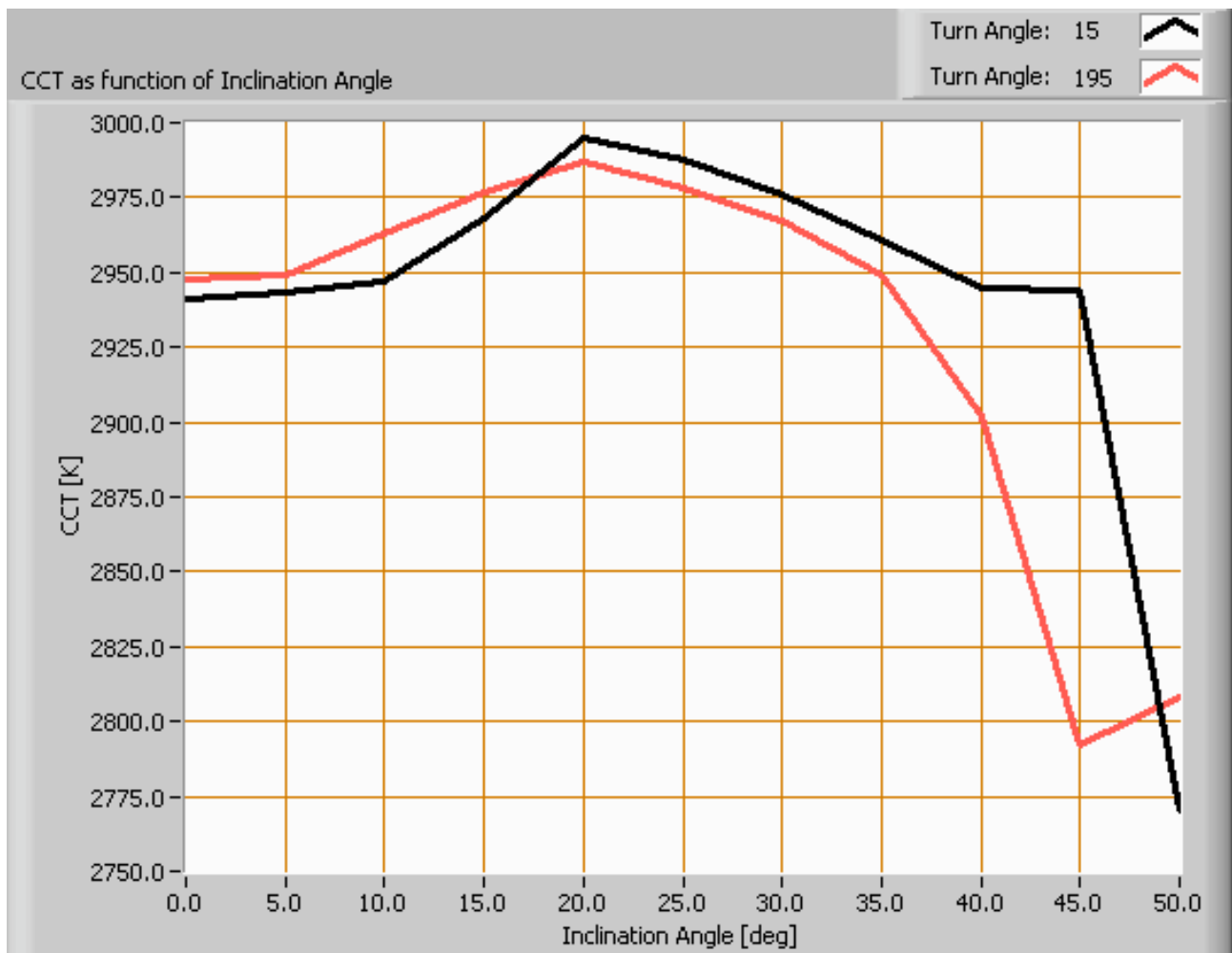


*The spectral power distribution of this light bulb.*

The measured color temperature is about 2950 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.

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*Color temperature as a function of inclination angle.*

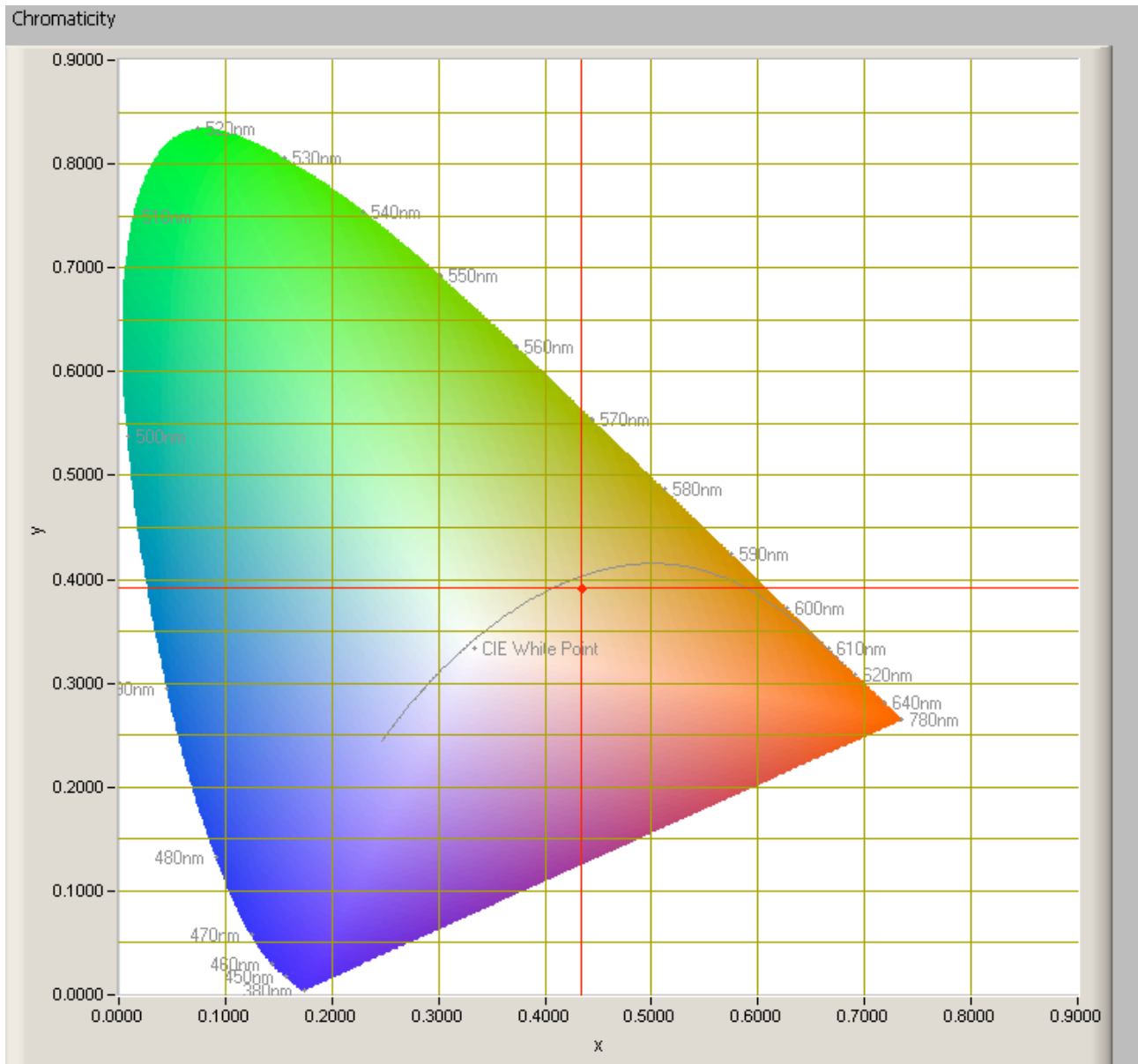
The color temperature is given for inclination angles up to 50 degrees since at larger inclination angles there is too little illumination.

The value remains constant within 4 %.



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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 at a distance from the Planckian Locus (the black path in the graph).

Its coordinates are  $x=0.4336$  and  $y=0.3912$ .

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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 Rx, and the first 8 indexes (R1 .. R8) are averaged to compute the Ra which is equivalent to the CRI.

☐ manual

Reference Illuminant: Planckian radiator CCT 2944 K

Chromaticity Difference DC= 4.80E-3

|           |            |                                                      |
|-----------|------------|------------------------------------------------------|
| R1= 80.85 | R8= 67.35  | <b>Ra</b><br>(mean value of R1 - R8)<br><b>81.12</b> |
| R2= 87.2  | R9= 24.9   |                                                      |
| R3= 90.1  | R10= 67.7  |                                                      |
| R4= 79    | R11= 74.8  |                                                      |
| R5= 78.7  | R12= 60.9  |                                                      |
| R6= 80.65 | R13= 81.75 |                                                      |
| R7= 85.3  | R14= 93.55 |                                                      |

*CRI of the light of this lightbulb.*

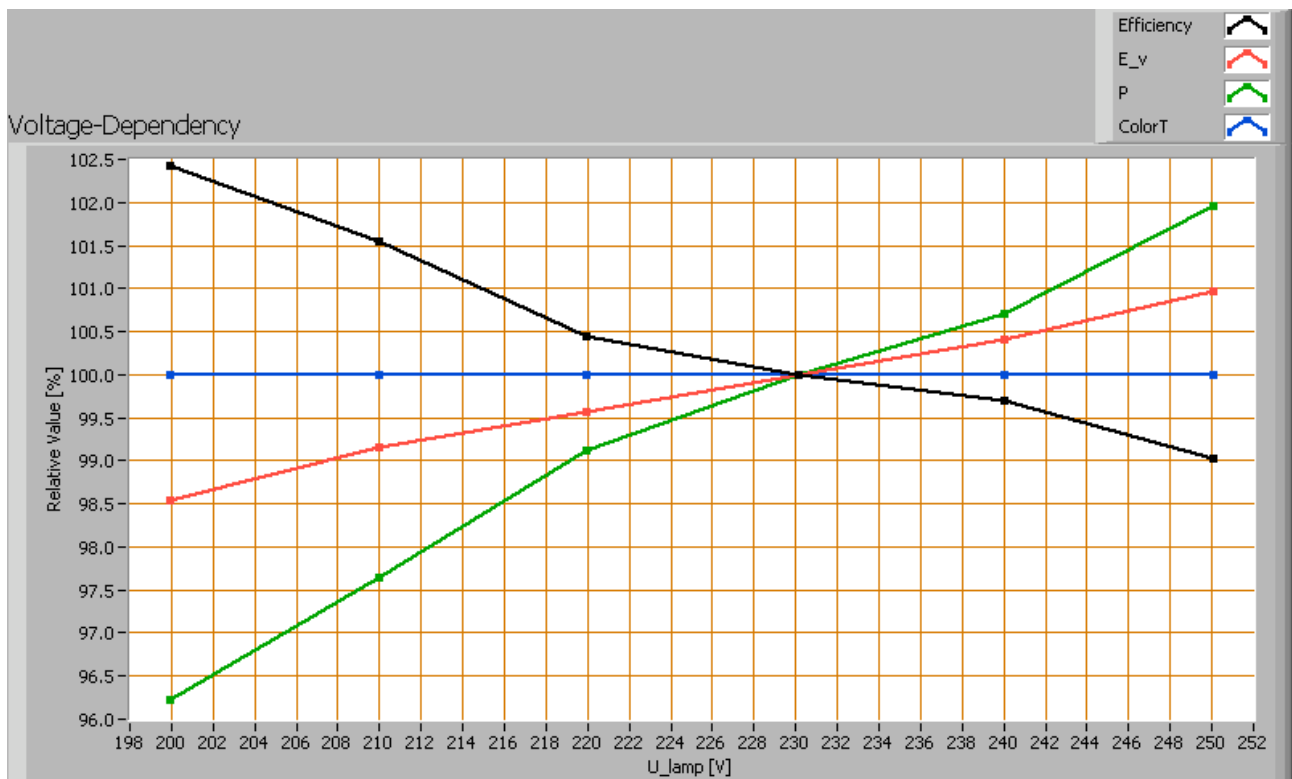
The value of 81 is higher than 80 which is considered a minimum value for indoor usage.

Note: the chromaticity difference is 0.0048 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 lamp parameters measured: 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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Lamp voltage dependencies of certain light bulb parameters, where the value at 12 V is taken as 100 %.

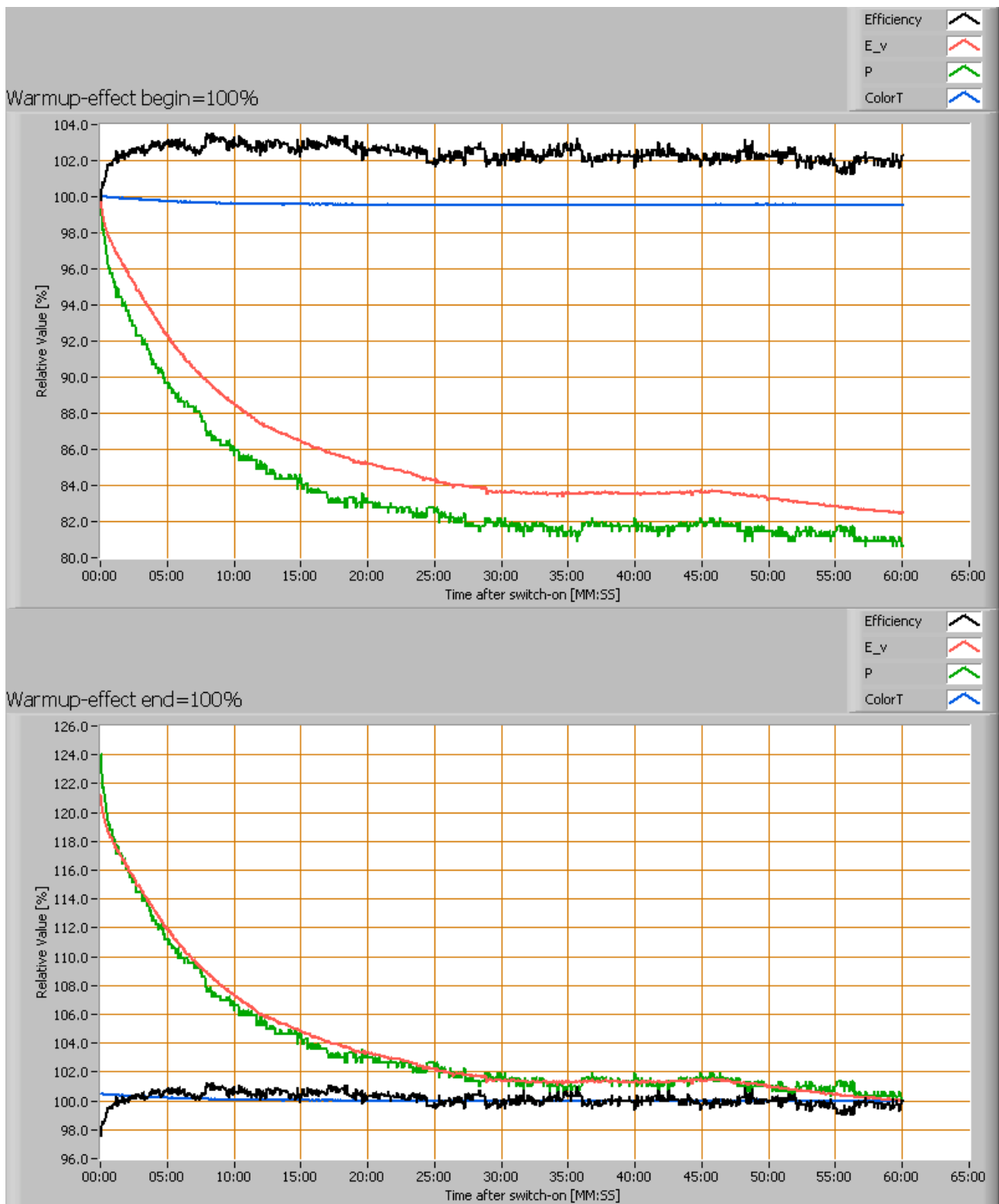
The consumed power and the illuminance vary slightly when the voltage varies between 10-16 V. This variation is almost linear.

When the voltage varies with + and - 5 V at 230 V, then the illuminance varies with less than + and - 0.5 %, which will not be visible when the voltage changes abruptly.

### 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], 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.



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During warm up time of about 30 minutes, the illuminance and power consumption decrease with 18 %.

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