

**Lamp measurement report – 24 May 09 for Line Lite  
International BV**

**Line Lite International BV PC-2423N-500 XRE**





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### Summary measurement data

parameter	meas. result	remark
Color temperature	4283 K	Neutral white
Luminous intensity $I_v$	1800 Cd	
Beam angle	19 deg	
Power P	13.0 W	
Power Factor	1.0	For every 1 kWh net power consumed, there has been 1.0 kVAhr for reactive power. Note that a 24 V DC power was used, therefore the power factor equals 1.
Luminous flux	445 lm	
Luminous efficacy	34 lm/W	
CRI_Ra	79	Color Rendering Index.
Coordinates chromaticity diagram	x=0.3687 and y=0.3694	
Fitting	24VDC	This is a DC voltage.
L x W external dimensions	510 x 55 mm	External dimensions of the led bar.
L x W luminous area	487 x 31 mm	Dimensions of the luminous area (used in Eulumdat file). This is equal to the size of the opening of the glass on top of the led bar. Through this glass the leds output their light.
General remarks		<p>The ambient temperature during the whole set of measurements was 25-25.5 deg C.</p> <p>Warm up effect: during the warm up time the illuminance decreases with 4% which is negligible.</p> <p>Voltage dependency: the illuminance and power consumption are almost independent on the voltage. Except when the voltage drops below 21 V.</p>

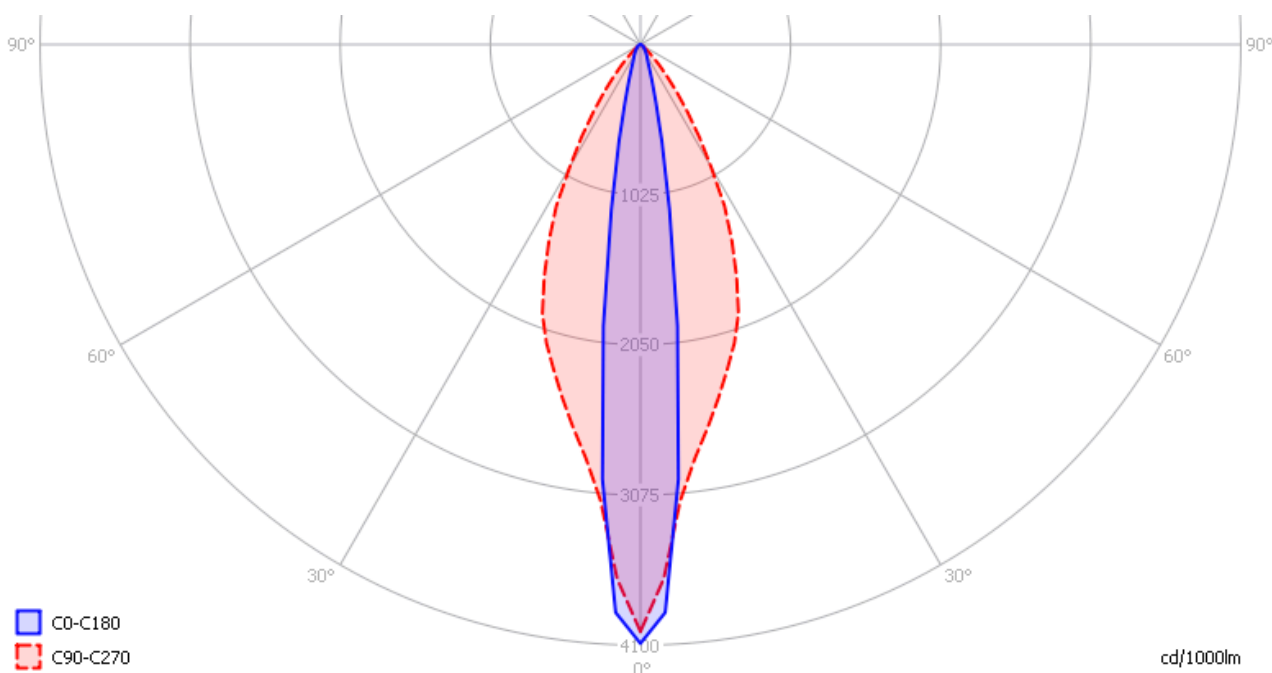


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### Eulumdat light diagram

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.*

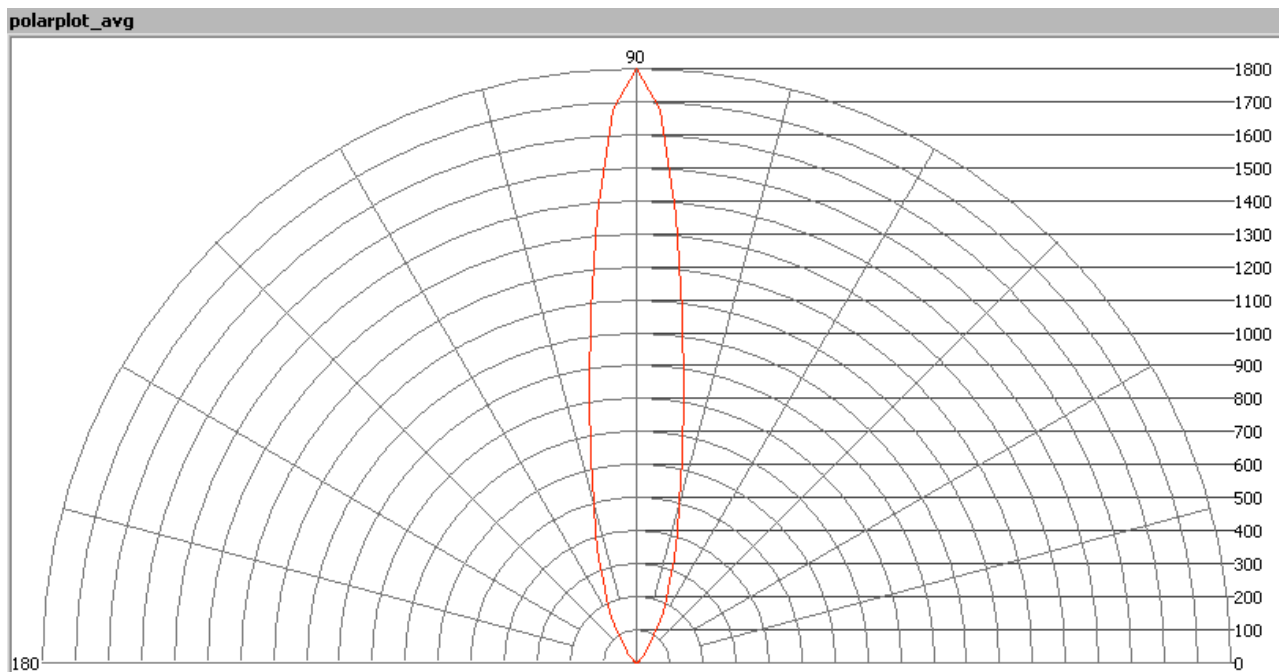
It indicates the luminous intensity around the light bulb. The C0-C180 plane is along the length of the led bar (here very focused light, no light strays around the led bar ends), and the C90-C270 is perpendicular to that (bundle somewhat bigger, meaning the led bar gives some light to the sides of the bar).

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.

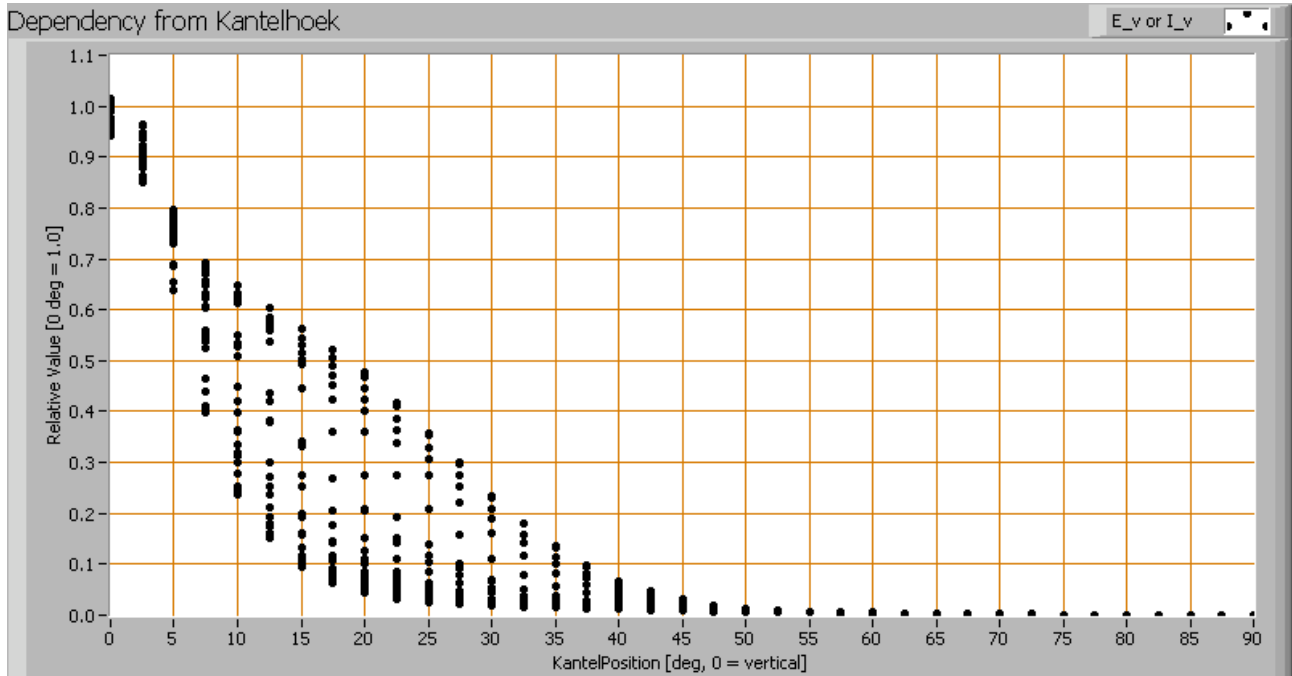
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*The radiation pattern of the light bulb.*

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.

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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 differences in illuminance values for different turn angles, as was already seen in the light diagram (the difference between the C-planes). 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 19 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 445 lm.

### Luminous efficacy

The luminous flux being 445 lm, and the power of the lightbulb being 13 W, yields a luminous efficacy of 34 lm/W.

A power factor of 1 (since DC voltage is used) means that for every 1 kWh net power



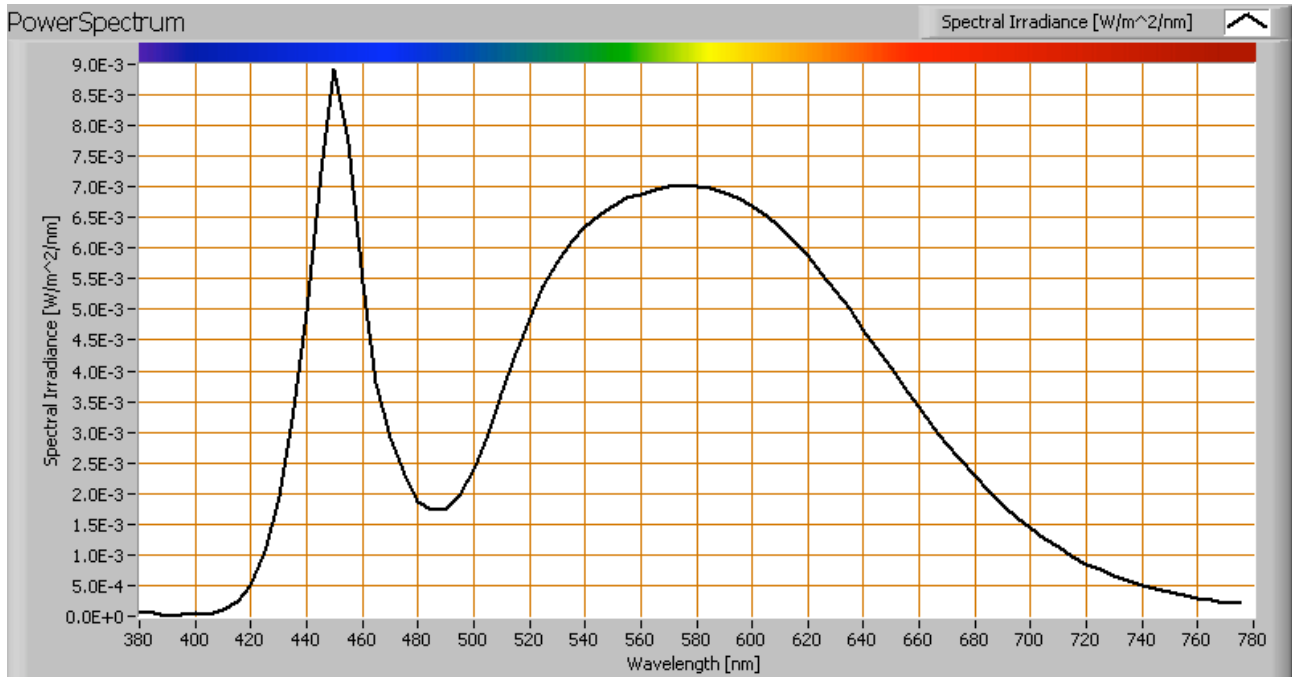
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consumed, a reactive component of 0.0 kVAr was needed.

Light bulb voltage	24 VDC
Light bulb current	541 mA
Power P	13.0 W
Apparent power S	13.0 VA
Power factor	1.0

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### Color temperature and Spectral power distribution



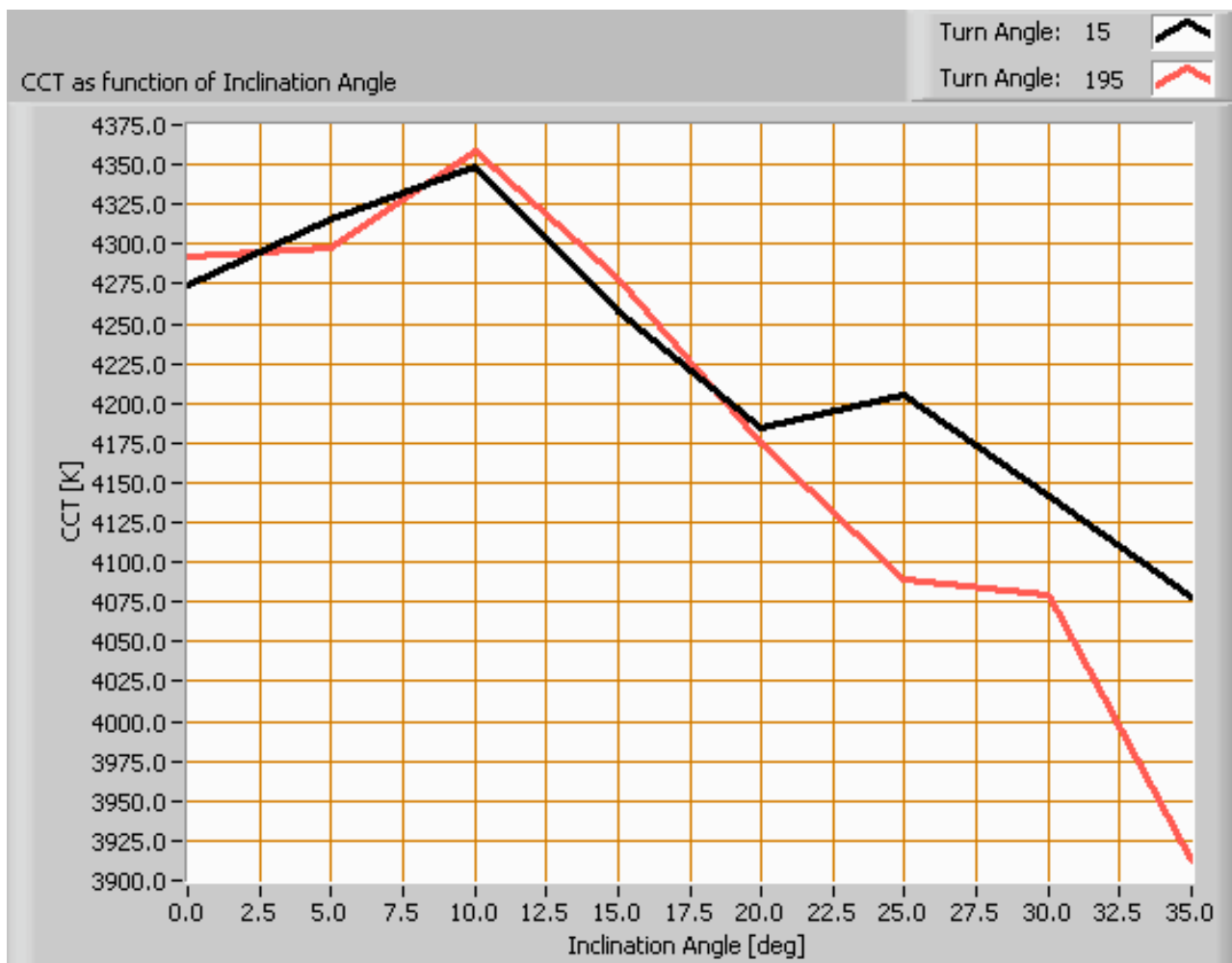
*The spectral power distribution of this light bulb.*

The measured color temperature is about 4300 K which is neutral 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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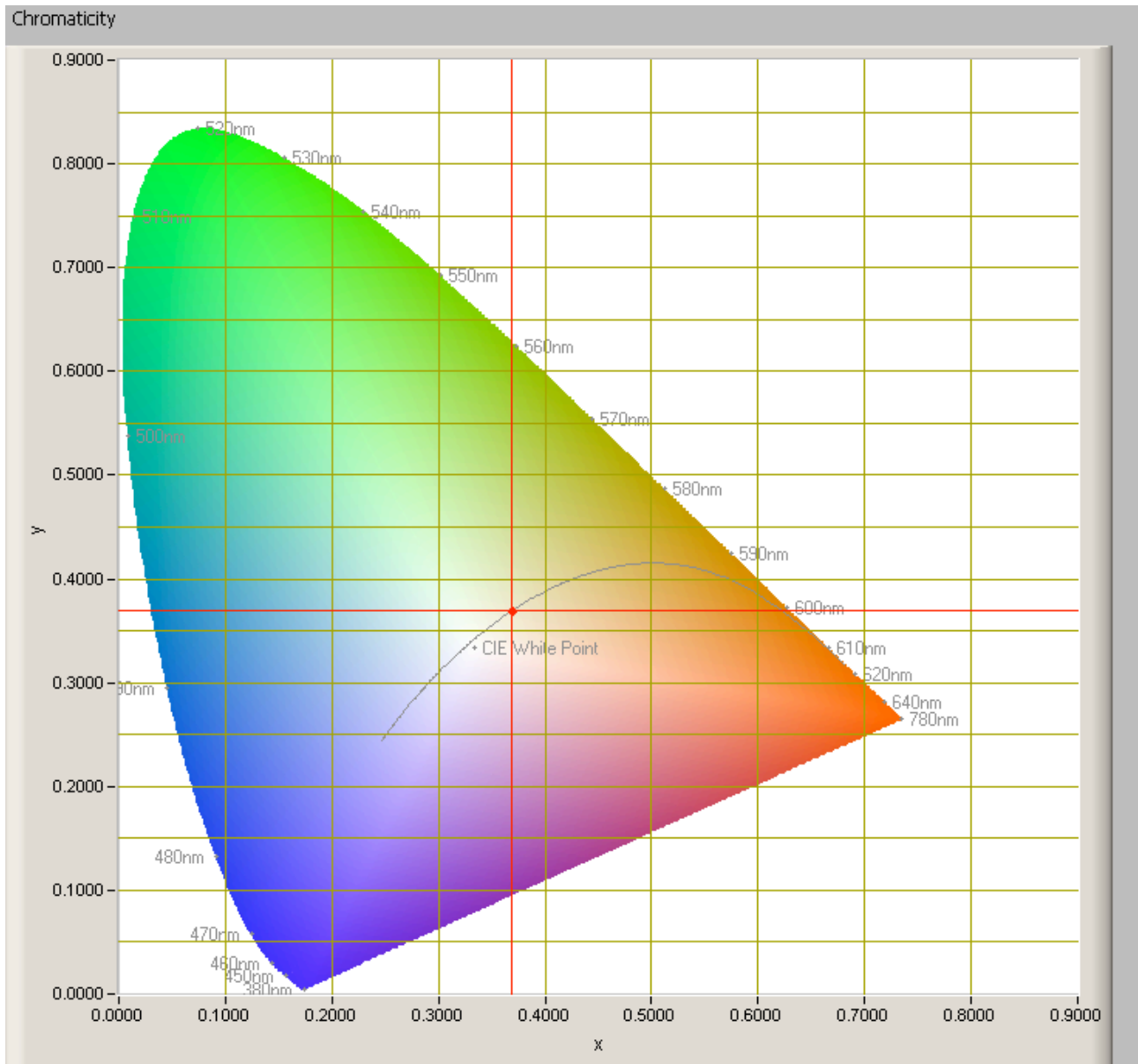
*Color temperature as a function of inclination angle.*

The color temperature is given for inclination angles up to 35 degrees, since at higher angles there is almost no light output anymore.

The value remains constant within 8 %.

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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 on top of the Planckian Locus (the black path in the graph).

Its coordinates are  $x=0.3687$  and  $y=0.3694$ .

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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: 4283 K

Chromaticity Difference DC= 3.65E-4

R1= 77.45	R8= 68.15	<b>Ra</b> (mean value of R1 - R8) <b>78.78</b>
R2= 83.3	R9= 11.35	
R3= 85.5	R10= 57.9	
R4= 78.1	R11= 73.4	
R5= 76.15	R12= 48.1	
R6= 74.75	R13= 78.3	
R7= 86.9	R14= 91.4	

*CRI of the light of this lightbulb.*

The value of 79 is a little bit lower than 80 which is considered a minimum value for indoor usage.

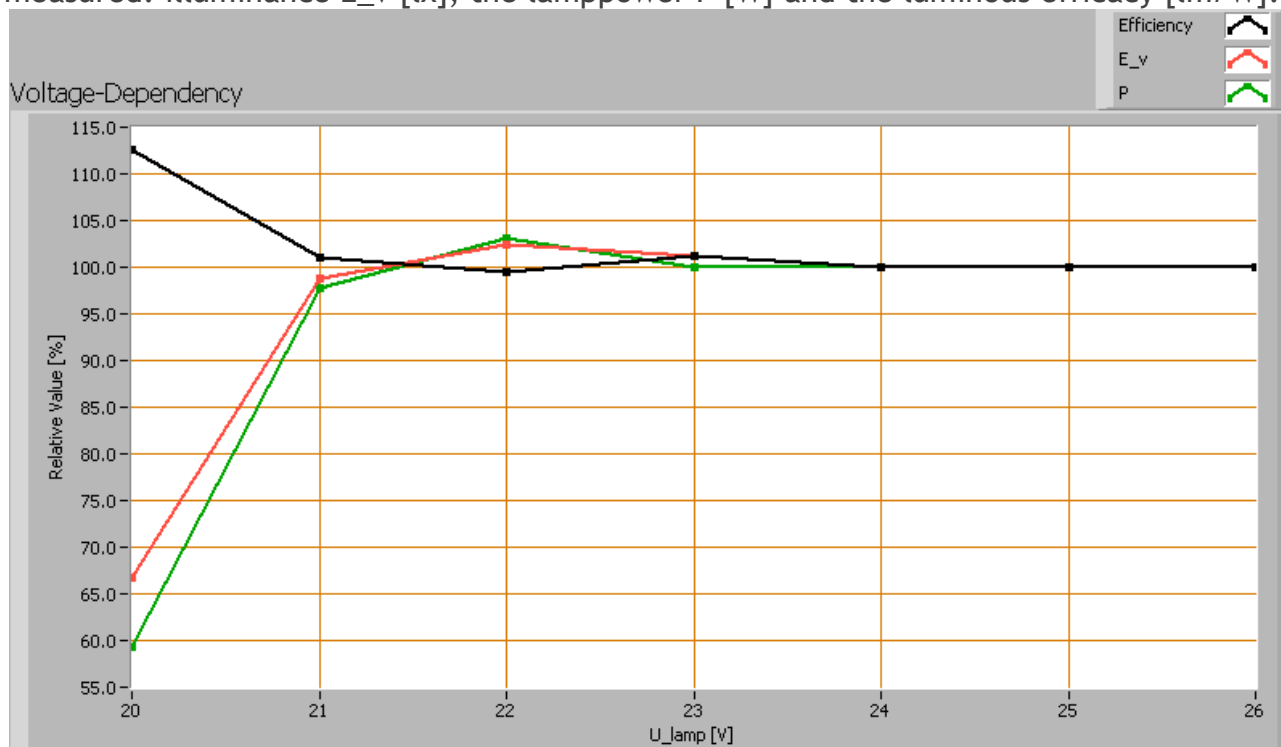
Note: the chromaticity difference is 0.0004 indicates the distance to the Planckian Locus. Its value is lower than 0.0054, which means that the calculated CRI result is meaningful.

### 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

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measured: illuminance  $E_v$  [lx], the lamp power  $P$  [W] and the luminous efficacy [lm/W].



Lamp voltage dependencies of certain light bulb parameters, where the value at 24 V is taken as 100 %.

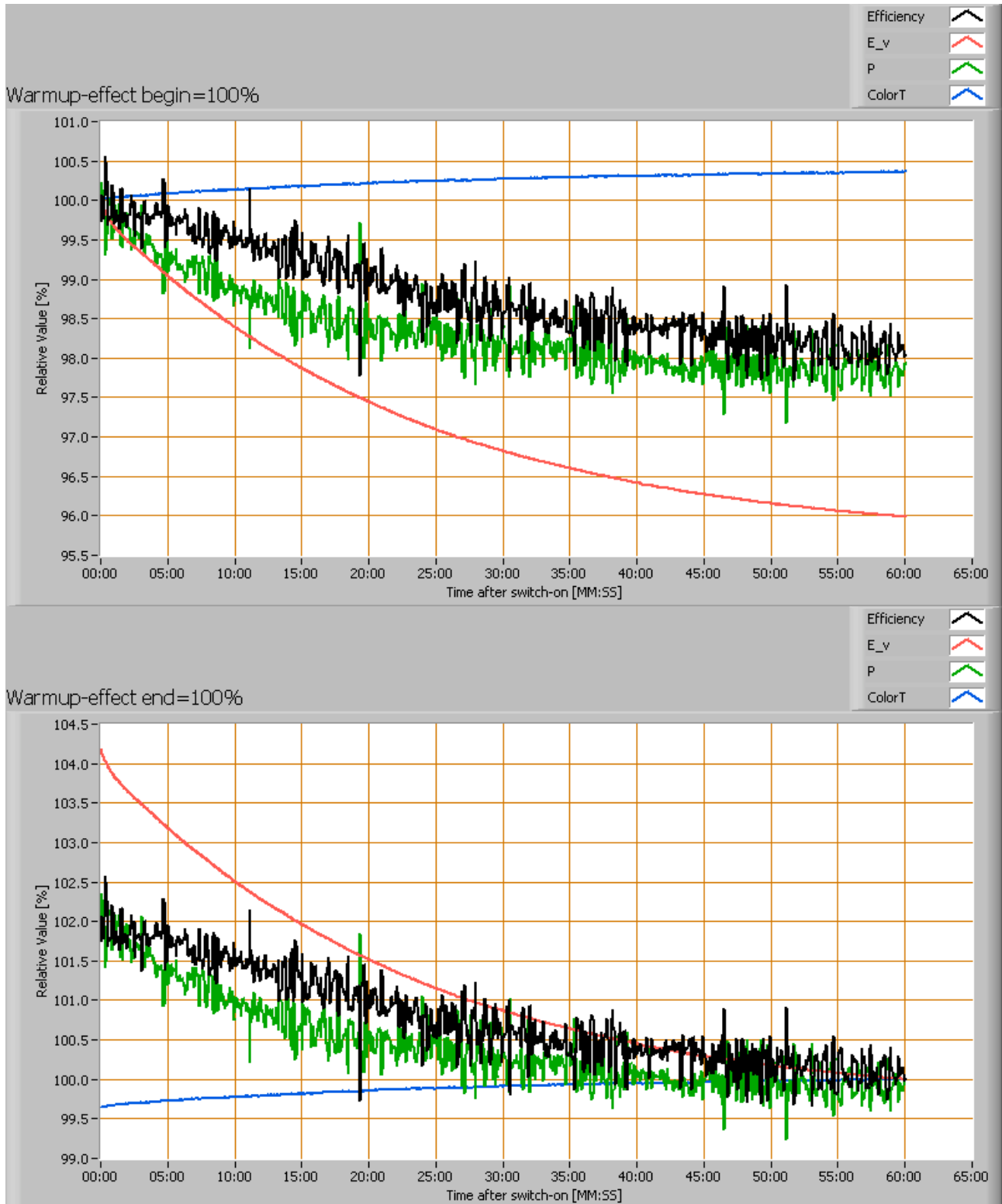
The consumed power and the illuminance vary insignificantly when the voltage varies between 21-26 V. It drops sharply below the 21 V.

When the voltage at 24 V varies with + and - 1 V, then the illuminance doesn't vary at all, 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.*

Note that the voltage unit, converting the mains voltage from 230 V AC into 24 V DC, is included in this measurement. The readings for the illumination are significant and come from the led bar only. The readings for the power are the sum of the voltage unit and the led bar, so these values need not be considered.

The illumination decreases with only 4 %, which is negligible.

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