

**Lamp measurement report – 2 June 2009 for Line Lite
International BV**

Line Lite International BV BB 2475 NW 1000 60D



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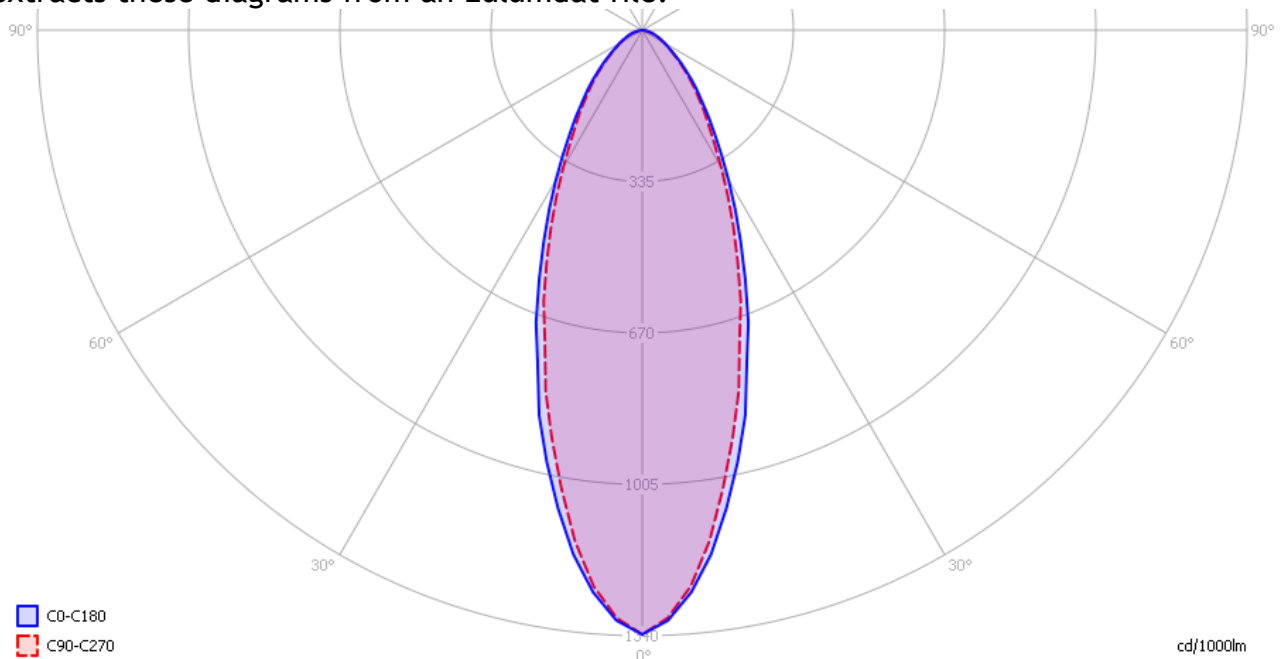
Summary measurement data

parameter	meas. result	remark
Color temperature	4129 K	Neutral white
Luminous intensity I_v	1144 Cd	
Beam angle	40 deg	
Power P	21.0 W	
Power Factor	1.0	For every 1 kWh net power consumed, there has been 0.0 kVAhr for reactive power. Note that a 24 V DC power was used, therefore the power factor equals 1.
Luminous flux	856 lm	
Luminous efficacy	41 lm/W	
CRI_Ra	70	Color Rendering Index.
Coordinates chromaticity diagram	x=0.3776 and y=0.3845	
Fitting	24VDC	This is a DC voltage.
L x W x H external dimensions	1000 x 77 mm x 77 mm	External dimensions of the led bar.
L x W luminous area	980 x 35 mm	Dimensions of the luminous area (used in Eulumdat file). This is equal to a small area around the leds at the front. It is not the total size of the glassplate of the front, as the leds occupy a too small percentage of the front surface for that.
General remarks		The ambient temperature during the whole set of measurements was 25.5 deg C. Warm up effect: during the warm up time the illuminance decreases with 5% which can be neglected. Voltage dependency: the illuminance and power consumption are almost independent on the voltage.

Lamp measurement report – 2 June 2009 for Line Lite International BV

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.

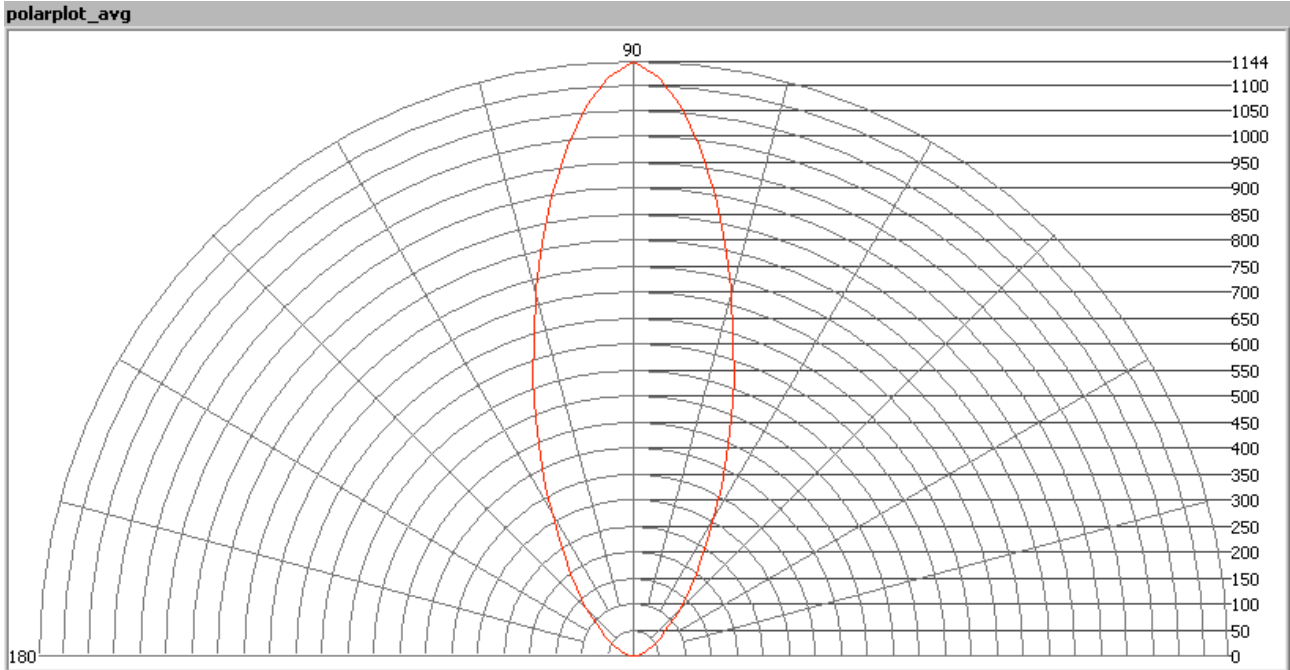
It indicates the luminous intensity around the light bulb. The C0-C180 plane is along the length of the led bar and the C90-C270 is perpendicular to that. The bundle is small (focused).

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.

Lamp measurement report – 2 June 2009 for Line Lite International BV

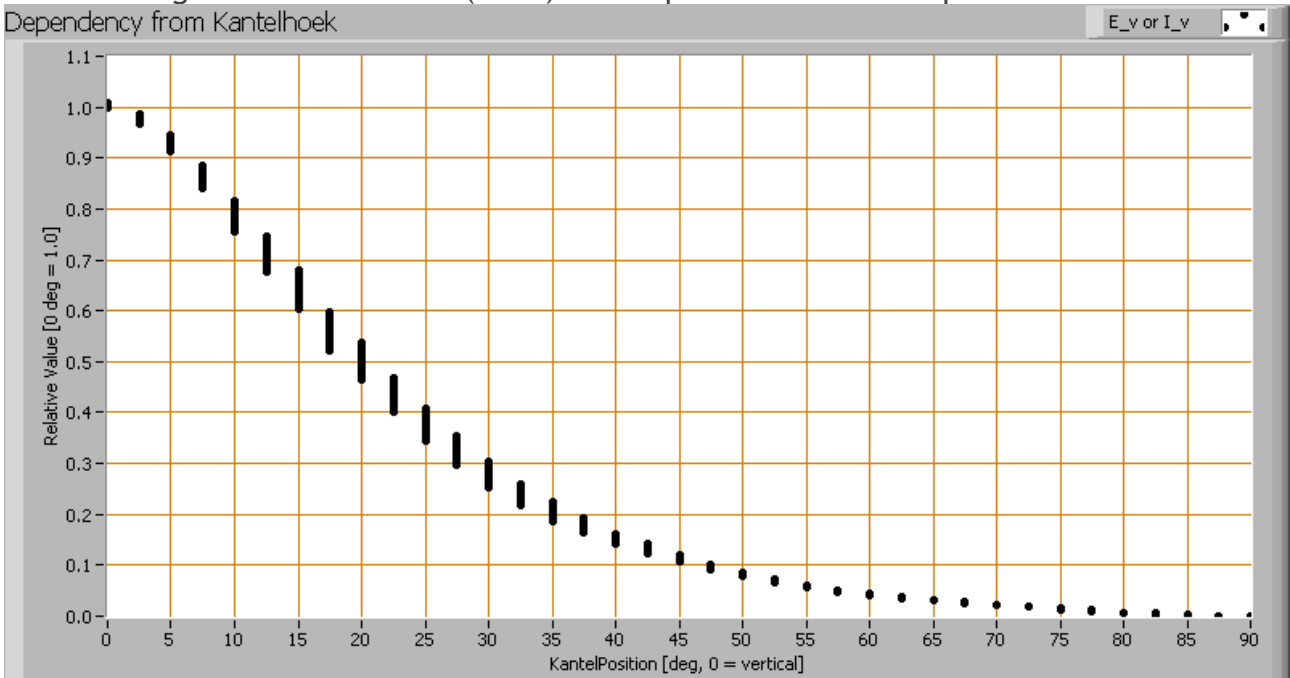


The radiation pattern of the light bulb.

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



Lamp measurement report – 2 June 2009 for Line Lite International BV

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 little 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 40 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 856 lm.

Luminous efficacy

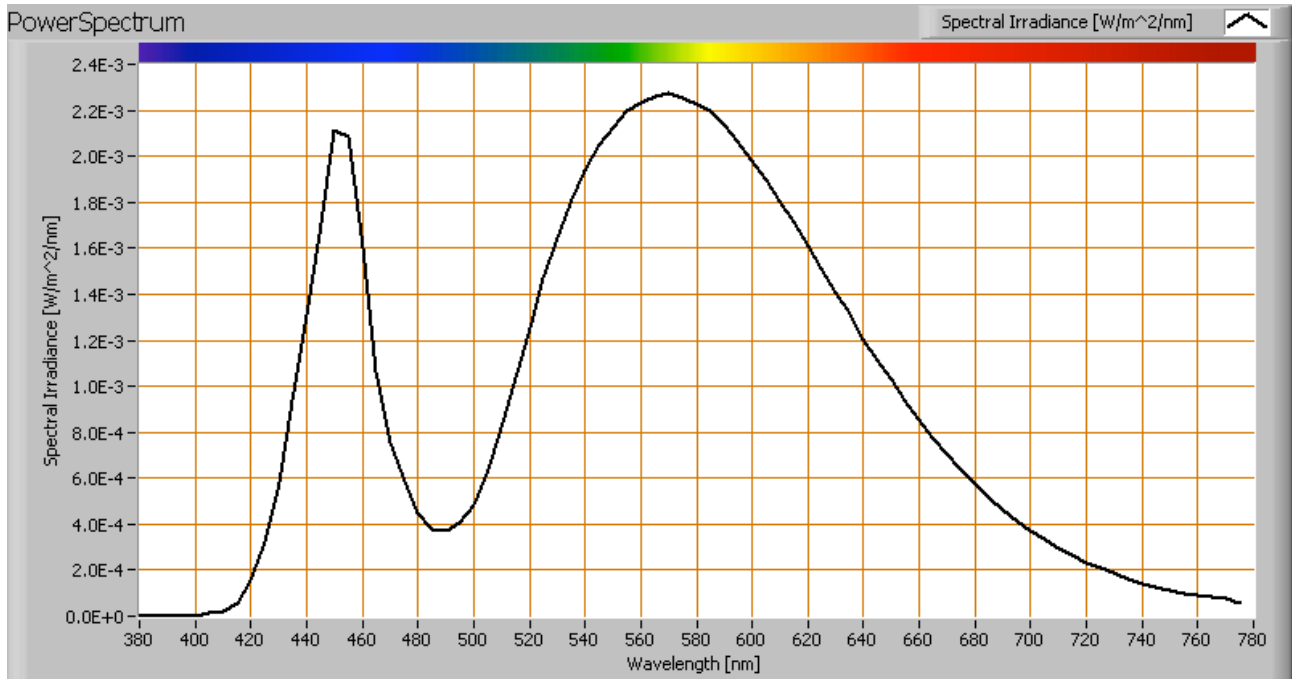
The luminous flux being 856 lm, and the power of the lightbulb being 21.0 W, yields a luminous efficacy of 41 lm/W.

A power factor of 1 (since DC voltage is used) means that for every 1 kWh net power consumed, a reactive component of 0.0 kVAR was needed.

Light bulb voltage	24 VDC
Light bulb current	873 mA
Power P	21.0 W
Apparent power S	21.0 VA
Power factor	1.0

Lamp measurement report – 2 June 2009 for Line Lite International BV

Color temperature and Spectral power distribution

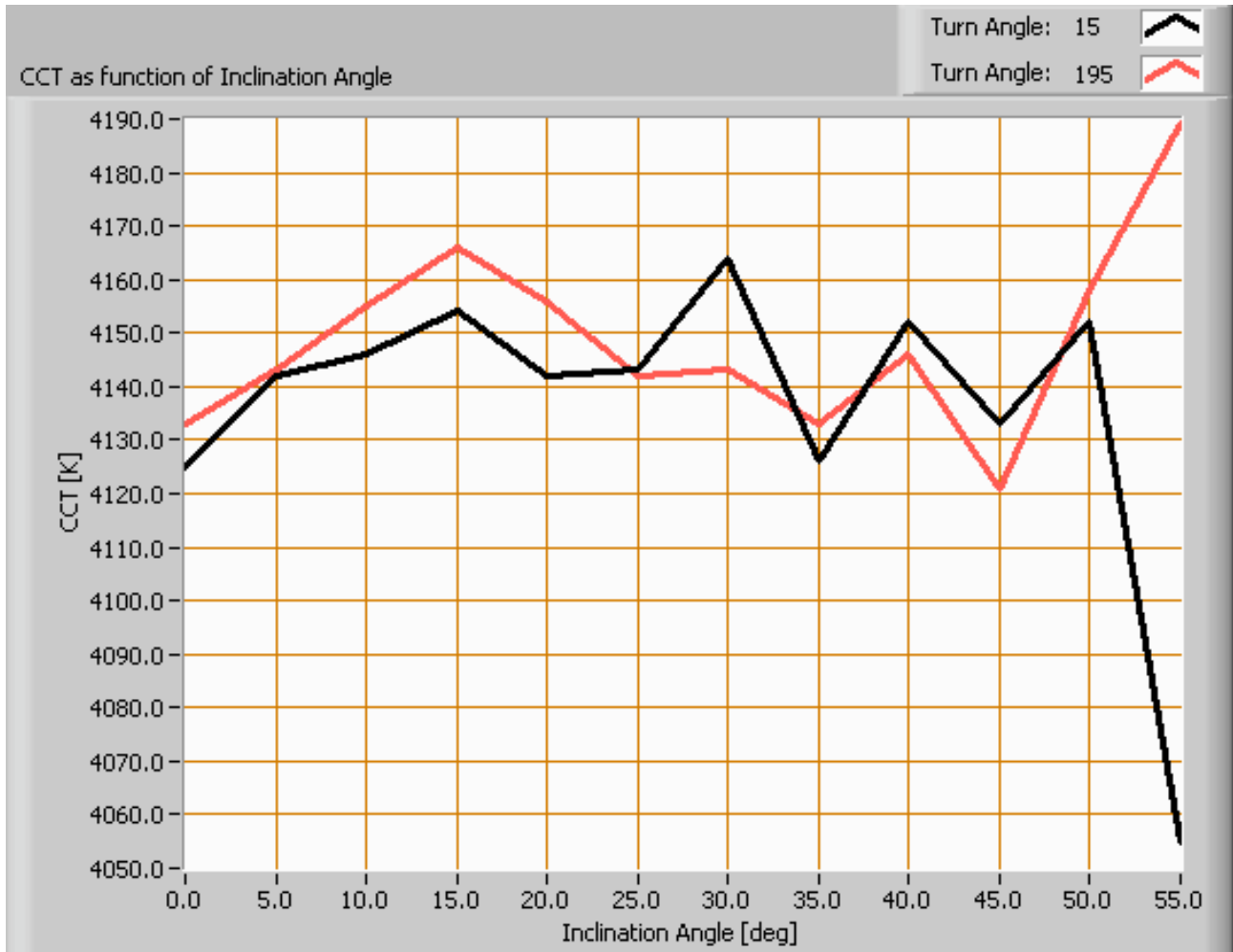


The spectral power distribution of this light bulb.

The measured color temperature is about 4125 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.

Lamp measurement report – 2 June 2009 for Line Lite International BV



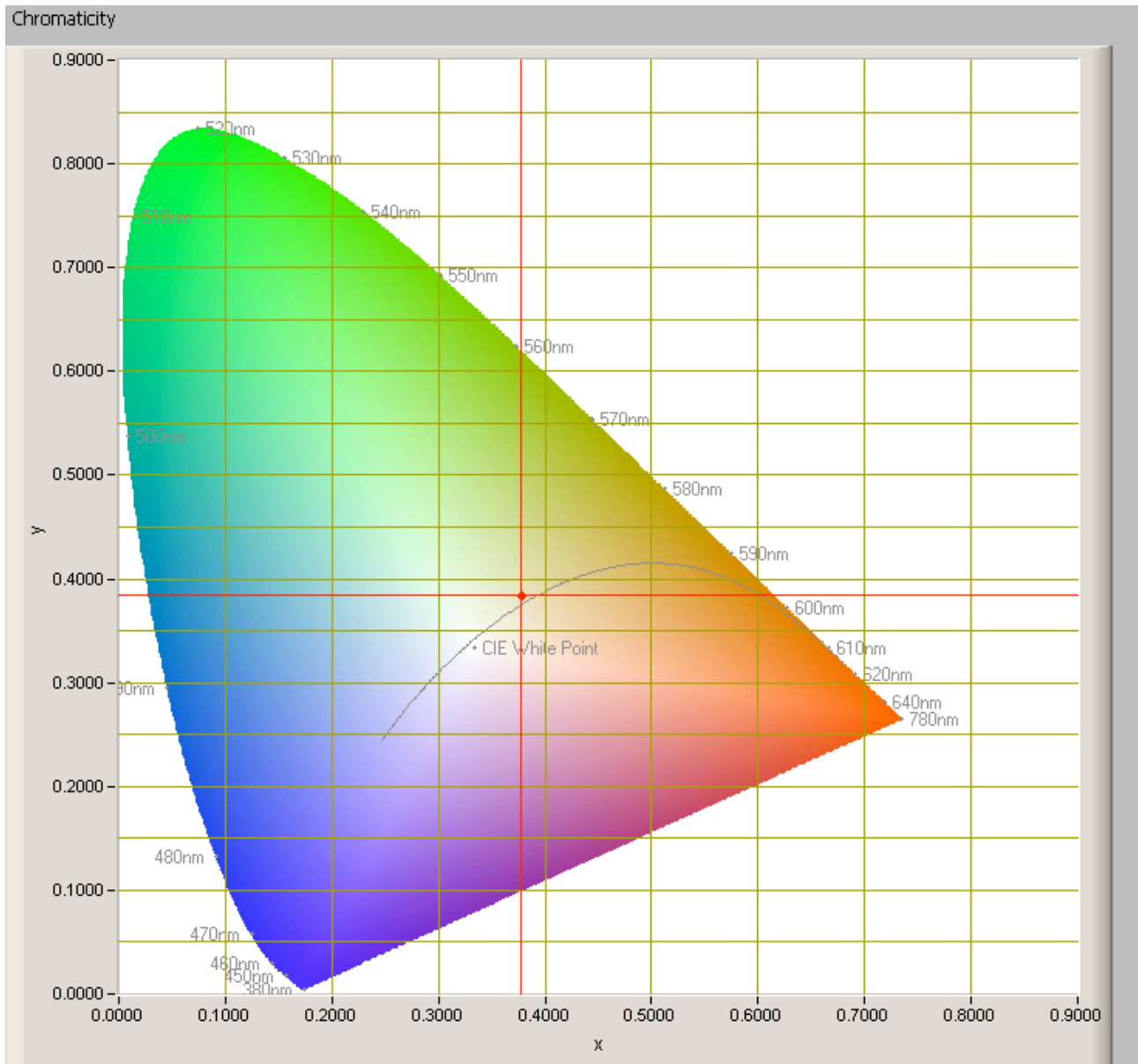
Color temperature as a function of inclination angle.

The color temperature is given for inclination angles up to 50 degrees, since at higher angles there is almost no light output anymore.

The value remains constant within 1 %.

Lamp measurement report – 2 June 2009 for Line Lite International BV

Chromaticity diagram



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

The light coming from this lamp is close to the Planckian Locus (the black path in the graph).

Its coordinates are $x=0.3776$ and $y=0.3845$.

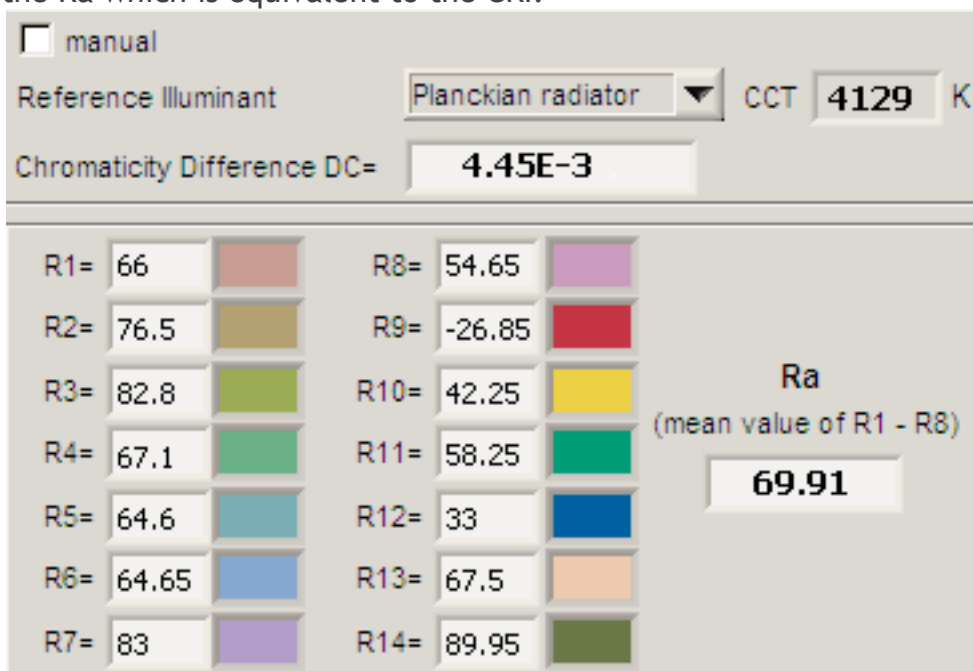


Lamp measurement report – 2 June 2009 for Line Lite International BV

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 ($R_1 .. R_8$) are averaged to compute the R_a which is equivalent to the CRI.



CRI of the light of this lightbulb.

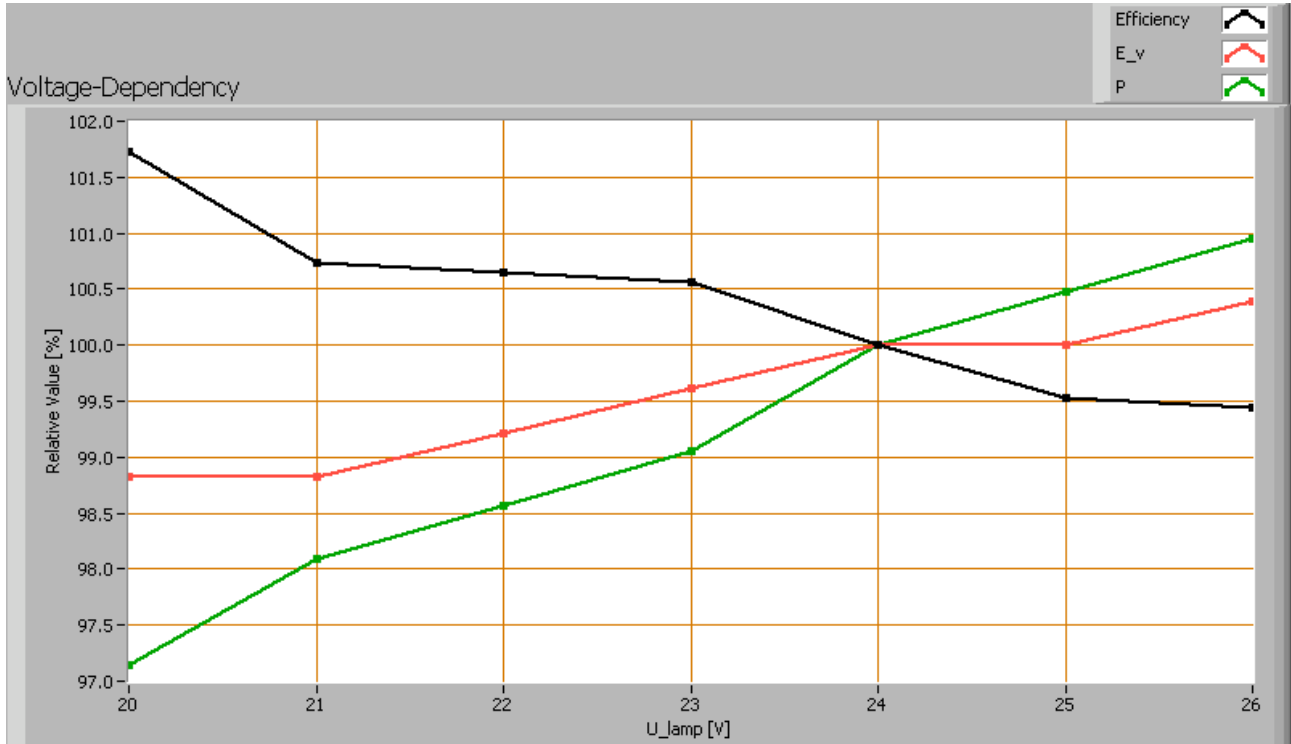
The value of 70 is lower than 80 which is considered a minimum value for indoor usage.

Note: the chromaticity difference is 0.0045 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], the lamp power P [W] and the luminous efficacy [lm/W].

Lamp measurement report – 2 June 2009 for Line Lite International BV



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

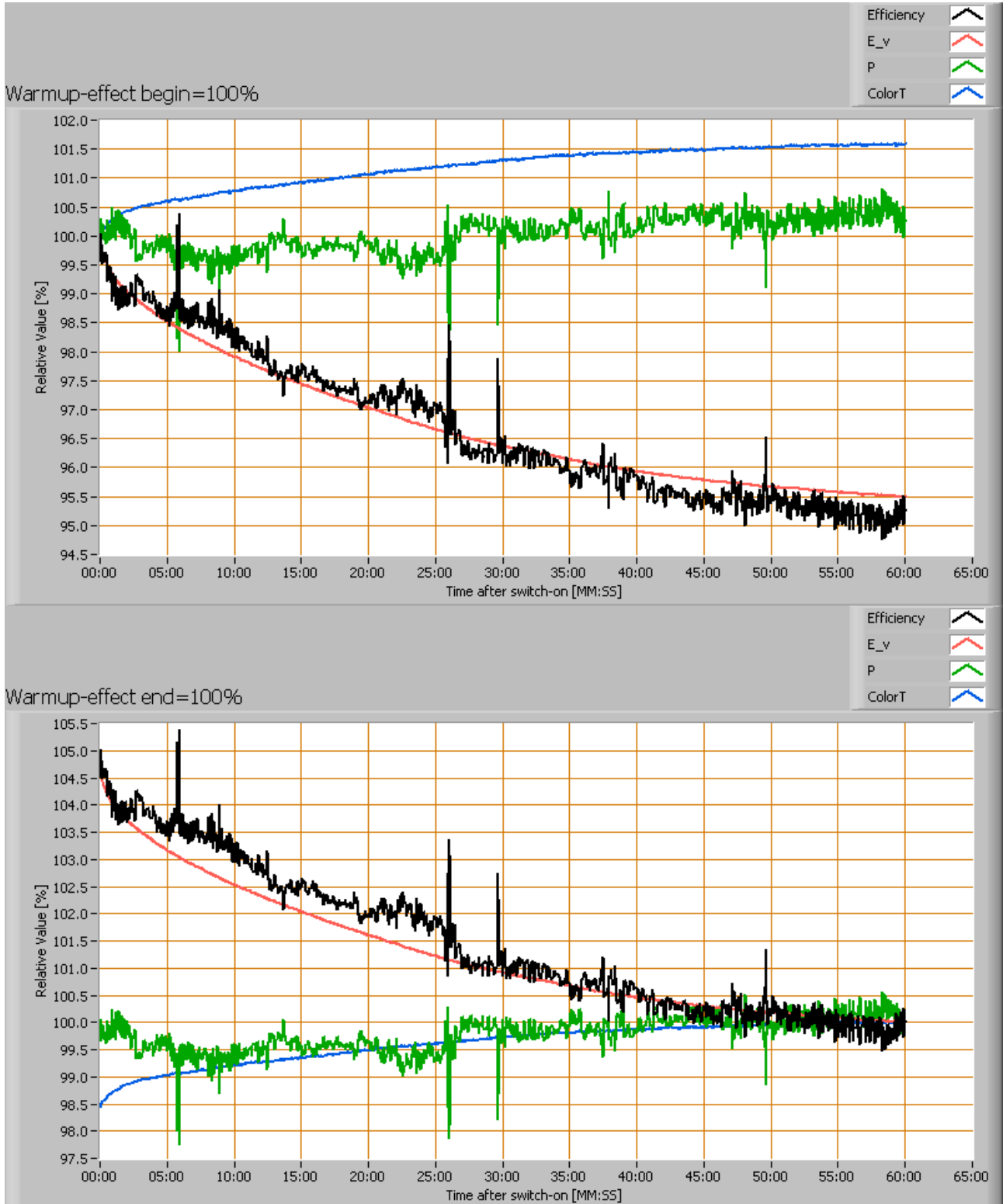
The consumed power and the illuminance vary insignificantly when the voltage varies between 21-26 V.

When the voltage at 24 V varies with + and - 1 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].

Lamp measurement report – 2 June 2009 for Line Lite International BV



Lamp measurement report – 2 June 2009 for Line Lite International BV

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 5 %, which can be neglected.

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