True specs for dimmed and colour tuned LED luminaires

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Abstract

Modern lighting installations in new and renovated commercial buildings often consist of controllable LED solutions. Luminaires are often permanently dimmed. Some installations also control correlated colour temperature (CCT) during the day. As luminaires and light sources are just characterised at full load, no one knows the actual power consumption in dimmed and colour-tuned stages. Further, well-known flicker problems typically increase when dimming. Existing characterisation methods and data-sharing formats do not carry this very relevant information.

A rapidly increasing use of controls are seen from household smart lamps with app-control, to dynamic luminaires in office environments and health care institutions. They are e.g., used to make the light follow the rhythm of daylight and for stimulation of nonvisual effects of light, e.g., for support of alertness and circadian rhythm.

Today, lamps and luminaires are just measured at full load as regulations [1] only set requirements for this and for standby power. The luminaire data is usually stored in IES and/or EULUMDAT files, and these just contain light intensity distribution, luminous flux, active power, CCT, and CRI for one setting only.

The question is how these dynamic light sources should be characterised, at which and how many settings, and how should the data be shared to enable efficient and accurate lighting design and simulation of systems. IES TM-33-18 [2] is a standard format that adds new characteristics e.g., spectral power distribution, different color rendering parameters, and parameters for temporal modulation of light, like the stroboscopic visibility measure, SVM, all for different settings. The problem is that this standard is not used much, and therefore efforts are taken in this work to support and influence global lighting data format [3] e.g., through IES, ISO and CIE.

Methods and results

An app-controlled dynamic LED smart lamp was selected for test to demonstrate the problems above. It was measured according to the international test standard CIE S025 [3] using an integrating spherespectroradiometer. In Figure 1 the measured luminous efficiency is seen to decrease when dimming, with highest drop going from 50 to 25%. At full load, 100%, the efficiency is highest for 4000 K with a value of 90 lm/W and lowest for 2200 K with a value of 63 lm/W.

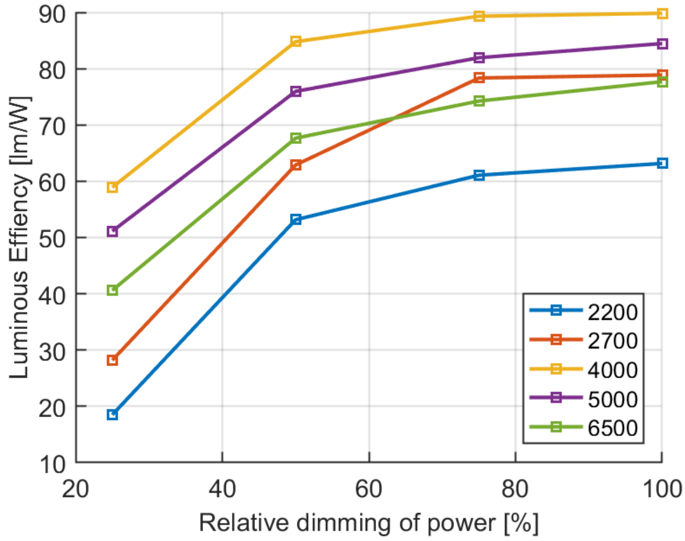

Figure 1, efficiency, measured luminous efficiency as a function of the relative power level in %, for five different CCT settings.

In Figure 2 the measured SVM increases from values below 1 at 100% to a value of 1.8 at 25%, making the stroboscopic effect visible for most observers.

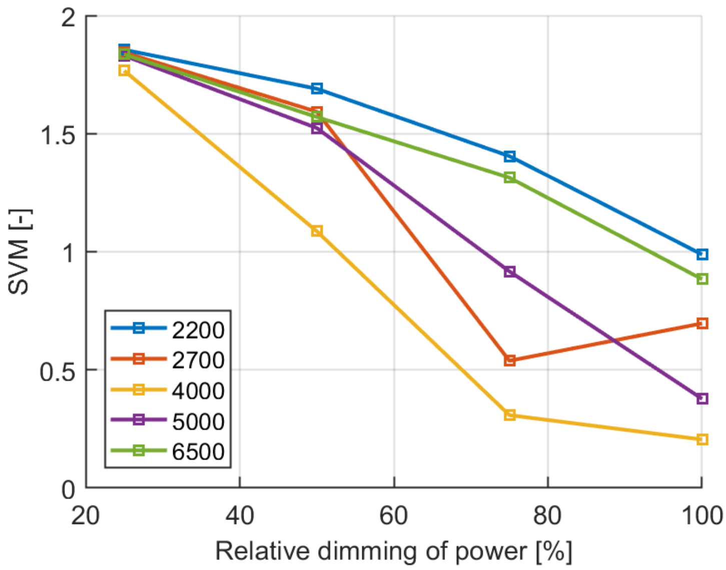

Figure 2, SVM, Measured SVM as a function of the relative power level in %, for five different CCT settings.

Conclusion

Measurement results shows very large variations in efficiency and SVM for the different settings, illustrating the need for extensive testing. Data are needed for reliable simulations since calculations will depend strongly on the chosen settings, and examples of datafiles will be given. Result will be used for test standard development for dynamic LED luminaires. This work is supported by ELFORSK through the project 353-014.

Keywords

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Dynamic lighting, LED luminaires, efficiency, metrology, dimming

References

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