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Background for the EUROPEAN LED QUALITY CHARTER

This short report is to a large extent in the format of the European LED Quality Charter and provides reference to quality requirements from organisations around, take care of comments received and gives justification for the performance and other criteria included in the European LED Quality Charter.

US Energy Star requires dimensions are not to exceed target diameter and length as per ANSI C78.20.2003.

March 2010, ELC and CELMA propose to require that directional retrofit LED lamps shall be designed physically and functionally to replace GLS and halogen reflector lamps with reference to the maximum outline specified by IEC.

EU LED QC requirements:

Directional retrofit LED lamps shall be designed physically and functionally to replace GLS and halogen reflector lamps with reference to the maximum outline specified in IEC 60630.

6. Glare, Light distribution and Blue light hazard

Measurement of the intensity of light from the source itself is important given the small size of LED lights and their corresponding brightness, which can cause discomfort glare as well as injury if users look directly into the light e.g. a test report [14] informs glare varied by a factor 1.4 and that glare was above the acceptable threshold in most cases. Unfortunately, many DLS applications with halogen lamps also give glare. At least, the problem should not be increased with use of LED lamps. Limiting glare (UGR) values are specified for many commercial applications.

US Energy Star requires brightness equal to or greater than existing lighting technologies and well light distribution over the area lighted by the fixture.

Blue light hazard is a very important issue that many people. In France[15], they have made some calculations based on the 2006/25/EC directive and found that for some cold white LEDs with flux higher than 200 lm should be considered as class 2 hazard = irreversible eye damage for exposure time in the order of 50 to 100 seconds while warm white LEDs are always class 0 with no risk. For class 2 lamps (available at the market), UK recommends to mark on the LED package to use protection glasses.

It could be recommended that brightness shall stay lower than 15,000 cd/m^2[16] in direct vision (= that the eye can see at normal standing or sitting position) for CCT corresponding to cold and neutral white while higher values might be acceptable for CCT corresponding to warm white. This requirement is directly linked to the blue light hazard for the retina[17].

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[14] "Measured off-grid lighting system performance", Evan Mills, LBNL and Arne Jacobsen, Schatz Research Center, Technical report 4, The Lumina project, December 2008, http://light.lbl.gov.

[15] Personal communication with professor Georges Zissis, LAPLACE University Paul Sabatier, Toulouse, France.

[16] Empirical value used by lighting engineers with origin from CIE work

[17] CIE Light and Lighting Conference with Special emphasis on LEDs and Solid State Lighting, May 2009, "Assessment of Optical Radiation Hazards of LEDs", Prick von Nandelstadh, Finnish Institute of Occupational Health, New Technologies and Risks, Helsinki, Finland.

EU LED Quality Charter requirements:

The visible radiation hazard class (ranging from 0 to 3) shall be 0 or 1 for all LED lamps sold in the residential marked.

7. **Dimming, automatic daylight shut-off and/or motion sensors**It is important to know if the lamp is available with dimming, automatic daylight shut-off (especially important for outdoor models) and/or motion sensors.

LENI (Light Efficiency Numeric Indicator) will require there are LE lamps including occupancy sensors and daylight sensors and perhaps also brightness sensors at the market primary for use in the commercial sector but this information may be passed on for application in the household sector.

For some indoor models, US Energy Star requires the LED lamp shall be available with dimming. For some outdoor models, US Energy Star requires that automatic daylight shut-off plus motion sensors shall be available.

UK EST requires that dimmable LED lamps shall be compatible with all dimmers available through major retailers. In the future, UK EST expect to require that all lamps shall be capable of dimming.

EU LED QC requirements:

No performance requirements concerning dimming.

8. **Stroboscope effect and flicker**

Power supplies using pulse-width modulation makes the LED blink/flicker with a certain frequency (typically between 100 and 150 Hz). The flicker frequency is not directly visible but may lead to: a) Stroboscopic effects on rotating objects (making it look like it is not moving or like it rotates at another speed or direction). b) "Cascades" of bright points in the visual field when moving the visual direction rapidly i.e. when turning the head.

US Energy Star requires the frequency ≥120 Hz and no flicker when the LED is dimmed at all light output levels.

EU LED QC requirements:

The frequency is required to be ≥100 Hz. No flicker must appear when the LED is dimmed covering all light output levels.

9. **Power factor**

There is no power factor regulation requirements for appliances and lamps with power below 25W which include all LED lamps for sales as replacement lamps for incandescent lamps.

For thirty years, it has been discussed whether the potential benefits to the electric grid of requiring high power factor CFLs and later LEDs outweigh the potential costs and risks that such requirements would produce. The debate often expose a lack of understand of the difference between active, reactive and apparent consumption and that the concept of the power factor (PF) is based on the fundamental frequency (50/60 Hz) whereas in practice we are dealing with