MEGAMAN®
Energy Saving Lamps

Comments to Energy Star requirements for Integral LED Lamps Draft 3

1. The determination of efficiency of the Directional LED lamp

Regarding the directional lamp requirement, minimum luminous efficacy needs to fulfill.

Minimum luminous efficacy - Lamp diameter ≤ 20/8 inch - Lamp diameter > 20/8 inch	 40 lm/W 45 lm/W	LM-79-08	10 units per model - 5 base-up - 5 base-down 9 of 10 lamps must meet specification	

However, this requirement may not appropriate to directional lamp. For general, domestic illumination, non-directional light sources (NDLS) are most suitable and all emitted lumens are functional. For directional light sources (DLS) that are intended for accent lighting, only the lumens that are emitted in a solid angle are functional. Any light emitted out of the solid angle is not useful and should therefore not be measured (i.e. stray light). Therefore, minimum luminous efficacy may not necessary to keep.

According to EN 12665, the definition of luminous flux, luminous intensity and luminance are as follow:

Luminous flux: Quantity derived from radiant flux (radiant power) by evaluating the radiation according to the spectral sensitivity of the human eye (as defined by the CIE standard photometric observer). It is the light power emitted by a source or received by a surface.

Luminous intensity (of a point source in a given direction): Luminous flux per unit solid angle in the direction in question, i.e. the luminous flux on a small surface, divided by the solid angle that the surface subtends at the source.

Luminance: Luminous flux per unit solid angle transmitted by an elementary beam passing through the given point and propagating in the given direction, dived by the area of a section of that beam normal to the direction of the beam and containing the given point.
It can also be defined as:

a) *The **luminous intensity** of the light emitted or reflected in a given direction from an element of the surface, divided by the area of the element project in the same direction.*
b) *The illuminance produced by the beam of light on a surface normal to its direction, divided by the solid angle of the source as seen from the illuminated surface.*

It is the physical measurement of the stimulus which produces the sensation of brightness.

Due to the above definition, directional lamp should consider the luminous intensity due to LED lamp bulb is a point source in a given direction and when it applies into real life usage, the luminance will be the lighting design criteria. EN 12464-1 has introduced the lighting design criteria.

According to clause 4.1 of EN 12464-1, the design criteria of luminous environment are as follow:

For good lighting practice it is essential that in addition to the required illuminance, qualitative and quantitative needs are satisfied.
Lighting requirements are determined by the satisfaction of three basic human needs:

- *visual comfort, where the workers have a feeling of well-being; in an indirect way also contributing to a high level,*
- *visual performance, where the workers are able to perform their visual tasks, even under difficult circumstances and during longer periods,*
- *Safety*

Main parameters determining the luminous environment are:

- ***luminance distribution,***
- *illuminance,*
- *glare,*
- *directionality of light,*
- *colour rendering and colour appearance of the light,*
- *flicker,*
- *daylight.*

Base on the above supporting, luminous intensity and the solid angle are the main parameters for LED directional lamp and luminous flux may not be useful due to it has considered all the radiant power emitted from the bulb but stray light would be included. Therefore lumen per watt cannot reflect the real situation of the useful light.

A more useful way of measuring the efficiency of the directional LED lamp is to focus on the intended replacement CD & beam angle.

1. For example, a 15W LED lamp can generate 3200cd with a beam angle of 25deg can competently replaces a halogen 75W PAR 30 / 25deg/3200cd.
There is 5 times of energy savings already in actual performance and there is no need for lumen efficacy of 45lm/W.

2. In another example, it is possible for a 15W LED PAR38 to generate 4300cd with a beam angle of 25deg. This is in fact competent performance to replace and retrofit the existing 100W halogen lamp. However, in order to meet the lumen per watt requirement, the manufacturer may not fully utilize the by reducing 1W to meet the 45lm/W and seek to replace 75W halogen instead of the 100W halogen lamp when the LED lamp is optimised in performance. This in fact will be counter-effective when lumen efficacy is required for reflectors lamp.

On the other hand, there is always lumen loss due to the reflector; a typical LOR for a good reflector lamp, compared to a non-reflector lamp can be considered as 0.8. Therefore, a correction factor should be applied for the reflector lamps to overcome the loss from the reflector. The latest preparatory studies for directional lamps from VITO have a proposal of a correction factor 1.25 applied to calculate the energy grading. (Please see page 73 of the attached study).

The values should be measured in compliance with EN and CIE standards (see chapter 1) (i.e. lamp lumen output measured after a defined period of operation) with the following additional corrections:

- For halogen reflector lamps, GLS-R or LED-R retrofit lamps the nominal luminous flux in a 90° cone of the lamp multiplied by 1.25;
- For CFLi-DLS lamps claimed to be retrofit lamps to halogen lamps, the nominal luminous flux in a 90° cone multiplied by 1.25;
- For CFLi-DLS lamps that make no claim to retrofit halogen lamps, the nominal luminous flux in a solid angle of π sr or a 120° cone multiplied by 1.25;

2. Power factor

Power Factor	For lamp power ≤5W, no minimum power factor is required For lamp power >5W, power factor must be ≥ 0.70	ANSI C82.77-2002 LM-79-08	10 units per model - 5 base-up - 5 base-down Average of 10 samples ≥0.70	DOE CALiPER Recognized or NVLAP Accredited for LM-79

Besides, power factor is not necessary to keep in 0.7 for lamp power > 5W. During the meeting minutes in European Commission dated 26 May 2009, it also claimed that raising the power factor is not necessary and will cause a higher price. (Please see page 6 of the attached meeting minutes)

Power factor:

ELC is preparing a statement about this issue. They claim that raising this power factor for lamps is not necessary and will cause a higher price.
The consultants admit that under the influence of different quality charters, the negative influence of the power factor on energy consumption (+5%) is exaggerated. They intend to lower this factor in this second part of the study for lamps with wattages lower than 25W (a.o. LED's).
PLDA refers to the New-Zealand situation where high power factor lamps are sold at lower prices than low factor ones.
Consultants react by saying that the experience of most European operators shows that their electricity distribution networks have more inductive than capacitive loads; as a consequence no problems are to be expected. Moreover lighting industry is already using the highest quality parameters on EMC compared to other domestic appliances and ICT equipment.

In conclusion, it is not necessary to keep 0.7 for the LED lamp > 5W.

3. Color Rendering Index

The Color Rendering Index has revised from 80 to 75.

Color Rendering Index (CRI)	Minimum CRI (R_a) of 75. In addition, the R_9 value must be greater than 0.	LM-79-08 ANSI C78.377-2008 CIE 13.3-1995	10 units per model - 5 base-up - 5 base-down Average of 10 samples must meet specification; none lower than 72	DOE CALiPER Recognized or NVLAP Accredited for LM-79

The stakeholders cited the technical difficulty of meeting 80 CRI at high efficacy levels. However, LED lamps should be the replacement of CFL in the future. The CRI of the current Energy Star requirement for CFL is 80 therefore we propose to keep CRI 80 for the integral LED lamp requirement due to LED is an advance technology comparing with CFL. Hence, the CRI is an important parameter to reflect the color quality. Apart from the efficacy, we should also take more concern in color quality.

4. Questions on the test procedures for Lumen Maintenance

Lumen Maintenance	≥ 70% lumen maintenance (L_{70}) at 25,000 hours of operation	LM-79-08; Elevated Temperature Test per ENERGY STAR CFL version 4.0; LM-80-08 (for early initial qualification option)	10 units per model - 5 base-up - 5 base-down -Must operate at 45°C between measurements. -Average of 10 samples must be ≥ 91.8% at 6000 hours	DOE CALiPER Recognized or NVLAP Accredited for LM-79

Elevated Temperature Test per Energy Star CFL version 4.0 is one of the reference test procedure. Since Elevated Temperature Test per Energy Star CFL version 4.0 has 2 options of test method. Would these 2 options are applicable to the integral LED aging?

Hence, the specific requirement has mentioned “Must operate at 45°C between”. Would this apply to the ambient temperature?