December 2016

Frequently Asked Questions on alleged LED health related issues

With the phasing-out of incandescent lamps in many countries, the introduction of new LED based light sources and luminaires sometimes raises the question of whether the spectral characteristics of the LED are suitable to replace traditional incandescent lamps. In the following, specific concerns are taken up and answered in detail.

1. Is LED light dangerous for the eyes because they produce more blue light than other lamp types?

Summary:
LED lamps do not produce more blue light than other types of lamps of the same color temperature. The idea that LED lamps emit dangerous levels of blue light, is a misunderstanding. When they were first introduced, most LED products tended to have cooler color temperatures. Some have mistakenly concluded that this was a built-in characteristic of LED. Nowadays, LED lamps are available in all color temperatures, from warm white to cool, and are safe to use for the purpose for which they were designed. All products made by Lighting Europe members comply with the applicable European safety standards.

Technical details:
Commonly discussed risks from light on the eye are the blue light hazard (BLH) and potentially a link with age-related macular degeneration (AMD). Typical common general illumination sources pose no risk. When these sources are used in fixtures or luminaires, the fixture or luminaire would also typically pose no risk.
Since LEDs are a relatively new lighting technology, and since earlier LED products tended to have bluer (cooler) color temperatures, some have mistakenly concluded this technology has an inherent ‘blue light issue’.
With regard to photo biological safety, LEDs are not fundamentally different to lamps using traditional technologies, such as incandescent or fluorescent (including CFL) lamps. The portion of blue light produced by typical LEDs is not higher than the portion of blue light in lamps using other technologies at the same color temperature.

Optical safety for lamps and other light sources refers to the prevention of potential hazards caused by optical radiation (electromagnetic radiation of wavelengths ranging from 100 nm to 1 mm) on eyes as well as the skin.

When looking directly into a bright light source, photochemical damage to the retina (blue light hazard) may occur, depending on the intensity involved, duration of exposure and the wavelengths of the light. People are familiar with this phenomenon from staring at the sun. To prevent retinal damage, appropriate protective eyewear must be worn when observing a solar eclipse, for instance. On a bright and sunny day, however, a natural aversion reflex occurs that protects the eye from being harmed. Furthermore, UV (ultraviolet) radiation may affect the eye, causing cataract or photo keratitis (sunburn of the cornea); IR (infrared) radiation can induce IR cataract (sometimes known as glassblower's cataract); and radiation of all wavelengths at extreme intensities can lead to retinal thermal injuries.
Optical radiation can also affect the skin causing sunburn, or, in severe cases, cancers upon long-term UV exposure or intermittent intense exposure. There exist certain groups of patients – for example those suffering from lupus or photo dermatoses - who are particularly sensitive to UV (and sometimes also to blue light) radiation. Note that the above-mentioned effects are predominantly caused by natural sun light; some of them can never be evoked by artificial lighting since the exposure levels from general illumination are too low.
Nevertheless, the optical safety of commonly used light sources needs to be ensured, and this is accomplished by lighting manufacturers meeting applicable safety standards that have been developed by experts and which are adopted or otherwise accepted in their respective countries or regions.

Photo biological Risk Assessment and Conclusions

The photochemical blue light hazard can be evaluated on the basis of several global standards that are based on the same accepted science but published by different organizations.
The General Product Safety Directive 2001/95/EC and the Low Voltage Directive 2014/35/EU requires as safety principles that with light sources and luminaires no danger from radiation can occur.
In Europe, EN 62471 is the product safety standard for lamps and lamp systems and is harmonized under the European safety directives
EN 62471, which is based on the international IEC 62471 standard, classifies light sources into Risk Groups 0, 1, 2 and 3 (from 0 = no risk through to 3 = high risk) and provides for cautions and warnings for consumers if needed. Typical consumer products are in the lowest risk category.
The risk level is determined according to assessment criteria intended to reflect various exposure scenarios:
General lighting is assessed at a location with an illuminance of 500 lx (a typical value for general lighting purposes). The 500 lx criterion has to be used for lamps intended for lighting of e. g. offices, schools and factories.

For all other lamps and lamp systems, the photo biological safety is assessed at a distance of 200 millimeters. This is used, for example, for lamps used in professional uses as such film projection, reprographic processes, sun tanning, industrial processes, medical treatment and searchlight applications. It is important to recognize that this is the assessment distance and people may be exposed at different distances. However, for lamps in Risk Groups 0 to 2, no further assessment of exposure of people is usually required.
After proper evaluation by either method, a light source is given a risk group (RG) classification, which indicates whether the source presents a risk and, if so, what labelling requirements should be undertaken to alert the user or other protection measures required.

Typical common general illumination sources pose no risk. When these sources are used in fixtures or luminaires, the fixture or luminaire would also typically pose no risk. RG classification of the source or luminaire is addressed as follows:
1. A luminaire employing a light source classified RG0 or RG1 requires no warning or caution.
2. If a luminaire uses a light source from a higher risk group (RG2 or RG3), product information must indicate the mentioned RG class and include suitable warnings or cautions.

In this manner, the end use product is suitably labelled if a potential risk exists.
In the evaluation of blue light hazard, it became clear, that different interpretation of the standard can exist, which might lead to a variation in risk classification. A more simplified solution was published as IEC 62778. The evaluation of blue light hazard is always done with a distance of 200 millimeters. As luminance, cannot be increased by components like optics or reflectors, the light source represents the highest possible risk and the classification of the light source can be taken over for the luminaire.
Where a product is evaluated as RG 2, IEC 62778 illustrates with a flow chart, how the limiting value of illumination level can be achieved by increasing the distance between viewer and luminaire (light source) and the distance where the equivalent of RG1will be reached.
In the attachment to IEC 62278 there are tables, showing the limiting value for luminance and illumination level of light source or luminaire in relation to color temperature. With these limiting values a classification without measurement can be done. However, it should be noted that the assessment method in IEC 62278 can be much more restrictive than the 500 lx method in EN 62471.

Standards help in the implementation of legal requirements. This is also true for the evaluation of the blue light hazard. By integrating the relevant requirements in the product safety regulations, the application of EN 62471 becomes unnecessary. Measurement and labelling of light sources and luminaires can be dropped or reduced to the absolute minimum. In the evaluation of the blue light of luminaires, the blue light evaluation of the light source can be assumed, as the hazard cannot be increased via the luminaire construction.

LEDs compared to other light sources
Since LEDs are a relatively new lighting technology, and since earlier LED products tended to have bluer (cooler) color temperatures, some have mistakenly concluded this technology has an inherent 'blue light issue'.
Regarding photo biological safety, LEDs are not fundamentally different to lamps using traditional technologies, such as incandescent or fluorescent (including CFL) lamps. The portion of blue light produced by typical LEDs is not higher than the portion of blue light in lamps using other technologies at the same color temperature. If LED or CFL retrofit products are observed in comparison to the products which they are intended to replace (e.g. LED MR16 vs. Halogen MR16, or a LED retrofit with screw base vs. frosted incandescent lamp), the risk group ratings are similar.
While the amount of energy in the blue portion of the spectra varies across lamp types, the overall contribution of blue is not appreciably different when evaluated for photo biological impact since the equations used to determine risk properly account for the spectral power distribution of such sources.

1a. Does a LED product become dangerous over lifetime due to the ageing of the yellow phosphor?

Summary:
European safety standards classify products into risk categories. Typical consumer products are in the lowest risk category. The classification into risk groups does not change over the lifetime of the product. Besides, although yellow phosphor degrades, the amount of blue light from an LED product will not change.

It is not expected that the absolute amount of blue light radiated from an LED will increase due to degradation over life of the yellow phosphor. The photo biological risk will not increase beyond the risk established at the beginning of the product lifecycle.

1b. Can the ageing of a phosphor cause more blue light to be emitted from the LED?

Summary:
Phosphor, applied in LEDs, degrades over time, but the share of blue light does not increase absolutely.

Technical details:
In theory yes: if a phosphor bleaches under degradation, i.e. it does not absorb the blue light as efficiently.
In practice no: the only potential LED phosphor known that shows bleaching is organic phosphor, but they are not applied in practice, certainly not directly on the LED
There are of course degradation mechanisms where the relative blue intensity increases, e.g. when the Ag mirror degrades, but we never see it increase absolutely

1c. Are the eyes of children affected particularly from blue light?

Summary:
A child's eye is more sensitive than an adult's eye. However, lighting products used in homes, offices, stores and schools do not produce intense and harmful levels of blue light. This can be said for various product technologies, such as LED-, compact or linear fluorescent- or halogen lamps or luminaires.

Technical details:
The lens of a child's eye filters blue light less efficiently than an adult's lens. Children are thus more sensitive to blue light hazard. However, it is not necessary that LEDs (or blue light in general) should be avoided in an environment with children present, since general illumination products used in homes, offices, stores, and schools do not produce intense levels of blue light. Since such applications have a low surface brightness (intensity) even "pure" blue light is completely harmless, regardless of whether it is the blue produced by LEDs or other common residential light sources, or the blue light found in sky light. (By way of a very simple example, the blue light from a blue LED Christmas tree lighting is no more hazardous than the blue light produced by its less efficient blue incandescent Christmas tree lighting.) However, children will find blue light considerably brighter than an adult, which can cause discomfort and stress. Therefore, installations using blue light LED, particularly with small sources (high luminance) should be assessed taking account of the increased transmission of the blue light to the retina.

1d. Is guidance needed for people with high sensitivity for blue light?

Summary:
LED lamps do not produce more blue light than other types of lamps of the same color temperature. People with blue light sensitivity (such as lupus) should consult their health care provider for special guidance on lighting.

Technical details:
The above statements are valid for healthy people in the public. However, people who have been medically diagnosed with highly sensitive skin or eyes for blue light may be wise to investigate alternative light sources that operate on a more specific radiation band not covered by the applied action curves that cover a broad range of radiations. As with any medical condition, people with blue light sensitivity (such as lupus) should consult their health care provider for special guidance.

2. Is there a risk for the eye from looking into an LED?

Summary:
Typical consumer products, light sources and luminaires, fall in the lowest risk category of the European safety directive. In normal use, they pose therefore no risk independent from the product technology (LED, fluorescent or halogen) used.

Technical details:
As described in detail under 1., the Technical Report IEC 62778 has been developed to evaluate the risk of high blue light density from LED in the case of looking at a light source. This Technical Report provides information and explanations on the blue light assessment of light sources (e.g. components, lamps, luminaires …) and measures that risk group 1 according to IEC 62471 – photo biological safety of lamp and lamp systems is not exceeded.

When evaluating photo biological risks, we need to consider the more severe case of looking directly into a light source. In everyday situations, this rarely happens. However, the standard EN 62471 was originally developed to protect workers particularly in the lighting industry, as lighting installers or in similar fields. It may happen that such professionals look into light sources several times a working day accumulating exposure to several seconds. In this situation, the blue radiance (to be precise: the spectral radiance of blue proportions of the lamp spectrum) is the critical factor for Blue Light Hazard (BLH) (the higher the radiance in the relevant action spectrum, the higher the likelihood that light hits photo pigments (with sufficient energy) and cause potential damage.

3. Are there flickering and stroboscopic effects from LED lighting that negatively impact the well-being and comfort of people?

Summary:
Lighting products, whether based on LED or fluorescent lamp technology, that exhibit flicker or stroboscopic effects are considered not good quality lighting. Current standards, however, do not define maximum permissible levels of these effects. LightingEurope has requested the market in a recent position paper to support research that defines acceptance criteria in the various applications so that products can be classified correctly.

Technical details:
The position paper on flicker and stroboscopic effects can be found on the LightingEurope website

Contact: Axel Baschnagel, LightingEurope, communication consultant, axel.baschnagel@lightingeurope.org