LED WATCH

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HOW SAFE IS THE LIGHT FROM LEDs?

A new report separates fact from fiction regarding the potential for damage caused by LEDs

The spectral emission of LEDs is a frequent topic of conversation among lighting professionals and others. There's no shortage of published material—some of it based on myth, some of it factual, and some of it a combination of the two—addressing the spectral power distribution (SPD) of LED products used for general illumination. So the question is: how safe is the light from LEDs, both for our health and for objects of value? The U.S. Department of Energy (DOE) recently published a technical brief on the topic to clarify any misconceptions people may have. Entitled *True Colors: LEDs and the Relationship Between CCT, CRI, Optical Safety, Material Degradation, and Photobiological Stimulation*, it separates myth from fact about the potential of LEDs to cause retinal damage, changes to artwork or other media, and stimulation of human circadian functions (which affect health). Based on standard blue-pump, phosphor-converted LEDs, the technical brief uses an example data set of 20 CALiPER-tested LED lighting products with nominal CCTs between 2700K and 6500K and CRIs between 62 and 98—for all intents and purposes, the range of what's commonly available on the market today.

It's important to note that there's no difference between the type of visible radiant energy emitted by LEDs and that emitted by every other kind of light source. However, LEDs do have a unique "signature" peak in the short-wavelength "blue" region of their SPDs, around 450 nm, with a broader peak somewhere between 550-650 nm. In general, this blue peak is more prominent in higher-CCT LED products, because of the need for proportionally more blue radiation (all high-CCT light sources have proportionally more short-wavelength energy).

Because of this peak in the SPDs of most LED lighting products, a lot of the concerns about LED safety focus on what's known as "blue light," which is light in the violet and blue range of the spectrum (between about 400 and 500 nm). Light in this range is known to cause retinal damage with too much exposure, as well as to readily stimulate the circadian system and to have greater potential to damage artwork than light at longer wavelengths.

BLUE IS BLUE

But just because most LED light sources have a blue peak in their SPDs doesn't mean they emit more blue light in total, or that they necessarily have more potential to cause retinal, material, or photobiological harm. And in fact, those risks are about the same for typical commercially available LEDs as they are for other light sources *having the same CCT*. That's because, in general, those sources all contain equivalent amounts of blue light. Any correlation between CCT and optical safety, material safety and photobiological safety exists because CCT calculations also include a weighting function covering the blue-light region; so if the proportion of blue light (and any associated risk) changes, so too does the CCT.

A DOE fact sheet entitled *Optical Safety of LEDs* illustrates the strong correlation between CCT and risk per lumen for all types of light sources and concludes that, based on current standards, white-light architectural lighting products do not pose a risk for blue-light hazard—although non-white light sources (such as pure-blue LEDs) and certain specific applications with high-risk populations need to be evaluated more carefully.

Even though lighting and museum experts have debunked the idea that LEDs are more damaging to works of art and other valuable materials than are other light sources, there's still a lingering amount of uncertainty among some people. The International Commission on Illumination (CIE) spectral damage function (SDF), which provides a way to characterize the potential of a light source to damage materials and includes a coefficient to tailor the action spectrum to various types of materials, illustrates that LED products carry no greater risk than do other sources of the same CCT. Among each type of light source, there's a strong linear correlation between damage potential and CCT, with a predictable increase in damage potential as CCT increases. What's more, among the products considered by the DOE evaluation, blue-pump LEDs were generally found to be the least likely product type to cause material degradation at any given CCT, and posed no more risk than a typical (unfiltered) incandescent lamp.

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CIRCADIAN STIMULATION

The fact that blue-pump LED packages have a short-wavelength peak is also the reason for the concern that LEDs might have more potential than other types of light sources to negatively impact health by stimulating the circadian system. The assumption here is that LEDs emit more blue light; but once again, the new study shows a strong correlation between CCT and stimulation of the specialized non-visual eye cells that play a major role in the circadian photoreception system. However, there remains much we still don't know about the human circadian system, and people's nonvisual photosensitivity can be affected by their state of adaptation, the time of day, and the quantity of light—so a lot more investigation is needed in this field.

One thing about LEDs is that they can be easily engineered to have any desired CCT—and increasing the CCT of any type of light source necessitates a higher proportion of blue light. In general, CCT can be used as an effective predictor of short-wavelength content across various source types, and as a reasonable predictor of optical safety, material degradation and circadian stimulation.

For more details, see the technical brief and the fact sheet, which are available online at *www.ssl.energy.gov/factsheets.html*.

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