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Time to act on optical radiation from LED luminaires

As LED technology improves year after year with more power output, the risks for hazardous areas continue to escalate. Standards and test protocols are only now just catching up, but it will take extra actions to close the gap, says Tarmo Rintala of Atexor Oy.

Light (lumens) produced by incandescent and fluorescent luminaires has remained stable for decades, but the intense light from modern LEDs is getting more powerful every year. Focused high-powered LED luminaires can be like lasers, able to ignite even air-borne particles.

Hazardous area safety experts have been discussing this more and more as their concerns about the potential dangers of LED luminaires increase.

A luminaire intended for Ex work areas has to be tested and accepted by a Notified Body to confirm its safety against the relevant standards, including IEC 60079-28 (Protection of equipment and transmission systems using optical radiation). When purchasing luminaires for hazardous areas, one should always ask for optical radiation certification.

Are work lights really that dirty, you may ask? Well, let me put it this way: I have never seen a clean used luminaire

This was my message at the Hazardex Conference in Cheshire, England, in late February 2018, and it resonated strongly with customers and safety professionals alike. For many in attendance, optical radiation was a vague, if not completely new topic, and its practical implications were largely unknown or misunderstood.

There is a desperate need to explain the potential hazard of optical radiation in more understandable ways than just pointing to a standards number and the marking 'op is'. And the time to act on that new understanding is now.

Demystifying optical radiation

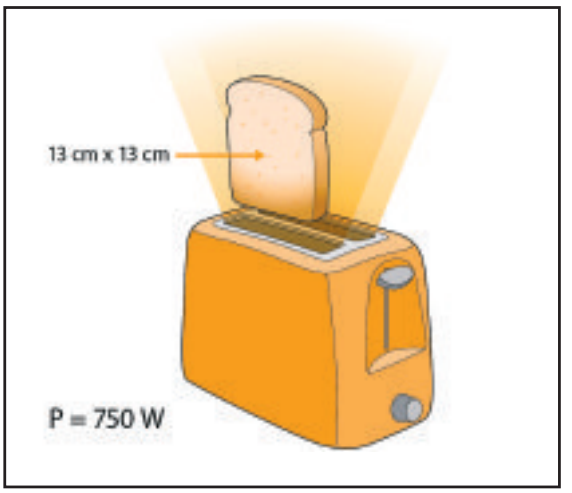
In a nutshell, the main risk from optical radiation is this: when a high-powered LED luminaire gets dirty, the dirt absorbs optical radiation energy, causing temperatures to rise and potentially creating an ignition source which may cause an explosion.

Consider a common household example of radiation, the toaster. A toaster (P=750W) toasting a 13 x 13 cm piece of bread provides approximately 5mW/mm2 of radiation during the toasting process. That is enough energy to toast the bread after a short while, or completely burn it in time.

That same amount of radiation, 5mW/mm2, is the commonly used limit for safe optical radiation in IEC 60079-28. Of course, the wavelength of toaster radiation is different from LEDs, but the underlying principles and results are the same.

With a toaster, the bread acts as the absorber of the radiation. With Ex luminaires, the absorber is a concoction of oil, dirt, grease and grime. Are work lights really that dirty, you may ask? Well, let me put it this way: I have never seen a clean used luminaire. When I visit worksites, the luminaires may look like the one illustrated at the top of this article or even worse.

Bear in mind, too, that the most common standards for temperature ratings do not take dirt into consideration. Luminaires are tested and certified when the products are fresh off the manufacturing line, in their cleanest state. If the explosion risk is from the presence of gases, optical radiation standard 60079-28 is the only standard today that specifies tests for a dirty luminaire. It even covers the worst-case scenario: a completely blackened surface.



What does 'op is' actually mean?

Decoding the 'op is' marking is quite easy:

- op = optically
- is = inherently safe

If you see that 'op is' mark on a luminaire, it means the light beam from the product cannot create an ignition source. With modern LEDs, typically the highest risk is close to the source. The energy carried in optical radiation gets weaker as it travels away from the source.

When purchasing luminaires for hazardous areas, one should always ask for optical radiation certification

There are four key factors that determine if otherwise harmless light can become an ignition source:

- the energy output of the light source,
- the focal point of the light waves,
- the distance from the light source and
- the presence of an energy-absorbing material (absorber).

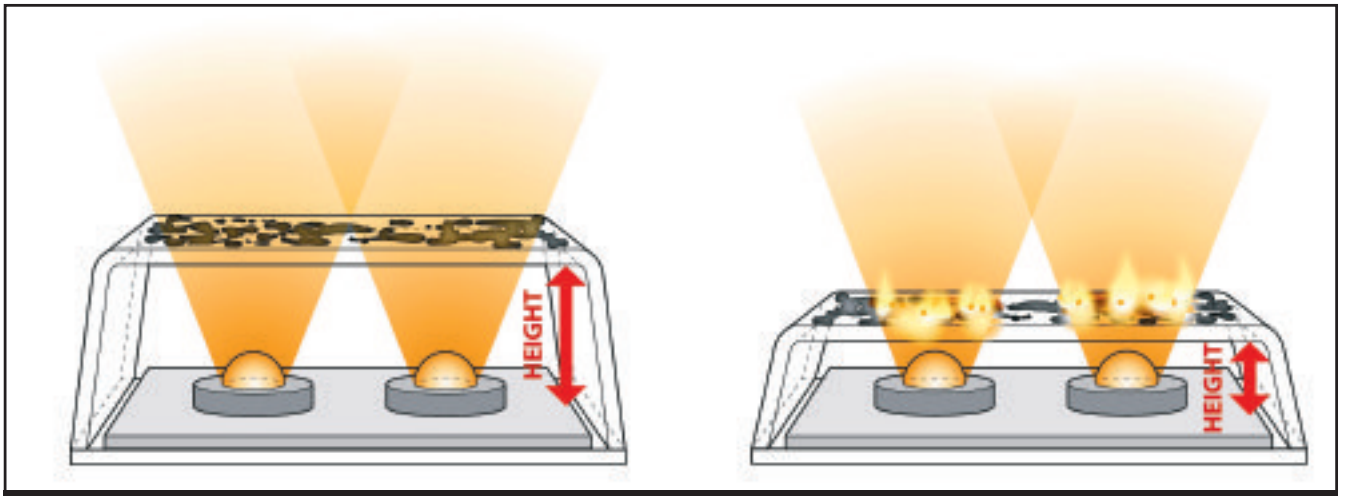
A magnifying glass, for example, can focus sunlight radiation, creating a small, yet powerful point of light that can easily start a fire. Equally, the powerful LEDs of today can create ignition sources if care is not taken in the design and manufacture of luminaires.

For Ex luminaires, the outer surface where dirt and grime collect is the main danger zone, as illustrated below:
The distance between a light source and an external surface with absorbers may be critical when taking into account optical radiation.

Progress on the standards front

"The risk of ignition due to optical radiation hazards shall always be addressed," is the expectation from IECEx Decision Sheet (DS 2017/003) loud and clear, in black and white. There is no guessing or interpretation needed. With a new IECEx-certified product, optical radiation must be taken into account. In the new IECEx certificates, there will be two options available:

- include the full reference to IEC60079-28



IP6X - The distance between a light source and an external surface with absorbers may be critical when taking into account optical radiation

including the marking ‘op is’, or
- include an explanation of why not to include full reference to IEC60079-28

Unfortunately, the IECEx DS is only valid for IECEx certificates. Within the EU, where the ATEX certification is required and IECEx is optional, optical radiation remains a clear and present danger.

To my knowledge, there are no ongoing actions to rectify this situation. All of us involved in product safety should be writing to our ATEX colleagues and encouraging them to take action without further delay.

What needs to be done now?

If you are responsible for product safety or the person who assesses Ex equipment for purchase, clearly you cannot just wait for standards to be updated and Notified Bodies to start testing new products. You have an arsenal of potential hazards already in use.

Because currently the biggest risk is with dirty Ex luminaires, that is where you need to start. Ask the simple question: are your luminaires getting dirty? If not, no further action is needed at this point.

If yes, however, you should conduct a visual inspection immediately. The best indicator of overheating is looking at the condition of the surfaces of the luminaire. These are typically made of plastic.

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Your Ex luminaires are normally rated T4: the highest temperature on the products should not exceed 135° C. However, the plastic cover on those luminaires may withstand up to 200° C. Beyond those temperatures, the plastic will start to degrade and deform.

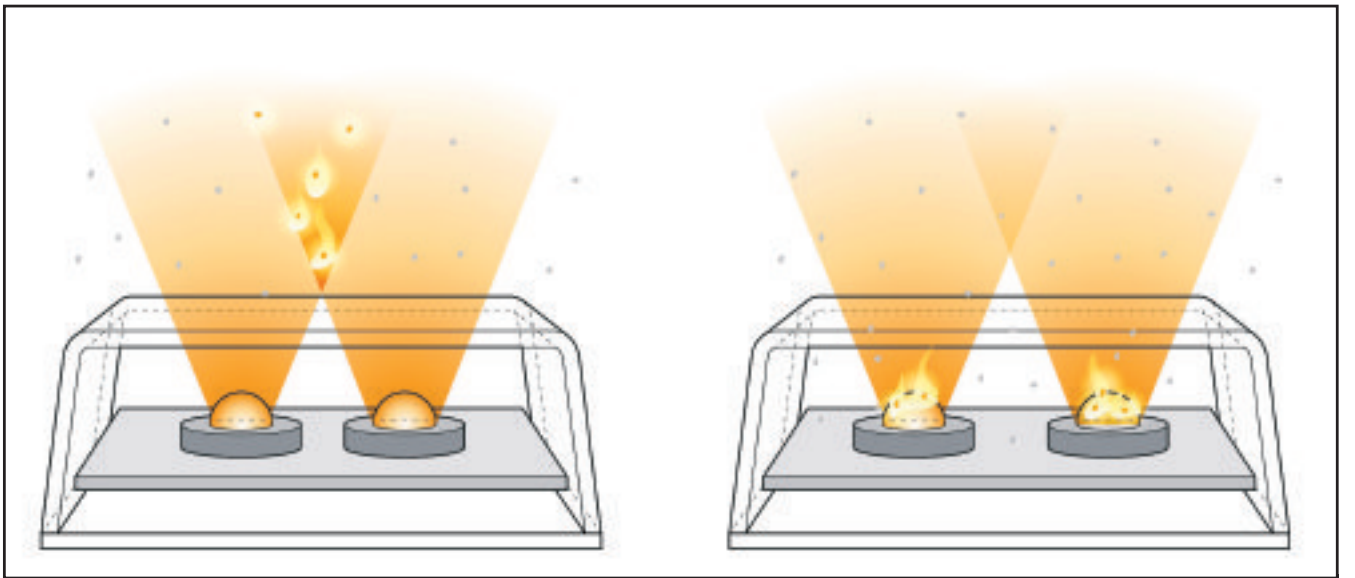
If you see any sign of deformation or particles penetrating through the surface of transparent plastic, the Ex luminaires should be taken out of use immediately! Such signs are a clear indication the luminaire is exceeding safe temperatures and poses a real explosion hazard.

Ex luminaires that pass this visual inspection are not necessarily safe, unfortunately. As a next step, you should check the product markings and certifications. If you see “Ex em op is IIC T4”, you are good to go and no further action is needed.

If you luminaire just has an Ex marking without the ‘op is’ indicator, you need to have a look at the standards listed in the certification. Do they include IEC60079-28 or not? If you have gotten upgrades since you first purchased the luminaires, you should also check if the products were re-certified with those upgrades. If the certification is lacking IEC60079-28 in either case, it’s time to make a risk assessment. ■

About the author

Tarmo Rintala is Technology Manager at Atexor Oy of Finland, which provides lighting solutions for harsh and hazardous environments, and has been heavily involved in certification processes of Ex products for over two decades. Since 2007, he has been working with particular focus on certification processes for products with ‘op is’ marking. He is a member of IEC TC 31 and IEC TC 34, as well as the national ATEX group of Finland.



IP6X - A single light source can be safe, but multiple adjacent light sources may overlap and create intense radiation

IP5X or less - If the enclosure in not dust tight (e.g. IP5X), absorbers may infiltrate the enclosure and become a possible ignition source