

Eye Safety Risk Assessment of Light or Infrared Emitting Diodes

INTRODUCTION

Product safety legislation (e.g. general product safety laws as in Europe the "low voltage- or machinery directives") requires conformity with "essential requirements", for instance, protection of health and safety that goods must meet when placed on the market. In this context, compliance with product safety standards for optical sources, such as the standards IEC 60825-1 and IEC 62471, should provide presumption of conformity with these "essential requirements". The compliance is guaranteed when the goods are classified according the standards as safe, expressed as with e.g. "class 1" or "exempt".

Therefore the operating conditions and the optical and mechanical construction of the final goods define the risk. The risk assessment of LED ⁽¹⁾ applications is not directly related to the LED component.

The risk assessment and classification is to be done with the final product, not with the built-in component. In

IEC/EN60825-1 that is expressed by "Laser products that are sold to other manufacturers for use as components of any system for subsequent sale are not subject to IEC 60825-1, since the final product will itself be subject to this standard". IEC 62471 demands a risk assessment of the lamp (LED) itself. This may be not sufficient for the application, especially when LED arrays are used.

RISK ASSESSMENT FOR LED - APPLICATIONS

Optical sources and optical radiation are covered by different regulative standards. After the latest changes in 2007 the eye safety standards compiled in the following table are applicable for LEDs.

Note

- (1) We are using sometimes in our documentation the abbreviation LED and the word light emitting diode also for infrared emitting diodes (IRED). Whenever the term LED is used, IREDs are included when not otherwise noted. That is common usage but not in agreement with IEC 60050-845.

EXAMPLE OF APPLICATIONS COVERED BY DIFFERENT OPTICAL RADIATION SAFETY STANDARDS

	IEC/EN 60825-1 ⁽¹⁾ (2007-03)	IEC 62471 (2006) CIE S009:2002 ⁽²⁾	DIRECTIVE 2006/25/EC ⁽³⁾
Fiber optical components	IEC 60825-2	x	w
Free air communication IR - remote control (TV, audio, video) IR - communication (IrDA®, home)	IEC 60825-12 removal expected	x	w
Lighting (visible und IR), lamps	-	x	w
IR - photo flash (traffic enforcement)	-	x	w
IR - light barriers	-	x	w
LED indicators	-	x	w
UV - lamps	-	x	w

Notes

w: for workers environment only

(1) **IEC/EN 60825-1 (2007-03), DIN EN 60825-1 (2008-05)**

"SAFETY OF LASER PRODUCTS - Part 1: Equipment classification and requirements"

(2) **IEC 62471 (2006), CIE S009 (2002)**

"Photobiological Safety of Lamps and Lamp Systems"

(3) **DIRECTIVE 2006/25/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL**

of 5 April 2006

on the minimum health and safety requirements regarding the exposure of workers to risks arising from physical agents (artificial optical radiation) (19th individual directive within the meaning of article 16(1) of directive 89/391/EEC)



THE DIFFERENT EYE SAFETY STANDARDS FOR LEDs

The standard **IEC (EN DIN) 60825-1** "SAFETY OF LASER PRODUCTS - Part 1: equipment classification and requirements", is applicable to safety of laser products emitting laser radiation in the wavelength range 180 nm to 1 mm. In previous editions, LEDs were included in the scope of IEC 60825-1, and they may be still included in other parts of the IEC 60825 series, as e.g. in IEC 60825 - Part 12, "Safety of free space optical communication systems used for transmission of information".

With the development of lamp safety standards, optical radiation safety of LEDs in general can be more appropriately addressed by lamp safety standards. The removal of LEDs from the scope of the Part 1 of IEC 60825 does not preclude other standards from including LEDs whenever they refer to lasers. CIE S009 or IEC 62471 may be applied to determine the risk group of an LED or product incorporating one or more LEDs.

IEC 60825-1 does not cover the LEDs emitting radiation for indication, illumination or lighting anymore.

A general standard for the safety of incoherent sources is **CIE S009** ("Photobiological Safety of Lamps and Lamp Systems"), which is published as a new common ISO/IEC standard **IEC 62471**. This is equivalent but not in all items identical with the **European Directive 2006/25/E** with the long title already mentioned above.

IEC 62471 failed to be converted and edited as EN 62471. A new edition of EN 62471-1 is under preparation. Until that is released IEC 62471 can be used representing the state of the art.

LEDs used for free air data communication (including e.g. short range applications as Remote Control or IrDA® links) are still covered by all three standards.

IEC 62471 (CIE S009) according the title "Photobiological Safety of Lamps and Lamp Systems" lets assume not only to cover the final product as IEC 60825-1 but especially the lamp. The original text, chapter 6 of IEC 62471 says it requires in first order the classification of the lamp: "This clause is concerned with lamp classification. However a similar classification system could be applicable to luminaires or other systems containing operating lamps".

While in case of e.g. incandescent lamps where e.g. in most cases just one single conventional lamp (bulb) is used for a luminaire the risk assessment can refer to the lamp. In case of LEDs with many LEDs e.g. combined in one luminaire this may be different.

LED manufacturers usually do not know the future application and would have to apply any limit set. Thus, since the risk group allocation bases in any case on the most restrictive limits, the result might be inappropriate for the future application or overly restrictive. As the laser safety standard IEC 60825-1 also IEC 62471 is to be interpreted like "The final product will itself be subject to this standard". Only this is strictly in agreement with general product safety laws (e.g. in Europe the "low voltage- or machinery directives").

For instance, the EU product safety legislation requires conformity with "essential requirements", e.g., protection of health and safety that goods must meet when they are placed on the common market. In this context, compliance with product safety standards, such as the standards IEC 60825-1 and IEC 62471, should provide presumption of conformity with these "essential requirements".

CLASSIFICATION

IREDS

Most IREDs are emitting in the 800 nm to 960 nm range. Radiation within these wavelengths causes a thermal retinal hazard and thermal injury risk of the cornea and possible delayed effects on the lens of the eye (cataractogenesis). In general the IEC 60825-1 is more restrictive in case of the thermal retinal hazard; the cornea/lens limits are only in IEC 62471 and in the European Directive 2006/25/EC.

Most of the IREDs can be classified by the simplified method according IEC 60825-1 comparing the maximum intensity emitted under absolute maximum rating conditions. When the intensity is above that limit, the source size has to be taken into account. With that none of the currently available (July/2008) Vishay IREDs violate the class 1 limit. In case of IEC 62471 and in the European Directive 2006/25/EC all Vishay IREDs are inside the exempt conditions. Only with arrays care must be taken not to violate the cornea/lens limits.

LEDs

Diode emitters in the visible spectrum cover the wavelength range from 400 nm to 780 nm including also wide band white LEDs. LEDs in the visible spectrum are used for lighting, signaling, or as indicators. Therefore the risk assessment is according IEC 62471 and in the European Directive 2006/25/EC.

Here the blue light hazard with the wavelength depending function $B(\lambda)$ is the limiting factor still on the red side of the spectrum. It has to be taken into account up to a wavelength of 700 nm.

The intensity specification of visible LEDs is done in terms of photometric units as Candela (cd). Due to the strong variation of the ratio to the radiometric units used for defining the limits this is more complicated or even confusing for the normal electrical engineer.

Nearly all LEDs are far below the Exempt limits. However, care should be taken on the short wavelength side of the spectrum. Therefore a general statement as for IREDs cannot be given.

Vishay supplies all necessary data for the risk assessment in the data sheet and on request, in case it is not published there. Either via the sales channel or simply the technical support box on the website this data will be available on request.