Safety- IR 850

The following model series refer to the safety as shown below:-

-IDS5
-BHS4
-LBRQ-3 Rows
-LBRQ-6 Rows
-LBRX-3 Rows
-LBRX-6 Rows
-LSW
-LLA
-BHLX3
-CAS2-00-025-X-X
-CAS2-00-040-X-X

General Information

As the radiated optical power of light emitting diodes (LEDs) has increased in recent years, the issue of eye safety has received an ever-increasing amount of attention. Within this context there has been much discussion about the right safety standard — either the laser standard IEC-60825 [2] or the lamp safety standard IEC-62471 [1] — to apply to the classification of LEDs. Before mid 2006 all LED applications were covered by the IEC-60825. Today most of the LED applications are covered by the lamp standard. Other than lasers, lamps are only generally defined in this standard as sources made to produce optical radiation. Lamp devices may also contain optical components such as lenses or reflectors. Examples are lensed LEDs or reflector type lamps which may include lens covers as well. The status quo is, that for different applications of LEDs, such as data transmission or irradiation of objects, different standards have to be used:

- Data transmission → IEC-60825
- Lamp applications → IEC-62471

Both safety standards do not cover general exposure scenarios and are not legally binding. However, the presented methods and limit calculations are used as a basis in regional guidelines, e.g. in the European Directive 2006/25/EC [3], which describes “the minimum health and safety requirements regarding the exposure of workers to risks arising from physical agents (artificial optical radiation)”.

Within this application note a general survey of the different hazards of IR-A radiation (780 — 1400 nm) and the basics of calculating the exposure limits are described. The different risk groups for lamp classification are introduced, and three example calculations are presented to show how to do the calculations.

This application note focuses on the IR-A range. Further photochemical hazards, e.g. by ultraviolet or blue radiation, are not considered. Only the main issues of the standard are explained and simplifications are made. The application note gives guidance to classify applications that use IR emitting components regarding eye safety.

OSRAM Opto Semiconductors gives assistance to the best of its knowledge, but does not guarantee that every hazard of any application is described by the information given in this text.

The eye safety classification of the final product, using IREDs, is the responsibility of the manufacturer.

In case you need help with the radiation safety certification of your application according to the latest available standards, please contact test houses that are accredited for offering such a consulting service

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Lamp Risk Group

According to IEC-62471-1 [1] the hazard values are reported at a fixed distance d = 200 mm. The emission limits for the risk groups are defined as (α given in rad):

- **Exempt group (no hazard)**
  $L_R \leq 28000/\alpha$ [W/m²/sr] within 10 s, acc. (8)
  L_{IR} (low vis stimulus) ≤ 6000/α [W/m²/sr] within 1000 s – for retina
  $E_{IR} \leq 100$ [W/m²] within 1000 s – for cornea
- **Risk Group 1 (low risk)**
  $L_R \leq 28000/\alpha$ [W/m²/sr] within 10 s
  L_{IR} (low vis stimulus) ≤ 6000/α [W/m²/sr] within 100 s
  $E_{IR} \leq 570$ [W/m²] within 100 s
- **Risk Group 2 (moderate risk)**
  $L_R \leq 71000/\alpha$ [W/m²/sr] within 0.25 s
  L_{IR} (low vis stimulus) ≤ 6000/α [W/m²/sr] within 10 s
  $E_{IR} \leq 3200$ [W/m²] within 10 s
- **Risk Group 3 (high risk)**
  One of the limits of Risk Group 2 is exceeded.

The labeling of the classified IR products is described in the second part of the safety standard IEC-62471-2 [4] as follows:

Hazard	Exempt Risk Group	Risk Group 1	Risk Group 2	Risk Group 3
Cornea/ lens infrared hazard 780-3000nm	Not required	CAUTION IR emitted from this product	CAUTION IR emitted from this product	WARNING IR emitted from this product
Retinal thermal hazard, weak visual stimulus 780- 1400nm	Not required	WARNING IR emitted from this product	WARNING IR emitted from this product	WARNING IR emitted from this product

Example (OSLON® Black):

Lamp classification (d = 0.2 m).

- Cornea hazard

Emission limit (EL) calculation: Assuming ideal overlap of radiation characteristics of 5 x SFH 4715AS (worst case).
=> total I_e = 3.9 W/sr

Based on (3)

$\mathbf{E_e} = I_e/d^2 = 3.9$ W/sr / (0.2 m)²
= **97.5 W/m²**
< $\mathbf{E_{IR}}$ **= 100 W/m²** (EL).

Note: E_e depends on the number of IREDs, limit would be exceeded when using more than 5 SFH 4715AS @ I_F = 1 A with ideal overlap.

- Retinal hazard

Calculation of the emission limit (EL): The angular subtense α is calculated according to (5) and (6) for the SFH 4715AS package. Using I_{LED} x w_{LED} = 1.3 mm x 1.3 mm (example from appendix).

α = Z/d = 1.3 mm/200 mm = 0.0065 rad, with Z = (l+w)/2 = (1.3 mm + 1.3 mm)/2 = 1.3 mm
=> α_{eff} = 0.011 rad (t = 1000 s) (according to Table 1)

Based on (9) the emission limit (EL) for the radiance is:
$\mathbf{L_{IR}}$ = 6000 / α_{eff} = **545.5 mW/mm²/sr**

Calculation of actual value L_{IR} based on example data:

R(λ=850 nm) = 0.50 (Figure 3)

$\mathbf{L_{IR}} = I_e \cdot R(\lambda) / ((l+w)/2)^2$ according to (10)
= 780 mW/sr · 0.50 / (1.3 mm + 1.3 mm/2)²
= **230 mW/mm²/sr**
<< 545.5 mW/mm²/sr (EL)

Summary: Limits of L_{IR} and E_{IR} are not exceeded within 1000 s.
=> **Exempt group (no risk)**

Actual exposure scenario in example 2 with distance r > 1 m:
$E_e = I_e / d^2 = 3.9$ W/sr / (1 m)²
= **3.9 W/m²**