LUXEON C and
LUXEON Flash
Photobiological Safety
Report

Application Brief AB41

LUXEON
NEVER BEFORE POSSIBLE

LUXEON® C and LUXEON® Flash

Photobiological Safety Report

Introduction

Unlike a laser, which is a coherent monochromatic light source, LEDs (light emitting diodes) are an incoherent, broad-band optical source that spans the visible wavelength from the 400 nm to 780 nm range. The determination of the photobiological safety for both skin and eyes for lasers and LEDs are very different and are covered by various safety standards. In the past LEDs were included in the laser eye safety standards (IEC 60825) but are now part of the lamp standards (IEC 62471).

Regardless of the risk factor classification, Philips Lumileds does not recommend staring directly into any LED lamp or luminaire.

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Photobiological Safety Standards

The IEC 62471:2006 Photobiological Safety of Lamps and Lamp Systems standard, primarily used in Europe, is commonly used to evaluate LED photobiological safety. Even though the scope of this standard applies to lamps and lamp systems including luminaires, Philips Lumileds understands the need to evaluate safety at a component level and provide customers some indications of the risk factor classification of standalone LUXEON LED components. It is still the end user's responsibility to ensure that the final product is fully assessed for photobiological safety as required by local or national regulatory requirements. The IEC 62471:2006 supersedes the CIE S 009:2002 which may be found in some older literatures.

In USA, the ANSI/IESNA RP-27 parts 1 to 3 are used to evaluate photobiological safety of lamps and lamps systems. The IEC 62471:2006 standards were based largely on the ANSI/IESNA RP-27 standards.

In this report, we evaluated LUXEON C and LUXEON Flash per IEC 62471:2006 standard.

Measurement and Sample Preparation

In assessing LUXEON LED safety, it is necessary to determine the spectral distribution of the LEDs at maximum irradiance (W.m-2) or radiance (W.m-2.sr-1), the apparent or projected source size of the LEDs and whether the source size is considered a small source or not. The wavelength measurement must cover 200 nm to 3000 nm.

The sample selected represented the top-end of the product distribution, at the time when the sample was prepared in terms of radiant flux (optical watt). Note that the radiant flux for LUXEON C and LUXEON Flash is also a function of how much blue power is emitted and is not only a function of luminous flux (lumens). Both continuous wave (DC) and pulse emission were tested and operated at maximum permissible current of the product specification and also per the IEC 62471 guidelines.

Philips Lumileds engaged Underwriters Laboratories, an independent external accreditation lab to perform the measurement analysis. A test report and certificate is available upon request.

Test Results

Table 1. LED Samples Tested by Philips Lumileds

LED Type	LUXEON C and LUXEON Flash
Luminous flux at 500 mA, 25°C	111 lm
Radiant flux at 500 mA, 25°C	378 mW
1931 CIE color points	(0.3169 , 0.3050)
CCT	6454 K

Summary Results Based on IEC 62471:2006 Testing

Testing Laboratory:	Underwriters Laboratories Inc. (UL), North Carolina, USA.
Date of issue:	15th Oct 2010
Distance to detector:	200 mm
Small Source:	YES
Risk Group Classification:	Risk Group 2 (Moderate Risk)

Table 2. Risk Group Categories for 500 mA Continuous Wave (DC)

RISK Factor	RISK Group Result
Actinic UV, E_S (200 – 400 nm)	Exempt
Near UV, E_{UVA} (315 – 400 nm)	Exempt
Blue Light, L_B (300 – 700 nm)	Risk Group 1 (Low Risk)
Blue Light Small Source, E_B (300 – 700 nm)	**Risk Group 2 (Moderate Risk)**
Retinal Thermal, L_R (380 – 1400 nm)	Exempt
Retinal Thermal Weak Stimulus, L_{IR} (780 – 1400 nm)	Exempt
IR Radiation, Eye, E_{IR} (780 – 3000 nm)	Exempt

Table 3. Risk Group Categories for 1.5 A, 0.25 sec Pulse Emission*

RISK Factor	RISK Group Result
Blue Light Small Source, E_B*t (300 – 700 nm)	Exempt
IR Radiation, Eye, E_{IR} (780 – 3000 nm)	Exempt
Skin Thermal, E_H*t (380 – 3000 nm)	Exempt
Retinal Thermal, L_R (380 – 1400 nm)	Exempt

* Even though the LUXEON *c* datasheet maximum pulse rating is up to 1.5 A, 0.5 sec, IEC 62471 limits the time evaluation to 0.25 sec because of natural reflex of the eye aversion in response to strong stimuli.

Spectral Result (for information only)

The chart below shows the spectral power distribution of the LED sample submitted to UL by Philips Lumileds. It was measured in an integrating sphere at 500 mA 25°C.

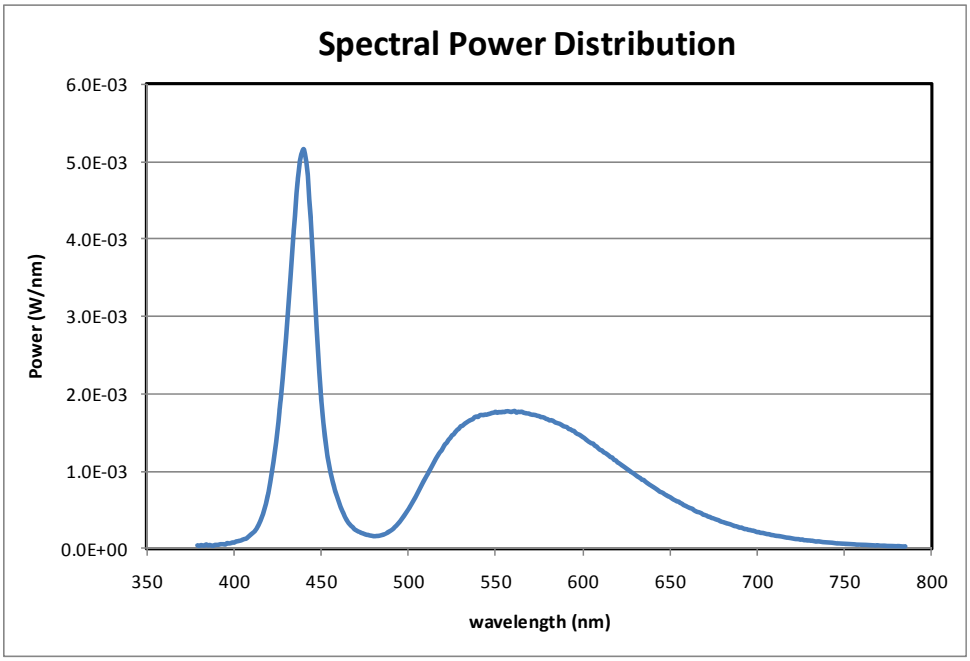

Figure 1. Spectral Power

Explanation of Risk Groups

The following IEC table[1] explains the control measures taken for each hazard type by risk group factor during lamp and lamps systems manufacturing.

Table 4. Explanation of Labelling Information and Guidance on Control Measures

Hazard	Exempt Risk	Risk Group 1	Risk Group 2	Rick Group 3
Ultraviolet hazard 200 nm to 400 nm	Not required	Minimize exposure to eyes or skin. Use appropriate shielding.	Eye or skin irritation may result from exposure. Use appropriate shielding.	Avoid eye and skin exposure to unshielded product.
Retinal blue light hazard 300 nm to 400 nm	Not required	Not required	Do not stare at operating lamp. May be harmful to the eyes.	Do not look at operating lamp. Eye injury may result.
Retinal blue light or thermal hazard 400 nm to 780 nm	Not required	Not required	Do not stare at operating lamp. May be harmful to the eyes.	Do not look at operating lamp. Eye injury may result.
Cornea/lens infrared hazard 780 nm to 3000 nm	Not required	Use appropriate shielding or eye protection.	Avoid eye exposure. Use appropriate shielding or eye protection.	Avoid eye exposure. Use appropriate shielding or eye protection.
Retinal thermal hazard, weak visual stimulus 780 nm to 1400 nm	Not required	Do not stare at operating lamp.	Do not stare at operating lamp.	Do not look at operating lamp.

Notes:

1. International Electrotechnical Commission, IEC 62471-2/TR (1st edition, 2009), Table 2 page 17.

Company Information

Philips Lumileds is a leading provider of LEDs for everyday lighting applications. The company's records for light output, efficacy and thermal management are direct results of the ongoing commitment to advancing solid-state lighting technology and enabling lighting solutions that are more environmentally friendly, help reduce CO_2 emissions and reduce the need for power plant expansion. Philips Lumileds LUXEON® LEDs are enabling never before possible applications in outdoor lighting, shop lighting, home lighting, consumer electronics, and automotive lighting.

Philips Lumileds is a fully integrated supplier, producing core LED material in all three base colors, (Red, Green, Blue) and white. Philips Lumileds has R&D centers in San Jose, California and in the Netherlands, and production capabilities in San Jose, Singapore and Penang, Malaysia. Founded in 1999, Philips Lumileds is the high flux LED technology leader and is dedicated to bridging the gap between solid-state technology and the lighting world. More information about the company's LUXEON LED products and solid-state lighting technologies can be found at www.philipslumileds.com.

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