

# Photobiological Safety in Lighting Applications

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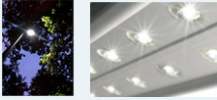

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The publication of IEC 62471 "Photobiological Safety of Lamps and Lamp Systems" heralded a new framework for the evaluation of the photobiological safety of non-laser sources of optical radiation. In Europe, a legal impetus was provided through its' harmonisation to the EU Low Voltage Directive. Issues with the application of IEC 62471, in the case of sources intended for lighting applications, have led to the development of a new approach for these products through the revision of lamp and luminaire standards to provide a consideration of photobiological safety and the implementation of IEC/TR 62778 where required.

## OVERVIEW OF IEC 62471: 2006

IEC62471:2006 provides guidance for the evaluation of the acute photobiological safety of all electrically-powered, non-laser sources of optical radiation emitting in the spectral range 200-3000nm.

- Potential hazards of exposure to the skin, the front surfaces of the eye and the retina evaluated through consideration of six hazards and associated exposure limits
- Classification framework defined, ranging from "Exempt" to "Risk Group 3"
- Evaluation performed at a distance dependant on application:

IEC 62471 Measurement Distance	
<b>General Lighting Service (GLS):</b> "White" light emitting finished products intended for illuminating spaces.  Hazard values reported at a distance at which the source produces an illuminance of 500 lux.	
<b>All other light sources:</b>  Hazard values reported at 200mm from the (apparent) source location.	
<b>The concerns relating to evaluation at 500 lux:</b> <ul style="list-style-type: none"> <li>• At 500 lux, exempt classification obtains for all but exceptionally high colour temperature white PC-LEDs</li> <li>• 500 lux distance may not represent a realistic exposure scenario</li> <li>• GLS definition ambiguous (does this include spotlights, desk lamps etc.?)</li> </ul>	

## THE WAY FORWARD FOR LIGHTING PRODUCTS

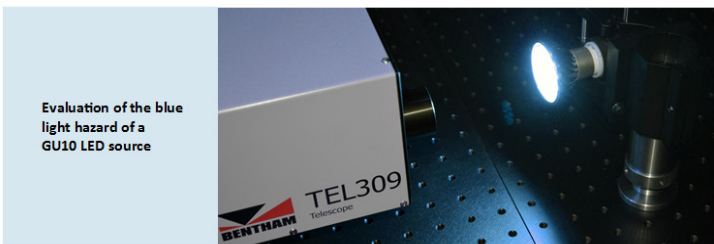
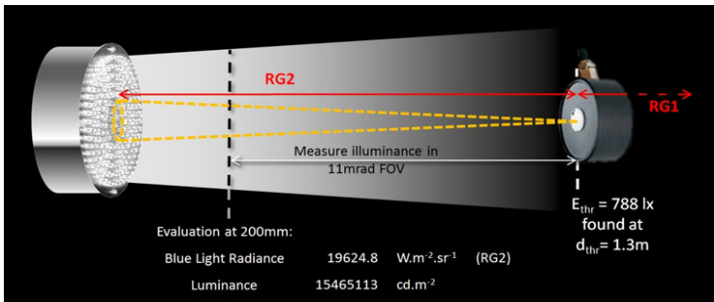
Broadly encompassing incandescent, fluorescent, discharge and LED sources, the optical radiation emitted by lighting products may not cover the whole spectral range considered by IEC 62471, nor be of a level to present cause for concern. A consideration of photobiological safety depends therefore on lamp type, and is treated by technology-specific vertical product standards.

- **Actinic UV hazard** considered in case of metal halide lamps (IEC 61167) and luminaires using these sources (IEC 60598-1)
- **IR hazard** dealt with by marking, in the case of one for tungsten halogen lamps (IEC 60432-3)
- **Blue light hazard** addressed by IEC/TR 62778 "Application of IEC 62471 for the assessment of blue light hazard to light sources and luminaires"

## SCOPE AND RATIONALE OF IEC/TR 62778

Driven principally by the development of SSL, for which the sole concern is potential blue light hazard, IEC/TR 62778 provides guidance on the assessment of the retinal blue light hazard of all lighting products, from component lamps and LEDs to finished products, importantly allowing the transfer of data from LED/lamp to finished products in certain cases.


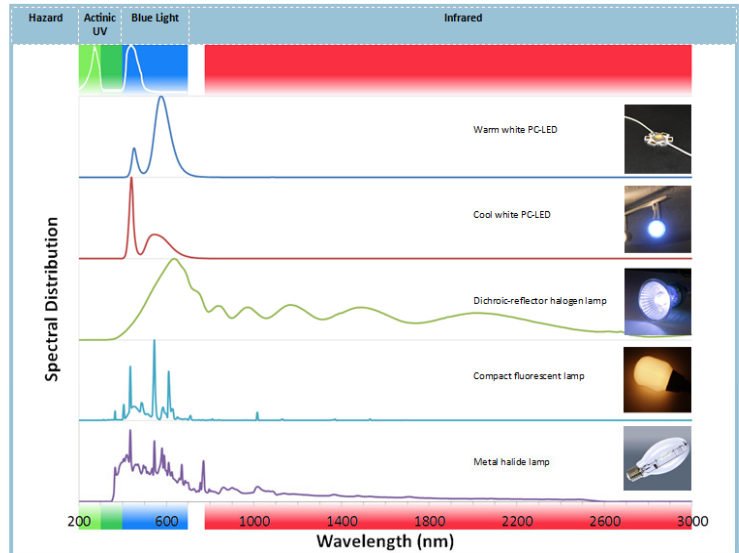
Based upon the assumption that light sources classified as blue light hazard exempt or RG1 are "safe", IEC/TR 62778 applies a test to determine if, at a distance of 200mm, the source in question exceeds the blue light RG1 emission limit.



## CONCLUSION

The move to consider photobiological safety on non-laser sources has essentially been driven by progress in LED technology and the adoption of LED sources in an exceptionally wide range of applications. IEC 62471 has arguably caused a significant level of consternation among those seeking to implement it due to the complex range of measurements and specific conditions required to evaluate photobiological safety. In the present case of lighting products, however, the introduction of IEC/TR 62778 has significantly reduced the measurement burden. It should not be long before  $E_{thr}$  and  $d_{thr}$  be seen to be reported in product literature.

Hazard (* weighting function required)	Wavelength Range (nm)	Quantity Measured	Principle Bioeffects	
			Skin	Eye
Actinic UV <sup>†</sup>	200-400	Spectral irradiance	Erythema Elastosis	Photokeratitis Cataractogenesis
Near UV	315-400		-	Cataractogenesis
Infrared Radiation	780-3000		-	Corneal burn Cataractogenesis
Thermal	380-3000	Spectral radiance	Skin burn	-
Retinal Blue Light <sup>†</sup>	300-700		-	Photoreinitis
Retinal Thermal <sup>†</sup>	380-1400		-	Retinal burn

IEC/TR 62778 Approach:	
Source Subtense > 11mrad	Source Subtense ≤ 11mrad
<b>MEASURE</b> spectral radiance in an 11mrad FOV at 200mm (300-780nm)	<b>MEASURE</b> spectral irradiance at 200mm (300-780nm)
<b>IF</b> blue light radiance < 10,000 W.m <sup>-2</sup> .sr <sup>-1</sup> , "RG1 unlimited"	<b>IF</b> blue light irradiance < 1 W.m <sup>-2</sup> , "RG1 unlimited"
<b>For component lamps/LEDs:</b> "RG1 unlimited" is applicable to both source and any product using that source	<b>For component lamps/LEDs:</b> "RG1 unlimited" is not applicable, report $E_{thr}$
<b>For finished products:</b> "RG1 unlimited" applicable	
<b>ELSE:</b> Compute the threshold illuminance, $E_{thr}$ , at which the boundary between RG1 and RG2 is found	
<b>Component lamps/LEDs:</b> Include $E_{thr}$ in the product data sheet to allow transfer of this information to the final product	
<b>Finished products:</b> The threshold distance, $d_{thr}$ , at which $E_{thr}$ found may be determined using goniophotometric data or a measurement of illuminance and reported in the product data sheet	

