IEC 62471-5

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Photobiological safety of lamps and lamp systems – Part 5: Image projectors

Sécurité photobiologique des lampes et des appareils utilisant des lampes – Partie 5: Projecteurs d'images

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Photobiological safety of lamps and lamp systems – Part 5: Image projectors

Sécurité photobiologique des lampes et des appareils utilisant des lampes – Partie 5: Projecteurs d'images

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PHOTOBIOLOGICAL SAFETY OF LAMPS AND LAMP SYSTEMS –

Part 5: Image projectors

FOREWORD

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International Standard IEC 62471-5 has been prepared by IEC technical committee 76: Optical radiation safety and laser equipment.

This bilingual version (2018-02) corresponds to the monolingual English version, published in 2015-06.

The text of this standard is based on the following documents:

FDIS	Report on voting
76/519/FDIS	76/521/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

Most lamps and lamp systems are safe and do not pose photobiological risks except under unusual exposure conditions. This also is the case for optical image projectors where experience shows that even high power cinema projectors may be safe for accidental momentary viewing and can only under some conditions pose optical hazards at close distances or for intentional 'long-duration' staring into the source. The rapid development of solid-state and other lamps or lamp systems has permitted new projector products, and generated the need for a photobiological safety standard for this group of lamp systems.

Optical radiation hazards from all types of lamps and lamp systems are currently assessed by the application of IEC 62471:2006 (CIE S 009:2002), *Photobiological safety of lamps and lamp systems*. IEC 62471 covers LEDs, incandescent, low- and high-pressure gas-discharge, arc and other lamps. Following the concept of vertical standards, the risk group classification system in IEC 62471 for lamps is to be adapted for specific product groups such as image projectors.

This part of IEC 62471 provides a risk group classification system for image projectors, and measurement conditions for optical radiation emitted by image projectors. It includes manufacturing requirements that may be required as a result of an image projector system being assigned to a particular risk group. Therefore, this part of IEC 62471 provides safety requirements for lamp systems that are intended to produce projected visible optical radiation, such as theatre projectors, data projectors and home-use projectors. The assigned risk group of a projector product also may be used by projector manufacturers to assist with any risk assessments, e.g. for occupational exposure in workplaces. National requirements may exist for the assessment of products or occupational exposure.

The emission limits provided in this part of IEC 62471 are derived from the exposure limits specified by ICNIRP in their 2013 Guidelines for incoherent visible and infrared radiation [1][1]. These exposure limits are also the basis for the emission limits to be specified in the future International Standard IEC 62471-12.

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1 Numbers in square brackets refer to the Bibliography.

2 Revision of IEC 62471:2006.

PHOTOBIOLOGICAL SAFETY OF LAMPS AND LAMP SYSTEMS –

Part 5: Image projectors

1 Scope

This part of IEC 62471 provides requirements regarding photobiological safety of the optical radiation emitted by image projectors. This part of IEC 62471 does not deal with other hazards such as electrical, mechanical or fire hazards.

This part of IEC 62471 provides requirements regarding:

- optical radiation safety assessment of image projectors;
- projector risk groups;
- testing conditions and measurement conditions;
- manufacturer's requirements including user information.

The scope of this part of IEC 62471 is photobiological safety of image projectors including the emissions from laser-illuminated projectors that fulfill the requirements as specified in IEC 60825-1:2014, 4.4 and for which visible light emission has been excluded from classification in IEC 60825-1.

This part of IEC 62471 does not address safety requirements for laser display products where collimated laser beams — generally scanned — are employed. It does address those laser-illuminated projectors that employ a laser source to illuminate, for example, a micro-electro-mechanical system (MEMS) without scanned beams or crystal-based display projector system.

NOTE Image projectors containing lasers are subject to those provisions of IEC 60825-1 applicable to the embedded laser. See IEC 60825-1:2014, 4.4 for which visible light emission has been excluded from the laser product classification.

This part of IEC 62471 includes projectors for only visible image projection and does not include ultraviolet (UV) projectors, infrared (IR) projectors, general lighting service (GLS) lamps (GLS; defined in IEC 62471) or projector lamp systems used for general lighting, which are treated in separate International Standards.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62471, *Photobiological safety of lamps and lamp systems*

IEC 60825-1:2014, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at http://www.electropedia.org)

IEC 60950-1, *Information technology equipment – Safety – Part 1: General requirements*

IEC 60065, *Audio, video and similar electronic apparatus – Safety requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62471, IEC 60050-845 [2] and the following apply.

3.1
accessible emission
AE
level of radiation determined at a certain distance from the product and with measurement conditions described in Clause 5

Note 1 to entry: The accessible emission is compared with the AEL (see 3.2) to determine the risk group of the product.

3.2
accessible emission limit
AEL
maximum accessible emission permitted within a particular risk group

3.3
angle of acceptance
γ
plane angle within which a detector will respond to optical radiation

Note 1 to entry: The angle of acceptance is usually measured in radians (SI unit).

Note 2 to entry: This angle of acceptance may be controlled by apertures or optical elements in front of the detector. The angle of acceptance is also sometimes referred to as the field of view (see 3.12).

Note 3 to entry: The angle of acceptance should not be confused with the angular subtense of the source (see 3.4) or the beam divergence.

3.4
angular subtense
α
visual angle subtended by the apparent source at the eye of an observer or at the point of measurement

Note 1 to entry: In this part of IEC 62471, subtended angles are denoted by the full included angle, not the half angle.

Note 2 to entry: SI unit: radian.

Note 3 to entry: The angular subtense α may be modified by incorporation of lenses and mirrors as projector optics, i.e. the angular subtense of the apparent source may differ from the angular subtense of the physical source.

Note 4 to entry: The limitations of α in this part of IEC 62471 are:

For continuous wave: α_{max} = 0,1 rad, α_{min} = 0,001 5 rad.

For pulsed emission: α_{max} is described in Table 7, α_{min} = 0,001 5 rad.

3.5
cinema-use projector
image projector used for projection in theatrical environment

3.6
consumer product
item intended for consumers or likely to be used by consumers, even if not intended for them

Note 1 to entry: Products provided in the framework of a service to consumers are also considered to be consumer products.

Note 2 to entry: RG3 products are intended for professional use only, and are not intended for consumer use.

3.7
continuous wave emission
CW emission
emission of a projector which can be considered continuous when the output is continuous for times greater than 0,25 s and the peak radiated power is not higher than 1,5 times the average radiated power

3.8
data projector
image projector system using digital imager(s) routinely employed in offices, meetings and sales presentations

Note 1 to entry: Examples of data imager are MEMS and liquid crystal based display.

3.9
exit pupil
image of the aperture stop which also functions as a virtual aperture of the projection lens

Note 1 to entry: The position of the apparent source is located at the apparent position of the exit pupil (see Figure 1).

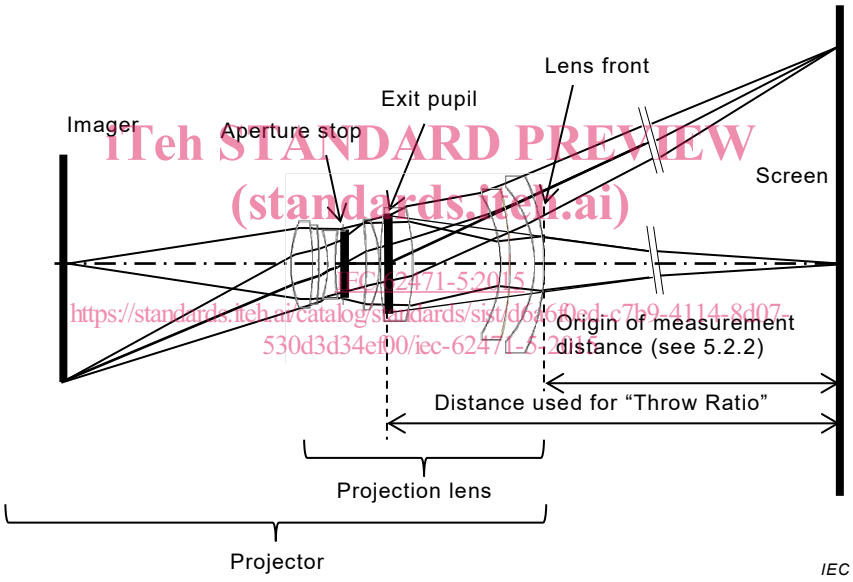

Figure 1 – Exit pupil in projector

3.10
exposure limit
EL
maximum level of exposure of optical radiation to the eye or skin that is not expected to result in adverse biological effects

Note 1 to entry: These ELs are used to determine hazard distances with respect to photobiological effects.

3.11
exposure to limit ratio
ELR
ratio of the exposure level and the exposure limit

Note 1 to entry: Since both values can be functions of distance and exposure duration, the ELR can depend on exposure distance and exposure duration.

3.12
field of view
γ
solid angle as "seen" by the detector (acceptance angle), for example of a radiometer or spectroradiometer, out of which the detector receives radiation

Note 1 to entry: SI unit: steradian (sr).

Note 2 to entry: The field of view should not be confused with the angular subtense of the apparent source, α.

Note 3 to entry: A plane angle is sometimes used to describe a circular symmetric solid angle field of view.

Note 4 to entry: The field of view is sometimes referred to as angle of acceptance (see 3.3).

3.13
fixed projector installation
projector installed permanently or semi-permanently in a fixed location

EXAMPLE A cinema-use projector mounted in an operating booth.

3.14
hazard distance
HD
distance from the projector's nearest point of human access, where the beam radiance or irradiance exceeds the applicable exposure limit (EL: see 3.10)

Note 1 to entry: The hazard distance for a projector is determined by the EL for a 0,25 s exposure. This also is the time base of the accessible emission limit of RG2.

3.15
home-use projector
image projector used for audio-visual presentations in the domestic environment under non-controlled conditions and non-professional use

3.16
image projector product
member of the family of products that includes all types of image projectors such as data projectors (see 3.8), home-use projectors (see 3.15) and cinema-use projectors (see 3.5)

3.17
intended use
usage of a product, process or application in accordance with specifications, instructions and information provided by the manufacturer or supplier

3.18
lamp
electrically powered device emitting optical radiation in the wavelength range between 200 nm and 3 000 nm, with the exception of direct, non-diffuse laser radiation

3.19
lamp system
electrically operated product incorporating lamp(s), including fixtures, projection optics and incorporated electrical or electronic components as intended by the manufacturer

Note 1 to entry: A lamp system can include diffusers, enclosures and/or beam modifying optics. An image projector (see 3.16) is a type of lamp system.

3.20
laser illuminated projecting system
LIP system
projection lamp system emitting visible diffused light as a result of laser light source(s) in order to replace traditional projector lamps

3.21
light emitting diode
LED
solid-state lamp device embodying a p-n junction, emitting incoherent optical radiation when excited by an electric current

3.22
liquid-crystal display projector
LCD projector
projector employing an LCD digitized image panel that is projected by the system

3.23
micro-electro-mechanical system based imager
MEMS based imager
micro-electro-mechanical system with electro-optical arrays of micro-mirrors

3.24
modifying optics
optical components that process the light, such as filters, lenses and reflectors, which change the characteristics of the optical radiation from the initial light source when incorporated into an image projector (see 3.16)

3.25
projector
optical system using reflection and/or refraction to increase the luminous intensity within a limited solid angle

Note 1 to entry: The light emitted into a limited solid-angle is generally referred to as the “beam”.

Note 2 to entry: The emitted beam is intended to be incident on a screen or some other diffuse surface such as a house or room wall.

3.26
projector lamp
lamp in which the luminous element is mounted in such a way that the lamp may be used with an optical system to project the light in chosen directions

3.27
pulse duration
t_p
time increment calculated by D/L_{peak} where D is the total radiance dose of the pulse and L_{peak} is the peak radiance of that pulse (see Figure 2)

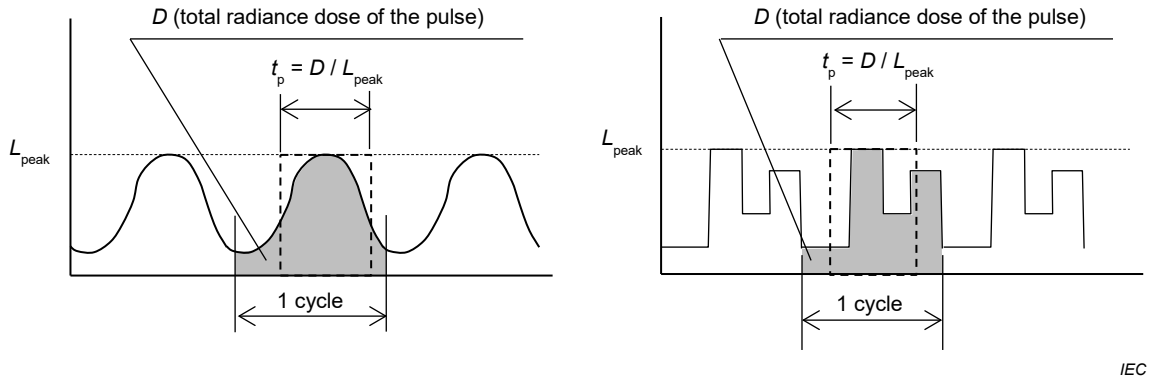

Figure 2 – Examples of the application of the definition of pulse duration

Note 1 to entry: Unit: second (s).

Note 2 to entry: For a pulse that has a triangular or rectangular temporal emission shape, this definition of pulse duration is identical to the full-width-half-maximum (FWHM) definition.

Note 3 to entry: A rectangular pulse, shown with dashed borders in Figure 2, with the pulse duration t_p has the same radiance dose and peak radiance as the actual pulse.

3.28
pulsed emission
emission in the form of a single pulse or a train of pulses where each pulse is assumed to have a duration of less than 0,25 s

Note 1 to entry: Pulsed emission refers to a product with a continuous train of pulses or modulated radiant energy where the peak radiated power is at least 1,5 times higher than the average radiated power.

3.29
radiance
L
quantity defined by the formula

$$L = d\Phi/(dA \cdot \cos\theta \cdot d\Omega)$$

in a given direction at a given point of a real or imaginary surface,

where

$d\Phi$ is the radiant power (flux) transmitted by an elementary beam passing through the given point and propagating in the solid angle ($d\Omega$) containing the given direction;

dA is the area of a section of that beam containing the given point;

θ is the angle between the normal to that section and the direction of the beam

Note 1 to entry: SI unit: watt per square metre per steradian ($W \cdot m^{-2} \cdot sr^{-1}$).

3.30
radiance dose
D
time integrated radiance quantity defined by the equation

$$D = dQ_e/(dA \cdot \cos\theta \cdot d\Omega)$$

where

dQ_e is the radiant energy transmitted by an elementary beam passing through the given point and propagating in the solid angle ($d\Omega$) containing the given direction;

dA is the area of a section of that beam containing the given point;

θ is the angle between the normal to that section and the direction of the beam

Note 1 to entry: SI unit: joule per square metre per steradian ($J \cdot m^{-2} \cdot sr^{-1}$).

Note 2 to entry: Equivalent term: “(time) integrated radiance”.

3.31
restricted area
area where an engineering and/or administrative control measure is established to restrict access except to authorized personnel with appropriate safety training

Note 1 to entry: Access is only possible through the use of a tool, lock, key or other means of security.

3.32
spatially averaged radiance
L_{sa}
quantity defined by the equation

$$L_{sa} = d\Phi/(dA_\gamma \cdot \cos\theta \cdot d\Omega)$$

radiance spatially averaged over a given angle of acceptance to account for physiological factors such as eye-movements (sometimes referred to as “physiological radiance”)