

Australian/New Zealand Standard™

**Photobiological safety of lamps and
lamp systems**



AS/NZS IEC 62471:2011

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee SF-019, Personal Protection Against Laser Radiation. It was approved on behalf of the Council of Standards Australia on 20 October 2011 and on behalf of the Council of Standards New Zealand on 25 October 2011. This Standard was published on 5 December 2011.

The following are represented on Committee SF-019:

Australasian Faculty of Occupational & Environmental Medicine
Australian Dental Association
Defence Materiel Organisation (Australia)
Defence Science & Technology Organisation
Electronics Industry Association
National Radiation Laboratory New Zealand
Royal Australian and New Zealand College of Ophthalmologists
Safety Institute of Australia
Telecom New Zealand
Telstra Corporation
University of New South Wales at the Australian Defence Force Academy

Keeping Standards up-to-date

Standards are living documents, which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about joint Australian/New Zealand Standards can be found by visiting the Standards Web Shop at www.saiglobal.com.au or Standards New Zealand website at www.standards.co.nz and looking up the relevant Standard in the on-line catalogue.

For more frequent listings or notification of revisions, amendments and withdrawals, Standards Australia and Standards New Zealand offer a number of update options. For information about these services, users should contact their respective national Standards organization.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Please address your comments to the Chief Executive of either Standards Australia or Standards New Zealand at the address shown on the back cover.

This Standard was issued in draft form for comment as DR AS/NZS IEC 62471.

Australian/New Zealand Standard™

**Photobiological safety of lamps and
lamp systems**

First published as AS/NZS IEC 62471:2011.

COPYRIGHT

© Standards Australia Limited/Standards New Zealand

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Australia) or the Copyright Act 1994 (New Zealand).

Jointly published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001 and by Standards New Zealand, Private Bag 2439, Wellington 6140.

ISBN 978 0 7337 9986 0

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee SF-019, Personal Protection Against Laser Radiation.

The objectives of this Standard are as follows:

- (a) To protect people from optical radiation in the wavelength range 200 nm to 3000 nm by introducing a system of classification for all electrically powered incoherent broadband sources of optical radiation, including light emitting diodes (LEDs) but excluding lasers, according to their degree of optical radiation hazard.
- (b) To provide a scheme for evaluation and control of photobiological hazards through specification of exposure limits and reference measurement technique.
- (c) To ensure adequate warnings are provided to individuals of hazards associated with accessible incoherent broadband sources of optical radiation through the use of labels and instructions (refer to next paragraph).

This is the first Standard adopted by Australia/New Zealand relating specifically to the photobiological safety of lamps and lamp systems and is normative. However, additional informative guidance may be found in IEC/TR 62471-2, Edition 1.0 (2009)*, *Photobiological safety of lamps and lamp systems—Part 2: Guidance on manufacturing requirements relating to non-laser optical radiation safety*. The aforementioned IEC technical report provides, in the context of classifications defined in AS/NZS IEC 62471, guidance on: requirements for optical radiation safety assessment; allocation of safety measures; and labelling of products.

This Standard is identical with, and has been reproduced from, IEC 62471, Ed.1.0 (2006), *Photobiological safety of lamps and lamp systems*.

As this Standard is reproduced from an International Standard, the following applies:

- (a) Its number appears on the cover and title page while the International Standard number appears only on the cover.
- (b) In the source text ‘This International Standard’ should read ‘This Australian/New Zealand Standard’.
- (c) A full point substitutes for a comma when referring to a decimal marker.

None of the normative references in the source document have been adopted as Australian or Australian/New Zealand Standards.

The term ‘informative’ has been used in this Standard to define the application of the annex to which it applies. An ‘informative’ annex is only for information and guidance.

* To be published as AS/NZS IEC adoption.

CONTENTS

1.	SCOPE	1
2.	NORMATIVE REFERENCES	1
3.	DEFINITIONS, SYMBOLS AND ABBREVIATIONS	1
4.	EXPOSURE LIMITS (EL'S).....	7
4.1	General	7
4.2	Specific factors involved in the determination and application of retinal exposure limits.....	8
4.2.1	Pupil diameter	8
4.2.2	Angular subtense of source and measurement field-of-view	8
4.3	Hazard exposure limits.....	9
4.3.1	Actinic UV hazard exposure limit for the skin and eye.....	9
4.3.2	Near-UV hazard exposure limit for the eye.....	10
4.3.3	Retinal blue light hazard exposure limit	11
4.3.4	Retinal blue light hazard exposure limit - small source	13
4.3.5	Retinal thermal hazard exposure limit	14
4.3.6	Retinal thermal hazard exposure limit – weak visual stimulus	14
4.3.7	Infrared radiation hazard exposure limits for the eye	15
4.3.8	Thermal hazard exposure limit for the skin	15
5.	MEASUREMENT OF LAMPS AND LAMP SYSTEMS.....	16
5.1	Measurement conditions	16
5.1.1	Lamp ageing (seasoning)	16
5.1.2	Test environment.....	17
5.1.3	Extraneous radiation.....	17
5.1.4	Lamp operation.....	17
5.1.5	Lamp system operation	17
5.2	Measurement procedure	17
5.2.1	Irradiance measurements.....	17
5.2.2	Radiance measurements.....	19
5.2.3	Measurement of source size	21
5.2.4	Pulse width measurement for pulsed sources.....	21
5.3	Analysis methods	21
5.3.1	Weighting curve interpolations	21
5.3.2	Calculations	21
5.3.3	Measurement uncertainty	21
6.	LAMP CLASSIFICATION	24
6.1	Continuous wave lamps	24
6.1.1	Exempt group	24
6.1.2	Risk Group 1 (Low-Risk)	24
6.1.3	Risk Group 2 (Moderate-Risk).....	25
6.1.4	Risk Group 3 (High-Risk).....	25
6.2	Pulsed lamps.....	25

ANNEX A (informative) SUMMARY OF BIOLOGICAL EFFECTS	27
Bioeffect datasheet #1: Infrared cataract	27
Bioeffect datasheet #2: Photokeratitis	27
Bioeffect datasheet #3: Photoretinitis	28
Bioeffect datasheet #4: Retinal thermal injury	29
Bioeffect datasheet #5: Ultraviolet cataract	30
Bioeffect datasheet #6: Ultraviolet erythema	31
ANNEX B (informative) MEASUREMENT METHOD	33
B.1 Instrumentation	33
B.1.1 Double monochromator: Recommended instrument	33
B.1.2 Broadband detectors	33
B.2 Instrument limitations	33
B.2.1 Noise equivalent irradiance	33
B.2.2 Instrument spectral response	34
B.2.3 Wavelength accuracy	35
B.2.4 Stray radiant power	35
B.2.5 Input optics for spectral irradiance measurements: Recommendation	36
B.2.6 Linearity	36
B.3 Calibration sources	36
ANNEX C (informative) UNCERTAINTY ANALYSIS	37
ANNEX D (informative) GENERAL REFERENCES	39

INTRODUCTION

Lamps were developed and produced in large quantities and became commonplace in an era when industry-wide safety standards were not the norm. The evaluation and control of optical radiation hazards from lamps and lamp systems is a far more complicated subject than similar tasks for a single-wavelength laser system. The required radiometric measurements are quite involved, for they do not deal with the simple optics of a point source, but rather with an extended source that may or may not be altered by diffusers or projection optics. Also the wavelength distribution of the lamp may be altered by ancillary optical elements, diffusers, lenses, and the like, as well as variations in operating conditions.

To evaluate a broad-band optical source, such as an arc lamp, an incandescent lamp, a fluorescent lamp, an array of lamps or a lamp system, it is first necessary to determine the spectral distribution of optical radiation emitted from the source at the point or points of nearest human access. This accessible emission spectral distribution of interest for a lighting system may differ from that actually being emitted by the lamp alone due to the filtration by any optical elements (e.g., projection optics) in the light path. Secondly, the size, or projected size, of the source must be characterized in the retinal hazard spectral region. Thirdly, it may be necessary to determine the variation of irradiance and effective radiance with distance. The performance of the necessary measurements is normally not an easy task without sophisticated instruments. Thus it was decided to include reference measurement techniques for lamps and lamp systems in this standard. The measurement techniques along with the described risk group classification scheme will provide common ground for both lamp manufacturers and users to define the specific photobiological hazards of any given lamp and/or lamp system.

Finally, there are well known optical radiation hazards associated with some lamps and lamp systems. The purpose of this standard is to provide a standardized technique for evaluation of potential radiation hazards that may be associated with various lamps and lamp systems.

AUSTRALIAN/NEW ZEALAND STANDARD

Photobiological safety of lamps and lamp systems**1. SCOPE**

This International Standard gives guidance for evaluating the photobiological safety of lamps and lamp systems including luminaires. Specifically it specifies the exposure limits, reference measurement technique and classification scheme for the evaluation and control of photobiological hazards from all electrically powered incoherent broadband sources of optical radiation, including LEDs but excluding lasers, in the wavelength range from 200 nm through 3000 nm.

2. NORMATIVE REFERENCES

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

CIE 17.4-1987	<i>International lighting vocabulary (ILV)</i> – Joint publication IEC/CIE
CIE 53-1982	<i>Methods of characterizing the performance of radiometers and photometers</i>
CIE 63-1984	<i>The spectroradiometric measurement of light sources</i>
CIE 105-1993	<i>Spectroradiometry of pulsed optical radiation sources</i>
ISO	<i>Guide to the expression of uncertainty in measurement</i> , ISO, Geneva, 1995.

3. DEFINITIONS, SYMBOLS AND ABBREVIATIONS

For the purposes of this standard, the following definitions, symbols and abbreviations apply.

3.1 actinic dose (see ILV 845-06-23)

Quantity obtained by weighting spectrally the dose according to the actinic action spectrum value at the corresponding wavelength.

Unit: $\text{J}\cdot\text{m}^{-2}$

Note: This definition implies that an action spectrum is adopted for the actinic effect considered, and that its maximum value is generally normalized to 1. When giving a quantitative amount, it is essential to specify which quantity dose or actinic dose is meant, as the unit is the same.

3.2 angular subtense (α)

Visual angle subtended by the apparent source at the eye of an observer or at the point of measurement. In this standard subtended angles are denoted by the full included angle, not the half angle.

Unit: radian

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

3.3 aperture, aperture stop

Opening that defines the area over which average optical emission is measured. For spectral irradiance measurements this opening is usually the entrance of a small sphere placed in front of the radiometer/spectroradiometer entrance slit.