

# PUBLICLY AVAILABLE SPECIFICATION

## PRE-STANDARD



Position statement on germicidal UV-C irradiation UV-C safety guidelines



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2021 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

#### IEC publications search - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

#### IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [sales@iec.ch](mailto:sales@iec.ch).

#### IEC online collection - [oc.iec.ch](http://oc.iec.ch)

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

preview generated by EVS

# PUBLICLY AVAILABLE SPECIFICATION

## PRE-STANDARD



**Position statement on germicidal UV-C irradiation UV-C safety guidelines**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

ICS 29.140.01

ISBN 978-2-8322-9843-5

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	3
INTRODUCTION TO THE PAS .....	5
Foreword to this guidance document.....	6
1 Introduction .....	6
2 Scope of this guidance document .....	7
3 UV-C radiation safety requirements .....	7
3.1 Summary of UV-C safety requirements of photobiological safety standard IEC 62471.....	7
3.1.1 Effective UV-C irradiance .....	8
3.1.2 Effective irradiance at a distance $d_2$ .....	9
3.1.3 Effective irradiance at a distance $d_2 = 200$ mm.....	9
3.1.4 UV-C risk groups .....	9
3.2 Effective UV-C irradiance distribution.....	10
3.3 UV-C irradiance safeguards .....	10
4 Ozone safety requirements.....	10
4.1 Long-term exposure limits for ozone .....	10
4.2 Ozone safeguard requirements .....	11
5 Information requirements.....	11
5.1 Warning symbols .....	11
5.2 Warning labels.....	11
5.3 Installation instructions and user manual.....	12
5.4 Instructional training .....	13
6 Compliance .....	13
7 Terms and definitions .....	13
8 References .....	14
Appendix A .....	15
Appendix B .....	16
Figure 1 – UV-C Risk Groups (UV-C RGs) .....	9
Figure 2 – Example of UV-C warning label.....	12
Figure 3 – Example of an ozone warning label.....	12
Table 1 – Spectral weighting $S(\lambda)$ .....	8
Table 2 – Maximum exposure time per UV-C RG for an 8 hours' time interval.....	10
Table 3 – Alternative ozone exposure levels .....	11
Table 4 – Instructional safeguards for ultraviolet hazard 180 nm to 280 nm .....	12

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

# POSITION STATEMENT ON GERMICIDAL UV-C IRRADIATION UV-C SAFETY GUIDELINES

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

A PAS is an intermediate specification made available to the public and needing a lower level of consensus than an International Standard to be approved by vote (simple majority).

IEC PAS 63313 has been processed by IEC technical committee 34: Lighting.

The text of this PAS is based on the following document:

This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document

Draft	Report on voting
34/795/DPAS	34/812/RVDPAS

Following publication of this PAS, which is a pre-standard publication, the technical committee or subcommittee concerned may transform it into an International Standard.

It is based on the Global Lighting Associations's *Position Statement on Germicidal UV-C Irradiation – UV-C Safety Guidelines*. The structure and editorial rules used in this publication reflect the practice of the organization which submitted it.

This PAS shall remain valid for an initial maximum period of 2 years starting from the publication date. The validity may be extended for a single period up to a maximum of 2 years, at the end of which it shall be published as another type of normative document, or shall be withdrawn.

**IMPORTANT** – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

## INTRODUCTION TO THE PAS

UV-C irradiation is a proven methodology for inactivating microorganisms (including viruses) in water, in air and on solid surfaces. UV-C devices, that intentionally generate effective UV-C radiation, are considered safe if they meet the electrical, thermal, mechanical, human exposure to electromagnetic fields (EMF) and photobiological safety requirements provided in international safety standards. Guidance on the effectiveness of UV-C irradiation is given in publications like CIE 155. Currently, a few UV-C devices are supported by dedicated product standards, like for air purifiers (IEC 60335-2-65, which also provides information on ozone limits). However, related to the present COVID-19 pandemic, many UV-C devices are entering the market for which no adequate product standards exist yet. IEC/TC 34 recognizes this standardization gap and will start working on the development of required product standards.

Pending the development and publication of comprehensive product safety standards, the Global Lighting Association (GLA) issued the GLA "UV-C Safety Guidelines" (May 2020) with safety measures and compliance criteria, these to be taken in conjunction with the requirements of IEC 62471:2006/CIE S 009:2002 (in the GLA document abbreviated to IEC 62471). In addition, the GLA "UV-C Safety Guidelines" include safety measures and compliance criteria to avoid excessive ozone exposure.

IEC/TC 34 considers the GLA "UV-C Safety Guidelines" as a good starting point for developing any missing IEC safety standard(s) for UV-C devices, although it is recognized that the GLA "UV-C Safety Guidelines" were considered as initial guidance and its contents are not complete. For example, the photobiological safety assessment is limited to the actinic hazard in the UV-C spectral region, referring to risk groups specified in IEC 62471:2006/CIE S 009:2002; additional radiation such as UV-B/A is not addressed. Furthermore, the effects of ozone production are only mentioned with limited guidance.

However, since the development and publication of a full IEC safety standard will take at least 2 to 3 years, it has been agreed to publish the GLA "UV-C safety guidelines" as an intermediate IEC Publicly Available Specification (PAS), to offer an IEC document that helps manufacturers introducing safe UV-C devices which tackle the present COVID-19 pandemic. The IEC PAS document is a copy of the existing GLA document. This approach was already offered for consideration to IEC/TC 34 members who concluded that there is indeed a need for publication of the GLA "UV-C Safety Guidelines" as an IEC PAS. This PAS will serve as an interim measure to fill gaps in the present standardization landscape, it is not intended to predetermine any future TC 34 responsibility in the field of germicidal UV radiation. Aspects of this PAS document might serve as a basis for future standard(s) in subsequent project(s) as advised by TC 34 Advisory Group 17 and for execution by IEC/TC 34 or any other standardization body, as appropriate.

## POSITION STATEMENT ON GERMICIDAL UV-C IRRADIATION UV-C SAFETY GUIDELINES

### Foreword to this guidance document

#### About the Global Lighting Association

The Global Lighting Association (GLA) is the voice of the lighting industry on a global basis. GLA shares information on political, scientific, business, social and environmental issues of relevance to the lighting industry and advocates the position of the global lighting industry to relevant stakeholders in the international sphere. See [www.globallightingassociation.org](http://www.globallightingassociation.org).

#### UV-C and urgent need for safety guidelines

UV-C<sup>1</sup> irradiation is a proven germicidal methodology for inactivating bacteria and viruses in water, air and solid surfaces. For effective disinfection purposes, the UV-C energy of UV-C devices is much higher than normal sunlight. These high UV-C energies can be a hazard to exposed humans and materials if proper safety measures are not observed.

In this context, and in the midst of a global COVID-19 epidemic, GLA is concerned at the proliferation of UV-C disinfecting devices – particularly being sold on the internet – with dubious safety features and inadequate safety instructions.

There is an urgent need for comprehensive technical safety standards for UV-C devices. Standards are expected to be developed by the International Electrotechnical Commission (IEC), Underwriters Laboratories (UL) and other standards development organisations (SDOs), but will take many months before they are published. Pending development and publication of such standards, the Global Lighting Association has published this document as an intermediate measure to draw attention to safety issues associated with UV-C products and to provide guidance on their safe use.

### 1 Introduction

UV-C devices are considered safe if they meet the electrical, thermal, mechanical, human exposure to electromagnetic fields (EMF) and photobiological safety requirements provided in IEC and UL standards. Regional safety codes or policies may reference these standards and other regional safety requirements. An overview of applicable IEC and UL safety standards is given in Appendix A.

Additionally, special attention should be given to UV-C **irradiance** hazards [1] which can damage the human eye and cause severe sunburn-like reaction to the human skin. UV-C **irradiance** can damage materials. It can also produce ozone (O<sub>3</sub>), a known human toxin. Ozone can be produced in air due to exposure to optical radiation at wavelengths below 240 nm.

The information in this document represents current UV-C safety knowledge. Pending publication of comprehensive safety standards by SDOs, this document provides safeguards to avoid human exposure to **irradiance** hazards (section 3) and to excessive ozone concentrations

---

1 UV-C forms part of the ultraviolet (UV) spectrum and is defined within ISO standard ISO-21348 as having wavelengths between 100 – 280 nm. In practice, 100 nm – 200 nm wavelengths are strongly absorbed by atmospheric oxygen which means they can only be used effectively under vacuum conditions. (This is also the reason the scope of the IEC standard *Photobiological safety of lamps and lamp systems* starts at 200 nm). This document changed the lower boundary from 200 nm to 180 nm to include low-pressure mercury lamps.



(section 4). The associated information requirements and compliance criteria are given in section 5 and 6 respectively. Definitions of **bold-marked** terms are given in section 7.

The Global Lighting Association strongly recommends applying these guidelines during safety assessments of UV-C devices in conjunction with applicable IEC and/or UL standards and/or other regional safety requirements.

## 2 Scope of this guidance document

The safety advice in this document applies to UV-C sources and UV-C products which emit in the wavelength range of 180<sup>2</sup> nm to 280<sup>3</sup> nm.

Not within the scope are:

- devices having their own product safety standard, such as IEC 60335-2-109 applicable to UV-C water disinfection equipment and IEC 60335-2-65 applicable to UV-C air disinfection equipment
- application environments of UV-C devices
- products combining UV-C **irradiance** with chemicals and additives
- products that do not emit UV-C radiation such as UV-A, UV-B and near-UV devices
- requirements for performance and functional characteristics
- requirements for preventing material degradation and material damage

## 3 UV-C radiation safety requirements

Section 3.1 summarises UV-C safety requirements identified in the photobiological safety standard IEC 62471 [3]. It also alters the lower wavelength boundary from 200 nm to 180 nm to extend safety considerations to common 185 nm sources as outlined in the scope of this document. Section 3.2 supplements these requirements with quantification of the effective UV-C **irradiance** distribution. Section 3.3 describes the safeguards which should be taken to avoid human exposure to **irradiance** hazards.

### 3.1 Summary of UV-C safety requirements of photobiological safety standard IEC 62471

[Source: IEC 62471 modified to lower 180 nm wavelength boundary and limited to upper 280 nm wavelength boundary]

2 The lower wavelength boundary of the UV-C wavelength range has been adjusted from 200 nm to 180 nm to include 185 nm low-pressure mercury lamps. The product safety requirements for this wavelength extension are derived from ICNIRP 2004 Guidelines [1].

3 There are also broadband UV-C devices with UV emission above 280 nm. These broadband UV-C devices have additional product safety requirements described in IEC 62471.