ANSI/IES RP-27-20

Illuminating Engineering Society

RECOMMENDED PRACTICE: PHOTOBIOLOGICAL SAFETY FOR LIGHTING SYSTEMS

AN AMERICAN NATIONAL STANDARD

Approved American National Standard ANSI

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Publication of this Recommended Practice
has been approved by IES.
Suggestions for revisions
should be directed to IES.

Prepared by:
The IES Photobiology Committee

Approved by the IES Standards Committee February 13, 2020 as a Transaction of the Illuminating Engineering Society.

Approved April 21, 2020 as an American National Standard.

Published by the Illuminating Engineering Society, 120 Wall Street, New York, New York 10005.

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Printed in the United States of America.

ISBN# 978-0-87995-353-9

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Foreword

This Recommended Practice combines and updates the material from the previous ANSI/IES RP-27 series:

- *ANSI/IES RP-27.1-15, Recommended Practice for Photobiological Safety for Lamps and Lamp Systems – General Requirements*
- *ANSI/IES RP-27.2-00(R17), Recommended Practice for Photobiological Safety for Lamps and Lamp Systems – Measurement Techniques*
- *ANSI/IES RP-27.3-17, Recommended Practice for Photobiological Safety for Lamps and Lamp Systems – Risk Group Classification and Labeling*

1.0 Introduction and Scope

1.1 Introduction

Lamps were developed and produced in large quantities and became commonplace in an era when industry-wide safety standards were not common. The evaluation and control of lamp hazards is a more complicated subject than similar tasks for a single-wavelength laser system, where only one optical hazard might apply. 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 such as diffusers and lenses, as well as variations in operating voltage.

To evaluate a broad-band optical source, such as an arc lamp, an incandescent lamp, a fluorescent lamp, LED (light emitting diode) singly or in an array, or a lamp system, three steps are necessary. First, the spectral distribution of optical radiation emitted from the source at an appropriate measurement location. The spectral distribution of the emission of interest for a lighting system may differ from that actually being emitted by the lamp alone, due to filtration by any optical elements (e.g., projection optics) in the light path. Second, the size, or projected size, of the source should be characterized in the retinal hazard spectral region. Third, it may be necessary to determine the variation of irradiance and projected radiance with distance.

The performance of the necessary measurements is not an easy task without sophisticated instruments. Photobiological action spectra, such as the ultraviolet (UV) Hazard Weighting Function, $S(\lambda)$, have rapidly changing values with slight changes in wavelength. Furthermore, sources such as lamps with glass envelopes have rapidly increasing output within the same ultraviolet wavelength band where $S(\lambda)$ is rapidly decreasing. (See **Annex E, Figure E-5**.) Hence, substantial inaccuracies in weighted results can arise from small measurement uncertainties. Users should normally rely upon the expertise of manufacturers for information on lamps and lamp systems. Safety requirements and reference measurement techniques for lamps and specific lamp systems are provided in this document.

The testing done for compliance with this Standard shall include a full analysis of the uncertainty in the results. This requirement leads to several corollary requirements:

- The testing shall be done by persons experienced in radiometry.
- The equipment used shall be fully characterized.
- The testing shall be scrutinized for all influences and sources of error.

This Standard recommends a double-monochromator system for measurements used in classifying sources, especially in the UV region, although such instrumentation may not be practical for some types of testing. The Standard therefore provides guidance on the use of other methods and when they may be appropriate. Alternative measurement methods described herein shall be used with full understanding of the limitations of each, and the method selected should be traceable back to spectral measurements. Further, the testing shall include a full analysis of the uncertainty of the results. The equipment used shall be fully characterized and major sources of error documented.

Finally, there are well known optical radiation hazards associated with some lamps and lamp systems. The purpose of this Standard is to inform the public and original equipment manufacturers (OEMs) about potential radiation hazards that may be associated with various lamps and lamp systems. It is also the purpose of this Standard to provide guidance, advice, and standard methods for evaluating and informing the user, both the public and the OEM, about the potential optical radiation hazards that may be associated with these products.

Note 1: Units of wavelength in this document are exclusively in nanometers (nm).

Note 2: Subtended angles are denoted by the full included angle, not the half angle.

1.2 Scope

This Recommended Practice covers the classification, labeling and informational requirements for lamps that emit optical radiation in the wavelength range from 200 nm to 3000 nm, with exception for LEDs used in optical fiber communication systems and for lasers. Lamps included are incandescent filament lamps including tungsten halogen types and incandescent heating sources, low pressure discharge lamps, high intensity discharge (HID) lamps, short arc lamps, carbon arcs, electroluminescent lamps, LEDs, organic LEDs (OLEDs), and laser-driven broadband sources. For the purposes of this document, induction lighting is classified under fluorescent lamps and plasma lighting is classified under HID lamps. Federal mandatory requirements for lamps subject to specific Federal Regulations take precedence over requirements included in this consensus standard.

Specific recommendations are included to provide consistency and to reduce test design time and effort. Further, this Recommended Practice is to be used by the radiometrist for guidance regarding special problems related to photobiological hazard measurements.

It is impractical for this Standard to teach all of the concepts or provide all experience needed to make accurate photobiological safety measurements.

2.0 References

2.1 Normative References

The following documents contain provisions which, through reference in this document, constitute provisions of the American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed here.

ANSI/IES LM-9-20, Approved Method: Electrical and Photometric Measurements of Fluorescent Lamps. New York: Illuminating Engineering Society; 2020.

ANSI/IES LM-20-20, Approved Method: Photometry of Reflector Type Lamps. New York: Illuminating Engineering Society; 2020.

ANSI/IES LM-45-20, Approved Method: Electrical and Photometric Measurements of General Service Incandescent Filament Lamps. New York: Illuminating Engineering Society; 2020.

ANSI/IES LM-51-20, Approved Method: Electrical and Photometric Measurements of High Intensity Discharge Lamps. New York: Illuminating Engineering Society; 2020.

ANSI/IES LM-54-20, Approved Method: IES Guide to Lamp Seasoning. New York: Illuminating Engineering Society; 2012.

ANSI/IES LM-58-20, Approved Method: Spectroradiometric Measurement Methods for Light Sources. New York: Illuminating Engineering Society; 2020.

ANSI/IES LM-66-20, Approved Method: Electrical and Photometric Measurements of Single-Based Fluorescent Lamps. New York: Illuminating Engineering Society; 2020.

ANSI/IES LM-79-19, Approved Method: Electrical and Photometric Measurements of Solid State Lighting