ANSI/IES LM-80-21

Illuminating ENGINEERING SOCIETY

APPROVED METHOD:
MEASURING MAINTENANCE OF LIGHT OUTPUT CHARACTERISTICS OF SOLID-STATE LIGHT SOURCES

AN AMERICAN NATIONAL STANDARD

Approved American National Standard ANSI

www.ies.org

ANSI/IES LM-80-21

APPROVED METHOD: MEASURING MAINTENANCE OF LIGHT OUTPUT CHARACTERISTICS OF SOLID-STATE LIGHT SOURCES

AN AMERICAN NATIONAL STANDARD

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

Prepared for IES
IES Testing Procedures Committee

Approved by the IES Standards Committee May 26, 2021, as a Transaction of the Illuminating Engineering Society.

Approved August 6, 2021, as an American National Standard.

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

IES Standards are developed through committee consensus and produced by the IES Office in New York. Careful attention is given to style and accuracy. If any errors are noted in this document, please forward them to Brian Liebel, Director of Standards, at standards@ies.org or the above address for verification and correction. The IES welcomes and urges feedback and comments.

Printed in the United States of America.

ISBN# 978-0-87995-407-9

DISCLAIMER

IES publications are developed through the consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on lighting recommendations. While the IES administers the process and establishes policies and procedures to promote fairness in the development of consensus, it makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

The IES disclaims liability for any injury to persons or property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this document.

In issuing and making this document available, the IES is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the IES undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The IES has no power, nor does it undertake, to police or enforce compliance with the contents of this document. Nor does the IES list, certify, test or inspect products, designs, or installations for compliance with this document. Any certification or statement of compliance with the requirements of this document shall not be attributable to the IES and is solely the responsibility of the certifier or maker of the statement.

AMERICAN NATIONAL STANDARD

Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria have been met by the standards developer.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether that person has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation to any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of approval. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

Prepared by the IES Testing Procedures Committee.
LM-80 Working Group

J. Hulett,
Technical Coordinator
A. Belyaev
C. Bloomfield
E. Bretschneider
A. Feldman
K. C. Fletcher
Y. Harada
J. Jiao
M. Kotrebai
K. Liepmann
J. Lockner
C. C. Miller
Y. Ohno
E. Radkov
A. Thorseth
R. Tuttle
Y. Zong

Testing Procedures Committee:

KC Fletcher, *Chair*
Andrew Jackson, *Vice Chair*
David N. Randolph, *Secretary*

Members

C. K. Andersen
R. P. Bergin
R. S. Bergman
E. Bretschneider
D. J. Ellis
M. L. Grather
Y. H. Hiebert
J. Hospodarsky
J. N. Hulett
P.-C. Hung
J. Jiao
M. Kotrebai
B. Kuebler
J. E. Leland
K. M. Liepmann
S. Longo
J. P. Marella
P. McCarthy
G. McKee
C. C. Miller
S. M[illegible]shi
E. Radkov
D. Rogers
M. B. Sapcoe
J. C. Vollers

Advisory Members

L. M. Ayers
C. A. Bloomfield
B. Boudreaux
P.-T. Chou
P. Cruz
M. Damle
L. Davis
J. J. Demirjian
M. E. Duffy
V. Eberhard
P. Elizondo
A. A. Feldman
J. Frazer
K. J. Hemmi
S. Hua
G. John
J. Juhasz
H. Ka[illegible]nejad
T. [illegible]
B. [illegible]
J. D. Kramer
K. C. Lerbs
J. Lockner
Y. Ohno
E. Page
D. Park
E. S. Perkins
M. Piscitelli
T. W. Rasinski
M. P. Royer
T. Schneider
A. Serres
G. A. Steinberg
L. Swainston
J. S. Swiernik
S.-H. Teoh
A. Thorseth
R. C. Tuttle
J. E. Walker
Y. Zong

CONTENTS

1.0 Introduction and Scope

1.1 Introduction

The output in optical radiation from solid-state light sources such as LEDs and laser diodes eventually decreases over time. This characteristic of declining output without sudden and permanent failure creates a risk that products incorporating a solid-state light source, that is operating near end of life may be performing outside the products' specifications, or outside required codes, standard practices, or regulations. These solid-state light sources may also undergo gradual shifts in the emitted spectrum over time that may result in unacceptable appearance, color rendering, efficacy, or efficiency.

Product characteristics obtained using this procedure are measured under controlled conditions that may allow direct comparison of results obtained at different laboratories. The resulting data may be used for direct evaluation and comparison of solid-state light source components, and they may be utilized in models that project long-term changes in performance characteristics.

1.2 Scope

This Approved Method describes the procedures by which solid-state light sources, such as LED packages, arrays and modules; or laser diode packages, arrays and modules may be tested for flux maintenance over time, including luminous flux, radiant flux, and photon flux maintenance. This document also provides methods for measurement of spectrum-dependent characteristic maintenance, including changes in chromaticity coordinates, peak wavelength, dominant wavelength, centroid wavelength, and spectral power distribution over time, when carried out under controlled environmental and operational conditions. For the purposes of this document, *solid-state light sources* include ultraviolet, visible, and infrared sources emitting optical radiation in the range of 200 nm to 2,000 nm.

This Approved Method does not cover lamps, light engines, or luminaires and does not provide guidance regarding predictive estimations or extrapolation for the maintenance characteristics beyond the duration of the actual measurements.

2.0 Normative References

2.1 ANSI/IES LS-1-20

Illuminating Engineering Society. Recommended Practice: Nomenclature and Definitions for Illuminating Engineering. New York: IES; 2020. Online: www.ies.org/standards/definitions/ (Accessed 2020 Dec 7).

2.2 ANSI/IES TM-27-20

Illuminating Engineering Society. Technical Memorandum: IES Standard Format for the Electronic Transfer of Spectral Data. New York: IES; 2020.

2.3 ASTM Standard E230/E23M-112

ASTM International. ASTM E230/E230M-17, Standard Specification and Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples. West Conshohocken, PA: ASTM International; 2017.

3.0 Definitions

Definitions found in this section are for the purpose of this document. Definitions not found in this section may be found in *ANSI/IES LS-1-20, Recommended Practice: Nomenclature and Definitions for Illuminating Engineering* (see **Section 2.1).**

3.1 air temperature (T_A)

The temperature of the air surrounding the DUT (device under test) during the maintenance test.

3.2 centroid wavelength (λ_c)

The wavelength calculated as the weighted center of a spectral distribution according to:

$$\lambda_c = \frac{\int_{\lambda_1}^{\lambda_2} \lambda \bullet \Phi_\lambda(\lambda)\, d\lambda}{\int_{\lambda_1}^{\lambda_2} \Phi_\lambda(\lambda)\, d\lambda},$$