ANSI/IES LP-4-20

Illuminating Engineering Society

LIGHTING PRACTICE: ELECTRIC LIGHT SOURCES – PROPERTIES,SELECTION, AND SPECIFICATION

AN AMERICAN NATIONAL STANDARD

Approved American National Standard ANSI

www.ies.org

ANSI/IES LP-4-20

LIGHTING PRACTICE: ELECTRIC LIGHT SOURCES – PROPERTIES, SELECTION, AND SPECIFICATION

AN AMERICAN NATIONAL STANDARD

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

Prepared for IES
By the IES Light Sources Committee

Approved by the IES Standards Committee September 9, 2019 as a Transaction of the Illuminating Engineering Society.

Approved February 7, 2020 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, they should be forwarded to Brian Liebel, Director 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# 978-0-87995-019-4

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 Light Sources Committee

Eric S. Perkins, ***Chair***
Jianzhong Jiao, ***Vice Chair***

Members

E. Bretschneider
E. Graff
Y. Hiebert
R. G. Janik
D. E. Korow
E. M. Mendoza Estrada
R. E. Valdes
K. Xu

Advisory Members

P. Appaiah
S. U. Rao

Honorary Member

D. L. Crawford

Please refer to the IES Bookstore for possible Errata: www.ies.org.

CONTENTS

1.0 Introduction and Scope

1.1 Introduction

Some electric lighting is necessary for every interior space. Proper light source selection depends on the functional and aesthetic requirements placed on the lighting system, economic and energy usage restrictions, and the personal preferences of the designer and/or the owner of the space. There are several thousand commercially available light sources. With such a wide selection, it is likely that several different choices could be made for a given lighting application. This document is intended to help facilitate light source selection for those involved in the design of the luminous environment, including architects, interior designers, engineers, lighting designers, owners, sustainability consultants, energy engineers, landscape architects, lighting product representatives, lighting manufacturers, contractors, and distributors.

Through the passage of time, new light sources have been developed as an improvement upon existing techniques to supplement daylight as a way to extend days and increase productivity of the workforce. The earliest electric light sources produced light by heating metal filaments until they glowed, thereby offering a safer and more convenient alternative to fire. Since then, various techniques to produce visible light have been explored that would last longer, consume less energy, or offer greater creative expression. Each lighting technology has unique characteristics that make it more or less desirable for specific applications. While LED lighting is quickly becoming the preferred light source technology for most lighting applications, to understand the operating principles of all technologies and their limitations provides a powerful toolbox in creating lighting design schemes and fuels the search for the perfect light source.

1.2 Scope

The sections of this document describe light source technologies commonly used for general lighting applications. Information is categorized according to the way visible light is produced. Details are provided regarding operating principles, characteristics of the technology, and configuration of systems. Guidelines are presented to assist in selecting and specifying each type of light source, highlighting application concerns that should be considered.

Some sources may have been commonplace in years past, but due to technology evolution, they may now only be infrequently used in situations with unique application or economic requirements. While new discoveries, innovative inventions, and legislation have rendered some light sources obsolete or rarely used, they will still be referenced briefly for the purposes of telling a complete story.

Light source technologies addressed in this document include:

- Solid State Lighting
  - Light-emitting diodes (LED)
  - Organic LED (OLED)
- Fluorescent
  - Linear fluorescent
  - Compact fluorescent
  - Induction fluorescent
  - Cold cathode fluorescent
- High intensity discharge
  - Metal halide
  - High pressure sodium (HPS)
  - Plasma
- Filament
  - Incandescent
  - Tungsten-halogen
- Other
  - Low pressure sodium (LPS)

2.0 Solid State Lighting

Although the scientific community had been aware from the beginning of the twentieth century that diodes were capable of emitting radiation, the first practical light-emitting diode (LED) to operate in the visible spectrum was invented in 1962 by Nick Holonyak of General Electric. Further inventions throughout the later 1960s and the 1970s facilitated the development