



**LIGHTING PRACTICE:
ELECTRIC LIGHT SOURCES –
PROPERTIES, SELECTION,
AND SPECIFICATION**
AN AMERICAN NATIONAL STANDARD



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**Prepared for IES
By the IES Light Sources Committee**



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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