



TECHNICAL MEMORANDUM:
AN OPTIONAL METHOD FOR ADJUSTING
THE RECOMMENDED ILLUMINANCE FOR
VISUALLY DEMANDING TASKS WITHIN IES
ILLUMINANCE CATEGORIES P THROUGH Y
BASED ON LIGHT SOURCE SPECTRUM
AN AMERICAN NATIONAL STANDARD



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

**Prepared for IES
IES Vision Science Committee.**



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1.0 Introduction and Scope

1.1 Introduction

This Technical Memorandum (TM) addresses how the spectral power distribution (SPD) of light sources can be incorporated into the IES Illuminance Determination System for visual tasks that are categorized as P through Y within interior lighting applications (refer to *ANSI/IES LS-8-20, Lighting Science: Vision – Perceptions and Performance*, Section 6.2¹). This TM describes how a light source's SPD affects pupil size, visual acuity, and visual efficiency under interior lighting conditions, and establishes an optional calculation method, Equivalent Visual Efficiency (EVE), for adjusting IES recommended illuminance targets under limited circumstances when visual tasks require the ability to discern achromatic visual detail to ensure speed and/or accuracy in the performance of the visual task. EVE is a method for achieving a balance between light level and SPD that results in *maintaining* equal visual acuity; it is not intended to improve visual acuity or visual performance. The calculation makes no claim as to any effect on overall visual performance, other than to state that the use of this calculation ensures equivalent visual efficiency for visually demanding tasks. The calculation is optional, and its use should be balanced with other lighting design criteria and objectives.

It is acknowledged that this version of TM-24 continues to use an empirically derived, physiologically inaccurate model of the pupillary light reflex based on the ratio of scotopic to photopic power of the light source. In conditions typical of interior lighting, long-course changes in pupil size are principally mediated by intrinsically photosensitive retinal ganglion cells (ipRGCs), not the rod photoreceptors. It is expected that the EVE method will be updated when quantities related to ipRGC photoreception are standardized by the IES.

1.2 Scope

This TM documents the fundamentals of visual efficiency, defines the EVE calculation method, and addresses practical concerns for implementation. The EVE method described herein should not be applied if any of these conditions apply:

- The task or tasks are covered by IES Illuminance Categories A through O for the Recommended Illuminance Target¹
- The task is nonvisual in nature
- The task is not visually demanding (see **Section 2.5**)
- The application is exterior
- It is known that there are a high number of occupants with abnormal vision or poor ocular health

Further discussion of the preconditions for application of the EVE method is included in **Section 4.5**.

The method described in this TM is based on how the SPD of a light source affects the ability to discern achromatic visual detail. The SPD can also affect brightness perception, color rendering, discomfort glare, circadian rhythms, and other physiological outcomes; these factors are discussed only in limited detail in this TM. The decision to apply the EVE method is at the discretion of the specifier.

2.0 Overview: Concepts and Definitions

2.1 The Role of Light Source Spectral Power Distribution

Quantifying the effects of lighting on human vision is one of the fundamental requirements of illuminating engineering. This task is accomplished by converting light as an electromagnetic quantity defined in radiometric values to units that have some relationship to human vision. This conversion is accomplished by using the spectral power distribution (SPD) of a light source as a radiometric quantity and weighting that SPD against the spectral response of the human visual system.

2.2 The Spectral Luminous Efficiency Function for Photopic Vision, $V(\lambda)$

The spectral luminous efficiency function for photopic vision, $V(\lambda)$, is used to weight radiant energy according to the sensitivity of the visual system at relatively high light levels. (For more information see *ANSI/IES LS-2-20*,