

ICS 91.160
CCS K 70



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 46119-2025

Non-visual biological effects action dose of light via eyes

光的人眼非视觉生物效应作用剂量

Issued on: August 29, 2025

Implemented on: March 1, 2026

**Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC**

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents". Drafting.

Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents.

This document was proposed by the China National Light Industry Council.

This document is under the jurisdiction of the National Technical Committee on Standardization of Lighting Appliances (SAC/TC224).

This document was drafted by: Fudan University, Chongqing University, National Electric Light Source Quality Supervision and Inspection Center (Beijing), and Foshan Electric Lighting Co., Ltd.

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Company, China National Institute of Metrology, MLS Co., Ltd., Beijing Miji Technology Co., Ltd., Guangdong Guangyang Electric Co., Ltd., Ningbo Bull Optoelectronics Technology Co., Ltd., Guangzhou Baiman Optoelectronics Technology Co., Ltd., Pujiang Sansi

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Introduction

Strong scientific evidence suggests that light is not only essential for vision, but also has important biological significance for human health, performance, and well-being.

These effects are independent of visual images. These "non-visual" (NIF) effects of light (sometimes also called "non-image-forming") originate from the eye and vary from person to person.

This relates to the skin's mediated response to light radiation (such as vitamin D production, skin cancer, or photodermatitis). This document focuses on the effects of light on the eye.

Mediated non-visual effects. These effects depend on spectral power distribution, spatial distribution, exposure timing, and duration. They also depend on the human...

Specific parameters, such as an individual's circadian rhythm and light intensity, are often helpful in visual science and photobiology in determining the effect of the spectrum.

Standard physical quantities are defined by (describing average sensitivity to light). The relationship between these standard physical quantities and the actual physiological response to light can be expressed using generalized methods.

The study uses the concept of light measurement, which itself does not depend on the subjective reactions of any individual being observed.

Light is a primary synchronizer of the human biological clock. It alters the phase of the circadian rhythm and determines the timing of sleep-wake cycles. Light can acutely suppress...

It inhibits the nighttime release of melatonin. There are also reports that light can increase heart rate, improve alertness, alleviate seasonal and non-seasonal depression, and affect...

It regulates body temperature and affects the electroencephalogram (EEG) spectrum. Exposure to light can elicit rapid responses in pupillary reflexes or brain activity (within milliseconds and seconds).

(within the range of seconds).

The aforementioned biological effects of light are caused by stimulating the photoreceptors in the eye. The photoreceptors that produce visual effects are rod cells and...

Cone cells. The photoreceptors that produce non-visual effects primarily originate from intrinsically photosensitive retinal ganglion cells (ipRGCs), which are located in the visible spectrum.

The shorter wavelength portion exhibits peak sensitivity, and its photosensitivity is based on photosensitive melanin contained within the cells, also known as the photosensitive melanin protein of the human retina. leukocyte.

For non-visual effects of light, the actual non-visual effects produced by the eye's exposure to light depend on the combined effect of all photoreceptors.

The response, and there is solid evidence that all receptor types are likely to facilitate these responses, rather than describing photoradiation solely based on the photoreaction spectrum.

Non-visual effects are not enough.

Scientific literature contains examples of variations in how each type of photoreceptor contributes to triggering certain non-visual effects, based on (retinal) radiance.

Illuminance and other light characteristics, such as environmental factors (subjective time, light climate zone, light adaptation, sleep pressure), duration, spectrum, and time-dependent effects.

Other characteristics, such as the spatial distribution of light and its changes over time, may exhibit similar effects when appropriate.

Therefore, it is necessary to combine the comprehensive effects of light, rather than just relying on the spectrum of action, to define the dosage of non-visual effects.

This document provides relevant definitions to quantify the characteristic quantities that cause the photosensitive retinal ganglion cells to respond to light, and further...

Considering its application in lighting for human rhythm stability, mood regulation, and high work performance, the aim is to provide corresponding quantifiable benefits for improving health and well-being. in accordance with.

Dosage of non-visual biological effects of light on the human eye

1 Scope

This document specifies the non-visual biological light requirements for human eyes in visual work scenarios, taking into account rhythmic stability, emotion regulation, and the need for high work performance.

Effect dose, and correction factors for non-visual biological effects based on age, field of

vision, and light climate zone.

This document applies to the dose and correction factor requirements for visible light radiation with wavelengths from 380nm to 780nm.

This document provides quantitative recommended values based on functional requirements only. Each application scenario should refer to and use these values according to its functional requirements.

This document does not cover chromaticity, photobiological safety, or other related topics; it only relates to the non-visual response of the human eye.

Note. The non-visual effect dosage system specified in this document includes. melanin-responsive sunlight (D65) equivalent illuminance (m-EDI), rhythmic stimulus value (CS) model.

And a daily cumulative photobiological effect-rhythmic phase shift (DCLA-CPS) model validated in the Chinese population. Based on retinas melanin in the human retina.

Cellular action spectrum, melatonin inhibition rate, and circadian rhythm phase shift suggest dosages for rhythm-stabilized lighting, mood lighting, and high-performance lighting.

Recommended values, applicable to health lighting designs that focus on different aspects.

2 Normative references

GB/T 2900.65

3 Terms and Definitions

The terms and definitions defined in GB/T 2900.65 and the following terms and definitions apply to this document.

3.1 Non-visual biological effects dose of light

Measuring the illuminance based on melanin-responsive sunlight (D65) equivalent illuminance (m-EDI), rhythmic stimulus value (CS), and daily cumulative photobiological effect (DCLA).

3.2 m-EDI

The illuminance produced by light radiation that conforms to standard daylight (D65) and provides a visual melanin-responsive irradiance E_m equal to that of the test source, is shown in the table. Shown as $ED_{65v,m} = E_m \cdot KD_{65m,v}$ in the formula.

E_m --- Melanin-responsive irradiance;