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Light and lighting — Integrative lighting — Non-visual effects

Lumière et éclairage — Éclairage intégratif — Effets non visuels

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11

Email: copyright@iso.org
Website: www.iso.org

CIE Central Bureau
Babenbergerstraße 9/9A • A-1010 Vienna

Phone: +43 1 714 3187
Fax: +41 22 749 09 47
Email: ciecb@cie.co.at
Website: www.cie.co.at

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Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Practical implementation **2**
4.1 General 2
4.2 Beneficial aims 3
4.2.1 General 3
4.2.2 Well established 3
4.2.3 Moderate evidence 3
4.2.4 Insufficient evidence 4
4.3 Avoidance of risks 4
4.3.1 General 4
4.3.2 Well established 4
4.3.3 Moderate evidence 4
4.3.4 Insufficient evidence 5
4.4 Implementation Considerations 5
4.5 Conclusion 5
Annex A (informative) **Scientific background** **7**
Bibliography **14**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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This document was prepared by ISO/TC 274, Light and lighting in cooperation with the International Commission on Illumination (CIE).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

The content of this document represents the state of the art at the date of publication and it is not necessarily complete.

At present ipRGC-influenced responses to light (IIL responses) are often referred to as non-image-forming (NIF) or non-visual (NV) responses to reflect their distinction from perceptual vision. This document reflects that interest while allowing for the possibility for the accepted range of light responses driven by ipRGCs to expand as we gain more knowledge.

The light patterns of exposure can be beneficial or non-beneficial for humans depending on the setting, relating to spectrum, intensity, duration, and timing of the resulting light exposure.

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Light and lighting — Integrative lighting — Non-visual effects

1 Scope

This document provides an analysis and evaluation of the current state of the art with regard to ipRGC-influenced responses to light in applying this knowledge in the context of identified topics to be considered for use in lighting applications. This analysis has taken into consideration published scientific papers, use cases, reports, best-practice guidelines and recommendations, see Annex A. However, evaluation of the results will be based on scientifically validated findings.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CIE S 017:2020, *ILV: International Lighting Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in CIE S 017 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

CIE maintains a terminology database for use in standardization at the following address:

— e-ILV: available at https://cie.co.at/e-ilv

3.1
integrative lighting
lighting integrating both visual and non-visual effects, and producing physiological and/or psychological benefits upon humans

Note 1 to entry: The term "integrative lighting" applies only to humans.

Note 2 to entry: Lighting primarily for therapeutic purposes (light therapy) is not included.

Note 3 to entry: The term "human centric lighting" is used with a similar meaning.

[SOURCE: CIE S 017:2020, entry 17-29-028]

3.2
ipRGCs
intrinsically-photosensitive retinal ganglion cells
retinal ganglion cells that are photosensitive by means of the photopigment melanopsin

[SOURCE: CIE S 026:2018, entry 3.11, modified — notes to entry omitted]

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3.3
ipRGC-influenced responses to light
ipRGC-influenced light (IIL) responses
light-induced responses or effects that can be elicited by ipRGCs

Note 1 to entry: ipRGCs can play a role in both visual and non-visual responses to ocular light exposure. At present ipRGC-influenced responses to light are often referred to as non-image-forming (NIF) or non-visual (NV) responses to reflect their distinction from perceptual vision.

Note 2 to entry: ipRGC-influenced responses to light can be influenced by rod, cone and melanopsin inputs.

[SOURCE: CIE S 026:2018, entry 3.12, modified — notes 1 and 2 to entry revised]

3.4
spectrum
display or specification of the monochromatic components of the radiation considered

[SOURCE: CIE S 017:2020, entry 17-21-015, modified — notes to entry omitted]

3.5
illuminance
density of incident luminous flux with respect to area at a point on a real or imaginary surface

$$E_{\mathrm{v}} = \frac{\mathrm{d}\Phi_{\mathrm{v}}}{\mathrm{d}A}$$

where

Φ_{v} is luminous flux;

A is the area on which the luminous flux is incident.

Note 1 to entry: The illuminance is expressed in lux ($\mathrm{lx} = \mathrm{lm \cdot m^{-2}}$).

[SOURCE: CIE S 017:2020, entry 17-21-060, modified — notes 1 and 2 to entry omitted]

3.6
electric lighting
lighting by electric light sources

[SOURCE: CIE S 017:2020, entry 17-29-025, modified — notes to entry omitted]

3.7
daylighting
lighting for which daylight is the light source

[SOURCE: CIE S 017:2020, entry 17-29-031, modified — notes to entry omitted]

4 Practical implementation

4.1 General

Daylighting and electric lighting can affect psychological and biological functioning via image-forming and non-image-forming pathways.[1] Due to benefits and risks that relate to both pathways, experience has shown that both ought to be considered in the lighting design process. Knowledge about both image-forming and non-image-forming effects of lighting enables a better evaluation of the effects of daylighting and electric lighting on the human body.

In particular, the processing of information contained in the light beyond the forming of images plays a crucial role. Among other things, this additional information can influence the human internal

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