
**Ergonomics of human-system
interaction —**

**Part 610:
Impact of light and lighting on users of
interactive systems**

Ergonomie de l'interaction homme-système —

*Partie 610: Impact de la lumière et de l'éclairage sur les utilisateurs
de systèmes interactifs*



This document is a preview generated by EUS



COPYRIGHT PROTECTED DOCUMENT

© ISO 2022

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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

Published in Switzerland

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Light and lighting — more than just vision	4
4.1 How radiation impacts the human body	4
4.2 The role of light for life	5
4.3 Non-visual effects of radiation	6
4.4 A new definition of lighting	9
4.5 Why light is not light and daylight in interiors is different from solar light	9
4.6 The role of daylight and solar radiation	11
5 Light and circarhythms	11
5.1 Basics	11
5.2 Importance of light for the circadian rhythm	12
5.3 A new perspective on light	14
5.4 Relation to other zeitgebers	16
6 Light at night (LAN)	17
6.1 General	17
6.2 Studies of light at night (LAN or ALAN)	18
7 Light history (memory effect)	19
8 Physical characteristics	21
8.1 Spatial distribution of the source	21
8.2 Location of the source	21
8.3 Light spectrum and its role for vision	22
8.4 Light spectrum and its role for non-visual effects	23
8.5 Time and timing	24
8.6 Intensity	24
8.7 The role of visual displays	24
9 Individual differences	26
9.1 Chronotype	26
9.2 Age dependency	26
9.3 Internal circadian time (body time)	27
10 Conclusions	28
10.1 Agreed facts	28
10.2 Controversial issues	28
Annex A (informative) Some useful behaviours of users or beneficial conditions for the physical environment	30
Bibliography	31

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 159, *Ergonomics*, Subcommittee SC 4, *Ergonomics of human-system interaction*.

A list of all parts in the ISO 9241 series can be found on the ISO website.

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.

Introduction

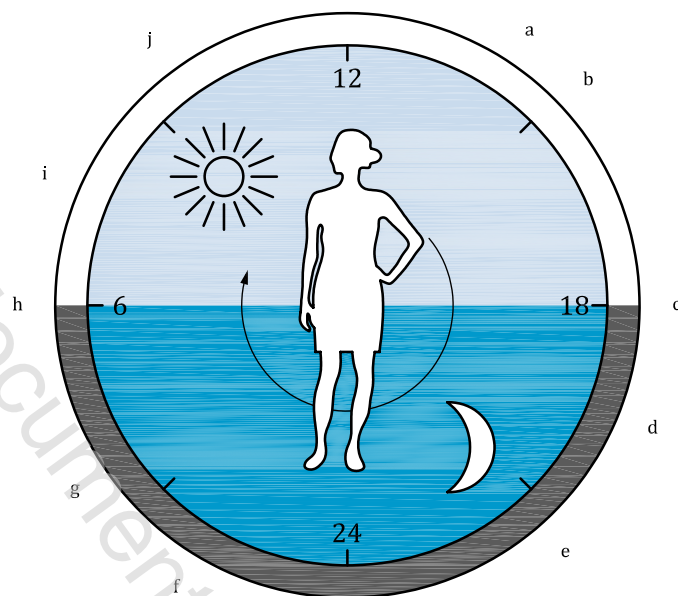
ISO 9241-6 was developed to give guidance on the work environment, including lighting to support vision. Since the discovery of a third sensor in the human eye, ample research has demonstrated that ocular light exposure, besides supporting visual perception, influences many aspects of human physiology and behaviour, including circadian rhythms, alertness and sleep, mood, neuroendocrine and cognitive function.

Users of interactive systems that mostly incorporate at least one visual display are likely to be affected both by the light generated by their work equipment and by lighting as an environmental factor. New scientific evidence establishes the fact that light exposure by the work equipment can reach levels of the same magnitude as ambient lighting^[1].

Lighting has been defined as the use of light for making things visible since the International Lighting Vocabulary of the CIE was published in 1938.^[2] In the 4th edition published in 1987, its definition was “application of light to scene, objects or their surroundings so that they may be seen”.^[3] The role of lighting has been thoroughly reconsidered in the light of the scientific evidence in the last two decades so that the internationally acknowledged definition was changed in the last version.^[4] The definition now reads “application of light to a scene, objects, or their surroundings” (E-ilv 17-29-001).

“... so that they may be seen” has been dropped because of the new, additional role of light. It is required by scientists as well as practitioners that the design of lighting be performed in consideration of health effects. Currently, “Light and Health” has become a slogan pointing to the new goal. This can be characterized as considering and supporting human circadian rhythms governed by the circadian clock. Although such rhythms have been studied for decades, the discovery of molecular mechanisms controlling them was awarded the Nobel Prize for Medicine in 2017. The illustration by the Nobel Prize Committee can also serve as a short description for this document: “This clock [circadian] helps to regulate sleep patterns, feeding behaviour, hormone release, blood pressure and body temperature.

A large proportion of our genes are regulated by the clock.” ([Figure 1](#))^[5].



- a Best coordination.
- b Fastest reaction times.
- c Highest body temperature.
- d Highest blood pressure.
- e Melatonin secretion.
- f Deep sleep.
- g Lowest body temperature.
- h Cortisol release.
- i Fastest increase in blood pressure.
- j High alertness.

SOURCE The Nobel Committee for Physiology or Medicine. ‘The 2017 Nobel Prize in Physiology or Medicine’ press release^[5]. Reproduced with permission of the copyright holder.

Figure 1 — The circadian clock (also known as the circadian oscillator) and its impacts on our physiology

It should be noted that the first Nobel Prize in Medicine was awarded in 1903 to Niels Ryberg Finsen for his contribution to the treatment of diseases with optical radiation.

The new role of light has been considered not only by scientists but also by various institutions that deal with ergonomics, work organization, safety and health. Due to a high variety of sources that can be of relevance, this document has been prepared on the basis of documents representing the published outcome of expert evaluations of literature with a good general agreement, although published with a time difference of more than a decade. This document has been prepared after studying References [1] and [6] to [11] and the literature reviewed by their respective authors.

Ergonomics of human-system interaction —

Part 610:

Impact of light and lighting on users of interactive systems

1 Scope

This document provides users of interactive systems with a summary of the existing knowledge about ergonomics considerations for the influence of artificial (electric) and natural lighting of environments on humans other than on vision, with a focus on non-image-forming effects.

The document can furthermore be used as guidance on the specification of use environments in consideration of non-visual effects of lighting, also called non-image-forming (NIF) functions.

Therapeutic use of light and optical radiation is not part of this document.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/>

3.1

correlated colour temperature CCT

temperature of a black body (Planckian) radiator whose perceived colour most closely resembles that of a given stimulus at the same brightness and under specified viewing conditions

[SOURCE: IEV 723-08-34]

3.2

chronobiology

field of biology pertaining to periodic rhythms that occur in living organisms in response to external stimuli such as photoperiod

3.3

chronotype

phase relationship of the circadian clocks to the zeitgeber

Note 1 to entry: A person's chronotype is the propensity for the individual to sleep at a particular time during a 24-h period.

3.4

circadian

biological process that displays an endogenous, entrainable oscillation of about 24 hours