International Standard

ISO/CIE 8995-1

Light and lighting — Lighting of work places —

Part 1: Indoor

Lumière et éclairage — Éclairage des lieux de travail —

Partie 1: Intérieur

First edition
2025-01

Reference number
ISO/CIE 8995-1:2025(en)

COPYRIGHT PROTECTED DOCUMENT

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

Published in Switzerland

Contents

Page

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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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 274, *Light and lighting*, in cooperation with the International Commission on Illumination (CIE).

This first edition of ISO/CIE 8995-1 cancels and replaces ISO 8995-1:2002, which has been technically revised

The main changes are as follows:

— prior document reference numbers (CIE S 008:2002, ISO 8995-1:2002) replaced with a combined reference number, ISO/CIE 8995-1;

— scope revised;

— Annex A, Annex B, Annex C and Annex D added;

— editorially updated.

A list of all parts in the ISO/CIE 8995 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

Good lighting will create a visual environment that enables people to see, to move about safely and to perform visual tasks efficiently, accurately, and safely without causing undue visual fatigue and discomfort. The illumination can be provided by daylight, electric light sources, or a combination of both.

Good lighting requires equal attention to the quantity and quality of the lighting. While the provision of sufficient illuminance on the task is necessary, in many instances the visibility depends on the way in which the light is delivered, the colour characteristics of the light source and surfaces together with the level of glare from the system. In this document, opportunity was taken to specify for various work places and task types, not just the illuminance, but also the limiting of discomfort glare and minimum colour rendering index of the source. Parameters to create comfortable visual conditions are proposed in the body of this document. The recommended values are considered to represent a reasonable balance, having regard to the requirements for safe, healthy, and efficient work performance. The values can be achieved with practical energy efficient solutions.

There are also visual ergonomic parameters such as perceptual ability and the characteristics and attributes of the task, which determine the quality of the operator's visual skills, and hence performance levels. In some cases, enhancement of these influencing factors can improve performance without the need to raise illuminance. This can be achieved, for example by improving the contrast of the task attributes, enlarging the task by the use of up to date visual aids (e.g. glasses) and by the provision of special lighting systems with local directional lighting capability.

Adequate and appropriate lighting enables people to perform visual tasks efficiently and accurately including tasks performed over a prolonged time period or of a repetitive nature. The degree of visibility and comfort required in a wide range of work places is governed by the type and duration of the activity. The lighting also affects circadian rhythms and mood as well as improving performance and well-being.

The final designed, installed and operated lighting system should provide efficient and effective good quality lighting for the user needs tailored to their visual capacity, e.g. visual capacity of elderly users in work places.

It is important that all clauses of this document are followed although the target values for lighting criteria and specific requirements, depending of each type of task/activity, are tabulated in the schedule of lighting requirements (see Clause 7).

This document reflects the generally recognized best practice at the time of publication.

Light and lighting — Lighting of work places —

Part 1: Indoor

1 Scope

This document specifies lighting requirements for humans in indoor work places, which meet the needs for visual comfort, performance and safety of people having normal, or corrected to normal visual capacity and response to light.

This document specifies requirements for lighting solutions for typical indoor work places and their associated areas in terms of quantity and quality of illumination. The illumination can be provided by daylight, electric light sources, or a combination of both.

This document gives recommendations for good lighting to fulfil the needs of integrative lighting.

This document neither provides specific solutions nor recommendations for atmosphere or aesthetics created by lighting. It does not restrict the designers' freedom from exploring new techniques nor restrict the use of innovative equipment.

This document is not applicable for emergency lighting. For emergency lighting, see ISO 30061.

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.

ISO 3864-1, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

ISO 9680, *Dentistry — Operating lights*

ISO/CIE TS 22012, *Light and lighting — Maintenance factor determination — Way of working*

CIE S 017, *ILV: International Lighting Vocabulary*

CIE S 026, *CIE System for Metrology of Optical Radiation for ipRGC-Influenced Responses to Light*

CIE 58, *Lighting for sports halls*

CIE 62, *Lighting for swimming pools*

IEC 60601-2-41, *Medical electrical equipment - Part 2-41: Particular requirements for the basic safety and essential performance of surgical luminaires and luminaires for diagnosis*

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
activity area
partial area in the work place in which more than one visual task is carried out

Note 1 to entry: Visual tasks can be different in type and/or position.

Note 2 to entry: A room can contain one or more activity areas.

Note 3 to entry: The spatial orientation needs to be specified by the designer.

Note 4 to entry: An activity area is not to be considered as aggregation of a number of distinct task areas across a larger area.

3.2
immediate surrounding area
zone of at least 0,5 m width surrounding the task area within the field of vision

3.3
background area
horizontal area at floor level adjacent to the *immediate surrounding area* (3.2) within the limits of space

3.4
work place
designated area in which work activities are carried out

4 Symbols and abbreviations

$\bar{E}_{m,wall}$	maintained average illuminance on walls[1)]
$\bar{E}_{m,ceiling}$	maintained average illuminance on ceiling[1)]
U_o	illuminance uniformity
$\bar{E}_m$	maintained average illuminance[1)]
α	shielding angle
C-plane angle	elevation angle
γ	vertical photometric angle
DGP	Daylight Glare Probability
L	luminance
R_{UG}	CIE Unified Glare Rating (UGR)
R_{UGL}	R_{UG} limit value
$\bar{E}_c$	average cylindrical illuminance[2)]
$\bar{E}_{m,c}$	maintained average cylindrical illuminance[1)]

1) According to CIE S 017, $\bar{E}_m$ is the value below which the average illuminance on a specified area shall not fall.

2) Approximated by the average of the four main directions

T_{cp}	correlated colour temperature
R_a	general colour rendering index
R_i	special colour rendering index
TLM	temporal light modulation
$P_{st,LM}$	IEC short-term light modulation/ temporal light modulation indicator
SVM	Stroboscopic Visibility Measure
DSE	display screen equipment
f_m	maintenance factor
$\bar{E}_i$	initial illuminance
$\bar{L}_{m,wall}$	maintained average luminance of the walls
$\bar{L}_{m,ceiling}$	maintained average luminance of the ceiling
ρ_{wall}	luminous reflectance of the wall
$\rho_{ceiling}$	luminous reflectance of the ceiling

5 Lighting design criteria

5.1 General

For good lighting practice, it is essential that, along with the required illuminances, additional qualitative and quantitative needs are satisfied.

Lighting requirements are determined by the satisfaction of three basic human needs:

— visual performance, in which the workers are able to perform their visual tasks, even under difficult circumstances and during longer periods;

— visual comfort, in which the workers experience physical and mental comfort; evidence shows that this state contributes to improved work motivation, work quality, and reduced absenteeism;

— safety.

The principal parameters that describe the luminous environment with respect to daylighting and electric lighting are:

— luminance distribution;

— illuminance and illuminance uniformity;

— glare;

— directionality of light;

— lighting in the interior space;

— colour rendering and colour appearance of the light;

— temporal light modulation.

These criteria are further detailed in Clause 5 and Clause 6, requirements and recommendations are given in Clause 7.

NOTE In addition to the lighting, there are other visual ergonomic parameters which influence visual performance, such as:

— the intrinsic task properties (size, shape, position, colour and reflectance properties of detail and background);

— normal visual capacity and response to light of the person (visual acuity, depth perception, colour perception) (see CIE 227);

— for the visually impaired, for example those who are sensitive to glare or have visual field defects, adaptation and decreased contrast and colour vision where dimming, protection against glare and colour rendering are especially important factors to consider, see CIE 227.

5.2 Luminance distribution

5.2.1 General

The luminance distribution is a crucial factor to determine a proper luminous environment. It affects task visibility and shall be properly controlled.

An appropriate adaptation luminance is needed to optimize:

— visual acuity (sharpness of vision);

— contrast sensitivity (discrimination of small relative luminance differences);

— efficiency of the ocular functions (such as accommodation, convergence, pupillary contraction, eye movements, etc.).

The luminance distribution in the visual field also affects visual comfort. The following shall be avoided for the reasons given:

— excessive luminances and luminance contrasts which can cause discomfort glare and reduced task visibility;

— excessive luminance variation which can cause fatigue because of constant re-adaptation of the eyes.

Attention shall also be given to adaptation in moving from zone to zone within a building.

To create a well-balanced luminance distribution, the luminance values of all surfaces shall be taken into consideration. They are determined by the reflectance and the illuminance on the surfaces. To avoid gloom and to raise adaptation levels and comfort of people in buildings, it is highly desirable to have bright interior surfaces. Room brightness is considered by specifying average illuminance values on walls and ceiling (see Clause 7) and by recommending typical reflectance values (5.2.3).

The lighting designer shall consider and select the appropriate illuminance/luminance values for the interior surfaces based on the guidance in 5.2.2, 5.2.3 and 5.2.4.

NOTE To simplify calculation procedures, this document does not consider the spectral reflectance values but only the average reflectances of the surfaces themselves and considers these perfectly Lambertian surfaces, except for the cases that deal with the surfaces with non-isotropic diffuse reflections.

5.2.2 Average luminance of surfaces

When isotropic diffuse reflection can be assumed, the luminance of a certain point on the surface is proportional to the product of the illuminance on that point multiplied by the reflectance of the surface. That means that the reflectance of and the illuminance on the surfaces is a simplified substitution of luminance requirement.

NOTE 1 When the surfaces do not have isotropic diffuse reflection, the same luminous environment is not necessarily assured from the different points of view even if it meets the illuminance requirements.

When calculating the luminance distribution by using lighting simulation programs, the lighting designer shall consider and select the appropriate minimum requirements of the average luminance of the interior surfaces based as below.

a) When isotropic diffuse reflection can be assumed.

   — The lighting designer can set view positions for calculating luminance distribution anywhere.

b) When isotropic diffuse reflection cannot be assumed.

   — The lighting designer shall choose several representative view positions in the space depending on the tasks and/or activities being performed and calculate the average luminance values of walls and ceiling from these positions. It is desirable to meet the minimum requirements for the average luminance of walls and ceiling from all these positions.

The average luminance of walls and ceiling from all these positions depending on the tasks and/or activities being performed in the space shall meet the minimum requirements. The minimum requirements for the average luminance can be calculated from the recommended minimum illuminance (Clause 7) multiplied by the recommended value of the reflectance in the wavelength between 380 nm to 780 nm for the calculation purpose (see 5.2.3).

The average maintained luminance on the walls is calculated using Formula (1):

$$\bar{L}_{\mathrm{m,wall}} = \frac{\bar{E}_{\mathrm{m,wall}} \cdot \rho_{\mathrm{wall}}}{\pi} \tag{1}$$

where

$\bar{E}_{\mathrm{m,wall}}$ is the average maintained illuminance on the walls given in Table 9 to Table 62;

ρ_{wall} is the reflectance of the walls (see 5.2.3 for recommended reflectances in the wavelength between 380 nm to 780 nm for the calculation purpose).

The average maintained luminance of the ceilings is calculated using Formula (2):

$$\bar{L}_{\mathrm{m,ceiling}} = \frac{\bar{E}_{\mathrm{m,ceiling}} \cdot \rho_{\mathrm{ceiling}}}{\pi} \tag{2}$$

where

$\bar{E}_{\mathrm{m,ceiling}}$ is the average maintained illuminance on the ceilings given in Table 9 to Table 62;

ρ_{ceiling} is the reflectance of the ceilings (see 5.2.3 for recommended reflectances in the wavelength between 380 nm to 780 nm for the calculation purpose)

NOTE 2 The choice of view positions is at the discretion of the lighting designer, therefore, this method can be considered as an auxiliary one in the lighting design process.

5.2.3 Reflectance of surfaces

For choice of materials and coatings, recommended diffuse reflectances in the wavelength between 380 nm to 780 nm for the calculation purpose are:

— ceiling: 0,7 to 0,9;

— walls: 0,5 to 0,8;

— floor: 0,2 to 0,6.

The diffuse reflectance in the wavelength between 380 nm to 780 nm of major objects (such as furniture and machinery) are normally in the range of 0,2 to 0,7.

NOTE Clear interior glass has a typical reflectance of 0,1.

5.2.4 Illuminance on surfaces

Illuminances on walls and ceiling together with surface reflectances (see 5.2.3) contribute to luminances and are indicators for perceived room brightness.

Clause 7 provides minimum requirements for the maintained illuminance on walls ($\bar{E}_{\mathrm{m,wall}}$) and ceiling ($\bar{E}_{\mathrm{m,ceiling}}$) depending on the tasks and/or activities being performed in the space.

NOTE Additional guidance can be found in Clause 6.

5.3 Illuminance

5.3.1 General

Areas to be lit are task areas and activity areas, the immediate surrounding area and background area, walls, ceiling, and objects in the space.

The illuminance and its distribution on the task area and on its immediate surrounding area have a great impact on how quickly, safely, and comfortably a person perceives and carries out the visual task.

All values of illuminances given in this document are maintained illuminances specified to fulfil visual comfort and performance needs of people having normal or corrected to normal visual capacity and response to light.

Designing for higher or lower illuminances in combination with controls allows the lighting installation to be tailored to the specific context (i.e., differences in activities or personal characteristics). This can be done using the context modifiers (see Table 1 and Table 2). Higher or lower illuminances shall be used when relevant, e.g., only parts of the day. For calculation and measurement of illuminance averages and uniformities, the grid specification in 5.5 shall be used.

5.3.2 Scale of illuminance

A factor of approximately 1,5 represents the smallest significant difference in subjective effect of illuminance. In normal lighting conditions, approximately 20 lx of horizontal illuminance is required to just discern features of the human face and is the lowest value taken for the scale of illuminances. The recommended steps of illuminance (in lx) are given considering a perceptual difference.

20 - 30 - 50 - 75 - 100 - 150 - 200 - 300 - 500 - 750 - 1 000 - 1 500 - 2 000 - 3 000 - 5 000 - 7 500 - 10 000

5.3.3 Illuminances on the task area or activity area

The maintained illuminance value shall at least meet the requirement as given in Clause 7 ($\bar{E}_{\mathrm{m,required}}$) and shall take into account the following factors:

— psycho-physiological aspects, such as visual comfort and well-being;

— requirements for visual tasks;

— visual ergonomics;

— visual capabilities of the workers;

— practical experience;

— contribution to functional safety;

— economy.

The values given in Clause 7 are maintained illuminances evaluated over the task area or activity area on the reference surface which can be horizontal, vertical or inclined.

However, it is required to increase the maintained illuminance (by one or two steps in the scale of illuminance (see 5.3.2)), depending on the context modifiers given in Table 1 if the assumptions differ from the normal visual conditions. The context modifiers apply when the actual conditions differ from the assumptions that were made when defining the recommended values.

As an example, an increase of one step is recommended if one or two of the conditions listed in Table 1 apply and an increase of two steps is recommended if more than two of these conditions apply. For examples, see Annex C.

A modified value which considers common context modifiers is given in Clause 7 ($\bar{E}_{\mathrm{m,modified}}$). This modified value shall not be seen as an upper limit. It shall not be applied in the case where general lighting is used, in which an entire space is uniformly lit without giving special consideration to individual visual tasks.

Table 1 — Context modifiers for increase of required maintained illuminance

visual work is critical;
errors are costly to rectify;
accuracy, higher productivity or increased concentration is of great importance;
task details are of unusually small size or low contrast;
the task is undertaken for an unusually long time;
the task area or activity area has a low daylight provision;
the visual capacity of the worker is reduced, e.g., due to age.

NOTE 1 When only general lighting is applied in a space, additional care is needed to ensure the lighting installation can be still contextualized (see 6.2.4).

NOTE 2 Retinal illuminance declines with age due to reduced pupil size and increased spectral absorption of the crystalline lens. It is reasonable for lighting practitioners to increase the illuminance in task area and not in background area to compensate for the decrease in retinal illuminance in the elderly while avoiding intraocular light scattering. More information can be found in CIE 227:2017.

NOTE 3 Daylight provision is considered in 6.5.

NOTE 4 For visually impaired people special requirements can be necessary with regard to illuminances and contrasts.

The values of required $\bar{E}_{\mathrm{m}}$ given in 7.3 are minimum values for normal working conditions.

Decreasing illuminance by one step may be considered when conditions from Table 2 apply.

Table 2 — Context modifiers for decrease of required maintained illuminance

task details are of an unusually large size or high contrast;
the task is undertaken for an unusually short time.

Dimming control may be used to achieve lower levels than $\bar{E}_{\mathrm{m,required}}$ in Clause 7. Using dimming will accommodate for possible future change in working conditions.

The size and position of the task area or the activity area shall be stated and documented by the lighting designers in the designing documents, see Figure 1.

For work stations where the size and/or location of the task area or activity area(s) is/are unknown either:

— the whole area is treated as the task area;

— the whole area is uniformly ($U_0 \geq 0{,}40$) lit to an illuminance level specified by the designer.

If the task area becomes known, the lighting scheme shall be re-designed to provide the required or modified illuminances.

If the type of the task is not known, then the designer has to make assumptions about the likely tasks and state task requirements.

If the whole area is lit to a given illuminance value, then it is recommended that the lighting is controlled in appropriate zones.

When multiple tasks take place in the area, requirements for all of these tasks shall be met. Usually this is done by designing according to the task with the most onerous requirements.

This applies also to an activity area.

5.3.4 Illuminance on the immediate surrounding area

Large spatial variations in illuminance around the task area or activity area can lead to visual stress and discomfort.

The illuminance on the immediate surrounding area shall be related to the illuminance on the task area or activity area and shall provide a well-balanced luminance distribution in the visual field. The immediate surrounding area is a band with a width of at least 0,5 m around the task area within the visual field.

The illuminance on the immediate surrounding area may be lower than the illuminance on the task area but shall be not less than the values given in Table 3.

In addition to the illuminance on the task and activity area, the lighting shall provide adequate adaptation luminance in accordance with 5.2.

The size and position of the immediate surrounding area shall be stated and documented by the lighting designers in the designing documents.

Table 3 — Relationship of illuminances on immediate surrounding to the illuminance on the task area or activity area

Illuminance on the task area or activity area $\bar{E}_m$ lx	Illuminance on immediate surrounding areas lx
≥ 750	500
500	300
300	200
200	150
≤ 150	equal to task area

5.3.5 Illuminance on the background area

In indoor work places, particularly those devoid of daylight, a large area outside the immediate surrounding area needs to be illuminated. The background area shall be illuminated with a maintained illuminance of at least 1/3 of the value of the immediate surrounding area. The background area shall be at least 3 m wide.

The size and position of the background area shall be stated and documented by the lighting designers in the designing documents.

Figure 1 illustrates the minimum dimension of the background area in relation to task and immediate surrounding area.