BS EN 12464-1:2021

BSI Standards Publication

Light and lighting — Lighting of work places

Part 1: Indoor work places

bsi.

National foreword

This British Standard is the UK implementation of EN 12464-1:2021. It supersedes BS EN 12464-1:2011, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EL/1, Light and lighting applications.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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This European Standard was approved by CEN on 9 May 2021.

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European foreword

This document (EN 12464-1:2021) has been prepared by Technical Committee CEN/TC 169 "Light and lighting", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2022, and conflicting national standards shall be withdrawn at the latest by February 2022.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 12464-1:2011.

The original standard EN 12464-1:2002 was already further developed in its first revision EN 12464-1:2011. It specifies the requirements for good lighting solutions rather than giving design guidelines. With the experience of applying the standard next steps are taken in the development of this new edition and human and user needs are given broader acknowledgement. Lighting requirements for task areas to fulfil visual tasks are given a close relation to the space in which they are carried out. Technologically LED has taken over as the main light source from previous technologies. The main changes with respect to the previous edition are:

— The recommendations given in the tables in Clause 7 take user needs more into account than in the past. Thus, the requirements for necessary illuminance according to Clause 7 are more differentiated.

— The impact of visual and non-visual (non-image forming) effects of light on people's performance and well-being are elaborated in the new informative Annex B.

— Requirements for walls, ceilings and cylindrical illuminances are moved from the main text to the tables in Clause 7 for increased visibility and usability.

— A new chapter on design considerations (Clause 6) gives advice on how to apply the requirements when designing lighting for visual tasks and activities within a space.

— Relation between task area and its immediate surround and the background area is more detailed (5.3.3, 5.3.4, 5.3.5).

— Glare requirements have been clarified for improved usability including clarification for shielding in 5.5 and recommended practices for UGR in non-standard situations has been added in a new informative Annex A.

— Flicker and stroboscopic effect is updated (5.8).

— A new informative Annex C is introduced including examples on how to derive the requirements in different applications (office/industry) for designing lighting.

— A new informative Annex D is introduced to provide additional information on the specific requirements for railway installations that are given in Table 61.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

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 our 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. elderly users in workplaces.

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.

1 Scope

This document specifies lighting requirements for humans in indoor work places, which meet the needs for visual comfort and performance of people having normal, or corrected to normal ophthalmic (visual) capacity. All usual visual tasks are considered, including Display Screen Equipment (DSE).

This document specifies requirements for lighting solutions for most indoor work places and their associated areas in terms of quantity and quality of illumination. In addition, recommendations are given for good lighting practice including visual and non-visual (non-image forming) lighting needs. This document does not specify lighting requirements with respect to the safety and health of people at work and has not been prepared in the field of application of Article 169 of Treaty on the Functioning of the European Union although the lighting requirements, as specified in this document, usually fulfil safety needs.

NOTE Lighting requirements with respect to the safety and health of workers at work can be contained in Directives based on Article 169 of Treaty on the Functioning of the European Union, in national legislation of member states implementing these directives or in other national legislation of member states.

This document neither provides specific solutions, nor restricts the designers' freedom from exploring new techniques nor restricts the use of innovative equipment. The illumination can be provided by daylight, electric lighting or a combination of both.

This document is not applicable for the lighting of outdoor work places and underground mining or emergency lighting. For outdoor work places, see EN 12464-2 and for emergency lighting, see EN 1838 and EN 13032-3.

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.

EN 12193, *Light and lighting — Sports lighting*

EN 12665, *Light and lighting — Basic terms and criteria for specifying lighting requirements*

EN 17037:2018, *Daylight in buildings*

EN 60601-2-41:2009,[1] *Medical electrical equipment — Part 2-41: Particular requirements for basic safety and essential performance of surgical luminaires and luminaires for diagnosis*

EN ISO 9680, *Dentistry — Operating lights (ISO 9680)*

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

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

[1] As impacted by EN 60601-2-41:2009/A11:2011 and EN 60601-2-41:2009/A1:2015.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12665, EN 17037 and the following apply.

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

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
activity area
area which contains one or more visual tasks

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
modelling
effect of directional lighting to reveal the depth, shape and texture of an object or person

[SOURCE: CIE S 017:2020, 17-29-170]

4 Symbols and abbreviations

$\bar{E}_{m,wall}$	maintained illuminance on walls	5.2.3
$\bar{E}_{m,ceiling}$	maintained illuminance on ceiling	5.2.3
U_o	illuminance uniformity	5.2.3
$\bar{E}_m$	maintained illuminance[2]	5.3.3
α	shielding angle	5.5.2
γ	vertical photometric angle	5.5.2
DGP	Daylight Glare Probability	5.5.3.1
R_{UG}	CIE Unified Glare Rating (UGR)	5.5.3.2
R_{UGL}	R_{UG} limit value	5.5.3.2
$\bar{E}_z$	average cylindrical illuminance[3]	5.6.2
$\bar{E}_{m,z}$	maintained average cylindrical illuminance	5.6.2

[2] According to EN 12655, $\bar{E}_m$ is the value below which the average illuminance on a specified area shall not fall.

[3] approximation of the average of the four main directions

T_{cp}	correlated colour temperature	5.7.2
R_a	colour rendering index	5.7.3
R_i	special colour rendering index	5.7.3
TLA	temporal light artefacts	5.8.1
P_{st}^{LM}	IEC short-term light modulation/flicker indicator	5.8.2
SVM	Stroboscopic Visibility Measure	5.8.3
$\bar{E}$	average illuminance	5.8.3
DSE	Display Screen Equipment	5.9
L	luminance	5.9.2
f_m	maintenance factor	6.3
$\bar{E}_i$	initial illuminance	6.3
LENI	lighting energy numeric indicator	6.4

5 Lighting design criteria

5.1 Luminous environment

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

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

— visual comfort, where the workers have a feeling of well-being; in an indirect way this also contributes to a higher productivity level and a higher quality of work;

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

— safety.

The main criteria determining the luminous environment with respect to electric lighting and daylighting are:

— luminance distribution;

— illuminance;

— glare;

— directionality of light, lighting in the interior space;

— colour rendering and colour appearance of the light;

— flicker;

— variability of light (levels and colour of light).

These criteria are further detailed in Clause 5 and 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),

— ophthalmic capacity of the person (visual acuity, depth perception, colour perception) (see CIE 227),

— for the visually impaired, for example those who are sensitive to glare, 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 in the visual field controls the adaptation level of the eyes which affects task visibility.

A well balanced adaptation luminance is needed to increase:

— 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 should be avoided for the reasons given:

— too high luminances and luminance contrasts which can give rise to glare;

— too high luminance variation which will cause fatigue because of constant re-adaptation of the eyes;

— too low luminances and too low luminance contrasts which result in a dull and non-stimulating working environment.

To create a well-balanced luminance distribution the luminances of all surfaces shall be taken into consideration. They are determined by the reflectance of 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 illuminances on walls and ceiling (see Clause 7) and by recommending reflectances. Annex B provides further details of possible measures.

Although luminance requirements would be a representative way of describing the visual environment, this document lists illuminance requirements as luminance requirements are more complex due to their dependence on exact material characteristics and viewing positions.

The lighting designer shall consider and select appropriate reflectance (5.2.2) and illuminance requirements for the interior surfaces (5.2.3) based on the guidance below.

5.2.2 Reflectance of surfaces

High surface reflectances contribute to energy savings and can lead to better visual comfort. For choice of materials, the following ranges of reflectances are recommended:

— ceiling: 0,7 to 0,9;

— walls: 0,5 to 0,8;

— floor: 0,2 to 0,6.

The reflectance of major objects (like furniture, machinery, etc.) should be in the range of 0,2 to 0,7.

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

In design calculations, surface reflectances should be defined as close to the real surfaces as possible taking into account the variation in reflectance across the surface.

5.2.3 Illuminance on surfaces

Illuminances on walls and ceilings together with surface reflectances (see 5.2.2) 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. Uniformity for walls and ceiling shall be $U_0 \geq 0{,}10$ (see 5.3.6).

NOTE Additional guidance can be found in Clause 6.

5.3 Illuminance

5.3.1 General

Areas to be lit are task 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.

Designing for higher illuminances allows enough capacity for applying context modifiers (see Table 1 and Table 2) and controls. Higher 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 5.4 shall be used.

5.3.2 Scale of illuminance

To give a perceptual difference the recommended steps of illuminance (in lx) are according to EN 12665:

5 - 7,5 - 10 - 15 - 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 be used for normal visual conditions taking into account the following factors:

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

— requirements for visual tasks;

— visual ergonomics;

— practical experience;

— contribution to functional safety;

— economy.

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

However, it is recommended to increase the maintained illuminance (by one or two steps in the scale of illuminances (see 5.3.2)), depending on the context modifiers given in Table 1 if the assumptions differ from the normal visual conditions.

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.

Table 1 — Context modifiers for increase of 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 below normal.

NOTE 1 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 task illuminance to help older people compensate for the age-related losses in retinal illuminance. More information can be found in CIE 227:2017.

NOTE 2 Daylight provision is considered in 6.5.

The required $\bar{E}_{\mathrm{m}}$ in 7.3 is a minimum value 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.

Using dimming will accommodate for possible future change in working conditions.

NOTE 3 For visually impaired people special requirements can be necessary with regard to illuminances and contrasts.

The size and position of the task or the activity area shall be stated and documented, 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; or

— the whole area is uniformly ($U_o \geq 0{,}40$) 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 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 these tasks shall be complied with.

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

The illuminance of 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.

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*

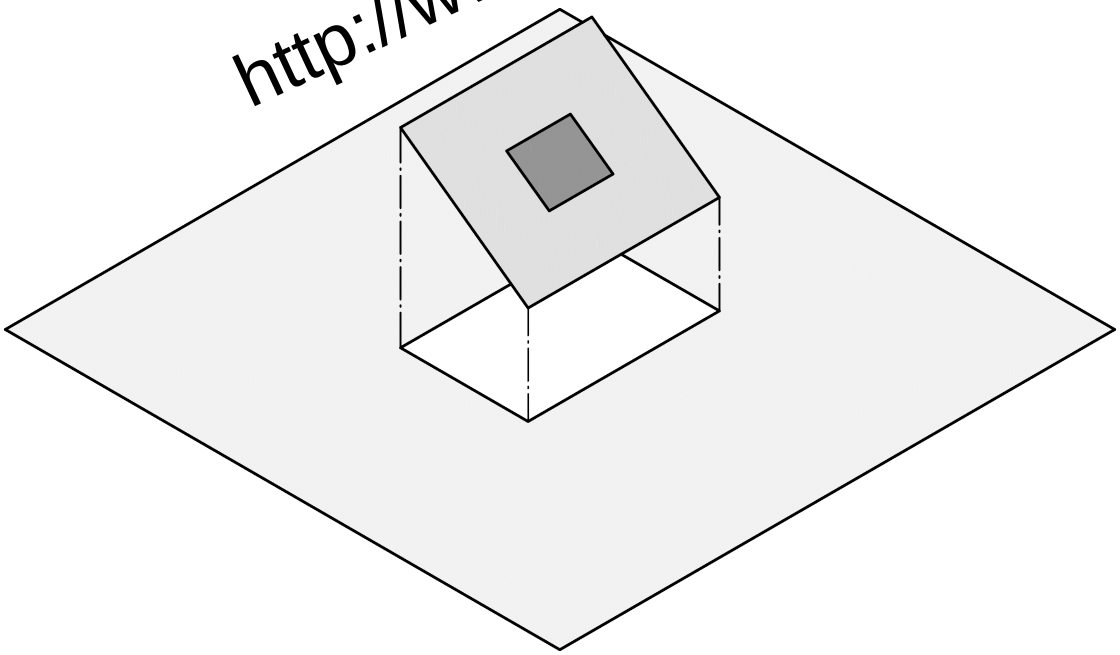
Figure 1 illustrates the minimum dimension of immediate surrounding area in relation to task area.

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 is a horizontal area on floor level. It is adjacent to the immediate surrounding area within the limits of space and shall be illuminated with a maintained illuminance of 1/3 of the value of the immediate surrounding area. For larger rooms the band shall be at least 3 m wide.

The size and position of the background area shall be stated and documented.

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



Key

- task area or activity area (not true to scale) in a specified size and position (see 5.3.3)
- immediate surrounding area (band with a width of at least 0,5 m around the task area or activity area within the visual field)
- background area (band with a width of at least 3 m adjacent to the immediate surrounding area or up to the limits of the space for smaller rooms) horizontal on floor level

Figure 1 — Minimum dimensions of immediate surrounding area and background area in relation to task and activity area (figure is not true to scale)

5.3.6 Illuminance uniformity

In the task area or activity area, the illuminance uniformity (U_0) shall be not less than the minimum uniformity values given in the tables in 7.3.

Uniformity in the immediate surrounding area shall be $U_0 \geq 0{,}40$.

On the background area, the walls and the ceiling the uniformity shall be $U_0 \geq 0{,}10$.

These uniformity levels shall only be applied with electric lighting.

Illuminance uniformity levels when daylight is available are not applicable because light intensity and distribution changes continuously due to weather conditions and outdoor context. Additional benefits of daylight can compensate for the lack of uniformity. More information can be found in 6.5 and B.7.

5.4 Illuminance grid

Grid systems shall be created to indicate the points at which the illuminance values are calculated and verified for the task and activity area(s), immediate surrounding area(s) and background area(s).

Grid cells approximating to a square are preferred, the ratio of length to width of a grid cell shall be kept between 0,5 and 2 (see also EN 12193 and EN 12464-2). The maximum grid size shall be:

$$p = 0,2 \times 5^{\log_{10}(d)} \quad (1)$$

where

$p \leq 10$ m

d is the longer dimension of the calculation area (m), however if the ratio of the longer to the shorter side is 2 or more then d becomes the shorter dimension of the area, and

p is the maximum grid cell size (m).

The number of points in the relevant dimension is given by the nearest whole number of d/p.

The resulting spacing between the grid points is used to calculate the nearest whole number of grid points in the other dimension. This will give a ratio of length to width of a grid cell close to 1.

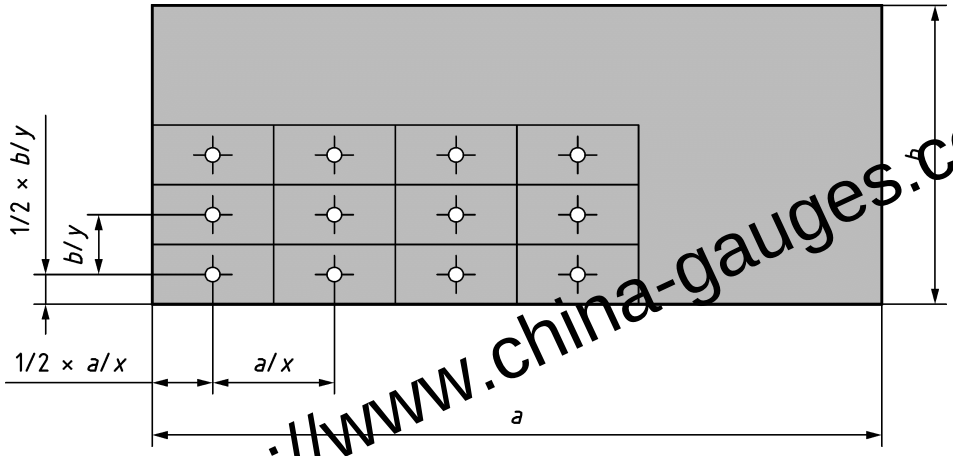
NOTE 1 Formula (1) (coming from CIE x005-1992) has been derived under the assumption that p is proportional to log(d), where:

p = 0,2 m for d = 1 m;

p = 1 m for d = 10 m;

p = 5 m for d = 100 m.

The illuminance values are calculated and measured at the centre point of grid rectangles. A typical grid is shown in Figure 2.



Key

a dimension of the longer side of the calculation area/verification area

b dimension of the shorter side of the calculation area/verification area

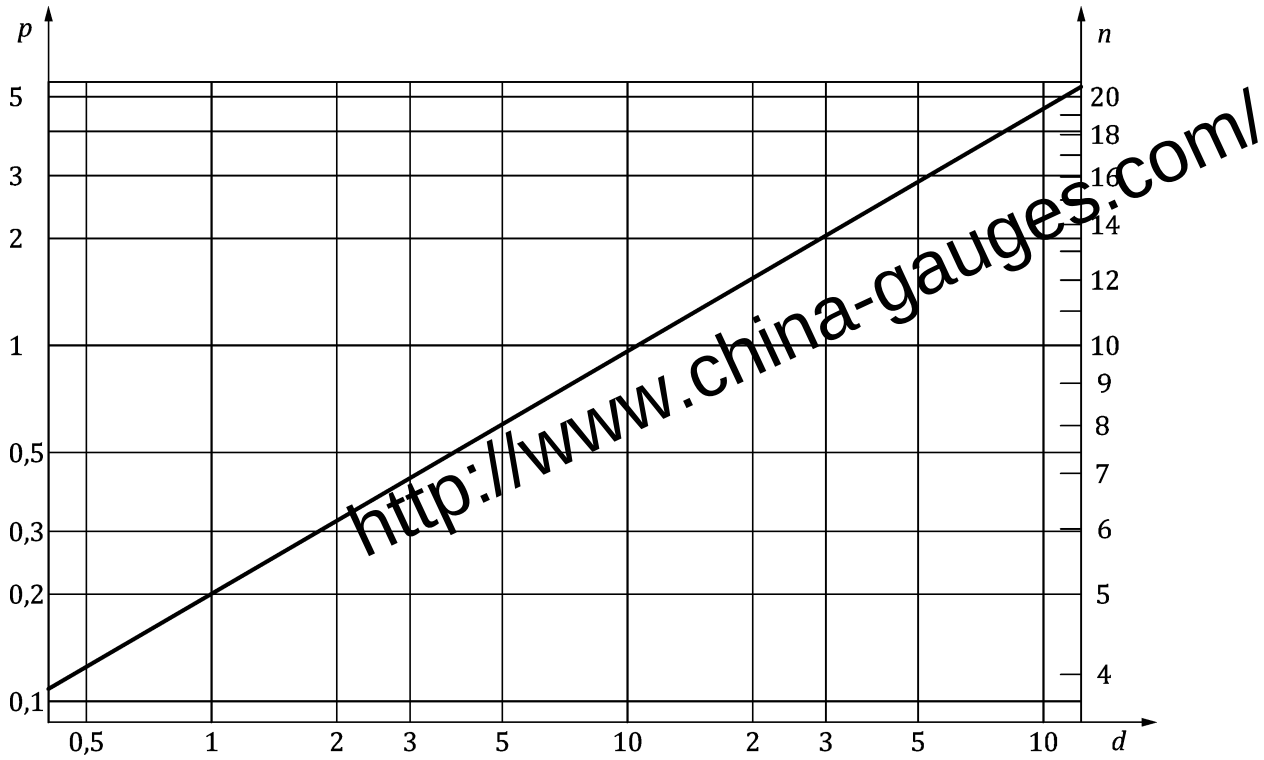
x number of points along the longer side

y number of points along the shorter side

Figure 2 — Typical grid

To avoid high impact on uniformity from calculation points near the wall, a band next to the wall can be excluded from the calculation except when the task area is in or extends into this border area. The width of this band is specified as 15 % of the smallest dimension of the area under consideration or 0,5 m, whichever of the two is smaller.

The grid cell size as function of calculation/measurement area dimension is shown in Figure 3.



Key

d longer dimension of the calculation area (m), however if the ratio of the longer to the shorter side is 2 or more then *d* becomes the shorter dimension of the area

p maximum grid cell size (m)

n number of points in relevant dimension

Figure 3 — Grid cell size as function of calculation/measurement area dimension

An appropriate grid size shall be applied to walls and ceiling and a band of 0,5 m may be applied also.

The grid point spacing should not coincide with the luminaire spacing.

NOTE 2 A separate grid for the calculation of daylight provision is specified in Annex B to EN 17037:2018. This grid is not applicable for electric lighting.

5.5 Glare

5.5.1 General

Glare is the unpleasant sensation produced by bright areas within the visual field, such as lit surfaces, parts of the luminaires, windows and/or roof lights. Glare shall be limited to avoid errors, fatigue and accidents. Glare can be experienced either as discomfort glare or as disability glare.

Glare caused by reflections in specular surfaces is usually known as veiling reflections or reflected glare.

Glare shall be avoided:

1. By shielding the light source and/or by limiting the luminance of the luminous surfaces (according to 5.5.2); and

2. By limiting the discomfort glare. For luminaires the UGR method shall be applied where valid (according to 5.5.3).

NOTE Special care is needed to avoid glare when the direction of view is significantly above the horizontal viewing direction, e.g. cases where a regular aspect of the work is looking high up/into the luminaires such as the storage racks, etc.

5.5.2 Limiting luminaire luminance

Bright sources of light can cause glare and can impair the vision of objects. It shall be avoided for example by suitable shielding of light sources or suitable shading from bright light through daylight openings.

For luminaires where the light source is directly visible, the minimum shielding angles (see Figure 4) in the visual field given in Table 4 shall be applied for the specified light source luminance.

For luminaires where a direct view of the light source is obscured via optics, the maximum average luminaire luminance for the values of vertical photometric angle given in Table 5 shall be applied (see Figure 4).

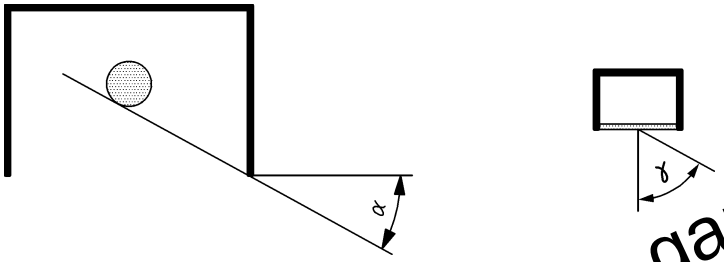
The values given in Table 4 and Table 5 do not apply to luminaires with an upward component only, mounted above normal eye level or to luminaires with a downward component only, mounted below normal eye level.

Table 4 — Minimum shielding angles at specified light source luminance

Light source luminance $kcd\ m^{-2}$	**Minimum shielding angle** α
20 to < 50	15°
50 to < 500	20°
≥ 500	30°

Table 5 — Maximum average luminance of a luminous optical element at specified vertical photometric angles

Vertical photometric angle γ	**Maximum average luminance of a luminous optical element** $kcd\ m^{-2}$
$75° \leq \gamma < 90°$	≤ 20
$70° \leq \gamma < 75°$	≤ 50
$60° \leq \gamma < 70°$	≤ 500



Key

α shielding angle

γ vertical photometric angle

NOTE Left figure shows a cross section of a conventional luminaire with a separate light source. Right picture shows a cross section of a luminous part of the optical element, e.g. a part of a LED luminaire.

Figure 4 — Shielding angle α and vertical photometric angle γ

5.5.3 Discomfort glare

5.5.3.1 Discomfort glare from daylight

In areas with daylight access, glare from daylight openings can occur, either by direct sunlight entering and/or when the luminance in the field of view seen through daylight openings is too high compared to the adaptation levels for which the occupant is adapted at a given time.

NOTE 1 To assess the occurrence of discomfort glare from daylight openings, EN 14501 and EN 17037 provide recommended levels for glare protection by the Daylight Glare Probability (DGP).

NOTE 2 For workspaces requiring higher visual comfort due to the tasks performed consider the glare protection classes from Annex A to EN 17037:2018.

NOTE 3 Glare caused by daylight openings differs from glare caused by electric light sources regarding size of the glare sources, complex luminance distributions and user's acceptance.

5.5.3.2 Discomfort glare from electric light – application of UGR tabular method

To select a luminaire suitable for the lighting installation of a given space the rating of discomfort glare caused directly from the luminaires shall be determined using the CIE Unified Glare Rating (UGR) tabular method.

NOTE 1 The UGR tabular method is detailed in CIE 117-1995 and in CIE 190:2010.

This UGR value determined using the UGR tabular method shall not exceed the R_{UG} limit value (R_{UGL}) given in Clause 7.

All assumptions made concerning luminaire, room dimensions, room surface reflectance's and spacing to height ratio in the determination of the R_{UGL} (formerly: UGR) shall be stated in the scheme documentation.

The tabular method is based on applying Formula (2) to a set of standard conditions (observer position, room dimensions and reflection factors).

$$R_{UG} = 8 \log_{10}\left(\frac{0,25}{L_B}\sum\frac{L^2\ \omega}{p^2}\right) \quad (2)$$

where

R_{UG} is the value of the Unified Glare Rating (UGR),

L_B is the background luminance in cd·m^{-2}, calculated as $E_{ind} \cdot \pi^{-1}$, in which E_{ind} is the vertical indirect illuminance at the observer's eye,

L is the luminance in cd·m^{-2} of the luminous parts of each luminaire in the direction of the observer's eye,

ω is the solid angle in steradian of the luminous parts of each luminaire at the observer's eye,

p is the Guth position index for each individual luminaire which relates to its displacement from the line of sight.

NOTE 2 For more information on discomfort caused by glare from luminaires with a non-uniform source luminance, refer to CIE 232:2019.

NOTE 3 The limiting values of the R_{UGL} form a series whose steps indicate noticeable changes in glare. This series of R_{UGL} is: 16, 19, 22, 25, 28 where a low value means “little likelihood of discomfort glare” and a high value means “significant possibility of discomfort glare”.

NOTE 4 For a tabular UGR value a variation of ± can also be given. This variation of UGR within the room can be determined using the comprehensive tables for different observer positions, as detailed in CIE 117-1995. A high variation indicates that even small changes in the observer position can result in larger changes in glare. The compliance of the indoor lighting installation is not considering any variation in the CIE Unified Glare Rating (*UGR*) tabular method.

The boundary conditions for the determination of the UGR value by the tabular method include having one type of luminaire only in a rectangular space, a regular luminaire grid, same installation height, same orientation (C and γ angles).

The UGR tabular method does also not apply to following luminaires:

— wall washers;

— totally indirect;

— asymmetric and double asymmetric;

— adjustable spots;

— very small or very large luminous surfaces (see A.2.1).

This limits the application of the methodology to some extent but does not exclude its use. To maximize the applicability of the tabular method, A.2 covers recommended practices when the above boundary conditions are not met.

5.5.3.3 Determination by UGR formula

If the tabular method is not applicable and the observer position and the viewing directions are known the UGR value can be determined by using the UGR Formula (2) from 5.5.3.2. However, the limits given in Clause 7 have to be considered as benchmarks and not mandatory limits.

Account should be taken of possible variations in observer position and viewing direction, up to the expected displacement/rotation of the head of a person

NOTE UGR values calculated by the formula are also suitable for making decision on optimal position(s) of the observer in the room.

All assumptions made concerning the calculation shall be stated in the scheme documentation.

5.5.4 Veiling reflections and reflected glare

High brightness reflections in the visual task can alter task visibility, usually detrimentally. Veiling reflections and reflected glare can be prevented or minimised by the following measures:

— arrangement of work stations with respect to luminaires and daylight openings;

— surface finish (matt surfaces);

— luminance restriction of luminaires and daylight openings;

— bright ceiling and bright walls.

5.6 Lighting in the interior space

5.6.1 General

In addition to lighting of the task and the activity areas the volume of space occupied by people should be lit. This light is required to highlight objects, reveal texture and improve the appearance of people within the space. The terms “average cylindrical illuminance”, "modelling" and “directional lighting” describe the lighting conditions.

5.6.2 Cylindrical illuminance requirement in the activity space

Good visual communication and recognition of objects within a space require that the volume of space in which people move or work shall be illuminated. This is fulfilled by providing adequate average cylindrical illuminance, $\bar{E}_{\mathrm{z}}$, in the space.

The required maintained average cylindrical illuminance ($\bar{E}_{\mathrm{m,z}}$) to be determined on a horizontal plane in the room and space (as in Table 8) is given in Clause 7 for each type of task or activity. The uniformity of the average cylindrical illuminance shall be $U_{\mathrm{o}} \geq 0{,}10$. The height of the horizontal plane shall be 1,2 m for seated people and 1,6 m for standing people above the floor.

Special attention is given to those spaces where visual recognition and communication is of higher importance.

When the complete space is treated as the task area or activity area and is used for the calculation of the required horizontal average illuminance, $\bar{E}_{\mathrm{m}}$, the maintained average cylindrical illuminance, $\bar{E}_{\mathrm{m,z}}$, shall be calculated for the same area size and position. When the task area and activity area / immediate surrounding area / background area are defined separately, the cylindrical illuminance requirement given in the tables in 7.3 shall be calculated and fulfilled for the space including task area and activity area and the immediate surrounding area.

NOTE As an approximation for the cylindrical illuminance, the average value of four vertical illuminances orthogonal to one another can be used.

5.6.3 Modelling

The general appearance of an interior is enhanced when its structural features, the people and objects within it are lit so that form and texture are revealed clearly and pleasingly.

The lighting should not be too directional or it will produce harsh shadows, neither should it be too diffuse or the modelling effect will be lost entirely, resulting in a very dull luminous environment. Multiple shadows caused by directional lighting from more than one position should be avoided as this can result in a confused visual effect.

Modelling describes the balance between diffuse and directed light and should be considered.

The ratio of cylindrical to horizontal illuminance at a point is an indicator of modelling. The grid points for cylindrical and horizontal illuminances shall coincide in x, y and z.

NOTE 1 For uniform arrangement of luminaires or roof lights a ratio of cylindrical to horizontal illuminance between 0,30 and 0,60 is an indicator of good modelling.

NOTE 2 Daylight from vertical openings has a large impact on modelling. For this reason, the additional benefits of daylight (see 6.5) can compensate for the above indicator of modelling, see Note 1.

5.6.4 Directional lighting of visual tasks

Lighting from a specific direction can reveal details within a visual task, increase their visibility and making the task easier to perform. Unintended veiling reflections and reflected glare should be avoided, see 5.5.4.

Harsh shadows that interfere with the visual task should be avoided. But some shadows help to increase the visibility of the task.

5.7 Colour aspects

5.7.1 General

The colour qualities of a near-white light source or transmitted daylight are characterized by two attributes:

— the colour appearance of the light;

— its colour rendering capabilities.

These two attributes shall be considered separately.

5.7.2 Colour appearance of the light

The colour appearance of a light source refers to the apparent colour (chromaticity) of the light emitted. It is quantified by its correlated colour temperature (T_{cp}), see Table 6.

Table 6 — Light source colour appearance groups

Colour appearance	Correlated colour temperature T_{cp}
warm	below 3 300 K
neutral	3 300 K to 5 300 K
cool	above 5 300 K

The choice of colour appearance of the light is a matter of psychology, aesthetics and what is preferred. The choice will depend on illuminance level, colours of the room and furniture, surrounding climate and the application. Additionally, dynamic colour temperature can be considered for increased personalization.

For further information on the physiological impact of spectral distribution and colour temperature change see Annex B. Careful consideration is necessary, especially in the case of night shift work.

In Clause 7, for specific applications a restricted band of suitable colour temperatures is given. These are applicable for daylighting as well as electric lighting.

5.7.3 Colour rendering

For visual performance and the feeling of comfort and well-being colours in the environment, of objects and of human skin, shall be rendered with sufficient accuracy according to the task requirements given in Clause 7.

To provide an objective indication of the colour rendering properties of a light source the general colour rendering index R_a is used. The maximum value of R_a is 100.

The minimum value of colour rendering index for distinct types of task and activity areas within a space are given in Clause 7.

Safety colours according to ISO 3864-1 shall always be identifiable as such.

Colour rendering properties of light from luminaires can be influenced by optics, glazing and coloured surfaces.

NOTE 1 Colour rendering properties for an observer in a space are affected by the reflectance properties of all surfaces.

NOTE 2 If coloured light is used, the colour rendering requirements given in Clause 7 are not applicable.

For accurate rendition of colours of objects and human skin the appropriate special colour rendering index (R_i) should be considered.

A colour rendering index below 80 should not be accepted in areas where people work permanently.

5.8 Flicker and stroboscopic effects

5.8.1 General

Flicker and stroboscopic effect (also called temporal light artefacts - TLA) can lead to undesired effects such as reducing visual comfort and reducing task performance and can lead to physiological effects such as fatigue or headaches.

Stroboscopic effects can also lead to dangerous situations by changing the perceived motion of rotating or reciprocating machinery. This is, however, outside of the scope of this document.

Lighting systems should be designed to avoid the negative effects of flicker and stroboscopic effect throughout the full dimming range (this includes light sources and control gears). Background information and methods to objectively quantify these effects can be found in CIE TN 006:2016.

5.8.2 Flicker

Flicker is specified by using the IEC short-term flicker indicator (P_{st}^{LM}) and test method as described in IEC TR 61547-1:2020.

NOTE The product-related EU regulation 2019/2020 and its amendments laying down ecodesign requirements for light sources and separate control gears includes requirements for P_{st}^{LM} for some specific lighting products. For details and definitions see the ecodesign regulation.

5.8.3 Stroboscopic effect

Stroboscopic effect perceived by individuals in indoor work places executing typical tasks, can be objectively quantified using the Stroboscopic Visibility Measure (SVM). The SVM can be used to quantify the visibility of this effect for applications where human motion is dominant and $\bar{E}$ > 100 lx. Limits for this measure are application dependent and currently under consideration. The test method is described in IEC TR 63158:2018.

NOTE 1 SVM is not suitable to quantify the effects of lighting on health and for rotating or reciprocating machinery as described in 5.8.1.

NOTE 2 The product-related EU regulation 2019/2020 and its amendments laying down ecodesign requirements for light sources and separate control gears includes requirements for SVM for some specific lighting products. For details and definitions see the ecodesign regulation.

5.9 Lighting of work stations with Display Screen Equipment (DSE)

5.9.1 General

The lighting for DSE work stations shall be appropriate for all tasks performed at the work station, e.g. reading from the screen, reading printed text, writing on paper, keyboard work.

For these areas the lighting criteria and system shall be chosen in accordance with type of task area or activity area, from the schedule in Clause 7.

Reflections in DSE and, in some circumstances, reflections from the keyboard can cause disability and discomfort glare. It is therefore necessary to select, locate and arrange the luminaires to avoid high brightness reflections.

The luminance of the background wall should be balanced to the brightness of the screen.

The designer shall determine the offending mounting zone and shall choose equipment and plan mounting positions which will cause no disturbing reflections.

5.9.2 Luminaire luminance limits with downward flux

Light can lower the contrast of the presentation on DSE by:

— veiling reflection caused by the illuminance on the display surface and

— luminances from luminaires and bright surfaces reflecting in the display.

EN ISO 9241-307 gives recommendations for the visual qualities of displays concerning unwanted reflections.

This subclause describes luminance limits for luminaires which can be reflected in DSE for normal viewing directions.

Table 7 gives the limits of the average luminaire luminance at elevation angles of 65° and above from the downward vertical, radially around the luminaires, for work stations where display screens which are vertical or inclined up to 15° tilt angle are used.

Table 7 — Limits for the average luminance of luminaires, which can be reflected in flat screens

Screen high state luminance	High luminance screen $L > 200$ cd·m^{-2}	Medium luminance screen $L \leq 200$ cd·m^{-2}
Case A (positive polarity and normal requirements concerning colour and details of the shown information, as used in office, education, etc.)	≤ 3 000 cd·m^{-2}	≤ 1 500 cd·m^{-2}
Case B (negative polarity and/or higher requirements concerning colour and details of the shown information, as used for CAD, colour inspection, etc.)	≤ 1 500 cd·m^{-2}	≤ 1 000 cd·m^{-2}
NOTE Screen high state luminance (see EN ISO 9241-302) describes the maximum luminance of the white part of the screen and this value is available from the manufacturer of the screen.		

If screen types are not known at the lighting design stage, the designer should inform the user about the luminance criteria chosen to the luminaires of the space.

If a high luminance screen is intended to be operated at luminances below 200 cd·m^{-2} the conditions specified for a medium luminance screen shall be considered.

Some tasks, activities or display screen technologies require different lighting treatment (e.g. lower luminance limits, special shading, individual dimming, etc.).

In areas of industrial activities and crafts screens are sometimes protected by additional front glasses. The unwanted reflections on these protection glasses have to be reduced by suitable methods (such as anti-reflection treatment, tilting of the protection glass or by shutters).

6 Lighting design considerations

6.1 General

To apply the lighting design criteria from Clause 5, the following aspects should be taken into account for the lighting design:

— recommended illuminance requirements, see 6.2;

— operation of the lighting system;

— energy efficiency requirements, see 6.4;

— variability of light, see 6.2.4.

Examples for the application of the processes described in 6.2 are given in Annex C.

Verification procedure can be found in Clause 8.

6.2 Illuminance requirements and recommendations

6.2.1 General

To allow for a larger variety in application requirements, Clause 7 provides maintained illuminances $\bar{E}_{\mathrm{m}}$ in steps according to the scale of illuminances in 5.3.2 from required to modified values.

6.2.2 Lighting of the task area or activity area and its immediate surrounding area (see 5.3)

The following steps shall be followed in selecting the appropriate lighting criteria for the task area or activity area and immediate surrounding area:

1. Define the task area and activity areas in the space.

2. Determine the appropriate type of task or activity based on the visual tasks executed in that area.

Note that the task area or activity area may be horizontal, vertical or inclined, and multiple tasks or activities may take place in the same area (consult 5.3.3 for guidance).

3. Select the "task or activity related requirements" from the tables in 7.3 ($\bar{E}_{\mathrm{m}}$, U_{o}, R_{a}, R_{UGL}). For activity areas with multiple tasks the most onerous requirements shall be used for design (see 5.3.3).

4. Select the adequate maintained illuminance $\bar{E}_{\mathrm{m}}$ in steps using the scale of illuminance in 5.3.2 starting from the required value for the actual working condition according to the specific context modifiers as specified in 5.3.3 (Table 1 and Table 2).

It is recommended to design higher illuminances by up to two steps than the required (minimum) maintained value on the task area or activity area ($\bar{E}_{\mathrm{m}}$) to allow adjustment of the illuminance on the task to cater for higher visual performance. To ensure satisfaction during different times of operation dimmable lighting can be used. When the task or activity is not being performed, or an activity of less visual difficulty is being performed, lower light levels can be employed using dimming or switching if appropriate. Further information is contained in CIE 222 and CIE 227.

5. Select the appropriate illuminance requirements for the immediate surrounding area and background area based upon the $\bar{E}_{\mathrm{m}}$ selection in step 3 and Table 3 (see 5.3.4 and 5.3.5)

6.2.3 Lighting of the space

To enhance the visual appearance and brightness impression of the room and space and good visual communication and recognition of objects, the following steps shall be followed:

1. Determine the relevant room surfaces around the workplaces (the walls and ceiling). The surfaces to be illuminated are at least those that contribute to the perception of room brightness.

   For example in high industrial halls the upper part of the wall and the ceiling may be excluded.

2. Select the requirements for "objects and people" and for "room brightness" from the tables in 7.3 ($\bar{E}_{\mathrm{m,z}}$, $\bar{E}_{\mathrm{m,wall}}$, $\bar{E}_{\mathrm{m,ceiling}}$) based on all selected tasks and activities in 6.2.2 steps 1 and 2. If different requirements apply select the highest requirements to respect all specified tasks and activities within the space.

3. In areas with high distance to the ceiling, a lower ceiling illuminance can be accepted. E.g. in industrial premises or other areas with only direct lighting and lower reflectance than the recommended values in 5.2.2, or areas where illumination of the ceiling is not appropriate.

The R_{UGL} determined by the task or activity requirements needs to be fulfilled by luminaires in the field of view within the space.

If in step 3 of 6.2.2 higher values have been selected for $\bar{E}_m$ on the task area or activity area, the wall, ceiling and cylindrical illuminance values should also be increased by up to the same number of steps (see 5.3.2 for step sizes).

6.2.4 Adjustability of the lighting system

A lighting installation can be adjusted by dimming and/or controlling. Dimming increases or decreases the lumen output from a luminaire. Controlling can have additional functionality to modify the operation of the luminaire(s) in an installation, for example variation in colour temperature or different lighting scenes or according to daylight provision.

Lighting should be adjustable to the actual user needs (see also 6.6). The system should ensure that illuminances can be achieved that meet or exceed the recommended maintained illuminance level using only the electric lighting (assuming a worst case scenario without daylight contribution). Illuminance can be achieved by both daylight and electric lighting or any combination of the two.

An adjustable system ensures that

— the benefit of available daylight is maximized;

— occupancy of the space can be taken into account;

— changes of visual tasks can be catered for;

— changes of occupants, occupant preferences or needs can be catered for.

This document recommends the use of the higher maintained illuminance $\bar{E}_m$ to give the user the full use of the lit environment. Designing a basic lighting installation only fulfilling the minimum criteria limits the possible benefits of good lighting quality.

6.3 Maintenance factor

The lighting scheme shall be designed taking into account an overall maintenance factor (f_m) calculated for the selected lighting equipment, environment and specified maintenance schedule for the task area or activity area according to ISO/CIE TS 22012.

The illuminance requirements for each task as specified in Clause 7 are given as maintained illuminance ($\bar{E}_m$) values. The initial illuminance $\bar{E}_i$ can be calculated from $\bar{E}_m$ as follows:

$$\bar{E}_i = \frac{\bar{E}_m}{f_m} \tag{3}$$

where

$\bar{E}_m$ is maintained illuminance

$\bar{E}_i$ is initial illuminance

f_m is maintenance factor

The designer shall:

— state the f_m and list all assumptions made in the derivation of the value;

— specify lighting equipment suitable for the application environment; and

— prepare a maintenance schedule to include e.g. frequency of light source replacement, luminaire and room cleaning intervals.

The maintenance factor f_m has a large impact on energy efficiency. The assumptions made in the derivation of the f_m shall be both realistically achievable and optimized in a way that leads to a high value.

NOTE 1 Guidance on the determination of the maintenance factor can be found in ISO/CIE TS 22012 and further information on the derivation of f_m for electric indoor lighting systems can be found in CIE 97.

NOTE 2 For daylight calculations, reduction of transmittance of daylight openings due to dirt deposition has an influence on daylight supply.

6.4 Energy efficiency requirements

Lighting should be designed to meet the lighting requirements of a particular task, activity or space in an energy efficient manner. It is important not to compromise the visual aspects of a lighting installation simply to reduce energy consumption. The required minimum illuminance values as set in this document are minimum values and shall be maintained over time (see 7.3).

Energy savings can be made by harvesting daylight, responding to occupancy patterns, improving maintenance characteristics of the installation, and making full use of controls.

Daylight can supply all or part of the light needed for visual tasks or activities, and therefore offers potential energy savings. The amount of daylight indoors depends firstly on the availability of daylight outside (i.e. the prevailing climate at the site) and, thereafter, the environment surrounding the building, the components immediately around the daylight opening and the configuration of the interior spaces. With a near vertical daylight opening in the façade, the daylight availability decreases rapidly with the distance from the façade. Supplementary lighting (e.g. electric light or additional daylight openings) can be needed to ensure the required illuminance levels at the work station are achieved and to balance the luminance distribution within the room. Controls can be used to ensure appropriate integration between electric lighting and daylight.

A procedure for the estimation of the energy requirements of a lighting installation is given in EN 15193-1. It gives a methodology for the calculation of a lighting energy numeric indicator (LENI), representing the energy performance of lighting within buildings. This indicator may be used for single rooms on a comparative basis only, as the benchmark values given in the CEN/TR 15193-2 are drawn up for some types of room or application areas. EN 15193-1 provides a simplified method for calculating the potential energy savings of daylight.

6.5 Additional benefits of daylight

Daylight can provide significant quantities of light indoors, with high colour rendering and variability in illuminance, direction and spectral composition throughout the day and season. Daylight openings in a vertical, inclined or horizontal surface are strongly favoured in work places for the light they deliver, and for the visual contact they provide with the outside environment. Additionally, daylight provides variable modelling and luminance patterns, which is also perceived as being beneficial for people in indoor working environments. For any space with daylight openings, it is recommended to provide shading devices to reduce risk of glare or thermal discomfort. Direct view of the sun or to a reflection of the sun should be avoided.

For a more comprehensive method EN 17037 defines metrics, gives principles of calculation and verification, with respect to using daylight to provide lighting within interiors.

6.6 Variability of light

Light is important to people's health and well-being. Light affects the mood, emotion and mental alertness of people. It can also support and adjust the circadian rhythms and influence people's physiological and psychological state. Varying illuminances in time and season (with values higher or temporarily lower than specified in this document) and varying in colour temperature or spectrum can enhance people's well-being. Up to date research indicates that these phenomena, in addition to the lighting design criteria defined in this document, can be provided by the so-called "non-image forming" illuminances and colour appearance of light, as described in CEN/TR 16791 and in CIE S 026. The non-image-forming effects will depend on quantity and timing of light exposure, spectral power distribution, duration of exposure, and individual parameters like circadian phase, light history, and others. These objectives can be achieved with daylight and electric lighting solutions.

More information about non-image forming aspects can be found in Annex B.

When varying lighting (e.g. using personal control) it is possible that lighting requirements (as stated in the tables in 7.3) are no longer met. However, the values listed in the tables in 7.3 shall remain achievable.

NOTE Variability of light is important in spaces that are occupied for extended periods. Examples are classrooms, healthcare, offices and productions spaces.

6.7 Room brightness

An indication of perceived room brightness in spaces where visual tasks or activities are carried out is obtained by a combination of reflectances and illuminances on walls and the ceiling.

Additional indications of perceived room brightness are explained in Annex B.

7 Schedule of specific lighting requirements

7.1 Composition of the tables

For the application of the tables in 7.3, see Clause 6.

Column 1 lists the **reference** number for each task area or activity area.

Column 2 lists those **tasks areas or activities areas**, for which specific requirements are given. If the particular task or activity is not listed, the values given for a similar, comparable situation should be adopted. Task areas or activity areas can also be a room, e.g. a corridor or resting room.

Column 3 gives the required **maintained illuminance** $\bar{E}_{\mathrm{m}}$ on the reference surface (see 5.3) for the interior (area) in which the task or activity from Column 2 is performed.

Column 4 gives the modified **maintained illuminance** $\bar{E}_{\mathrm{m}}$ considering common context modifiers when the visual conditions differ from the normal assumptions (see 5.3.3) on the reference surface (see 5.3) for the interior (area) in which the task or activity from Column 2 is performed.

NOTE Lighting control can be required to achieve adequate flexibility for the variety of tasks performed.

Column 5 gives the **minimum illuminance uniformity** U_{o} on the reference surface for the maintained illuminance $\bar{E}_{\mathrm{m}}$ chosen according to Clause 7.

Column 6 gives the **minimum colour rendering indices** (R_{a}) (see 5.7.3) for the situation listed in Column 2.

Column 7 gives the **UGR limits** (Unified Glare Rating limit, R_{UGL}) that are applicable to the situation listed in Column 2 (see 5.5.3.2).

Column 8 gives the **maintained cylindrical illuminance** $\bar{E}_{m,z}$ for the recognition of objects and people as described in 5.6.2.

Column 9 gives the **maintained illuminance on walls** $\bar{E}_{m,wall}$ as described in 5.2.3.

Column 10 gives the **maintained illuminance on ceilings** $\bar{E}_{m,ceiling}$ as described in 5.2.3.

Column 11 gives **specific requirements** for the situations listed in Column 2.

7.2 Schedule of task and activity areas

7.3 Lighting requirements for task areas, activity areas, room and space brightness

The requirements for task areas and activity areas are given in Table 8 to Table 64. The columns are understood as shown in Table 8.

The requirements for the specific tasks and activities are given by $\bar{E}_{m}$, U_o, R_a and R_{UGL}. The requirements for the space in which the task(s) or activities are carried out are given by $\bar{E}_{m,z}$ for the perception of objects and people within this space and $\bar{E}_{m,wall}$ and $\bar{E}_{m,ceiling}$ for room brightness. The latter are used for designing the room and the space including R_{UGL}. Glare (by R_{UGL}) is dedicated to the space in which a task is carried out. The first four columns are used for of task area or activity area design and more than one of these areas can occur within one space.

This applies to column 3 to column 10 in all tables in 7.3.

Table 8 — Assignment of columns to requirements

<table>
<tr><td colspan="5">Task area or activity area design</td><td colspan="3">Room or space design requirements</td></tr>
<tr><td colspan="5">Task or activity related requirements</td><td>For visual communication and recognition of objects (5.6.2)</td><td colspan="2">Brightness appearance of rooms (5.2.2/5.2.3)</td></tr>
<tr><td colspan="2">$\bar{E}_{m}$
lx</td><td rowspan="2">U_o</td><td rowspan="2">R_a</td><td rowspan="2">R_{UGL}</td><td>$\bar{E}_{m,z}$
lx</td><td>$\bar{E}_{m,wall}$
lx</td><td>$\bar{E}_{m,ceiling}$
lx</td></tr>
<tr><td>required[a]</td><td>modified[b]</td><td colspan="3">$U_o \geq 0,10$</td></tr>
<tr><td colspan="8">[a] required: minimum value
[b] modified: considers common context modifiers in 5.3.3</td></tr>
</table>

Table 9 — Traffic zones inside buildings

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
9.1	Corridors and circulation areas	100	150	0,40	40	28	50	50	30	Illuminance at floor level. R_a and R_{UGL} similar to adjacent areas. 150 lx if there are vehicles on the route. The lighting of exits and entrances shall provide a transition zone to avoid sudden changes in illuminance between inside and outside by day or night. Care should be taken to avoid glare to drivers and pedestrians
9.2	Stairs, escalators, travolators	100	150	0,40	40	25	50	50	30	Illuminance at floor level. Requires enhanced contrast on leading edge of the steps.
9.3	Elevators, lifts	100	150	0,40	40	25	50	50	30	Illuminance at floor level. Light in front of elevator, see Ref.no. 8.4.

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGR}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
9.4	Area in front of lifts, elevators and escalators	200	300	0,40	40	25	75	75	50	Area up to 1 m in front of lift, elevators and escalators. Illuminance at floor level.
9.5	Loading ramps/bays	150	200	0,40	40	25	50	50	-	
9.6	Building entrance with canopy	30	50	0,40	-	-	-	-	-	
9.7	Gangways: manned	150	200	0,40	60	25	-	50	30	Illuminance at floor level. For storage rack face – see Table 13 — Logistics and warehouses

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 10 — General areas inside buildings – Rest, sanitation and first aid rooms

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
10.1	Canteens and break areas	200	300	0,40	80	22	75	75	50	
10.2	Resting rooms	100	200	0,40	80	22	50	50	30	
10.3	Rooms for physical exercise	300	500	0,40	80	22	100	100	75	
10.4	Cloakroom (area), washrooms, bathrooms, dressing-, lockers-, shower-, sink- and toilet areas	200	300	0,40	80	25	75	75	50	In each individual toilet if these are fully enclosed.
10.5	Facial lighting in front of mirrors	200	300	0,40	80	-	-	-	-	Vertical illuminance, 0,5 m in front of mirror at head height.
10.6	Sick bay	500	750	0,60	80	19	150	150	100	
10.7	Rooms for medical attention	500	1 000	0,60	90	19	150	150	100	4 000 K ≤ T_{cp} ≤ 5 000 K
10.8	General cleaning	100	150	0,40	-	-	50	50	30	Applicable where regular cleaning is necessary.

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 11 — General areas inside buildings – Control rooms

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
11.1	Plant rooms, switch gear rooms	200	300	0,40	80	25	50	50	30	
11.2	Post sorting, switchboard	500	750	0,60	80	19	150	150	100	
11.3	Surveilance station	300	500	0,60	80	19	100	100	75	1. Control panels are often vertical 2.Lighting should be dimmable, see 6.2.4 3. DSE-work, see 5.9.

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 12 — General areas inside buildings – Store rooms, cold stores

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
12.1	Store and stockrooms	100	150	0,40	80	25	50	50	30	200 lx if continuously occupied.
12.2	Dispatch packing handling areas	300	500	0,60	80	25	100	50	30	
12.3	Larder	200	300	0,40	80	25	-	-	-	Sufficient vertical illuminances shall be applied to shelving
For Logistics and warehouses – see Table 13 — Logistics and warehouses.										

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 13 — Logistics and warehouses

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
13.1	Unloading / loading area	200	300	0,40	80	25	50	50	30	
13.2	Packing / grouping area	300	500	0,50	80	25	100	100	30	
13.3	Configuration and rehandling	750	1000	0,60	80	22	150	150	30	
13.4	Open goods storage	200	300	0,40	80	25	50	50	30	
13.5	Rack storage - floor	150	200	0,50	80	25		-	30	Illuminance at floor level, R_{UGL} only in the viewing direction of the luminaire.
13.6	Rack storage - rack face	75	100	0,40	80	–	-	-	-	On aisle rack face. Band of 1,0 m may be excluded from the perimeter (see 5.4).
13.7	Central logistics corridor (heavy traffic)	300	500	0,60	80	25	100	100	30	
13.8	Automated zones (unmanned)	75	100	0,40	80	25				

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 14 — Industrial activities and crafts – Agriculture

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
14.1	Loading and operating of goods, handling equipment and machinery	200	300	0,40	80	25	50	50	-	
14.2	Buildings for livestock	50	75	0,40	40	-	-	-	-	
14.3	Sick animal pens; calving stalls	200	-	0,60	80	25	50	50	-	
14.4	Feed preparation; dairy; utensil washing	200	-	0,60	80	25	50	50	-	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 15 — Industrial activities and crafts – Bakeries

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
15.1	Preparation and baking	300	500	0,60	80	22	100	100	50	
15.2	Finishing, glazing, decorating	500	750	0,70	80	22	150	150	75	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 16 — Industrial activities and crafts – Cement, cement goods, concrete, bricks

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
16.1	Drying	50	-	0,40	20	28	-	-	-	Safety colours shall be identifiable.
16.2	Preparation of materials; work on kilns and mixers	200	300	0,40	40	28	50	50	-	
16.3	General machine work	300	500	0,60	80	25	100	100	-	
16.4	Rough forms	300	500	0,60	80	25	100	100	-	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 17 — Industrial activities and crafts – Ceramics, tiles, glass, glassware

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
17.1	Drying	50	-	0,40	20	28	-	-	-	Safety colours shall be identifiable.
17.2	Preparation, general machine work	300	500	0,60	80	25	100	100	-	
17.3	Enamelling, rolling, pressing, shaping simple parts, glazing, glass blowing	300	500	0,60	80	25	100	100	-	
17.4	Grinding, engraving, glass polishing, shaping precision parts, manufacture of glass instruments	750	1 000	0,70	80	19	150	150	100	
17.5	Grinding of optical glass, crystal, hand grinding and engraving	750	1 000	0,70	80	16	150	150	100	
17.6	Precision work, e.g. decorative grinding, hand painting	1 000	1 500	0,70	90	16	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K
17.7	Manufacture of synthetic precious stones	1 500	2 000	0,70	90	16	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 18 — Industrial activities and crafts – Chemical, plastics and rubber industry

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
18.1	Remote-operated processing installations	50		0,40	20	-	-	-	-	Safety colours shall be identifiable.
18.2	Processing installations with limited manual intervention	150	200	0,40	40	28	50	50	30	
18.3	Constantly manned work stations in processing installations	300	500	0,60	80	25	100	100	50	
18.4	Precision measuring rooms, laboratories	500	750	0,60	80	19	150	150	75	
18.5	Pharmaceutical production	500	750	0,60	80	22	150	150	75	
18.6	Tyre production	500	750	0,60	80	22	150	150	75	
18.7	Colour inspection	1 000	1 500	0,70	90	19	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K
18.8	Cutting, finishing, inspection	750	1 000	0,70	80	19	150	150	100	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 19 — Industrial activities and crafts – Electrical and electronic industry

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified				$U_o \geq 0,10$			
19.1	Cable and wire manufacture	300	500	0,60	80	25	100	100	50	
19.2	Winding:									
19.2.1	- large coils	300	500	0,60	80	25	100	100	50	
19.2.2	- medium-sized coils	500	750	0,60	80	22	150	150	75	
19.2.3	- small coils	750	1000	0,70	80	19	150	150	100	
19.3	Coil impregnating	300	500	0,60	80	25	100	100	50	
19.4	Galvanising	300	500	0,60	80	25	100	100	50	
19.5.	Assembly work:									
19.5.1	- rough, e.g. large transformers	300	500	0,60	80	25	100	100	50	
19.5.2	- medium, e.g. switchboards	500	750	0,60	80	22	150	150	100	
19.5.3	- fine, e.g. telephones, radios, IT equipment (computers)	750	1 000	0,70	80	19	150	150	100	
19.5.4	- precision, e.g. measuring equipment, printed circuit boards	1 000	1 500	0,70	80	16	150	150	100	
19.6	Electronic workshops, testing, adjusting	1 500	2 000	0,70	80	16	150	150	100	

[a] required: minimum value

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
[b] modified: considers common context modifiers in 5.3.3										

Table 20 — Industrial activities and crafts – Food stuffs and luxury food industry

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
20.1	Work stations and zones in: - breweries, malting floor, - for washing, barrel filling, cleaning, sieving, peeling, - cooking in preserve and chocolate factories, - work stations and zones in sugar factories, - for drying and fermenting raw tobacco, fermentation cellar	200	300	0,40	80	25	50	50	30	
20.2	Sorting and washing of products, milling, mixing, packing	300	500	0,60	80	25	100	100	50	

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	$R_{UGR,L}$	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
20.3	Work stations and critical zones in slaughter houses, butchers, dairies mills, on filtering floor in sugar refineries	500	750	0,60	80	25	150	150	75	
20.4	Cutting and sorting of fruit and vegetables	300	500	0,60	80	25	100	100	50	
20.5	Manufacture of delicatessen foods, kitchen work, manufacture of cigars and cigarettes	500	750	0,60	80	22	150	150	75	
20.6	Inspection of glasses and bottles, product control, trimming, sorting, decoration	500	750	0,60	80	22	150	150	100	
20.7	Laboratories	500	750	0,60	80	19	150	150	100	
20.8	Colour inspection	1 000	1 500	0,70	90	19	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 21 — Industrial activities and crafts – Foundries and metal casting

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
21.1	Man-size underfloor tunnels, cellars, etc.	50	-	0,40	20	-	-	-	-	Safety colours shall be identifiable.
21.2	Platforms	100	-	0,40	40	25	50	50	30	
21.3	Sand preparation	200	300	0,40	80	25	50	50	30	
21.4	Dressing	200	300	0,40	80	25	50	50	30	
21.5	Work stations at cupola and mixer	200	300	0,40	80	25	50	50	30	
21.6	Casting bay	200	300	0,40	80	25	50	50	30	
21.7	Shake out areas	200	300	0,40	80	25	50	50	30	
21.8	Machine moulding	200	300	0,40	80	25	50	50	30	
21.9	Hand and core moulding	300	500	0,60	80	25	100	100	50	
21.10	Die casting	300	500	0,60	80	25	100	100	50	
21.11	Model building	500	750	0,60	80	22	150	150	75	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 22 — Industrial activities and crafts – Hairdressers

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
22.1	Hairdressing	500	750	0,60	90	19	150	150	100	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 23 — Industrial activities and crafts – Jewellery manufacturing

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
23.1	Working with precious stones	1 500	2 000	0,70	90	16	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K
23.2	Manufacture of jewellery	1 000	1 500	0,70	90	16	150	150	100	
23.3	Watch making (manual)	1 500	2 000	0,70	80	16	150	150	100	
23.4	Watch making (automatic)	500	750	0,60	80	19	150	150	100	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 24 — Industrial activities and crafts – Laundries and dry cleaning

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
24.1	Goods in, marking and sorting	300	500	0,60	80	25	100	100	50	
24.2	Washing and dry cleaning	300	500	0,60	80	25	100	100	50	
24.3	Ironing, pressing	300	500	0,60	80	25	100	100	50	
24.4	Inspection and repairs	750	1 000	0,70	80	19	150	150	100	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 25 — Industrial activities and crafts – Leather and leather goods

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
25.1	Work on vats, barrels, pits	200	300	0,40	80	25	75	75	30	
25.2	Fleshing, skiving, rubbing, tumbling of skins	300	500	0,40	80	25	100	100	50	
25.3	Saddlery work, shoe manufacture: stitching, sewing, polishing, shaping, cutting, punching	500	750	0,60	80	22	150	150	100	
25.4	Sorting	500	750	0,60	90	22	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K
25.5	Leather dyeing (machine)	500	750	0,60	80	22	150	150	100	
25.6	Quality control	1 000	1 500	0,70	80	19	150	150	100	
25.7	Colour inspection	1 000	1 500	0,70	90	19	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K
25.8	Shoe making	500	750	0,60	80	22	150	150	100	
25.9	Glove making	500	750	0,60	80	22	150	150	100	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 26 — Industrial activities and crafts – Metal working and processing

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
26.1	Open die forging	200	300	0,60	80	25	50	50	30	
26.2	Drop forging	300	500	0,60	80	25	75	75	30	
26.3	Welding	300	500	0,60	80	25	75	75	30	
26.4	Rough and average machining: tolerances ≥ 0,1 mm	300	500	0,60	80	22	75	75	30	
26.5	Precision machining; grinding: tolerances < 0,1 mm	500	750	0,70	80	19	150	150	75	
26.6	Scribing; inspection	750	1000	0,70	80	19	150	150	100	
26.7	Wire and pipe drawing shops; cold forming	300	500	0,60	80	25	75	75	30	
26.8	Plate machining: thickness ≥ 5 mm	200	300	0,60	80	25	50	50	30	
26.9	Sheet metalwork: thickness < 5 mm	300	500	0,60	80	22	75	75	30	
26.10	Tool making; cutting equipment manufacture	750	1 000	0,70	80	19	150	150	75	
26.11	Assembly:									
26.11.1	- rough	200	300	0,60	60	25	50	50	30	
26.11.2	- medium	300	500	0,60	80	25	75	75	30	
26.11.3	- fine	500	750	0,60	80	22	150	150	75	

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
26.11.4	- precision	750	1 000	0,70	80	19	150	150	100	
26.12	Galvanizing	300	500	0,60	80	25	75	75	30	
26.13	Surface preparation and painting	750	1 000	0,70	80	25	150	150	100	
26.14	Tool, template and jig making, precision mechanics, micro-mechanics	1 000	1 500	0,70	80	19	150	150	100	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 27 — Industrial activities and crafts – Paper and paper goods

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
27.1	Edge runners, pulp mills	200	300	0,40	80	25	50	50	30	
27.2	Paper manufacture and processing, paper and corrugating machines, cardboard manufacture	300	500	0,60	80	25	75	75	50	
27.3	Standard bookbinding work, e.g. folding, sorting, gluing, cutting, embossing, sewing	500	750	0,60	80	22	150	150	100	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 28 — Industrial activities and crafts – Power stations

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}m,wall$ lx	$\bar{E}m,ceiling$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
28.1	Fuel supply plant	50	-	0,40	20	-	-	-	-	Safety colours shall be identifiable.
28.2	Boiler house	100	150	0,40	40	28	50	50	30	
28.3	Machine halls	200	300	0,40	80	25	50	50	30	
28.4	Side rooms, e.g. pump rooms, condenser rooms, etc.; switchboards (inside buildings)	200	300	0,40	80	25	50	50	30	
28.5	Control rooms	500	1 000	0,70	80	19	150	150	100	1. Control panels are often vertical. 2. Dimming might be required. 3. DSE-work, see 5.9.

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 29 — Industrial activities and crafts — Printers

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
29.1	Cutting, gilding, embossing, block engraving, work on stones and platens, printing machines, matrix making	500	750	0,60	80	19	150	150	75	
29.2	Paper sorting and hand printing	500	750	0,60	80	19	150	150	75	
29.3	Type setting, retouching, lithography	1 000	1 500	0,70	80	19	150	150	100	
29.4	Colour inspection in multicoloured printing	1 500	2 000	0,70	90	16	150	150	100	$4\,000\ K \leq T_{cp} \leq 6\,500\ K$
29.5	Steel and copper engraving	2 000	3 000	0,70	80	16	150	150	100	For directionality, see 5.6.4.

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 30 — Industrial activities and crafts – Rolling mills, iron and steel works

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified				$U_o \geq 0,10$			
30.1	Production plants without manual operation	50	-	0,40	20	-	-	-	-	Safety colours shall be identifiable.
30.2	Production plants with occasional manual operation	150	200	0,40	40	28	50	50	30	
30.3	Production plants with continuous manual operation	200	300	0,60	80	25	50	50	30	
30.4	Slab Store	50	-	0,40	20	-	-	-	-	Safety colours shall be identifiable.
30.5	Furnaces	200	300	0,40	20	25	50	50	30	Safety colours shall be identifiable.
30.6	Mill train; coiler; shear line	300	500	0,60	40	25	75	75	30	
30.7	Control platforms; control panels	300	500	0,60	80	22	75	75	30	
30.8	Test, measurement and inspection	500	750	0,60	80	22	150	150	100	
30.9	Underfloor man-sized tunnels; belt sections, cellars, etc.	50	-	0,40	20	-	-	-	-	Safety colours shall be identifiable.

[a] required: minimum value

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
[b] modified: considers common context modifiers in 5.3.3										

Table 31 — Industrial activities and crafts – Textile manufacture and processing

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
31.1	Work stations and zones in baths, bale opening	200	300	0,60	60	25	50	50	30	
31.2	Carding, washing, ironing, devilling machine work, drawing, combing, sizing, card cutting, pre-spinning, jute and hemp spinning	300	500	0,60	40	22	100	100	50	
31.3	Spinning, plying, reeling, winding	500	750	0,60	40	22	150	150	75	Prevent stroboscopic effects.
31.4	Warping, weaving, braiding, knitting	500	750	0,60	60	22	150	150	75	Prevent stroboscopic effects.
31.5	Sewing, fine knitting, taking up stitches	750	1 500	0,70	80	22	150	150	100	
31.6	Manual design, drawing patterns	750	1 500	0,70	90	22	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K
31.7	Finishing, dyeing	500	1 000	0,60	80	22	150	150	100	
31.8	Drying room	100	-	0,40	60	28	50	50	30	
31.9	Automatic fabric printing	500	-	0,60	90	25	100	100	50	
31.10	Burling, picking, trimming	1 000	1 500	0,70	80	19	150	150	100	
31.11	Colour inspection; fabric control	1 000	1 500	0,70	90	19	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
31.12	Invisible mending	1 500	2 000	0,70	90	19	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K
31.13	Hat manufacturing	500	750	0,60	80	22	150	150	75	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 32 — Industrial activities and crafts – Vehicle construction and repair

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
32.1	Press shop - large parts	300	500	0,60	80	25	100	50	30	
32.2	Press shop - visual inspection	500	750	0,60	80	22	150	50	30	
32.3	Body work and assembly - automatic line	300	500	0,60	80	25	100	50	30	
32.4	Body work and assembly - manual welding	500	750	0,60	80	22	150	50	30	
32.5	Painting, spraying chamber, polishing chamber	750	1 000	0,70	80	22	150	150	30	
32.6	Painting, inspection, touch-up and polishing	1 000	1 500	0,70	90	19	150	150	30	4 000 K ≤ T_{cp} ≤ 6 500 K
32.7	Upholstery manufacture (manual)	1 000	1 500	0,70	80	19	150	50	30	

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
32.8	Detailing: - Subparts assembly (doors, dashboard, upholstery) - Underchassis assembly - Motor and mechanical assembly - Final assembly conveyor line	750	1 000	0,70	80	22	150	50	30	
32.9	Detailing: - work with electronics	750	1 000	0,60	90	22	150	50	30	4 000 K ≤ T_{cp} ≤ 6 500 K for recognition of colours
32.10	Final inspection	1 000	1 500	0,70	90	19	150	150	30	
32.11	General vehicle services, repair and testing	500	750	0,60	80	22	100	50	30	Consider local lighting.

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 33 — Industrial activities and crafts – Wood working and processing

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
33.1	Automatic processing, e.g. drying, plywood manufacturing	50	-	0,40	40	28	-	-	-	
33.2	Steam pits	150	200	0,40	40	28	50	50	30	

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	$R_{UGR,L}$	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
33.3	Saw frame	300	500	0,60	60	25	100	100	50	Prevent stroboscopic effects.
33.4	Work at joiner's bench, gluing, assembly	300	500	0,60	80	25	100	100	50	
33.5	Polishing, painting, fancy joinery	750	1 000	0,70	80	22	150	150	100	
33.6	Work on wood working machines, e.g. turning, fluting, dressing, rebating, grooving, cutting, sawing, sinking	500	750	0,60	80	19	150	150	75	Prevent stroboscopic effects.
33.7	Selection of veneer woods	750	1 000	0,70	90	22	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K
33.8	Marquetry, inlay work	750	1 000	0,70	90	22	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K
33.9	Quality control, inspection	1 000	1 500	0,70	90	19	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 34 — Offices

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGR}	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx		Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
34.1	Filing, copying, etc.	300	500	0,40	80	19	100	100	75	
34.2	Writing, typing, reading, data processing	500	1 000	0,60	80	19	150	150	100	DSE-work, see 5.9 Room brightness, see 6.7 and Annex B Lighting should be controllable, see 6.2.4. For smaller cellular offices the wall requirement applies to the front wall. For other walls a lower requirement of minimum 75 lx could be accepted.
34.3	Technical drawing	750	1 500	0,70	80	16	150	150	100	DSE-work, see 5.9 room brightness, see 6.7
34.4	CAD work stations	500	1 000	0,60	80	19	150	150	100	DSE-work, see 5.9.
34.5.1	Conference and meeting rooms	500	1 000	0,60	80	19	150	150	100	Lighting should be controllable, see 6.2.4.
34.5.2	Conference table	500	1 000	0,60	80	19	150	150	100	Lighting should be controllable, see 6.2.4.
34.6	Reception desk	300	750	0,60	80	22	100	100	75	If reception desk includes regular work station tasks these should be lit accordingly.
34.7	Archiving	200	300	0,40	80	25	75	75	50	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 35 — Retail premises

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
35.1	General sales area	300	750	0,40	80	22	75	75	30	Ensure sufficient vertical illuminance on shelves.
35.2	Till area	500	1 000	0,60	80	19	100	75	30	
35.3	Wrapper table	500	1 000	0,60	80	22	100	-	50	
35.4	Storage area	300	500	0,40	80	25	50	-	-	
35.5	Dressing/fitting room	300	500	0,4	90	-	-	-	-	Consider vertical illuminance and modelling in front of mirror.

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 36 — Places of public assembly – General areas

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
36.1	Entrance halls	100	200	0,40	80	22	50	50	30	R_{UGL} only if applicable
36.2	Cloakrooms	200	300	0,40	80	25	75	75	50	
36.3	Lounges	200	300	0,40	80	22	75	75	50	
36.4	Ticket offices	300	500	0,60	80	22	75	75	50	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 37 — Places of public assembly – Restaurants and hotels

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
37.1	Reception/cashier desk, porters desk	300	500	0,60	80	22	100	100	75	
37.2	Kitchen	500	1 000	0,60	80	22	100	100	75	There should be a transition zone between kitchen and restaurant.
37.3	Restaurant, dining room, function room	-		-	80	-	-	-	-	The lighting should be designed to create the appropriate atmosphere.
37.4	Self-service restaurant	200	300	0,40	80	22	75	75	50	
37.5	Buffet	300	500	0,60	80	22	75	75	50	
37.6	Conference rooms	500	1 000	0,60	80	19	150	150	100	Lighting should be controllable, see 6.2.4. Room brightness, see 6.7
37.7	Corridors	100	150	0,40	80	25	50	50	30	During night-time lower levels are acceptable. Illuminance on floor level

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 38 — Places of public assembly – Theatres, concert halls, cinemas, places for entertainment

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
38.1	Practice rooms	300	500	0,60	80	22	100	100	75	
38.2	Dressing rooms	300	500	0,60	90	22	100	100	75	Lighting at mirrors for make-up shall be “glare-free”. Disability glare should be avoided at mirrors for make-up.
38.3	Seating areas – maintenance, cleaning	200	500	0,50	80	22	50	50	30	Illuminance at floor level.
38.4	Stage area rigging	300	500	0,40	80	25	75	75	30	Illuminance at floor level.

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 39 — Places of public assembly – Trade fairs, exhibition halls

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
39.1	General lighting	300	500	0,40	80	22	50	50	30	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 40 — Places of public assembly – Museums

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
40.1	Exhibits, insensitive to light	-	-	-	80	-	-	-	-	Lighting is determined by the display requirements.
40.2	Exhibits sensitive to light	-	-	-	80	-	-	-	-	1. Lighting is determined by the display requirements. 2. Protection against damaging radiation is paramount.

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 41 — Places of public assembly – Libraries

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
41.1	Bookshelves	200	300	0,40	80	19	-	-	-	Vertical illuminance on shelves. For dedicated bookshelf lighting the R_{UGL} value does not apply.
41.2	Reading area	500	750	0,60	80	19	100	100	50	Pleasant atmosphere should be achieved
41.3	Counters	500	750	0,60	80	19	150	150	50	
41.4	General lighting	300	500	0,40	80	22	75	75	50	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 42 — Places of public assembly – Car parks (indoor)

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
42.1	Entry/exit ramps (during daylight hours)	300	500	0,40	40	25	75	75	50	1. Illuminance level to extend 5 m into parking floor 2. Illuminances at floor level.
42.2	Entry/exit ramps (at night)	75	100	0,40	40	25	50	50	30	1. Illuminances at floor level.

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
42.3	Traffic lanes, internal ramps and pedestrian paths	75	100	0,40	40	25	50	50	30	1. Illuminances at floor level. 2. A high vertical illuminance increases recognition of people's faces and therefore the feeling of safety.
42.4	Parking areas – not open to public	75	100	0,25	40	-	50	30	15	1. Illuminances at floor level. 2. A high vertical illuminance increases recognition of people's faces and therefore the feeling of safety.
42.5	Parking areas – open to public with a large number of users e.g shopping centers, arenas.	150	200	0,40	40	-	50	50	15	1. Illuminances at floor level. 2. A high vertical illuminance increases recognition of people's faces and therefore the feeling of safety.
42.6	Ticket office	300	500	0,60	80	19	75	75	50	1. Reflections in the windows shall be avoided. 2. Glare from outside shall be prevented.

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 43 — Educational premises – Nursery school, play school

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
43.1	Play room	300	500	0,40	80	22	100	100	75	High luminances should be avoided in viewing directions from below by use of diffuse covers.
43.2	Nursery	300	500	0,40	80	22	100	100	75	High luminances should be avoided in viewing directions from below by use of diffuse covers.
43.3	Handicraft room	300	500	0,60	80	19	100	100	75	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 44 — Educational premises – Educational buildings

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
44.1	Classroom - General activities	500	1000	0,60	80	19	150	150	100	Lighting should be controllable, see 6.2.4, for different activities and scene settings. For classrooms used by young children, an $\bar{E}_m$ required of 300 lx may be used by dimming (see 5.3.3). Ambient light should be considered, see Annex B, room brightness, see 6.7.
44.2	Auditorium, lecture halls	500	750	0,60	80	19	150	150	50	Lighting should be controllable, see 6.2.4, to accommodate various A/V needs, room brightness, see 6.7.
44.3	Attending lecture in seating areas in auditoriums and lecture halls	200	300	0,60	80	19	75	75	50	Reduction by dimming. DSE-work, see 5.9.
44.4	Black, green and white boards	500	750	0,70	80	19	-	-	-	Vertical illuminances. Specular reflections shall be prevented. Presenter/teacher shall be illuminated with suitable vertical illuminance.

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	$R_{UGR,L}$	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
44.5	Black, green and white boards in auditorium and lecture halls	500	750	0,70	80	19	-	-	-	Vertical illuminances. Specular reflections shall be prevented. Presenter/teacher shall be illuminated with suitable vertical illuminance.
44.6	Projector and smartboard presentation	-	-	-	-	-	-	-	-	1. Lighting should be controllable, see 6.2.4. 2. Specular reflections shall be prevented. 3. 200 lx vertically behind (around) screen. 4. Direct lighting on screen when displaying content shall be avoided
44.7	Display board	200	300	0,60	80	19	-	-	-	Vertical illuminances
44.8	Demonstration table in auditoriums and lecture halls	750	1 000	0,70	80	19	-	-	-	
44.9	Light on teacher / presenter	-	-	-	80	-	150	-	-	At 1,6 m above the floor. Suitable vertical illuminance.
44.10	Light on podium area	300	500	0,70	80	-	-	-	-	Illuminance should be vertical in direction of audience, Lighting should be controllable, see 6.2.4, to accommodate various A/V needs.

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	$R_{UGR,L}$	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
44.11	Computer work only	300	500	0,60	80	19	100	100	75	DSE-work, see 5.9, lighting should be controllable, see 6.2.4, room brightness, see 6.7
44.12	Art rooms in art schools	750	1 000	0,70	90	19	150	150	100	Lighting should be controllable, see 6.2.4. Ambient light should be considered, see Annex B, room brightness see 6.7. $4\,000\ K \leq T_{cp} \leq 6\,500\ K$
44.13	Technical drawing rooms	750	1 000	0,60	80	19	150	150	100	Lighting should be controllable, see 6.2.4. Ambient light should be considered, see Annex B, room brightness see 6.7.
44.14	Practical rooms and laboratories	500	750	0,60	80	19	150	150	100	Lighting should be controllable, see 6.2.4. Ambient light should be considered, see Annex B, room brightness see 6.7.
44.15	Handcraft rooms	500	750	0,60	80	19	150	100	100	Lighting should be controllable, see 6.2.4. Ambient light should be considered, see Annex B, room brightness see 6.7.

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
44.16	Teaching workshop	500	750	0,60	80	19	150	150	100	Lighting should be controllable, see 6.2.4. Ambient light should be considered, see Annex B, room brightness see 6.7.
44.17	Preparation rooms and workshops	500	750	0,60	80	22	150	150	100	Lighting should be controllable, see 6.2.4. Ambient light should be considered, see Annex B, room brightness see 6.7.
44.18	Entrance halls	200	300	0,40	80	22	75	75	50	
44.19	Circulation areas, corridors	100	150	0,40	80	25	50	50	30	Horizontal illuminance floor level.
44.20	Stairs	150	200	0,40	80	25	50	50	30	Horizontal illuminance at floor level.
44.21	Student common rooms and assembly halls	200	300	0,40	80	22	75	75	50	
44.22	Teachers rooms	300	500	0,60	80	19	100	100	50	For office work see Table 34 —Offices.
44.23	Library: bookshelves	200	300	0,60	80	19	-	-	-	Vertical illuminance on shelves. For dedicated bookshelves lighting the R_{UGL} value does not apply.

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	$R_{UGR,L}$	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
44.24	Library: reading areas	500	750	0,60	80	19	100	100	50	See Table 41 —Places of public assembly – Libraries
44.25	Stock rooms for teaching materials	100	150	0,40	80	25	50	50	30	
44.26	Sports halls, gymnasiums, swimming pools	300	500	0,60	80	22	100	75	30	These requirements are only applicable for schools. For non-school use, training and competition, apply the specific requirements given in EN 12193.
44.27	School canteens	200	300	0,40	80	22	75	75	50	
44.28	Kitchen	500	750	0,60	80	22	100	100	75	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 45 — Health care premises – Rooms for general use

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
45.1	Waiting rooms	200	300	0,40	80	22	75	75	30	
45.2	Corridors: during the day	100	200	0,40	80	22	50	50	30	Illuminance at floor level.
45.3	Corridors: cleaning	100	200	0,40	80	22	50	50	30	Illuminance at floor level.
45.4	Corridors: during the night	50	-	0,40	80	22	-	-	-	Illuminance at floor level.
45.5	Corridors with multi-purpose use (e.g. preexamination of patients)	200	300	0,60	80	22	75	75	50	Illuminance at task/activity level.
45.6	Day rooms	300	500	0,60	80	22	75	75	50	
45.7	Elevators, lifts for persons and visitors	100	200	0,60	80	22	50	50	30	Illuminance at floor level.
45.8	Service lifts	200	300	0,60	80	22	75	75	50	Illuminance at floor level.
Too high luminances in the patients' visual field shall be prevented.										

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 46 — Health care premises – Staff rooms

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
46.1	Staff office	500	1 000	0,60	80	19	150	150	100	
46.2	Staff rooms	300	750	0,60	80	19	100	100	50	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 47 — Health care premises – Wards, maternity wards

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
47.1	General lighting	100	200	0,40	80	19	50	50	30	Illuminance at floor level. Lighting for the walls should be controllable. Room brightness, see 6.7.
47.2	Reading lighting	300	750	0,70	80	19	100	100	75	Lighting should be controllable, see 6.2.4, and limited to each bed.

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	$R_{UGR,L}$	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
47.3	Wards - Simple examinations	300	500	0,60	80	19	100	100	75	For normal examination and special treatment see also Table 48 —Health care premises – Examination rooms (general) and Table 59 — Health care premises – Autopsy rooms and mortuaries.
47.4	Examination and treatment	1 000	1 500	0,70	90	19	150	150	100	Room brightness, see 6.7, should be considered. Lighting should be controllable, see 6.2.4.
47.5	Night lighting, observation lighting	5	-	-	80	-	-	-	-	2 200 K ≤ T_{cp} ≤ 3 000 K Illuminance at floor level.
47.6	Bathrooms and toilets for patients	200	300	0,40	90	22	75	75	50	Lower colour temperature and lower illuminance for night lighting should be considered.
Too high luminances in the patients' visual field shall be prevented.										

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 48 — Health care premises – Examination rooms (general)

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
48.1	General lighting	500	750	0,60	90	19	150	150	100	4 000 K ≤ T_{cp} ≤ 5 000 K
48.2	Examination and treatment	1 000	1 500	0,70	90	19	150	150	100	4 000 K ≤ T_{cp} ≤ 5 000 K.

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 49 — Health care premises – Eye Examination rooms

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
49.1	General lighting	500	750	0,60	90	19	150	150	100	4 000 K ≤ T_{cp} ≤ 5 000 K
49.2	Examination of the outer eye	1 000	1 500	-	90	-	150	150	100	4 000 K ≤ T_{cp} ≤ 5 000 K
49.3	Reading and colour vision tests with vision charts	500	750	0,70	90	16	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 50 — Health care premises – Ear Examination rooms

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
50.1	General lighting	500	750	0,60	90	19	150	150	100	4 000 K ≤ T_{cp} ≤ 5 000 K
50.2	Ear examination	1 000	1 500	-	90	-	150	150	100	4 000 K ≤ T_{cp} ≤ 5 000 K

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 51 — Health care premises – Scanner rooms

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
51.1	General lighting	300	500	0,60	80	19	100	100	75	
51.2	Scanners with image enhancers and television systems	50	-	-	80	19	-	-	-	DSE-work, see 5.9

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 52 — Health care premises – Delivery rooms

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
52.1	General lighting	300	500	0,60	90	19	100	100	75	Lighting should be controllable, see 6.2.4
52.2	Examination and treatment	1 000	1 500	0,70	90	19	150	150	100	Lighting should be controllable, see 6.2.4

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 53 — Health care premises – Treatment rooms (general)

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
53.1	Dialysis	500	750	0,60	80	19	150	150	100	Lighting should be controllable, see 6.2.4.
53.2	Dermatology	500	750	0,60	90	19	150	150	100	
53.3	Endoscopy	300	500	0,60	80	19	100	100	75	
53.4	Plastering	500	750	0,60	80	19	150	150	100	
53.5	Medical baths	300	500	0,60	80	19	100	100	75	
53.6	Massage and radiotherapy	300	500	0,60	80	19	100	100	75	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 54 — Health care premises – Operating areas

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,2}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
54.1	Pre-op and recovery rooms	500	750	0,60	90	19	150	150	100	
54.2	Operating cavity surround	1 000	1 500	0,60	90	19	150	150	100	The illuminance of the cavity area should be luminance balanced to the immediate surrounding.
54.3	Operating theatre	1 000	1 500	0,60	90	19	-	-	-	
54.4	Operating cavity	-	-	-	90	-	-	-	-	Apply specific requirements given in EN 60601-2-41:2009[4].

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

[4] As impacted by EN 60601-2-41:2009/A11:2011 and EN 60601-2-41:2009/A1:2015.

Table 55 — Health care premises – Intensive care unit

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
55.1	General lighting	300	500	0,60	90	19	50	50	30	Illuminance at floor level.
55.2	Simple examinations	500	750	0,60	90	19	100	100	75	Illuminance at bed level.
55.3	Examination and treatment	1 000	1 500	0,70	90	19	150	150	100	Illuminance at bed level.
55.4	Night watch	20	-	-	90	19	-	-	-	Colour temperature should be considered.

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 56 — Health care premises – Dentists

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
56.1	General lighting	500	750	0,60	90	19	150	150	100	Lighting should be glare-free for the patient.
56.2	At the patient	1 000	1 500	0,70	90	-	150	150	100	
56.3	Operating cavity	-	-	-	-	-	-	-	-	Apply specific requirements given in EN ISO 9680.
56.4	White teeth matching	-	-	-	-	-	-	-	-	Apply specific requirements given in EN ISO 9680.

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	$R_{UGR,L}$	$\bar{E}_{m,hz}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 57 — Health care premises – Laboratories and pharmacies

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
57.1	General lighting	500	750	0,60	80	19	150	150	100	
57.2	Colour inspection	1 000	1 500	0,70	90	19	150	150	100	4 000 K ≤ T_{cp} ≤ 6 500 K

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 58 — Health care premises – Decontamination rooms

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
58.1	Sterilization	500	750	0,60	80	22	100	100	75	
58.2	Disinfection	500	750	0,60	80	22	100	100	75	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 59 — Health care premises – Autopsy rooms and mortuaries

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
59.1	General lighting	500	750	0,60	90	19	150	150	100	
59.2	Autopsy table and dissecting table	5 000	7 500	0,70	90	-	150	150	100	Values higher than 5 000 lx might be required.

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 60 — Transportation areas – Airports

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
60.1	Arrival and departure halls, baggage claim areas	200	300	0,40	80	22	75	75	30	
60.2	Connecting areas	150	200	0,40	80	22	50	50	30	
60.3	Information desks, check-in desks	500	750	0,70	80	19	150	150	100	DSE-work, see 5.9.
60.4	Customs and passport control desks	500	750	0,70	80	19	150	150	100	Facial recognition has to be provided.
60.5	Waiting areas	200	300	0,40	80	22	50	50	30	
60.6	Luggage storage rooms	200	300	0,40	80	25	50	50	30	
60.7	Security check areas	300	500	0,60	80	19	100	100	75	DSE-work, see 5.9.

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
60.8	Air traffic control tower	500	750	0,60	80	16	50	-	-	1. Lighting should be dimmable, see 6.2.4. 2. DSE-work, see 5.9. 3. Glare from daylight shall be avoided. 4. Reflections in windows, especially at night shall be avoided.
60.9	Tasks in hangars: - Testing and repair areas - Engine test areas - Measuring areas	500	750	0,60	80	22	50	50	30	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

Table 61 — Transportation areas – Railway installations

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
61.1.1	Fully enclosed platforms, small number of passengers	50	-	0,30	80	-	-	-	-	1. Special attention to the edge of the platform, see also D.1 2. Avoid glare for vehicle drivers and passengers. See also D.2 and D.3. 3. Illuminance at floor level in reference area.
61.1.2	Fully enclosed platforms, medium number of passengers	100	-	0,40	80	-	-	-	-	1. Special attention to the edge of the platform, see also D.1 2. Avoid glare for vehicle drivers and passengers. See also D.2 and D.3. 3. Illuminance at floor level in reference area.
61.1.3	Fully enclosed platforms, large number of passengers	200	-	0,50	80	-	-	-	-	1. Special attention to the edge of the platform, see also D.1 2. Avoid glare for vehicle drivers and passengers. See also D.2 and D.3. 3. Illuminance at floor level in reference area.

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGR}	$\bar{E}_{mz}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
61.2.1	Fully enclosed passenger subways (underpasses), small number of passengers	50	-	0,40	80	-	-	-	-	1. Avoid glare for passengers. See also D.3. 2. Illuminance at floor level in reference area. 3. In case of high reflecting enclosure surfaces the average illuminance level can be reduced by 50 %. 4. See also D.4.
61.2.2	Fully enclosed passenger subways (underpasses), medium number of passengers	100	-	0,40	80	-	-	-	-	1. Avoid glare for passengers. See also D.3. 2. Illuminance at floor level in reference area. 3. In case of high reflecting enclosure surfaces the average illuminance level can be reduced by 50 %. 4. See also D.4.

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGR}	$\bar{E}_{mz}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
61.2.3	Fully enclosed passenger subways (underpasses), large number of passengers	200	-	0,40	80	-	-	-	-	1. Avoid glare for passengers. See also D.3. 2. Illuminance at floor level in reference area. 3. In case of high reflecting enclosure surfaces the average illuminance level can be reduced by 50 %. 4. See also D.4.
61.3.1	Stairs, ecalators, small number of passengers	50	-	0,30	80	-	-	-	-	1. Avoid glare for passengers. See also D.3. 2. Special attention to landings.
61.3.2	Stairs, ecalators, medium number of passengers	100	-	0,40	80	-	-	-	-	1. Avoid glare for passengers. See also D.3. 2. Special attention to landings.
61.3.3	Stairs, ecalators, large number of passengers	200	-	0,50	80	-	-	-	-	1. Avoid glare for passengers. See also D.3. 2. Special attention to landings.
61.4	Ticket hall and concourse	200	300	0,50	80	28	75	75	50	Illuminance at floor level in reference area
61.5	Ticket counters and luggage offices	300	500	0,50	80	19	100	100	75	Illuminance in task areas

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGR}	$\bar{E}_{mz}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0{,}10$			
61.6	Waiting rooms	200	300	0,40	80	22	75	75	30	
61.7	Entrance halls, station halls	200	300	0,40	80	-	75	75	30	
61.8	Switch and plant rooms	200	300	0,50	80	28	50	50	30	Illuminance in task areas (horizontal, vertical, inclined), individually dimmable in task areas.
61.8.1	Railway control centre (area of dispatcher)	200	300	0,50	80	16	-	-	-	Illuminance in task areas and uniformity (horizontal, vertical, inclined). 1. Lighting should be controllable preferably by dimming, see 6.2.4. 2. DSE work, see 5.9. 3. Glare from daylight should be avoided. 4. Reflections in windows, especially at night shall be avoided. 5 Safety colours shall be identifiable. 6. Control desks and control walls require a constant illuminance over the whole surface.
61.9	Access tunnels	50	75	0,40	20	-	-	-	-	Illuminance at floor level.

Ref. no.	Type of task/activity area	$\bar{E}_m$ lx		U_o	R_a	R_{UGR}	$\bar{E}_{mz}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx	Specific requirements
		required[a]	modified[b]				$U_o \geq 0,10$			
61.10.1	Assembly work in maintenance sheds - rough	200	-	0,40	80	-	-	-	-	Avoid glare for passengers. See also D.3.
61.10.2	Assembly work in maintenance sheds - medium	300	-	0,50	80	-	-	-	-	Avoid glare for passengers. See also D.3.
61.10.3	Assembly work in maintenance sheds - fine	500	-	0,60	80	-	-	-	-	Avoid glare for passengers. See also D.3.
61.10.4	Assembly work in maintenance sheds - precision	750	-	0,70	80	-	-	-	-	Avoid glare for passengers. See also D.3.
61.10.5	Circulation areas for maintenance halls for railway vehicles (without additional vehicular traffic)	100	150	0,25	80	-	-	-	-	
61.10.6	Circulation areas for maintenance halls for railway vehicles (with additional vehicular traffic)	150	200	0,40	80	-	-	-	-	

[a] required: minimum value

[b] modified: considers common context modifiers in 5.3.3

8 Verification procedures

8.1 General

Specified design criteria which are listed in this document shall be verified by the following procedures.

In lighting design, calculations and measurements, certain assumptions including degree of accuracy have been made. These shall be declared.

The installation and the environment shall be checked against the design assumptions.

8.2 Illuminances

When verifying conformity to the illuminance requirements the measurement points shall coincide with any design points or grids used. Verification shall be made to the criteria of the relevant surfaces.

For subsequent measurements, the same measurement points shall be used.

Verification of illuminances that relate to specific tasks shall be measured perpendicular to the plane of the task.

When verifying illuminances, account should be taken of the calibration of the light meters used, the conformity of the light source and luminaires to the published photometric data, and of the design assumptions made about surface reflectance, etc., compared with the real values.

The average illuminance and uniformity shall be calculated from the measured values and taking into account the maintenance factor shall be not less than the values specified.

8.3 Unified Glare Rating

Authenticated UGR data produced by the tabular method shall be provided for the luminaire scheme by the manufacturer of the luminaire. The spacing shall be declared for the UGR-tables provided.

8.4 Colour rendering and colour appearance

Authenticated colour rendering index R_a and correlated colour temperatures T_{cp} data shall be provided for the light source in the scheme by the manufacturer of the light source. The light sources shall be checked against the design specifications.

8.5 Luminaire luminance

The average luminance of the luminous parts of the luminaire shall be measured and/or calculated in the C-plane (azimuth) at intervals of 15° starting at 0° and the γ-plane (elevation) for angles of 65°, 70°, 75°, 80° and 85°. Usually the manufacturer of the luminaire shall provide these data based on maximum (light source/luminaire) output (see also EN 13032-1, EN 13032-2 and EN 13032-4).

8.6 Maintenance schedule

The maintenance schedule shall be provided according to 6.3.

Annex A
(informative)

Recommended practice regarding implementation of UGR tabular method for 'non-standard' situations

A.1 General

The boundary conditions for the determination of the UGR value include having a rectangular space, a regular luminaire grid and only one type of luminaire. The UGR methodology does not apply to totally indirect luminaires. The UGR tabular method is only applicable for luminaires with at least 2-axis symmetrical light distribution in horizontal position of the light emission surface. This limits the application of the methodology to some extent, but does not exclude its use. However, as the limiting values (in the tables in 7.3) have been determined based on the UGR tabular method, the limiting values cannot be applied to other uses of the UGR formula (such as individual point calculations) without further scientific validation. To maximize the applicability of the tabular method, A.2 covers recommended practices when specific boundary conditions are not met.

NOTE 1 The UGR methodology is intended to support the selection of luminaires which are appropriate for the given application. It is not intended as an exact prediction of glare in the given space.

NOTE 2 The highest UGR value will generally occur in the largest room with the lowest reflectances. When using the recommended practices below it is advisable to keep this in mind when determining the worst-case scenarios.

A.2 Recommended Practices

A.2.1 Deviating luminaire sizes

The UGR methodology can be applied to luminaires visible in boundaries 0,000 3 sr to 0,1 sr as given in CIE 117 (for usual room heights (except high halls) this corresponds to luminaires from 0,005 m^2 to 1,5 m^2). For luminaires outside this range some advice is given in CIE 147.

A.2.2 Irregular area shapes

The UGR methodology is based upon rectangular rooms. For a non-rectangular room, the room dimensions can be approximated by fitting it with a rectangle. The used dimensions of the approximated rectangle should be documented in the lighting design.

A.2.3 Irregular luminaire placement patterns

As the UGR-tabular method uses a 'virtual' luminaire placement to determine the UGR value, the exact luminaire placement pattern can be disregarded. However, in extreme cases such as clusters of luminaires tightly grouped together, the UGR-tabular method should not be used.

A.2.4 Deviating room reflectances

If the exact reflectances are not given in the standard UGR table, the set of reflectances closest to these reflectances should be used as a best approximation. Keep in mind that the lower the reflectances, the higher the UGR value. As such, for the worst-case scenario it is preferable to select a set of values lower than the requested values. Alternatively, a set of transfer values can be calculated allowing the calculation of standard UGR values for the required reflectances.

A.2.5 Multiple luminaire types

When multiple luminaire types are used, the UGR should be determined for each individual luminaire type. For the worst-case scenario, the luminaire type with the highest UGR value should be referenced against the set limiting value.

A.2.6 Luminaires with (only) up-lighting or luminous ceilings

The UGR methodology does not apply to up-lighters (i.e. luminaires with only up-light or luminaires in which the downward component only has an aesthetic function and does not contribute to achieving the lighting requirements specified within this document). Additionally, the UGR methodology does not apply to luminous ceilings (see size limits in A.2.1).

A.2.7 Room dimensions smaller or larger than the tabular values

Assuming 'H' as the distance between the observer and luminaire plane, for room dimensions larger than 12H (the maximum dimension ratio in the tabular method), 12H can be taken as a representative value. In this case, the used dimension should be reported. For room dimensions smaller than 2H, discomfort glare is unlikely to occur.

For room dimensions > 12H or in production facilities with large height differences between the height of the user's eye and the mounting height (e.g. > 7 m), it should be checked whether the UGR method should be used or whether in these cases disability glare could be more important than discomfort glare.

Annex B
(informative)

Additional information on visual and non-visual (non-image forming) effects of light

B.1 General

There is strong scientific evidence that light is not only essential for vision but also elicits important biological, non-image-forming effects, and emotional effects that are highly relevant for human performance, well-being and health.

Current lighting practice and the demand for energy saving tends to reduce indoor illumination levels. This can create lighting conditions that are not supportive for human well-being and visual performance.

The emotional and non-visual (non-image forming) effects of light have a direct impact on peoples performance and well-being in their social and work life. This has implications for architecture, interior design, and lighting. The consideration of these effects in lighting designs and applications requires additional design practices and methods to those currently in use.

This document suggests using the recommended value (see Clauses 5 and 6) as a first step in this direction.

B.2 Perceived room brightness

The perceived brightness of a space is important for the occupants' well-being and alertness. In the visual field, the perceived brightness (luminance pattern) is a result of the interaction between illumination and the reflectance properties of objects and room surfaces. However, illuminances are more practical to evaluate than luminance, since often no detailed information is available on interior decor or occupant seating and primary viewing directions in the design practice.

By using the values for $\bar{E}_{\mathrm{m,wall}}$ and $\bar{E}_{\mathrm{m,ceiling}}$ as well as $\bar{E}_{\mathrm{z}}$ as specified in the tables in 7.3 proper perceived room brightness and illumination of people and objects can be ensured. The values are application specific and as such need to be adapted to the activity and/or task characteristics. These include visual communication (e.g. in classrooms, meeting rooms and offices) and visual comfort for areas where the specified task or activity is performed for extended periods of time.

B.3 Alternative parameters

B.3.1 General

As stated in B.2, the wall, ceiling and cylindrical illuminances are employed by this document as indicators of room brightness and the recognition of objects and people. Due to their practical and intuitive nature, alternative methods have been proposed and three of these are briefly described below.

B.3.2 Mean ambient illuminance, $\bar{E}_{\mathbf{amb}}$ (Govén et al.)[1]

This method calculates an approximation of the apparent brightness within a space by evaluating the total amount of light reaching the walls and ceiling of the space. The average illuminances on these surfaces are calculated and these values are then averaged to calculate the mean ambient illuminance for the room.

$$\bar{E}_{amb} = (\bar{E}_{v\ wall1} + \bar{E}_{v\ wall2} + \bar{E}_{v\ wall3} + \bar{E}_{v\ wall4} + \bar{E}_{ceiling}) / 5 \quad \text{(B.1)}$$

For work spaces where ambient light is considered (for example offices, class rooms, hospital wards), the mean ambient illuminance is recommended to be within a band of 200 lx < $\bar{E}_{amb}$ < 500 lx and the ratio between the mean ambient illuminance and the maintained illuminance on the task area or activity area, $\bar{E}_{amb}$ / $\bar{E}_{m}$, should not be lower than 1:2 (i.e. ≥ 50 %).

Formula (B.1) is applicable for mid and large size rooms. For small rooms (such as cellular offices) the wall illuminance within the normal visual field can be used as the value for $\bar{E}_{amb}$.

B.3.3 Mean room surface luminous exitance, M_{rs} (Cuttle)[2]

This approach considers that the visual appearance of a space is based upon the brightness of the room surfaces. That is the luminous flux leaving a surface as opposed to the luminous flux falling onto the surface. It proposes the use of mean room surface luminous exitance, which serves as a measure of average illuminance for all points within the space due to reflected light from the room surfaces, (direct light from either luminaires or windows is excluded) and is expressed in lm m^{-2}. It is calculated as the first reflected flux (Φ_{fr}, abbreviation FRF) for the room divided by the absorption-weighted room area A_{α}. The luminous flux Φ_{fr} is the sum of the direct flux reflected from each surface in the room.

$$M_{rs} = \frac{\Phi_{fr}}{A_{\alpha}} \qquad \Phi_{fr} = \sum_{s} \Phi_{s(d)} \cdot \rho_s \qquad A_{\alpha} = \sum_{s} A_s \cdot (1 - \rho_s)$$

where

$\Phi_{s(d)}$ is the direct flux onto surface *s*, ρ_s is the reflectance of surface *s* and A_s is the area of surface *s*.

M_{rs} values may be used to specify perceived adequacy of illumination (PAI) for specific applications in lighting standards, or by lighting designers to specify perceived brightness of illumination (PBI) on a scale of very dim to very bright.

Tentative values of mean room surface luminous exitance give 10 lm m^{-2} as the lowest level for reasonable colour discrimination, 30 lm m^{-2} as having a dim appearance, 100 lm m^{-2} as the lowest level for an acceptably bright appearance, 300 lm m^{-2} for a bright appearance and 1000 lm m^{-2} for a distinctly bright appearance.

B.3.4 Visual lightness and interest - 40 degree band luminance (Loe et al.)[3]

This considers that the key factors in the perception of a space are the two subjective parameters of 'visual lightness' and 'visual interest' related to the brightness of a horizontal band, 40° high and centred at normal eye height. In relatively small rooms this 40° band relates closely to the area of the walls, but in larger rooms it includes the ceiling and the floor.

On the basis of the results of experiments it was proposed that for a commercial interior (e.g. salesrooms, restaurants) to have a measure of visual lightness the average luminance of the horizontal 40° band should not be less than 30 cd m^{-2}. For a possible maximum value it was noted that beyond 100 cd m^{-2} there was little change in subjective assessment.

Regarding visual interest it was suggested that the ratio of maximum to minimum luminance within the 40° band should be between 10 % and 50 % which can be achieved either by a variation in illuminance or reflectance or both. These values are only relevant for commercial interior spaces, not for work spaces.

B.4 Adaptation luminance within the normal visual field

The adaptation luminance describes the luminance to which the eye is adapted. The viewing direction and spatial luminance distribution have an impact on adaptation luminance within the visual field.

Within the visual field space dimensions and the position of the observer determine which parts of the space are the dominant aspects, e.g. walls, ceilings, furniture and partition walls.

Which main surfaces determine the adaptation luminance to which extent, is highly dependent on the space dimensions. In smaller spaces, the walls will be major determining factor, whereas in larger spaces the ceiling, floor and furniture will start to play a more prominent role.

B.5 The influence of spectral power distribution on non-image forming effects

The spectral power distribution of a light source plays a large role in the stimulation of the different receptors in the eye. The receptors for vision, the rods and cones, are relatively well understood and their spectral sensitivities characterized by documents such as CIE S 026 and CEN/TR 16791. Although scientific evidence shows that melanopsin containing retinal ganglion cells (intrinsically photosensitive Retinal Ganglion Cells, ipRGCs,), which are most sensitive to short wavelength parts of the spectral power distribution (between 460 nm and 500 nm), play an important role in the non-image-forming effects of light, this evidence was not yet included in existing lighting standards and recommendations. Therefore, a description of optical radiation solely according to the photopic spectral luminous efficiency $V(\lambda)$ is not sufficient. The actual biological effect of ocular exposure to light will depend on the relative response of all photoreceptors and there is good evidence for synergistic responses between the receptors. For a deeper understanding of how a stimulation of the photoreceptors leads to a desirable or undesirable biological effect, light must be characterized in a way to quantify the input to each of the five known photoreceptors. CIE S 026 and CEN/TR 16791, have defined a method to characterize illuminants according to their potential in eliciting biological stimulation and sensation.

It is also important to recognize the importance of darkness, and the daily pattern of light and dark, particularly around and during periods of sleep. Additionally, certain changes to the balance of the spectrum of light at different times of day can be helpful in stabilizing circadian rhythms, but further practice-oriented evidence is needed to support this as a general principle. Analysing the involvement of different photoreceptors would be crucial to understand how such outcomes can have an impact on human well-being.

NOTE 1 The spectral power distribution has an impact on human circadian rhythm. This impact can be described approximately by means of the Correlated Colour Temperature (T_{cp}) or, more accurately, by means of evaluation of the spectral power distribution of the light source.

NOTE 2 The perception of light colour in a space is related to the illuminance of the electrical lighting system, the colour of the décor of the room, and the amount of daylight penetration. High T_{cp} is more likely to have impact on non-image forming effects.

NOTE 3 The variability of the light colour over the day is one factor that can also influence the circadian rhythm. Individual preferences arising from, e.g. gender and culture can be considered.

B.6 Varying lighting conditions

Varying lighting conditions in time by changing illuminances, different luminance distributions and wider range of colour temperature with daylight and/or electric lighting solutions can enhance people's well-being. Variation in illuminance can also make a space appear less monotonous. However, the perceived difference between bright and dark zones should be moderate to fit the adaptation luminance of the eye.

The acceptance of lighting systems can be increased by the possibility of personal influence on light settings, e.g. with the use of adjustable task lighting (direction of light, illuminance and possibly colour temperature).

Electric light can be used to support space functions. Pre-programmed light scenarios can improve occupants' well-being through variation and personal interaction, while enabling energy savings, see also 6.6.

B.7 Daylight provision

Daylight is the essential illumination source for human well-being. Daylighting is dynamic and it varies in magnitude, direction and spectral distribution with time and season. It provides variable modelling and luminance patterns, which is perceived as being beneficial for people in indoor environments. Daylight needs to be assessed in terms of daylight quantity and distribution, exposure to sunlight and protection from glare. Daylight openings should also be assessed in terms of view out.

EN 17037:2018 specifies an evaluation method for daylight provision in a space to ensure sufficient levels of daylight throughout the year. To demonstrate compliance with EN 17037, it is necessary to show that a target illuminance level is achieved across 50 % of a reference plane for at least half of the yearly daylight hours. In addition, for spaces with vertical or inclined daylight openings, a minimum target illuminance level is also to be achieved across 95 % of the reference plane. The standard proposes two methods to assess daylight provision in the interior:

— Method 1: A calculation method based on daylight factor and yearly daylight availability of diffuse skylight;

— Method 2: A calculation method based on the direct prediction of illuminance levels using hourly climate data of diffuse skylight and direct sunlight.

Recommended values of illuminance level and daylight factor are provided for all capital cities of CEN national members.

Relevant differences between EN 17037 and EN 12464-1 are:

— illuminance levels stated in EN 17037 are not identical to the values of the maintained illuminance levels referred to in this document;

— the reference plane described in EN 17037 is different from the reference area referred to in this document;

— specification of calculation grids.

The interplay between daylight and electric lighting is of utmost importance. Possibilities to adjust the electric lighting to the daylight conditions over time can be used. The available daylight decreases rapidly with the distance from vertical or inclined openings and this introduces strong illuminance gradients, especially close to openings. It is recommended to ensure uniformity levels on the task or activity area and immediate surrounding similar to those in 5.3.6.

Increasing ambient illuminance and task area illuminance provided by electric lighting with an appropriate spectral power distribution can partly reduce negative impacts of insufficient levels of daylight.

Annex C
(informative)

Lighting design considerations - Examples

C.1 Example for offices

A large open plan office has a number of activities including writing, typing, reading, data processing, and filing/copying. The computer based tasks are flexible and may be performed in a number of positions, whilst the filing/copying is fixed in a number of positions throughout the office.

The staff ages within the space range from mid-20s to early 60s with a mid-range in their early 50s. No current staff members are visually impaired.

The office is to be lit to preserve the flexibility of the space whilst ensuring all tasks can be performed optimally.

The requirements from the schedule (Table 34) for the tasks listed are:

Table C.1 — Basic requirements from Table 34

Task	**Ref. no.**	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx
		required	*modified*				$U_o \geq 0{,}10$		
Data processing – open plan office	34.2	500	1 000	0,60	80	19	150	150	100
Filing/copying	34.1	300	500	0,40	80	19	100	100	75

Due to the flexible nature of the office space the most onerous requirements shall be met throughout the space, which means the requirements for the office are:

Table C.2 — Basic requirements for the entire office

$\bar{E}_m$		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx
required	*modified*				$U_o \geq 0{,}10$		
500	1 000	0,60	80	19	150	150	100

As there is a high percentage of older staff within the space the required illuminance of 500 lx would be inappropriate. Using the scale of illuminance given in 5.3.2 the design team proposes that this should be raised by at least one step according to the context modifiers in 5.3.3:

… 200 - 300 - **500 → 750** - 1 000 - 1 500 - 2 000 …

Therefore, the modified requirements become:

Table C.3 — Modified requirements for the office

$\bar{E}_m$ lx	U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx
				$U_o \geq 0,10$		
750	0,60	80	19	150	150	100

However as the task illuminance has been raised by one step the cylindrical illuminance $\bar{E}_{m,z}$, wall illuminance $\bar{E}_{m,wall}$ and ceiling illuminance $\bar{E}_{m,ceiling}$ should also be raised by one step on the scale of illuminance, resulting in the requirements:

Table C.4 — Final requirements for the office

$\bar{E}_m$ lx	U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx
				$U_o \geq 0,10$		
750	0,60	80	19	200	200	150

From Table 3 of the standard (5.3.4) this would require an illuminance on the immediate surrounding area of 500 lx and an illuminance on the background area of 500 lx/3 = 167 lx.

Obviously, for maximum flexibility the modified value for $\bar{E}_m$ of 1 000 lx (see Table C.2) could be used with suitable lighting controls to achieve the basic requirements but allow for variability in the visual environment throughout the day.

C.2 Example for industry machine workshop

An industrial machine workshop in a large hall is to be lit by luminaires mounted 6 m above the ground. It is used for rough machining of large metal components. The space is dusty and noisy and protective equipment such as eye and ear protection is needed when operating machinery.

Gangways for fork lift trucks are placed between machinery to deliver raw materials and remove finished goods.

The requirements from the schedule for the tasks listed are:

Table C.5 — Basic requirements from Table 9 and Table 26

Task	***Ref. no.***	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx
		required	*modified*				$U_o \geq 0,10$		
Rough machining	26.4	300	500	0,60	80	22	75	75	30
Circulation areas	9.1	100	150	0,40	40	28	50	50	30

As the spaces overlap to an extent the most onerous requirements shall be met throughout the space, which means the requirements for the workshop are:

Table C.6 — Basic requirements for the workshop

$\bar{E}_{m}$		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx
required	*modified*				$U_o \geq 0,10$		
300	500	0,60	80	22	75	75	30

Due to the distraction caused by the noise within the workshop and lower visibility due to dust on eye protection and surfaces within the workshop, the design team proposes that the required illuminance of 300 lx would be inappropriate. Using the scale of illuminance given in 5.3.2 this should be raised by at least one step according to the context modifiers in 5.3.3:

... 100 - 150 - 200 - **300 → 500** - 750 - 1 000 - 1 500 ...

Therefore the modified requirements become:

Table C.7 — Modified requirements for the workshop

$\bar{E}_{m}$ lx	U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx
				$U_o \geq 0,10$		
500	0,60	80	22	75	75	30

As the task illuminance has been raised by one step the cylindrical illuminance $\bar{E}_{m,z}$, wall illuminance $\bar{E}_{m,wall}$ and ceiling illuminance $\bar{E}_{m,ceiling}$ should also be raised by one step on the scale of illuminance.

However as the components are of a large size which reduces the visual difficulty of the task, the design team proposes it would be acceptable to reduce the modified illuminance by one step, according to the context modifiers in 5.3.3, Table 2, resulting in the original requirements of:

Table C.8 — Final requirements for the workshop

$\bar{E}_{m}$ lx	U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx
				$U_o \geq 0,10$		
300	0,60	80	22	75	75	30

From Table 3 (see 5.3.4) this would require an illuminance on the immediate surrounding area of 200 lx and an illuminance of the background area of 200 lx/3 = 67 lx.

However, this would limit the flexibility of the lighting in the event more detailed work was required within the space and the higher level given for modified $\bar{E}_{m}$ of 500 lx or more could be used with suitable lighting controls to achieve the base requirements but allow for flexibility in the manufacturing processes.

C.3 Example for industrial machine workshop with inspection area

Within the large area of the industrial machine shop in the example above with luminaires mounted at 6 m above the floor, a smaller area for inspection is to be lit with luminaires mounted at 2,5 m above the floor. The position of this area is defined and fixed. The requirements from the schedule for this task are:

Table C.9 — Basic requirement for the inspection area from Table 26

Task	***Ref. no.***	$\bar{E}_{m}$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx
		required	*modified*				$U_o \geq 0{,}10$		
Inspection area	26.6	750	1 000	0,70	80	19	150	150	100

The requirements for the machine shop determined within industry example above are:

Table C.10 — Basic requirements for the workshop from Table 26

Task	***Ref. no.***	$\bar{E}_{m}$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx
		required	*modified*				$U_o \geq 0{,}10$		
Rough machining	26.4	300	500	0,60	80	22	75	75	30

As the requirements for the inspection task are more onerous than those for the main machining area the requirements for the entire machine shop should be raised to achieve the inspection area criteria.

However the inspection area is a smaller section with a pendant ceiling within the larger hall, albeit without separate walls. The design team proposes that the requirements in the inspection area for the task illuminance, the cylindrical illuminance $\bar{E}_{m,z}$, the ceiling illuminance $\bar{E}_{m,ceiling}$, and their uniformities U_o need to be considered for the inspection area.

For the machining hall the requirements for the wall illuminance $\bar{E}_{m,wall}$, the task illuminance, the cylindrical illuminance $\bar{E}_{m,z}$, the ceiling illuminance $\bar{E}_{m,ceiling}$, and their uniformities U_o for the rough machine task should be used.

The UGR requirements R_{UGL} for the inspection area shall be used for the inspection area and entire machining hall as all of the luminaires have an effect on the inspection work places.

Therefore the requirements become:

Table C.11 — Basic requirements for machining hall inspection area

Task	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx
	required	*modified*				$U_o \geq 0,10$		
Inspection area	750	1 000	0,70	80	19	150	-	100
Rough machining	300	500	0,60	80	19	75	75	30

From Table 3 (see 5.3.4) this would require an illuminance on the immediate surround of 500 lx in the inspection area and of 200 lx in the machining area. In addition, a background illuminance of 200 lx/3 = 67 lx for the main machine hall and a background illuminance of 500 lx/3 = 167 lx for the inspection area are required. The final lighting design shall comply with the illuminances in all these areas.

C.4 Example for electronics industry

Within an electronics industry manufacturing area with luminaires mounted at 4 m above the floor, there are both rough and medium assembly work. The position of the different areas are defined and fixed and the visual conditions are normal. The requirements from the schedule for these tasks are;

Table C.12 — Basic requirements from Table 19

Task	***Ref. no.***	$\bar{E}_m$ lx		U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx
		required	*modified*				$U_o \geq 0,10$		
Medium assembly work area	19.5.2	500	750	0,60	80	22	150	150	100
Rough assembly work area	19.5.1	300	500	0,60	80	25	100	100	50

The requirements for the medium assembly work task are more onerous than those for the rough assembly work but since the two different assembly areas are well defined within the total space, the design team proposes that the task illuminances $\bar{E}_m$ and the cylindrical illuminance $\bar{E}_{m.z}$ should be designed for each area.

However, a luminaire that fulfils R_{UGL} 22 has to be chosen for the entire assembly area and the wall illuminance $\bar{E}_{m,wall}$ and ceiling illuminance $\bar{E}_{m.ceiling}$ should follow the stricter medium assembly work requirements throughout the total assembly hall.

Therefore the requirements become:

Table C.13 — Final requirements for electronic industry

Task	$\bar{E}_{m}$ lx	U_o	R_a	R_{UGL}	$\bar{E}_{m,z}$ lx	$\bar{E}_{m,wall}$ lx	$\bar{E}_{m,ceiling}$ lx
					$U_o \geq 0,10$		
Medium assembly work area	500	0,60	80	22	150	150	100
Rough assembly work area	300	0,60	80	22	100	150	100

From Table 3 (in 5.3.4) this would require an illuminance on the immediate surrounding area of 200 lx and an illuminance of the background area of 200 lx/3 = 67 lx for the rough assembly work area and an illuminance on the immediate surrounding area of 300 lx and an illuminance of the background area of 300 lx/3 = 100 lx for the medium assembly work area. For overlapping areas the stricter requirements apply.

Annex D
(informative)

Transportation areas – Railway installations

D.1 Platform edge

An average illuminance in a strip of 1 m width along the platform edge not less than 50 % of the average platform illuminance provides appropriate visual conditions along the platform edge.

D.2 Limitation of glare for train drivers

For relevant positions and viewing directions a threshold increment TI not exceeding 15 % based on an adaptation luminance of 10 % of the average platform luminance avoids glare for train drivers (for calculation methods see EN 13201-3).

D.3 Maintenance sheds

Where direct views towards luminaires are unavoidable, a luminous flux density of the luminaire luminous areas not exceeding 1 000 lm per 0,03 m^2 avoids glare for personnel under normal working conditions, e.g. in maintenance pits, and for passengers.

D.4 Circulation areas

A ratio of vertical to horizontal illuminance E_v/E_h in the direction of traffic not less than 0,20 (disregarding inter-reflected light), enables adequate visual communication and recognition of objects in narrow but very long circulations areas, e.g. between tracks in maintenance sheds.

Annex E
(informative)

A–deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CEN/CENELEC member.

This European Standard does not fall under any Directive of the EU. In the relevant CEN/CENELEC countries these A-deviations are valid instead of the provisions of the European Standard until they have been removed.

Clause	Deviation
5.4	Slovakia

In accordance with the Slovak regulations[5] at common field measurements (within the accuracy class 2) of the general illuminance on an area or its functionally specific part the relative distance of control points must not be more than the height of luminaires above the reference plane. At rough measurements (within the accuracy class 3) this distance can be increased by one third. At accurate measurements (within the accuracy class 1) the relative distance of control points shall be estimated according to clause 5.4 of the EN 12464-1.

Measurements of illuminance on walls and ceilings should be carried out merely in wellgrounded cases.

5 Special regulation of the Ministry of Health of the Slovak Republic specifying the procedure for measurement and evaluation of lighting (Bulletin MZ SR Vol. 61, Section 27-49, 20.10.2013)

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