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Light and lighting – Lighting of work places Part 1: Indoor work places

Licht und Beleuchtung – Beleuchtung von Arbeitsstätten – Teil 1: Arbeitsstätten in Innenräumen

Lumière et éclairage – Eclairage des lieux de travail – Partie 1: Lieux de travail intérieur

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ÖNORM EN 12464-1 consists of

- this national cover page
- the official English version of EN 12464-1:2002.

Continuation
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English version

Light and lighting - Lighting of work places - Part 1: Indoor work places

Lumière et éclairage - Eclairage des lieux de travail - Partie
1: Lieux de travail intérieur

Licht und Beleuchtung - Beleuchtung von Arbeitsstätten -
Teil 1: Arbeitsstätten in Innenräumen

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Foreword

This document EN 12464-1:2002 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of an identical text or by endorsement, at the latest by May 2003, and conflicting national standards shall be withdrawn at the latest by May 2003.

Annex A is informative.

This document includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard : Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

To enable people to perform visual tasks efficiently and accurately, adequate and appropriate lighting should be provided. The illumination can be provided by daylight, artificial lighting or a combination of both.

The degree of visibility and comfort required in a wide range of work places is governed by the type and duration of activity.

This standard specifies requirements for lighting systems 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.

It is important that all clauses of the standard are followed although the specific requirements are tabulated in the schedule of lighting requirements (see clause 5).

1 Scope

This European Standard specifies lighting requirements for indoor work places, which meet the needs for visual comfort and performance. All usual visual tasks are considered, including Display Screen Equipment (DSE).

This European Standard does not specify lighting requirements with respect to the safety and health of workers at work and has not been prepared in the field of application of Article 137 of the EC treaty, although the lighting requirements, as specified in this standard, usually fulfil safety needs. Lighting requirements with respect to the safety and health of workers at work may be contained in Directives based on Article 137 of the EC treaty, in national legislation of member states implementing these directives or in other national legislation of member states.

This standard neither provides specific solutions, nor restricts the designers freedom from exploring new techniques nor restricts the use of innovative equipment.

This standard is not applicable for the lighting of outdoor work places and underground mining.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 12193		<i>Light and lighting - Sports lighting.</i>
EN 12665:2002		<i>Light and lighting - Basic terms and criteria for specifying lighting requirements.</i>
prEN 13032-1		<i>Lighting applications - Measurement and presentation of photometric data of lamps and luminaires - Part 1: Measurement.</i>
CIE 117	1995	<i>Discomfort glare in interior lighting.</i>

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 12665:2002 and the following apply.

NOTE This clause defines terms and quantities that are in use and important to this standard, and which may not be given in IEC 60050-845.

3.1

visual task

visual elements of the work being done

NOTE The main visual elements are the size of the structure, its luminance, its contrast against the background and its duration.

3.2

task area

partial area in the work place in which the visual task is carried out. For places where the size and/or location of the task area is unknown, the area where the task may occur shall be taken as the task area

3.3

immediate surrounding area

band with a width of at least 0,5 m surrounding the task area within the field of vision

3.4

maintained illuminance (\bar{E}_m)

value below which the average illuminance on the specified surface is not allowed to fall

NOTE It is the average illuminance at the time maintenance should be carried out.

3.5

shielding angle

angle between the horizontal plane and the first line of sight at which the luminous parts of the lamps in the luminaire are directly visible

3.6

display screen equipment (DSE)

alphanumeric or graphic display screen, regardless of the display process employed [90/270/EEC]

3.7

illuminance uniformity

ratio of minimum illuminance to average illuminance on a surface (see also IEC 60050-845 / CIE 17.4: 845-09-58 Uniformity ratio of illuminance)

4 Lighting Design Criteria

4.1 Luminous environment

For good lighting practice it is essential that in addition to the required illuminance, 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 also contributing to a high productivity level,
- visual performance, where the workers are able to perform their visual tasks, even under difficult circumstances and during longer periods,
- safety.

Main parameters determining the luminous environment are:

- luminance distribution,
- illuminance,

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- glare,
- directionality of light,
- colour rendering and colour appearance of the light,
- flicker,
- daylight.

Values for illuminance, discomfort glare and colour rendering are given in clause 5.

4.2 Luminance distribution

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

- too high luminances which may give rise to glare,
- too high luminance contrasts 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.

The luminances of all surfaces are important and will be determined by the reflectance and the illuminance on the surfaces.

Ranges of useful reflectances for the major interior surfaces are:

- ceiling: 0,6 to 0,9
- walls: 0,3 to 0,8
- working planes: 0,2 to 0,6
- floor: 0,1 to 0,5

4.3 Illuminance

The illuminance and its distribution on the task area and the 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 specified in this standard are maintained illuminances and will provide for visual comfort and performance needs.

4.3.1 Recommended illuminances at the task area

The values given in clause 5 are maintained illuminances over the task area on the reference surface which may be horizontal, vertical or inclined. The average illuminance for each task shall not fall below the value given in

clause 5, regardless of the age and condition of the installation. The values are valid for normal visual conditions and take into account the following factors:

- psycho-physiological aspects such as visual comfort and well-being,
- requirements for visual tasks,
- visual ergonomics,
- practical experience,
- safety,
- economy.

The value of illuminance may be adjusted by at least one step in the scale of illuminances (see below), if the visual conditions differ from the normal assumptions.

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

20 - 30 - 50 - 75 - 100 - 150 - 200 - 300 - 500 - 750 - 1000 - 1500 - 2000 - 3000 - 5000

The required maintained illuminance should be increased, when:

- visual work is critical,
- errors are costly to rectify,
- accuracy or higher productivity is of great importance,
- the visual capacity of the worker is below normal,
- task details are of unusually small size or low contrast,
- the task is undertaken for an unusually long time.

The required maintained illuminance may be decreased when:

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

In continuously occupied areas, the maintained illuminance shall be not less than 200 lx.

4.3.2 Illuminances of immediate surroundings

The illuminance of immediate surrounding areas shall be related to the illuminance of the task area and should provide a well-balanced luminance distribution in the field of view.

Large spatial variations in illuminances around the task area may lead to visual stress and discomfort.

The illuminance of the immediate surrounding areas may be lower than the task illuminance but shall be not less than the values given in Table 1.

Table 1 — Uniformities and relationship of illuminances of immediate surrounding areas to task area

Task illuminance lx	Illuminance of immediate surrounding areas lx
≥ 750	500
500	300
300	200
≤ 200	E_{task}
Uniformity: ≥ 0,7	Uniformity: ≥ 0,5

In addition to the task illuminance the lighting shall provide adequate adaptation luminance in accordance with clause 4.2.

4.3.3 Uniformity

The task area shall be illuminated as uniformly as possible. The uniformity of the task area and the immediate surrounding areas shall be not less than the values given in Table 1.

4.4 Glare

Glare is the sensation produced by bright areas within the field of view and may be experienced either as discomfort glare or disability glare. Glare caused by reflections in specular surfaces is usually known as veiling reflections or reflected glare.

It is important to limit the glare to avoid errors, fatigue and accidents.

In interior work places, discomfort glare may arise directly from bright luminaires or windows. If discomfort glare limits are met, disability glare is not usually a major problem.

NOTE Special care is needed to avoid glare when the direction of view is above horizontal.

4.4.1 Discomfort glare

The rating of discomfort glare directly from the luminaires of an indoor lighting installation shall be determined using the CIE Unified Glare Rating (UGR-) tabular method, based on the formula:

$$UGR = 8 \log_{10} \left(\frac{0,25}{L_b} \sum \frac{L^2 \omega}{p^2} \right)$$

where:

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

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

ω is the solid angle (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.

All assumptions made in the determination of UGR shall be stated in the scheme documentation. The UGR value of the lighting installation shall not exceed the value given in clause 5.

NOTE 1 The variations of UGR within the room may be determined using the formula (or the comprehensive table) for different observer positions. Limits for this condition are under consideration.

NOTE 2 If the maximum UGR value in the room is higher than the UGR limit given in clause 5, information on appropriate positions for work stations within the room may be needed.

NOTE 3 Discomfort glare from windows is still a topic of research. There is currently no suitable glare rating method available.

4.4.2 Shielding against glare

Bright light sources can cause glare and can impair the vision of objects. It shall be avoided for example by suitable shielding of lamps or shading of windows by blinds.

The minimum shielding angles given in Table 2 shall be applied for the specified lamp luminances.

NOTE The values given in Table 2 do not apply to uplighters or to luminaires mounted below normal eye level.

Table 2 — Minimum shielding angles at specified lamp luminances

Lamp luminance $\text{kcd} \times \text{m}^{-2}$	Minimum shielding angle
20 to < 50	15°
50 to < 500	20°
≥ 500	30°

4.4.3 Veiling reflections and reflected glare

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

- arrangement of luminaires and work places,
- surface finish (matt surfaces),
- luminance restriction of luminaires,
- increased luminous area of the luminaire,
- bright ceiling and bright walls.

4.5 Directional lighting

Directional lighting may be used to highlight objects, reveal texture and improve the appearance of people within the space. This is described by the term "modelling". Directional lighting of a visual task may also affect its visibility.

4.5.1 Modelling

Modelling is the balance between diffuse and directional light. It is a valid criterion of lighting quality in virtually all types of interiors. 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. This occurs when the light comes predominantly from one direction; the shadows so essential to good modelling are then formed without confusion.

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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.

4.5.2 Directional lighting of visual tasks

Lighting from a specific direction may reveal details within a visual task, increasing their visibility and making the task easier to perform. Veiling reflections and reflected glare should be avoided, see 4.4.3.

4.6 Colour aspects

The colour qualities of a near-white lamp are characterised by two attributes:

- the colour appearance of the lamp itself,
- its colour rendering capabilities, which affect the colour appearance of objects and persons illuminated by the lamp.

These two attributes shall be considered separately.

4.6.1 Colour appearance

The "colour appearance" of a lamp refers to the apparent colour (chromaticity) of the light emitted. It is quantified by its correlated colour temperature (T_{CP}).

Colour appearance may also be described as in Table 3.

Table 3 — Lamp colour appearance groups

Colour appearance	Correlated colour temperature T_{CP} K
Warm	below 3300 K
Intermediate	3300 to 5300 K
Cool	above 5300 K

The choice of colour appearance is a matter of psychology, aesthetics and of what is considered to be natural. The choice will depend on illuminance level, colours of the room and furniture, surrounding climate and the application. In warm climates generally a cooler light colour appearance is preferred, whereas in cold climates a warmer light colour appearance is preferred.

4.6.2 Colour rendering

It is important for visual performance and the feeling of comfort and well being, that colours in the environment, of objects and of human skin are rendered naturally, correctly and in a way that makes people look attractive and healthy.

Safety colours shall always be recognisable as such (see also ISO 3864).

To provide an objective indication of the colour rendering properties of a light source the general colour rendering index R_a has been introduced. The maximum value of R_a is 100. This figure decreases with decreasing colour rendering quality.

Lamps with a colour rendering index lower than 80 should not be used in interiors where people work or stay for longer periods. Exceptions may apply for some places and/or activities (e.g. high-bay lighting), but suitable

measures shall be taken to ensure lighting with higher colour rendering at fixed continually occupied work places and where safety colours have to be recognised.

The minimum value of colour rendering index for distinct types of interiors (areas), tasks or activities are given in clause 5.

4.7 Flicker and stroboscopic effects

Flicker causes distraction and may give rise to physiological effects such as headaches.

Stroboscopic effects can lead to dangerous situations by changing the perceived motion of rotating or reciprocating machinery.

Lighting systems should be designed to avoid flicker and stroboscopic effects.

NOTE This can usually be achieved for example by use of DC electrical supply for incandescent lamps, or by operating incandescent or discharge lamps at high frequencies (around 30 kHz).

4.8 Maintenance factor

The lighting scheme should be designed with an overall maintenance factor calculated for the selected lighting equipment, space environment and specified maintenance schedule.

The recommended illuminance for each task is given as maintained illuminance. The maintenance factor depends on the maintenance characteristics of the lamp and control gear, the luminaire, the environment and the maintenance programme.

The designer shall:

- state the maintenance factor and list all assumptions made in the derivation of the value,
- specify lighting equipment suitable for the application environment,
- prepare a comprehensive maintenance schedule to include frequency of lamp replacement, luminaire and room cleaning intervals and cleaning method.

4.9 Energy considerations

A lighting installation should meet the lighting requirements of a particular space without waste of energy. However, it is important not to compromise the visual aspects of a lighting installation simply to reduce energy consumption.

This requires the consideration of appropriate lighting systems, equipment, controls and the use of available daylight.

4.10 Daylight

Daylight may provide all or part of the lighting for visual tasks. It varies in level and spectral composition with time and therefore provides variability within an interior. Daylight may create a specific modelling and luminance distribution due to its nearly horizontal flow of light from side windows.

Windows may provide visual contact with the outside world, which is preferred by most people.

In interiors with side windows the available daylight decreases rapidly with the distance from the window. Supplementary lighting is needed to ensure the required illuminance at the work place and to balance the luminance distribution within the room. Automatic or manual switching and/or dimming may be used to ensure appropriate integration between electric lighting and daylight.

To reduce glare from windows, screening should be provided where appropriate.

4.11 Lighting of workstations with Display Screen Equipment (DSE) including VDUs

4.11.1 General

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

For these areas the lighting criteria and system shall be chosen in accordance with activity area, task type and type of interior from the schedule in clause 5; some countries have additional requirements.

The DSE and, in some circumstances, the keyboard may suffer from reflections causing disability and discomfort glare. It is therefore necessary to select, locate and arrange the luminaires to avoid high brightness reflections.

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

4.11.2 Luminaire luminance limits with downward flux

This paragraph describes luminance limits for luminaires which may be reflected in DSE screens for normal viewing directions.

Table 4 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 places where display screens, which are vertical or inclined up to 15° tilt angle, are used.

NOTE For certain special places using for example sensitive screens or variable inclination the above luminance limits should be applied for lower elevation angles (e.g. 55°) of the luminaire.

Table 4 — Luminance limits of luminaires which can be reflected in the screen

Screen classes in accordance with ISO 9241-7	I	II	III
Screen quality	good	medium	poor
Average luminances of luminaires which are reflected in the screen	$\leq 1000 \text{ cd} \times \text{m}^{-2}$		$\leq 200 \text{ cd} \times \text{m}^{-2}$

5 Schedule of lighting requirements

The lighting requirements for various rooms and activities are given in the Tables of 5.3.

5.1 Composition of the tables

Column 1 lists the **reference number** for each interior (area), task or activity.

Column 2 lists those **interiors (areas), tasks or activities**, for which specific requirements are given. If the particular interior (area), task or activity is not listed, the values given for a similar, comparable situation should be adopted.

Column 3 gives the **maintained illuminance \bar{E}_m** on the reference surface (see 4.3) for the interior (area), task or activity given in column 2.

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

Where **UGR limits (Unified Glare Rating limit, UGR_l)** are applicable to the situation listed in column 2, they are listed in **column 4** (see 4.4).

Column 5 gives the minimum **colour rendering indices (R_a)** (see 4.6.2) for the situation listed in column 2.

In **column 6, advice and footnotes** are given for exceptions and special applications for the situations listed in column 2.

5.2 The schedule of interiors (areas), tasks and activities

Table 5.1: Traffic zones and general areas inside buildings

- 1.1 Traffic zones
- 1.2 Rest, sanitation and first aid rooms
- 1.3 Control rooms
- 1.4 Store rooms/cold stores
- 1.5 Storage rack areas

Table 5.2: Industrial activities and crafts

- 2.1 Agriculture
- 2.2 Bakeries
- 2.3 Cement, cement goods, concrete, bricks
- 2.4 Ceramics, tiles, glass, glassware
- 2.5 Chemical, plastics and rubber industry
- 2.6 Electrical industry
- 2.7 Food stuffs and luxury food industry
- 2.8 Foundries and metal casting
- 2.9 Hairdressers
- 2.10 Jewellery manufacturing
- 2.11 Laundries and dry cleaning
- 2.12 Leather and leather goods
- 2.13 Metal working and processing
- 2.14 Paper and paper goods
- 2.15 Power stations
- 2.16 Printers
- 2.17 Rolling mills, iron and steel works
- 2.18 Textile manufacture and processing
- 2.19 Vehicle construction
- 2.20 Wood working and processing

Table 5.3: Offices

Table 5.4: Retail premises

Table 5.5: Places of public assembly

- 5.1 General areas
- 5.2 Restaurants and hotels
- 5.3 Theatres, concert halls, cinemas
- 5.4 Trade fairs, exhibition halls
- 5.5 Museums
- 5.6 Libraries
- 5.7 Public car parks (indoor)

Table 5.6: Educational premises

- 6.1 Nursery school, play school
- 6.2 Educational buildings

Table 5.7: Health care premises

- 7.1 Rooms for general use
- 7.2 Staff rooms
- 7.3 Wards, maternity wards

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- 7.4 Examination rooms (general)
- 7.5 Eye examination rooms
- 7.6 Ear examination rooms
- 7.7 Scanner rooms
- 7.8 Delivery rooms
- 7.9 Treatment rooms (general)
- 7.10 Operating areas
- 7.11 Intensive care units
- 7.12 Dentists
- 7.13 Laboratories and pharmacies
- 7.14 Decontamination rooms
- 7.15 Autopsy rooms and mortuaries

Table 5.8: Transportational areas

- 8.1 Airports
- 8.2 Railway installations

5.3 Lighting requirements for interiors (areas), tasks and activities

Table 5.1 — Traffic zones and general areas inside buildings

1.1 Traffic zones					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
1.1.1	Circulation areas and corridors	100	28	40	1. Illuminance at floor level. 2. R _a and UGR similar to adjacent areas. 3. 150 lx if there are vehicles on the route. 4. 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. 5. Care should be taken to avoid glare to drivers and pedestrians.
1.1.2	Stairs, escalators, travolators	150	25	40	
1.1.3	Loading ramps/bays	150	25	40	
1.2 Rest, sanitation and first aid rooms					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
1.2.1	Canteens, pantries	200	22	80	
1.2.2	Rest rooms	100	22	80	
1.2.3	Rooms for physical exercise	300	22	80	
1.2.4	Cloakrooms, washrooms, bathrooms, toilets	200	25	80	
1.2.5	Sick bay	500	19	80	
1.2.6	Rooms for medical attention	500	16	90	T _{CP} ≥ 4000 K
1.3 Control rooms					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
1.3.1	Plant rooms, switch gear rooms	200	25	60	
1.3.2	Telex, post room, switchboard	500	19	80	
1.4 Store rooms, cold stores					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
1.4.1	Store and stockrooms	100	25	60	200 lx if continuously occupied.
1.4.2	Dispatch packing handling areas	300	25	60	

Table 5.1 — Traffic zones and general areas inside buildings (continued)

1.5 Storage rack areas					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
1.5.1	Gangways: unmanned	20	-	40	Illuminance at floor level.
1.5.2	Gangways: manned	150	22	60	Illuminance at floor level.
1.5.3	Control stations	150	22	60	

Table 5.2 — Industrial activities and crafts

2.1 Agriculture					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
2.1.1	Loading and operating of goods, handling equipment and machinery	200	25	80	
2.1.2	Buildings for livestock	50	-	40	
2.1.3	Sick animal pens; calving stalls	200	25	80	
2.1.4	Feed preparation; dairy; utensil washing	200	25	80	
2.2 Bakeries					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
2.2.1	Preparation and baking	300	22	80	
2.2.2	Finishing, glazing, decorating	500	22	80	
2.3 Cement, cement goods, concrete, bricks					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
2.3.1	Drying	50	28	20	Safety colours shall be recognisable.
2.3.2	Preparation of materials; work on kilns and mixers	200	28	40	
2.3.3	General machine work	300	25	80	For high-bay: see 4.6.2.
2.3.4	Rough forms	300	25	80	For high-bay: see 4.6.2.

Table 5.2 — Industrial activities and crafts (continued)

2.4 Ceramics, tiles, glass, glassware					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR_L	R_a	Remarks
			-	-	
2.4.1	Drying	50	28	20	Safety colours shall be recognisable.
2.4.2	Preparation, general machine work	300	25	80	For high-bay: see 4.6.2.
2.4.3	Enamelling, rolling, pressing, shaping simple parts, glazing, glass blowing	300	25	80	For high-bay: see 4.6.2.
2.4.4	Grinding, engraving, glass polishing, shaping precision parts, manufacture of glass instruments	750	19	80	For high-bay: see 4.6.2.
2.4.5	Grinding of optical glass, crystal, hand grinding and engraving	750	16	80	
2.4.6	Precision work e.g. decorative grinding, hand painting	1000	16	90	$T_{CP} \geq 4000$ K.
2.4.7	Manufacture of synthetic precious stones	1500	16	90	$T_{CP} \geq 4000$ K.
2.5 Chemical, plastics and rubber industry					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR_L	R_a	Remarks
			-	-	
2.5.1	Remote-operated processing installations	50	-	20	Safety colours shall be recognisable
2.5.2	Processing installations with limited manual intervention	150	28	40	
2.5.3	Constantly manned work places in processing installations	300	25	80	
2.5.4	Precision measuring rooms, laboratories	500	19	80	
2.5.5	Pharmaceutical production	500	22	80	
2.5.6	Tyre production	500	22	80	
2.5.7	Colour inspection	1000	16	90	$T_{CP} \geq 4000$ K.
2.5.8	Cutting, finishing, inspection	750	19	80	

Table 5.2 — Industrial activities and crafts (continued)

2.6 Electrical industry					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
2.6.1	Cable and wire manufacture	300	25	80	For high-bay: see 4.6.2.
2.6.2	Winding:				
	- large coils	300	25	80	For high-bay: see 4.6.2.
	- medium-sized coils	500	22	80	For high-bay: see 4.6.2.
	- small coils	750	19	80	For high-bay: see 4.6.2.
2.6.3	Coil impregnating	300	25	80	For high-bay: see 4.6.2.
2.6.4	Galvanising	300	25	80	For high-bay: see 4.6.2.
2.6.5	Assembly work:				
	- rough e.g. large transformers	300	25	80	For high-bay: see 4.6.2.
	- medium e.g. switchboards	500	22	80	For high-bay: see 4.6.2.
	- fine e.g. telephones	750	19	80	
	- precision e.g. measuring equipment	1000	16	80	
2.6.6	Electronic workshops, testing, adjusting	1500	16	80	
2.7 Food stuffs and luxury food industry					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
2.7.1	Work places and zones in - breweries, malting floor, - for washing, barrel filling, cleaning, sieving, peeling, - cooking in preserve and chocolate factories, - work places and zones in sugar factories, - for drying and fermenting raw tobacco, fermentation cellar	200	25	80	
2.7.2	Sorting and washing of products, milling, mixing, packing	300	25	80	
2.7.3	Work places and critical zones in slaughter houses, butchers, dairies mills, on filtering floor in sugar refineries	500	25	80	
2.7.4	Cutting and sorting of fruit and vegetables	300	25	80	
2.7.5	Manufacture of delicatessen foods, kitchen work, manufacture of cigars and cigarettes	500	22	80	
2.7.6	Inspection of glasses and bottles, product control, trimming, sorting, decoration	500	22	80	
2.7.7	Laboratories	500	19	80	
2.7.8	Colour inspection	1000	16	90	T _{CP} ≥ 4000 K.

Table 5.2 — Industrial activities and crafts (continued)

2.8 Foundries and metal casting					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR_L	R_a	Remarks
2.8.1	Man-size underfloor tunnels, cellars, etc.	50	-	20	Safety colours shall be recognisable.
2.8.2	Platforms	100	25	40	
2.8.3	Sand preparation	200	25	80	For high-bay: see 4.6.2.
2.8.4	Dressing room	200	25	80	For high-bay: see 4.6.2.
2.8.5	Work places at cupola and mixer	200	25	80	For high-bay: see 4.6.2.
2.8.6	Casting bay	200	25	80	For high-bay: see 4.6.2.
2.8.7	Shake out areas	200	25	80	For high-bay: see 4.6.2.
2.8.8	Machine moulding	200	25	80	For high-bay: see 4.6.2.
2.8.9	Hand and core moulding	300	25	80	For high-bay: see 4.6.2.
2.8.10	Die casting	300	25	80	For high-bay: see 4.6.2.
2.8.11	Model building	500	22	80	For high-bay: see 4.6.2.
2.9 Hairdressers					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR_L	R_a	Remarks
2.9.1	Hairdressing	500	19	90	
2.10 Jewellery manufacturing					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR_L	R_a	Remarks
2.10.1	Working with precious stones	1500	16	90	$T_{CP} \geq 4000$ K.
2.10.2	Manufacture of jewellery	1000	16	90	
2.10.3	Watch making (manual)	1500	16	80	
2.10.4	Watch making (automatic)	500	19	80	
2.11 Laundries and dry cleaning					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR_L	R_a	Remarks
2.11.1	Goods in, marking and sorting	300	25	80	
2.11.2	Washing and dry cleaning	300	25	80	
2.11.3	Ironing, pressing	300	25	80	
2.11.4	Inspection and repairs	750	19	80	

Table 5.2 — Industrial activities and crafts (continued)

2.12 Leather and leather goods					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
2.12.1	Work on vats, barrels, pits	200	25	40	
2.12.2	Fleshing, skiving, rubbing, tumbling of skins	300	25	80	
2.12.3	Saddlery work, shoe manufacture: stitching, sewing, polishing, shaping, cutting, punching	500	22	80	
2.12.4	Sorting	500	22	90	T _{CP} ≥ 4000 K.
2.12.5	Leather dyeing (machine)	500	22	80	
2.12.6	Quality control	1000	19	80	
2.12.7	Colour inspection	1000	16	90	T _{CP} ≥ 4000 K.
2.12.8	Shoe making	500	22	80	
2.12.9	Glove making	500	22	80	
2.13 Metal working and processing					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
2.13.1	Open die forging	200	25	60	
2.13.2	Drop forging	300	25	60	
2.13.3	Welding	300	25	60	
2.13.4	Rough and average machining: tolerances ≥ 0,1 mm	300	22	60	
2.13.5	Precision machining; grinding: tolerances < 0,1 mm	500	19	60	
2.13.6	Scribing; inspection	750	19	60	
2.13.7	Wire and pipe drawing shops; cold forming	300	25	60	
2.13.8	Plate machining: thickness ≥ 5 mm	200	25	60	
2.13.9	Sheet metalwork: thickness < 5 mm	300	22	60	
2.13.10	Tool making; cutting equipment manufacture	750	19	60	
2.13.11	Assembly:				
	- rough	200	25	80	For high-bay: see 4.6.2.
	- medium	300	25	80	For high-bay: see 4.6.2.
	- fine	500	22	80	For high-bay: see 4.6.2.
	- precision	750	19	80	For high-bay: see 4.6.2.
2.13.12	Galvanising	300	25	80	For high-bay: see 4.6.2.
2.13.13	Surface preparation and painting	750	25	80	
2.13.14	Tool, template and jig making, precision mechanics, micro-mechanics	1000	19	80	

Table 5.2 — Industrial activities and crafts (continued)

2.14 Paper and paper goods					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR_L	R_a	Remarks
			-	-	
2.14.1	Edge runners, pulp mills	200	25	80	For high-bay: see 4.6.2.
2.14.2	Paper manufacture and processing, paper and corrugating machines, cardboard manufacture	300	25	80	For high-bay: see 4.6.2.
2.14.3	Standard bookbinding work, e.g. folding, sorting, gluing, cutting, embossing, sewing	500	22	80	
2.15 Power stations					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR_L	R_a	Remarks
			-	-	
2.15.1	Fuel supply plant	50	-	20	Safety colours shall be recognisable.
2.15.2	Boiler house	100	28	40	
2.15.3	Machine halls	200	25	80	For high-bay: see 4.6.2.
2.15.4	Side rooms, e.g. pump rooms, condenser rooms etc.; switchboards (inside buildings)	200	25	60	
2.15.5	Control rooms	500	16	80	1. Control panels are often vertical. 2. Dimming may be required. 3. For DSE-work see 4.11.
2.15.6	Outdoor switch gear	20	-	20	Safety colours shall be recognisable.
2.16 Printers					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR_L	R_a	Remarks
			-	-	
2.16.1	Cutting, gilding, embossing, block engraving, work on stones and platens, printing machines, matrix making	500	19	80	
2.16.2	Paper sorting and hand printing	500	19	80	
2.16.3	Type setting, retouching, lithography	1000	19	80	
2.16.4	Colour inspection in multicoloured printing	1500	16	90	T _{CP} ≥ 5000 K.
2.16.5	Steel and copper engraving	2000	16	80	For directionality see 4.5.2.

Table 5.2 — Industrial activities and crafts (continued)

2.17 Rolling mills, iron and steel works					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
2.17.1	Production plants without manual operation	50	-	20	Safety colours shall be recognisable.
2.17.2	Production plants with occasional manual operation	150	28	40	
2.17.3	Production plants with continuous manual operation	200	25	80	For high-bay: see 4.6.2.
2.17.4	Slab Store	50	-	20	Safety colours shall be recognisable.
2.17.5	Furnaces	200	25	20	Safety colours shall be recognisable.
2.17.6	Mill train; coiler; shear line	300	25	40	
2.17.7	Control platforms; control panels	300	22	80	
2.17.8	Test, measurement and inspection	500	22	80	
2.17.9	Underfloor man-sized tunnels; belt sections; cellars etc.	50	-	20	Safety colours shall be recognisable.
2.18 Textile manufacture and processing					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
2.18.1	Work places and zones in baths, bale opening	200	25	60	
2.18.2	Carding, washing, ironing, devilling machine work, drawing, combing, sizing, card cutting, pre-spinning, jute and hemp spinning	300	22	80	
2.18.3	Spinning, plying, reeling, winding	500	22	80	Prevent stroboscopic effects.
2.18.4	Warping, weaving, braiding, knitting	500	22	80	Prevent stroboscopic effects.
2.18.5	Sewing, fine knitting, taking up stitches	750	22	80	
2.18.6	Manual design, drawing patterns	750	22	90	T _{CP} ≥ 4000 K.
2.18.7	Finishing, dyeing	500	22	80	
2.18.8	Drying room	100	28	60	
2.18.9	Automatic fabric printing	500	25	80	
2.18.10	Burling, picking, trimming	1000	19	80	
2.18.11	Colour inspection; fabric control	1000	16	90	T _{CP} ≥ 4000 K.
2.18.12	Invisible mending	1500	19	90	T _{CP} ≥ 4000 K.
2.18.13	Hat manufacturing	500	22	80	

Table 5.2 — Industrial activities and crafts (continued)

2.19 Vehicle construction					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
2.19.1	Body work and assembly	500	22	80	
2.19.2	Painting, spraying chamber, polishing chamber	750	22	80	
2.19.3	Painting: touch-up, inspection	1000	19	90	T _{CP} ≥ 4000 K.
2.19.4	Upholstery manufacture (manned)	1000	19	80	
2.19.5	Final inspection	1000	19	80	
2.20 Wood working and processing					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
2.20.1	Automatic processing e.g. drying, plywood manufacturing	50	28	40	
2.20.2	Steam pits	150	28	40	
2.20.3	Saw frame	300	25	60	Prevent stroboscopic effects.
2.20.4	Work at joiner's bench, gluing, assembly	300	25	80	
2.20.5	Polishing, painting, fancy joinery	750	22	80	
2.20.6	Work on wood working machines e.g. turning, fluting, dressing, rebating, grooving, cutting, sawing, sinking	500	19	80	Prevent stroboscopic effects.
2.20.7	Selection of veneer woods	750	22	90	T _{CP} ≥ 4000 K.
2.20.8	Marquetry, inlay work	750	22	90	T _{CP} ≥ 4000 K.
2.20.9	Quality control, inspection	1000	19	90	T _{CP} ≥ 4000 K.

Table 5.3 — Offices

3 Offices					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
3.1	Filing, copying, etc.	300	19	80	
3.2	Writing, typing, reading, data processing	500	19	80	DSE-work: see 4.11.
3.3	Technical drawing	750	16	80	
3.4	CAD work stations	500	19	80	DSE-work: see 4.11.
3.5	Conference and meeting rooms	500	19	80	Lighting should be controllable.
3.6	Reception desk	300	22	80	
3.7	Archives	200	25	80	

Table 5.4 — Retail premises

4 Retail premises					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
4.1	Sales area	300	22	80	Both illuminance and UGR requirements are determined by the type of shop.
4.2	Till area	500	19	80	
4.3	Wrapper table	500	19	80	

Table 5.5 — Places of public assembly

5.1 General areas					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
5.1.1	Entrance halls	100	22	80	UGR only if applicable.
5.1.2	Cloakrooms	200	25	80	
5.1.3	Lounges	200	22	80	
5.1.4	Ticket offices	300	22	80	
5.2 Restaurants and hotels					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
5.2.1	Reception/cashier desk, porters desk	300	22	80	
5.2.2	Kitchen	500	22	80	There should be a transition zone between kitchen and restaurant.
5.2.3	Restaurant, dining room, function room	-	-	80	The lighting should be designed to create the appropriate atmosphere.
5.2.4	Self-service restaurant	200	22	80	
5.2.5	Buffet	300	22	80	
5.2.6	Conference rooms	500	19	80	Lighting should be controllable.
5.2.7	Corridors	100	25	80	During night-time lower levels are acceptable.
5.3 Theatres, concert halls, cinemas					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
5.3.1	Practice rooms, dressing rooms	300	22	80	Lighting of mirrors for make-up shall be glare-free.

Table 5.5 — Places of public assembly (continued)

5.4 Trade fairs, exhibition halls					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
5.4.1	General lighting	300	22	80	
5.5 Museums					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
5.5.1	Exhibits, insensitive to light				Lighting is determined by the display requirements.
5.5.2	Light sensitive exhibits				1. Lighting is determined by the display requirements. 2. Protection against damaging radiation is paramount.
5.6 Libraries					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
5.6.1	Bookshelves	200	19	80	
5.6.2	Reading area	500	19	80	
5.6.3	Counters	500	19	80	
5.7 Public car parks (indoor)					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
5.7.1	In/out ramps (during the day)	300	25	20	1. Illuminances at floor level. 2. Safety colours shall be recognisable.
5.7.2	In/out ramps (at night)	75	25	20	1. Illuminances at floor level. 2. Safety colours shall be recognisable.
5.7.3	Traffic lanes	75	25	20	1. Illuminances at floor level. 2. Safety colours shall be recognisable.
5.7.4	Parking areas	75	-	20	1. Illuminances at floor level. 2. Safety colours shall be recognisable. 3. A high vertical illuminance increases recognition of peoples faces and therefore the feeling of safety.
5.7.5	Ticket office	300	19	80	1. Avoid reflections in the windows. 2. Prevent glare from outside.

Table 5.6 — Educational premises

6.1 Nursery school, play school					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
6.1.1	Play room	300	19	80	
6.1.2	Nursery	300	19	80	
6.1.3	Handicraft room	300	19	80	
6.2 Educational buildings					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
6.2.1	Classrooms, tutorial rooms	300	19	80	Lighting should be controllable.
6.2.2	Classroom for evening classes and adults education	500	19	80	Lighting should be controllable.
6.2.3	Lecture hall	500	19	80	Lighting should be controllable.
6.2.4	Black board	500	19	80	Prevent specular reflections.
6.2.5	Demonstration table	500	19	80	In lecture halls 750 lx.
6.2.6	Art rooms	500	19	80	
6.2.7	Art rooms in art schools	750	19	90	T _{CP} ≥ 5000 K.
6.2.8	Technical drawing rooms	750	16	80	
6.2.9	Practical rooms and laboratories	500	19	80	
6.2.10	Handicraft rooms	500	19	80	
6.2.11	Teaching workshop	500	19	80	
6.2.12	Music practice rooms	300	19	80	
6.2.13	Computer practice rooms (menu driven)	300	19	80	DSE-work: see 4.11.
6.2.14	Language laboratory	300	19	80	
6.2.15	Preparation rooms and workshops	500	22	80	
6.2.16	Entrance halls	200	22	80	
6.2.17	Circulation areas, corridors	100	25	80	
6.2.18	Stairs	150	25	80	
6.2.19	Student common rooms and assembly halls	200	22	80	
6.2.20	Teachers rooms	300	19	80	
6.2.21	Library: bookshelves	200	19	80	
6.2.22	Library: reading areas	500	19	80	
6.2.23	Stock rooms for teaching materials	100	25	80	
6.2.24	Sports halls, gymnasiums, swimming pools (general use)	300	22	80	For more specific activities, the requirements of EN 12193 shall be used
6.2.25	School canteens	200	22	80	
6.2.26	Kitchen	500	22	80	

Table 5.7 — Health care premises

7.1 Rooms for general use					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	All illuminances at floor level.
7.1.1	Waiting rooms	200	22	80	
7.1.2	Corridors: during the day	200	22	80	
7.1.3	Corridors: during the night	50	22	80	
7.1.4	Day rooms	200	22	80	
7.2 Staff rooms					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
7.2.1	Staff office	500	19	80	
7.2.2	Staff rooms	300	19	80	
7.3 Wards, maternity wards					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	Prevent too high luminances in the patients' field of view.
7.3.1	General lighting	100	19	80	Illuminance at floor level.
7.3.2	Reading lighting	300	19	80	
7.3.3	Simple examinations	300	19	80	
7.3.4	Examination and treatment	1000	19	90	
7.3.5	Night lighting, observation lighting	5	-	80	
7.3.6	Bathrooms and toilets for patients	200	22	80	
7.4 Examination rooms (general)					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
7.4.1	General lighting	500	19	90	
7.4.2	Examination and treatment	1000	19	90	

Table 5.7 — Health care premises (continued)

7.5 Eye examination rooms					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
7.5.1	General lighting	300	19	80	
7.5.2	Examination of the outer eye	1000	-	90	
7.5.3	Reading and colour vision tests with vision charts	500	16	90	
7.6 Ear examination rooms					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
7.6.1	General lighting	300	19	80	
7.6.2	Ear examination	1000	-	90	
7.7 Scanner rooms					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
7.7.1	General lighting	300	19	80	
7.7.2	Scanners with image enhancers and television systems	50	19	80	DSE-work: see 4.11.
7.8 Delivery rooms					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
7.8.1	General lighting	300	19	80	
7.8.2	Examination and treatment	1000	19	80	
7.9 Treatment rooms (general)					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
7.9.1	Dialysis	500	19	80	Lighting should be controllable.
7.9.2	Dermatology	500	19	90	
7.9.3	Endoscopy rooms	300	19	80	
7.9.4	Plaster rooms	500	19	80	
7.9.5	Medical baths	300	19	80	
7.9.6	Massage and radiotherapy	300	19	80	

Table 5.7 — Health care premises (continued)

7.10 Operating areas					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
7.10.1	Pre-op and recovery rooms	500	19	90	
7.10.2	Operating theatre	1000	19	90	
7.10.3	Operating cavity				\bar{E}_m : 10 000 to 100 000 lx.
7.11 Intensive care unit					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
7.11.1	General lighting	100	19	90	At floor level.
7.11.2	Simple examinations	300	19	90	At bed level.
7.11.3	Examination and treatment	1000	19	90	At bed level.
7.11.4	Night watch	20	19	90	
7.12 Dentists					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
7.12.1	General lighting	500	19	90	Lighting should be glare-free for the patient.
7.12.2	At the patient	1000	-	90	
7.12.3	Operating cavity	5000	-	90	Values higher than 5000 lx may be required.
7.12.4	White teeth matching	5000	-	90	T _{CP} ≥ 6000 K.
7.13 Laboratories and pharmacies					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
7.13.1	General lighting	500	19	80	
7.13.2	Colour inspection	1000	19	90	T _{CP} ≥ 6000 K.
7.14 Decontamination rooms					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
7.14.1	Sterilisation rooms	300	22	80	
7.14.2	Disinfection rooms	300	22	80	

Table 5.7 — Health care premises (continued)

7.15 Autopsy rooms and mortuaries					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
7.15.1	General lighting	500	19	90	
7.15.2	Autopsy table and dissecting table	5000	-	90	Values higher than 5000 lx may be required.

Table 5.8 — Transportational areas

8.1 Airports					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
8.1.1	Arrival and departure halls, baggage claim areas	200	22	80	For high-bay: see 4.6.2.
8.1.2	Connecting areas, escalators, travolators	150	22	80	
8.1.3	Information desks, check-in desks	500	19	80	DSE-work: see 4.11.
8.1.4	Customs and passport control desks	500	19	80	Vertical illuminance is important.
8.1.5	Waiting areas	200	22	80	
8.1.6	Luggage store rooms	200	25	80	
8.1.7	Security check areas	300	19	80	DSE-work: see 4.11.
8.1.8	Air traffic control tower	500	16	80	1. Lighting should be dimmable. 2. DSE-work see clause 4.11. 3. Glare from daylight shall be avoided. 4. Avoid reflections in windows, especially at night.
8.1.9	Testing and repair hangars	500	22	80	For high-bay: see 4.6.2.
8.1.10	Engine test areas	500	22	80	For high-bay: see 4.6.2.
8.1.11	Measuring areas in hangars	500	22	80	For high-bay: see 4.6.2.

8.2 Railway installations					
Ref. no.	Type of interior, task or activity	\bar{E}_m lx	UGR _L	R _a	Remarks
			-	-	
8.2.1	Covered platforms and passenger subways (underpasses)	50	28	40	
8.2.2	Ticket hall and concourse	200	28	40	
8.2.3	Ticket and luggage offices and counters	300	19	80	
8.2.4	Waiting rooms	200	22	80	

6 Verification procedures

6.1 Illuminance

When verifying a lighting design, the measurement points shall coincide with any design points or grids used.

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

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

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

The average illuminance and uniformity shall be calculated and shall be not less than the values given in clause 5 and Table 1 respectively.

6.2 Unified Glare Rating

Authenticated UGR data produced by the tabular method as described in CIE-publication 117 shall be provided for the luminaire scheme by the manufacturer of the luminaire. Manufacturers publishing UGR-tables, calculated at spacing to height ratios other than the ratio described in CIE-publication 117, shall declare this ratio. The installation lay-out and the surface finishes shall be checked against the design assumptions.

The installation shall be in accordance with the design assumptions.

6.3 Colour Rendering Index

Authenticated R_a data shall be provided for the lamps in the scheme by the manufacturer of the lamps. The lamps shall be checked against the design specifications.

The lamps shall be as specified in the design.

6.4 Luminaire luminance (see also 4.11)

The average luminance of the luminous parts of the luminaire shall be measured and/or calculated in the C-plane at intervals of 15° starting at 0° and the elevation in γ -angles of 65° , 75° and 85° . Normally the manufacturer of the luminaire shall provide these data based on maximum (lamp/luminaire) output.

The values shall not exceed the limits specified in Table 4 (see also prEN 13032-1).

Annex A
(informative)

A-deviation

A-Deviations: 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 EC.

In Denmark this A-deviation is valid instead of the provisions of the European Standard until it has been removed.

Denmark

Danish Building Regulations BR 95 and BR S 98, published by the National Building and Housing Agency.

Related to Clause 4, 5 and 6

According to legal Danish Building Regulations BR 95 and BR S 98 the use of DS 700 is mandatory.

Bibliography

CIE 29.2	1986	Guide of interior lighting; second edition.
CIE 40	1978	Calculations for interior lighting; basic method.
CIE 60	1984	Vision and the visual display unit work station.
CIE 97	1992	Maintenance of indoor electric lighting systems.
IEC 60050-845		International electrotechnical vocabulary - Chapter 845 "Lighting".
ISO 3864		Safety colours and safety signs.
ISO 8995		Principles of visual ergonomics - The lighting of indoor work systems.
ISO 9241-6		Ergonomic requirements for office work with visual display terminals (VDTs) - Part 6: Guidance on the work environment.
ISO 9241-7		Ergonomic requirements for office work with visual display terminals (VDTs) - Part 7: Requirements for display with reflections.
90/270/EEC		Council directive of 29 May 1990 on the minimum safety and health requirements for work with display screen equipment.

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Rooms for physical exercise (Rest rooms, etc.)	1.2.3
Rough forms (Cement, etc.)	2.3.4
Rubber industry	2.5
Rubbing of skins (Leather and leather goods)	2.12.2
Saddlery work (Leather and leather goods)	2.12.3
Sales area (Retail premises)	4.1
Sand preparation (Foundries, etc.)	2.8.3
Sanitation rooms	1.2
Saw frame (Wood processing)	2.20.3
Sawing (Wood processing)	2.20.6
Scanner rooms (Health care)	7.7
Scanner rooms, general lighting (Health care)	7.7.1
Scanners with image enhancers (Health care)	7.7.2
Scanners with television systems (Health care)	7.7.2
School canteens (Education)	6.2.25
Scribing (Metal processing)	2.13.6
Security check areas (Airports)	8.1.7
Selection of veneer woods (Wood processing)	2.20.7
Self-service restaurant (Restaurants and hotels)	5.2.4
Sewing (Leather and leather goods)	2.12.3
Sewing (Paper and paper goods)	2.14.3
Sewing (Textile manufacture)	2.18.5
Shake out areas (Foundries, etc.)	2.8.7
Shaping (Leather and leather goods)	2.12.3
Shaping of precision parts (Ceramics, etc.)	2.4.4
Shaping of simple parts (Ceramics, etc.)	2.4.3
Shear line (Rolling mills, etc.)	2.17.6
Sheet metal work (Metal processing)	2.13.9
Shoe making (Leather and leather goods)	2.12.8
Shoe manufacture (Leather and leather goods)	2.12.3
Sick animal pens (Agriculture)	2.1.3
Sick bay (Rest rooms, etc.)	1.2.5
Side rooms (Power stations)	2.15.4
Sieving (Food industry)	2.7.1

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Simple examinations, intensive care (Health care)	7.11.2
Simple examinations, wards (Health care)	7.3.3
Sinking (Wood processing)	2.20.6
Sizing (Textile manufacture)	2.18.2
Skiving of skins (Leather and leather goods)	2.12.2
Slab store (Rolling mills, etc.)	2.17.4
Slaughter houses (Food industry)	2.7.3
Sorting (Food industry)	2.7.6
Sorting (Laundries and dry cleaning)	2.11.1
Sorting (Leather and leather goods)	2.12.4
Sorting (Paper and paper goods)	2.14.3
Sorting of fruit (Food industry)	2.7.4
Sorting of products (Food industry)	2.7.2
Sorting vegetables (Food industry)	2.7.4
Spinning (Textile manufacture)	2.18.3
Sports halls (Education)	6.2.24
Spraying chamber (Vehicle construction)	2.19.2
Staff office (Health care)	7.2.1
Staff rooms (Health care)	7.2
Staff rooms (Health care)	7.2.2
Stairs (Education)	6.2.18
Stairs (Traffic zones)	1.1.2
Steam pits (Wood processing)	2.20.2
Steel engraving (Printers)	2.16.5
Steel works	2.17
Sterilisation rooms (Health care)	7.14.1
Stitches, taking up (Textile manufacture)	2.18.5
Stitching (Leather and leather goods)	2.12.3
Stockrooms (Store rooms, etc.)	1.4.1
Stockrooms for teaching materials (Education)	6.2.23
Stones, work on (Printers)	2.16.1
Storage rack areas	1.5
Store rooms	1.4
Store rooms (Store rooms, etc.)	1.4.1
Student common rooms (Education)	6.2.19
Sugar factories (Food industry)	2.7.1
Sugar refineries (Food industry)	2.7.3
Surface preparation (Metal processing)	2.13.13
Swimming pools (Education)	6.2.24
Switch gear, outdoor (Power stations)	2.15.6
Switch gear rooms (Control rooms)	1.3.1
Switchboard (Control rooms)	1.3.2
Switchboards (Power stations)	2.15.4
Synthetic precious stones (Ceramics, etc.)	2.4.7
Teachers rooms (Education)	6.2.20
Teaching workshop (Education)	6.2.11
Technical drawing (Offices)	3.3
Technical drawing rooms (Education)	6.2.8
Telex room (Control rooms)	1.3.2
Template making (Metal processing)	2.13.14
Test (Rolling mills, etc.)	2.17.8
Testing (Electrical industry)	2.6.6
Testing hangars (Airports)	8.1.10
Textile manufacture	2.18
Textile processing	2.18
Theatres	5.3
Ticket counters (Railways)	8.2.3
Ticket hall (Railways)	8.2.2
Ticket office (Public car parks)	5.7.4
Ticket offices (Places of public assembly)	5.1.4
Ticket offices (Railways)	8.2.3
Tiles	2.4
Till area (Retail premises)	4.2
Toilets (Rest rooms, etc.)	1.2.4

Toilets for patients (Health care)	7.3.6
Tool making (Metal processing)	2.13.10
Tool making (Metal processing)	2.13.14
Trade fairs	5.4
Traffic lanes (Public car parks)	5.7.3
Traffic zones	1.1
Transportational areas	8
Travolators (Airports)	8.1.2
Travolators (Traffic zones)	1.1.2
Treatment rooms, general (Health care)	7.9
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Treatment, general (Health care)	7.4.2
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Trimming (Food industry)	2.7.6
Trimming (Textile manufacture)	2.18.10
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Type setting (Printers)	2.16.3
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Tyre production (Chemical industry)	2.5.6
Underfloor tunnels, man-size (Foundries, etc.)	2.8.1
Underfloor tunnels, man-size (Rolling mills, etc.)	2.17.9
Underpasses (Railways)	8.2.1
Upholstery manufacture (Vehicle construction)	2.19.4
Utensil washing (Agriculture)	2.1.4
Vats, work on (Leather and leather goods)	2.12.1
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Veneer woods, selection of (Wood processing)	2.20.7
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Waiting rooms (Health care)	7.1.1
Waiting rooms (Railways)	8.2.4
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Warping (Textile manufacture)	2.18.4
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Washing (Laundries and dry cleaning)	2.11.2
Washing (Textile manufacture)	2.18.2
Washing of products (Food industry)	2.7.2
Washrooms (Rest rooms, etc.)	1.2.4
Watch making, automatic (Jewellery manufact.)	2.10.4
Watch making, manual (Jewellery manufacturing)	2.10.3
Weaving (Textile manufacture)	2.18.4
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White teeth matching (Health care)	7.12.4
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Winding of large coils (Electrical industry)	2.6.2
Winding of medium-sized coils (Electrical ind.)	2.6.2
Winding of small coils (Electrical industry)	2.6.2
Wire drawing shops (Metal processing)	2.13.7
Wire manufacture (Electrical industry)	2.6.1
Wood processing	2.20.1
Wood working	2.20
Wood working machines (Wood processing)	2.20.6
Work shops (Education)	6.2.15
Wrapper table (Retail premises)	4.3
Writing (Offices)	3.2