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Light and lighting — Lighting of work places

Part 2: Outdoor work places

National foreword

This British Standard is the UK implementation of EN 12464-2:2014. It supersedes BS EN 12464-2:2007 which is withdrawn.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 secretary.

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CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 12464-2:2014) 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of an identical text or by endorsement, at the latest by July 2014, and conflicting national standards shall be withdrawn at the latest by July 2014.

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

This document supersedes EN 12464-2:2007.

Significant changes between this document and EN 12464-2:2007 are:

a) the terms and definitions were deleted to avoid duplication with EN 12665;

b) symbols were aligned with EN 12665;

c) Figure 1 was corrected;

d) 4.4.2 “Glare rating”, the reflectance has a default value of ρ = 0,15;

e) 4.7.3 “colour rendering”, aligned with EN 12464-1;

f) 4.10 “energy considerations”, aligned with EN 12464-1 and extended;

g) subclause 5.1, insertion of requirements regarding routine cleaning of work spaces;

h) Table 5.1 “General requirements for areas and for cleaning at outdoor work places”, title changed and new activity added;

i) Table 5.12 “Railways and tramways”, updated and extended;

j) Clause 6 “Verification procedures”, revised and harmonized with EN 12464-1.

EN 12464, *Light and lighting - Lighting of work places* consists of the following parts:

— *Part 1: Indoor work places*

— *Part 2: Outdoor work places*

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

Introduction

To enable people to perform outdoor visual tasks efficiently and accurately, especially during the night, adequate and appropriate lighting should be provided.

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

This standard specifies requirements for lighting of tasks in most outdoor wor k 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 outdoor work places, which meet the needs for visual comfort and performance. All usual visual tasks are considered. This Europ ean Standard is not applicable for emergency lighting; see EN 1838 and EN 13032-3.

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 153 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 153 of the EC treaty, in national legislation of member states implementing these directives or in other national legislation of member states.

This European Standard neither provides specific solutions, nor restricts the designer's freedom from exploring new techniques nor restricts the use of innovative equipment.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition c ited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12665:2011, *Light and lighting - Basic terms and criteria for specifying lighting requirements*

EN 13201-2, *Road lighting - Part 2: Performance requirements*

EN 13201-3, *Road lighting - Part 3: Calculation of performance*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12665:2011 apply.

4 Lighting design criteria

4.1 Luminous environment

For good lighting practice it is essential that, in addition to the required illuminance, other 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,

— glare,

— directionality of light,

— colour rendering and colour appearance of the light,

— flicker.

Values for illuminance and its uniformity, discomfort glare and colour rendering index are given in Clause 5; other parameters are described in Clause 4.

NOTE Intentionally improved and des igned luminous environment, glare -free illumination, good colour rendering, high contrast markings and optical and tactile guiding systems can improve visibility and sense of direction and locality. See CIE 196:2011.

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),

Attention to these factors can enhance visual performance without the need for higher illuminance.

4.2 Luminance distribution

The luminance distribution in the visual field controls the adaptation level of the eyes, which affects task visibility.

A well balanced luminance distribution is needed to increase:

— visual acuity (sharpness of vision),

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

— efficiency of the ocular functions (such as accommodati on, convergence, pupil lary contraction, eye movements).

The luminance distribution in the visual field also affects visual comfort. Sudden changes in luminance should be avoided.

4.3 Illuminance

4.3.1 General

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, visual performance and safety needs.

All illuminance average and uniformity values are dependent upon the grid definition (see 4.3.4).

4.3.2 Illuminance on the task area

The values given in Clause 5 are maintained illuminances over the task area on the reference sur face, 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. The recommended scale of illuminance (in lx) is:

5 – 10 – 15 – 20 – 30 – 50 – 75 – 100 – 150 – 200 – 300 – 500 – 750 – 1 000 – 1 500 – 2 000

The required maintained illuminance should be increased, when:

— visual work is critical,

— visual task or worker is moving,

— 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 or on only rare occasions.

4.3.3 Illuminance of surroundings

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

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

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

The surrounding area should be a band with a width of at least 2 m around the task area within the visual field.

Table 1 — Relationship of illuminances of surrounding areas to task area

Task illuminance lx	Illuminance of surrounding areas lx
≥ 500	100
300	75
200	50
150	30
$50 \leq \overline{E}_m \leq 100$	20
< 50	no specification

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

4.3.4 Illuminance grid

A grid system shall be created for the task and surrounding areas to indicate the points at which the illuminance values are calculated and verified.

Grids approximating 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). The maximum grid size shall be:

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

where

d is the longer dimension of the area, in m, if the ratio of the longer to the shorter side is less than 2, otherwise d is the shorter dimension of the area; and

p is the maximum grid cell size in m.

The value of p should be that $p \leq 10$ m.

NOTE Formula (1) (coming from CIE x005:1992) has been derived under the assumption that p is proportional to $\log_{10} d$, where:

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

p = 1 m for d = 10 m;

p = 5 m for d = 100 m.

4.3.5 Uniformity and diversity

The task area shall be illuminated as uniformly as possible. The illuminance uniformity of the task area shall be not less than the values given in Clause 5. The uniformity of the surroundings shall not be less than 0,10.

In some cases, e.g. railways, illuminance diversity is also an important quality criterion.

4.4 Glare

4.4.1 General

Glare is the sensat ion produced by bright areas within the field of vision 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 the users to avoid errors, fatigue and accidents.

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

4.4.2 Glare rating

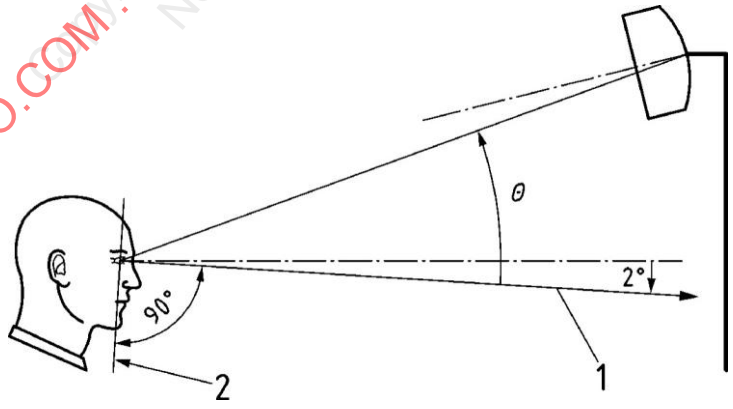
The glare directly from the luminaires of an outdoor lighting installation shall be determined using the CIE Glare Rating (R_G) method, based on the formula:

$$R_G = 27 + 24 \log_{10} \left(\frac{L_{vl}}{L_{ve}^{0,9}} \right) \quad (2)$$

where

L_{vl} is the total veiling luminance in cd·m $^{-2}$ caused by the lighting installation and is the sum of the veiling luminances produced by each individual luminaire ($L_{vl} = L_{v1} + L_{v2} + \ldots L_{vn}$). The veiling luminance of the individual luminaires is calculated as $L_v = 10 \cdot (E_{eye} \cdot \Theta^{-2})$, in which E_{eye} is the illuminance at the observer's eye in a plane perpendicular to the line of sight (2° below horizontal, see Figure 1) and Θ is the angle between the observer's line of sight and the direction of the light incident from the individ ual luminaire;

L_{ve} is the equivalent veiling luminance of the environment in cd·m_^{2}. From the assumption that the reflection of the environment is totally diffuse, the equivalent veiling reflection from the environment may be calculated as $L_{ve} = 0{,}035 \cdot \rho \cdot E_{hav} \cdot \pi^{-1}$, in which ρ represents the average reflectance and E_{hav} the average horizontal illuminance of the area. If the value of reflectance is not known, ρ should be taken as 0,15.



Key

1 line of sight

2 plane of E_{eye}

Figure 1 — The angle between the observer's line of sight and the direction of the light incident from the individual luminaire

R_G should be computed at grid positions as defined in 4.3.4, at 45° intervals radially about the grid points with 0° direction parallel to the long side of the task area.

All assumptions made in the determination of R_G shall be stated in the scheme documentation. The R_G value of the lighting installation shall not exceed the R_{GL}-value given in Clause 5.

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:

— appropriate arrangement of luminaires and work places,

— surface finish (e.g. matte surfaces),

— luminance restriction of luminaires,

— increased luminous area of the luminaire.

4.5 Obtrusive light

To safeguard and enhance the night time environment it is necessary to control obtrusive ligh t (also known as light pollution), which can present physiological and ecological problems to surroundings and people.

The limits of obtrusive light for exterior lighting installations, to minim ize problems for people, flora and fauna, are given in Table 2 and for road users in Table 3.

Table 2 — Maximum obtrusive light permitted for exterior lighting installations

Environmental zone	Light on properties		Luminaire intensity		Upward light ratio	Luminance	
	E_v lx		I cd		R_{UL} %	L_b cd·m^{-2}	L_s cd·m^{-2}
	Pre-curfew[a]	Post-curfew	Pre-curfew	Post-curfew		Building facade	Signs
E1	2	0	2 500	0	0	0	50
E2	5	1	7 500	500	5	5	400
E3	10	2	10 000	1 000	15	10	800
E4	25	5	25 000	2 500	25	25	1 000

where

E1 represents intrinsically dark areas, such as national parks or protected sites;

E2 represents low district brightness areas, such as industrial or residential rural areas;

E3 represents medium district brightness areas, such as industrial or residential suburbs;

E4 represents high district brightness areas, such as town centres and commercial areas;

E_v is the maximum value of vertical illuminance on properties in lx;

I is the light intensity of each source in the potentially obtrusive direction in cd;

R_{UL} is the proportion of the flux of the luminaire(s) that is emitted above the horizontal, when the luminaire(s) is (are) mounted in its (their) installed position and attitude, and given in %;

L_b is the maximum average luminance of the facade of a building in cd·m_^{2};

L_s is the maximum average luminance of signs in cd·m_^{2}.

[a] In case no curfew regulations are available, the higher values shall not be exceeded and the lower values should be taken as preferable limits.

For users of transport systems for the relevant viewing positions in the path of tr avel the threshold increment shall not exceed 15 % based on the actual adaptation level. If the adaptation level is not known and no road lighting is provided, an adaptation luminance of 0,1 cd/m^2 shall be applied.

Table 3 — Maximum values of threshold increment from non-road lighting installations

Light technical parameter	**Road lighting classes**[a, b]			
	No road lighting	**ME5**	**ME4 / ME3**	**ME2 / ME1**[f]
Threshold increment (*TI*) [c, d, e]	15 % based on adaptation luminance of 0,1 cd·m^{-2}	15 % based on adaptation luminance of 1 cd·m^{-2}	15 % based on adaptation luminance of 2 cd·m^{-2}	15 % based on adaptation luminance of 5 cd·m^{-2}
NOTE During the life of this standard, the designations are likely to change from ME, CE, S to M, C, P.				

[a] Road lighting classes as given in EN 13201-2.

[b] If CE -class or S -class has to be applied, adaptation level of luminance should be used according to CEN/TR 13201-1:2004, Table 3 or equivalent national standards.

[c] *TI* calculation as given in EN 13201-3.

[d] Limits apply where users of transport systems are subject to a reduction in the ability to see essential information. Values given are for relevant positions and for viewing directions in the path of travel.

[e] Table 5.2 in CIE 150:2003 gives corresponding values for the veiling luminance L_v.

[f] The adaptation luminance values are taken from CIE 150:2003, Table 2.4.

4.6 Directional lighting

4.6.1 General

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

4.6.2 Modelling

Modelling is the balance between diffuse and directional light. It is a valid criterion of lighting quality in virtually all applications. The people and objects should be 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.

The lighting should not be too directional or it will produce harsh shadows.

4.6.3 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.

4.7 Colour aspects

4.7.1 General

The colour qualities of a near-white lamp are characterized 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.

4.7.2 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 4.

Table 4 — Lamp colour appearance groups

Colour appearance	Correlated colour temperature T_{cp} K
Warm	below 3 300
Intermediate	3 300 to 5 300
Cool	above 5 300

The choice of colour appearance is a matter of psychology, aesthetics and of what is considered to be natural.

4.7.3 Colour rendering

Good colour rendering improves visual performance and the feeling of comfort and well-being. Colours in the environment and of objects shall be rendered correctly and , where reasonably practicable, human skin shall be rendered naturally. The latter may allow some compromise at outdoor workplaces.

To provide an objective indication of the colour rendering properties of a light s ource 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 outdoor areas, tasks or activities are given in Tables 5.1 to 5.15.

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

Colour rendering properties of light from a light source may be reduced by optics, glazing and coloured surfaces.

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

4.8 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 r otating or reciprocating machinery.

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

NOTE This can usually be achieved by technical measures adjusted to the chosen lamp type (e.g. operating discharge lamps at high frequencies).

4.9 Maintenance factor (*MF*)

The lighting scheme should be designed with a maintenance factor calculated for the selected lighting equipment, space environment and specified maintenance schedule, as defined in CIE 154:2003.

The recommended illuminance for eac h 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 cleaning intervals and cleaning method.

4.10 Energy considerations

The lighting solution should be designed to meet the lighting requirement of a particular task or area in an energy efficient manner. It is also important not to compromise the visual effectiveness of a lighting installati on simply to reduce energy consumption.

The lighting conditions and light levels recommended in this European Standard are minimum average values and these shall be maintained at all required times.

Energy savings can be made by harvesting daylight when av ailable, controlling the electric lights in response to workers presence and improving the maintenance characteristics of the lighting installation. These require the consideration and integration of appropriate lighting controls with the lighting system solution.

The amount of daylight available during the day depends on time and climate conditions. However, in many places during the day daylight can provide the lighting needs and it is free and uses no energy. Including automatic or manual switching or di mming controls with the lighting system will give much opportunity for energy savings and will ensure satisfactory integration of electric lighting with daylight.

The absence of people can be detected by suitable absence/presence detection circuits and can form an integral part of the lighting system. This control can save energy by reducing the use of the electric lights when the area is unoccupied or not in use. However , caution should be applied when using light sources requiring long run -up or restrike time.

4.11 Sustainability

Consideration should be given to the sustainability of the lighting installation. The choice of a specific design solution should achieve a reasonable balance between the various environmental aspects (Environmental Life - Cycle thinking: aimed to reduce the environmental impacts of products across the whole of their life cycle, including transport, installation, maintenance, possibilities for re -use, recycling and recovery of materials) and between environmental aspects and other relevant considerations, such as safety and health, technical requirements for functionality, quality, and performance, and economic aspects.

5 Schedule of lighting requirements

5.1 General

The lighting requirements for various areas, tasks and activities are given in the Tables of 5.4 (see also EN 12193).

Adequate lighting conditions shall be provided for all work spaces where and when routine cleaning of the space is carried out. The whole space shall be considered as the cleaning service task area and the relevant re quirements are given in Table 5.1.

Use lighting control to achieve adequate flexibility for the variety of tasks performed.

5.2 Composition of the Tables 5.1 to 5.15 below

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

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

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

— **Column 4** gives the minimum illuminance uniformity U_0 on the reference surface (see 4.3) for the area, task or activity given in column 2.

— **Column 5** gives the Glare Rating limits (R_{GL}) where these are applicable to the situations listed in column 2 (see 4.4)

— **Column 6** gives the minimum colour rendering indices (R_a) (see 4.7.3) for the situation listed in column 2.

— **Column 7**, contains advice and footnotes for exceptions and special applications for the situations listed in column 2.

5.3 The schedule of areas, tasks and activities

Table 5.1 General requirements for areas and for cleaning at outdoor work places

Table 5.2 Airports

Table 5.3 Building sites

Table 5.4 Canals, locks and harbours

Table 5.5 Farms

Table 5.6 Fuel filling stations

Table 5.7 Industrial sites and storage areas

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Table 5.9 Parking areas

Table 5.10 Oil and other chemical industries

Table 5.11 Power, electricity, gas and heat plants

Table 5.12 Railways and tramways

Table 5.13 Saw mills

Table 5.14 Shipyards and docks

Table 5.15 Water and sewage plants

5.4 Lighting requirements for areas, tasks and activities

Table 5.1 — General requirements for areas and for cleaning at outdoor work places

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.1.1	Walkways exclusively for pedestrians	5	0,25	50	20	
5.1.2	Traffic areas for slowly moving vehicles (max. 10 km/h), e.g. bicycles, trucks and excavators	10	0,40	50	20	
5.1.3	Regular vehicle traffic (max. 40 km/h)	20	0,40	45	20	At shipyards and in docks, R_{GL} may be 50
5.1.4	Pedestrian passages, vehicle turning, loading and unloading points	50	0,40	50	20	
5.1.5	Cleaning and servicing	50	0,25	50	20	All relevant surfaces

Table 5.2 — Airports

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
General						1. Direct light in the direction of the control tower and landing aircraft shall be avoided. 2. Direct light emitted above horizontal from floodlights should be restricted to the minimum.
5.2.1	Hangar apron	20	0,10	55	20	
5.2.2	Terminal apron	20	0,25	50	20	
5.2.3	Loading areas	20	0,25	50	40	For reading labels: $\overline{E}_m$ = 50 lx
5.2.4	Fuel depot	50	0,25	50	40	
5.2.5	Aircraft maintenance stands	200	0,50	45	60	

NOTE For aircraft stand, see ICAO, Annex 14.

Table 5.3 — Building sites

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.3.1	Clearance, excavation and loading	20	0,25	55	20	
5.3.2	Construction areas, drain pipes mounting, transport, auxiliary and storage tasks	50	0,40	50	20	
5.3.3	Framework element mounting, light reinforcement work, wooden mould and framework mounting, electric piping and cabling	100	0,40	45	40	
5.3.4	Element jointing, demanding electrical, machine and pipe mountings	200	0,50	45	40	

Table 5.4 — Canals, locks and harbours

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.4.1	Waiting quays at canals and locks	10	0,25	50	20	
5.4.2	Gangways and passages exclusively for pedestrians	10	0,25	50	20	
5.4.3	Lock control and ballasting areas	20	0,25	55	20	
5.4.4	Cargo handling, loading and unloading	30	0,25	55	20	For reading labels: $\overline{E}_m$ = 50 lx
5.4.5	Passenger areas in passenger harbours	50	0,40	50	20	
5.4.6	Coupling of hoses, pipes and ropes	50	0,40	50	20	
5.4.7	Dangerous part of walkways and driveways	50	0,40	45	20	

Table 5.5 — Farms

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.5.1	Farm yard	20	0,10	55	20	
5.5.2	Equipment shed (open)	50	0,20	55	20	
5.5.3	Animals sorting pen	50	0,20	50	40	

Table 5.6 — Fuel filling stations

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.6.1	Vehicle parking and storage areas	5	0,25	50	20	
5.6.2	Entry and exit driveways: dark environment	20	0,40	45	20	
5.6.3	Entry and exit driveways: light environment	50	0,40	45	20	
5.6.4	Air pressure and water checking points and other service areas	150	0,40	45	20	
5.6.5	Meter reading area	150	0,40	45	20	

Table 5.7 — Industrial sites and storage areas

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.7.1	Short-term handling of large units and raw materials, loading and unloading of solid bulk goods	20	0,25	55	20	
5.7.2	Continuous handling of large units and raw materials, loading and unloading of freight, lifting and descending location for cranes, open loading platforms	50	0,40	50	20	
5.7.3	Reading of addresses, covered loading platforms, use of tools, ordinary reinforcement and casting tasks in concrete plants	100	0,50	45	20	
5.7.4	Demanding electrical, machine and piping installations, inspection	200	0,50	45	60	Use local lighting

Table 5.8 — Off-shore gas and oil structures

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.8.1	Sea surface below the rig	30	0,25	50	20	
5.8.2	Ladders, stairs, walkways	100	0,25	45	20	On treads
5.8.3	Boat landing areas / transport areas	100	0,25	50	20	
5.8.4	Helideck	100	0,40	45	20	1. Direct light in the direction of the control tower and landing aircraft shall be avoided. 2. Direct light emitted above horizontal from floodlights should be restricted to the minimum.
5.8.5	Derrick	100	0,50	45	40	
5.8.6	Treatment areas	100	0,50	45	40	
5.8.7	Pipe rack area / deck	150	0,50	45	40	
5.8.8	Test station, shale shaker, wellhead	200	0,50	45	40	
5.8.9	Pumping areas	200	0,50	45	20	
5.8.10	Life boat areas	200	0,40	50	20	
5.8.11	Drill floor and monkey board	300	0,50	40	40	Special attention to string entry is needed
5.8.12	Mud room, sampling	300	0,50	40	40	
5.8.13	Crude oil pumps	300	0,50	45	40	
5.8.14	Plant areas	300	0,50	40	40	
5.8.15	Rotary table	500	0,50	40	40	

Table 5.9 — Parking areas

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.9.1	Light traffic, e.g. parking areas of shops, terraced and apartment houses; cycle parks	5	0.25	55	20	
5.9.2	Medium traffic, e.g. parking areas of department stores, office buildings, plants, sports and multipurpose building complexes	10	0,25	50	20	
5.9.3	Heavy traffic, e.g. parking areas of major shopping centres, major sports and multipurpose building complexes	20	0,25	50	20	

Table 5.10 — Oil and other chemical industries

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.10.1	Handling of servicing tools, utilization of manually regulated valves, starting and stopping motors, lighting of burners	20	0,25	55	20	
5.10.2	Filling and emptying of container trucks and wagons with risk free substances, inspection of leakage, piping and packing	50	0,40	50	20	
5.10.3	Filling and emptying of container trucks and wagons with dangerous substances, replacements of pump packing, general service work, reading of instruments	100	0,40	45	40	
5.10.4	Fuel loading and unloading sites	100	0,40	45	20	
5.10.5	Repair of machines and electric devices	200	0,50	45	60	Use local lighting

Table 5.11 — Power, electricity, gas and heat plants

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.11.1	Pedestrian movements within electrically safe areas	5	0,25	50	20	
5.11.2	Handling of servicing tools, coal	20	0,25	55	20	
5.11.3	Overall inspection	50	0,40	50	20	
5.11.4	General servicing work and reading of instruments	100	0,40	45	40	
5.11.5	Repair of electric devices	200	0,50	45	60	Use local lighting

Table 5.12 — Railways and tramways

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
General	Railway areas including light railways, tramways, monorails, miniature rails, metro, etc.					Avoid glare for vehicle drivers.
5.12.1	Open platforms, very small number of passengers, e.g. train stops	5	0,20	55	20	1. Special attention to the edge of the platform 2. $U_d \geq 1/10$
5.12.2	Tracks in passenger station areas, including stabling	10	0,25	50	20	$U_d \geq 1/8$
5.12.3	Railway yards: flat marshalling, retarder and classification yards	10	0,40	50	20	$U_d \geq 1/5$
5.12.4	Hump areas	10	0,40	45	20	$U_d \geq 1/5$
5.12.5	Freight track, short duration operations	10	0,25	50	20	$U_d \geq 1/8$
5.12.6	Open platforms, small number of passengers, e.g. rural and local trains,	10	0,25	50	20	1. Special attention to the edge of the platform 2. $U^d \geq 1/8$
5.12.7	Walkways in railway areas, open footbridges	10	0,25	50	20	
5.12.8	Level crossings	20	0,40	45	20	
5.12.9	Open platforms, medium number of passengers, e.g. suburban or regional trains or inter-city services	20	0,30	45	20	1. Special attention to the edge of the platform 2. $U_d \geq 1/6$
5.12.10	Freight track, continuous operation	20	0,40	50	20	$U_d \geq 1/5$
5.12.11	Open platforms in freight areas	20	0,40	50	20	$U_d \geq 1/5$
5.12.12	Servicing trains and locomotives	20	0,40	50	40	$U_d \geq 1/5$
5.12.13	Railway yards handling areas	30	0,40	50	20	$U_d \geq 1/5$
5.12.14	Coupling area	30	0,40	45	20	$U_d \geq 1/5$
5.12.15	Stairs, small number of passengers	50	0,40	45	40	
5.12.16	Open platforms, large number of passengers, e.g. inter-city services	50	0,40	45	20	1. Special attention to the edge of the platform 2. $U_d \geq 1/5$
5.12.17	Covered platforms, small number of passengers, e.g. suburban or regional trains or inter-city services	50	0,40	45	40	1. Special attention to th e edge of the platform 2. $U_d \geq 1/5$
5.12.18	Covered platforms in freight areas, short duration operations	50	0,40	45	20	$U_d \geq 1/5$
5.12.19	Covered platforms, large number of passengers, e.g. inter-city services	100	0,50	45	40	1. Special attention to the edge of the platform 2. $U_d \geq 1/3$
5.12.20	Stairs, large number of passengers	100	0,50	45	40	
5.12.21	Covered platforms in freight areas, continuous operation	100	0,50	45	40	$U_d \geq 1/5$
5.12.22	Inspection pit	100	0,50	40	40	Use low-glare local lighting

Table 5.13 — Saw mills

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.13.1	Timber handling on land and in water, sawdust and chip conveyors	20	0,25	55	20	
5.13.2	Sorting of timber on land or in water, timber unloading points and sawn timber loading points, mechanical lifting to timber conveyor, stacking	50	0,40	50	20	
5.13.3	Reading of addresses and markings of sawn timber	100	0,40	45	40	
5.13.4	Grading and packaging	200	0,50	45	40	
5.13.5	Feeding into stripping and chopping machines	300	0,50	45	40	

Table 5.14 — Shipyards and docks

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.14.1	General lighting of shipyard area, storage areas for prefabricated goods.	20	0,25	55	40	
5.14.2	Short-term handling of large units	20	0,25	55	20	
5.14.3	Scraping, cleaning and painting of ship hull	50	0,25	50	20	
5.14.4	Painting and welding	100	0,40	45	60	
5.14.5	Mounting of electrical and mechanical components	200	0,50	45	60	

Table 5.15 — Water and sewage plants

Ref. no.	Type of area, task or activity	$\overline{E}_m$ lx	U_o –	R_{GL} –	R_a –	Specific requirements
5.15.1	Handling of service tools, utilization of manually operated valves, starting and stopping of motors, piping packing and raking plants	50	0,40	45	20	
5.15.2	Handling of chemicals, inspection of leakage, changing of pumps, general servicing work, reading of instruments	100	0,40	45	40	
5.15.3	Repair of motors and electric devices	200	0,50	45	60	

6 Verification procedures

6.1 General

Specified design criteria which are listed in this European Standard 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.

6.2 Illuminance

When verifying conformity to the illuminance requirements the measurement points shall coincide with any design points or grids used according to requirements in 4.3.4. Verification shall be made to the criteria of the relevant surfaces.

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

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

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

The average illuminance and uniformity shall be not less than the values specified.

6.3 Glare Rating

Verification of the glare criteria shall be made by inspection of the design data and parameters provided for the scheme. All assumptions shall be declared.

6.4 Colour Rendering Index and colour appearance

Authenticated colour rendering index R_a and correlated colour temperatures T_{cp} data shall be provided for the lamps used in the scheme by the manufacturer of the lamps. The lamps shall be checked for conformity with the design specification.

6.5 Obtrusive light

The relevant calculated values of upward light ratio R_{UL}, vertical illuminance E_v, luminaire intensity I, and the maximum average luminance façade L_b and signs L_s for the designed scheme shall be declared by the designer and checked for conformity with the design specification.

The verification of the vertical illuminance E_v and luminances L_b and L_s can be made by measurement taking into account all design assumptions.

6.6 Maintenance schedule

The maintenance schedule shall be provided and shall be based on the results from the calculations under item 4.9.

Annex A
(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
4.5	**Germany** “Hinweise zur Messung, Beurteilung und Minderung von Lichtimmissionen”, Beschluss des Bund-/Länderausschusses für Immissionsschutz instead of environmental zones the “Baunutzungsverordnung” has to be observed, the values for light on properties are different, there is a special method for glare evaluation instead of limiting the luminaire intensities.
4.3.4	**Slovakia** In accordance with the Slovak regulations[1)] by common measurement (within the accuracy class 2) of general illuminance of an area or its functionally restricted part the relative distance of control points must not be more than the height of luminaires above the reference plane. By rough measurement (within the accuracy class 3) the distance can be increased by a one third, by accurate measurement (within the accuracy class 1) the distance shall be estimated according to Clause 4.4 of the EN 12464-1. Illuminance measurements of walls and ceiling surfaces should be executed merely in well-grounded cases.
5.4	**Hungary** In accordance with the Hungarian special regulation of the Ministry for National Economy of Hungary the 103/2003. (XII.27.) GKM decree, The National Railway Regulation has to be applied instead of Table 5.12.

1) Special regulation of the Ministry of Health Service of the Slovak Republic modifying the procedure of measurement and evaluation of lighting, (Bulletin MZ SR, 2013, upcoming).

Bibliography

[1] EN 1838, *Lighting applications - Emergency lighting*

[2] EN 12193, *Light and lighting - Sports lighting*

[3] EN 12464-1, *Light and lighting - Lighting of work places - Part 1: Indoor work places*

[4] EN 13032-1, *Light and lighting - Measurement and presentation of photometric data of lamps and luminaires - Part 1 : Measurement and file format*

[5] EN 13032-3, *Light and lighting - Measurement and presentation of photometric data of lamps and luminaires - Part 3: Presentation of data for emergency lighting of work places*

[6] CEN/TR 13201-1:2004, *Road lighting - Part 1: Selection of lighting classes*

[7] IEC 60050-845/CIE 17.4, *International Electrotechnical Vocabulary - Chapter 845: Lighting*

[8] CIE 112:1994, *Glare evaluation system for use within outdoor and area lighting*

[9] CIE 115:2010, *Lighting of roads for motor and pedestrian traffic*

[10] CIE 126:1997, *Guidelines for minimizing sky glow*

[11] CIE 129:1998, *Guide for lighting exterior work areas*

[12] CIE 140:2000, *Road lighting calculations*

[13] CIE 150:2003, *Guide on the limitation of the effects of obtrusive light from outdoor lighting installations*

[14] CIE 154:2003, *Maintenance of outdoor lighting systems*

[15] CIE 196:2011, *CIE Guide to increasing accessibility in light and lighting*

[16] ICAO, *Annex 14 - Aerodromes.Volume I - Aerodrome Design and Operations*.Available from ICAO, Customer Services Unit, 999 University Street, Montréal, Quebec, Canada H3C 5H7.

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