FINAL
DRAFT

INTERNATIONAL
STANDARD

**ISO/FDIS
8995-2
CIE S 015/E**

CIE

Voting begins on:
2005-09-15

Voting terminates on:
2006-02-15

Lighting of work places —

Part 2:
Outdoor

Éclairage des lieux de travail —

Partie 2: Extérieur

Please see the administrative notes on page iii

Reference number
ISO/FDIS 8995-2:2005(E)
CIE S 015/E:2005

ISO/CEN PARALLEL PROCESSING

The CEN Secretary-General has advised the ISO Secretary-General that this final draft International Standard covers a subject of interest to European standardization. Consultation on the ISO/DIS had the same effect for CEN members as a CEN enquiry on a draft European Standard. In accordance with the ISO-lead mode of collaboration as defined in the Vienna Agreement, this final draft, established on the basis of comments received, is hereby submitted to a parallel two-month FDIS vote in ISO and formal vote in CEN.

Positive votes shall not be accompanied by comments.

Negative votes shall be accompanied by the relevant technical reasons.

This document is submitted to all ISO member bodies for voting within 5 months, as a standard prepared by an international standardizing body. The proposer, the International Commission on Illumination (CIE), has been recognized by the ISO Council as an international standardizing body for the purposes of Council Resolution 42/1999.

Votes are required to be explicit: positive, negative or abstention. Amy request or proposal to change the text will be regarded as a negative vote.

In accordance with the provisions of Council Resolution 15/1993, this document is **circulated in the English language only**.

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

ISO 8995-2 was prepared as Standard CIE S 015 by the International Commission on Illumination, which has been recognized by the ISO Council as an international standardizing body. It was adopted by ISO under a special procedure which requires approval by at least 75 % of the member bodes casting a vote, and is published as a joint ISO/CIE edition.

The International Commission on Illumination (abbreviated as CIE from its French title) is an organization devoted to international cooperation and exchange of information among its member countries on all matters relating to the science and art of lighting.

ISO 8995-2 was prepared jointly by Division 5 of the CIE and CEN/TC 169, *Light and lighting*.

COMMISSION INTERNATIONALE DE L'ECLAIRAGE
INTERNATIONAL COMMISSION ON ILLUMINATION
INTERNATIONALE BELEUCHTUNGSKOMMISSION

CIE S 015/E:2005

Standard

Lighting of Outdoor Work Places

Eclairage des lieux de travail extérieurs

Beleuchtung von Arbeitsplätzen im Freien

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CIE S 015/E:2005

UDC: 628.971.9 Descriptor: Lighting for outdoor work

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FOREWORD

Standards produced by the Commission Internationale de l'Eclairage (CIE) are a concise documentation of data defining aspects of light and lighting, for which international harmony requires such unique definition. CIE Standards are therefore a primary source of internationally accepted and agreed data, which can be taken, essentially unaltered, into universal standard systems.

This document CIE S 015/E:2005 has been prepared by a joint Technical Committee of the CIE Division 5 and CEN/TC 169 "Light and lighting", the secretariat of which was held by DIN, and has been approved by the National Committees of the CIE.

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INTRODUCTION

To enable people to perform visual tasks efficiently and accurately, especially during the night, adequate and appropriate lighting has to 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 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 standard specifies lighting requirements for outdoor work places, which meet the needs for visual comfort and performance. All usual visual tasks are considered.

This standard does not specify lighting requirements with respect to the safety and health of workers at work, although the lighting requirements, as specified in this standard, usually fulfil safety needs.

This 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 referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CIE 112-1994. *Glare evaluation system for use within outdoor sports and area lighting.*

CIE 115-1995. *Recommendations for the lighting of roads for motor and pedestrian traffic.*

CIE 140-2000. *Road lighting calculations.*

CIE 150:2003. *Guide on the limitation of the effects of obtrusive light from outdoor lighting installations.*

CIE 154:2003. *The maintenance of outdoor lighting systems.*

3. TERMS AND DEFINITIONS

For the purposes of this standard, the terms and definitions given in IEC 60050-845/CIE 17.4[1] 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 EN 12665[2] and other national documents.

3.1 curfew

time during which stricter requirements (for the control of obtrusive light) will apply; often a condition of use of lighting applied by a government controlling authority, usually the local government

3.2 diversity (U_d)

ratio of minimum illuminance (luminance) to maximum illuminance (luminance) on (of) a surface

3.3 glare rating limit (GR_L)

upper limit of glare by the CIE Glare Rating system

3.4 maintained average 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 obtrusive light

spill light which because of quantitative, directional or spectral attributes in a given context, gives rise to annoyance, discomfort, distraction or a reduction in the ability to see essential information

3.6 spill light (stray light)

light emitted by a lighting installation which falls outside the boundaries of the property for which the lighting installation is designed

3.7 surrounding area

a strip surrounding the task area within the field of vision

NOTE This strip should have a width of at least 2 m.

3.8 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 are unknown, the area where the task may occur is the task area

3.9 illuminance uniformity (U_o)

ratio of minimum illuminance (luminance) to average illuminance (luminance) on (of) a surface

NOTE See also IEC 60050-845/ CIE 17.4[1]; 845-09-58 uniformity ratio of illuminance.

3.10 upward light ratio (*ULR*)

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

3.11 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.

3.12 work place

place intended to house work stations on the premises of the undertaking and/or establishment and any other place within the area of undertaking and/or establishment to which the worker has access in the course of his employment

3.13 work station

combination and spatial arrangement of work equipment, surrounded by the work environment under the conditions imposed by the work tasks

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, glare rating 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 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 accommodation, convergence, pupillary contraction, eye movements etc.).

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

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, visual performance and safety needs.

4.3.1 Illuminance on 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.

NOTE 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.

4.3.2 Illuminance of surroundings

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

Table 1. Relationship of maintained illuminances of surrounding areas to task area.

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

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

4.3.3 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.

