SLOVENSKI STANDARD
SIST EN 14255-4:2007

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Merjenje in ocenjevanje izpostavljenosti oseb inkoherentnemu optiļ nemu sevanju - 4. del: Terminologija in veliļ ine pri meritvah izpostavljenosti UV-, vidnemu in IR-sevanju

Measurement and assessment of personal exposures to incoherent optical radiation - Part 4: Terminology and quantities used in UV-, visible and IR-exposure measurements

Messung und Beurteilung von personenbezogenen Expositionen gegenüber inkohärenter optischer Strahlung - Teil 4: Terminologie und Größen für Messungen von UV-, sichtbaren und IR-Strahlungs-Expositionen

Mesurage et évaluation de l'exposition des personnes aux rayonnements optiques incohérents - Partie 4 : Terminologie et grandeurs utilisées pour le mesurage de l'exposition au rayonnement ultraviolet, visible et infrarouge

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ICS:

17.180.20	Barve in merjenje svetlobe	Colours and measurement of light
17.240	Merjenje sevanja	Radiation measurements

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This European Standard was approved by CEN on 18 September 2006.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Foreword

This document (EN 14255-4:2006) 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of an identical text or by endorsement, at the latest by April 2007, and conflicting national standards shall be withdrawn at the latest by April 2007.

EN 14255 *Measurement and assessment of personal exposures to incoherent optical radiation* is published in four parts:

Part 1: Ultraviolet radiation emitted by artificial sources in the workplace

Part 2: Visible and infrared radiation emitted by artificial sources in the workplace

Part 3: UV-Radiation emitted by the sun (in preparation)

Part 4 (this part): Terminology and quantities used in UV-, visible and IR-exposure measurements

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

Introduction

People may be exposed to adversely high levels of optical radiation (ultraviolet, visible and infrared radiation) from strong optical radiation sources in the workplace and elsewhere. In order to protect people from harm their optical radiation exposures should be determined in these cases and compared with limit values which are set by national authorities or recommended by international organisations (e.g. ICNIRP[1)], see [5], [6], [7], [8], [11]). Part 1 of this standard describes methods to determine ultraviolet (UV) radiation exposures in the workplace, part 2 of this standard describes methods to determine visible (VIS) and infrared (IR) radiation exposures in the workplace and part 3 of this standard describes methods to determine ultraviolet radiation exposures by the sun.

There are several quantities in which optical radiation exposures are expressed. Unfortunately some of these quantities are defined and named in different ways by different reference sources, such as standards and limit value recommendations. Additionally, some of the quantities are not always very well defined in a strong physical and mathematical sense. Hence there is a need for clarification and uniform definition of these quantities.

In this part 4 of the standard a uniform terminology for quantities is specified and the quantities are defined in a way which makes them reasonably applicable in practical use. The terminology and quantities defined may be used when parts 1, 2 and 3 of this standard are applied or when relevant standards or limit value recommendations are to be revised.

In this standard, terms which are often expressed elsewhere as summations have been reformulated and expressed mathematically as integrals. Cumbersome terms in current use, such as time integrated radiance, have been replaced by newly defined terms which clarify the relationship between, for example, radiance and radiance dose.

In order to specify and define quantities more clearly, some of the quantities have been renamed. In this standard the names of these quantities differ from the names used in other reference sources. The reason is that within the referred sources the names of these quantities are not sufficiently descriptive, e.g. "effective irradiance E_{eff}" and "effective radiant exposure H_{eff}" are very general expressions (see CIE[2)] 17.4) but are used in some references in very specific meanings. In the definition of ICNIRP [5] "effective irradiance" is a quantity which describes the effect of UV radiation as well on the skin as on the eyes. So the quantity is mainly used for prevention purposes when it is often not known which part of the body will be exposed. So this useful quantity has a very specific meaning and it is named in this standard with the specific name "ultraviolet hazard irradiance E_s".

Another reason for renaming the quantity "effective irradiance" is that it is used in some applications to indicate a net effect such as the difference between incident and emitted heat radiation. In order to avoid misunderstandings the term "effective irradiance" is not used in this standard. The more specific term "ultraviolet hazard irradiance" is used instead.

NOTE Terms and quantities which are not covered by this part of the standard can be found in other reference sources like CIE 17.4, CIE S 007 or CIE S 009.

1) ICNIRP International Commission on Non-Ionizing Radiation Protection.

2) CIE Commission Internationale de l'Éclairage.

1 Scope

This standard specifies the terminology and the quantities that are used in UV-, VIS- and IR-exposure measurements according to parts 1, 2 and 3 of EN 14255.

NOTE Parts 1 and 2 were published in 2005, while part 3 is under preparation.

This standard can also be applied to the terminology and quantities used in international recommendations from, e.g. ICNIRP, CIE, etc. The purpose of this standard is to unify the definitions of quantities for optical radiation measurements since inconsistencies occur between existing publications from different origins.

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.

Not applicable.

3 Terms and definitions

3.1 Symbols, terms and units

Within the field of applications of parts 1, 2 and 3 of EN 14255 the symbols, terms and units listed in Table 1 are used.

Table 1 —Symbols, terms and units

Symbol	Term	Unit	Defined in
λ	wavelength	nm	CIE 17.4:1987 ref 845-01-14
λ_1 , λ_2	boundaries of a wavelength-range $\Delta\lambda$	nm	EN 14255-4
Δt_{exp},	exposure duration	s	EN 14255-4
E	irradiance	W/m²	CIE 17.4:1987 ref 845-01-37
$E_\lambda(\lambda,t)$, $E_\lambda(\lambda)$	spectral irradiance	W/(m² × nm)	EN 14255-4
H	radiant exposure	J/m²	CIE 17.4:1987 ref 845-01-42
$H_\lambda(\lambda)$	spectral radiant exposure	J/(m² × nm)	EN 14255-4
E_s	ultraviolet hazard irradiance	W/m²	EN 14255-4
H_s	ultraviolet hazard radiant exposure	J/m²	EN 14255-4
E_b	blue-light irradiance	W/m²	EN 14255-4
H_b	blue-light radiant exposure	J/m²	EN 14255-4
L	radiance	W/(m² × sr)	CIE 17.4:1987 ref 845-01-34 and CIE S 009/E:2002 clause 3.31
$L_\lambda(\lambda)$	spectral radiance	W/(m² × nm × sr)	CIE S 009/E:2002 clause 3.41
L_b	blue-light radiance	W/(m² × sr)	EN 14255-4
L_r	retinal thermal radiance	W/(m² × sr)	EN 14255-4
G	radiance dose	J/(m² × sr)	EN 14255-4
G_b	blue-light radiance dose	J/(m² × sr)	EN 14255-4
—	spectral weighting function	—	EN 14255-4
$s(\lambda)$	ultraviolet hazard weighting function	—	EN 14255-4
$b(\lambda)$	blue light hazard weighting function	—	EN 14255-4
$r(\lambda)$	retinal thermal hazard weighting function	—	EN 14255-4
D	source diameter	m	EN 14255-4
D_L	viewing source diameter	m	EN 14255-4
D_{app}	apparent source diameter	m	EN 14255-4
r	viewing distance	m	EN 14255-4
ϕ	viewing angle	rad	EN 14255-4
γ	angle of acceptance	rad	EN 14255-4

Table 1 (continued)

Symbol	Term	Unit	Defined in
α	angular subtense of the apparent source	rad	CIE S009/E:2002 clause 3.2
I_{UV}	UV-Index	—	CIE S 013/E
f_{OE}	ocular exposure factor	—	ILO/ICNIRP Guide
f_{SE}	skin exposure factor	—	ILO/ICNIRP Guide
$s_{er}(\lambda)$	erythemal weighting function	—	ISO/CIE 17166 and EN 14255-4
E_{er}	erythemal effective irradiance	W/m²	ISO/CIE 17166
H_{er}	erythemal effective radiant exposure	J/m²	ISO/CIE 17166
SED	standard erythema dose	100 J/m²	ISO/CIE 17166
MED	minimal erythema dose	J/m² or SED	ISO/CIE 17166
$s_{nmsc}(\lambda)$	non-melanoma skin cancer weighting function	—	CIE DS 019.2/E
E_{nmsc}	non-melanoma skin cancer effective irradiance	W/m²	EN 14255-4
H_{nmsc}	non-melanoma skin cancer effective radiant exposure	J/m²	EN 14255-4
NOTE Angles like angular subtense α, viewing angle ϕ and angle of acceptance γ are often expressed in degrees instead of radians.			

3.2 Definitions

NOTE Quantities for the irradiance, radiance and radiant exposure, which are calculated by using spectral weighting functions, are named in reference to the specific action spectrum in question. For any specific effect "x", if a spectral weighting function x(λ) exists, the "x-irradiance E_x" can be calculated equivalent to equation (4); e. g. the name "blue-light irradiance E_b" is used for the wavelength integral of the spectral irradiance which is spectrally weighted with the blue-light hazard weighting function $b(\lambda)$. The blue-light hazard weighting function $b(\lambda)$ is related to the action spectrum of the blue-light hazard of the eye. Likewise, other names of quantities which allow the assessment of a specific effect are chosen in relation to the action spectra in question. The same procedure may be applied for other spectrally weighted quantities such as radiant exposure H_x, radiance L_x, etc.

3.2.1
boundaries of a wavelength-range

λ_1, λ_2

lower and upper wavelength value specifying the boundaries for a wavelength-range of interest

NOTE Wavelength-ranges are used to specify the spectral boundaries for weighting functions (for hazards or beneficial effects), measurement device specifications, source emission spectra, etc. When applying exposure limit values the wavelength range of interest will depend on the biological effect under consideration.