SLOVENSKI STANDARD
SIST EN 16237:2013

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Klasifikacija neelektričnih virov inkoherentnega optičnega sevanja

Classification of non-electrical sources of incoherent optical radiation

Klassifizierung nicht elektrisch betriebener Quellen inkohärenter optischer Strahlung

Classification des sources non électriques de rayonnement optique incohérent

Ta slovenski standard je istoveten z: **EN 16237:2013**

ICS:

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

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Foreword

This document (EN 16237:2013) 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of an identical text or by endorsement, at the latest by July 2013, and conflicting national standards shall be withdrawn at the latest by July 2013.

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Introduction

Optical radiation consists of the spectral regions covered by ultraviolet, visible and infrared radiation. Sources of incoherent optical radiation are used both in workplaces and privately. The radiation may intentionally be applied to carry out a specific task or may occur unintentionally as a by-product. Some sources are powered electrically, others are powered non-electrically, e.g. by gas or other fuels. Examples for non-electrically powered sources are burners, furnaces, heaters, gas welding, thermal cutting, chemical torches, hot materials etc.

People staying near to or working in the vicinity of such sources may be exposed to optical radiation. Depending on the level of exposure, injuries may occur to the skin and/or to the eyes. In order to avoid such injuries, European [1] and national legislation require the determination of exposures and the assessment of the associated risks in workplaces. In addition, maximum allowed optical radiation exposure limit values are set by legislation. Workers must not exceed these exposure limit values. If necessary, exposure reduction measures have to be applied.

Optical radiation exposures can be determined by several procedures: measurements, calculations, derivations from source emission data, etc. Not all of these procedures are appropriate in every case. Exposure measurements can be made in accordance with EN 14255-1 and EN 14255-2, but are expensive and time consuming. Generally, it is preferable to carry out a risk assessment without expensive measurements, if possible. Calculations of exposures may be done with the aid of software such as Catrayon[1)] [3], but not in all cases. If quantitative emission data from the source are available, the user may in some cases estimate the possible exposure of people in the vicinity of the radiation source.

A simpler approach for risk assessment is the classification of the optical radiation emissions. If such an emission classification is available, the user may easily assess the risk from use of the source. Emission classifications are already provided by standards for laser devices (EN 60825-1) [8] and for machinery (EN 12198-1) [7] as well as for lamps and lamp systems (EN 62471) [9]. This present standard provides a specific emission classification for non-electrically powered optical radiation sources.

The classification in this standard is intended to be user-friendly. The emission classes depend on the duration Δt_{max} beyond which the exposure limit values of the European directive on artificial optical radiation 2006/25/EC [1] may be exceeded. By comparing the actual exposure duration occurring at the workplace with Δt_{max}, the user can easily estimate if the exposure limit values may or may not be exceeded. Therefore, for a classified source, a risk assessment as required by Directive 2006/25/EC can easily be carried out.

The measurement of the optical radiation emission for the classification of the source is always carried out at a standard distance and at greater distances if that is where emission is at the maximum. Therefore, this classification represents the worst case exposure. This is appropriate if people are likely to be in the vicinity. However, sources are often operated in such a way that people will be further away than the worst-case location. For these applications, a classification shall be made not only for the worst case, but in addition for normal use conditions. The source classification measurements shall then be made for several distances around the source including the normal operating distance(s). As a result, emission classes are produced depending on the distance or even iso-emission-class lines around the source. The user is then able to estimate more easily the maximum possible exposure under normal use conditions and also under worst case conditions.

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1) Catrayon is an example of a suitable software available commercially. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN or CENELEC of this product.

There is a limitation of the concept of risk assessment with classified sources. A risk assessment can only be carried out if the classified source contributes predominantly to the optical radiation exposure of people. If there are several optical radiation sources that significantly contribute to the exposure, the risk assessment has to be carried out in a different way, e.g. by measurement of the exposure and comparison with the exposure limit values. In many cases however, one source will be predominant and an easy risk assessment can be carried out using the emission classification. Therefore, emission classification of a source forms a practical approach.

1 Scope

This European Standard provides a scheme for the classification of artificial non-electrical sources of incoherent optical radiation with regard to their radiation emissions. It helps users of the sources to easily carry out a risk assessment when people can be exposed to radiation from the sources.

This standard applies for sources emitting optical radiation in the wavelength between 180 nm and 3 000 nm.

This standard does not apply for electrically powered sources.

This standard does not apply for machinery, for laser devices and for lamps and lamp systems.

NOTE A classification for machinery is given in EN 12198-1 [7], a classification for laser devices is given in EN 60825-1 [8] and a classification for lamps and lamp systems is given in EN 62471 [9].

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 cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 14255-1:2005, *Measurement and assessment of personal exposures to incoherent optical radiation — Part 1: Ultraviolet radiation emitted by artificial sources in the workplace*

EN 14255-2:2005, *Measurement and assessment of personal exposures to incoherent optical radiation — Part 2: Visible and infrared radiation emitted by artificial sources in the workplace*

EN 14255-4:2006, *Measurement and assessment of personal exposures to incoherent optical radiation — Part 4: Terminology and quantities used in UV-, visible and IR-exposure measurements*

ISO 7010, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

ENV 13005, *Guide to the expression of uncertainty in measurement*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14255-4:2006 and the following apply.

3.1
emission class
characteristic of an optical source which reflects the level of optical radiation emission at a specified distance

Note 1 to entry: Emission classes in this standard are correlated to maximum exposure durations Δt_{max} according to Tables 2, 3, 4 and 5.

3.2
maximum exposure duration
Δt_{max}
time duration up to which a person being exposed to optical radiation does not exceed the exposure limit values

Note 1 to entry: Exposure limit values associated with Δt_{max} in this standard are taken from the European Directive on artificial optical radiation 2006/25/EC [1].

3.3
irradiance
E
quotient of the radiant power incident on an element of a surface by the area of that element

Note 1 to entry: See also CIE 17.4 [5].

Note 2 to entry: The irradiance E may be defined for a specified wavelength-band, e.g. 315 nm to 400 nm (UV-A), 380 nm to 3 000 nm (visible and IR-A and IR-B), 780 nm to 3 000 nm (IR-A and IR-B).

3.4
ultraviolet hazard irradiance
E_s
irradiance spectrally weighted with the ultraviolet hazard weighting function $s(\lambda)$, given by:

$$E_{\mathrm{s}} = \int_{\lambda_1}^{\lambda_2} E_{\lambda}(\lambda) s(\lambda) \mathrm{d}\lambda \tag{1}$$

[SOURCE: EN 14255-4]

Note 1 to entry: Values for the function $s(\lambda)$ are specified in EU directive 2006/25/EC in the wavelength range 180 nm to 400 nm.

3.5
retinal thermal radiance
L_r
radiance spectrally weighted with the retinal thermal hazard weighting function $r(\lambda)$, given by:

$$L_r = \int_{\lambda_1}^{\lambda_2} L_{\lambda}(\lambda) r(\lambda) \mathrm{d}\lambda \tag{2}$$

[SOURCE: EN 14255-4]

Note 1 to entry: The retinal thermal radiance can be defined in specific wavelength bands e.g. 380 nm to 1 400 nm and 780 nm to 1 400 nm. See Table 4.

3.6
blue-light radiance
L_b
radiance spectrally weighted with the blue-light hazard weighting function $b(\lambda)$, given by:

$$L_b = \int_{\lambda_1}^{\lambda_2} L_{\lambda}(\lambda) b(\lambda) \mathrm{d}\lambda \tag{3}$$

[SOURCE: EN 14255-4]

Note 1 to entry: Values for the function $b(\lambda)$ are specified in EU directive 2006/25/EC in the wavelength range 300 nm to 700 nm.

3.7
blue-light irradiance
E_b
irradiance spectrally weighted with the blue-light hazard weighting function $b(\lambda)$, given by:

$$E_b = \int_{\lambda_1}^{\lambda_2} E_\lambda(\lambda) b(\lambda) \mathrm{d}\lambda \tag{4}$$

[SOURCE: EN 14255-4]

Note 1 to entry: Values for the function $b(\lambda)$ are specified in EU directive 2006/25/EC in the wavelength range 300 nm to 700 nm

3.8
optical radiation
electromagnetic radiation in the wavelength range between 100 nm and 1 mm

3.9
incoherent optical radiation
optical radiation with no constant phase-relationship between any two points in space and time

Note 1 to entry: In practice, this means optical radiation other than laser radiation.

3.10
angular subtense of the source
α
plane angle in radians under which a source is seen from the point of observation, given by:

$$\alpha = D / r \tag{5 a}$$

where

D diameter of the source

r distance between source and point of observation

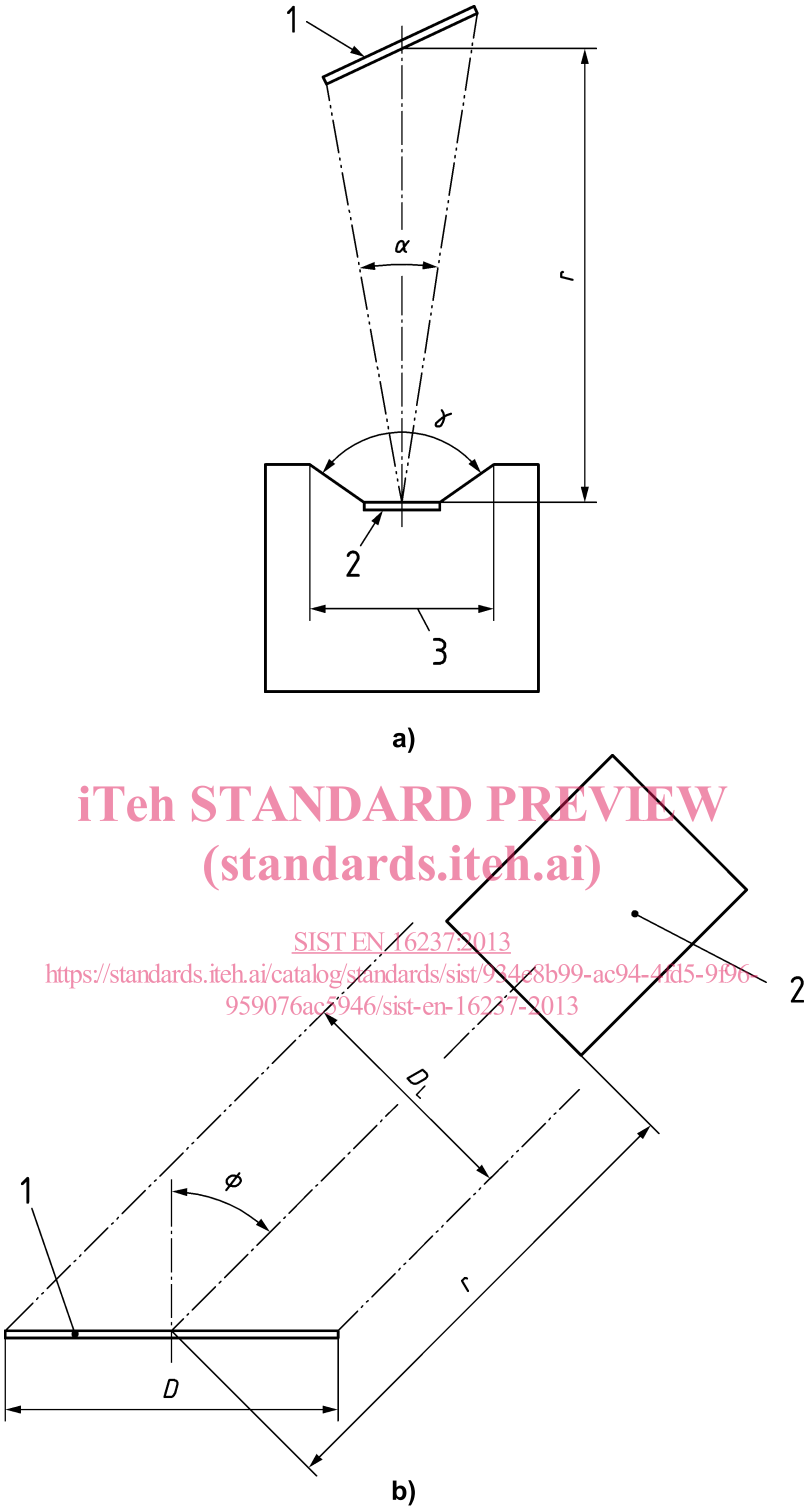
If the surface of the source is not perpendicular to the line of sight, the diameter of the source D is replaced by the viewing source diameter D_L. In this case, the angular subtense of the source α is given by:

$$\alpha = D_L / r \tag{5 b}$$

where

D_L viewing source diameter (see EN 14255-4)

r distance between source and point of observation



Key

1 source

2 detector

3 aperture

α angular subtense of the source

D diameter of the source

r distance between source and point of observation

γ angle of acceptance

ϕ viewing angle

D_L viewing source diameter (see EN 14255-4)

Figure 1 — Angle of acceptance γ of the detector and angular subtense α of the source (simplified drawings)

3.11
source diameter
D
diameter of the circle, if the source is circular,

or

arithmetic mean of the longest and shortest geometric dimension, if the source is oblong

[SOURCE: EN 14255-4]

3.12
angle of acceptance
γ
largest plane angle between all directions in which a radiation detector is sensitive

Note 1 to entry: In practical applications the angle of acceptance is determined by both the choice of an aperture and the distance between this aperture and the detector (see Figure 1a).

Note 2 to entry: The angle of acceptance γ is a property of a radiation detector. It should not be confused with the angular subtense α, which is a property of the radiation source.

[SOURCE: EN 14255-4]

4 Classification

4.1 General

The radiation emissions of the source shall be determined by measurement or reliable estimation. Measurements shall be done according to Clause 5. Subsequently the source shall be assigned a class between 0 and 6, based upon the measured or reliably estimated emissions, according to the classification scheme in 4.2.

The classification shall be done for each wavelength band (ultraviolet, visible and infrared) and for all quantities specified in Tables 1 to 5. In wavelength bands where the emissions are reliably known to be insignificant, the source can be assigned to Class 0. The highest emission class of all quantities in all wavelength bands shall then be assigned to the source. Emission measurements for the classification of the source shall be carried out at points specified in 5.4.3. Hence the emission class finally assigned to the source represents the worst case when people may be exposed to the source.

If the assigned emission class is greater than 0, it shall be provided in the information for use of the source and marked on the source.

If during normal use of the source people stay farther than the distance for which the standard worst-case classification is done (see 5.4.3.1), then classifications shall also be done for the distance(s) of the normal use (see 5.4.3.2). The emissions in different normal use conditions shall then be determined and iso-emission-class lines around the source shall be provided (see 5.4.3.2).

NOTE Under some unusual conditions of use (such as servicing, maintenance or repair) the classification might no longer be valid.

4.2 Emission classes

4.2.1 General

Emission classes are specified in Tables 2 to 5 depending on the optical radiation emission levels with respect to the following quantities:

— ultraviolet hazard irradiance E_s (180 nm to 400 nm);