



SLOVENSKI STANDARD

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Ohranjanje kulturne dediščine - Smernice in postopki za izbiro ustrezne razsvetljave za razstave v zaprtih prostorih

Conservation of Cultural Heritage - Guidelines and procedures for choosing appropriate lighting for indoor exhibitions

Erhaltung des kulturellen Erbes - Leitlinien und Verfahren für die Auswahl geeigneter Beleuchtung für Innenausstellungen

Conservation du patrimoine culturel - Lignes directrices et procédures concernant le choix d'un éclairage adapté pour les expositions en intérieur

Ta slovenski standard je istoveten z: **EN 16163:2024**

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Conservation of cultural heritage - Guidelines and procedures for choosing appropriate lighting for indoor exhibitions

Conservation du patrimoine culturel - Lignes directrices et procédures concernant le choix d'un éclairage adapté pour les expositions en intérieur

Erhaltung des kulturellen Erbes - Leitlinien und Verfahren für die Auswahl geeigneter Beleuchtung für Innenausstellungen

This European Standard was approved by CEN on 18 November 2024.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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 CEN-CENELEC Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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EN 16163:2024 (E)

European foreword

This document (EN 16163:2024) has been prepared by Technical Committee CEN/TC 346 "Conservation of Cultural Heritage", the secretariat of which is held by UNI.

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 June 2025, and conflicting national standards shall be withdrawn at the latest by June 2025.

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

This document supersedes CEN/TS 16163:2014.

EN 16163:2024 includes the following significant technical changes with respect to CEN/TS 16163:2014:

Since the publication of the CEN/TS 16163 in 2014, the technology of lighting has evolved considerably and an update of the content has proven to be necessary. In addition to taking into account technological advances and new calculation methods in the field of lighting in recent years, the present version of the standard contains the elements of good practices for the exhibition lighting design, in its subjective form, as an element of museography, which had not found its place in the previous version.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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

Introduction

Lighting is needed for many specific functions in museums and other cultural heritage buildings, such as research, conservation and permanent or temporary exhibitions. Lighting is one of the most important factors enabling visitors to fully enjoy works of art and other cultural property. In fact, lighting is a key medium in which visitors interpret and appreciate cultural heritage. Light is needed to see well but this can present a challenge when what is being viewed will deteriorate in the presence of light. When displaying exhibits as a part of Cultural Heritage, it is essential to consider a controlled use of light, to preserve them for the future generations. Indeed, light is an environmental factor, which is a threat to many objects. Alone or in combination with other environmental factors (temperature, humidity, pollution, etc.) light causes fading, discoloration and embrittlement of a wide range of materials. This damage is cumulative and irreversible: no conservation treatment can restore original appearance of colours and the material characteristics. Therefore, the challenge of museum exhibition lighting is to find an appropriate compromise between the long-term preservation of the object and the needs of visitors to view them within a suitable exhibition design. As an integral part of exhibition lighting, the following aspects should be considered, mentioned below without priority:

- the conservation aspect, related to the sensitivity of the exhibit at different wavelengths of the incident radiant energy, the spectral composition of the light source and the total luminous exposure;
- the visual aspect, related to the impact of lighting on the visitor experience: lighting should allow visitors to see exhibits on display, with the correct colour perceptions without glare, reflections or insufficient illumination;
- the design aspect related to the concept and position of the exhibition architecture, the point of view of the curator and all others involved in the purpose and/or didactic objectives of the exhibition.

This document uses terms defined in European and International (CIE International lighting vocabulary) terminology standards, but their definitions have been adapted to the intended users of this document.

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1 Scope

This document defines the procedures as well as the means to implement adequate lighting, with regard to the exhibition lighting and the conservation policy. This also includes security and cleaning lighting. It takes visual, exhibition and conservation aspects into account and it also discusses the implications of the lighting design on the safeguarding of cultural heritage. This document gives recommendations on luminous exposure values. It aims to provide a tool for setting up a common European policy and a guide to help curators, conservators and project managers to assess the correct lighting that can ensure the safeguarding of the objects. This document covers indoor lighting for heritage objects on exhibition in both public and private sites and does not consider lighting in other cultural heritage contexts such as open-air collections, etc.

This document does not cover non-public activities such as conservation-restoration, storage, emergency lighting and research.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp/>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

accent lighting

directional lighting to emphasize a particular *exhibit* (3.19) or to draw attention to a spot in the field of vision

[SOURCE: CIE S 017/E:2020, 17-29-023, modified.]

3.2

annual luminous exposure

H_m

total luminous exposure (3.49) per year

Note 1 to entry: One year of museum display is approximately 3 000 h. See also 3.34.

Note 2 to entry: The unit is expressed in lux hours per years, lx·h per year.

3.3

blue wool test

test for light fastness

certified set of eight pieces of wool each dyed with a different specific blue dye graded to fade after a specific exposure test to *light* (3.25)

Note 1 to entry: This system is usually referred to as the Blue Wool Standard (BWS) and it is used in museums to assess the radiation exposure of materials. The eight wool pieces are numbered #1 to #8, with sensitivity doubling at every step. High sensitivity is defined as materials rated #1, #2, or #3; medium as #4, #5, or #6; and

low as #7, #8. A panel of selected blue wool samples is left at the measurement point and after a period of time it can be seen which samples have faded and the dose of *light* (3.24) received approximated.

Note 2 to entry: See ISO 105-B08:1995.

3.4

brightness

attribute of a visual perception according to which an area appears to emit, transmit or reflect more or less *light* (3.25)

[SOURCE: CIE S17/E:2022, 17-22-059, modified: Notes 1 to 3 to entry omitted.]

3.5

colour rendering

<of a light source> effect of an illuminant on the perceived colour of *exhibits* (3.19) by conscious or subconscious comparison with their perceived colour under a reference illuminant

[SOURCE: CIE S 017/E:2020, 17-22-107, modified: Notes 1 and 2 to entry omitted, “object” is replaced by “exhibits”.]

3.6

colour rendering index

R_a

index derived from the *colour rendering* (3.5) indices for a specified set of 8 test colour samples

Note 1 to entry: See Annex F.

3.7

colour fidelity index

R_f

derived from the colour fidelity indices for a specified set of 99 test colour samples

Note 1 to entry: See Annex F.

Note 2 to entry: See CIE 224:2017 for further information.

3.8

gamut index

R_g

index that provides information about the relative range of colours that can be produced by a white *light source*

Note 1 to entry: A score close to 100 indicates that, on average, the *light source* (3.26) reproduces colours with similar levels of saturation as a reference source of the same *correlated colour temperature* (3.10).

Note 2 to entry: See Annex F.

3.9

colour temperature

T_c

temperature of a Planckian radiator whose radiation has the same chromaticity as that of a given stimulus

Note 1 to entry: The unit is expressed in K.

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[SOURCE: CIE S 017/E:2020, 17-23-067, modified – Notes 2 and 3 to entry omitted.]

3.10**correlated colour temperature*****CCT***

temperature of the Planckian radiator whose perceived colour most closely resembles that of a given stimulus at the same brightness and under specified viewing conditions

Note 1 to entry: The unit is expressed in K.

Note 2 to entry: Based on EN 12665 and modified for specific use.

3.11**cultural heritage**

tangible and intangible entities of significance to present and future generations

Note 1 to entry: The term “*object*” (3.36) is used in this document for cultural heritage. In specific professional contexts, other terms are used: e.g. “*artefact*”, “*cultural property*”, “*item*”.

[SOURCE: EN 15898:2019, modified: Note 1 to entry added.]

3.12**damage potential** **P_{dm}**

ratio of *effective damaging irradiance* E_{dm} (3.18) and the *illuminance* E (3.22) at a point on the surface for a specific *light source* (3.26)

Note 1 to entry: The unit is expressed in W/lm.

3.13**daylight**

part of global solar radiation capable of causing a visual sensation

<https://standards.iteh.ai/catalog/standards/sist/983fc6e0-9339-428b-9fc9-7600c95ff465/sist-en-16163-2025>

Note 1 to entry: When dealing with actinic effects of optical radiation, this term is commonly used for radiations extending beyond the visible region of the spectrum.

[SOURCE: CIE ILV:2020, 17-29-105, modified: Note 1 to entry added.]

3.14**daylighting**

lighting for which *daylight* (3.13) is the *light source* (3.26)

Note 1 to entry: It means that window or other devices are taken into consideration.

[SOURCE: CIE S 017/E:2020, 17-29-031, modified: original Note 1 to entry deleted.]

3.15**daylight factor** **D**

quotient of the *illuminance* (3.22) at a point on a given plane due to the *light* (3.25) received directly and indirectly from a sky of assumed or known *luminance* (3.33) distribution and the *illuminance* (3.22) on a horizontal plane due to an unobstructed hemisphere of this sky, where the contribution of direct sunlight to both *illuminances* (3.22) is excluded

Note 1 to entry: This is the ratio of the *illuminance* (3.22) at a given point in the interior space with respect to horizontal exterior *illuminance* (3.22), at a clear point, measured at the same time, excluding direct sunlight.

[SOURCE: CIE S 017/E:2020, 17-29-121, modified: Notes 1 to 5 to entry deleted, new Note 1 to entry added.]

3.16 diversity extreme uniformity

U_d

quotient (or ratio) of minimum *illuminance* (3.22) (*luminance* (3.33)) to maximum *illuminance* (3.22) (*luminance* (3.33)) on (of) a surface

Note 1 to entry: Diversity is dimensionless.

[SOURCE: CIE S 017/E:2020, 17-31-143, modified "(or ratio)" added, Note 1 to entry changed, Note 2 to entry deleted.]

3.17 dosimeter

indicator revealing the effects of total irradiant exposure during a given time

Note 1 to entry: The above definition is valid in the context of this document and concerns lighting field only.

3.18 effective damaging irradiance

E_{dm}

part of the *irradiance* (3.24) causing damaging photochemical reaction

Note 1 to entry: It takes account of the spectrum of the incident radiation and the spectral response of the receiving material

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<https://standards.iteh.ai/> The unit is expressed in watt per square metre, $W m^{-2}$.

Note 3 to entry: See the following formula:

$$E_{dm} = \int E_{e,\lambda} S_{dem,rel}(\lambda) d\lambda \quad (1)$$

where

$E_{e,\lambda}$ is the total irradiance (3.24) at a specified wavelength;

$S_{dem,rel}(\lambda)$ is the spectral responsivity value of a material at a specified wavelength;

dm stands for damaging.

3.19 exhibit

item shown in the *exhibition* (3.20)

3.20 exhibition

designed display of *exhibit(s)* (3.19) and information

EN 16163:2024 (E)**3.21****filter**

any device that modifies or reduces a portion of the electromagnetic spectrum

Note 1 to entry: More information is included in Annexes B and C.

3.22**illuminance** **E**

<at a point of a surface> quotient of the *luminous flux* (3.34) $d\Phi$ incident on an element of the surface containing the point, to the area dA of that element

Note 1 to entry: It represents the quantity of *light* (3.25) impinging on a surface.

Note 2 to entry: The unit is expressed in lux, $\text{lx} = \text{lm}\cdot\text{m}^{-2}$.

[SOURCE: CIE S017:2020, 17-21-060, modified: Notes 1 and 2 to entry added.]

3.23**infrared radiation** **IR**

optical radiation for which the wavelengths are longer than those for visible radiation

Note 1 to entry: For infrared radiation, the range between 780 nm and 1 mm is commonly subdivided into:

- IR-A: 780 nm to 1 400 nm, or 0,78 μm to 1,4 μm ;
- IR-B: 1,4 μm to 3,0 μm ;
- IR-C: 3 μm to 1 mm.

Note 2 to entry: A precise border between “visible” and “infrared” cannot be defined, because visual sensation at wavelengths greater than 780 nm is noted for very bright *sources* (3.47) at longer wavelengths.

Note 3 to entry: In some applications the infrared spectrum has also been divided into “near”, “middle” and “far” infrared; however, the borders necessarily vary with the application.

[SOURCE: CIE S 017/2020, 17-21-004, modified – Notes 4 and 5 to entry have been omitted.]

3.24**irradiance** **E_e**

radiometric quantity (3.40); the *radiant flux* (3.39) per unit area at a point on the surface

3.25**visible radiation****light**

electromagnetic radiation of wavelengths causing visual sensations for humans

Note 1 to entry: Visible radiation is generally accepted to be within the wavelength band of 380 nm to 780 nm.

Note 2 to entry: The term “light” is sometimes used for optical radiation extending outside the visible range, but this usage is not recommended in scientific context.

[SOURCE: ISO 9488:2022, 3.2.9]

3.26**light source**

surface or device emitting *light* (3.25)

Note 1 to entry: A light source can be self-emitting (primary light source) or non-self-emitting (secondary light source).

[SOURCE: CIE S 017/E:2020, 17-27-001, modified, “object” is replaced by “device”.]

3.27**lighting**

deliberate use of natural or artificial *light* (3.25) to obtain aesthetic and/or functional visual stimulation

3.28**lighting design**

result of the *lighting designer* (3.29) proposal

3.29**lighting designer**

professional with suitable education and relevant experience in *lighting design* (3.28), able to manage the aesthetic, behavioural and technical issues of the project

3.30**lighting management**

all actions that contribute to the control and organisation of *lighting* (3.27)

3.31**lighting management protocol**

language that allows different lighting devices to communicate

3.32**luminaire**

apparatus which distributes, *filters* (3.21) or transforms the *light* (3.25) emitted from one or more *light sources* (3.26) and which includes, all the parts necessary for fixing and protecting the *light sources* (3.26) and, where necessary, circuit auxiliaries together with the means for connecting them to the electric supply

3.33**luminance**

L

light (3.25) reflected or emitted by a surface in the direction of the observer's eyes

Note 1 to entry: The unit is expressed in candela/m² (cd/m²).

Note 2 to entry: Based on EN 12665 and modified for specific use.

3.34**luminous flux**

Φ

quantity derived from the radiant flux, by evaluating the radiation in accordance with its action upon the CIE standard photometric observer

[SOURCE: ISO 4007:2018, 3.4.4]

EN 16163:2024 (E)**3.35****luminous intensity*****I***density of *luminous flux* (3.34) with respect to solid angle in a specified directionNote 1 to entry: The unit is expressed in candela, cd = lm sr⁻¹; sr = steradian.Note 2 to entry: It is the *luminous flux* (3.34) on a small surface, divided by the solid angle that the surface subtends at the *source* (3.47) (CIE S 017/E:2011 or IEC-IEV, 1987, 845-01-31).

Note 3 to entry: The candela is the base SI photometric unit. For its definition, see CIE S 17/E:2011 or IEC-IEV, 1987, 845-01-050 or the BIPM SI Brochure.

Note 4 to entry: Based on EN 12665 and modified for specific use.

3.36**object**single manifestation of tangible *cultural heritage* (3.11)Note 1 to entry: The term “object” is used in this document for *cultural heritage* (3.11), both immovable and movable. In specific professional contexts, other terms are used: e.g. “artefact”, “cultural property”, “item”, “site”, “building”, “monument”, “specimen”, “structure”, “cultural landscape”, “document”, “exhibit”.

[SOURCE: EN 15898:2019, 3.13 – modified, “exhibit” added to the Note 1 to entry.]

3.37**optical radiation**electromagnetic radiation at wavelengths between the region of transition to X-rays ($\lambda \approx 1$ nm) and the region of transition to radio waves ($\lambda \approx 1$ mm)Note 1 to entry: For the purposes of this document, only optical radiation from the vacuum ultraviolet (100 nm) to the mid-infrared (50 μ m) is considered.

Note 2 to entry: “Light” is sometimes used as a synonym to “optical radiation”, but it not recommended in scientific context.

[SOURCE: CIE S 017:2020, 17-21-002/IEV 845-21-002, modified — Notes 1 and 2 to entry omitted.]

3.38**photometric quantity**

quantity that is based on the perception of radiation by the human eye and is valid only for visible radiation

3.39**radiant flux** **Φ_e** all radiation emitted in all directions from a *light source* (3.26)

Note 1 to entry: The unit is expressed in watt, W.

3.40**radiometric quantity**

quantity that is physically related to the electromagnetic radiation