SLOVENSKI STANDARD
SIST-TS CEN/TS 16163:2014

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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

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

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

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (CEN/TS 16163:2014) has been prepared by Technical Committee CEN/TC 346 “Conservation of Cultural Heritage”, the secretariat of which is held by UNI.

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Introduction

Lighting is needed for many specific functions in museums and other cultural heritage buildings, for example, for 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. Enough light is needed to see well but this may present a challenge when what is being viewed will deteriorate in the presence of light. Where cultural heritage is judged to be worth preserving for future generations it is essential to consider the controlled use of light. 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 change of colour or loss in strength of materials damaged by light. Therefore, the challenge of museum exhibition lighting is to find an appropriate compromise between the long term preservation of the exhibit 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:

— 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 has to 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 scenographic and/or didactic objectives of the exhibition.

Due to its non-technical nature the last mentioned aspect cannot be dealt with in this Technical Specification.

This Technical Specification uses terms defined in European (EN 12665 and EN 15898) and International (CIE International lighting vocabulary) terminology standards, but their definitions have been adapted to the intended users of this specification.

1 Scope

This Technical Specification defines the procedures as well as the means to implement adequate lighting, with regard to the conservation policy. It takes visual, exhibition and conservation aspects into account and it also discusses the implications of the lighting design on the safeguarding of cultural property. This Technical Specification gives recommendations on values of minimum and maximum illumination levels. 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 assure the safeguarding of the exhibits. This Technical Specification covers 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.

2 Normative references

Not relevant.

3 Terms and definitions

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

3.1
accent lighting
lighting focused on an exhibit or a group of exhibits to emphasize them

[SOURCE: CIE S 017/E:2011]

3.2
annual luminous exposure
H_m
total luminous exposure per year (unit: lux hours per years, lx h / a)

Note 1 to entry: One year of museum display is approximately 3 000 h. See also 3.35.

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 set exposure to light

[SOURCE: ISO 105-B08:1995]

Note 1 to entry: This system is usually referred as 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, each about 2 to 3 times as sensitive as the next. 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 it can be seen which samples have faded and the dose of light received determined.

3.4
colour rendering
effect of an illuminant on the colour appearance of exhibits by conscious or subconscious comparison with their colour appearance under a reference illuminant

[SOURCE: CIE S 017/E:2011 or IEC-IEV:1987, 845-02-059]

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

Note 1 to entry: *Ra* has a maximum of 100, which generally occurs when the spectral distributions of the light source and the reference light source are substantially identical.

[SOURCE: CIE S 017/E:2011 or IEC-IEV:1987-845-02-61 and CIE 015:2004]

3.6
colour temperature
T_c
temperature of a Planckian radiator whose radiation has the same chromaticity as that of a given stimulus (unit: kelvin, K)

[SOURCE: CIE S 017/E:2011 or IEC-IEV:1987, 845-03-049; see also CIE 015:2004]

3.7
cultural heritage
tangible and intangible entities of significance to present and future generations

Note 1 to entry: The term “exhibit” is used in this standard for cultural heritage. In specific professional contexts, other terms are used: e.g. "artefact", “cultural property", “item”.

[SOURCE: EN 15898]

3.8
damage potential
Pdm
ratio of effective damaging irradiance and the illuminance at a point on the surface for a specific light source (unit : W/lm)

3.9
daylight
visible part of global solar radiation

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: IEC-IEV:1987, 845-09-84]

3.10
daylighting
lighting for which daylight is the light source

[SOURCE: CIE S 017/E:2011]

3.11
daylight factor
D
ratio of the illuminance at a point on a given plane due to the light received directly or indirectly from a sky of assumed or known luminance distribution, to the illuminance on a horizontal plane due to an unobstructed hemisphere of this sky, excluding the contribution of direct sunlight to both illuminances

Note 1 to entry: Glazing, dirt effects, etc. are included.

Note 2 to entry: When evaluating the lighting of interiors, the contribution of direct sunlight needs to be considered separately.

[SOURCE: CIE S 017/E:2011 and IEC-IEV, 1987, 845-09-087]

3.12
dosimeter
indicator measuring total irradiant exposure during a given time

Note 1 to entry: The above definition is valid in the context of the present Technical Specification and concerns with the light measurement only.

3.13
effective damaging irradiance
E_{dm}
radiant flux per unit area at a point on the surface weighted by the relative damage action spectrum (unit: watt per square metre, W m^{-2})

3.14
effective irradiance
***E_{eff}*: $E_{eff} = \int E_{e,\lambda}\, s(\lambda)\, d\lambda$**
irradiance weighted on the spectral sensitivity of the materials constituting the exhibit

3.15
exhibit
object on display illuminated by natural and/or artificial light

3.16
filter
any device that modifies or reduces a portion of the electromagnetic spectrum

Note 1 to entry: Common filters are: coloured and neutral filters, conversion temperature blue (CTB) and conversion temperature orange (CTO) filters, UV or IR absorbing filters. Neutral-density filters decrease the transmitted light by a known amount without selecting any particular wavelength.

3.17
illuminance (at a point of a surface)
E
ratio of the luminous flux $d\Phi$ incident on an element of the surface containing the point, to the area dA of that element (unit: lux, lx = lm·m^{-2})

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

[SOURCE: IEC-IEV, 1987, 845-01-038]

3.18
infrared radiation
IR
part of the electromagnetic spectrum with wavelength longer than those of the visible radiation, from about 780 nm to tens of micrometres

3.19
irradiance
E_e
radiometric quantity; the radiant flux per unit area at a point on the surface (unit: watt per square metre, W m^{-2})

3.20
lamp
source made in order to produce an optical radiation, usually visible

Note 1 to entry: This term is also sometimes used for certain types of luminaires (see below).

[SOURCE: CIE S 017/E:2011 and IEC-IEV, 1987, 845-07-003]

3.21
light
radiation that is considered from the point of view of its ability to excite the visual system

Note 1 to entry: It corresponds to the so-called visible radiation in the range between 380 nm and 780 nm.

Note 2 to entry: In the field of conservation, this term sometimes extends the range outside the visible portion, including parts of the ultraviolet (UV) and near infrared (IR) regions.

[SOURCE: CIE S 017/E:2011]

3.22
luminaire
apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except the lamps themselves, all the parts necessary for fixing and protecting the lamps and, where necessary, circuit auxiliaries together with the means for connecting them to the electric supply

[SOURCE: CIE S 017/E:2011 or IEC-IEV 1987-845-10-001]

3.23
luminance
L
quantity defined by the formula:

$$L = \frac{d\Phi}{dA \cos \vartheta d\Omega}$$

where

L is the luminance in a given direction or at a given point of a surface

$d\Phi$ is the luminous flux transmitted by an elementary beam passing through the given point and propagating in the solid angle dΩ containing the given direction

dA is the area of a section of that beam containing the given point

$d\Omega$ is the solid angle

ϑ is the angle between the normal to that section and the direction of the beam

(unit: $cd \cdot m^{-2} = lm \cdot m^{-2} \cdot sr^{-1}$)

Note 1 to entry: It corresponds to the light coming from a surface.

[SOURCE: CIE S 017/E:2011 or IEC-IEV, 1987, 845-01-035]

3.24
luminous flux
Φ
photometric quantity derived from the radiometric quantity radiant flux (radiant power) by evaluating the radiation according to the spectral sensitivity of the human eye (as defined by the CIE standard photometric observer) (unit: lumen, lm)

Note 1 to entry: It is the luminous power emitted by a source or received by a surface.

Note 2 to entry: For the practical use of this document, in this definition, the values used for the spectral sensitivity of the CIE standard photometric observer are those of the spectral luminous efficiency function V(*λ*) (photopic vision).

Note 3 to entry: See CIE S 017/E:2011 or IEC-IEV, 1987, 845-01-22 for the definition of spectral luminous efficiency, 845-01-23 for the definition of the CIE standard photometric observer and 845-01-56 for the definition of luminous efficacy of radiation and ISO 23539:2005(E)/CIE S 010/E:2004.

3.25
luminous intensity
I
luminous flux per unit solid angle in that direction (unit: candela, cd = lm sr^{-1} ; sr = steradian)

Note 1 to entry: It is the luminous flux on a small surface, divided by the solid angle that the surface subtends at the source (CIE S 017/E:2011 or IEC-IEV, 1987, 845-01-31).

Note 2 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.

3.26
lux
symbol lx; SI unit of illuminance

Note 1 to entry: For more information see CIE S 17/E:2011 or IEC-IEV, 1987, 845-01-052 or the BIPM SI Brochure.

3.27
photometric quantities
quantities that are based on the perception of radiation by the human eye and are valid only for visible radiation

3.28
radiant flux
Φ_e
radiometric quantity representing the radiant energy transported per unit time into a region of space by electromagnetic waves (unit: watt, W)

3.29
reflectance
ρ
ratio of the reflected radiant or luminous flux to the incident flux in the given conditions

[SOURCE: IEC-IEV, 1987, 845-04-058]

3.30
relative damage potential
ratio of the damage potential of a specific light source and the damage potential of the CIE standard Illuminant A (2 856 K) (equals to the incandescent lamp); it is dimensionless and assumes values between 0 and 1

3.31
relative damage action spectrum
$s(\lambda)_{dm,rel}$
describes the wavelength dependence of the photochemical damage properties, such as fading; it is dimensionless and assumes values between 0 and 1

$$s(\lambda)_{dm,rel} = \alpha(\lambda) \cdot \frac{1}{\lambda} \cdot f(\lambda)$$

where

$\alpha(\lambda)$ is the spectral absorbance

$f(\lambda)$ is a function of wavelength determined by the receiving material

Note 1 to entry: It is normalised at 300 nm so that $\mathbf{s(\lambda)_{dm,rel}}$ = 1 for λ = 300 nm (see also Figure 1).

[SOURCE: CIE 157:2004]