SLOVENSKI STANDARD
SIST EN 15193:2007

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Energijske značilnosti stavb - Energijske zahteve za osvetlitev

Energy performance of buildings - Energy requirements for lighting

Energetische Bewertung von Gebäuden - Energetische Anforderungen an die Beleuchtung

Performance énergétique des bâtiments - Exigences énergétiques pour l'éclairage

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Energy performance of buildings - Energy requirements for lighting

Performance énergétique des bâtiments - Exigences énergétiques pour l'éclairage

Energetische Bewertung von Gebäuden - Energetische Anforderungen an die Beleuchtung

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 15193:2007) 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of an identical text or by endorsement, at the latest by March 2008, and conflicting national standards shall be withdrawn at the latest by March 2008.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, 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

This European Standard was devised to establish conventions and procedures for the estimation of energy requirements of lighting in buildings, and to give a methodology for a numeric indicator of energy performance of buildings. It also provides guidance on the establishment of notional limits for lighting energy derived from reference schemes.

Having the correct lighting standard in buildings is of paramount importance and the convention and procedures assume that the designed and installed lighting scheme conforms to good lighting practices. For new installations the design should be to EN 12464-1.

This European Standard also gives advice on techniques for separate metering of the energy used for lighting that will give regular feedback on the effectiveness of the lighting controls.

The methodology of energy estimation not only provides values for the numeric indicator but will also provide input for the heating and cooling load impacts on the combined total energy performance of building indicator.

Figure 1 gives an overview of the methodology and the flow of the processes involved.

The methodology and format of the presentation of the results would satisfy the requirements of the EC Directive on Energy Performance of Buildings 2002/91/EC.

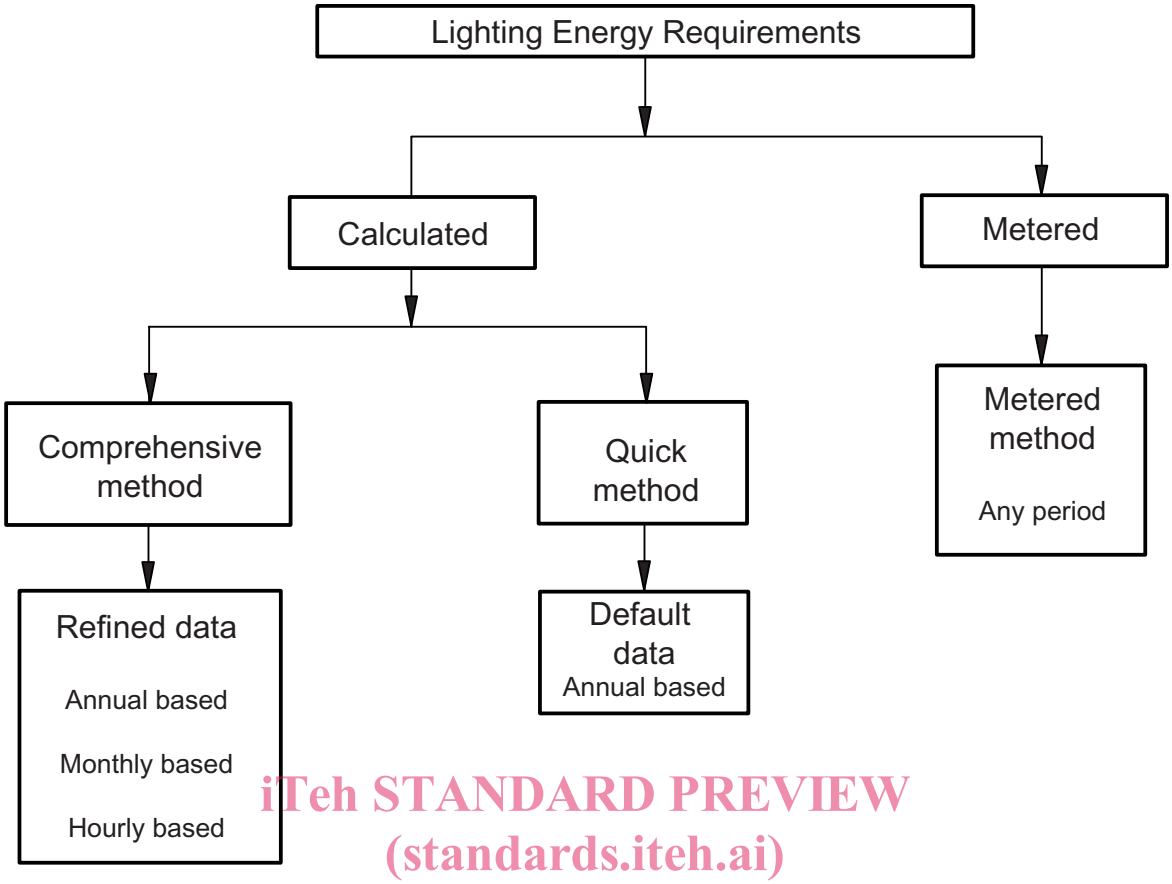

Figure 1 — Flow chart illustrating alternative routes to determine energy use

1 Scope

This European Standard specifies the calculation methodology for the evaluation of the amount of energy used for indoor lighting inside the building and provides a numeric indicator for lighting energy requirements used for certification purposes. This European Standard can be used for existing buildings and for the design of new or renovated buildings. It also provides reference schemes to base the targets for energy allocated for lighting usage. This European Standard also provides a methodology for the calculation of instantaneous lighting energy use for the estimation of the total energy performance of the building. Parasitic powers not included in the luminaire are excluded.

In this European Standard, the buildings are classified in the following categories: offices, education buildings, hospitals, hotels, restaurants, sports facilities, wholesale and retail services and manufacturing factories.

In some locations outside lighting may be fed with power from the building. This lighting may be used for illumination of the façade, open-air car park lighting, security lighting, garden lighting etc. These lighting systems may consume significant energy and if they are fed from the building, this load will not be included in the Lighting Energy Numeric Indicator or into the values used for heating and cooling load estimate. If metering of the lighting load is employed, these loads may be included in the measured lighting energy.

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.

EN 1838, *Lighting applications — Emergency lighting*

EN 12193, *Light and lighting — Sports lighting*

EN 12464-1:2002, *Light and lighting — Lighting of work places — Part 1: Indoor work places*

EN 60570, *Electrical supply track systems for luminaires (IEC 60570:2003, modified)*

EN 60598 (all parts), *Luminaires*

EN 61347 (all parts), *Lamp controlgear*

3 Terms and definitions

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

3.1
built-in luminaires
fixed luminaires installed to provide illumination in the building

3.2
control gear
components required to control the operation of the lamp(s)

3.3
power

3.3.1
luminaire power
(P_i)
electrical power from the mains supply consumed by the lamp(s), control gear and control circuit in or associated with the luminaire, measured in watts which includes any parasitic power when the luminaire is turned on

NOTE The rated luminaire power (P_i) for a specific luminaire may be obtained from the luminaire manufacturer.

3.3.2
total installed lighting power in the room or zone
(P_n)
power of all luminaires in the room or zone, measured in watts

$$P_n = \sum_i P_i \text{ [W]} \quad (1)$$

3.3.3
parasitic power

3.3.3.1
luminaire parasitic power
(P_{Pi})
electrical power from the mains supply consumed by the charging circuit of emergency lighting luminaires and the standby power for automatic controls in the luminaire when lamps are not operating, measured in watts

$$P_{pi} = P_{ci} + P_{ei} \text{ [W]} \quad (2)$$

3.3.3.2
parasitic power of the controls only during the time with the lamps off (P_{ci})
stand-by power for any controls and/or any battery charging power consumed by an emergency lighting system when the luminaire is turned off, measured in watts

3.3.3.3
emergency lighting charging power
(P_{ei})
input power to the charging circuit of emergency luminaires when the lamps are not operating, measured in watts

3.3.4
total installed parasitic power of the controls in the room or zone
(P_{pc})
input power of all control systems in luminaires in the room or zone when the lamps are not operating, measured in watts

$$P_{pc} = \sum_i P_{ci} \text{ [W]} \quad (3)$$

3.3.5
total installed charging power of the emergency lighting luminaires in the room or zone
(P_{em})
input charging power of all emergency lighting luminaires in the room or zone, measured in watts

$$P_{em} = \sum_i P_{ei} \quad [W] \qquad (4)$$

3.4
energy

3.4.1
total energy used for lighting
(W_t)
energy consumed in period *t*, by the sum of the luminaires when the lamps are operating, plus the parasitic loads when the lamps are not operating, in a room or zone, measured in kWh

3.4.2
energy consumption used for illumination
($W_{L,t}$)
energy consumed in period *t*, by the luminaire when the lamps are operating to fulfil the illumination function and purpose in the building, measured in kWh

3.4.3
luminaire parasitic energy consumption
($W_{P,t}$)
parasitic energy consumed in period *t*, by the charging circuit of emergency lighting luminaire and by the standby control system controlling the luminaires when the lamps are not operating, measured in kWh

3.5
time

3.5.1
operating time
(t)
time period for the energy consumption measured in hours [h]

3.5.2
annual operating time
(t_o)
annual number of operating hours of the lamp(s) and luminaires with the lamps operating

$$t_o = t_D + t_N \quad [h] \qquad (5)$$

NOTE This number is determined depending on the building use.

3.5.3
standard year time
(t_y)
time taken for one standard year to pass, taken as 8 760 h

3.5.4
daylight time usage
(t_D)
operating hours during the daylight time, measured in hours

3.5.5
non-daylight time usage
(t_N)
operating hours during the non-daylight time, measured in hours

3.5.6
emergency lighting charge time
(t_{em})
operating hours during which the emergency lighting batteries are being charged, measured in hours

3.5.7
scene setting operation time
(t_s)
operating hours of the scene setting controls, measured in hours

3.6
useful area
(A)
floor area inside the outer walls excluding non-habitable cellars and un-illuminated spaces, measured in m^2

3.7
dependency factors

3.7.1
daylight dependency factor
(F_D)
factor relating the usage of the total installed lighting power to daylight availability in the room or zone

3.7.2
occupancy dependency factor
(F_O)
factor relating the usage of the total installed lighting power to occupancy period in the room or zone

3.7.3
absence factor
(F_A)
factor relating to the period of absence of occupants

3.7.4
constant illuminance factor
(F_C)
factor relating to the usage of the total installed power when constant illuminance control is in operation in the room or zone

3.8
Maintenance Factor
(*MF*)
ratio of the average illuminance on the working plane after a certain period of use of a lighting installation to the initial average illuminance obtained under the same conditions for the installation

NOTE CIE 97 gives further information.

3.9
Lighting Energy Numeric Indicator
(*LENI*)
numeric indicator of the total annual lighting energy required in the building and given in kWh (m^2 x year)

NOTE The *LENI* can be used to make direct comparisons of the lighting energy used in buildings that have similar functions but are of different size and configuration.

4 Calculating energy used for lighting

4.1 Total energy used for lighting

4.1.1 Total estimated energy

The total estimated energy required for a period in a room or zone shall be estimated by the following equation:

$$W_t = W_{L,t} + W_{P,t} \text{ [kWh]} \quad (6)$$

where

An estimate of the lighting energy required to fulfil the illumination function and purpose in the building ($W_{L,t}$) shall be established using the following equation:

$$W_{L,t} = \sum\{ (P_n \text{ x } F_c) \times [(t_D \times F_o \times F_D) + (t_N \times F_o)]\}/1\ 000 \text{ [kWh]} \quad (7)$$

An estimate of the parasitic energy ($W_{P,t}$) required to provide charging energy for emergency lighting and for standby energy for lighting controls in the building shall be established using the following equation:

$$W_{P,t} = \sum\{\{P_{pc} \times [t_y - (t_D + t_N)]\} + (P_{em} \times t_e)\}/1\ 000 \text{ [kWh]} \quad (8)$$

NOTE 1 The total lighting energy can be estimated for any required period *t* (hourly, daily, weekly, monthly or annually) in accordance with the time interval of the dependency factors used.

NOTE 2 For existing buildings, $W_{P,t}$ and $W_{L,t}$ can be established more accurately by directly and separately metering the energy supplied to the lighting (see Clause 5).

NOTE 3 This estimation does not include the power consumed by control systems remote from the luminaire and not drawing power from the luminaire. Where known this should be added.

NOTE 4 Equation (8) does not include the power consumed by a central battery emergency lighting system.

4.1.2 Total annual energy used for lighting

$$W = W_L + W_P \text{ [kWh/year]} \quad (9)$$

where

An estimate of the annual lighting energy required to fulfil the illumination function and purpose in the building (W_L) and annual parasitic energy (W_P) required to provide charging energy for emergency lighting and for standby energy for lighting controls in the building shall be established by Equations (7) and (8) respectively.

4.2 Lighting Energy Numeric Indicator (*LENI*)

Lighting Energy Numeric Indicator for the building shall be established using the following equation:

$$LENI = W/A \text{ [kWh/(m}^2 \times \text{year)]} \quad (10)$$

where

W is the total annual energy used for lighting [kWh/year];

A is the total useful floor area of the building [m^2].

5 Metering

5.1 General

The lighting consumption shall be separately measured using one of the following methods:

a) kWh meters on dedicated lighting circuits in the electrical distribution;

b) local power meters coupled to or integrated in the lighting controllers of a lighting management system;

c) a lighting management system that can calculate the local consumed energy and make this information available to a building management system (BMS);

d) a lighting management system that can calculate the consumed energy per building section and make this information available in an exportable format, e.g. a spread sheet format;

e) a lighting management system that logs the hours run, the proportionality (dimming level) and relates this to its internal data base on installed load.

NOTE The measured value may be compared with the real kilowatt hours consumption measured during commissioning of the building.

5.2 Load segregation

The network of a BMS/lighting management system shall provide the same function in segregation as in the power distribution.

5.3 Remote metering

a. Remote metering is recommended for buildings having completely segregated power distribution systems.

b. Remote metering in buildings can also be used for more intelligent (lighting management) systems to provide data.

NOTE Annex A gives examples of metering methods.

6 Calculation of lighting energy in buildings

6.1 Installed lighting power

6.1.1 General

There are two forms of installed power in buildings, luminaire power and parasitic power.

Luminaire power, which provides power for functional illumination shall conform to EN 12193 for lighting of sports facilities and EN 12464-1 for lighting of indoor work places.

Parasitic power, which provides power for lighting control systems and for charging batteries for emergency lighting shall conform to EN 1838.

6.1.2 Luminaire

Luminaires and electrical components of luminaires shall be designed and constructed in accordance with the relevant parts of EN 60598, EN 60570 and/or EN 61347.

6.1.3 Luminaire power (P_i)

The total rated power (in watts) of a specific luminaire should be obtained in accordance with Annex B.

6.1.4 Parasitic powers (P_{ci} and P_{ei})

Parasitic power should be obtained in accordance with Annex B.

6.2 Calculation methods

6.2.1 Quick method

When using the quick method of estimation of the annual lighting energy estimation for typical building types, Equation (9) shall be used.

NOTE 1 The energy requirement estimation by the quick method will yield higher *LENI* values than that obtained by the more accurate comprehensive method described in 6.3.

NOTE 2 If the national values are not available, use the default values for t_D, t_N, F_c, F_D, F_O and W_p are given in Annexes E, F and G.

6.2.2 Comprehensive method

6.2.2.1 General

The comprehensive method allows for a more accurate determination of the lighting energy estimations for different periods e.g. annual or monthly.

When using the comprehensive method of lighting energy estimations Equation (6) shall be used for the required period *t*.

NOTE 1 The daylight dependency factor (F_D) for a room or zone can be determined as described in Annex C.

NOTE 2 The occupancy dependency factor (F_O) for a room or zone can be determined as described in Annex D.

NOTE 3 This method may be used for any periods and for any locations provided that the full estimation of occupancy and daylight availability is predicted.