INTERNATIONAL STANDARD

ISO 10916

First edition
2014-06-15

Calculation of the impact of daylight utilization on the net and final energy demand for lighting

Calcul de l'effet d'utiliser la lumière du jour à la demande énergétique net et finale pour l'éclairage

Reference number
ISO 10916:2014(E)

© ISO 2014



COPYRIGHT PROTECTED DOCUMENT

© ISO 2014

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword ... **iv**

Introduction ... **v**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **2**

4 Symbols, indices, and abbreviated terms ... **3**
4.1 Symbols ... 4
4.2 Indices ... 5

5 Proof calculation method ... **5**
5.1 Energy demand for lighting as function of daylight ... 5
5.2 Subdivision of a building into zones ... 7
5.3 Operating time ... 8
5.4 Artificial lighting ... 8
5.5 Constant illuminance control ... 8
5.6 Daylight ... 8
5.7 Occupancy dependency factor $\boldsymbol{F}_{O,n}$ ... *9*

6 Daylight Performance Indicator ... **9**

Annex A (informative) **Simple calculation method** ... **10**

Annex B (normative) **Comprehensive calculation** ... **53**

Annex C (informative) **Daylight performance indicator** ... **54**

Annex D (informative) **Examples** ... **55**

Bibliography ... **63**

© ISO 2014 – All rights reserved

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 2, *Calculation methods*.

© ISO 2014 – All rights reserved

Introduction

This International Standard is part of a set of standards allowing to rate the overall energetic performance of buildings. Facades and rooflights have a key impact on the building's energy balance. This International Standard supports the daylighting and lighting-energy-related analysis and optimization of facade and rooflight systems. It was therefore specifically devised to establish conventions and procedures for the estimation of daylight penetrating buildings through vertical facades and rooflights, as well as on the energy consumption for electric lighting as a function of daylight provided in indoor spaces.

© ISO 2014 – All rights reserved

Calculation of the impact of daylight utilization on the net and final energy demand for lighting

1 Scope

This International Standard defines the calculation methodology for determining the monthly and annual amount of usable daylight penetrating non-residential buildings through vertical facades and rooflights and the impact thereof on the energy demand for electric lighting. This International Standard can be used for existing buildings and the design of new and renovated buildings.

This International Standard provides the overall lighting energy balance equation relating the installed power density of the electric lighting system with daylight supply and lighting controls (proof calculation method).

The determination of the installed power density is not in the scope of this method, neither are controls relating, for instance, to occupancy detection. Provided the determination of the installed power density and control parameters using external sources, the internal loads by lighting and the lighting energy demand itself can be calculated. The energy demand for lighting and internal loads by lighting can then be taken into account in the overall building energy balance calculations:

— heating;

— ventilation;

— climate regulation and control (including cooling and humidification);

— heating the domestic hot-water supply of buildings.

For estimating the daylight supply and rating daylight-dependent artificial lighting control systems, a simple table-based calculation approach is provided. The simple method describes the division of a building into zones as required for daylight illumination-engineering purposes, as well as considerations on the way in which daylight supplied by vertical facade systems and rooflights is utilized and how daylight-dependent lighting control systems effect energy demand. Dynamic vertical facades with optional shading and light redirection properties are considered, i.e. allowing a separate optimization of facade solutions under direct insolation and under diffuse skies. For rooflighting systems standard, static solutions like shed rooflights and continuous rooflights are considered. The method is applicable for different latitudes and climates. For standard building zones (utilizations), operation times are provided.

For detailed computer-based analysis (comprehensive calculation), minimum requirements are specified.

To support overall building performance assessment, additional daylight performance indicators on the overall building level are provided.

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.

CIE S 017/E:2011, *ILV: International Lighting Vocabulary*

© ISO 2014 – All rights reserved

3 Terms and definitions

For the purposes of this document, the terms and definitions given in CIE S 017/E:2011 ILV apply.

3.1
ballast
unit inserted between the supply and one or more discharge lamps, which by means of inductance, capacitance, or a combination of inductance and capacitance, serves mainly to limit the current of the lamp(s) to the required value

3.2
control system
various types of electrical and electronic systems including the following:

— systems used to control and regulate;

— systems to protect against solar radiation and/or glare;

— artificial lighting in relation to the currently available daylight;

— systems used to detect and record the presence of occupants

3.3
daylight factor
D
ratio of the illuminance at a point on a given plane due to the light received directly and 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, where the contribution of direct sunlight to both illuminances is excluded

[SOURCE: CIE S 017/E:2011 ILV, modified]

Note 1 to entry: CIE S 017/E:2011 defines the unit as 1. However, daylight factor is in practice, usually presented in percent values.

3.4
electrical power of artificial lighting system
P
the total electrical power consumption of the lighting system in the considered space

3.5
illuminance
E
quotient of the luminous flux dΦ incident on an element of the surface containing the point, by the area dA of that element

[SOURCE: CIE S 017/E:2011 ILV, modified]

Note 1 to entry: Unit: $lx = lm \times m^{-2}$.

3.6
lamp
source made to produce optical radiation, usually visible

3.7
light reflectance
ratio of the reflected luminous flux to the incident luminous flux in the given conditions

Note 1 to entry: Unit: 1.

© ISO 2014 – All rights reserved