SLOVENSKI STANDARD
SIST EN 15255:2007

01-december-2007

Toplotne znaḷ ilnosti stavb - Izraḷ un senzibilne hladilne obremenitve prostora - Sploġna merila in validacija postopka

Thermal performance of buildings - Sensible room cooling load calculation - General criteria and validation procedures

Wärmetechnishes Verhalten von Gebäuden - Berechnung der wahrnehmbaren Raumkühllast - Allgemeine Kriterien und Validierungsverfahren

Performance thermique des bâtiments - Calcul de la charge de refroidissement en chaleur sensible d'un local - Criteres généraux et procédures de validation

Ta slovenski standard je istoveten z: **EN 15255:2007**

ICS:

91.120.10	Toplotna izolacija stavb	Thermal insulation

SIST EN 15255:2007 **en,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 15255

August 2007

ICS 91.140.99; 91.120.10

English Version

Energy performance of buildings - Sensible room cooling load calculation - General criteria and validation procedures

Performance thermique des bâtiments - Calcul de la charge de refroidissement en chaleur sensible d'un local - Critères généraux et procédures de validation

Wärmetechnisches Verhalten von Gebäuden - Berechnung der wahrnehmbaren Raumkühllast - Allgemeine Kriterien und Validierungsverfahren

This European Standard was approved by CEN on 6 July 2007.

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 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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 15255:2007: E

Contents

Page

Foreword

This document (EN 15255:2007) has been prepared by Technical Committee CEN/TC 89 “Thermal performance of buildings and building components”, the secretariat of which is held by SIS.

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 February 2008, and conflicting national standards shall be withdrawn at the latest by February 2008.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/343), and supports essential requirements of EU Directive 2002/91/EC on the energy performance of buildings (EPBD). It forms part of a series of standards aimed at European harmonisation of the methodology for the calculation of the energy performance of buildings. An overview of the whole set of standards is given in prCEN/TR 15615.

Attention is drawn to the need for observance of EU Directives transposed into national legal requirements. Existing national regulations (with or without reference to national standards) may restrict for the time being the implementation of this European Standard.

This European Standard is one of a series of standards on general criteria and validation procedures for transient calculation methods for the design and the evaluation of the thermal and energy performance of buildings and building components. No existing European Standard is superseded.

The target audience of this European Standard are software developers of building simulation tools and policy makers in the building regulation sector. The standard specifies the boundary conditions and the simplifications needed to reach calculation results for the building part which are comparable.

It needs to be emphasized that there exist more sophisticated energy simulation methods and procedures including interactions with the heating, cooling, ventilating and lighting systems which may be used for the design and optimization process of a building but are not in line with existing European Standards.

This European Standard provides the means (in part) to assess the contribution that building products and services make to energy conservation and to the overall energy performance of buildings.

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

The proper design and sizing of air conditioning systems requires the calculation of the cooling load in the space to be conditioned (room cooling load). The variables affecting the room cooling load calculation are numerous, often difficult to define precisely and always intricately inter-related. Many cooling load components vary widely in magnitude during a 24-hour period.

Since these cyclic changes are often out of phase with each other, they need to be analyzed to establish the maximum room cooling load for a building or zone. The maximum cooling capacity for a zoned building is the largest hourly total of the simultaneous zone loads throughout a design day; but it needs to handle the peak cooling load for each zone at its peak hour. This means that a calculation method needs to be able to determine the cooling load of each zone throughout the calculation period.

A large number of calculation methods are available in Europe. These methods generally are based on different solution techniques that include simplifications of the real phenomena. According to those simplifications they are able to consider specific or general situations. One specific situation is represented by the calculation of the maximum peak load of a single zone for convective source with the control of the air temperature.

This European Standard includes the criteria and the level of input and output data required for a simplified calculation method of the cooling load of a single room.

A simplified load calculation method is given in the informative Annex A.

Any calculation method satisfies the standard if it complies with the assumptions, data requirements and the validation procedures described in Clause 7.

The series of European Standards, giving general criteria and validation procedures for the building part of energy simulation models for the different calculation subjects, are listed below.

European Standard	Subject
EN ISO 13791 EN ISO 13792	Temperature calculations (air and operative)
EN 15255	Load calculations (sensible cooling)
EN 15265	Energy need calculations (heating and cooling)

1 Scope

This European Standard sets out the level of input and output data, and prescribes the boundary conditions required for a calculation method of the sensible cooling load of a single room under constant and/or floating temperature taking into account the limit of the peak cooling load of the system. It includes a classification scheme of the calculation method and the criteria to be met by a calculation method in order to comply with this European Standard.

The purpose of this European Standard is to validate calculation methods used to:

— evaluate the maximum cooling load for equipment selection and cooling system design;

— evaluate the temperature profile when the cooling capacity of the system is reduced;

— provide data for evaluation of the optimum possibilities for load reduction;

— allow analysis of partial loads as required for system design, operation and control.

The validation procedure is used to check the room sensible heat balance model, taking into account:

— the external surface heat balance;

— the conduction through the building envelope;

— the effect of the thermal mass of the structures;

— the internal surface heat balance;

— the air heat balance;

— the heat balance solution method.

All other aspects are given either by fixed boundary conditions or by input data and are not in the focus of the model validation. It is assumed that for all these other matters e.g. embedded heating and cooling systems, prescriptive models have to be used according to existing European Standards.

Informative Annex A gives a simplified method for cooling load calculation.

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 410, *Glass in building — Determination of luminous and solar characteristics of glazing*

EN 13363-2, *Solar protection devices combined with glazing — Calculation of total solar energy transmittance and light transmittance — Part 2: Detailed calculation method*

EN 15377-1, *Heating systems in buildings — Design of embedded water based surface heating and cooling systems — Part 1: Determination of the design heating and cooling capacity*

prEN ISO 6946, *Building components and building elements — Thermal resistance and thermal transmittance — Calculation method (ISO/DIS 6946:2005)*

EN ISO 7345:1995, *Thermal insulation — Physical quantities and definitions (ISO 7345:1987)*

EN ISO 9251:1995, *Thermal insulation — Heat transfer conditions and properties of materials — Vocabulary (ISO 9251:1987)*

EN ISO 9288:1996, *Thermal insulation — Heat transfer by radiation — Physical quantities and definitions (ISO 9288:1989)*

prEN ISO 9346:2007, *Hygrothermal performance of buildings and building materials — Physical quantities for mass transfer — Vocabulary (ISO/DIS 9346:2005)*

EN ISO 10077-1, *Thermal performance of windows, doors and shutters — Calculation of thermal transmittance — Part 1: General (ISO 10077-1:2006)*

prEN ISO 13370, *Thermal performance of buildings — Heat transfer via the ground — Calculation methods (ISO/DIS 13370:2005)*

prEN ISO 13786, *Thermal performance of building components — Dynamic thermal characteristics — Calculation methods (ISO/ 13786:1999)*

EN ISO 13792:2005, *Thermal performance of buildings — Calculation of internal temperatures of a room in summer without mechanical cooling — Simplified methods (ISO 13792:2005)*

3 Terms, definitions, symbols and units

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 7345:1995, EN ISO 9288:1996, EN ISO 9251:1995, prEN ISO 9346:2007 and the following apply.

3.1.1
internal environment
closed space delimited from the external environment or adjacent spaces by a building fabric component

3.1.2
envelope element
element of a building fabric delimited by two parallel surfaces, one of them is exposed to the room under consideration

3.1.3
room air
air of the internal environment

3.1.4
internal air temperature
temperature of the room air

3.1.5
internal surface temperature
temperature of the internal surface of each element of the envelope

3.1.6
mean radiant temperature
uniform surface temperature of an enclosure in which an occupant would exchange the same amount of radiant heat as in the actual non-uniform enclosure

3.1.7
operative temperature
uniform temperature of an enclosure in which an occupant would exchange the same amount of heat by radiation plus convection as in the actual non-uniform environment

NOTE As approximation, the operative temperature is calculated as mean value of the air temperature and the mean radiant temperature.

3.1.8
thermal source
component which exchanges heat with the internal environment

3.1.8.1
convective thermal source
thermal source that exchanges heat only with the air

3.1.8.2
surface source
thermal source that exchanges heat with the surrounding surfaces by long-wave radiation and with the air by convection

3.1.9
internal design temperature
internal temperature assumed as reference for the system control.

NOTE The internal design temperature may be the internal air temperature or the operative temperature.

3.2 Symbols and units

The principal symbols used are listed in the following table. Other symbols are defined where they are used within the standard.

Symbol	Quantity	Unit
A	area	m^2
A_s	sunlit area	m^2
c_p	specific heat capacity of air at constant pressure	J/(kg·K)
c_d	coefficient of discharge	-
d	layer thickness	m
f	correction factor	-
f_{df}	solar distribution factor	-
f_{ic}	internal convective factor	-
f_{lf}	solar loss factor	-
f_s	sunlit factor	-
f_{sa}	solar to air factor	-
h	surface heat transfer coefficient	$W/(m^2·K)$
I	intensity of solar radiation	W/m^2
l	length	m
$\dot{m}$	mass flow rate	kg/s
P	power	W
q	density of heat flow rate	W/m^2
R	thermal resistance	$m^2·K/W$
T	thermodynamic temperature	K
t	time	s
U	thermal transmittance under steady state conditions	$W/(m^2·K)$
V	volume	m^3
v	velocity	m/s

α	solar absorptance	-
ε	total hemispherical emissivity	-
Φ	heat flow rate	W
Λ	thermal conductance	$W/(m^2 \cdot K)$
λ	thermal conductivity	$W/(m \cdot K)$
ρ	solar reflectance	-
ρ	density	kg/m^3
θ	Celsius temperature	°C
τ_e	solar direct transmittance	-

3.3 Subscripts

a	air	lr	long wave radiation
av	average	mr	mean radiant
b	building	n	normal to surface
c	convection	op	operative
cd	conduction	out	out of section
D	direct solar radiation	r	radiation
d	diffuse solar radiation	ref	reference
e	external	sa	solar to air
ec	external cavity	se	external surface
ef	external floor	set	set point value
eq	equivalent	si	internal surface
g	ground	sk	sky
i	internal	sr	short wave radiation
ic	internal cavity	T	total
if	internal floor	t	time
il	inlet section	v	ventilation

va	ventilation through air cavity

4 Basic assumptions

For the purposes of this standard the following basic assumptions are considered as minimum requirements:

— the room is considered to be a closed space delimited by enclosure elements;

— the air temperature is uniform throughout the room;

— the thermophysical properties of all materials composing the enclosure elements are constant;

— the convective heat transfer coefficients are fixed;

— the heat conduction through each enclosure element is one-dimensional and the surface of each enclosure element is isothermal;

— air spaces within envelope components are treated as air layers bounded by two isothermal surfaces;

— the mean radiant temperature is calculated as the area-weighted average of the internal surface temperatures of each component;

— the operative temperature is calculated as the arithmetic mean of the internal air temperature and the mean radiant temperature;

— the distribution of the solar radiation on the internal surfaces of the components of the room is time independent;

— the distribution of the radiative heat flow due to internal gains is uniform;

— the long-wave radiative and the convective heat transfers at the internal surface of each component are treated separately;

— thermal bridges are treated by steady state calculations.

5 Data requirement

5.1 General

For evaluating the hourly values of the room cooling load and the internal temperatures the following information is required:

— the design climatic data for the location;

— the descriptions of the envelope elements (area, exposure, boundary conditions);

— for each envelope element the calculation of the thermophysical parameters (steady state and transient conditions) and the solar factors of the opaque and the transparent components;

— the design internal temperature;

— the schedule of the ventilation and infiltration rate;

— the scheduled values of the convective and radiative heat flow due to lighting and occupants;

— the scheduled values of the convective and radiative heat flow due to internal equipment and appliances;

— the characteristics of the cooling system and maximum room cooling power.

5.2 Climatic data

For a location with given latitude and longitude the following hourly climatic data are required:

— external air temperature;

— the intensity of solar radiation (direct normal and diffuse horizontal);

— the external radiant temperature (sky and surrounding);

— the ground albedo.

NOTE Design climatic data, derived from EN ISO 15927-4, can be included in a national annex.

5.3 Descriptions of the envelope elements

5.3.1 General

The following types of room enclosure elements are considered:

— external components: opaque walls, windows including external and/or internal shading devices, roof and floor;

— internal components: adjacent to similar rooms (adiabatic elements);
adjacent to rooms with pre-defined conditions;

— components with a fixed known surface temperature (cooling surface).

The thermophysical properties shall be calculated according to the standards for specific elements, such as windows and glazing according to EN ISO 10077-1, EN 410 and EN 13363-2, walls and roofs according to prEN ISO 6946 and prEN ISO 13786 and ground floors according to prEN ISO 13370.

For each of these situations the boundary conditions are defined in 5.3.2.

5.3.2 Boundary conditions

5.3.2.1 External components

Boundary conditions are the hourly values of the climatic data defined in 5.2 and solar shading by the horizon, overhangs and fins. For an element in contact with the ground the design external temperature shall be defined in accordance with prEN ISO 13370.

5.3.2.2 Internal components

5.3.2.2.1 Adjacent to similar rooms (adiabatic components)

The air temperature, the mean radiant temperature and the solar radiation absorbed by the surface are the same at the external and the internal surfaces of the component.