# SLOVENSKI STANDARD
# SIST EN ISO 13788:2013

**01-maj-2013**

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**Higrotermalno obnašanje sestavnih delov stavb in elementov stavb - Notranja površinska temperatura za preprečevanje kritične vlage na površini konstrukcije in kondenzacije v konstrukciji - Računska metoda (ISO 13788:2012)**

Hygrothermal performance of building components and building elements - Internal surface temperature to avoid critical surface humidity and interstitial condensation - Calculation methods (ISO 13788:2012)



Wärme- und feuchtetechnisches Verhalten von Bauteilen und Bauelementen - Raumseitige Oberflächentemperatur zur Vermeidung kritischer Oberflächenfeuchte und Tauwasserbildung im Bauteilinneren - Berechnungsverfahren (ISO 13788:2012)



Performance hygrothermique des composants et parois de bâtiments - Température superficielle intérieure permettant d'éviter l'humidité superficielle critique et la condensation dans la masse - Méthodes de calcul (ISO 13788:2012)

**Ta slovenski standard je istoveten z:** **EN ISO 13788:2012**

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**ICS:**

| | | |
|---|---|---|
| 91.120.10 | Toplotna izolacija stavb | Thermal insulation |
| 91.120.30 | Zaščita pred vlago | Waterproofing |

**SIST EN ISO 13788:2013** **en,fr,de**

# EUROPEAN STANDARD
# NORME EUROPÉENNE
# EUROPÄISCHE NORM

**EN ISO 13788**

December 2012

ICS 91.060.01; 91.120.10

Supersedes EN ISO 13788:2001

English Version

## Hygrothermal performance of building components and building elements - Internal surface temperature to avoid critical surface humidity and interstitial condensation - Calculation methods (ISO 13788:2012)

Performance hygrothermique des composants et parois de bâtiments - Température superficielle intérieure permettant d'éviter l'humidité superficielle critique et la condensation dans la masse - Méthodes de calcul (ISO 13788:2012)

Wärme- und feuchtetechnisches Verhalten von Bauteilen und Bauelementen - Raumseitige Oberflächentemperatur zur Vermeidung kritischer Oberflächenfeuchte und Tauwasserbildung im Bauteilinneren - Berechnungsverfahren (ISO 13788:2012)

This European Standard was approved by CEN on 28 December 2012.

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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
EUROPÄISCHES KOMITEE FÜR NORMUNG

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# Contents

Page

## Foreword

This document (EN ISO 13788:2012) has been prepared by Technical Committee ISO/TC 163 "Thermal performance and energy use in the built environment" in collaboration with 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 June 2013, and conflicting national standards shall be withdrawn at the latest by June 2013.

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

This document supersedes EN ISO 13788:2001.

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**Endorsement notice**

The text of ISO 13788:2012 has been approved by CEN as a EN ISO 13788:2012 without any modification.

# INTERNATIONAL STANDARD

# ISO 13788

Second edition
2012-12-15

# Hygrothermal performance of building components and building elements — Internal surface temperature to avoid critical surface humidity and interstitial condensation — Calculation methods



*Performance hygrothermique des composants et parois de bâtiments — Température superficielle intérieure permettant d'éviter l'humidité superficielle critique et la condensation dans la masse — Méthodes de calcul*



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# Contents

Page

# 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 13788 was prepared by Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 2, *Calculation methods* in cooperation with CEN/TC 89, *Thermal performance of buildings and building components*.

This second edition cancels and replaces the first edition (ISO 13788:2001), which has been technically revised.



 

# Introduction

Moisture transfer is a very complex process and the knowledge of moisture transfer mechanisms, material properties, initial conditions and boundary conditions is often limited. Therefore this International Standard lays down simplified calculation methods, which assume that moisture transport is by vapour diffusion alone and use monthly climate data. The standardization of these calculation methods does not exclude use of more advanced methods. If other sources of moisture, such as rain penetration or convection, are negligible, the calculations will normally lead to designs well on the safe side and if a construction fails a specified design criterion according to this procedure, more accurate methods may be used to show that the design will pass.

This International Standard deals with:

a) the critical surface humidity likely to lead to problems such as mould growth on the internal surfaces of buildings,

b) interstitial condensation within a building component, in:

   — heating periods, where the internal temperature is usually higher than outside;

   — cooling periods, where the internal temperature is usually lower than the outside;

   — cold stores, where the internal temperature is always lower than outside.

c) an estimate of the time taken for a component, between high vapour resistance layers, to dry, after wetting from any source, and the risk of interstitial condensation occurring elsewhere in the component during the drying process.



This International Standard does not cover other aspects of moisture, e.g. ground water and ingress of precipitation.



In some cases, airflow from the interior of the building into the structure is the major mechanism for moisture transport, which can increase the risk of condensation problems very significantly. This International Standard does not address this issue; where it is felt to be important, more advanced assessment methods should be considered.

The limitations on the physical processes covered by this International Standard mean that it can provide a more robust analysis of some structures than others. The results will be more reliable for lightweight, airtight structures that do not contain materials that store large amounts of water. They will be less reliable for structures with large thermal and moisture capacity and which are subject to significant air leakage.

# Hygrothermal performance of building components and building elements — Internal surface temperature to avoid critical surface humidity and interstitial condensation — Calculation methods

## 1 Scope

This International Standard gives simplified calculation methods for:

a) The internal surface temperature of a building component or building element below which mould growth is likely, given the internal temperature and relative humidity. The method can also be used to assess the risk of other internal surface condensation problems.

b) The assessment of the risk of interstitial condensation due to water vapour diffusion. The method used does not take account of a number of important physical phenomena including:

- the variation of material properties with moisture content;
- capillary suction and liquid moisture transfer within materials;
- air movement from within the building into the component through gaps or within air spaces;
- the hygroscopic moisture capacity of materials.



Consequently, the method is applicable only where the effects of these phenomena can be considered to be negligible.



c) The time taken for water, from any source, in a layer between two high vapour resistance layers to dry out and the risk of interstitial condensation occurring elsewhere in the component during the drying process.

## 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.

ISO 6946:2007, *Building components and building elements — Thermal resistance and thermal transmittance — Calculation method*

ISO 9346, *Hygrothermal performance of buildings and building materials — Physical quantities for mass transfer — Vocabulary*

ISO 15927-1, *Hygrothermal performance of buildings — Calculation and presentation of climatic data — Part 1: Monthly means of single meteorological elements*

## 3 Terms and definitions, symbols and units

### 3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9346 and the following apply.

**3.1.1**
**monthly mean temperature**
mean temperature calculated from hourly values or the daily maximum and minimum temperature over a month

**3.1.2**
**temperature factor at the internal surface**
difference between the temperature of the internal surface and the external air temperature, divided by the difference between the internal operative temperature and the external air temperature, calculated with a surface resistance at the internal surface $R_{si}$:

$$f_{R_{si}} = \frac{\theta_{si} - \theta_e}{\theta_i - \theta_e}$$

Note 1 to entry: The operative temperature is taken as the arithmetic mean value of the internal air temperature and the mean radiant temperature of all surfaces surrounding the internal environment.

Note 2 to entry: Methods of calculating the temperature factor in complex constructions are given in ISO 10211.

**3.1.3**
**design temperature factor at the internal surface**
minimum acceptable temperature factor at the internal surface:

$$f_{R_{si,min}} = \frac{\theta_{si,min} - \theta_e}{\theta_i - \theta_e}$$



**3.1.4**
**minimum acceptable temperature**
lowest internal surface temperature before mould growth may start



**3.1.5**
**mean annual minimum temperature**
mean of the lowest temperature recorded in each year of a set of at least ten years' data

**3.1.6**
**internal moisture excess**
rate of moisture production in a space divided by the air change rate and the volume of the space:

$$\Delta \nu = \nu_i - \nu_e = G / (n \cdot V)$$

**3.1.7**
**water vapour diffusion-equivalent air layer thickness**
thickness of a motionless air layer which has the same water vapour resistance as the material layer in question: $s_d = \mu \cdot d$

**3.1.8**
**relative humidity**
ratio of the vapour pressure to the saturated vapour pressure at the same temperature:

$$\varphi = \frac{p}{p_{sat}}$$

**3.1.9**
**critical surface humidity**
relative humidity at the surface that leads to deterioration of the surface, specifically mould growth

**3.1.10**
**heating period**
external climate that leads to risk of condensation when a building is being heated, so that the internal temperature and vapour pressure are higher than outside

 

**3.1.11**
**cooling period**
external climate that leads to risk of condensation when a building is being cooled, so that the internal temperature and vapour pressure are lower than outside

## 3.2 Symbols and units

| Symbol | Quantity | Unit |
|---|---|---|
| $D$ | water vapour diffusion coefficient in a material | $m^2/s$ |
| $D_0$ | water vapour diffusion coefficient in air | $m^2/s$ |
| $G$ | internal moisture production rate | kg/h |
| $M_a$ | accumulated moisture content per area at an interface | $kg/m^2$ |
| $R$ | thermal resistance | $m^2·K/W$ |
| $R_v$ | gas constant for water vapour = 462 | $Pa·m^3/(K·kg)$ |
| $T$ | thermodynamic temperature | K |
| $U$ | thermal transmittance of component or element | $W/(m^2·K)$ |
| $V$ | internal volume of building | $m^3$ |
| $Z_p$ | water vapour diffusion resistance with respect to partial vapour pressure | $m^2·s·Pa/kg$ |
| $Z_v$ | water vapour diffusion resistance with respect to humidity by volume | $s/m^2$ |
| $d$ | material layer thickness | m |
| $f_{Rsi}$ | temperature factor at the internal surface | - |
| $f_{Rsi,min}$ | design temperature factor at the internal surface | - |
| $g$ | density of water vapour flow rate | $kg/(m^2·s)$ |
| $n$ | air change rate | $h^{-1}$ |
| $p$ | water vapour pressure | Pa |
| $q$ | density of heat flow rate | $W/m^2$ |
| $s_d$ | water vapour diffusion-equivalent air layer thickness | m |
| $t$ | time | s |
| $w$ | moisture content mass by volume | $kg/m^3$ |
| $\delta_p$ | water vapour permeability of material with respect to partial vapour pressure | kg/(m·s·Pa) |
| $\delta_0$ | water vapour permeability of air with respect to partial vapour pressure | kg/(m·s·Pa) |
| $v$ | humidity of air by volume | $kg/m^3$ |
| $\Delta v$ | internal moisture excess, $v_i - v_e$ | $kg/m^3$ |
| $\Delta p$ | internal vapour pressure excess, $p_i - p_e$ | Pa |
| $\varphi$ | relative humidity | - |
| $\lambda$ | thermal conductivity | W/(m·K) |
| $\mu$ | water vapour resistance factor | - |
| $\theta$ | Celsius temperature | °C |
| $\theta_{si,min}$ | minimum acceptable surface temperature | °C |



 