SLOVENSKI STANDARD
SIST EN ISO 15927-1:2004

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Higrotermalne karakteristike stavb – Računanje in predstavitev klimatskih podatkov – 1. del: Mesečno in letno povprečje posameznih vremenskih elementov (ISO 15927-1:2003)

Hygrothermal performance of buildings - Calculation and presentation of climatic data - Part 1: Monthly means of single meteorological elements (ISO 15927-1:2003)

Wärme- und feuchteschutztechnisches Verhalten von Gebäuden - Berechnung und Darstellung von Klimadaten - Teil 1: Monats- und Jahresmittelwerte einzelner meteorologischer Elemente (ISO 15927-1:2002)

Performance hygrothermique des bâtiments - Calcul et présentation des données climatiques - Partie 1: Moyennes mensuelles et annuelles des éléments météorologiques simples (ISO 15927-1:2002)

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Hygrothermal performance of buildings - Calculation and presentation of climatic data - Part 1: Monthly means of single meteorological elements (ISO 15927-1:2003)

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This European Standard was approved by CEN on 10 April 2003.

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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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, 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

Contents

Foreword

This document (EN ISO 15927-1:2003) has been prepared by Technical Committee CEN/TC 89, "*Thermal performance of buildings and building components*", the secretariat of which is held by SIS, in collaboration with Technical Committee ISO/TC 163, *"Thermal performance and energy use in the built environment"*, Subcommittee SC 2 "*Calculation methods"*.

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 May 2004, and conflicting national standards shall be withdrawn at the latest by May 2004.

This standard is one of a series of standards on calculation methods for the design and evaluation of the thermal and moisture performance of buildings. EN ISO 15927, *Hygrothermal performance of buildings – Calculation and presentation of climatic data,* consists of six parts:

Part 1: *Monthly means of single meteorological elements*;
Part 2: *Data for design cooling loads and risk of overheating*;
Part 3: *Calculation of a driving rain index for vertical surfaces from hourly wind and rain data*;
Part 4: *Data for assessing the annual energy for heating and cooling*;
Part 5: *Winter external design air temperatures and related wind data*;
Part 6: *Accumulated temperature differences for assessing energy use in space heating.*

Annexes A and B are informative.

This document includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies procedures for calculating and presenting the monthly means of those parameters of climatic data needed to assess some aspects of the thermal and moisture performance of buildings. Numerical values should be obtained from the meteorological service in the relevant country.

This European Standard covers the following single climate variables:

- air temperature;
- atmospheric humidity;
- wind speed;
- precipitation;
- solar radiation;
- longwave radiation.

Meteorological instrumentation and methods of observation are not covered; these are specified by the World Meteorological Organisation (WMO).

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

World Meteorological Organisation: *Guide to meteorological instruments and methods of observation.* 6th Edition WMO - No.8 1996.

3 Terms, definitions, symbols and units

3.1 Terms and definitions

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

3.1.1
mixing ratio
ratio of the mass of water vapour to the mass of dry air with which the water vapour is associated

3.1.2
water vapour pressure
part of the total atmospheric pressure exerted by water vapour

3.1.3
saturated vapour pressure over water
vapour pressure of moist air in equilibrium with a plane liquid water surface

3.1.4
relative humidity
ratio of the vapour pressure of moist air to the vapour pressure it would have if it were saturated

3.1.5
reference wind speed
wind speed measured at a height of 10 m above ground level in open country without nearby obstacles

3.1.6
gust speed
greatest instantaneous wind speed observed during the period over which the mean is calculated

3.1.7
solar irradiance
radiation power per area generated by the reception of solar radiation on a plane of any tilt and orientation

The following special quantities can be distinguished according to the conditions of reception:

3.1.7.1
global solar irradiance
irradiance generated by reception of solar radiation from the full hemisphere

NOTE According to the following definitions it is equal to the reception of direct solar and diffuse solar radiation on a horizontal plane. In the case of tilted planes a portion of the ground reflected global solar radiation is also received.

3.1.7.2
direct solar irradiance
irradiance generated by the reception of solar radiation from a conical angle which surrounds concentrically the apparent solar disk

NOTE 1 Also referred to as "beam solar radiation".

NOTE 2 The horizontal component of the direct solar irradiance is a part of the global solar irradiance.

NOTE 3 Any component of the direct solar irradiance is generated nearly exclusively from unscattered solar radiation.

NOTE 4 The diameter of the apparent solar disk corresponds to about 0,5 degrees; for technical reasons the available radiometers receive the direct solar irradiance from solid angles around the solar disk which correspond mostly to field-of-view angles between 3° and 6°.

3.1.7.3
diffuse solar irradiance
irradiance generated by the reception of scattered solar radiation from the full sky hemisphere , with the exception of that solid angle which is used to measure the direct solar irradiance

NOTE 1 Practical measurement requires a sun following disk, which permanently shades the receiver of the radiometer with a 'field of shade' angle which equals the field of view angle used for measuring direct solar irradiance. This allows the global irradiance to be calculated as the sum of diffuse solar and the horizontal component of the direct solar irradiance.

NOTE 2 The use of a ring to shade the sun along its daily path instead of a disk requires an equation to correct for the corresponding losses of diffuse solar irradiance.

3.1.7.4
reflected solar irradiance
irradiance generated by reception of the rising reflected global radiation on a downward looking plane

NOTE 1 The ratio of reflected solar and global solar irradiance is called albedo.

NOTE 2 Part of the reflected global solar radiation is received on any tilted plane.

3.1.8
solar irradiation
radiant energy per area received from the sun on a plane of defined inclination and orientation during a given period of time

NOTE The same components as indicated in 3.1.7 for irradiance can be distinguished.

3.1.9
longwave (terrestrial) radiation
radiation with wavelength greater than 3 μm from surfaces at the ground and from the atmosphere

NOTE The exchange of longwave radiation occurs permanently between buildings, the ground and the atmosphere at temperatures between 240 K and 340 K.

3.1.10
thermometer screen
white painted, wooden, plastic, or aluminium louvered enclosure, which allows a free flow of air over thermometers while shielding them from solar radiation, longwave radiation and precipitation

3.2 Symbols and units

Symbol	Quantity	Unit
C_R	roughness coefficient	-
C_T	topography coefficient	-
D	wind direction from North	°
d_m	number of days in a month	-
d_y	number of days in a year	-
$G_{l,a}$	longwave irradiancefrom the atmosphere on a horizontal plane	°W/m^2
G_s	solar irradiance	W/m^2
$G_{s,b}$	direct (beam) solar irradiance	W/m^2
$G_{s,d}$	diffuse solar irradiance	W/m^2
$G_{s,g}$	global solar irradiance	W/m^2
$G_{s,r}$	reflected global solar irradiance	W·m^2
H	effective height of topographic feature	m
H_s	solar irradiation	MJ/m^2
h_m	number of hours in a month	-
K_R	terrain factor	-
L_d	actual length of downwind slope	m
L_e	effective length of upwind slope	m
L_u	actual length of upwind slope	m
R	rainfall total (or equivalent amount of melted solid precipitation)	mm
P	total atmospheric pressure	hPa
p	water vapour pressure	hPa
$p_{sat}\ (\theta)$	saturated vapour pressure over water at temperature θ	hPa
s	scale factor for topography coefficient	-
T	temperature	K
v	wind speed	m/s
$\hat{v}$	gust wind speed	m/s

Symbol	Quantity	Unit
$\bar{v}_r$	reference mean wind speed	m/s
$\bar{v}_s$	mean wind speed at a site	m/s
x	mixing ratio	g/kg
$x_{sat}(\theta)$	saturated mixing ratio with respect to liquid water at temperature θ	g/kg
y	horizontal distance of site from crest of topographic feature	m
z	height above ground	m
z_{min}	minimum height	m
z_0	roughness height	m
ε	ratio of gas constant of dry air to gas constant of water vapour (ε = 0,62198)	-
θ	air temperature	°C
Φ	upwind slope of topographic feature	-
φ	relative humidity	-

3.2.1 Subscripts

Subscript	Meaning
a	atmosphere
*d*m	mean over a day
*d*x	maximum over a day
*d*n	minimum over a day
h	values representative of an hour (either instantaneous measurements or the mean of many readings in the hour)
ic	inclination of a surface
*m*m	mean over a month
N	values representative of a number of hours N (e.g. 3 h, 6 h or 12 h but less than 24 h) (either instantaneous measurements or the mean of many readings in the period)
l	longwave
p*q*	value exceeded for q % of the time
s	solar
sd	standard deviation

4 Periods over which parameters are calculated

The methods specified in clauses 5 to 9 can be used to calculate monthly means or totals from either individual months (e.g. a January from a specified year) or from all the corresponding months from many years (e.g. all the Januarys from a 30 year data set).

Calculations of the standard deviation of daily means or totals about the monthly or annual means or totals (see 5.3 and 5.4) shall refer to a specified month or year.

The specified year or the multi-year period over which all parameters are calculated shall be quoted with the values of the parameters.

5 Air temperature

5.1 Sources of data

The dry-bulb air temperature data used to calculate monthly means shall come from observations from a thermometer screen fitted with louvers to allow a free flow of air.

5.2 Calculation of the monthly mean

5.2.1 From hourly data

The hourly temperature may be either: a) the mean of continuous measurements recorded during that hour or b) measurements recorded at a particular moment within the hour (e.g. on the hour).

The monthly means shall be calculated as:

$$\theta_{m\mathrm{m}} = \frac{\sum_{h=1}^{h_m} \theta_h}{h_m} \qquad (1)$$

where

θ_h is the hourly temperature, in °C;

h_m is the number of hours in the month under consideration.

5.2.2 From data measured at intervals of 3 h or 6 h

If dry-bulb outdoor air temperature data are available at intervals of 3 h or 6 h (each value may be either the mean of continuous measurements during the interval or an instantaneous measurement taken on the interval), the monthly mean is calculated from:

$$\theta_{m\mathrm{m}} = \frac{\sum_{N=1}^{n_m} \theta_N}{n_m} \qquad (2)$$

where

n_m = 8 d_m for data at three-hour intervals;

= 4 d_m for data at six-hour intervals;

d_m is the number of days in the month under consideration.

5.2.3 From daily maximum and minimum data

If the only dry-bulb outdoor air temperatures available are the daily maximum and minimum for each day of the month, the daily mean for each day is calculated as:

$$\theta_{d\mathrm{m}} = \frac{\theta_{d\mathrm{n}} + \theta_{d\mathrm{x}}}{2} \qquad (3)$$

and the monthly means obtained as:

$$\theta_{m\mathrm{m}} = \frac{\sum_{d=1}^{d_m} \theta_{d\mathrm{m}}}{d_m} \tag{4}$$

where

d_m is the number of days in the month under consideration.

NOTE Daily means calculated from the daily maximum and minimum temperature will, in general, be different from those calculated from hourly values. Most (95 %) of the differences lie between ± 1,0 °C but they can range up to ± 2,0 °C. Monthly means calculated from daily maximum and minimum values will also differ from those calculated from hourly values, but in this case 95 % of the differences lie between ± 0,2 °C and the maximum difference lies between ± 0,25 °C.

5.2.4 From instantaneous data at 07:30, 14:30 and 21:30 or at other similar times

If dry-bulb outdoor air temperature data are available only at 07:30, 14:30 and 21:30, or at other similar times, the daily mean for each day is calculated using Equation (5), or the equivalent equation for the appropriate times.

$$\theta_{d\mathrm{m}} = \frac{\theta_{07:30} + \theta_{14:30} + 2\theta_{21:30}}{4} \tag{5}$$

and the monthly mean obtained from Equation (4).

5.3 Calculation of the standard deviation of daily means about the monthly mean

If not defined in 5.2.2, 5.2.3 or 5.2.4, the daily mean temperatures for each day in the month are calculated from data measured at one, three or six hourly intervals using:

$$\theta_{d\mathrm{m}} = \frac{\sum_{N=1}^{n_d} \theta_N}{n_d} \tag{6}$$

where

n_d = 24 for data at one-hour intervals;

= 8 for data at three-hour intervals;

= 4 for data at six-hour intervals;

or from daily maximum and minimum data using Equation (3) or at 07:30, 14:30 and 21:30 or similar times using Equation (5).

Then the standard deviation of the daily means from the monthly mean is given by:

$$\theta_{\mathrm{sd}m} = \sqrt{\frac{d_m \sum_{d=1}^{d_m} \theta_{d\mathrm{m}}^2 - \left(\sum_{d=1}^{d_m} \theta_{d\mathrm{m}}\right)^2}{d_m (d_m - 1)}} \tag{7}$$

5.4 Calculation of the annual mean and standard deviation

The annual mean temperature shall be calculated from the daily means using:

$$\theta_{y\mathrm{m}} = \frac{\sum_{d=1}^{d_y} \theta_{d\mathrm{m}}}{d_y} \tag{8}$$

The standard deviation of the daily means from the annual mean shall be calculated by:

$$\theta_{\mathrm{sd}\,y} = \sqrt{\frac{d_y \sum_{d=1}^{dy} \theta_{d\mathrm{m}}^{2} - \left(\sum_{d=1}^{d_y} \theta_{d\mathrm{m}} \right)^{2}}{d_y (d_y - 1)}} \tag{9}$$

5.5 Expression of results

Monthly mean values of the dry-bulb outdoor temperature shall be expressed to the nearest 0,1 °C and the type of data (i.e. hourly, daily, etc.) used for the monthly mean calculation shall be specified.

The following parameters shall be reported for each month:

a) the measurement dates from which the parameters are calculated;

b) the monthly means of the dry-bulb outdoor temperature;

c) the standard deviation of the daily mean dry-bulb temperature about the monthly mean;

and, when available:

d) the maximum value of the hourly dry-bulb outdoor temperatures;

e) the minimum value of the hourly dry bulb outdoor temperatures;

f) the values of the hourly dry-bulb outdoor temperature at the 1 %, 5 %, 10 %, 90 %, 95 % and 99 % percentiles.

NOTE If four or more values of the dry-bulb outdoor temperature per day are available, provided that these values are reasonably spread through the day, it is possible to estimate hourly values by linear or other interpolation of the raw data and then calculate the statistical values specified in f).

These parameters summarised in b) to f) shall be presented in tabular form similar to the example shown in Table 1.