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Hygrothermal performance of buildings — Calculation and presentation of climatic data —

Part 4:
Data for assessing the annual energy for cooling and heating systems

Performance hygrothermique des bâtiments — Calcul et présentation des données climatiques —

Partie 4: Données permettant d'évaluer la demande annuelle en énergie des systèmes de climatisation et de chauffage

ICS 07.060; 91.120.10

ISO/CEN PARALLEL ENQUIRY

This draft International Standard is a draft European Standard developed within the European Committee for Standardization (CEN) and processed under the CEN-lead mode of collaboration as defined in the Vienna Agreement. The document has been transmitted by CEN to ISO for circulation for ISO member body voting in parallel with CEN enquiry. Comments received from ISO member bodies, including those from non-CEN members, will be considered by the appropriate CEN technical body. **Accordingly, ISO member bodies who are not CEN members are requested to send *a copy* of their comments on this DIS directly to CEN/TC 89** (BST, 27, Möllerörsgatan, S - 216 11 Malmö) **as well as returning their vote and comments in the normal way to the ISO Central Secretariat.** Should this DIS be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month FDIS vote in ISO and formal vote in CEN.

In accordance with the provisions of Council Resolution 15/1993 this document is circulated in the English language only.

Conformément aux dispositions de la Résolution du Conseil 15/1993, ce document est distribué en version anglaise seulement.

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Foreword

This document (prEN ISO 15927-4) 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 document is currently submitted to the second parallel Enquiry.

This standard is one of a series of standards, which specify methods for analysing meteorological data for use in the evaluation of the energy and moisture performance of buildings. ISO 15927, *Hygrothermal performance of buildings – Calculation and presentation of climatic data*, consists of six parts:

— Part 1: *Monthly and annual 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*

Introduction

This standard covers the selection of appropriate meteorological data for the assessment of the long-term mean energy use for heating and cooling of buildings. Means of selecting data to assess the maximum cooling demand likely to occur once every ten years are specified in ISO 15927-2[1] and the maximum heating demand in ISO 15927-5[1].

Correct simulation of building performance depends not only on the appropriate mean values of the meteorological parameters, but also on the frequency distributions of individual parameters and the cross correlations between them. As these can be difficult to retain in the type of artificially constructed reference year discussed in this standard the use of long periods (at least ten years but preferably more) of hourly meteorological data should be preferred where possible. This also takes account of long spells of unusually warm or cold weather, lasting several months, which will be eliminated in the construction of a Reference Year. In practice, however, long runs of hourly data containing all the necessary parameters are very expensive and can be difficult to obtain for many areas. There is, therefore, still a need for annual sets of data which can be used to represent the long term mean performance of buildings.

This standard specifies a method for the construction of a reference year from a longer meteorological record. Other methods are possible for constructing reference years for specific purposes.

[1] To be published

Hygrothermal performance of buildings — Calculation and presentation of climatic data —

Part 4:
Data for assessing the annual energy for cooling and heating systems

1 Scope

This standard specifies a method for constructing a reference year of hourly values of appropriate meteorological data suitable for assessing the average annual energy for heating and cooling. Other reference years representing average conditions can be constructed for special purposes. The procedures in this standard are not suitable for constructing extreme or semi-extreme years for simulation of, for example, moisture damage or energy demand in cold years.

Meteorological instrumentation and methods of observation are not covered: these are specified by the World Meteorological Organisation.

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.

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

3 Definitions, symbols and units

3.1 Definitions

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

3.1.1
cumulative distribution function
normalised rank order of the values of a parameter, when drawn up in increasing order, within a specified period

3.1.2
reference year
year of hourly values of appropriate meteorological parameters representative of the long term climate

3.2 Symbols and quantities

Symbol	Quantity
$F(p)$	cumulative distribution function of p within each individual month
J	rank order of daily means within a calendar month in one year
K	rank order of daily means within that calendar month in the whole data set
N	number of days in any calendar month in the whole data set
m	month of the year
n	number of days in an individual month
p	climate parameter (temperature, solar radiation or humidity)
$\overline{p}$	daily mean of any climate parameter
y	year
$\Phi(p)$	cumulative distribution function of p within each calendar month in all the years in a sample

4 Sources of meteorological data

Data used for calculations according to this standard shall have been measured by the methods specified in WMO Guide No. 8, 1996.

Because the data used in the selection process (5.3.1 items a) to g)) are processed in a way different from than normally used by the weather services, much care has to be exercised in the quality control of the raw data. Missing values should be generated by interpolation or by estimate, and sudden, unnatural jumps or singular values should be examined and corrected. If the raw data are available as three-hourly data only (sometimes referred to as synoptic data), then the missing values should be interpolated making use of daily maximum and minimum temperatures, if present.

5 Construction of reference year

5.1 Necessary parameters

The reference year shall contain hourly values of at least the following meteorological parameters, taken from a location representative of the climate concerned :

— dry bulb air temperature;

— direct normal solar irradiance and diffuse solar irradiance on a horizontal surface;

— relative humidity, absolute humidity, water vapour pressure or dewpoint temperature;

— wind speed at a height of 10 metres above ground.

As temperature, radiation and humidity are the key parameters for cooling and heating calculations these are used to construct the reference year.

NOTE Other parameters can be used to develop reference years for special applications.

5.2 Principle of construction

In principle, if a year existed within the long term data in which each month was representative of the long term conditions, this year could be used as a reference year. However that is unlikely and in practice the most appropriate months are selected from a number of different years and joined together, with smoothing at the joins, to construct a complete year.

The procedure specified below is designed to construct a year of hourly values in which

a) the mean value of individual variables;

b) their frequency distribution;

c) correlations between the different variables within each month;

are as close as possible to the corresponding calendar month of the long term data set.

The procedure therefore has two stages:

1) selection of the best month, as defined in 5.3, from the multi-year record for each calendar month;

2) adjustment of the hourly values in the selected month so as to provide a smooth transition when the different months are joined to form a year.

The procedures in 1) and 2) are such that the correlations between variables are retained.

5.3 Procedure

5.3.1 Selection of months to form the reference year

In the procedure described below, dry bulb temperature, solar radiation and humidity are taken as the primary parameters for selecting the 'best' months to form the reference year, with wind speed as a secondary parameter. Other combinations of primary and secondary parameters can be used to develop reference years for special purposes; the variables chosen as the basis of the reference year shall always be stated in the accompanying documentation.

For each climatic parameter p (where p is dry bulb temperature, solar radiation or humidity) carry out the following operations.

a) From at least 10 years (but preferably more) of hourly values of p, calculate the daily means $\overline{p}$.

b) For each calendar month, calculate the cumulative distribution function of the daily means over all years in the data set , $\Phi(p,m,i)$, by sorting all the values in increasing order and then using Equation (1):

$$\Phi(p,m,i) = \frac{K(i)}{N+1} \qquad (1)$$

where $K(i)$ is the rank order of the i^{th} value of the daily means within that calendar month in the whole data set.

c) For each year of the data set, calculate the cumulative distribution function of the daily means within each calendar month, $F(p,y,m,i)$ by sorting all the values for that month and that year in increasing order and then using Equation (2):

$$F(p,y,m,i) = \frac{J(i)}{n+1} \qquad (2)$$

where $J(i)$ is the rank order of the i^{th} value of the daily means within that month and that year.