# SVENSK STANDARD
# SS-EN 13829

Fastställd/Approved: 2000-12-22
Publicerad/Published: 2000-12-22
Utgåva/Edition: 1
Språk/Language: engelska/English
ICS: 91.120.10; 92.200.20

## Byggnaders termiska egenskaper – Bestämning av byggnaders lufttäthet – Tryckprovningsmetod (ISO 9972:1996, modifierad)

## Thermal performance of buildings – Determination of air permeability of buildings – Fan pressurization method (ISO 9972:1996, modified)

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Denna standard ersätter SS 21551, utgåva 2.

The European Standard EN 13829:2000 has the status of a Swedish Standard. This document contains the official English version of EN 13829:2000.

This standard supersedes the Swedish Standard SS 21551, edition 2.



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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 13829

November 2000

ICS 91.120.10

English version

# Thermal performance of buildings - Determination of air permeability of buildings - Fan pressurization method (ISO 9972:1996, modified)

Performance thermique des bâtiments - Détermination de la perméabilité à l'air des bâtiments - Méthode de pressurisation par ventilateur (ISO 9972:1996, modifiée)

Wärmetechnisches Verhalten von Gebäuden - Bestimmung der Luftdurchlässigkeit von Gebäuden - Differenzdruckverfahren (ISO 9972:1996, modifiziert)

This European Standard was approved by CEN on 18 October 2000.

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

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Ref. No. EN 13829:2000 E

**Contents**

## Foreword

This European Standard 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of an identical text or by endorsement, at the latest by May 2001, and conflicting national standards shall be withdrawn at the latest by May 2001.

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, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This document modifies prEN ISO 9972:1996 "Thermal insulation - Determination of building airtightness - Fan pressurization method" which failed the Unique Acceptance Procedure (UAP).

This standard is one of a series of standards for the assessment of the thermal performance of buildings and building components.

Annexes A, B, C and D of this European Standard are for information only.

This standard includes a bibliography.

## Introduction

The fan pressurization method is intended to characterize the air permeability of the building envelope or parts thereof. It can be used:

a) to measure the air permeability of a building or part thereof for compliance with a design airtightness specification,
b) to compare the relative air permeability of several similar buildings or parts of buildings,
c) to identify the leakage sources, and
d) to determine the air leakage reduction resulting from individual retrofit measures applied incrementally to an existing building or part of building.

This method does not measure the air infiltration rate of a building. The results of the fan pressurization test can be used to estimate the air infiltration by means of calculation. Other methods are applicable when it is desired to obtain a direct measurement of the air infiltration rate. It is better to use the fan pressurization method for diagnostic purposes and measure the actual infiltration rate with tracer gas methods. A single tracer gas measurement will give limited information on the performance of ventilation and infiltration of buildings.

This method applies to measurements of air flow through the construction from outside to inside or vice versa. It does not apply to air flow measurements from outside through the construction and back to outside.

The proper use of this standard requires a knowledge of the principles of air flow and pressure measurements. Ideal conditions for the test described in this standard are small temperature differences and low wind speeds. For tests conducted in the field, it needs to be recognized that field conditions may be less than ideal. Nevertheless, strong winds and large indoor-outdoor temperature differences should be avoided.

# 1 Scope

This standard is intended for the measurement of the air permeability of buildings or parts of buildings in the field. It specifies the use of mechanical pressurization or depressurization of a building or part of a building. It describes the measurement of the resulting air flow rates over a range of indoor-outdoor static pressure differences.

This standard is intended for the measurement of the air leakage of building envelopes of single-zone buildings. For the purpose of this standard, many multi-zone buildings can be treated as single-zone buildings by opening interior doors or by inducing equal pressures in adjacent zones.

It does not address evaluation of air permeability through individual components.

# 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).

EN ISO 7345
Thermal Insulation - Physical quantities and definitions (ISO 7345:1987)

# 3 Terms and definitions

For the purposes of this standard, the terms and definitions in accordance with EN ISO 7345 and, as indicated in the follow, apply.

**3.1**
**air leakage rate**
air flow rate across the building envelope.

NOTE This movement includes flow through joints, cracks and porous surfaces, or a combination thereof, induced by the air-moving equipment used in this standard (see clause 4).

**3.2**
**internal volume**
deliberately heated, cooled or mechanically ventilated space within a building or part of a building subject to the measurement, generally not including the attic space, basement space and attached structures.

**3.3**
**building envelope**
boundary or barrier separating the internal volume subject to the test from the outside environment or another part of the building.

**3.4**
**air change rate at reference pressure**
air leakage rate per internal volume at the test reference pressure differential across the building envelope.

NOTE Usually 50 Pa.

**3.5**
**air permeability**
air leakage rate per envelope area at the test reference pressure differential across the building envelope.

NOTE Usually 50 Pa.

**3.6**
**specific leakage rate**
air leakage rate per net floor area at the test reference pressure differential across the building envelope.

NOTE A pressure difference of 50 Pa is the most common**.**

## 3.7 Symbols and units

| Symbol | Quantity | Unit |
|---|---|---|
| $\dot{V}_r$ | readings of air flow rate | m³/h |
| $\dot{V}_m$ | measured air flow rate | m³/h |
| $\dot{V}_{env}$ | air flow rate through the building envelope | m³/h |
| $\dot{V}_L$ | air leakage rate | m³/h |
| $\dot{V}_{pr}$ | air leakage rate at a specified reference pressure difference | m³/h |
| $\dot{V}_{50}$ | air leakage rate at 50 Pa | $m^3/h$ |
| $q$ | tracer gas injection rate | $m^3/h$ |
| $C_{env}$ | air flow coefficient | $m^3/(h \cdot Pa^n)$ |
| $C_L$ | air leakage coefficient | $m^3/(h \cdot Pa^n)$ |
| $\rho$ | air density | $kg/m^3$ |
| $\phi$ | relative humidity | - |
| $\theta$ | temperature | °C |
| $n$ | air flow exponent | - |
| $p$ | pressure | Pa |
| $p_{bar}$ | uncorrected barometric pressure | Pa |
| $p_v$ | partial vapour pressure of water | Pa |
| $p_{vs}$ | saturation vapour pressure of water | Pa |
| $\Delta p$ | induced pressure difference | Pa |
| $\Delta p_m$ | measured pressure difference | Pa |
| $\Delta p_0$ | zero flow pressure difference (average) | Pa |
| $\Delta p_{0,1}$; $\Delta p_{0,2}$ | zero-flow pressure difference before and after the test (air moving equipment closed) | Pa |
| $\Delta p_r$ | reference pressure | Pa |
| $A_E$ | envelope area | $m^2$ |
| $A_F$ | floor area | m² |
| $V$ | internal volume | $m^3$ |
| $n_{50}$ | air change rate at 50 Pa | $h^{-1}$ |
| $q_{50}$ | air permeability at 50 Pa | $m^3/(h \cdot m^2)$ |
| $w_{50}$ | specific leakage rate at 50 Pa | $m^3/(h \cdot m^2)$ |

# 4 Apparatus

## 4.1 General

The following description of apparatus is general in nature. Any arrangement of equipment using the same principles and capable of performing the test procedure within the allowable tolerances is permitted. Examples of equipment configurations commonly used are indicated in annex A.

Periodic calibration of the measurement system used in this test method according to manufacturer specifications or to standardized quality insurance systems is required.

## 4.2 Equipment

### 4.2.1 Air-moving equipment

Device that is capable of inducing a specific range of positive and negative pressure differences across the building envelope or part thereof. The system shall provide constant air flow at each pressure difference for the period required to obtain readings of air flow rate.

In large buildings, the heating, ventilating and air conditioning systems can be used.

### 4.2.2 Pressure-measuring device

Instrument capable of measuring pressure differences with an accuracy of ± 2 Pa in the range of 0 Pa to 60 Pa.

### 4.2.3 Air flow rate measuring system

Device to measure air flow rate within ± 7 % of the reading.

Care shall be taken if the principle underlying the measurement of volumetric flow rate is an orifice. The reading of the air flow rate shall be corrected according to air density (see manufacturers' specifications)

### 4.2.4 Temperature-measuring device

Instrument to measure temperature to an accuracy of ± 1 K.

# 5 Measurement procedure

## 5.1 Measurement conditions

### 5.1.1 General

The accuracy of this measurement procedure is largely dependent on the instrumentation and apparatus used and on the ambient conditions under which the data are taken.

### 5.1.2 Measured extent

The extent of the building or part of the building measured is defined as follows.

1) Normally the part of the building measured includes all deliberately conditioned rooms.

2) In special cases the extent of the part of the building actually to be tested can be defined in agreement with the client.
3) If the aim of the measurement is compliance with the airtightness specification of a building code or standard and the measured extent is not defined in this code or by a standard, the measured extent is defined as in 1).

Individual parts of a building can be measured separately; e.g. in apartment buildings each apartment can be measured individually. However, interpretation of results shall consider that air leakage measured in this way may include flow through leaks to adjacent parts of the building.

NOTE 1 It is possible that an apartment building meets airtightness requirements but one or more individual apartments do not.

NOTE 2 Good practice would require measuring pressures induced in adjoining spaces such as the attic and basement or adjacent apartments, since air flow into or out of these spaces may be induced by the test method.

#### 5.1.3 Time of measurement

The measurement can only take place after the envelope of the building or part of the building to be tested has been completed.

NOTE A preliminary air permeability measurement of the air barrier may allow leakages to be repaired more easily, than when the building is completed.

#### 5.1.4 Meteorological conditions

If the product of the indoor/outdoor air temperature difference, in K, multiplied by the height of the building envelope, in m, gives a result greater than 500 m·K it is unlikely that a satisfactory zero flow pressure difference will be obtained (see 5.3.3).

If the meteorological wind speed exceeds 6 m/s or reaches 3 on the Beaufort scale it is unlikely that a satisfactory zero flow pressure difference will be obtained (see 5.3.3).

### 5.2 Preparation

#### 5.2.1 General

This standard describes two types of test method depending on the purpose. Both types need different preparation of the building:

Method A (test of a building in use):

The condition of the building envelope should represent its condition during the season in which heating or cooling systems are used.

Method B (test of the building envelope):

Any intentional opening in the building envelope shall be closed or sealed as specified in 5.2.2 and 5.2.3.

#### 5.2.2 Building components

Close all intentional exterior openings of the building or part of the building to be tested (windows, doors, fireguard).

For the purpose of method A (building in use) do not take any further measures to improve the airtightness.