SLOVENSKI STANDARD
SIST ISO 9972:1997

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Toplotna izolacija - Doloị anje tesnosti stavb - Metoda vzdrģevanja nadtlaka z ventilatorjem

Thermal insulation -- Determination of building airtightness -- Fan pressurization method

Isolation thermique -- Détermination de l'étanchéité à l'air des bâtiments -- Méthode de pressurisation par ventilateur

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INTERNATIONAL STANDARD

ISO 9972

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Thermal insulation — Determination of building airtightness — Fan pressurization method

Isolation thermique — Détermination de l'étanchéité à l'air des bâtiments — Méthode de pressurisation par ventilateur

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Contents

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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.

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.

International Standard ISO 9972 was prepared by Technical Committee ISO/TC 163, *Thermal insulation*, Subcommittee SC 1, *Test and measurement methods*.

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

Introduction

The fan pressurization method produces a result that characterizes the airtightness of the building envelope or parts thereof. It can be used:

a) to compare the relative airtightness of several similar buildings or building components;

b) to identify the leakage sources and rates of leakage from different components of the same building envelope;

c) to determine the air leakage reduction for individual retrofit measures applied incrementally to an existing building or building component.

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. If a direct measurement of the air infiltration is desired, other methods must be used. It is better to use the fan pressurization method for diagnostic purposes and measure the absolute infiltration rate with the tracer dilution method.

Thermal insulation — Determination of building airtightness — Fan pressurization method

1 Scope

This International Standard specifies the use of mechanical pressurization or depressurization of a building or building component. It describes techniques for measuring the resulting air flow rates at given indoor-outdoor static pressure differences. From the relationship between the air flow rates and pressure differences, the air leakage characteristics of a building envelope can be evaluated.

This International Standard is applicable to small temperature differentials and low-wind pressure conditions. For tests conducted in the field, it must be recognized that field conditions may be less than ideal. Nevertheless, strong winds and large indoor-outdoor temperature differentials should be avoided. The proper use of this International Standard requires a knowledge of the principles of air flow and pressure measurements.

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

This International Standard is intended for the measurement of the airtightness of buildings and building components in the field. It does not address laboratory evaluation of air leakage through individual components. The results of the field measurements are not intended to characterize the air leakage of an isolated component but of the component and its junction with the building envelope under given conditions of installation. Therefore, the results from field tests of component airtightness may not be in agreement with the results from laboratory tests.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6781:1983, *Thermal insulation — Qualitative detection of thermal irregularities in building envelopes — Infrared method.*

ISO 7345:1987, *Thermal insulation — Physical quantities and definitions.*

3 Definitions, symbols and units

For the purposes of this International Standard, the following definitions and those given in ISO 7345 apply. Symbols and units are given in table 1.

3.1 air leakage rate: Air flow rate across the building envelope or component.

NOTE 1 This movement includes flow through joints, cracks, and porous surfaces, or a combination thereof, induced by the air-moving equipment (4.2.1).

3.2 building envelope: Boundary or barrier separating the interior volume of a building from the outside environment.

NOTE 2 The interior volume is the deliberately conditioned space within a building, generally not including the attic space, basement space, and attached structures, unless such spaces are connected to the heating and air conditioning system, such as a crawl space plenum.

Table 1 — Symbols and units

Symbol	Quantity	Unit
$\dot{V}$	Measured air flow rate	m^3/s
$\dot{V}_0$	Air leakage rate	m^3/s
q	Tracer gas injection rate	m^3/s
C	Air leakage coefficient	$m^3/(s \cdot Pa^n)$
ρ	Air density	kg/m^3
ϕ	Relative humidity	%
θ	Celsius temperature	°C
n	Air flow exponent	–
p	Pressure	Pa
p_{bar}	Uncorrected barometric pressure	Pa
p_v	Partial water vapour pressure	Pa
p_{vs}	Saturation water vapour pressure	Pa
Δp	Induced pressure difference	Pa
Δp_m	Measured pressure difference	Pa
Δp_0	Zero-flow pressure difference	Pa
Δp_{ref}	Reference pressure	Pa
η	Dynamic air viscosity	Pa · s
A	Area	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 given in annex A.

4.2 Equipment

4.2.1 Air-moving equipment

A device that is capable of inducing a specific range of positive and negative pressure differences across the building envelope or component. The air-moving equipment 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 (HVAC) systems can be used.

4.2.2 Pressure-measuring device

An instrument capable of measuring pressure differences with an accuracy of ± 5 % of reading in the range of 10 Pa to 60 Pa.

4.2.3 Air flow measuring system

A device to measure air flow within ± 5 % of the reading.

4.2.4 Temperature-measuring device

An instrument to measure temperature to an accuracy of ± 1 K.

4.3 Optional equipment

4.3.1 Wind-measuring device

4.3.2 Barometer

4.3.3 Humidity-measuring device

5 Procedure

5.1 Measurement of the building envelope

5.1.1 General

The entire building must be configured to respond to pressurization as a single zone for the whole building airtightness test. The accuracy of this procedure is largely dependent on the instrumentation and apparatus used and on the ambient conditions under which the data are recorded. It is more precise to record data at higher pressure differences than at lower differences. Therefore, special care should be exercised when measurements are taken at low pressure differences.

5.1.2 Steps of the procedure

All interconnecting doors in the conditioned space shall be opened (except for cupboards and closets, which should be closed) so that a uniform pressure is maintained within the conditioned space to within a range of less than 10 % of the measured inside-outside pressure difference. This condition shall be verified by selected differential pressure measurements throughout the structure at the highest pressure contemplated.

NOTE 3 Good practice would require measuring pressures induced in adjoining spaces such as the attic and basement or adjacent apartments, since airflow into or out of these spaces may be induced by the test method.

The building should be prepared in accordance with the purpose of the test. Thus the opening, closing or sealing of specific openings such as vent dampers and fireplace openings should be based on whether or not it is the intention of the test to include these openings in the definition of the tightness of the building envelope.

NOTE 4 Good practice requires periodic calibration of the measurement system used in this test method, especially if unskilled operators perform the test.

HVAC balancing dampers and registers should not be adjusted. Fireplaces and other operable dampers should be closed unless they are used to pass air to pressurize or depressurize the building.

Make general observations of the condition of the building. Take notes on the windows, doors, opaque walls, roof and floor.

Measure the outdoor temperature at the beginning and end of the test. Record the wind speed.

Measure and record the indoor temperature at the beginning and end of the test so that their average values can be estimated. If the product of the indoor-outdoor air temperature difference, in kelvins, multiplied by the building height, in metres, gives a result greater than 200 m·K, do not perform the test, as the pressure difference induced by the stack effect is too large to allow accurate interpretation of the results.

Connect the air-moving equipment (4.2.1) to the building envelope (3.2) using a window, door, or vent opening. Ensure that the joints between the equipment and the building are sealed to eliminate any leakage.

In an airtight building, it is possible that the greatest amount of leakage occurs at the door, window or vent used to pass air during the test. Take care in such cases with the selection of the position of the air-moving equipment and/or the interpretation of the test results.

Temporarily cover the opening used by the air-moving equipment for moving air into or out of the building.

Zero the pressure-measuring device (4.2.2) by connecting the sample port to the reference port. Record the zero reading and adjust the device to indicate zero. At the end of the test, recheck the zero of the pressure-measuring device.

Install the pressure-measuring device across the building envelope at any convenient representative location. It is good practice to use more than one location across the building envelope for pressure measurement, for example, one across each facade. In checking for zero pressure, protected exterior areas should not be used and the exterior pressure tap should be placed in an exposed location near the building facade. At the beginning and end of the test, measure the zero-flow pressure difference across the building envelope induced by natural conditions with the air-moving equipment off and air intakes and exhausts covered.

It is important that, for tall buildings or large temperature differences, the pressure difference is measured close to the neutral plane of the building.

In situations where there are significant variations in pressure across the different facades of the building and at the top and bottom of the building (for example, due to wind), an average pressure difference across the four facades should be measured.

Record the zero-flow pressure reading. If the absolute value of the zero-flow pressure reading is greater than 3 Pa, do not perform the test. Analyse induced flows only for an induced pressure difference 10 times the zero-flow pressure difference.

If the wind speed is greater than 3 m/s, it is unlikely that an acceptable zero pressure reading can be obtained.