# SLOVENSKI STANDARD
# SIST EN 16445:2013

**01-junij-2013**

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**Prezračevanje stavb - Difuzija zraka - Aerodinamično preskušanje in ocenitev aplikacij toka zraka: neizotermni postopek s hladnim curkom**

Ventilation for buildings - Air diffusion - Aerodynamic testing and rating for mixed flow application: non-isothermal procedure for cold jet

Lüftung von Gebäuden - Luftverteilung - Aerodynamische Prüfung und Bewertung von Mischstromanwendungen: Nicht-isothermes Verfahren für einen Kaltluftstrahl



Ventilation des bâtiments - Bouches d'air - Essais aérodynamiques et étalonnage pour applications de fluides mixtes pour les essais non-isothermes pour jet froid



**Ta slovenski standard je istoveten z:** **EN 16445:2013**

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**ICS:**

| | | |
|---|---|---|
| 91.140.30 | Prezračevalni in klimatski sistemi | Ventilation and air-conditioning |

**SIST EN 16445:2013** **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 16445

February 2013

ICS 91.140.30

English Version

# Ventilation for buildings - Air diffusion - Aerodynamic testing and rating for mixed flow application: non-isothermal procedure for cold jet

Ventilation des bâtiments - Bouches d'air - Essais aérodynamiques et étalonnage pour applications de fluides mixtes pour les essais non-isothermes pour jet froid

Lüftung von Gebäuden - Luftverteilung - Aerodynamische Prüfung und Bewertung von Mischstromanwendungen: Nicht-isothermes Verfahren für einen Kaltluftstrahl

This European Standard was approved by CEN on 8 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 16445:2013) has been prepared by Technical Committee CEN/TC 156 “Ventilation for buildings”, the secretariat of which is held by BSI.

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 August 2013, and conflicting national standards shall be withdrawn at the latest by August 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.

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## 1 Scope

This European Standard specifies methods for the laboratory aerodynamic testing and rating of air terminal devices for mixed flow applications, including the specification of suitable test facilities and measurement techniques. This standard applies to laboratory testing of ATD for technical characterisation.

The standard gives only tests for the assessment of characteristics of the air terminal devices for mixed flow applications, under non-isothermal conditions with a cold jet. It does not cover the testing of isothermal or low velocity terminal devices which are covered by other published standards.

This European Standard applies to ventilation or air conditioning systems designed for the maintenance of comfort conditions for buildings. It is not applicable in the case of systems for the control of industrial or other special process environments. In the latter case however, it may be referred to if the system technology is similar to that of the above mentioned ventilation and air conditioning systems.

The principles described in this European Standard can also be used on site or in a lab for full-scale measurements.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.



EN 12238, *Ventilation for buildings — Air terminal devices — Aerodynamic testing and rating for mixed flow application*

EN 12239, *Ventilation for buildings — Air terminal devices — Aerodynamic testing and rating for displacement flow applications*



EN 13182, *Ventilation for buildings — Instrumentation requirements for air velocity measurements in ventilated spaces*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply:

**3.1**
**supply air**
air entering a supply air terminal device from an upstream duct

**3.2**
**exhaust air**
air leaving an exhaust air terminal device into a downstream duct

**3.3**
**local measured mean air velocity**
measured value of local airstream velocity as described in EN 12238

**3.4**
**treated space**
enclosure served by an air distribution system; in this standard this is the test room

**3.5**
**envelope**
geometrical surface in a treated space where the local measured air velocity has the same value and is the reference velocity (generally 0,5 m/s) associated with this envelope

**3.6**
**throw (for a supply air terminal device)**
maximum distance between the centre of the core and a plane which is tangent to a specified envelope, such as 0,25 $m.s^{-1}$, 0,5 $m.s^{-1}$, etc. and the centre of the ATD

**3.7**
**drop (for a supply air terminal device)**
vertical distance between the lowest horizontal plane tangent to a specified envelope, such as 0,25 $m.s^{-1}$, 0,5 $m.s^{-1}$, etc., and the centre of the ATD

**3.8**
**rise (for a supply air terminal device)**
vertical distance between the highest horizontal plane tangent to a specified envelope, such as 0,25 $m.s^{-1}$, 0,5 $m.s^{-1}$, etc., and the centre of the ATD

**3.9**
**spread (for a supply air terminal device)**
maximum distance between two vertical planes tangent to a specified envelope, such as 0,25 $m.s^{-1}$, 0,5 $m.s^{-1}$, etc., and perpendicular to a plane through the centre of the ATD

Note 1 to entry: There may be two different spreads, not always equal: One for the left side, the other for the right side (considered when looking at the treated space from the supply air terminal device).



**3.10**
**distance to maximum spread**
distance from the centre of the ATD to the maximum spread determined



**3.11**
**separation distance**
for cold jet with Coanda effect on ceiling, distance between the centre of the ATD and the point where the jet separates from the ceiling to drop

**3.12**
**supply temperature**
temperature of air in supply ATD

**3.13**
**room air temperature**
arithmetical average value of room air temperature measured in the occupied zone outside the envelope of the jet

**3.14**
**temperature quotient**
ratio of the local temperature difference at point x and at the point of discharge

$$\theta_Q = \Delta\theta_x / \Delta\theta_0$$

where

$\Delta\theta_0$ is the temperature difference between supply and room air

$\Delta\theta_x$ is the temperature difference between the point of maximum velocity in the distance x from the ATD and room air

**3.15**
**free area**
**$A_f$**
sum of the minimum measured areas at each opening in the ATD through which air can pass

**3.16**
**effective area**
**$A_k$**
effective area in the ATD measured as described in EN 12238

**3.17**
**effective velocity**
**$v_k$**
effective velocity in the ATD measured as described in EN 12238

## 4 Symbols (and abbreviated terms)

| Symbol | Quantity | SI unit |
|---|---|---|
| $h$ $h_1$ $h_2$… | Distances from ceiling at which measurements are made on vertical sections | m |
| $\Delta p$ | Pressure difference (for a pressure difference device) | Pa |
| $q_v$ | Volume rate of flow | $m^3.s^{-1}$ |
| $v$ | Velocity | $m.s^{-1}$ |
| $v_x$ | Maximum mean velocity at distance $x$ from centre of supply air terminal device | $m.s^{-1}$ |
| $x$ | Distance from supply ATD along the centreline of the jet | m |
| $x_s$ | Separation distance | m |
| $X$ | Throw | m |
| $Y$ | Spread | m |
| $Z$ | Drop | m |
| $\theta_Q$ | Temperature quotient | |
| $\Delta\theta_0$ | Temperature difference between supply and room air | K |
| $\Delta\theta_x$ | Temperature difference between the point of maximum velocity in the distance x from the ATD and room air | K |
| $\rho$ | Density of air | $kg.m^{-3}$ |
| $A_f$ | Free area of the ATD | $m^2$ |
| $A_k$ | Effective area of the ATD (k factor area) | $m^2$ |
| $A_d$ | Area corresponding to the cross section of the nominal size of the duct to which the device is fitted (neck area) | $m^2$ |
| $b_R$ | Test room width (Figure 1) | m |
| $h_R$ | Test room height (Figure 1) | m |
| $l_R$ | Test room length (Figure 1) | m |
| $R$ | Area parameter that relates to the effective size of the ATD (see EN 12238) | $m^2$ |
| $S$ | Linear parameter that relates to the effective size of the ATD (see EN 12238) | m |
| $v_k$ | Effective velocity in the ATD $\left(\frac{q_v}{A_k}\right)$ | $m.s^{-1}$ |

# 5 Requirements

## 5.1 Instrumentation

### 5.1.1 Air flow rate measurement

The air flow rate shall be measured according to one of the standards quoted in Clause 2 with maximum uncertainty of ± 5 %.

### 5.1.2 Temperature measurements

Measurements of temperatures (in room and in jet) shall be made by means of resistance thermometers, thermocouples or other suitable instruments as long as they are calibrated with an accuracy better than ± 0,25 K. The objective is to achieve a global accuracy better than ± 0,5 K.

The measurement of temperature in jet may involve exploration in areas with gradients and this may place restrictions on the size of the sensing head. In addition, when temperature and velocity measurements are done together, the temperature sensor shall be as close as possible to the correct location in jet with a minimum perturbation of the velocity measurement.

A minimum measuring period of 60 s is recommended.

When temperature fluctuations with low frequency occur, this may be due to air stream major instability which can be determined by jet flow visualisation (e.g. using smoke). If this is the case, these results shall be reported. If the air stream appears stable, increase the measuring period to provide a stable temperature reading.



### 5.1.3 Velocity measurements



The measurements of low velocities within treated spaces to determine air terminal device performance characteristics shall be made with a measuring device in accordance with EN 13182.

## 5.2 Test room and conditions

The test room (size, walls, equipment…) shall be as described in EN 12238.

If heating elements are necessary, they shall be distributed uniformly over the floor area and covered by the floor. The surface temperature of the floor should not exceed the room air temperature by more than 4 K.

The temperature of all other walls shall not differ from the air temperature of the test room by more than 1 K unless there are special requirements associated with full scale/mock up testing (e.g. solar gain through a window).

In any case, the sum of all room heat loads shall be equal to the cooling capacity of supply air to match the steady state conditions described in 6.2.2.

Where high cooling performance is required (high $\Delta\theta_0$), it might not be possible to achieve this with heat loads only on the floor. If this is the case, point heat sources may be used and shall be equally distributed over the test room floor. The details and locations of such heat loads shall be reported

When used for mock-up testing, representation of actual specified heat loads shall be used.

## 5.3 ATD isothermal characteristics

Determination of the ATD isothermal characteristics shall be made according to EN 12238 including pressure drop, rise, drop, throw and spread.

# 6 Test to measure the non isothermal air discharge characteristics of a supply ATD

## 6.1 Installation of ATD

Terminal devices can be divided into four broad classes as described in EN 12238:

a) Class I Devices from which the jet is essentially three dimensional (e.g. conical):

Class I.A nozzles;

Class I.B grilles and registers;

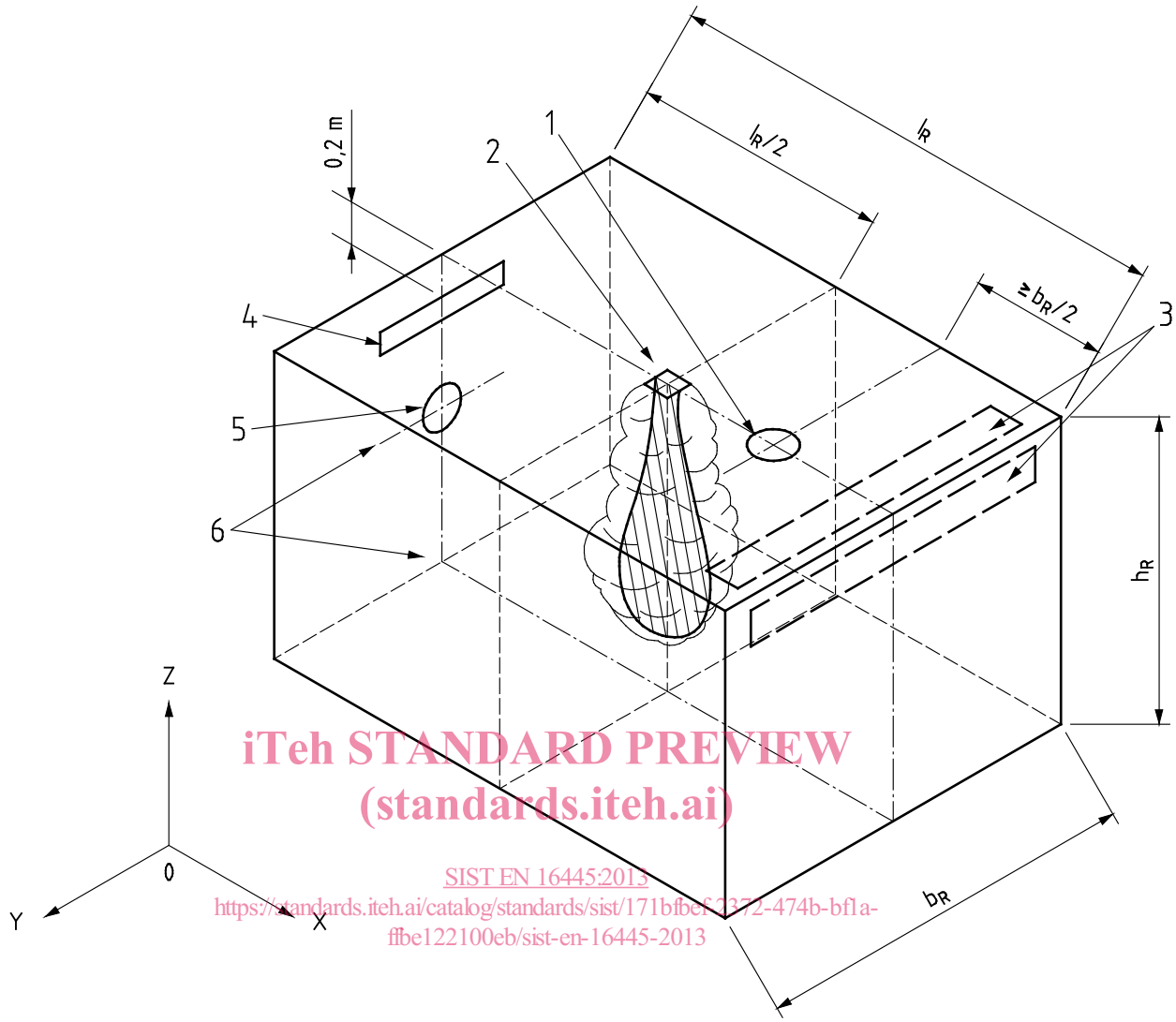
Class I.C ceiling diffusers with vertical discharge.

b) Class II Devices from which the jet flows radially along a surface or as a free jet, ceiling diffusers.

c) Class III Devices from which the jet is essentially two dimensional; linear grilles, slots and linear diffusers.

d) Class IV Low velocity air terminal devices; not included in this standard (see EN 12239).

The air terminal device shall be installed (using the method recommended by the manufacturer) in the following positions (see Figure 1).






**Key**

1 Class II
2 Class I.C
3 Class III
4 Class I.B
5 Class I.A
6 Centrelines

**Figure 1 — ATD position for test installation**

Class IA devices (nozzles) shall be mounted in such a position as to provide the maximum throw with a minimum effect from adjacent boundaries, for example at the centre of one of the smaller test room walls.

Class IB devices (grilles and registers) shall be positioned on the centre line of one of the smaller walls of the test room with the inner upper surface of the ATD 0,2 m from the ceiling.

Class IC devices shall be mounted so that the centre of the test duct is no closer to any one wall than approximately half the width of the test room.

Class II devices (diffusers) shall be mounted flush with the mounting surface and in a position defined by: