BRITISH STANDARD

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13141-1:2004

Ventilation for buildings — Performance testing of components/products for residential ventilation —

Part 1: Externally and internally mounted air transfer devices

The European Standard EN 13141-1:2004 has the status of a British Standard

ICS 91.140.30

National foreword

This British Standard is the official English language version of EN 13141-1:2004.

The UK participation in its preparation was entrusted to Technical Committee RHE/2, Air distribution and air diffusion, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Ventilation des bâtiments - Essais des performances des composants/produits pour la ventilation des logements - Partie 1: Dispositifs de transfert d'air montés en extérieur et en intérieur

Lüftung von Gebäuden - Leistungsprüfungen von Bauteilen/Produkten für die Lüftung von Wohnungen - Teil 1: Außenwand- und Überströmluftdurchlässe

This European Standard was approved by CEN on 22 October 2003.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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 Central Secretariat has the same status as the official versions.

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Foreword

This document (EN 13141-1:2004) 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 July 2004, and conflicting national standards shall be withdrawn at the latest by July 2004.

This standard is one of a series of standards on residential ventilation. The performance characteristics of the components/products for residential ventilation are given in EN 13142.

The position of this standard in the field of mechanical building services is shown in Figure 1.

Annex A is 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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

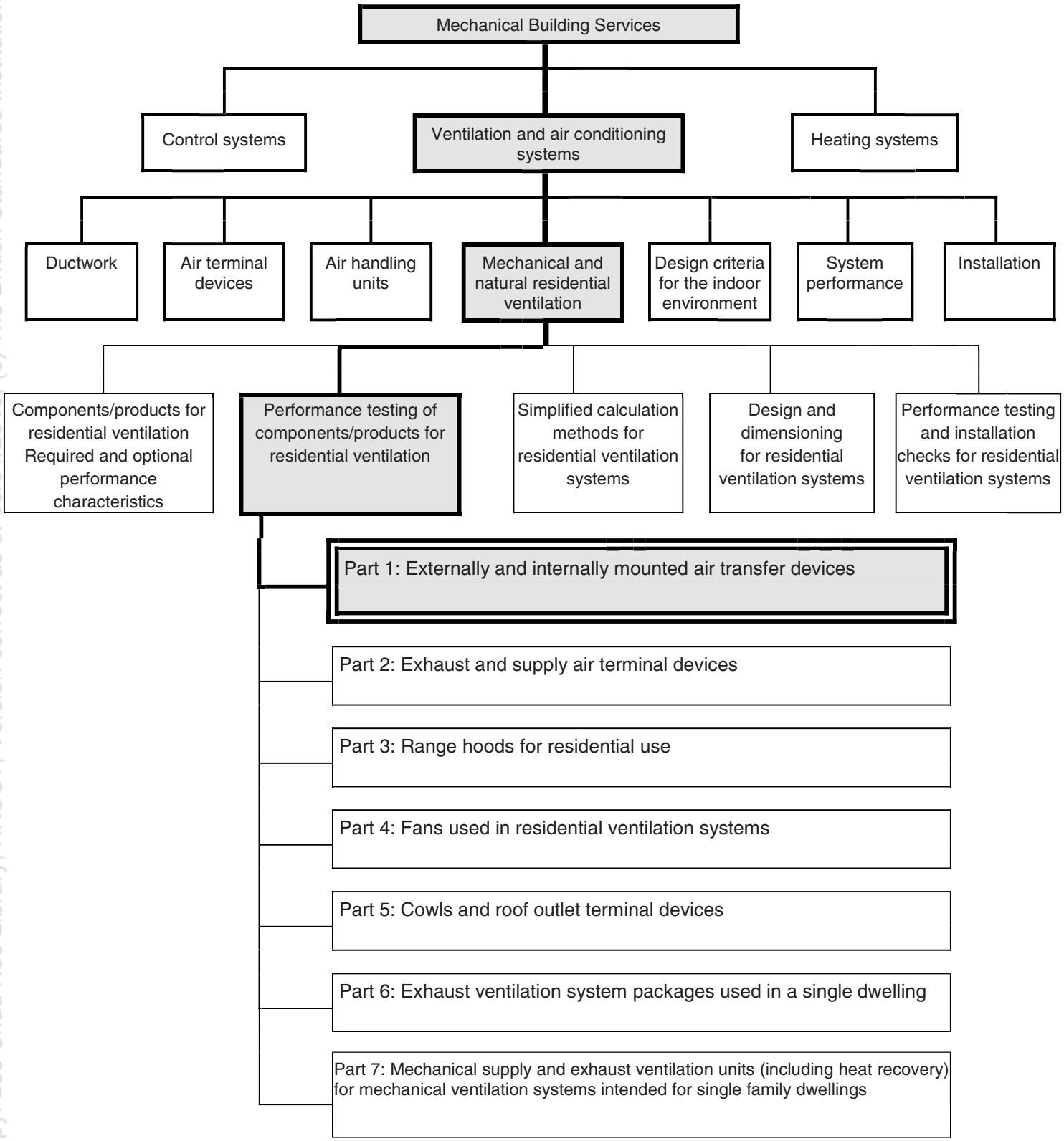


Figure 1 - Position of EN 13141-1 in the field of mechanical building services

1 Scope

This European Standard specifies laboratory methods for testing externally and internally mounted air transfer devices operating under pressure differences.

It applies to devices located between two spaces (between one room and outside, or between two rooms) of the following types:

- devices with fixed opening(s);
- devices with manually adjustable opening(s);
- devices with pressure difference controlled opening(s);
- window openings specifically designed to act as an air transfer device.

It describes tests intended to characterise the following:

- flow rate/pressure;
- non-reverse flow ability;
- 'air tightness when closed' (for closeable externally mounted air transfer device);
- geometrical free area;
- air diffusion in the occupied zone;
- sound insulation;
- water tightness.

This standard does not apply to evaluation of:

- air filtration;
- condensation risk;
- noise production.

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 1027, *Windows and Doors – Watertightness – Test method.*

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

EN 12792, *Ventilation for buildings – Symbols, terminology and graphical symbols.*

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

EN 20140, *Acoustics – Measurement of sound insulation in buildings and of building element.*

ISO 5221, *Air distribution and air diffusion – Rules to methods of measuring air flow rate in an air handling duct.*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 12792 together with the following apply.

3.1
externally mounted air transfer device
device designed to allow the passage of air through the building envelope with the minimum ingress of rain, snow, foreign bodies, etc.

3.2
internally mounted air transfer device
device designed to allow the passage of air between two internal spaces

3.3
fixed device
device without any moving part intended to control the air flow rate

3.4
manually adjustable device
device whose moving parts are controlled by the user

3.5
pressure difference controlled device
device whose moving parts are controlled according to the pressure difference - across it

3.6
static pressure difference(Δp)
static pressure difference between the upstream and the downstream part of the tested device (in Pa)

3.7
flow rate/pressure characteristic
relationship between the flow rate through a device and the pressure difference across it

3.8
non-reverse flow ability
ability of an air transfer device to prevent the air flow to reverse when the pressure difference Δp across it is inverted

3.9
occupied zone (for laboratory purpose)
zone of the test room limited to 1,8 m above floor level 0,5 m from any wall and 0,1 m from floor

3.10
water tightness
ability of an externally mounted air transfer device to resist water penetration

NOTE It is observed in the conventional conditions of test defined in this standard.

3.11
water penetration
penetration of water that would continuously or repeatedly wet parts of a building or components not designed to be wetted

3.12
pressure limit of water tightness
maximum pressure recorded during the test at which water tightness is assured

3.13
equivalent area
area of a sharp edged circular orifice which would pass the same air flow rate and at the same applied pressure difference as the product or device being tested

3.14
geometrical free area
sum of the cross sectional areas of all unobstructed openings measured in the plane of maximum restriction and at right angles to the flow through the openings

4 Performance testing of aerodynamic characteristics

4.1 Flow rate/pressure

4.1.1 Principle

This test consists of measuring several volume flow rates induced through a device by the applied static pressure difference to define the flow rate/pressure characteristic curve. In the case of manually adjustable devices this test shall be carried out at maximum and minimum opening conditions specified by the manufacturer.

NOTE The test described below may also be used for testing the non-reverse flow ability (see 4.2) and/or for determining the "air tightness when closed" for closeable externally mounted air transfer devices (see 4.3).

4.1.2 Test installation, conditions and uncertainty of measurement

4.1.2.1 Test installation and conditions

Externally and internally mounted air transfer devices shall be mounted, according the manufacturer's instructions, for testing on a board which represents the thickness of partition in which they are intended to be installed, for example:

— board 20 mm thick to represent a window glass;

— board 60 mm thick to represent a window frame;

— board 300 mm thick to represent a wall

The thickness of the board shall be recorded in the report (see 4.1.4).

The device to be tested shall be installed in accordance with Figure 2.

The test installation shown in Figure 2 comprises:

— a test box where air velocity is negligible (see design data given in Figure 2).

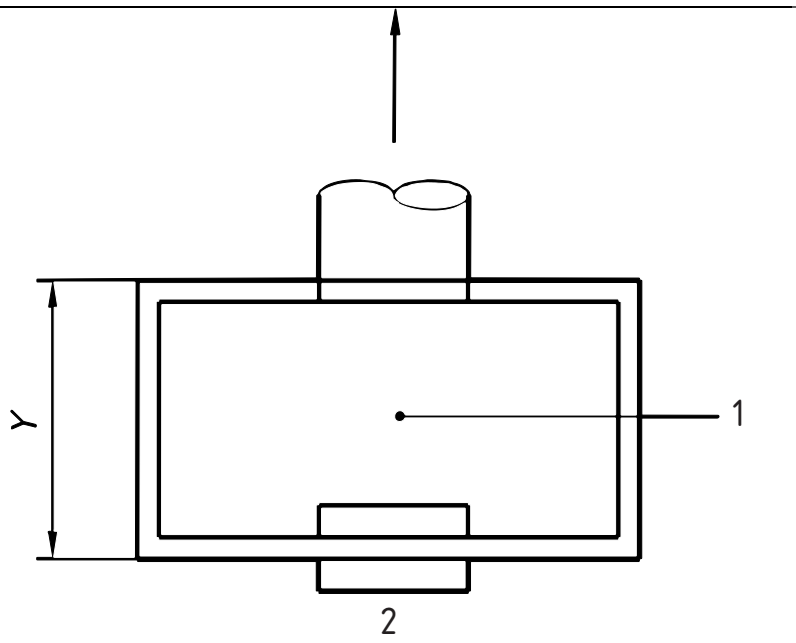
The test box shall be rigid enough to avoid a pulsing air flow. and no displacement of more than 2 mm shall be accepted on any face under the given test conditions;

— a means for measuring static pressure inside the test box relative to the surrounding space with an uncertainty in accordance with 4.1.2.2;

— measuring duct with an air flow meter and air flow straightener in accordance with ISO 5221. Other measurement devices may be used, provided they allow measurements with an uncertainty in accordance with 4.1.2.2;

— a fan with means to vary the pressure difference across the device, covering the range of Table 1.

The test facilities shall have a range from 0 Pa to + 100 Pa.



Board thickness according intended mounting, for instance:

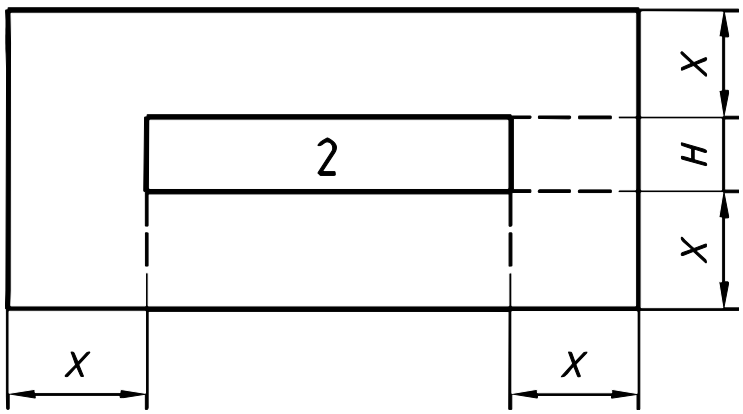
window glass	20 mm
window frame	60 mm
wall	300 mm

y ≥ 0,5 m

Key

1 Static pressure probe
2 Device under test

(a) Test box

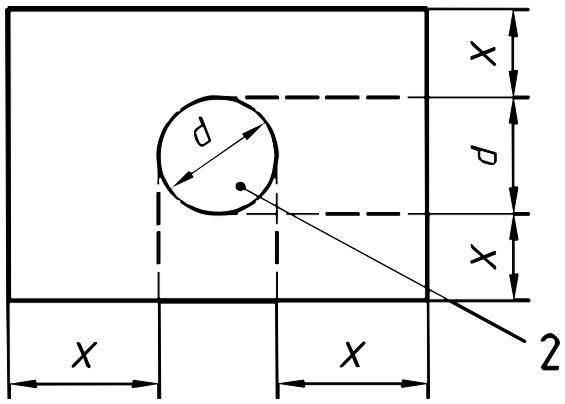


x ≥ 0,3 m

Key

2 Device under test

(b) Mounting of a rectangular device box



x ≥ 0,3 m

Key

2 Device under test

(c) Mounting of a round device

NOTE *H* and *d* are dimensions (height or diameter) of the device under test.

Figure 2 — Test installation

The air permeability of the test equipment shall be measured with the test specimen sealed, over the same range of pressure differences used during the performance testing of the specimen.

The air permeability of the test equipment shall be reported and shall generate a leakage lower than 1 l/s at 100 Pa.

4.1.2.2 Uncertainty of measurement

In the case of air transfer devices with pressure difference controlled openings:

— the pressure shall be measured with an uncertainty lower than:

(0,2 + 0,03) × (measured value) (Pa)

— the volume flow rate shall be measured with an uncertainty lower than:

(0,3 + 0,03) × (measured value) ($l \cdot s^{-1}$)

For other air transfer devices:

— the pressure shall be measured with an uncertainty lower than:

(0,5 + 0,03) × (measured value) (Pa)

— the volume flow rate shall be measured with an uncertainty lower than:

(0,3 + 0,03) × (measured value) ($l \cdot s^{-1}$)

NOTE The combined uncertainties of measurement will result in a total accuracy of the test method in the range of 3 % to 5 %.

4.1.3 Test procedure

According to the type of the tested device, the measurements shall be taken for the following number of points, each taken within one of the pressure difference ranges (bands) given in Table 1:

- for fixed devices, 6 points (matched with the operational range of the device as stated by the manufacturer);

- for manually adjustable devices, 6 points at maximum opening and 6 points at minimum opening points (matched with the operational range of the device as stated by the manufacturer;

- for other devices, 12 points (all the 12 bands) shall be measured. If steady state conditions cannot be achieved in some bands delete these points and report it.

NOTE In this case, it is recommended to use another test procedure of ISO 5220.

Table 1 — Pressure difference ranges

Pressure difference	Permissible deviation
Δp (P_a)	(P_a)
1	± 0,5 Pa
2	± 0,5 Pa
4	± 1 Pa
8	± 1 Pa
10	± 1 Pa
15	± 1 Pa
20	± 1 Pa
30	± 2 Pa
40	± 2 Pa
60	± 2 Pa
80	± 2 Pa
100	± 2 Pa

The environmental conditions existing during the tests such as temperature, barometric pressure shall be recorded.

Air temperature θ_a shall be (20 ± 5) °C. During the test, temperature θ_a shall not vary more than $\pm$ 2 °C.

The test shall be carried out by continuously increasing (or continuously decreasing) the pressure difference across the device.

Where the device contains a movable part, a first serie of measurement shall be made with continuously increasing the pressure difference, then a second serie with continuously decreasing it.

At each point the couple (pressure difference Δp, volume flow rate $q_{v\ meas}$) shall be recorded when steady state conditions are achieved.

The volume flow rate $q_{v\ meas}$ may be directly measured or alternatively calculated from the measured value of mass flow rate q_m.

4.1.4 Analysis of results

The measured result shall be corrected if temperature and barometric pressure are different from standard conditions (20 °C and 101325 Pa), as follows:

$$q_{\text{v cor}} = q_{\text{v meas}} \times \frac{293}{273 + \theta_{\text{a}}} \times \frac{p_{\text{a}}}{101325} \quad (1)$$

where

p_{a} is the atmospheric pressure, in Pa;

θ_{a} is the ambient temperature, in °C;

$q_{\text{v meas}}$ is the measured volume air flow rate, in l s^{-1};

$q_{\text{v cor}}$ is the corrected volume air flow rate, in l s^{-1}.

For a fixed or manually device, it shall be checked whether the device follows a relationship as:

$$Q_{\text{v cor}} = \text{K}(\Delta p)^{\text{n}} \quad (2)$$

where

K is the airflow characteristic of the device;

n is the flow exponent which shall be comprised after rounding between 0,5 and 1: 0,5 (turbulent) ≤ n ≤ 1 (laminar).

To that effect, the measurements recorded according to 4.1.3, and corrected by equation (1) when needed, shall be plotted on an log-log diagram and a regression line [$\log(q_{\text{v cor}}) = \log(\text{K}) + \text{n} \log(\Delta p)$] searched by a best least square fit method.

The law $q_{\text{v cor}} = K\,(\Delta p)^{\text{n}}$ is valid only if the regression coefficient is greater than 0.98

This approach may be also applied to any part of curve of self regulating device (for instance reverse flow part or the part before action of the regulating device).

4.1.5 Presentation of results

All measured and analysed data shall be presented in accordance with Table 2. The measurement conditions shall be recorded.

For fixed or manually adjustable device, the characteristics K and n (as determined in 4.1.4) shall be presented if the regression coefficient was greater than 0,98.

If needed, a method to calculate an equivalent area from the air flow rate is given in annex A.

Table 2 — Presentation of the flow rate/pressure results

Volume air flow rate in $l \cdot s^{-1}$					
Increasing[a]			Decreasing [a]		
pressure difference Δp (P_a)	q_v meas	q_v cor	pressure difference Δp (P_a)	q_v meas	q_v cor
Δp_1 ▼			Δp_1 ▲		
Δp_2			Δp_2		
Δp_3			Δp_3		
Δp_4			Δp_4		
$\Delta p_{6(or\ 11)}$			$\Delta p_{6(or\ 11)}$		

[a] Both sets (increasing and decreasing variations of pressure) are only relevant for devices which contain moving parts.

To allow for an easier comparison of the devices a second Table shall be presented in accordance with Tables 3 and 4 for the following values of pressure differences 1 Pa, 2 Pa, 4 Pa, 8 Pa, 10 Pa and 20 Pa

For fixed or manually adjustable devices, the corresponding values of air flow rates shall be determined according the law $q_{v\ cor} = K\ (\Delta p)^n$ if valid (as determined in 4.1.4), otherwise by interpolation between the two closest measured points.

Table 3 — Presentation of the flow rate/pressure characteristics (standardized) for fixed or manually adjustable devices

Pressure difference Δp (P_a)	q_v ($l \cdot s^{-1}$)
1	
2	
4	
8	
10	
20	

For pressure difference controlled devices, the corresponding values of air flow rates shall be determined by interpolation between the two closest measured points.

Table 4 — Presentation of the flow rate/pressure characteristics (standardized) for pressure difference controlled devices

Pressure difference	Increasing pressure	Decreasing pressure
Δp (P_a)	q_v ($l \cdot s^{-1}$)	q_v ($l \cdot s^{-1}$)
1		
2		
4		
8		
10		
15		
20		
30		
40		
60		
80		
100		

4.2 Non-reverse flow ability

The non-reverse flow ability shall be tested by carrying the same flow rate/pressure characteristic measurement as described in 4.1 after having reversed the device under test or its mounting.

4.3 Air tightness when closed (for closeable externally mounted air transfer device)

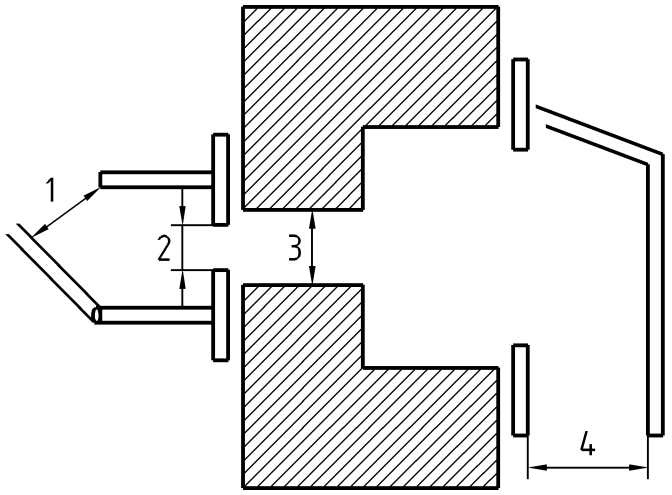
The 'air tightness when closed' shall be tested by carrying the same flow rate/pressure characteristic measurement as described in 4.1 after having closed the device under test.

4.4 Geometrical free area

Geometrical free area is a geometrical quantity, which is defined for air terminal devices in EN 12792. For the purposes of this standard that definition also applies to externally mounted air transfer devices. Geometrical free area shall be determined with the product in the fully open position.

Geometrical free area shall be calculated from the measurements in one plane either of the product or of the mounting slots/holes specified in the manufacturer's installation instructions. The measurement plane shall be such that the total cross section area of the air flow passage(s) crossing the plane is the minimum for the installed product (see Figure 3). The local air flow direction shall be approximately perpendicular to the plane at all points.

NOTE It may be necessary to measure dimensions and calculate geometrical free area at several positions through an installed product to establish where the area is a minimum.



Key

1 Adjustable slot (when fully open)
2 Flow restriction inside product
3 Holes or slot in window frame
4 Insect screen

In this example, assuming that all opening are of rectangular form with the same width, the geometrical free area shall be determined at position B.

Figure 3 — Geometrical free area

4.5 Air diffusion in the occupied zone

4.5.1 Principle

Supply air may create adverse comfort conditions in the occupied zone.

The following tests are intended to assess the possibility of draughts due to externally mounted air transfer devices.

4.5.2 Test installation and conditions

The test shall be carried out in a test room which simulates a room comprising an outside wall with a window and three inner walls, with the following specifications:

a) Test room dimensions

- height 2,5 m to 3,5 m
- width (window wall) 2,5 m to 4 m
- depth 2,5 m to 6 m

b) Window dimensions

The test room shall be equipped with a cold surface representing a window:

- height of window 1,0 m to 1,3 m
- width of window 1,0 m to 1,5 m
- height of sill above floor 0,8 m to 1,0 m

c) Wall temperature

The specifications depend on the value of the temperature difference ($\Delta\theta$) between indoor and outdoor air

$\Delta\theta = \theta_{in} - \theta_{out}$

where

θ_{in} = indoor air temperature

θ_{out} = outdoor dry air temperature (dry bulb temperature)

The cold surface representing a window shall be maintained to a set value θ_w corresponding to either a double-glazed window (when $\Delta\theta = 20$ K) or a triple-glazed window (when $\Delta\theta = 40$ K).

$\Delta\theta = 0$ K : $\theta_w = \theta_{in}$

$\Delta\theta = 20$ K : $\theta_w = \theta_{in} - 5$

$\Delta\theta = 40$ K : $\theta_w = \theta_{in} - 10$

The thermal transmittance *U* through the window wall itself and the other walls shall not significantly impair the air flow pattern.

This latter requirement is assumed to be fulfilled if the transmission heat losses of the walls ($\Delta\theta \cdot U$) are lower than 10 $W \cdot m^{-2}$ (excluding the cold surface).

d) Test room heating

The indoor air temperature, θ_{in}, shall be measured at 1,1 m above the floor at the middle of the room using a sensor insensitive to the radiant temperature.

θ_{in} shall be in the range (20 ± 5) °C.

The measurement uncertainty shall be less than 0,5 °C.

The heating device shall be chosen and located in accordance with the recommendations of the manufacturer of the air transfer device.

Temperature variations shall be less than 1 °C during the test.

e) Air inlet location

The air inlet position of the device shall be chosen and located in accordance with the recommendations of the manufacturer of the air transfer device.

f) Air outlet location

The air outlet shall be placed in the opposite of the test device or at any place where it does not influence the flow field.

4.5.3 Test procedure

4.5.3.1 General

Air temperatures θ_i and velocities v_i within the test room are measured at various positions (*i)* of the occupied zone (minimum 75). The number and position of the measurement points are specified in Figure 4.

Measurement requirements shall be as given in EN 13182 and EN 12238.

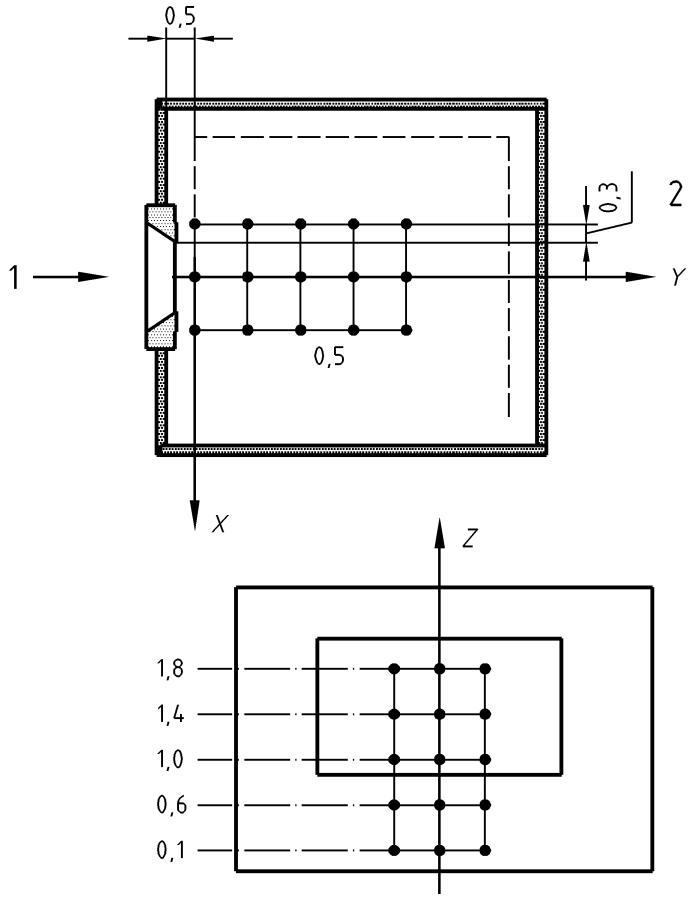
The airflow pattern depends on both the outdoor temperature and pressure difference.

For externally mounted air transfer devices, the air velocity and temperature measurement shall be expressed for combinations of Δp and $\Delta\theta$ chosen from the Table 5. The temperature difference may be chosen according to the intended climate conditions

Table 5 — Possible combinations of temperature and pressure differences

Δp in Pa	$\Delta\theta$ in K		
	0	20	40
10	x	x	x
50	x	not to be measured	

Dimensions in metres



Key

1 Airflow

2 0,3 from the interior opening of the device

Figure 4 - Location of measurement points

4.5.3.2 Aperture area of the externally mounted air transfer device

For non fixed devices, the aperture area of the device is not unique. The aperture areas for testing air diffusion characteristics are specified below and the test shall be carried out at the following pressure differences:

a) *For manually adjustable devices:*

Δp = 10 Pa with the manual adjustment set to maximum aperture area, as specified by the manufacturer.

Δp = 50 Pa with the manual adjustment set to minimum aperture area, as specified by the manufacturer.

b) *For pressure difference controlled devices:*

Δp = 10 Pa or 50 Pa with the pressure difference control to adjust automatically.

c) *For devices which are both manually adjustable and pressure difference controlled:*

Δp = 10 Pa Two tests shall be carried out, with the manual adjustment set to the maximum aperture area in one test and the minimum aperture area in the other. In both cases the pressure difference control shall be allowed to adjust automatically.

Δp = 50 Pa With the manual adjustment set to the minimum aperture area and the pressure difference control allowed to adjust automatically.

4.5.4 Presentation of results

The air velocity v_i and temperature θ_i shall be recorded for each measurement location, as well as the test conditions:

- supply air flow rate $q_{V\,cor}$

- temperature of supply air flow θ_{out};

- temperature of the window θ_W .

NOTE The test report should mention the test installation and conditions and should stress that the results presented are only valid for these test conditions, and may not reflect the on site values in another configuration.

5 Performance testing of sound insulation

EN 20140 shall be used to determine the sound insulation $D_{n,e}$ of an air transfer device installed in a partition which separate 2 reverberant rooms, and to present the results.

The partition board in which the device is installed shall be:

60 mm thick when representing a window glass or a window frame,

300 mm thick when representing a wall.

For all devices, the characterisation of the sound insulation shall be done with maximum aperture of the device.

6 Performance testing of water tightness

6.1 Principle

The principle of the test is to apply a quantity of water and an air pressure under defined conditions, to the outside surface of the externally mounted air transfer device and to record any water penetration.

For closeable air transfer device, the device shall be closed during the test.

The principle is based on the method EN 1027.

6.2 Test installation and conditions

The basic test apparatus consists of:

— a chamber with an opening to which the device to be tested is fitted;

— means of providing a controlled air pressure difference across the device;

— means of spraying water such that a continuous film is applied over the whole face of the device to be tested;

— means of measuring the amount of water sprayed;

— means of measuring the pressure difference between the two faces of the device to be tested.

6.3 Test procedure

The temperature of the water used in the test chamber shall be maintained between + 8 °C and + 25 °C.

The spraying device shall be set to apply 2 l/min per m² of tested area (± 10 %).

The test shall be carried out according to EN 1027.

The pressure differences and duration of water spraying shall be as given in Table 6

Table 6 — Pressure difference and duration of water spraying

Pressure difference between the chamber and the exterior Pa	Duration of water spraying s
10	120
20	
50	
100	
150	

6.4 Test report

The test report shall indicate the spraying method used.

The pressure and the time at which the leakage occurs shall be indicated in the report; this pressure is defined as the "pressure limit of water tightness".

Annex A
(informative)

Method for calculation of the equivalent area

The equivalent area A (in mm^2) is defined in relation with the air flow rate by the following formula

$$A = C \cdot q_v$$

where

q_v is the volume flow rate for a certain pressure difference in $l\,s^{-1}$;

C is given in Table A.1.

NOTE This formula is a simple way to put in useful form the air flow rate and the equivalent area.

Table A.1 - Values of *C* for several pressure differences

Δp Pa	C $mm^{-1} \cdot s$
1	1 272,5
2	899,7
4	636,2
8	449,9
10	402,4
20	284,5

Bibliography

EN 13142, *Ventilation for buildings – Components/products for residential ventilation – Required and optional performance characteristics.*

ISO 5220, *Air distribution and air diffusion – Aerodynamic testing and rating of constant and variable dual or single duct boxes and single duct units*.

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