BS EN 13141-8:2014

BSI Standards Publication

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

Part 8: Performance testing of un-ducted mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for a single room

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 13141-8:2014. It supersedes BS EN 13141-8:2006 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RHE/2, Ventilation for buildings, heating and hot water services.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 76416 5

ICS 91.140.30

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 July 2014.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 13141-8

June 2014

ICS 91.140.30

Supersedes EN 13141-8:2006

English Version

Ventilation for buildings - Performance testing of components/products for residential ventilation - Part 8: Performance testing of un-ducted mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for a single room

Ventilation des bâtiments - Essais de performance des composants/produits pour la ventilation des logements - Partie 8 : Essais de performance des unités de soufflage et d'extraction (y compris la récupération de chaleur) pour les systèmes de ventilation mécaniques non raccordés prévus pour une pièce

Lüftung von Gebäuden - Leistungsprüfung von Bauteilen/Produkten für die Lüftung von Wohnungen - Teil 8: Leistungsprüfung von mechanischen Zuluft- und Ablufteinheiten ohne Luftführung (einschließlich Wärmerückgewinnung) für ventilatorgestützte Lüftungsanlagen von einzelnen Räumen

This European Standard was approved by CEN on 6 February 2014.

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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 13141-8:2014 E

Contents

Page

Foreword

This document (EN 13141-8:2014) 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 September 2014, and conflicting national standards shall be withdrawn at the latest by September 2014.

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.

This document supersedes EN 13141-8:2006.

In comparison to EN 13141-8:2006 the following changes have been made:

— alternating ventilation units including a storage type heat exchangers have been included;

— measurement of the deviation of air flow rate due to façade pressures in normal use has been introduced;

— temperature conditions have been modified to be the same as in EN 13141-7 that is to say 7 °C / 20 °C.

EN 13141 consists of the following parts, under the general title *Ventilation for buildings — Performance testing of components/products for residential ventilation*:

— *Part 1: Externally and internally mounted air transfer devices;*

— *Part 2: Exhaust and supply air terminal devices;*

— *Part 3: Range hoods for residential use;*

— *Part 4: Fans used in residential ventilation systems;*

— *Part 5: Cowls and roof outlet terminal devices;*

— *Part 6: Exhaust ventilation system packages used in a single dwelling;*

— *Part 7: Performance testing of a mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for single family dwellings;*

— *Part 8: Performance testing of un-ducted mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for a single room;*

— *Part 9: Externally mounted humidity controlled air transfer device;*

— *Part 10: Humidity controlled extract air terminal device.*

— *Part 11: Positive pressure ventilation systems.*

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard specifies methods for the performance testing of components used in residential ventilation systems to establish the performance characteristics as identified in EN 13142 [1].

This European Standard incorporates many references to other European and International Standards, especially on characteristics other than the aerodynamic characteristics, for instance on acoustic characteristics.

In most cases some additional tests or some additional conditions are given for the specific use in residential ventilation systems.

This European Standard can be used for the following applications:

— laboratory testing;

— attestation purposes.

The position of this European Standard in the field of standards for the mechanical building services is shown in Figure 1.

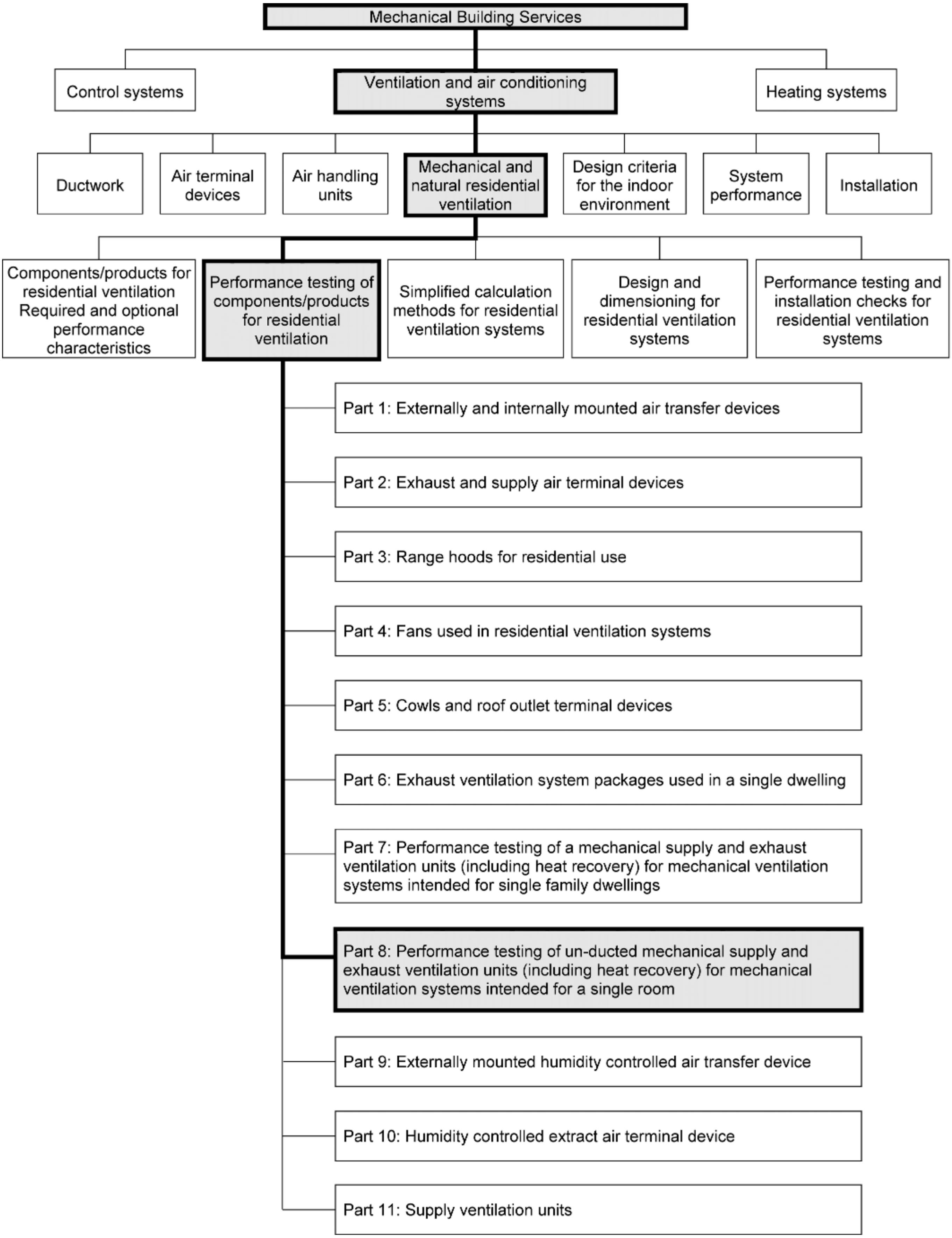


Figure 1 — Position of EN 13141-8 in the field of the mechanical building services

1 Scope

This European Standard specifies the laboratory test methods and test requirements for the testing of aerodynamic, thermal and acoustic performance, and the electrical power of an un-ducted mechanical supply and exhaust ventilation unit used in a single room.

The purpose of this European Standard is not to consider the quality of ventilation but to test the performance of the equipment.

In general, a ventilation unit contains:

— supply and exhaust air fans;

— air filters;

— air to air heat exchanger or air storage mass for exhaust air heat and humidity recovery;

— control system;

— inlet and outlet grilles.

Such equipment can be provided in more than one assembly, the separate assemblies of which are designed to be used together.

Such equipment can contain alternating heat exchangers which provide separate supply and exhaust air flows.

In certain cases, i.e. alternating ventilation unit, the manufacturer may recommend that the equipment can be installed in such a way that it serves more than one room. For the purpose of this European Standard, these products are assessed in a single room.

This European Standard does not deal with ducted units or units with heat pumps.

Safety requirements are given in EN 60335-2-80:2003 [2].

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 306, *Heat exchangers - Methods of measuring the parameters necessary for establishing the performance*

EN 779, *Particulate air filters for general ventilation - Determination of the filtration performance*

EN 12792:2003, *Ventilation for buildings - Symbols, terminology and graphical symbols*

EN 13141-4, *Ventilation for buildings - Performance testing of components/products for residential ventilation - Part 4: Fans used in residential ventilation systems*

EN ISO 717-1, *Acoustics - Rating of sound insulation in buildings and of building elements - Part 1: Airborne sound insulation (ISO 717-1)*

EN ISO 3741, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Precision methods for reverberation test rooms (ISO 3741)*

EN ISO 3743-1, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for small movable sources in reverberant fields - Part 1: Comparison method for a hard-walled test room (ISO 3743-1)*

EN ISO 3743-2, *Acoustics - Determination of sound power levels of noise sources using sound pressure - Engineering methods for small, movable sources in reverberant fields - Part 2: Methods for special reverberation test rooms (ISO 3743-2)*

EN ISO 3744, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane (ISO 3744)*

EN ISO 3745, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Precision methods for anechoic rooms and hemi-anechoic rooms (ISO 3745)*

EN ISO 9614-1, *Acoustics - Determination of sound power levels of noise sources using sound intensity - Part 1: Measurement at discrete points (ISO 9614-1)*

EN ISO 9614-2, *Acoustics - Determination of sound power levels of noise sources using sound intensity - Part 2: Measurement by scanning (ISO 9614-2)*

EN ISO 10140-1:2010, *Acoustics - Laboratory measurement of sound insulation of building elements - Part 1: Application rules for specific products (ISO 10140-1:2010)*

EN ISO 10140-2, *Acoustics - Laboratory measurement of sound insulation of building elements - Part 2: Measurement of airborne sound insulation (ISO 10140-2)*

EN ISO 10140-5, *Acoustics - Laboratory measurement of sound insulation of building elements - Part 5: Requirements for test facilities and equipment (ISO 10140-5)*

3 Terms, definitions and classification

For the purpose of this document, the terms and definitions given in EN 12792:2003 and the following apply.

3.1 Terms and definitions

3.1.1
external leakage
leakage to or from the air flowing inside the casing of the unit to or from the air external to the equipment under test

3.1.2
internal leakage
leakage inside the unit between the exhaust and the supply air flows

3.1.3
filter bypass leakage
air bypass around filter cells

3.1.4
indoor/outdoor airtightness
maximum of air flow at – 20 Pa and + 20 Pa corresponding to the setting when the fans are off

3.1.5
outdoor mixing
mixing of the two airflows external to the equipment under test between discharge and intake ports at outdoor terminal points caused by short circuiting

3.1.6
indoor mixing
mixing of the two airflows under test between discharge and intake ports at indoor terminal points caused by short circuiting

3.1.7
maximum air volume flow
air flow corresponding to that at the maximum setting and at no pressure difference, 0 Pa, between indoor and outdoor

Note 1 to entry: If the supply and exhaust air volume flows are different, then the maximum air volume flow is equal to the smaller of the two air volume flows.

3.1.8
minimum air volume flow
air flow corresponding to that at the minimum setting and at no pressure difference, 0 Pa, between indoor and outdoor

Note 1 to entry: If the supply and exhaust air volume flows are different, then the minimum air volume flow is equal to the smaller of the two air volume flows.

3.1.9
reference air volume flow
airflow at 70 % of the maximum air volume flow

Note 1 to entry: If the supply and exhaust air volume flows are different, then the reference air volume flow is equal to the smaller of the two air volume flows.

Note 2 to entry: If the air volume flow cannot be adjusted on the product itself, the closest value above 70 % is selected.

3.1.10
air flow sensitivity
sensitivity to variations in the balance between supply airflow and exhaust airflow due to pressure difference variations over the façade

Note 1 to entry: Unbalanced (unequal) supply and exhaust air streams influence the thermal efficiency of the ventilation unit and its air exchange capacity.

3.1.11
air exchange capacity
ability of the ventilation unit to exchange the used indoor air by fresh outdoor air in a room, under the varying occurring circumstances

3.1.12
temperature ratio
temperature difference between inlet and outlet of one of the airflows divided by the temperature difference between the inlets of both airflows

3.1.13
humidity ratio
difference of water content between inlet and outlet of one of the air flows divided by the difference of water content between the inlets of both air flows

3.1.14
effective power input
average electrical power input to the equipment within a defined interval of time obtained from:

— power input of the fans;

— power input for operation of any power input including the control, the transformer and for defrosting, excluding additional electrical heating devices not used for defrosting;

— power input of all controls, transformers, power supplies and safety devices of the equipment

Note 1 to entry: Effective power input is expressed in watts.

3.1.15
test voltage
voltage used for supplying the components during the testing

3.2 Classification

The classification of heat exchangers is the following:

— Category I: Recuperative heat exchangers (e.g. air-to-air plate or tube heat exchanger)

Recuperative heat exchangers are designed to transfer thermal energy (sensible or total) from one air stream to another without moving parts. Heat transfer surfaces are in form of plates or tubes. This heat exchanger may have parallel flow, cross flow or counter flow construction or a combination of these. Plate and tube heat exchangers with vapour diffusion (for instance cellulose) are also in this category.

— Category II: Regenerative heat exchangers (e.g. rotary or alternating heat exchanger)

A rotary heat exchanger is a device incorporating a rotating “thermal wheel” for the purpose of transferring energy (sensible or total) from one air stream to the other. It incorporates material allowing latent heat transfer, a drive mechanism, a casing or frame, and includes any seals which are provided to retard bypassing and leakage or air from one air stream to the other. Regenerative heat exchangers have varying degrees of moisture recovery, depending on the material used (e.g. “condensation rotor/non hygroscopic rotor”, “hygroscopic rotor” and “sorption rotor” heat exchangers).

4 Symbols and abbreviations

For the purpose of this document, the symbols and abbreviations given in EN 12792:2003 and the following apply.

The symbols used in this document are listed in Table 1.

Table 1 — Symbols

Symbol	Designation	Unit
θ	Air temperature	°C
θ_{11}	Air temperature for extract air	°C
θ_{12}	Air temperature for exhaust air	°C
θ_{21}	Air temperature for outdoor air	°C
θ_{22}	Air temperature for supply air	°C
θ_{w11}	Wet bulb temperature for extract air	°C
θ_{w21}	Wet bulb temperature for outdoor air	°C
$\eta_{\theta, ex}$	Temperature ratio of the unit on exhaust air side	—
$\eta_{\theta, su}$	Temperature ratio of the unit on supply air side	—
$\eta_{x, ex}$	Humidity ratio of the unit on exhaust air side	—
$\eta_{x, su}$	Humidity ratio of the unit on supply air side	—
11	Extract air (see Figure 2)	—

12	Exhaust air (see Figure 2)	—
21	Outdoor air (see Figure 2)	—
22	Supply air (see Figure 2)	—
C_{11}	Concentration of tracer gas on extract air side using one of the test configuration a), b), c) or d) of Figure 2 or Figure 4	mg/m^3
C_{22}	Concentration of tracer gas on supply air side using one of the test configuration a), b), c) or d) of Figure 2 or Figure 4	mg/m^3
C_{12}	Concentration of tracer gas on exhaust air side using one of the test configuration a), b), c) or d) of Figure 2 or Figure 4	mg/m^3
$D_{n,e}$	Airborne sound insulation in third octave bands	dB
$D_{n,e,w}$	Global airborne sound insulation index	dB
L_W	Sound power level	dB
L_{WA}	A-weighted sound power level	dB
P_E	Electric power input	W
p_s	Static pressure	Pa
q_m	Mass air flow rate	$kg.s^{-1}$ or $g.s^{-1}$
q_{m11}	Mass extract air flow rate	$kg.s^{-1}$ or $g.s^{-1}$
q_{m12}	Mass exhaust air flow rate	$kg.s^{-1}$ or $g.s^{-1}$
q_{m21}	Mass outdoor air flow rate	$kg.s^{-1}$ or $g.s^{-1}$
q_{m22}	Mass supply air flow rate	$kg.s^{-1}$ or $g.s^{-1}$
q_{me}	Outdoor mixing (calculated)	%
q_{mi}	Indoor mixing	$m^3.s^{-1}$ or $l.s^{-1}$
q_v	Volume air flow rate	$m^3.s^{-1}$ or $l.s^{-1}$
q_{vd}	Maximum air flow rate	$m^3.s^{-1}$ or $l.s^{-1}$
q_{vmax}	Maximum air volume flow rate	$m^3.s^{-1}$ or $l.s^{-1}$
q_{ve}	External leakage air volume flow rate	$m^3.s^{-1}$ or $l.s^{-1}$
q_{vi}	Internal leakage air volume flow rate	$m^3.s^{-1}$ or $l.s^{-1}$
q_{vio}	Average volume flow rate for alternating ventilation unit	$m^3.s^{-1}$ or $l.s^{-1}$
q_{vies}	Internal leakage from exhaust to supply flow	$m^3.s^{-1}$ or $l.s^{-1}$
q_{vise}	Internal leakage from supply to exhaust flow	$m^3.s^{-1}$ or $l.s^{-1}$
$q_{vmeasured}$	Measured air volume flow rate	$m^3.s^{-1}$ or $l.s^{-1}$

q_{vref}	Reference air volume flow	$m^3.s^{-1}$ or $l.s^{-1}$
q_{vs}	Supply air volume flow	$m^3.s^{-1}$ or $l.s^{-1}$
R	Recirculation fraction, measured with tracer gas test	—
t_1	“On” period of the cycle with alternating ventilation units working in one way	s
t_2	“Off” period of the cycle for alternating ventilation units	s
t_3	“On” period of the cycle with alternating ventilation units working in the other way	s
t_4	“Off” period of the cycle for alternating ventilation units	s
t_{cycle}	Time of an operating cycle for alternating ventilation units	s
x	Water content	kg water / kg dry air
x_{11}	Water content for extract air	kg water / kg dry air
x_{12}	Water content for exhaust air	kg water / kg dry air
x_{21}	Water content for outdoor air	kg water / kg dry air
x_{22}	Water content for supply air	kg water / kg dry air

5 Test methods

5.1 General

Tests shall be conducted with a unit containing all components (including wall ducts and grilles, if applicable) as supplied for intended use, and installed according to the manufacturer's instructions.

The mass flows q_{m11} and q_{m22} shall be balanced to within 3 % without any pressure difference between the two climatic test chambers unless the manufacturer specifies otherwise. Over 3 %, the unit is declared unbalanced and the imbalance shall be reported.

The mass flows q_{m11} and q_{m22} shall be measured in steady-state conditions at the same time.

Where a single value is assigned by the manufacturer as rated voltage, this shall be the test voltage. Where a voltage range is assigned to the product by the manufacturer that includes 230 VAC, the test shall be conducted at 230 VAC. This voltage shall be maintained throughout the testing to ± 1 %.

Where a product requires a voltage regulation device (transformer), this device shall also be supplied or clearly specified. The power consumption of this device shall be taken into account. The tests shall be conducted at the primary voltage.

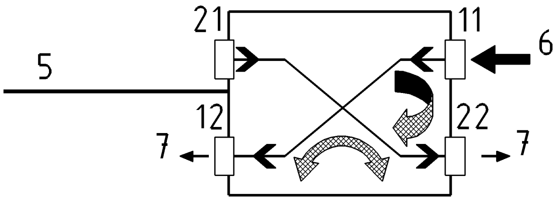
5.2 Performance testing of aerodynamic characteristics

5.2.1 General

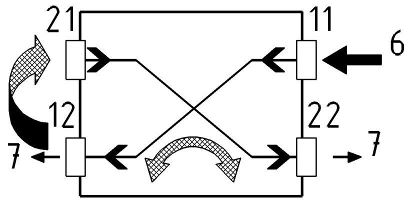
If one of the tests (leakage or mixing) describe in Figure 2 a), b), c) or d) give a value of internal leakage and mixing over 10 %, all further tests shall not be carried out (see Table 7).

5.2.2 Internal leakages and mixing

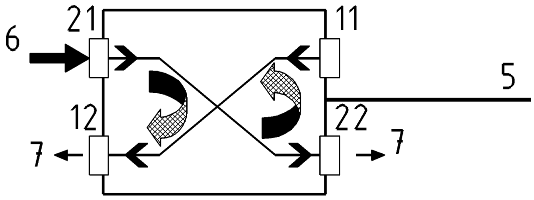
5.2.2.1 General



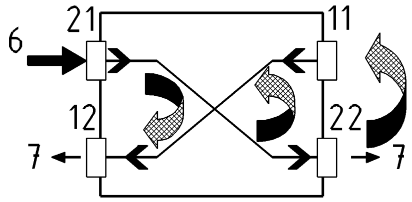
a) internal leakages



b) internal leakages + outdoor mixing



c) internal leakages on outdoor air



d) internal leakages on outdoor air + indoor mixing

Key

21	outdoor air	5	deflector
11	extract air	6	tracer gas introduction
22	supply air	7	tracer gas measurement
12	exhaust air		

Figure 2 — Test configurations for internal leakages and mixing

The internal leakages and mixing are calculated using Formulae (1) to (4):

$$\text{internal leakage} = \left(\frac{C_{22}}{C_{12}}\right)_a \tag{1}$$

$$\text{outdoor mixing} = \left(\frac{C_{22}}{C_{12}}\right)_b - \left(\frac{C_{22}}{C_{12}}\right)_a \tag{2}$$

$$\text{internal leakage on outdoor air} = \left(\frac{C_{12}}{C_{22}}\right)_c \tag{3}$$

$$\text{indoor mixing} = \left(\frac{C_{12}}{C_{22}}\right)_d - \left(\frac{C_{12}}{C_{22}}\right)_c \tag{4}$$

where terms a, b, c and d refer to subfigures a, b, c and d of Figure 2.

5.2.2.2 External leakage

The external leakage shall be measured according to Annex B.

The external leakage air volume flow q_{ve} at over and under-pressure of 50 Pa shall be reported as such and also compared to the maximum air volume flow of the unit as a percentage.

During the tests, the fans of the unit under test shall be switched off.

5.2.2.3 Internal leakage

Internal leakage shall be measured by means of a tracer gas or pressurization test and the test shall be conducted as follows:

a) For pressurization test, as defined in Annex B, the fan shall be off and the difference between the two air flows shall be fixed at 20 Pa according to Table 8.

b) For tracer gas method, the test as described below shall be done without applying any pressure drop on the system.

Test for tracer gas method:

— The fans shall be on and working at maximum setting.

— The tracer gas should be introduced into the indoor extract duct as close as possible to the grille, if this is not possible, a short length of duct (less than 150 mm) of the same cross section as the grille should be fastened to the grille and the tracer gas introduced into the ductwork.

— The tracer gas concentration should be measured at the line of the indoor grilles. If this is impossible short pieces of ductwork of the same cross section should be applied and measurement made within the ductwork.

— To measure internal leakage a deflector is introduced between the outdoor grilles and sealed to ensure that exhaust gas cannot be mixed back into the intake port. The deflector should be applied between the extract and intake ports. It should be fixed to the outside of the grille and extend to at least 300 mm in each direction. Tracer gas is introduced into the extract port and the concentration is measured in both the extract and supply ports.

— The internal leakage, as a percentage of the supply flow, is then the ratio of the two concentrations, as defined in 5.2.2.

5.2.2.4 Mixing

5.2.2.4.1 Outdoor mixing – Determination of the test needs

Due to the small dimensions of a single room unit the distance between the air inlets and outlets can be very small and thus there is a great risk of mixing fresh outdoor air with used indoor air.

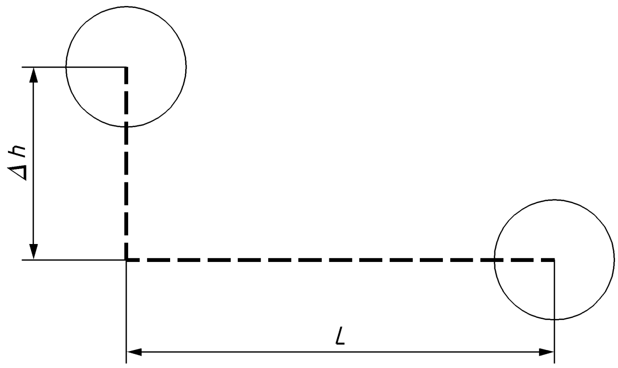
Tests are not necessary when the maximum air flow rate in $l.s^{-1}$ is according or below the values mentioned in Table 2. Horizontal distance L and vertical distance Δh used in Table 2 are defined in Figure 3.

NOTE 1 The values in Table 2 do not consider thermal effect.

NOTE 2 Table 2 can only be used to determine whether or not an additional test is necessary and cannot be used to determine the maximum air flow rate of the unit.

Table 2 — Maximum air volume flow rates in relation to distance between inlet and outlet to avoid measurement for determining indoor mixing or outdoor mixing

Air flow rate l.s^{-1}												
Δh vertical distance m	L horizontal distance m											
	0,0	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1,0**	**1,1**
0,0	0	0	2	4	7	11	15	21	27	34	42	51
0,1	0	1	3	5	9	13	18	24	31	38	47	56
0,2	0	2	4	7	11	15	21	27	34	42	51	—
0,3	1	3	5	9	13	18	24	31	38	47	56	—
0,4	2	4	7	11	15	21	27	34	42	51	—	—
0,5	3	5	9	13	18	24	31	38	47	56	—	—
0,6	4	7	11	15	21	27	34	42	51	—	—	—
0,7	4	9	13	18	24	31	38	47	56	—	—	—
0,8	7	11	15	21	27	34	42	51	—	—	—	—
0,9	9	13	18	24	31	38	47	56	—	—	—	—
1,0	11	15	21	27	34	42	51	—	—	—	—	—
1,1	13	18	24	31	38	47	56	—	—	—	—	—
1,2	15	21	27	34	42	51	—	—	—	—	—	—
1,3	18	24	31	38	47	56	—	—	—	—	—	—
1,4	21	27	34	42	51	—	—	—	—	—	—	—
1,5	24	31	38	47	56	—	—	—	—	—	—	—



Key

Δh vertical distance

L horizontal distance

Figure 3 — Illustration of terms “horizontal distance” and “vertical distance” used in Table 2

5.2.2.4.2 Indoor mixing − Determination of the test needs

Due to the small dimensions of a single room unit the distance between the air inlets and outlets can be very small and thus there is a risk of mixing extract air with fresh outdoor air.

Tests are not necessary when the maximum air flow rate in $l.s^{-1}$ is according or below the values given in Table 2.

5.2.2.4.3 Method of testing and calculation

When the deflector is removed the concentration of the tracer gas at the indoor supply grille is now the sum of the internal leakage and the mixing between discharge and intake grilles, expressed as a percentage of the supply flow. The mixing is therefore calculated as the difference between the percentages measured during this test and the internal leakage.

A separate mixing measurement is made at both the indoor and outdoor grille locations, the measurement with the highest percentage figure is used for the calculations. The method is described in Annex C (normative).

NOTE The duration of the test is limited such that any influence of the contamination/saturation of the test room from the gas is reduced to a minimum

5.2.3 Air flow

The air flow, for both supply and exhaust air flows, shall be determined according to EN 13141-4 simultaneously or not, as convenient. This is illustrated in Annex A, using a duct with a cross section area sufficient for the flow velocity to be less than 1 $m.s^{-1}$ and an additional fan to ensure that the pressure at the port is atmospheric.

Tests shall be made in accordance with Category A installation (free inlet and outlet) as defined in EN 13141-4. The fans shall be switched on.

In order to determine the air flow at no pressure difference between the indoor and outdoor space at least three measurements shall be carried out as follows (these measurements are used to classify maximum deviation of air flow, see Table 3 for temperature conditions):

— two measurements at + 20 Pa and - 20 Pa respectively;

— one measurement of the airflow at no pressure (0 Pa), this point shall not be an interpolation between the two measurements at + 20 Pa and - 20 Pa.

For multiple air volume flow fans the following set points shall be measured:

— minimum air volume flow;

— maximum air volume flow;

— reference air volume flow (or closest to if possible).

NOTE If the air volume flow rate is not adjustable the reference air volume flow can be the maximum.

5.2.4 In/out airtightness

If the intended use of the product include a situation with one or both fans off, the in/out airtightness test shall be performed.

The difference of pressure between inside and outside shall be adjusted at – 20 Pa and + 20 Pa and the correspondent air flow shall be measured as described in 5.2.2.

5.2.5 Filter bypass

The filter bypass characteristic should be determined by a visual inspection including all the following details:

— design and construction of the air filters and frames shall allow an easy assembly and ensuring a tight fit;

— tight fit shall not be affected under the impact of humidity (that means materials shall not be affected by humidity and water, for example a metal, plastic or impregnated cardboard frame).

5.3 Specific performance testing of aerodynamic characteristics for alternating ventilation unit including a storage type heat exchangers

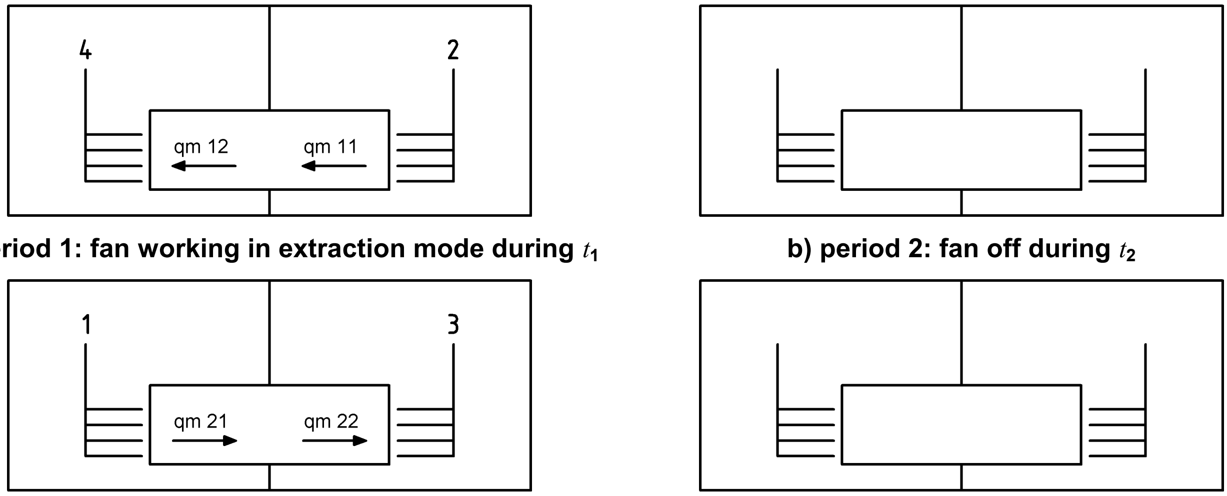
5.3.1 Reference air flow

In this type of device, the exhaust air flow and supply air flow are sequential. The direction of the flow can change from exhaust to supply with a stop period in between.

The energy from exhaust air is stored in the heat exchanger or heat storage mass and transferred to the supply air.

To make sure that there is no influence of the wall, the product shall be insulated from the wall.

Example of operating sequence: 60 s in one way (t_1), 3 s stop (t_2), 60 s in the other way (t_3), 3 s stop (t_4) (see Figure 4) with $t_{cycle} = t_1 + t_2 + t_3 + t_4$.



a) period 1: fan working in extraction mode during t_1

b) period 2: fan off during t_2

c) period 3: fan working in supply mode during t_3

d) period 4: fan off during t_4

Key

1 outdoor air 21

2 extract air 11

3 supply air 22

4 exhaust air 12

Figure 4 — Schematic diagram for one unit of alternating heat exchangers

The corrected mass air flow rate for one unit (two paired devices) is calculated using Formula (5).

$$q_{\mathrm{m}} = \frac{2}{t_{\mathrm{cycle}}} \mathrm{MIN} \left| \int^{t_1} q_{\mathrm{m11}}.dt \; ; \int^{t_3} q_{\mathrm{m22}}.dt \right| \tag{5}$$

NOTE Total air change for the test room is considered with paired devices working synchronised in opposite way (only the minimum air flow is considered).

q_{m11} and q_{m22} can be measured in steady-state conditions and the simpler Formula (6) can be used.

$$q_{\mathrm{m}} = \mathrm{MIN} \left| q_{\mathrm{m11}} \; ; q_{\mathrm{m22}} \right| \cdot \frac{(t_1 + t_3)}{t_{\mathrm{cycle}}} \tag{6}$$

The graph for mass air flow rate for one unit is given in Figure 5.

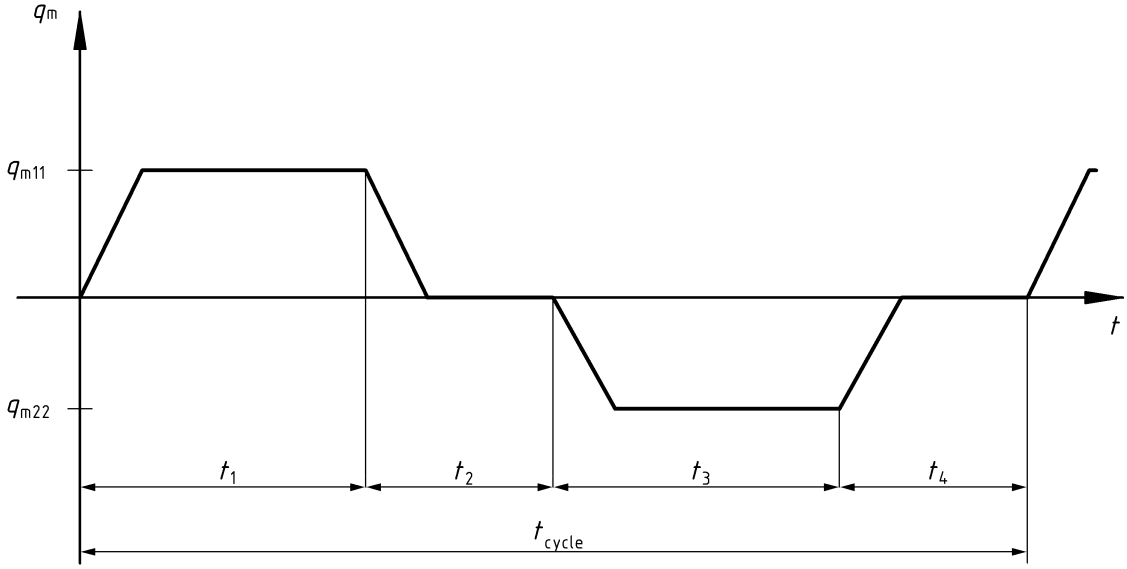


Figure 5 — Mass air flow rate for one unit

It would be possible to consider the rise and fall times for calculate q_m but as they are quite similar in each direction, the simplify Formula (6) is used.

5.3.2 Leakages

5.3.2.1 External leakage

The external leakage shall be measured according to Annex B.

The external leakage air volume flow q_{ve} at over-pressure and under-pressure of 50 Pa shall be reported as such and also compared to the maximum air volume flow of the unit as a percentage.

During the tests, the fans of the unit under test shall be switched off.

5.3.2.2 Internal leakage

Internal leakage measurements are not applicable.

5.3.2.3 Outdoor mixing and carry over

The volume inside the unit is carried over at each cycle and shall not be incorporated for calculating the air volume flows. Depending on the frequency of reverse mode and stop time, the percentage of the maximum air volume flow shall be determined.

Due to the fact that one duct is used for the air inlets and outlets, there is a risk of mixing fresh outdoor air with used indoor air because the used air can be recirculated for the next period.

The measurement of the outdoor mixing air by using the tracer gas method is mandatory. The test method is described below:

— Spaces 1 (outdoor air side) and 4 (exhaust air side) (see Figure 4) shall be open to the outside.

— Introduce gas in the extract side 2 (see Figure 4) during the first part of the cycle t_1.

— Measure the concentration of tracer gas C_{11}.

— Stop the sending of the gas after t_1.

— Measure the concentration of tracer gas C_{22} in the supply air 3 (see Figure 4) during the third part of the cycle (t_3).

— Calculate the outdoor mixing using Formula (7).

$$\text{Outdoor mixing} = \frac{\frac{1}{t_3}\int_{t_3}(C_{22})}{\frac{1}{t_1}\int_{t_1} C_{11}} \tag{7}$$

5.3.3 In/out airtightness

When the fan is off, the in/out airtightness shall comply with Table 9. In this case, the air volume flow at + 20 Pa or – 20 Pa shall be recalculated for one hour depending on the frequency and the duration of the off period.

q_{vio} shall comply with Table 9 and is calculated using Formula (8).

$$q_{\text{vio}} = \frac{q_{\text{vmesured}} \times t_2}{t_{\text{cycle}}} \tag{8}$$

5.4 Performance testing of thermal characteristics

5.4.1 Temperature and humidity ratios on supply air side (mandatory measurement)

The temperature ratio on supply air side and humidity ratio on supply air side are calculated using respectively Formula (9) and Formula (10).

$$\eta_{\theta,\text{ su}} = \frac{\theta_{22} - \theta_{21}}{\theta_{11} - \theta_{21}} \cdot \frac{q_{\text{m22}}}{q_{\text{m11}}} \tag{9}$$

$$\eta_{\text{x,su}} = \frac{x_{22} - x_{21}}{x_{11} - x_{21}} \cdot \frac{q_{\text{m22}}}{q_{\text{m11}}} \tag{10}$$

5.4.2 Temperature and humidity ratios on exhaust air side (optional measurement)

The temperature ratio on exhaust air side and humidity ratio on exhaust air side are calculated using respectively Formula (11) and Formula (12).

$$\eta_{\theta,\text{ ex}} = \frac{\theta_{11} - \theta_{12}}{\theta_{11} - \theta_{21}} \cdot \frac{q_{\text{m12}}}{q_{\text{m21}}} \tag{11}$$

$$\eta_{\text{x,ex}} = \frac{x_{11} - x_{12}}{x_{11} - x_{21}} \cdot \frac{q_{\text{m12}}}{q_{\text{m21}}} \tag{12}$$

5.4.3 Test requirements

For category II of heat exchangers the nominal rotor speed specified by the manufacturer shall be used.

For rotary exchangers of category II, the purge sector shall be adjusted in accordance with the recommendations of the manufacturer.

With the exception of automated defrost heaters, heaters in the unit shall not operate during the tests.

5.4.4 Test operating conditions

During thermal test, the air flows measured shall be the ones given by the device at 0 Pa over the device and measured in accordance with 5.2.3 for a Category A installation.

The ambient temperature of the unit shall be maintained at the same dry bulb temperature than the extract air: (11 ± 1) °C.

Temperature ratios for supply and extract air shall be measured at reference air flow and optionally at other airflows and shall be reported.

Humidity ratios for supply and extract air shall be measured for any exchanger of category II at reference air flow if applicable and optionally at other airflows, and shall be reported.

NOTE 1 If ratios for supply and exhaust are much different, several causes are possible: thermal bridges, leakage, fan absorbed power. To investigate this, it is sometimes possible to compare test results with and without over insulation of the casing or to use tracer gas measurements.

NOTE 2 There is no correction of the thermal input due to the fans or other components, for the temperature ratio.

5.4.5 Temperature conditions

Thermal tests shall be performed at the temperature conditions for standard test, accordingly to the type and use of the heat recovery device (see Table 3):

— point 1 is a dry air test, mandatory for all units;

— point 2 is an intermediate point, mandatory for units of category II and optional for units of category I for condensation;

— point 3 is an optional point intended to show extreme condensation conditions;

— point 4 is an optional point for cold climate. The test shall run for a minimum of 6 h and up to a maximum of 24 h to a point where the airflow is stabilized.

If condensation occurs, then the condensation test shall also be performed.

If the unit is designed to operate at outdoor temperature below - 15°C, then the cold climate test shall be performed.

Table 3 — Temperature conditions

Application mode		Temperature conditions °C			
		Standard test			Cold climate test [a]
Point Number		1	2	3	4
Heat exchanger category	I	mandatory	optional	optional	optional
	II	mandatory	mandatory	optional	optional
Extract air					
Temperature	θ_{11}	+ 20	+ 20	+ 20	+ 20
Wet bulb temperature	θ_{w11}	+ 12	+ 15	+ 12	+ 10
Outdoor air					
Temperature	θ_{21}	+ 7	+ 2	- 7	- 15
Wet bulb temperature	θ_{w21}	—	+ 1	- 8	—

[a] Additional test for cold climates.

Following a test for cold climates, the unit shall be visually inspected. This inspection shall be carried out immediately after defrosting or other similar action. Observations shall be noted in the test report as to the influence of freezing and condensation on the operation of the heat recovery device, and the condensation water outlet.

5.4.6 Test procedure

The temperature and humidity ratios shall be established by measuring the mean values of dry and wet bulb temperatures in sections 11, 22, 21 and optionally in section 12 in case of measuring for an exhaust temperature ratio.

There shall be at least four temperature measuring points at each port and these shall be evenly distributed across the port.

Uncertainties of measurements shall comply with the values of the following Table 4.

Table 4 — Uncertainties of measurement

Measured quantity	Uncertainty of measurement
Dry bulb temperature	±0,2 K
Wet bulb temperature	±0,3 K
Air flow rate	±3 %

Steady-state conditions are considered obtained and maintained when all the measured quantities remain constant without having to alter the set values, for a minimum duration of 1 h, with respect to the tolerances given in Table 4. Periodic fluctuations of measured quantities caused by the operation of regulation and control devices are permissible, on condition the mean value of such fluctuations does not exceed the permissible deviations listed in Table 5.

For the output measurement, it is necessary to record all the meaningful data continuously. In the case of recording instruments which operate on a cyclic basis, the sequence shall be adjusted such that a complete recording is performed at least once every 30 s.

The duration of measurement shall not be less than 30 min.

Table 5 — Permissible deviations from set values

Measured quantity	Permissible deviation of	
	arithmetic mean values from set values	individual measured values from set values
Air (supply and extract)		
— inlet temperature (dry bulb)	±0,3 K	±1 K
— inlet temperature (wet bulb)	±0,3 K	±1 K
— volume flow rate	±5 %	±10 %
— pressure	—	±10 %
Voltage	±1 %	±1 %

5.4.7 Test model for testing alternating ventilation units

5.4.7.1 General

In case of testing alternating ventilation units, temperature measurements shall be faster and stable enough to be accurate after a change of several °C in a period of $\frac{t_2}{4}$.

The test shall be conducted with two devices, according to Figure 6, working in opposite phase. The measurement shall be made when the devices are running in stabilized conditions. This is normally achieved after 1 h of operation in stable test conditions. The measurement shall be conducted afterwards, over a period of 30 min and then the average value shall be used for calculation purposes.

The size and construction of each test chamber shall be such that the conditions at the inlet of the devices (θ_{11} and θ_{21}) are kept constant. Ambiance air can be prepared by recirculating air in each test chamber to maintain the aerodynamic conditions in each test chamber.

The values shall be used for calculation in 8.2.

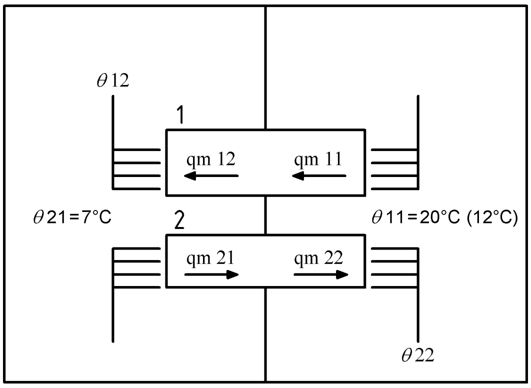
5.4.7.2 Special features

Alternating ventilation units use regenerative heat exchangers for heat recovery. These are cyclically charged and discharged via flow reversal.

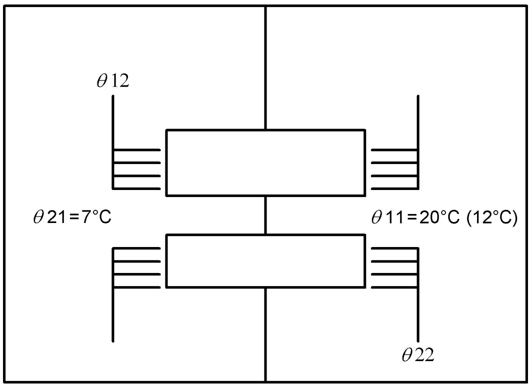
At least two devices working in opposition are required in order to maintain the correct balance of air in a room.

5.4.7.3 Thermal test

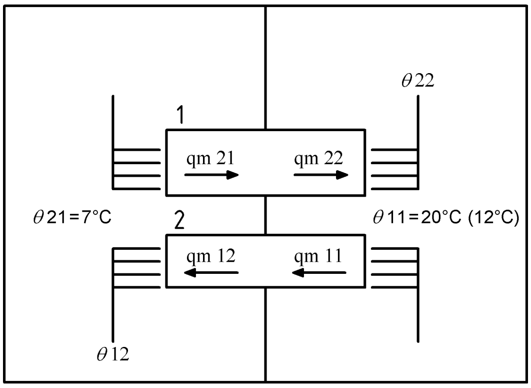
The schematic diagram for two identical devices of alternating heat exchangers is given in Figure 6 where $t_{cycle} = t_1 + t_2 + t_3 + t_4$.



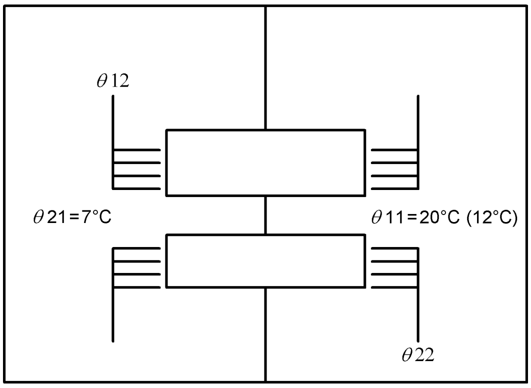
a) period 1: device 1 working in extraction mode and device 2 working in supply mode during t_1



b) period 2: fan off during t_2



c) period 3: device 1 working in supply mode and device 2 working in extraction mode during t_3



d) period 4: fan off during t_4

Key

1 device 1

2 device 2

Figure 6 — Schematic diagram for two identical devices of alternating heat exchangers

The thermal measure is possible if the temperature probes are fast enough and if there are two probes working in phase opposition. The positioning of the probes shall be made that way in order that they measure the calorific mean temperature of the air flow. Then the received and restored temperatures could be measured and an average temperature ratio could be calculated.

As well, it is possible to make flow/pressure curve in one way and in the other way at + 20 Pa, 0 Pa and - 20 Pa for the two units and the average of airflow is considered.

The devices operate in an alternating manner for heat recovery. The cycle time is measured. The temperature conditions are measured using double climate chamber, one for the outdoor air side (outdoor air chamber, 21) and one for the exhaust air side (exhaust air chamber, 11). There is no pressure difference in the chambers with respect to each other. The devices are installed between the chambers. The devices shall be installed in accordance with manufacturer instructions, part of the device which is not in the wall shall be adequately insulated.

The airflow short-circuit between the devices shall be prevented, this could be done either by additional partition wall between the devices or by ensuring that the two devices have a minimum distance of 1,5 m between them. Depending on the current direction of operation, each device extracts the air from one chamber and blows it into the other chamber.

Table 6 — Mode of operation of two alternating ventilation units

Description	Operation			
	Period 1 Direction	Period 2 Fans	Period 3 Direction	Period 4 Fans
Unit 1	in/out	off	out/in	off
Unit 2	out/in	off	in/out	off
Duration	t_1	t_2	t_3	t_4
Total duration	t_{cycle}			

5.5 Effective power input

The electrical power input of the unit P_E at 0 Pa shall be measured at maximum air flow, minimum air flow and reference air flow at least, according to 5.2.3, and shall be reported.

In active mode, the unit is connected to the mains power source and is providing the intended service. This means the control system is operating and the unit provides suitable ventilation rates according to the controls strategy.

NOTE 1 Fans and electronic control are operating.

NOTE 2 In case of alternating ventilation unit, the electrical power of the unit represents the electrical power of two devices.

If the system includes a mode in which the fans are not operating and controls components are still active (necessary for function of the unit internal or external), then the electric power input shall also be measured in this mode.

If the system can be switched off manually or with any remote control system and if the end of this mode is also given by a manual action, the electric power input shall be measured with the high voltage in operation.

6 Classification

6.1 Leakage classification

Table 7 defines three classes of leakage depending of the four following ratios: internal leakage, outdoor mixing, indoor mixing and external leakage divided by maximum air volume flow.

Table 7 — Leakage classes

Class	**Internal leakage** %		**Outdoor mixing** %		**Indoor mixing** %		**External leakage** at 50 Pa %
U1	≤ 2	and	≤ 2	and	≤ 2	and	≤ 2
U2	≤ 5	and	≤ 5	and	≤ 5	and	≤ 5
U3	≤ 10	and	≤ 10	and	≤ 10	and	≤ 10
Not classified	> 10	or	> 10	or	> 10	or	> 10

Because of measurement uncertainty, the tests for air flow/pressure curve and thermal performances shall not be made if the unit is not classified.

6.2 Airflow sensitivity classification

The airflow sensitivity influences the balance of the two air flows in the unit resulting in variations in the temperature ratios and volume flows that shall be corrected according to EN 13142 [1].

The airflow sensitivity classification is given in Table 8.

Table 8 — Classification of airflow sensitivity to pressure difference variations

Class	**Maximum deviation of airflow compared to maximum airflow** %	
	at + 20 Pa	at – 20 Pa
S1	≤ 10	≤ 10
S2	≤ 20	≤ 20
S3	≤ 30	≤ 30

Because of the major rule of the airflow, the unit shall be able to renew the air at a pressure difference of ± 20 Pa on the wall.

For deviation values higher than 30 %, the units do not fulfil the intended use and therefore the tests for thermal performances shall not be made.

6.3 Indoor/outdoor airtightness of the complete unit

For some products, in normal operating conditions, it is possible to switch off the device. If the device has a manual shutter, an extra measurement of airtightness shall be made with manually closed shutter. For all cases, the product shall respect a maximal leakage given by the airtightness classification, see Table 9.

For alternating ventilation unit including a storage type heat exchanger:

— if the cycle cannot be switched off, the leakage airflow is measured during the t_2 period when the fan is off (see 5.4.7.3) and the maximum leakage airflow for Table 9 is calculated using Formula (13).

$$q_{\text{vio}} = q_{\text{vmeasured}} \times \frac{t_2}{t_{\text{cycle}}} \qquad (13)$$

— if the unit can be switched off, the leakage air flow is measured during that time and the maximum leakage airflow for Table 9 is the following:

$$q_{\text{vio}} = q_{\text{vmeasured}}$$

Table 9 — Indoor/outdoor airtightness classification of the complete unit

Class	**Maximum** unit under test **leakage airflow when fans are off** m^3/h	
	at + 20 Pa	at – 20 Pa
D1	≤ 7	≤ 7
D2	≤ 10	≤ 10
D3	≤ 15	≤ 15

7 Requirements

To correctly assess the thermal performance, the aerodynamic characteristics, including all leakages, shall be tested before or together with any thermal characteristics testing.

The following characteristics shall be tested, measured, or calculated:

- external leakage;
- internal leakage;
- indoor mixing;
- outdoor mixing;
- minimum air volume flow;
- maximum air volume flow;
- air flow sensitivity classification;
- indoor/outdoor airtightness (if applied);
- filter classes supply and exhaust air;
- measured temperature ratio;
- functioning at low outdoor temperatures (frost protection function and control);
- sound power level radiated in the indoor space;
- sound power level radiated in the outdoor space;
- airborne sound insulation;
- effective power input.

8 Calculations

8.1 General calculations

All the leakages, mixing and flow balance variations has an influence on the air exchange capacity of the unit and on the unit efficiency.

Starting from the measured air flow q_0 and the temperature ratio η_0 on supply air, corrected air volume flows q_5 and corrected temperature ratios η_5 should be calculated depending on the value in % of:

- w of the internal leakage;
- x of the outdoor mixing;
- y of the indoor mixing;
- v of the air flow sensitivity;

according to Table 11.

To take into account the uncertainty of measurement, these corrections shall be applied for each individual value in percentage only if the deviation for this criterion is bigger than 2 %, and the correction shall be reduced from this percentage as shown in Table 10 and Table 11.

No corrections can be applied for external leakages because it is not possible to know how thermal transfers apply.

Table 10 — Example of calculation

Measure	Result	Unit	Influence on	
			Temperature ratio η	Air exchange capacity q
Measured airflow	q_0	$l.s^{-1}$	—	—
Temperature ratio on supply air	η_0	%	—	—
Internal leakage	w	%	$\eta_1 = \eta_0 \times (1\text{-} (w - 0{,}02))$	$q_1 = q_0 \times (1\text{-} (w - 0{,}02))$
Outdoor mixing	x	%	$\eta_2 = \eta_1 \times (1\text{-} (x - 0{,}02))$	$q_2 = q_1 \times (1\text{-} (x - 0{,}02))$
Indoor mixing	y	%	$\eta_3 = \eta_2 \times (1\text{-} (y - 0{,}02))$	$q_3 = q_2 \times (1\text{-} (y - 0{,}02))$
Outdoor mixing	z	%	$\eta_4 = \eta_3$	$q_4 = q_3$
Airflow sensitivity	v	%	$\eta_5 = \eta_4 \times (1\text{-} (v - 0{,}02))$	$q_5 = q_4 \times (1\text{-} (v - 0{,}02))$

Table 11 — Example of corrections

Measure	Input measured data	Calculated corrections	
		Temperature ratio	Air exchange capacity
Measured airflow	$q_0 = 11{,}11$ $l.s^{-1}$	—	—
Temperature ratio on supply air	$\eta_0 = 90$ %	—	—
Internal leakage	$w = 4$ %	$\eta_1 = 88{,}2$ %	$q_1 = 10{,}89$ $l.s^{-1}$
Outdoor mixing	$x = 1$ %	$\eta_2 = 88{,}2$ %	$q_2 = 10{,}89$ $l.s^{-1}$
Indoor mixing	$y = 5$ %	$\eta_3 = 85{,}6$ %	$q_3 = 10{,}56$ $l.s^{-1}$
Outdoor mixing	$z = 5$ %	$\eta_4 = \eta_3 = 85{,}6$ %	$q_4 = q_3 = 10{,}56$ $l.s^{-1}$
Airflow sensitivity	$v = 5$ %	$\eta_5 = 83$ %	$q_5 = 10{,}25$ $l.s^{-1}$

8.2 Special calculations for alternating heat exchangers

All the results shall be having a post calculation to consider the use of two alternating heat exchangers in order to represent the real use of one unit.

For example, the temperature ratio shall be calculated using Formula (14) for two units working like in Table 6.

$$\eta_{\theta,\,su} = \frac{1}{t_{cycle}} \left(\left[\int_{t_1} \left(\frac{\theta_{22} - \theta_{21}}{\theta_{11} - \theta_{21}} \right) dt \right]_{unit1} + \left[\int_{t_3} \left(\frac{\theta_{22} - \theta_{21}}{\theta_{11} - \theta_{21}} \right) dt \right]_{unit2} \right) \quad (14)$$

The corrected calculation as indicated in EN 13142 [1] shall be made with $\eta_{\theta,\,su}$ and q_{vio}.

9 Performance testing of acoustic characteristics

9.1 General

The unit shall be installed according to the manufacturer's instructions; if optional components (e.g. silencers, extra connection ducts) are included in the test, they shall be mentioned and described in the test report.

9.2 Radiative sound power in the indoor or outdoor space

9.2.1 General

Acoustic measurements shall be carried out for at least three operating points for which the fan aerodynamic performance characteristics have been determined, including minimum and maximum air volume flow.

The measurement of radiated sound power shall be made by one of the methods described below, for both noise radiated into the indoor space and noise radiated into the outdoor space:

— precision methods described in EN ISO 3741 (reverberation room) or EN ISO 3745 (anechoic or semi-anechoic room);

— engineering methods described in EN ISO 3743-1 (hard-walled test room) or EN ISO 3743-2 (special reverberation test room), or EN ISO 3744 (essentially free field over reflecting plane);

— sound intensity methods described in EN ISO 9614-1 or EN ISO 9614-2.

The accuracy of measurements should be particularly checked in case of free field or sound intensity measurement.

The unit shall be installed according to the manufacturer's instructions; if optional components (e.g. silencers, extra connection ducts) are included in the test, they shall be mentioned and described in the test report.

The unit shall be mounted at least at 1 m distance from any intersection of walls or corner of the room, unless it is intended specifically for mounting at surface intersection or in a corner. If this is the case, this should be specified by the manufacturer and mentioned and described in the test report.

Airflow control devices used by laboratories shall not interfere with acoustic measurements.

Sound power levels shall be determined at least at three air volume flows, included the maximum air volume flow.

9.2.2 Reverberant room method

The unit shall be mounted at least at 1 m distance from any intersection of walls or corner of the room, unless it is intended specifically for mounting at surface intersection or in a corner. If this is the case, this should be specified by the manufacturer and mentioned and described in the test report. Particular attention should be paid to seal the gaps between the unit under test and the test room wall.

An example of a test installation for reverberant room method is given in Figure 7.

Key

1 reverberant room

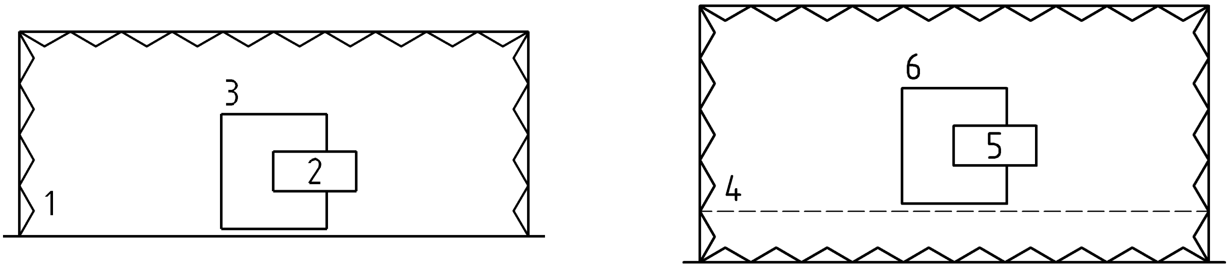
2 unit under test

Figure 7 — Reverberant room method: test rooms – Cross section

9.2.3 Anechoic or semi-anechoic room method

The unit shall be fitted in a sound insulating and absorbing box in order to eliminate the influence of the side (inner or outer) which is not being measured. Particular attention should be paid to seal the gaps between the unit under test and the box.

An example of a test installation for anechoic and semi-anechoic room method is given in Figure 8.



a) semi anechoic room method **b) anechoic room method**

Key

1 semi-anechoic room

2 unit under test

3 sound absorbing and insulating box

4 anechoic room

5 unit under test

6 sound absorbing and insulating box

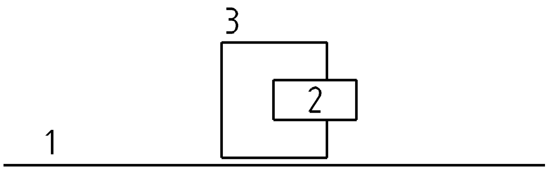
Figure 8 — Set-up for anechoic and semi-anechoic room method: cross section

9.2.4 Free field method

NOTE The sound power radiated can be extremely low and the conditions for free field conditions can be hardly fulfilled (the measured values can be very close to background noise).

The unit shall be mounted over a reflecting plane in a flat outdoor area or in a large room and shall be fitted in a sound insulating and absorbing box in order to eliminate the influence of the side (inner or outer) which is not being measured. Particular attention should be paid to seal the gaps between the unit under test and the box.

An example of a test installation for free field over a reflecting plane is given in Figure 9.



Key

1 reflecting plane

2 unit under test

3 sound absorbing and insulating box

Figure 9 — Setup for measurement in free field over a reflecting plane: cross section

9.3 Airborne sound insulation

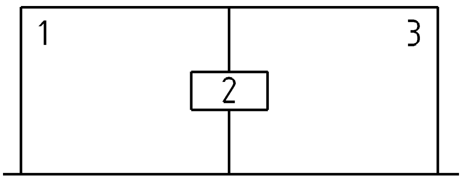
Acoustic measurement shall be carried out according to engineering methods described in EN ISO 10140-1:2010, EN ISO 10140-2 and EN ISO 10140-5.

The unit shall be installed according to the manufacturer's instructions; if optional components (e.g. silencers, extra connection ducts) are included in the test, they shall be mentioned and described in the test report. The unit shall be mounted at least at 1 m distance from any intersection of walls or corner of the room, unless it is intended specifically for mounting at surface intersection or in a corner. If this is the case, this should be specified by the manufacturer and mentioned and described in the test report. Particular attention should be paid to seal the gaps between the unit under test and the test room wall.

Airflow control devices used by laboratories shall not interfere with acoustic measurements.

The fans shall be switched off but the dampers, if present, shall be open like in the normal conditions of working of the unit.

An example of a test installation is given in Figure 10.



Key

1 transmitting room

2 unit under test

3 receiving room

Figure 10 — Double room set-up: cross section of test rooms

10 Test results

10.1 Test report

The test report shall include at least the following information:

a) name and address of testing laboratory and location where the test is carried out when different from the address of the testing laboratory;

b) unique identification of report (such as serial number) and of each page, and total number of pages of the report;

c) name and address of the client;

d) description and identification of the test item;

e) date of receipt of test item and date(s) of performance of test;

f) identification of the test specification or description of the procedure;

g) description of the sampling procedure, where relevant;

h) any deviations, additions to or exclusions from the test specification, and any other information relevant to a specific test;

i) identification of any non-standard test method or procedure utilized;

j) measurements, examinations and derived results, supported by tables, graphs, sketches and photographs as appropriate, and any failures identified (see 5.2 to 5.5);

k) a statement on measurement uncertainty (where relevant);

l) a signature and title or an equivalent marking of person(s) accepting technical responsibility for the test report and date of issue;

m) a statement to the effect that the results are only for the items tested;

n) a reference to this European standard (i.e. EN 13141-8);

o) qualitative specification of visual inspection of the filter, if appropriate.

10.2 Product specifications

The product specification shall be given as follows:

— maximum air volume flow: q_{vmax} in $m^3.s^{-1}$ or $l.s^{-1}$;

— filter class according to EN 779.

10.3 Additional information related to the performance of the product

The manufacturer should declare which strategy is used to:

— control condensation problems during the critic seasons (that could be winter time in northern Europe as summer time in southern Europe with humid climates);

— avoid frosting in the SRHR unit.

NOTE For example it is interesting to know the time of unbalanced conditions when one fan is off.

The laboratory shall report the part of the strategy that can be checked.

10.4 Leakages

The equipment leakages established in accordance with 5.2.1 shall be given as follows:

— external leakage: q_{ve} in $m^3.s^{-1}$ or $l.s^{-1}$;

— external leakage/maximum flow rate: q_{ve}/q_{vd} in %;

— internal leakage from supply to exhaust flow: q_{vise} in $m^3.s^{-1}$ or $l.s^{-1}$;

— internal leakage from exhaust to supply flow: q_{vies} in $m^3.s^{-1}$ or $l.s^{-1}$;

— internal leakage from exhaust to supply/supply flow rate: q_{vies}/q_v in %;

— external leakage/maximum flow rate: q_{vi}/q_{vmax} in %;

— indoor mixing: q_{mi} in $m^3.s^{-1}$ or $l.s^{-1}$;

— indoor/outdoor airtightness in m^3/h;

— outdoor mixing (calculated): q_{me} in %;

— indoor mixing/maximum flow rate: q_{mi}/q_{vmax} in %;

— outdoor mixing/maximum flow rate (calculated): q_{me}/q_{vmax} in %;

— external leakage/pressure curve;

— leakage class.

10.5 Air flow

The air flow/pressure characteristic established in accordance with 5.2.2 for supply and exhaust air flows, for each voltage and for each setting shall be recorded as follows:

— supply air volume flow: q_{vs} in $m^3.s^{-1}$ or $l.s^{-1}$;

— extract air volume flow: q_{ve} in $m^3.s^{-1}$ or $l.s^{-1}$;

— reference air volume flow: q_{vref} in $m^3.s^{-1}$ or $l.s^{-1}$;

— airflow sensitivity classification;

— corrected air flow according to EN 13142 [1].

10.6 Effective power input

For the effective power input the following results shall be reported at each operating point according to 5.2.2.

— list of the major electrical components of the unit;

— total electric power input P_E in active mode at each point according to 5.5 in W;

— specific effective power input P_E/q_{vmax} at each point (including reference point) according to 5.5 in $W/(m^3.s^{-1})$ or $W/(l.s^{-1})$;

— total electric power input P_E in fans off mode according to 5.5 in W;

— total electric power input P_E in manual off mode according to 5.5 in W.

10.7 Temperature and humidity ratios

a) The temperature ratios, according to 5.4, shall be reported including the following values:

  — temperature θ_{11}, θ_{22}, θ_{12}, θ_{21};

- water content x_{11}, x_{22}, x_{12}, x_{21};
- mass flow q_{m11}, q_{m22}, q_{m12}, q_{m21};
- temperature ratio for supply air without condensation.

b) The following optional information shall be reported if measured:

- temperature ratio for exhaust air without condensation;
- temperature ratio for supply air with condensation;
- temperature ratio for exhaust air with condensation.

c) The following additional information for cold climate shall be reported if tested:

- temperature ratio for supply air (optional);
- temperature ratio for exhaust air (optional);
- observations of the influence of freezing and condensation on the operation of the heat recovery unit and the condensation water outlet.

Temperature ratios shall always be stated together with the leakage class of the unit (see 6.1).

Every operating point shall be recorded with all relevant information (airflows, pressure conditions, humidity values, temperature, etc.).

10.8 Acoustic characteristics

The test installation and conditions shall be clearly described.

All the information concerning the measurements shall be recorded according to the specifications of the standard adopted.

For the assessment of noise radiated toward the inner side and the outer side, in accordance with 9.2, the presentation of the results in the report shall include the following for both the internal and external sides of the unit:

- test method and description of set-up;
- A-weighted sound power levels (indoor and outdoor), L_{WA}, in dB;
- sound power levels (indoor and outdoor), L_W in dB, in third octave bands between 125 Hz and 10 000 Hz, or in octave bands between 125 Hz and 8 000 Hz, according to the standard adopted;
- air volume flows at acoustic test conditions: minimum air volume flow, maximum air volume flow (q_{vmax}) and third air volume flow chosen (q_v), in $m^3.s^{-1}$ or $l.s^{-1}$.

For the assessment of airborne sound insulation, in accordance with 9.3, the presentation of the results in the report shall include the following:

- test method and description of set-up;
- global airborne sound insulation index $D_{n,e,w}$ (Ctr) in dB calculated according to EN ISO 717-1;
- airborne sound insulation $D_{n,e}$ in third octave bands, in dB, between 125 Hz and 10 000 Hz.

11 Cleaning and maintenance

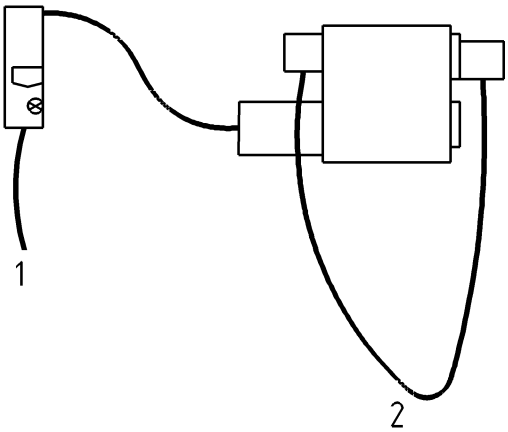
The manufacturer should declare how the SRHR should be cleaned.

NOTE SRHR main problem concerns the fact that it is not easy to reach the external grilles from the room where the SRHR is installed.

Annex A
(informative)

Test layouts

The test setups to determine the internal leakage using tracer gas method, airflows, and temperature ratios shall be as shown in Figures A.1, A.2 and A.3.

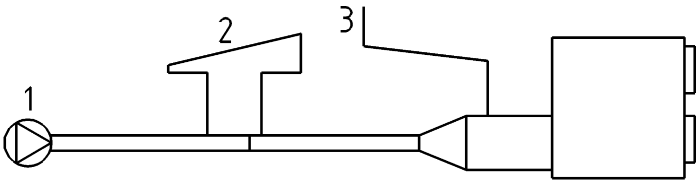


Key

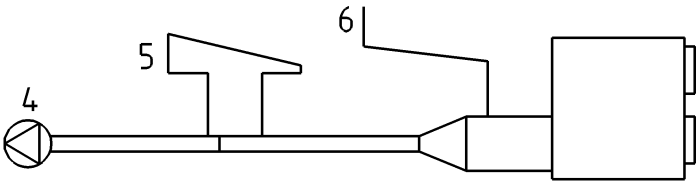
1 tracer gas inlet — extract air (11)

2 tracer gas measurement — supply air (22) and exhaust air (12)

Figure A.1 — Tracer gas internal leakage measurement



a) measuring supply

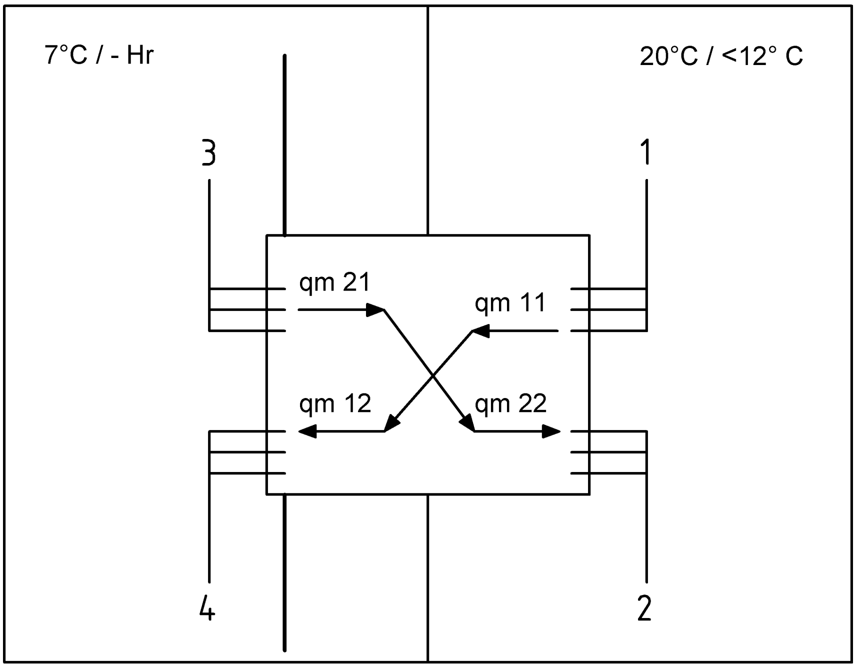


b) measuring extract flow

Key

1 auxiliary fan
2 airflow rate measurement device
3 static pressure measurement
4 auxiliary fan
5 airflow rate measurement device
6 static pressure measurement

Figure A.2 — Measurement set up using balancing fan



Key

1 extract air

2 supply air

3 outdoor air

4 exhaust air

Figure A.3 — Temperature measurement layout

Annex B
(normative)

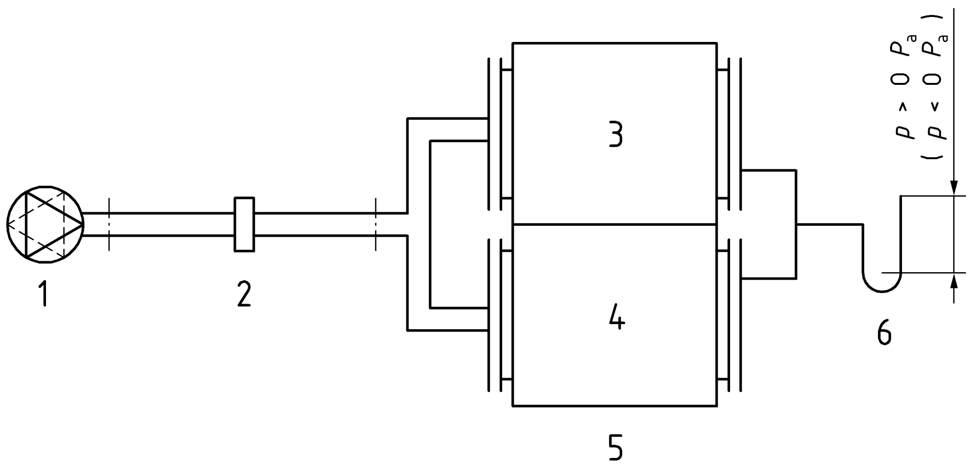
Pressure leakage test method

B.1 External leakage test

The external leakage test shall be carried out by blanking off and sealing all ducts and connecting a fan to both the supply and the exhaust air sides of the recovery devices as shown in Figure B.1.

The static pressure of the casing shall be taken as the mean value at the two sides. Thus, static pressure tappings are located on a blanking off plate each side and both taps are connected to the same pressure measuring instrument. The external leakage flow rates at over-pressure in the casing and at under-pressure are established with suitable air flow measuring equipment.

The accuracy of the measured values shall be kept within ± 5 % for the flow rates and ± 3 % for the static pressures of the casing.



Key

1 adjustable fan

2 air flow measuring equipment

3 exhaust air side

4 supply air side

5 heat recovery device

6 static pressure measuring equipment

Figure B.1 — Test setup for leakage

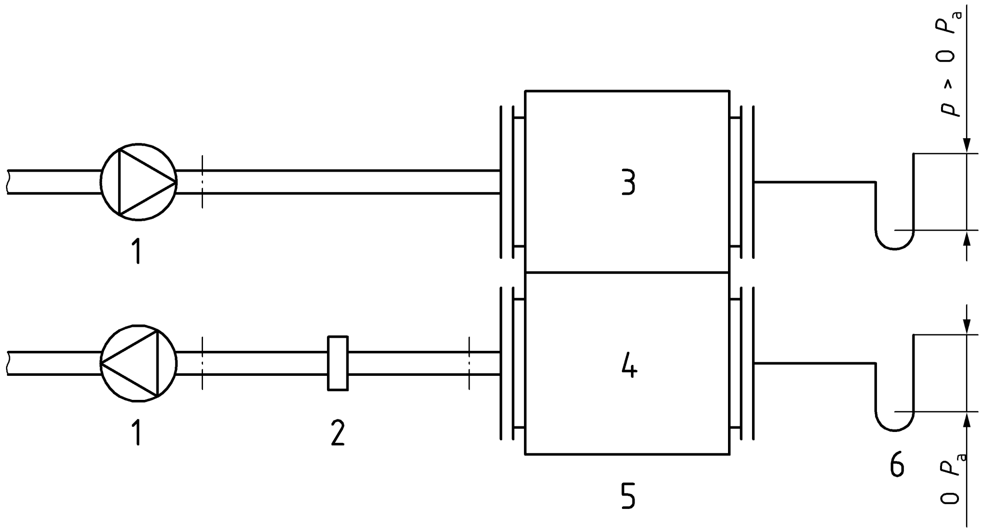
For alternating ventilation unit including a storage type heat exchanger, the test setup for leakage is simplified because Key 3 and 4 are combined.

Measurement devices shall comply with EN 306.

B.2 Internal leakage test

The internal leakage test shall be carried out by blanking off and sealing all ducts and connecting one supply fan to the exhaust air side and one exhaust fan to the supply air side of the recovery device as shown in Figure B.2. The over-pressure on the exhaust air side is ascertained with the aid of a static pressure tapping in the blanking off plate and the pressure 0 Pa at a corresponding tapping on the supply side. The internal leakage flow rate is established with air flow measuring equipment connected to the supply air side.

The uncertainty of the measured values shall not exceed ± 5 % for the flow rate and ± 3 % for the static pressure difference between the two sides of the recovery device.



Key

1 adjustable fan

2 air flow measuring equipment

3 exhaust air side

4 supply air side

5 heat recovery device

6 static pressure measuring equipment

Figure B.2 — Test setup for internal leakage

Measurement devices shall comply with EN 306.

Annex C
(normative)

Indoor mixing

C.1 General

Indoor mixing represents the risk of short-cut between the supply air and the extract air, and therefore is linked directly with the efficiency of the ventilation system. Two tests are needed in order to determine the indoor mixing.

C.2 Determination of indoor mixing - First test

Internal leakage on outdoor air shall be measured by means of a tracer gas at 0 Pa and fans at maximum setting according to Figure 2 c). The tracer gas should be introduced into the outdoor inlet duct as close as possible to the grille, if this is not possible, a short length of duct (less than 150 mm) of the same cross section as the grille should be fastened to the grille and the tracer gas introduced into the ductwork.

The tracer gas concentration should be measured at the line of the outdoor grilles. If this is impossible short pieces of ductwork of the same cross section as the grille should be applied and measurement made within the ductwork.

To measure internal leakage on outdoor air a deflector is introduced between the indoor grilles and sealed to ensure that exhaust gas cannot be mixed back into the intake port. The deflector should be applied between the extract and intake ports. It should be fixed to the outside of the grille and extend to at least 300 mm in each direction. Tracer gas is introduced into the outdoor inlet duct and the concentration is measured in both the extract and supply ports. The internal leakage on outdoor air, as a percentage of the supply flow, is then the ratio of the two concentrations, so that:

internal leakage on outdoor air = $$\left(\frac{C_{12}}{C_{22}}\right)_c$$

where term c refer to subfigure c of Figure 2.

C.3 Determination of indoor mixing - Second test

The second test measures the consequences of both the internal leakages on outdoor air and the indoor mixing, when the deflector is removed according to Figure 2 d).

A separate mixing measurement is made at both the indoor and outdoor grille locations, the measurement with the highest percentage figure is used for the calculations.

C.4 Indoor mixing calculation

The indoor mixing is therefore calculated as the difference between the percentages measured during this test and the internal leakage on outdoor air, so that:

indoor mixing = $$\left(\frac{C_{12}}{C_{22}}\right)_d - \left(\frac{C_{12}}{C_{22}}\right)_c$$

where terms c and d refer to subfigures c and d of Figure 2.

NOTE The duration of the test is limited such that any influence of the contamination/saturation of the test room from the gas is minimised.

Bibliography

[1] EN 13142, *Ventilation for buildings - Components/products for residential ventilation - Required and optional performance characteristics*

[2] EN 60335-2-80:2003, *Household and similar electrical appliances — Safety — Part 2-80: Particular requirements for fans (IEC 60335-2-80:2002)*

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

bsi.

...making excellence a habit.™