



BSI Standards Publication

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

Part 8: Performance testing of non-ducted mechanical supply and exhaust ventilation units (including heat recovery)

National foreword

This British Standard is the UK implementation of EN 13141-8:2022. It supersedes BS EN 13141-8:2014, which is withdrawn.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 committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2022
Published by BSI Standards Limited 2022

ISBN 978 0 539 00694 0

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 October 2022.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

English Version

Ventilation for buildings - Performance testing of
components/products for residential ventilation - Part
8: Performance testing of non-ducted mechanical supply
and exhaust ventilation units (including heat recovery)

Ventilation des bâtiments - Essais de performance
des composants/produits pour la ventilation des
logements - Partie 8 : Essais de performance des
unités de ventilation double flux décentralisées
(y compris la récupération de chaleur)

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

This European Standard was approved by CEN on 10 January 2022.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents

Page

European foreword	iv
Introduction	vi
1 Scope	8
2 Normative references	8
3 Terms and definitions	9
4 Symbols and abbreviations	15
5 Categories of heat exchangers	18
6 Requirements	19
7 Test methods	20
7.1 General	20
7.2 Performance testing of aerodynamic characteristics	20
7.2.1 Leakages, mixing and air transfer	20
7.2.2 In/out airtightness	23
7.2.3 Filter bypass	23
7.2.4 Air flow	23
7.2.5 Electrical power input	27
7.3 Performance testing of thermal characteristics	28
7.3.1 General	28
7.3.2 Test operating conditions	28
7.3.3 Temperature conditions	29
7.3.4 Test procedure	30
7.3.5 Evaluation on supply air side (mandatory measurement) excluding alternating ventilation units	31
7.3.6 Evaluation on exhaust air side (optional measurement) excluding alternating ventilation units	32
7.4 Deviating aspects concerning alternating ventilation units	33
7.4.1 General	33
7.4.2 Internal leakage - Exhaust air transfer ratio	33
7.4.3 Determination of air volume flow	34
7.4.4 Electrical power input	38
7.4.5 Performance testing of thermal characteristics	39
8 Classification	45
8.1 Leakage classification	45
8.2 Air flow sensitivity classification	45
8.3 Indoor/outdoor airtightness of the complete unit	46
9 Performance testing of acoustic characteristics	46
9.1 General	46
9.2 Radiative sound power in the indoor or outdoor space	47
9.2.1 General	47
9.2.2 Reverberant room method	47
9.2.3 Anechoic or semi-anechoic room method	47
9.2.4 Free field method	48
9.3 Airborne sound insulation	48
10 Test results	49
10.1 Test report	49
10.2 Product specifications	49
10.3 Additional information related to the performance of the product	49
10.4 Leakages	50
10.5 Filter bypass	51
10.6 Air flow	51

10.7 Effective power input 51

10.8 Temperature and humidity ratios 52

10.9 Acoustic characteristics 52

Annex A (normative) Test layouts 54

Annex B (normative) Pressure leakage test method 57

Annex C (normative) Indoor mixing 59

Bibliography 61

European foreword

This document (EN 13141-8:2022) 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 March 2023, and conflicting national standards shall be withdrawn at the latest by March 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13141-8:2014.

In addition to a number of editorial revisions, the following main changes have been made with respect to EN 13141-8:2014:

- scope has been changed, and concerns now also non-ducted units which ventilate more than one single room;
- terms and definitions as well as symbols and abbreviations have been updated in accordance with the parameters used in the document;
- new categories of heat exchanger have been added;
- designations in [7.2.1.4](#) and the [Formulae \(1\) to \(4\)](#) have been changed;
- reference of the internal and external leakage rates has been changed to the reference air volume flow;
- extrapolation of the leakage rates has been added;
- [7.2.1.3.2](#) concerning exhaust air transfer ratio has been added;
- [7.2.4](#) concerning air flow measurement has been revised;
- requirements to convert the measured values to standard conditions have been added in [7.2.4](#) and [7.3.2](#);
- [7.3.3](#) has been divided into two separate [subclauses 7.3.3.1](#) for standard tests and [7.3.3.2](#) for cold climate tests;
- formulae to calculate the temperature ratios have been changed;
- wet bulb temperature for the cold climate test has been changed;
- the order of the specific test for alternating units including storage heat exchanges has been changed;
- deviating aspects for alternating units to determine the air flow correction, thermal performance and the exhaust air transfer ratio have been revised;
- [Table 10](#) concerning the temperature conditions for the cooling performance test has been moved in EN 13142.

A list of all parts in the EN 13141 series, published under the general title *Ventilation for buildings — Performance testing of components/products for residential ventilation* can be found on the CEN website.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania,

of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Introduction

This document specifies methods for the performance testing of components used in residential ventilation systems to establish the performance characteristics as identified in EN 13142.

This document 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 document can be used for the following applications:

- laboratory testing;
- attestation purposes.

The position of this document in the field of standards for the mechanical building services is shown in [Figure 1](#).

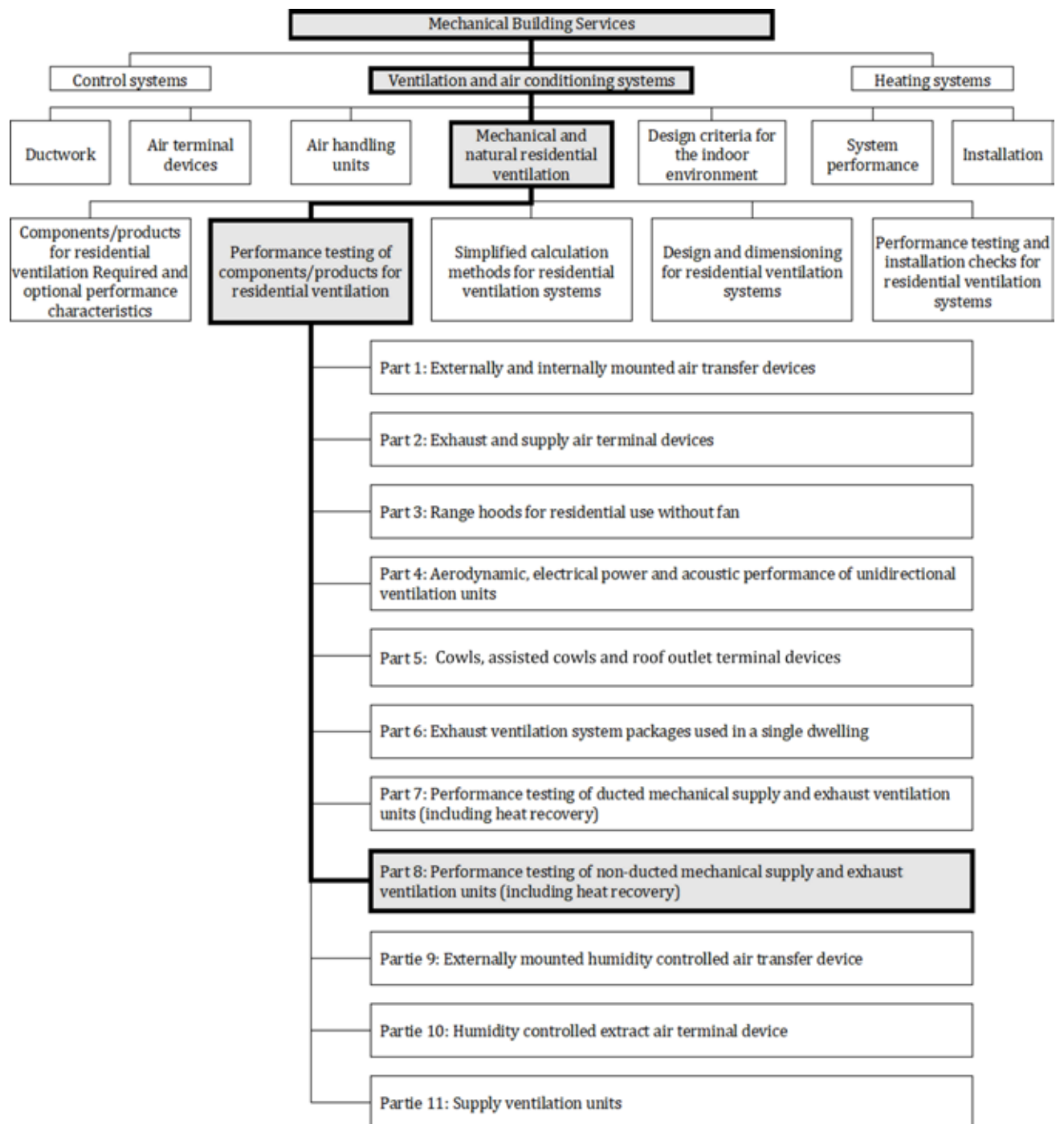


Figure 1 — Position of EN 13141-8 in the field of the mechanical building services

1 Scope

This document specifies the laboratory test methods and test requirements for the testing of aerodynamic, thermal, acoustic and the electrical performance characteristics of non-ducted mechanical supply and exhaust residential ventilation units used in single dwellings.

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

This document is applicable to ventilation units, the latter:

- a) containing either:
 - fans for mechanical supply and exhaust;
 - air filters;
 - air-to-air heat exchanger for heat and possibly humidity recovery;
 - control system;
 - inlet and outlet grilles; or
 - alternating heat exchangers which provide separate supply and exhaust air flows;
- b) provided either:
 - in one assembly; or
 - in more than one assembly, the separate assemblies of which are designed to be used together.

This document does not deal with ducted units which are covered by EN 13141-7 or units with heat pumps.

Safety requirements are given in EN 60335-2-40 and EN 60335-2-80.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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 5801, *Fans - Performance testing using standardized airways (ISO 5801)*

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

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 10140-4, *Acoustics - Laboratory measurement of sound insulation of building elements — Part 4: Measurement procedures and requirements (ISO 10140-4)*

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

EN ISO 16890 (all parts), *Air filters for general ventilation (ISO 16890 (all parts))*

ISO 13347-2, *Industrial fans - Determination of fan sound power levels under standardized laboratory conditions - Part 2: Reverberant room method*

ISO 13347-3, *Industrial fans - Determination of fan sound power levels under standardized laboratory conditions - Part 3: Enveloping surface methods*

ISO 13347-4, *Industrial fans - Determination of fan sound power levels under standardized laboratory conditions - Part 4: Sound intensity method*

EN ISO/IEC 17025:2017, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2017)*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for the use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

external leakage

q_{ve}

leakage to or from the air flowing inside the casing of the ventilation unit to or from the surrounding air

[SOURCE: EN 13141-4:2021, 3.11]

3.2

internal leakage

q_{vi}

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

[SOURCE: EN 13141-7:2021, 3.2]

3.3

filter bypass leakage

air bypass around filter cells

[SOURCE: EN 13141-7:2021, 3.4]

3.4 indoor/outdoor airtightness

q_{vio}

maximum air volume flow between the indoor and the outdoor environments at static pressure difference of -20 Pa and +20 Pa when the fans are “OFF” and all shutters are closed

NOTE Indoor/outdoor airtightness is not the external leakage.

[SOURCE: EN 13141-4:2021, 3.13, modified – Removal of “through a non-ducted ventilation unit”, “corresponding to the setting” and “additional”, adding of “between the indoor and the outdoor environments”]

3.5 exhaust air transfer ratio

R_s

mass transfer of the discharged air to a zone from extract to supply that is actually recirculated air from the same zone, due to internal leakage and external casing leakage

3.6 outdoor mixing

R_{me}

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

3.7 indoor mixing

R_{mi}

mixing of the two air flows external to the equipment under test between discharge and intake ports at indoor terminal points caused by short circuiting

3.8 declared maximum air volume flow

$q_{vmax,d}$

declared maximum air volume flow of the unit at 0 Pa static pressure difference, between indoor and outdoor

[SOURCE: EN 13141-4:2021, 3.6, modified – “at 0 Pa static pressure difference, between indoor and outdoor” has been added]

3.9 maximum air volume flow

q_{vmax}

air volume flow corresponding to the maximum achievable fan curve setting of the unit at 0 Pa static pressure difference between indoor and outdoor, either declared or measured

NOTE 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.

[SOURCE: EN 13141-4:2021, 3.7, modified – Note 1 to entry has been replaced by “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.”]

3.10 declared minimum air volume flow

$q_{vmin,d}$

minimum air volume flow of the unit declared at 0 Pa static pressure difference between indoor and outdoor

NOTE If the supply and exhaust air volume flows are different, then the minimum air volume flow is equal to the higher of the two air volume flows.

[SOURCE: EN 13141-7:2021, 3.8, modified – “at the reference pressure declared” has been replaced by “at 0 Pa static pressure difference between indoor and outdoor”]

3.11 reference air volume flow

q_{vref}

air volume flow at 70 % of the maximum air volume flow

NOTE If the air volume flow at 70 % of the maximum air volume flow cannot be adjusted on the product itself, the closest value above is selected.

[SOURCE: EN 13141-4:2021, 3.8, modified – Note 1 to entry “To determine reference air volume flow, see 5.2.3.4, Table 6.” has been replaced by the one above]

3.12 unit static pressure

p_{us}

pressure increase induced by the ventilation unit given as difference between the static pressure at the unit outlet and the total pressure at the unit inlet

NOTE The parameter p_{us} for a ventilation unit is defined as the parameter p_{fs} described in EN ISO 5801 for a stand alone fan.

[SOURCE: EN 13141-4:2021, 3.2]

3.13 external static pressure difference

$p_{s,ext}$

pressure increase induced by the ventilation unit given as difference between the static pressures at the unit outlet and the unit inlet

NOTE The external static pressure difference, $p_{s,ext}$, is used to determine the maximum air volume flow, the reference air volume flow and the minimum air volume flow.

[SOURCE: EN 13141-4:2021, 3.3, modified – “and the minimum air volume flow” has been added in Note 1 to entry]

3.14 air flow sensitivity

v

maximum relative deviation of the maximum air volume flow q_{vmax} due to a static pressure difference of +20 Pa and – 20Pa

NOTE Unbalanced (unequal) supply and exhaust air streams influence the thermal efficiency of the ventilation unit and its air exchange capacity.

[SOURCE: EN 13141-4:2021, 3.12, modified – “of a non-ducted ventilation unit” has been removed from the definition, Note 1 to entry has been added]

3.15 temperature ratio

η_{θ}

temperature difference between inlet and outlet of one of the air flows divided by the temperature difference between the inlets of both air flows

[SOURCE: EN 13141-7:2021, 3.15]

3.16 humidity ratio

η_x

difference of vapour mixing ratio between inlet and outlet of one of the air flows divided by the difference of vapour mixing ratio between the inlets of both air flows

[SOURCE: EN 13141-7:2021, 3.16]

3.17 electrical power input

P_E

average overall electrical power input to the equipment within a defined interval of time for standard air conditions obtained from:

- the power input of the fans;
- controller(s), compressor(s), safety devices of the equipment(s) excluding additional electrical heating devices not used for defrosting

NOTE Electrical power consumption includes the consumption of the heating device for defrosting during the cold climate test.

[SOURCE: EN 13141-4:2021, 3.15, modified – Note 1 to entry has been added]

3.18 maximum electrical power input

$P_{E,max}$

electrical power input at maximum air volume flow,
 q_{vmax}

[SOURCE: EN 13141-4:2021, 3.17, modified – “, and its corresponding pressure,
 p_{qvmax}
” has been removed]

3.19 electrical power input at the reference air volume flow

$P_{E,ref}$

electrical power input at reference air volume flow
 q_{vref}

[SOURCE: EN 13141-4:2021, 3.16, modified – “, and reference pressure,
 p_{ref}
” has been removed]

3.20 supply air transfer ratio

R_e

mass fraction of the discharged air to a zone from outdoor to exhaust that is actually recirculated air from the same zone, due to internal leakage, external casing leakage and short circuiting

3.21 alternating ventilation unit

pair of mechanical ventilation devices using storage heat exchangers operating in opposite, synchronized periodically changing air flow direction incorporated in common or two separate casing(s)

3.22 alternating mode

operating mode in which a ventilation unit periodically changes from exhausting air to supplying air and vice versa

3.23

ventilation mode

constant operating mode where the alternating devices are running in an opposite direction with no heat recovery

3.24

indoor side

supply and extract air side of the ventilation devices

3.25

cycle time

duration of a cycle in which each path of the alternating device performs one complete supply and exhaust phase

4 Symbols and abbreviations

For the purposes of this document, the symbols and abbreviations given in EN 12792 and in [Table 1](#) apply.

Table 1 — Symbols

Symbol	Designation	Unit
c	concentration of tracer gas	ppm
$dq_{v,over}$	absolute deviation of maximum air volume flow due to over pressure of 20 Pa	—
$dq_{v,under}$	absolute deviation of maximum air volume flow due to under pressure of 20 Pa	—
d/λ	thermal resistance	K/W
$D_{n,e}$	airborne sound insulation in third octave bands	dB
$D_{n,e,w}$	global airborne sound insulation index	dB
f_{red}	quotient reduction factor	—
L_W	sound power level in third octave band	dB
L_{WA}	A-weighted sound power level	dB
n	fan speed	min ⁻¹
n_{vent}	fan speed in ventilation mode	min ⁻¹
P_E	electrical power input	W
$P_{E,ref}$	electrical power input at the reference air volume flow	W
$P_{E,max}$	maximum electrical power input	W
$P_{E,Te}$	electrical power input under test conditions measured at the density ρ_{Te}	W
$P_{el,max}$	electrical power input at the maximum air flow, q_{vmax}	W
$P_{el,ref}$	electrical power input at the reference air volume flow	W

Symbol	Designation	Unit
$P_{el,max,vent}$	electrical power input at the maximum air flow, q_{vmax} in ventilation mode	W
$P_{el,ref,vent}$	electrical power input at the reference air volume flow in ventilation mode	W
p_s	static pressure	Pa
$p_{s,ext}$	external static pressure difference	Pa
p_{s,ext,T_e}	external static pressure difference under test conditions measured at the density ρ_{Te}	Pa
$p_{s,max}$	maximum static pressure	Pa
$p_{s,vent,D1/2,ex/su}$	maximum static pressure for each device and each direction	Pa
p_{us}	unit static pressure	Pa
$p_{us,Te}$	unit static pressure under test conditions measured at the density ρ_{Te}	Pa
q_m	air mass flow	$kg \cdot s^{-1} b$
$q_{m,max,vent}$	unit mass air flow	$kg \cdot s^{-1} b$
q_{mp}	purge mass air flow	$kg \cdot s^{-1} b$
$q_{mp,I}$	purge mass air flow on the indoor side	$kg \cdot s^{-1} b$
$q_{mp,O}$	purge mass air flow on the outdoor side	$kg \cdot s^{-1} b$
$q_{m,ex,alt}$	mean extract mass air flow rate of the device in alternating mode	$kg \cdot s^{-1} b$
$q_{m,set}$	to be set air mass flow	$kg \cdot s^{-1} b$
$q_{m,su,alt}$	mean supply mass air flow rate of the device in alternating mode	$kg \cdot s^{-1} b$
q_v	air volume flow	$m^3 \cdot s^{-1a}$
$q_{v,alt}$	air volume flow for alternating ventilation unit	$m^3 \cdot s^{-1a}$
q_{ve}	external leakage air volume flow	$m^3 \cdot s^{-1a}$
$q_{v,ex,alt}$	mean extract air volume flow in alternating mode	$m^3 \cdot s^{-1a}$
$q_{v,ex,Di}$	extract air flow in ventilation mode of device x	$m^3 \cdot s^{-1a}$
$q_{v,ex,vent}$	mean extract air volume flow in ventilation mode	$m^3 \cdot s^{-1a}$
q_{vi}	internal leakage air volume flow	$m^3 \cdot s^{-1a}$

Symbol	Designation	Unit
q_{vin}	flow rate at intermediate fan speed setting	$m^3 \cdot s^{-1a}$
q_{vio}	indoor/outdoor airtightness	$m^3 \cdot s^{-1a}$
q_{vmax}	maximum air volume flow	$m^3 \cdot s^{-1a}$
$q_{vmax,d}$	declared maximum air volume flow	$m^3 \cdot s^{-1a}$
q_{vmin}	minimum air volume flow	$m^3 \cdot s^{-1a}$
$q_{vmin,d}$	declared minimum air volume flow	$m^3 \cdot s^{-1a}$
$q_{v,p}$	purge air volume flow	$m^3 \cdot s^{-1a}$
q_{vref}	reference air volume flow	$m^3 \cdot s^{-1a}$
$q_{v,set}$	air volume flow $q_{ve,set}$ at a density of 1,2 kg/m ³	$m^3 \cdot s^{-1a}$
$q_{v,su,alt}$	mean supply air volume flow in alternating mode	$m^3 \cdot s^{-1a}$
$q_{v,su,Di}$	supply air flow in ventilation mode of device x	$m^3 \cdot s^{-1a}$
$q_{v,su,vent}$	mean supply air volume flow in ventilation mode	$m^3 \cdot s^{-1a}$
$q_{v,vent}$	air volume flow in ventilation mode	$m^3 \cdot s^{-1a}$
R_e	supply air transfer ratio	%
R_{me}	outdoor mixing	%
R_{mi}	indoor mixing	%
R_s	exhaust air transfer ratio	%
t_{cycle}	time of an operating cycle for alternating ventilation units	s
v	air flow sensitivity	%
V_a	air volume content of device	m ³
V_c	volume of the casing	m ³
θ	air temperature	°C
θ_{I1}	purge air temperature on the indoor side	°C
θ_{O1}	purge air temperature on the outdoor side	°C
θ_w	wet bulb temperature	°C
θ_{wl1}	wet bulb temperature on the indoor side	°C

Symbol	Designation	Unit
θ_{w02}	wet bulb temperature on the outdoor side	°C
x	vapour mixing ratio	kg water/kg dry air
11	extract air (ETA) (see Figure 2)	—
12	exhaust air (EHA) (see Figure 2)	—
21	outdoor air (ODA) (see Figure 2)	—
22	supply air (SUP) (see Figure 2)	—
$\eta_{x,ex}$	humidity ratio of the unit on exhaust air side	—
$\eta_{x,su}$	humidity ratio of the unit on supply air side	—
$\eta_{\theta,ex}$	temperature ratio of the unit on exhaust air side	—
$\eta_{\theta,su}$	temperature ratio of the unit on supply air side	—
ρ_{st}	density of 1,2 kg/m ³ corresponding to the air under standard conditions (20 °C and 101 325 Pa)	kg/m ³
ρ_{Te}	density of the ambient air at the test enclosure	kg/m ³
^a l/s or m ³ /h can be used for measurement of air flow but it shall be verified that all parameters are consistent with the chosen unit. ^b kg · h ⁻¹ or g · s ⁻¹ can be used for measurement of air flow but it shall be verified that all parameters are consistent with the chosen unit.		

For the purposes of this document, the following abbreviations apply.

POM Power input in Operable Mode

PSM Power input in Standby Mode

5 Categories of heat exchangers

Categories of heat exchangers are given in [Table 2](#).

Table 2 — Categories of heat exchangers

Category	Definition
HRC1	Recuperative heat exchangers (e.g. air-to-air plate or tube heat exchanger)
HRC1a	Recuperative heat exchangers of the category 1a are designed to transfer sensible thermal energy from one air stream to another without moving parts. Heat transfer surfaces are in form of plates or tubes. This heat exchanger can have parallel flow, cross flow or counter flow construction or a combination of these.
HRC1x	Recuperative heat exchangers of the category 1x are designed to transfer total thermal energy including vapour diffusion from one air stream to another without moving parts. Heat transfer surfaces are in form of plates or tubes. This heat exchanger can have parallel flow, cross flow or counter flow construction or a combination of these.
HRC3	Regenerative heat exchangers
HRC3a	Regenerative heat exchangers with moving masses e.g. rotary
HRC3b	Regenerative heat exchangers with stationary masses and changing of flow direction