BS EN 13141-7:2021+A1:2025

BSI Standards Publication

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

Part 7: Performance testing of ducted mechanical supply and exhaust ventilation units (including heat recovery)

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National foreword

This British Standard is the UK implementation of EN 13141-7:2021+A1:2025. It supersedes BS EN 13141-7:2021, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by ⟨A1⟩ ⟨A1⟩.

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.

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Ventilation for buildings - Performance testing of components/products for residential ventilation - Part 7: Performance testing of 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 7 : Essais de performance des centrales double flux (y compris la récupération de chaleur)

Lüftung von Gebäuden - Leistungsprüfungen von Bauteilen/Produkten für die Lüftung von Wohnungen - Teil 7: Leistungsprüfung von mechanischen Zuluft- und Ablufteinheiten mit Luftführung (einschließlich Wärmerückgewinnung)

This European Standard was approved by CEN on 25 January 2021 and includes Amendment 1 approved by CEN on 3 November 2025.

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European foreword

This document (EN 13141-7:2021+A1:2025) 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of an identical text or by endorsement, at the latest by June 2026, and conflicting national standards shall be withdrawn at the latest by June 2026.

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 includes Amendment 1 approved by CEN on 2025-11-03.

This document supersedes A1 EN 13141-7:2021 A1.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1.

In addition to a number of editorial revisions, the following main changes have been made with respect to EN 13141-7:2010:

— terms and definitions as well as the symbols and abbreviations have been updated in accordance with the parameters used in the document;

— new categories of heat exchanger have been added;

— general requirements of the static pressure distribution have been added in 7.1;

— the reference of the internal and external leakage rates has been changed to the reference air volume flow;

— requirements to convert the measured values to standard conditions have been added in 7.2.2.1 and 7.3.2;

— determination of the external static pressure difference, maximum air flow and reference air flow has been added;

— 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;

— the formulas to calculate the temperature ratios have been changed;

— the wet bulb temperature for the cold climate test has been changed;

— Annex D, giving examples for the evaluation of maximum air volume flow and pressure, has been added;

— Annex E giving examples for the evaluation of reference pressure has been added;

— the description of the connection box has been moved to Annex F.

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.

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

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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 13142:2021.

This document does not contain any information on ductwork and fittings, which are covered by other European Standards.

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.

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Figure 1 — Position of EN 13141-7 in the field of the mechanical building services

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1 Scope

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

NOTE Such units are referred to as bidirectional ventilation units in EN 13142:2021.

This document is applicable to unit that contain at least, within one or more casing:

— fans for mechanical supply and exhaust;

— air filters;

— air-to-air heat exchanger and/or air-to-air heat pump for air heat recovery;

— control system.

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

Examples of different possible arrangements of heat recovery, heat exchangers and/or heat pumps are described in Annex A.

This document covers ventilation units with continuous mass flows for each setting point.

This document does not deal with non-ducted units that are treated in prEN 13141-8:2021.

This document does not cover ventilation systems that may also provide water space heating and hot water that are treated in EN 16573.

This document does not cover units including combustion engine driven compression heat pumps and absorption heat pumps.

Electrical 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, *Ventilation for buildings — Symbols, terminology and graphical symbols*

EN 14511 (all parts), *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling and process chillers, with electrically driven compressors*

EN 14511-3, *Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors — Part 3: Test methods*

EN 14511-4, *Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors — Part 4: Requirements*

EN ISO 5135, *Acoustics — Determination of sound power levels of noise from air-terminal devices, air-terminal units, dampers and valves by measurement in a reverberation test room (ISO 5135)*

EN ISO 5136, *Acoustics — Determination of sound power radiated into a duct by fans and other air-moving devices — In-duct method (ISO 5136)*

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

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*

3 Terms and definitions

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

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

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

3.3
transfer ratio
R_s
mass transfer of the discharged air to a zone that is actually recirculated air from the same zone, due to internal leakage and external casing leakage

Note 1 to entry: If the transfer ratio is determined with the induct method then it is called $R_{s,int}$ and if it is determined with the chamber method then it is called $R_{s,tot}$.

Note 2 to entry: In Figure 2 that represents a test installation for single inlet/outlet unit, the mass transfer of the discharged air to a zone goes from key 4 (extract air) to key 5 (supply air).

3.4
filter bypass leakage
air bypass around filter cells

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3.5
maximum air volume flow at zero pressure
$q_{vmax,0}$
measured air volume flow corresponding to the maximum achievable fan curve setting of the unit, at 0 Pa unit static pressure, p_{us}

[SOURCE: EN 13141-4:2021, 3.4]

3.6
declared maximum air volume flow
$q_{vmax,d}$
declared maximum air volume flow of the unit

[SOURCE: EN 13141-4:2021, 3.6]

3.7
maximum air volume flow
q_{vmax}
air volume flow corresponding to the maximum achievable fan curve setting of the unit at the pressure p_{qvmax}, either declared or measured

Note 1 to entry: To determine maximum air volume flow, see 7.2.2.2, Table 9.

Note 2 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.

[SOURCE: EN 13141-4:2021, 3.7, modified – Note 2 to entry has been added]

3.8
declared minimum air volume flow
$q_{vmin,d}$
minimum air volume flow of the unit declared at the reference pressure declared

Note 1 to entry: 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.

3.9
reference air volume flow
q_{vref}
air volume flow corresponding to the reference pressure

Note 1 to entry: To determine reference air volume flow, see 7.2.2.3, Table 10.

[SOURCE: EN 13141-4:2021, 3.8]

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3.10
unit pressure
p_u
pressure increase induced by the ventilation unit given as difference between the total pressures at the unit outlet and the unit inlet

Note 1 to entry: In case of equal cross-section areas of the inlet and outlet, the total pressure difference is equal to the external static pressure difference.

Note 2 to entry: The parameter p_u for a ventilation unit is defined as the parameter p_f described in EN ISO 5801 for a stand alone fan.

[SOURCE: EN 13141-4:2021, 3.1]

3.11
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 1 to entry: 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]

3.12
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 1 to entry: The external static pressure difference 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]

3.13
pressure at maximum air volume flow
p_{qvmax}
external static pressure difference, $p_{s,ext}$, corresponding to the maximum air volume flow

[SOURCE: EN 13141-4:2021, 3.5]

3.14
reference pressure
p_{ref}
external static pressure difference, $p_{s,ext}$, corresponding to the reference air volume flow

[SOURCE: EN 13141-4:2021, 3.9]

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3.15
temperature ratio
$\boldsymbol{\eta_\theta}$
temperature difference between inlet and outlet of one of the air flows divided by the temperature difference between the inlets of both air flows

3.16
humidity ratio
$\boldsymbol{\eta_x}$
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

3.17
electrical power input
$\boldsymbol{P_E}$
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 1 to entry: 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
$\boldsymbol{P_{E,max}}$
electrical power input at maximum air volume flow, q_{vmax}, and its corresponding pressure, p_{qvmax}

[SOURCE: EN 13141-4:2021, 3.17]

3.19
electrical power input at the reference air volume flow
$\boldsymbol{P_{E,ref}}$
electrical power input at reference air volume flow, q_{vref}, and reference pressure, p_{ref}

[SOURCE: EN 13141-4:2021, 3.16]

3.20
ventilation unit
casing incorporating at least a fan, and that may include duct connections, filters, coils, electrical heating, or any other air treatment component

[SOURCE: EN 13141-4:2021, 3.10]

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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
D	diameter of the measurement duct (see Figure 3)	m
D_{h2}	hydraulic diameter of the connecting duct (see Figure 3)	m
D_i	instantaneous deviation from net transfer ratio	—
L_i	instantaneous apparent net transfer ratio	—
L_W	sound power level	dB
L_{WA}	A-weighted sound power level	dB
$L_{w,global}$	global sound power level	dB
$L_{w,single}$	sound power level of a single duct connection	dB
m	mass	kg
N	number of identical duct connections	—
P_E	electrical power input	W
$P_{E,max}$	maximum electrical power input	W
$P_{E,ref}$	electrical power input at the reference air volume flow	W
$P_{E,Te}$	electrical power input under test conditions measured at the density of the ambient air at the test enclosure, ρ_{Te}	W
p	pressure	Pa
p_{qvmax}	pressure at maximum air volume flow	Pa
p_{ref}	reference pressure	Pa
$p_{s,ext}$	external static pressure difference	Pa
$p_{s,ext,set}$	to be set external static pressure difference	Pa
p_{s,ext,T_e}	unit static pressure difference under test conditions measured at the density ρ_{Te}	Pa
p_u	unit pressure	Pa
p_{us}	unit static pressure	Pa
p_{us,T_e}	unit static pressure under test conditions measured at the density ρ_{Te}	Pa
p_3	static pressure at inlet side	Pa

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Symbol	Designation	Unit
p_4	usable static pressure at outlet side	Pa
q_m	mass flow rate	kg.s^{-1} b
$q_{m_{dry}}$	dry mass flow rate	kg.s^{-1} b
$q_{m\ moist}$	moisture mass flow rate	kg.s^{-1} b
$q_{m,set}$	to be set mass flow	kg.s^{-1} b
q_v	air volume flow	m^3.s^{-1} a
q_{ve}	external leakage air volume flow rate	m^3.s^{-1} a
$q_{ve,set}$	to be set air volume flow	m^3.s^{-1} a
q_{vi}	internal leakage air volume flow	m^3.s^{-1} a
q_{vmax}	maximum air volume flow	m^3.s^{-1} a
$q_{vmax,d}$	declared maximum air volume flow	m^3.s^{-1} a
$q_{vmax,0}$	maximum air volume flow at zero pressure	m^3.s^{-1} a
$q_{vmin,d}$	declared minimum air volume flow	m^3.s^{-1} a
q_{vref}	reference air volume flow	m^3.s^{-1} a
R_e	transfer ratio of recirculated air in the exhaust air stream	%
$R_{e,i}$	instantaneous estimated true transfer ratio of recirculated air in the exhaust air stream (ducted units)	%
$R_{e,max}$	maximum transfer ratio of recirculated air in the exhaust air stream	%
R_s	transfer ratio of recirculated air in the supply air stream	%
$R_{s,i}$	instantaneous estimated true transfer ratio of recirculated air in the supply air stream (ducted units)	%
$R_{s,int}$	internal transfer ratio from extract to supply air	%
$R_{s,max}$	maximum transfer ratio of recirculated air in the supply air stream	%
$R_{s,tot}$	total transfer ratio in supply air	%
v	air velocity in the measurement duct (see Figure 3)	m.s^{-1}
x	vapour mixing ratio	kg water/kg dry air
21	outdoor air (ODA) (see Figure 2)	—
22	supply air (SUP)(see Figure 2)	—
11	extract air (ETA) (see Figure 2)	—
12	exhaust air (EHA) (see Figure 2)	—

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Symbol	Designation	Unit
η_{θ}	temperature ratio	—
$\eta_{\theta,ex}$	temperature ratio of the unit on exhaust air side	—
$\eta_{\theta,su}$	temperature ratio of the unit on supply air side	—
η_{x}	humidity ratio	—
$\eta_{x,ex}$	humidity ratio of the unit on exhaust air side	—
$\eta_{x,su}$	humidity ratio of the unit on supply air side	—
θ	air temperature	°C
θ_{w}	wet bulb temperature	°C
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
≡	(mathematics) identity of two mathematical expressions	—
[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.

COP	Coefficient Of Performance
EER	Energy Efficiency Ratio
POM	Power input in Operable Mode
PSM	Power input in Standby Mode

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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 HRC1a 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 HRC1x 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 [b] (e.g. rotary heat exchanger [a]).
[a] A rotary heat exchanger is a device incorporating a rotating heat recovery wheel for the purpose of transferring thermal 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. [b] 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).	

6 Requirements

In addition, to assess correctly the thermal performance, aerodynamic characteristics, including all leakages, shall be tested before or together with any thermal characteristics testing (see 7.3).

Aerodynamic characteristics (see 7.2) shall include the three characteristics listed below:

— external leakage or/and total transfer ratio ($R_{s,tot}$) in supply air; and

— internal leakage or transfer ratio ($R_{s,int}$) from extract to supply air or total transfer ratio ($R_{s,tot}$) in supply air; and

— air flow/pressure curve.

Other characteristics such as filter bypass leakage are optional.

The tests for thermal performances shall not be made because of measurement uncertainty when leakages according to 7.2.1 are too high. The unit shall have the leakage class specified in Table 3.

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