BRITISH STANDARD

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

Part 10: Humidity controlled extract air terminal device

ICS 91.140.30,

National foreword

This British Standard is the UK implementation of EN 13141-10:2008.

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

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Contents

Page

Foreword

This document (EN 13141-10:2008) 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of an identical text or by endorsement, at the latest by November 2008, and conflicting national standards shall be withdrawn at the latest by November 2008.

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

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

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

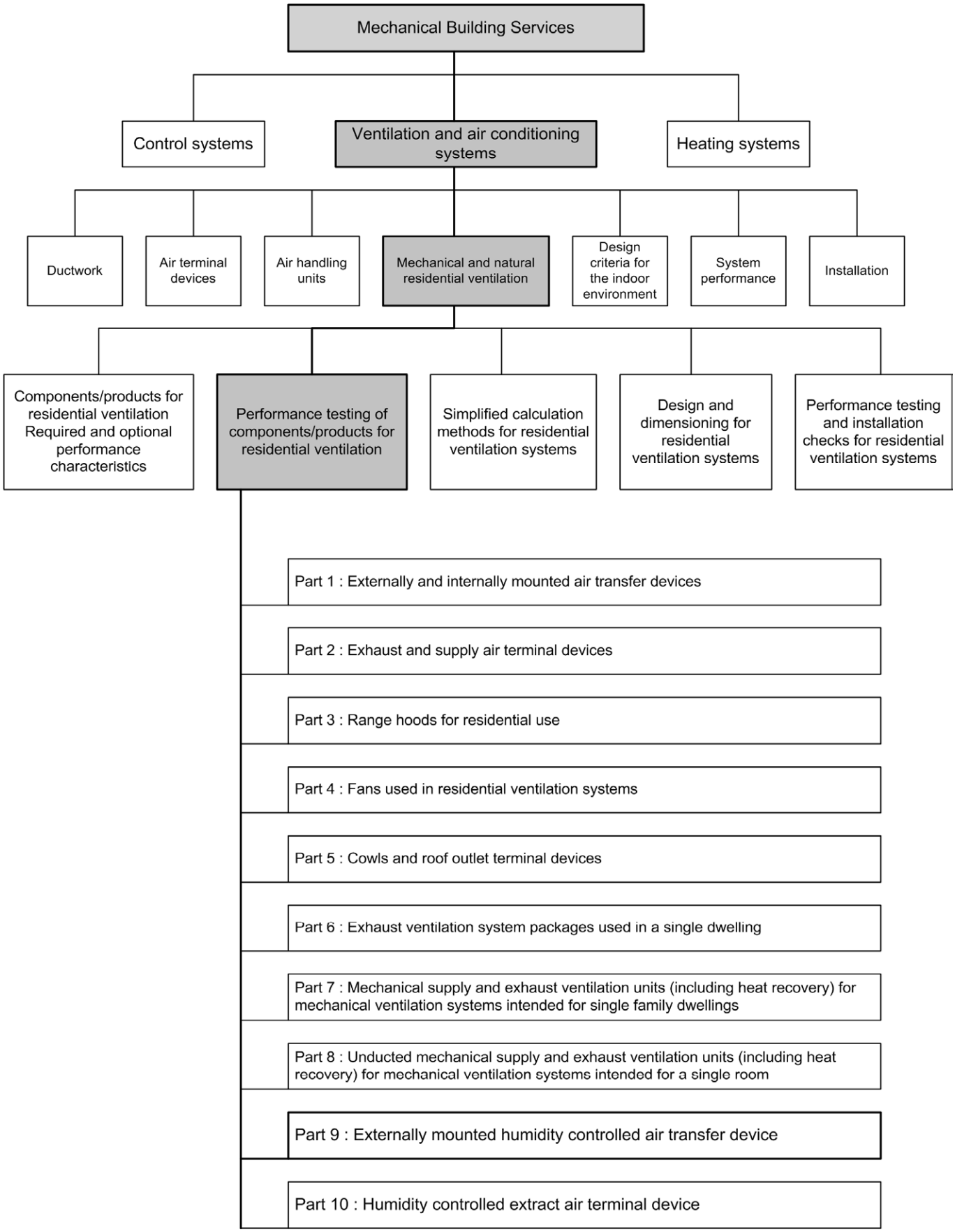


Figure 1 — Position of EN 13141-10 in the field of the mechanical building services

1 Scope

This European Standard specifies laboratory methods for testing humidity controlled exhaust air terminal devices.

This European Standard applies to all controlled devices on indoor humidity, used in mechanical and natural powered residential ventilation systems. For instance, devices of the following types:

— humidity controlled devices with a manually adjustable opening;

— humidity controlled devices with fixed setting;

— humidity controlled devices self-adjusting on pressure difference.

This European Standard describes tests intended to characterize:

— aero and hygro-dynamic performance;

— acoustic characteristics (including noise production of the device; insertion loss of the device; sound insulation);

— time response.

2 Normative references

The following referenced documents are indispensable for the application 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 13141-2:2004, *Ventilation for buildings — Performance testing of components/products for residential ventilation - Part 2: Exhaust and supply air terminal devices*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12792:2003, EN 13141-2:2004 and the following apply.

3.1
hysteresis
value defined as the difference of relative humidity, read on the response curve for the same flow, in % RH

4 Symbols and abbreviations

For the purposes of this document, the symbols and units given in EN 12792:2003 and the symbols and units given in Table 1 apply.

Table 1 — Symbols and units

Term	Symbol	Unit
humidity	φ	
minimum airflow	$q_{v\,\min}$	l. s^{-1}
maximum airflow	$q_{v\,\max}$	l. s^{-1}
relative humidity	φ_p	% RH
maximum relative humidity for minimum airflow	$\varphi_{p\,\min}$	% RH
minimum relative humidity for maximum airflow	$\varphi_{p\,\max}$	% RH

5 Performance testing of aerodynamic and hygro-dynamic characteristics

5.1 Aero and hygro-dynamic performances

5.1.1 Principle

This test consists of measuring several volume flow rates induced through a device by humidity conditions, under an applied static pressure difference, to define the flow rate/humidity characteristic curve.

In the case of manually adjustable devices, a test according to EN 13141-2 shall be carried out at specific opening conditions specified by the manufacturer.

Some exhaust air terminal devices are designed to work under both natural and mechanical ventilation systems. In this case the manufacturer may have to specify two operational ranges, and the device shall be tested for each of them.

5.1.2 Test installation, conditions and uncertainty of measurement

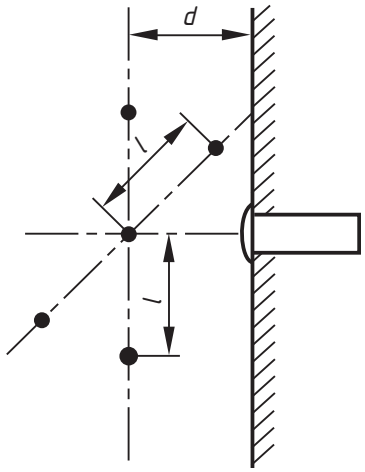
5.1.2.1 Test installation and conditions

The test facility shall include one room controlled both in humidity and temperature, representing indoor conditions. The airflow test rig may be either in this room or outside but in this case, it shall be verified that all test conditions are still valid, i.e leakages shall be included to achieve the overall uncertainty of measurement that is required.

The test installation shall comply with those of EN 13141-2:2004, 4.1.2.1 for indoor rooms.

The test facilities shall have a range from – 300 Pa to 0 Pa.

Special care to limit air velocities around the inlet in the test box shall be taken: air velocities shall be measured at locations specified in Figure 2. The measures shall not exceed 0,10 $m.s^{-1}$ at these points without airflow through the exhaust vent.



Key

- Locations of the measurement points

d = 0,04 m

l = 0,20 m

Figure 2 — Locations of measurement points

To avoid difficulties in the control of the humidity and temperature controlled room, the volume should be big enough.

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

The air permeability of the test equipment shall be reported and shall generate a leakage lower than 0,1 l. s^{-1} at 100 Pa.

NOTE For low airflow measurements, it can be necessary to introduce some intentional leakage.

In this case, the leakage airflow shall be measured and used in the test report for correction of values and for uncertainty calculations.

5.1.2.2 Uncertainty of measurement

The pressure shall be measured with an uncertainty lower than:

$0,2 + 0,03 \times$ (measured value) (Pa)

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

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

The temperature shall be measured with an uncertainty lower than ± 0,5 K.

The relative humidity shall be measured with an uncertainty lower than 2 % RH.

5.1.3 Test procedure

5.1.3.1 Choice of tests to be performed

For fixed setting devices and manually adjustable, all the specified positions shall be tested with at least the minimum and maximum open positions.

For a device or position humidity controlled, the measurements shall be taken (see 5.1.3.2) for at least one pressure difference (chosen by the manufacturer) in the following pressure difference ranges (bands) given in Table 2.

For positions without humidity control, the same measurements as for fixed device (according to EN 13141-2) in specific conditions shall be performed.

For pressure difference controlled devices, self regulation shall be verified (see 5.1.3.3).

For non pressure difference controlled devices, an additional and optional test shall be done according to EN 13141-1 to determine the flow exponent at the middle point of the response curve to measure the impact of pressure on the aperture: use description in 5.1.3.3.

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

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

Table 2 — Pressure difference ranges

Pressure difference, Δp Pa	**Permissible deviation during test** Pa
10	± 1
20	± 1
50	± 2
80	± 5
100	± 5
160	± 5

The report shall give values of the flow exponent for the corresponding pressure difference as shown in Table 3. If the regression law coefficient is lower or equal to 0,95, a unique value of the flow exponent shall be provided.

Table 3 — Values of the flow exponent for the corresponding pressure difference

Pressure difference, Δp (Pa)	**Flow exponent, Kp**
10	Kp10
20	Kp20
50	Kp50
80	Kp80
100	Kp100
160	Kp160

The values Kp10 to Kp160 shall be calculated according to the following:

$$q_v(\Delta p) = q_v(\Delta p_{\text{nom}}) \times (\Delta p / \Delta p_{\text{nom}})^{\text{Kp}}$$

For humidity controlled extract air without pressure difference controlled device, the following correction shall be applied:

$$q_{\text{v}} = q_{\text{vmeas}} \times \sqrt{\frac{\Delta p_{\text{nom}}}{\Delta p_{\text{meas}}}}$$

where

$q_{\text{v meas}}$ = measured value at Δp_{meas} , in l. s^{-1}

Δp_{meas} = test pressure, in Pa

Δp_{nom} = nominal test pressure given by the manufacturer, in Pa

With q_{v} = corrected value for the nominal pressure, in l. s^{-1}

For humidity controlled extract air with pressure difference controlled device, this correction shall not be applied.

5.1.3.2 Tests of humidity control

The characteristic curve airflow vs indoor relative humidity shall be measured at the pressure difference defined by the manufacturer.

The range of humidity during the test shall also be defined by the manufacturer's declaration.

The minimum value of humidity shall be the minimum declared less 20 % RH, so that

$$\varphi_{\text{p min}} - 20\%\text{RH} \leq \varphi_{\text{p1}} \leq \varphi_{\text{p min}}$$

NOTE 1 If this value is lower than 30 % RH, a minimum value of 30 % may be accepted for test conditions due to the difficulty of realisation.

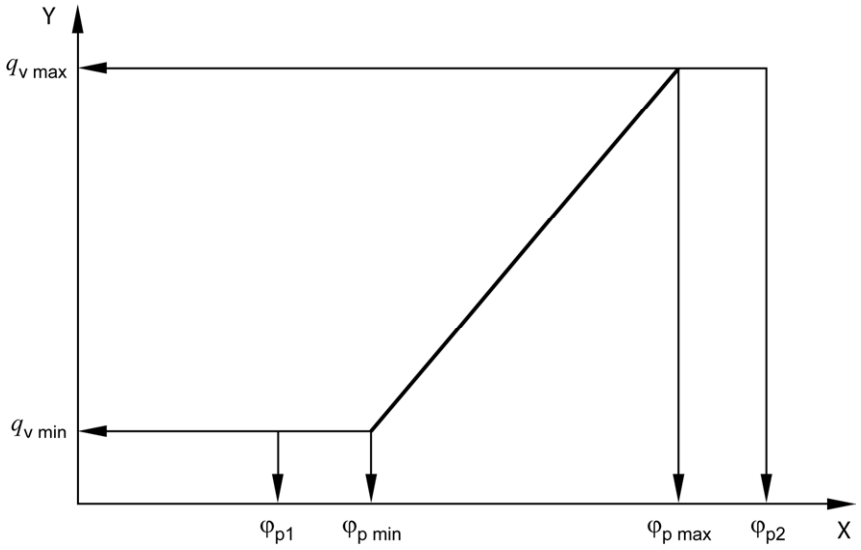
The maximum value of humidity shall be the maximum declared plus 20 % RH, so that:

$$\varphi_{p\,max} \leq \varphi_{p2} \leq \varphi_{p\,max} + 20\%RH$$

NOTE 2 If this value is greater than 85 % RH, a maximum value of 85 % can be accepted for test conditions due to the difficulty of realisation.

The tests shall be performed with first an increase of humidity from minimum φ_{p1} to maximum $\varphi_{p2,}$ then a decrease back. This test shall be done in the same conditions as for isothermal measurements. The measurements shall be done at minimum humidity, in three humidity regularly spaced in between minimum and maximum (one in the middle point) and then at maximum for the increasing cycle. If necessary, more points shall be tested to avoid steps of humidity larger than 10 % RH. Same points down to the minimum shall be measured while decreasing, which induces a minimum of 9 test points. Before measurements, the device shall at least realise such one cycle of humidity.

The parameters are illustrated in Figure 3.



Key

X humidity

Y airflow

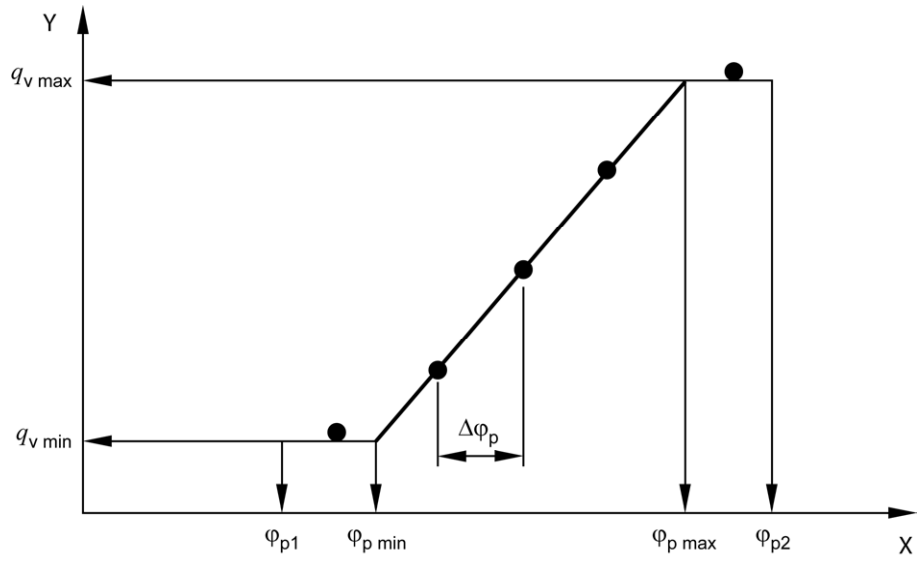
If φ_{p1} < 30 % RH the minimum measurement point may be limited at 30 % RH.

If φ_{p2} > 85 % RH then the maximum measurement point may be limited at 85 % RH.

Figure 3 — Test parameters

The humidity declared range $[\varphi_{pmin}, \varphi_{pmax}]$ and the declared airflow range $[q_{vmin}, q_{vmax}]$ under the test pressure difference shall be given by the manufacturer.

The repartition of the measurement points shall be equally distributed on the declared range.



Key

X humidity

Y airflow

Figure 4 — Example of distribution of measurement points

The condition [$\Delta\varphi_p \leqq 10$ % RH] shall be applied: the number of measurement points shall be chosen to ensure a relative humidity difference lower than 10 % RH between 2 points (see Figure 4). The number of measuring points shall be chosen accordingly if the declared range is wider than 40 %.

The nine minimum measurement points shall be detailed as follows:

— one for $q_{v\,min}$,

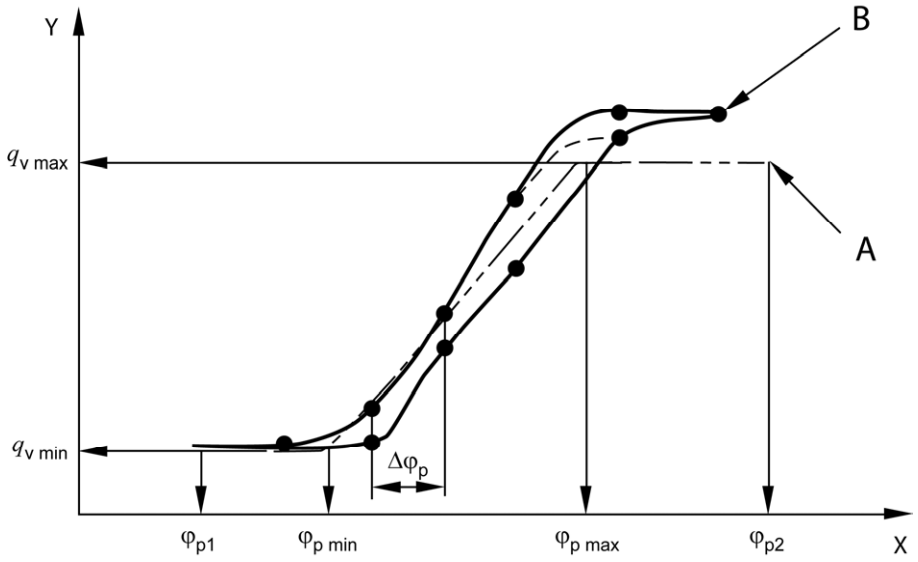
— three for the increasing humidity within the range ($\varphi_{p\,min}, \varphi_{p\,max}$),

— one for $q_{v\,max}$,

— three for the decreasing humidity within the range ($\varphi_{p\,min}, \varphi_{p\,max}$),

— one for $q_{v\,min}$.

NOTE If the hysteresis of the curve is relatively important, it should be checked that all the relevant points are measured. In Figure 5, the last measurement point (B) is necessary to get the upper part of the curve. Without this point, the curve would be limited to the dotted one (from point A).



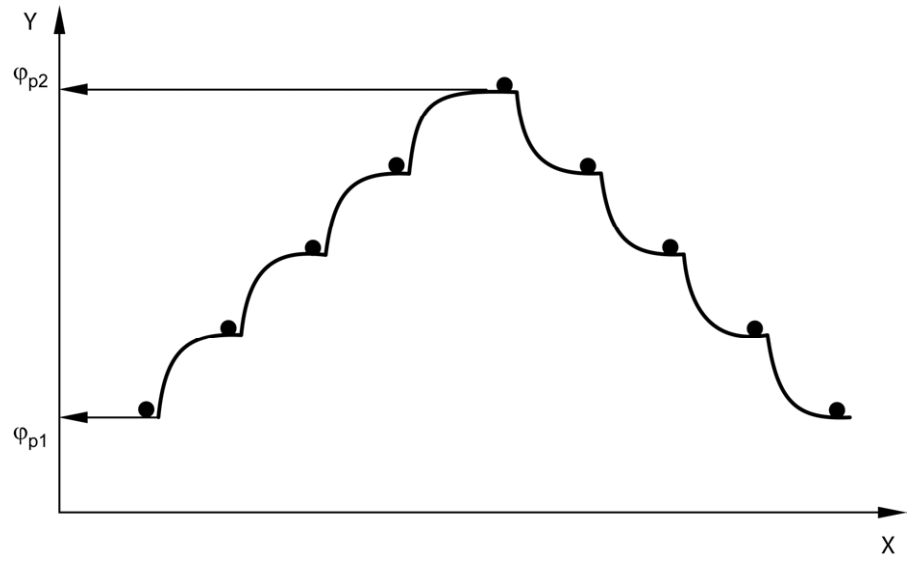
Key

X humidity

Y airflow

Figure 5 — Example of hysteresis

Figure 6 gives an example of measurement cycle.



Key

X humidity

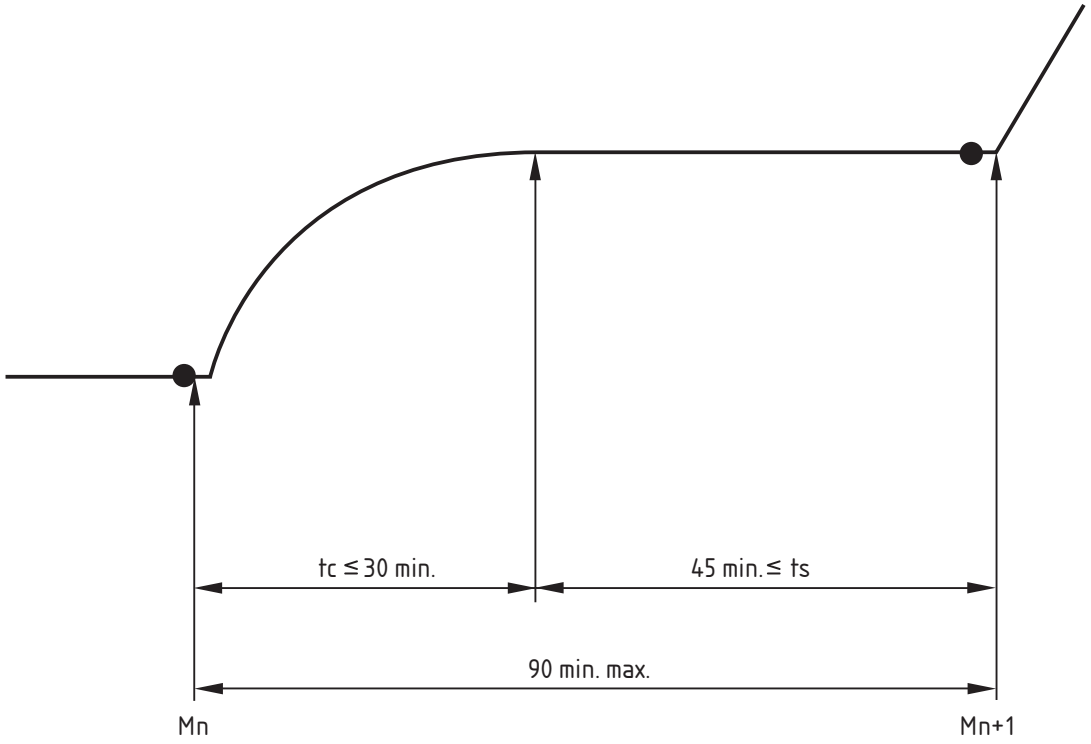
Y time

Figure 6 — Example of measurement cycle

The relative humidity shall be stable for a certain time between measurement of the flow across the device to allow the humidity sensitive element to come to an equilibrium.

The stability at a given level shall be satisfied with a fluctuation of +/- 2 % RH.

The stable level shall be kept for 45 min to 60 min and the maximum time between two measurements shall be less than 90 min, as illustrated in Figure 7.



Key

Mn	n measure
Mn+1	n+1 measure
tc	necessary time to increase/decrease the relative humidity (one step)
ts	stable time before measurement

Figure 7 — Example of measurement stabilisation

The indoor air temperature shall be measured in three points around the sensor (one of them at maximum 5 cm from the component and being the reference). Each indoor air temperature shall be 21 °C. The 3 temperatures shall have the same value (± 1 K).

During the test, each of these temperatures shall not vary more than ± 1 K.

Indoor relative humidity shall be measured at the point situated at (5 ± 1) cm maximum of the component.

5.1.3.3 Self regulation tests

Air temperatures shall be 21 °C. During the test, the temperature shall not vary more than ± 1 K.

Three tests shall be done at the minimum humidity and maximum humidity of the declared range and at an average value (middle point of the response curve, humidity increasing).

One test shall be performed at the minimum airflow and maximum airflow of the declared range and at a mean value (middle point of the response curve, humidity increasing).

The setting of the device corresponding to the three different humidity levels can be obtained by mechanical locking of the regulating component.

When the humidity conditions have to be controlled, they shall be stable at +/- 2 % during a minimum of 30 min before testing and during testing.

Then, each test shall be carried out by continuously increasing (or continuously decreasing) the pressure difference across the device according to the method described in EN 13141-2.

5.1.4 Analysis of results

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

$$q_{v\,cor} = q_{v\,meas} \times \frac{293}{273 + \theta_a} \times \frac{p_a}{101325} \quad (1)$$

where

pa is the atmospheric pressure, in Pa

θa is the ambient temperature, in °C (average when there are 3 measurements)

$q_{v\ meas}$ is the measured volume airflow rate, in l. s^{-1}

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

5.1.5 Test report

The test report shall include the following elements for each test performed:

— ambient conditions (barometric pressure);

— range of humidity (declared and measured);

— pressure chosen by the manufacturer according to Table 2;

— indoor temperature(s);

— for test of humidity control, a curve plotting airflows vs indoor φ_p. Declared limits of range shall be indicated on the curve. The curve shall be completed by a complete table indicating the measured sets of points (increasing, decreasing) and the pressure at which the measures have been performed;

— for self regulation tests (if needed), 3 characteristic curve according to EN 13141-2 mentioning the 3 indoor φ_p. tested;

— characteristic curve flow vs pressure if additional test has been performed for non self regulated component. The characteristics K and n (as determined in EN 13141-1:2004, 4.1.4) shall be presented if the regression coefficient was greater than 0,98.

5.2 Other tests

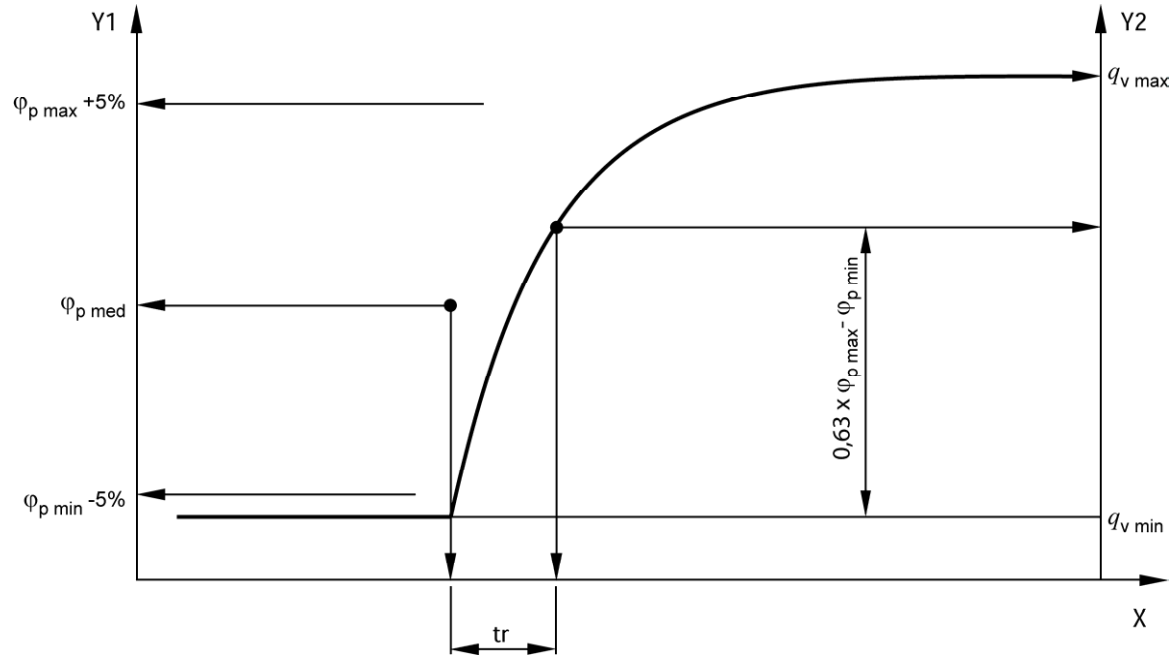
5.2.1 Time response test

To assess the reactivity of the component, an additional test on the time response shall be performed.

The test shall be done in the same conditions as for measurements specified in 5.1.

The humidity in the room shall vary from $\varphi_{p\ min}$ – 5 % RH to $\varphi_{p\ max}$ + 5 % RH with an equivalent minimum slope of 5 % per minute: max time between the extreme points is (($\varphi_{p\ max}$ + 5 % RH) – ($\varphi_{p\ min}$ – 5 % RH)) / 5.

Figure 8 gives an example of the time response *tr* as the time from the moment when the humidity reaches $\varphi_{pmed} = (\varphi_{pmax} - \varphi_{pmin})/2$ to the moment the response curve has reached 63 % of its maximum change.



Key

Y1 relative humidity in % RH

Y2 airflow in l. s^{-1}

X time

Figure 8 — Example of time response curve

The time response curve shall be given in the report.

The time response *tr* shall always be linked to the absolute change in l. s^{-1} and the humidity range involved ($\varphi_{p\ min}$;$\varphi_{p\ max}$):

EXAMPLE

tr (63 %) = 4 min 25 sec

airflow change from: 1,5 l. s-1 to 7.2 l. s^{-1}

humidity step: 30 % from 20 % to 50 %

5.2.2 Performance testing of acoustic characteristics

For all devices, the characterisation of the acoustic characteristics shall be carried out with a flow corresponding to 65 % of humidity. Tests and report shall be carried out according to EN 13141-2.

Bibliography

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

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