BRITISH STANDARD

BS EN
14134:2004

Ventilation for buildings — Performance testing and installation checks of residential ventilation systems

The European Standard EN 14134:2004 has the status of a British Standard

ICS 91.140.30

National foreword

This British Standard is the official English language version of EN 14134:2004.

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

— aid enquirers to understand the text;

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

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

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

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English version

Ventilation for buildings - Performance testing and installation checks of residential ventilation systems

Ventilation des bâtiments - Essai de performances et contrôles d'installation des systèmes de ventilation résidentiels

Lüftung von Gebäuden - Leistungsprüfung und Einbaukontrollen von Lüftungsanlagen von Wohnungen

This European Standard was approved by CEN on 3 November 2003.

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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 Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Contents

Foreword

This document (EN 14134:2004) has been prepared by Technical Committee CEN/TC 156 “Ventilation for building”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2004, and conflicting national standards shall be withdrawn at the latest by July 2004.

Annexes A, B and C are informative.

This document includes a bibliography.

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

1 Scope

This European Standard specifies checks and test methods in order to verify the fitness for purpose of installed ventilation systems in dwellings. It can be applied to commissioning of new systems and performance testing of existing systems.

The standard enables the choice between simple test methods, when sufficient, and extensive measurements, when necessary.

The standard applies to mechanical and non-mechanical (natural) ventilation systems comprising any of the following:

- passive stack ventilation ducts;
- air terminal devices (supply, exhaust);
- air transfer devices (externally mounted, internally mounted);
- controls;
- ducts;
- fans;
- filters;
- heat recovery;
- heating/cooling of supply air;
- recirculation air;
- cooker hood;
- cowls;

¾ dampers;

¾ sound reduction devices.

The standard is intended to define the procedure by which the system is checked and assessed before handing over (see Figure 1).

This standard does not apply to:

¾ heating systems and their control;

¾ refrigerating systems and their control;

¾ electric power supply systems.

This standard does not include consideration of the airtightness of building envelope is in. The whole dwelling and the individual room ventilation rate can be influenced by air infiltration through the building envelope (see informative annex A).

This standard does not include the effect of the ventilation system on indoor air velocity within the occupied zone although this can have an effect (see informative annex B).

This standard does not included any requirements concerning the installation contract.

This standard give example of a maintenance manual (see informative annex C).

Figure 1 illustrates the different stages of the design, installation and checking of a ventilation system. This standard deals only with items D, E, F, and G below. Items B and C are referred to as "preliminary work" in this standard.

Terms "designer", "installer" and "inspector" are defined by the task defined in Figure 1.

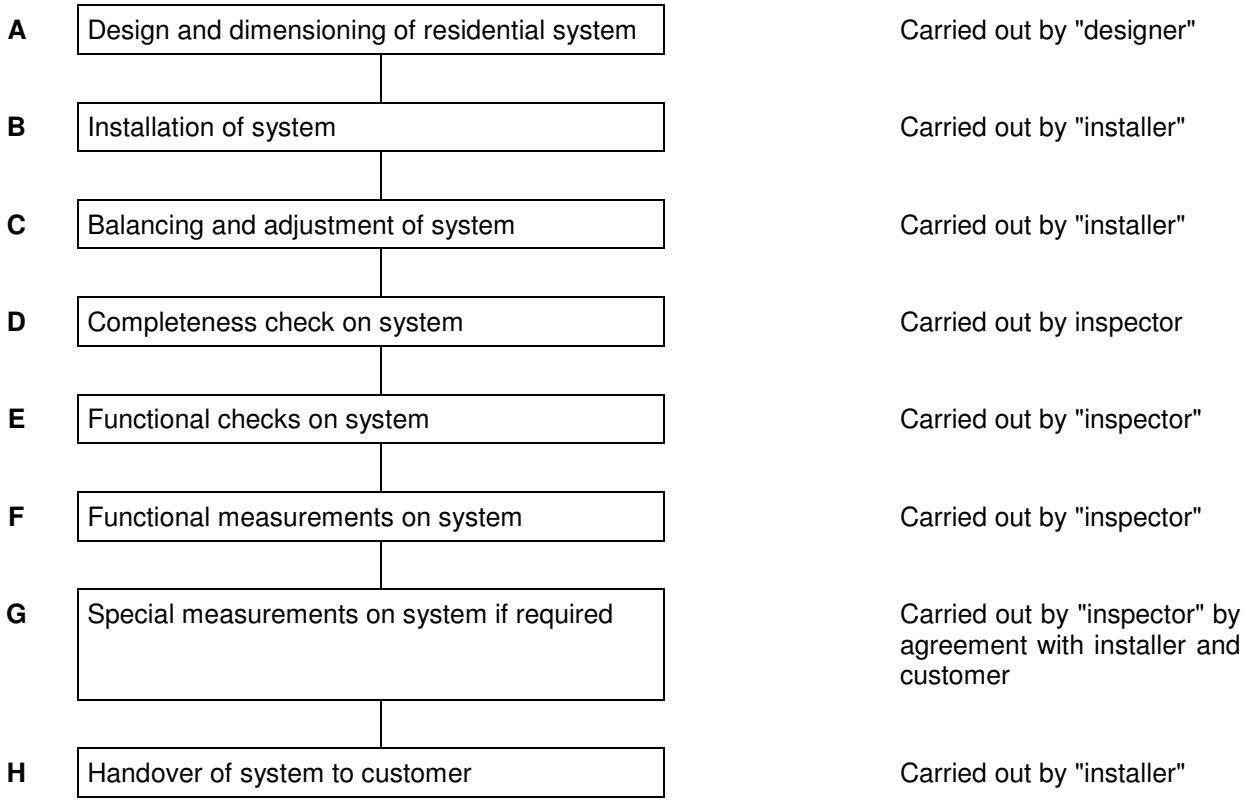


Figure 1 — Schematic illustration of the different stages of the design, installation, checking and handover of a ventilation system

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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

EN 13141-1, *Ventilation for buildings – Performance testing of components/products for residential ventilation – Part 1: Externally and internally mounted air transfer devices.*

EN 13141-2, *Ventilation for buildings – Performance testing of components/products for residential ventilation – Part 2: Exhaust and supply air terminal devices.*

prEN 13141-5, *Ventilation for buildings – Performance testing of components/products for residential ventilation – Part 5: Cowls and roof outlet terminal devices.*

prEN 14788, *Ventilation for buildings – Design and dimensioning of residential ventilation systems.*

EN ISO 3747, *Acoustics – Determination of sound power levels of noise sources using sound pressure – Comparison method for use in situ (ISO 3747:2000)*.

3 Terms and definitions

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

3.1
"run-on" timer
device which ensures that air flow through a ventilation system or an air terminal device (ATD) continues for a specific time period after a user operated control has been turned off

NOTE Commonly used to control exhaust fans which are operated by the room light switch in internal rooms.

3.2
passive stack ventilation duct
ductwork for passive stack ventilation which does not comprise any mechanical pressure increase devices from duct inlet to duct outlet

3.3
obstacles
items which affect the stated function of any component in the ventilation system

4 Test and check procedure

For new residential ventilation systems the following checks shall be carried out in the specified order:

a) completeness checks;

b) functional checks;

c) functional measurements.

In case of special measurements they shall be carried out in accordance with clause 8. Special measurements allow a different level of measurement uncertainty and require extra associated work and hence cost. Special measurements are therefore a matter to be agreed between the client and the person carrying out the tests before the testing work begins.

The extent of the functional checks and functional measurements to be made on the system is specified in clauses 6 and 7 and by agreement between the client and the person carrying out the testing work begins.

For existing systems the extent of the testing procedures applied will depend upon the purpose of carrying out the tests and is a matter for agreement between the client and the person carrying out the tests before testing work begins. For example, if the purpose is simply to establish the ventilation air flow rates being provided by an existing system then only limited functional measurements might be made, with no need for functional and completeness checks. However, these checks may need to be made subsequently in order to diagnose faults revealed by the functional measurements.

5 Completeness checks

5.1 General

The purpose of the completeness check is to ensure that the system is in accordance with the design specification and relevant standards and regulations, that it has been installed properly, that the system is free from loose objects and reasonably clean and that all relevant documentation for the system has been provided.

5.2 Documents to hand over to the customer

5.2.1 Design specification

The design specification, which may be included in the operation and maintenance manual (see 5.2.2 below), shall contain the list of design assumptions required by prEN 14788 in addition to the following informations:

- type of ventilation system (natural, fan assisted natural, mechanical supply/exhaust/balanced or a combination of these);
- type of controls (if any) and intended mode(s) of operation (e.g. continuous or intermittent running of fans);
- design air volume flow rates for the system as a whole and for individual air terminals (or equivalent information for natural ventilation systems; e.g. duct sizes, equivalent areas of air transfer devices, etc.).

5.2.2 Operation and maintenance manual

The operation and maintenance manual shall contain instructions to the occupants on how and when to use the ventilation system and/or its components should be cleaned and maintained. Depending upon the type of system and how it is controlled this may include information on the following:

- using externally mounted air transfer devices (if adjustable);
- setting automatic controls (if user-adjustable, e.g. humidity controls);
- using on/off and boost settings for fan assisted ventilation system;
- using controls for natural air extract devices (e.g. adjustable exhaust air terminals on vertical ducts);
- instructions to the occupants and/or maintenance services on how any required cleaning and maintenance should be carried out.

The operation and maintenance manual shall also contain relevant manufacturers' literature which was supplied with the system or with individual components of the system.

NOTE This might include components specifications, installation guidance, operating instructions, maintenance schedules, guarantees, spare part lists, means of obtaining spare parts, etc.

5.3 Component checks

5.3.1 Checks applicable to all type of ventilation system

Check that the ventilation installation including its access path complies with all the requirements of the relevant standards and regulations which may be established by visual inspection, and that the system is safe to operate and maintain. This may include checks for mechanical safety (e.g. guards on rotating machinery), electrical safety (e.g. correct wiring and protection from electric shock), fire protection (e.g. fire dampers correctly installed), thermal insulation (e.g. ducts in unheated spaces), and perhaps other matters. This visual inspection does not replace any certification procedure and prescribed national regulations or relevant European directives.

Check that there is adequate access and free space to the system for the purposes of operation and maintenance including access path and service points, complies with design specifications.

EXAMPLE The user is able to remove or open all covers/hatches necessary to carry out normal maintenance of the ventilation system and to change any removable items such as filters and heat exchangers etc.

For systems serving more than one dwelling these requirements apply and in addition there may be a need for access hatches on ductwork.

All ventilation system user controls should be readily accessible by adults in the dwelling, but not necessarily by young children. Access for maintenance in residential ventilation systems will mainly be limited to allowing cleaning of fans, heat exchangers, ducts and air terminal devices, together with the cleaning or replacement of air filters.

Check that the system has been left reasonably clean after installation. A useable definition of what is meant by "reasonably clean", and methods of quantifying it have yet to be established so this is currently a subjective assessment. The requirement applies only to the inside of ducts, fans, heat exchangers, etc., unless dirt and debris on the outside would constitute a health hazard to persons in the building or impair the performance of the system. Clearly, packaging materials, off-cuts of sealing tape and similar debris shall not be left inside ventilation systems and no more than light covering of dust would be expected to be found in the bottom of ducts and other components when newly installed. Traces of oil left from the manufacturing process are sometimes found on ducting but should not be excessive.

Check that all components are in good condition. Clients may accept components which have suffered minor damage (e.g. minor dents in metal ducts) but shall not be asked to accept components which are damaged to the extent that any aspect of their performance in use is impaired.

5.3.2 Natural ventilation systems

Check that all the following components are present as required in the design specification, and that they are properly and securely fixed:

- externally mounted air transfer devices;
- internally mounted air transfer devices;
- exhaust air terminals on ducts (passive stack ventilation ducts);
- ducts;
- cowls or roof outlets on ducts;
- insulation on ducts;
- any other component required by the design specification.

Checks shall be made that these components are fitted in their correct positions relative to each other, and relative to other parts of the building (e.g. fire dampers in wall and floors which are intended to be fire resisting).

5.3.3 Mechanical ventilation systems (supply, extract or balanced)

Check that all the following components are present as required in the design specification, and that they are properly and securely fixed:

- externally mounted air transfer devices;
- internally mounted air transfer devices;
- exhaust air terminals devices;
- supply air terminals devices;
- ductwork;
- flow control dampers;
- fire dampers;
- cowls or roof outlets or other air terminal devices on the outside of the building;
- insulation on ducts;
- fans;
- heat exchangers and/or heat pumps;
- air filters;
- sound attenuators (silencers);
- control devices and switches;
- any other component required by the design specification.

Checks shall be made that these components are fitted in their correct positions relative to each other, and relative to other parts of the building (e.g. fire dampers in wall and floors which are intended to be fire resisting).

6 Functional checks

6.1 General

The purpose of the functional checks is to prove the operational ability of the system according to the specification. The test shows whether the particular components of the system such as filters, fans, heat exchangers, etc. have been properly assembled and installed and whether those components containing moving parts operate correctly.

6.2 Preliminary work

It is necessary that the installation work is completes and that the system has been adjusted by the installer to fulfil the requirements of the system before starting the functional checks.

6.3 Procedure

6.3.1 General

Functional checks shall be carried out on all installed equipment which is part of the ventilation system.

Before starting the checks a checklist shall be drawn up.

6.3.2 Extent of functional checks

For a system serving only one dwelling a complete functional check is carried out.

For a complex of dwellings built identically (of the same type on the same site, by the same contractor, and by the same installer) functional checks are carried out on a random statistical sample of dwellings. For a complex of dwellings, which are not identical, functional checks are carried out on a statistical sample of each type of dwelling. Functional checks may also be carried out in any specific dwelling(s) as part of a diagnosis of ventilation deficiency. The statistical sample for functional checks for commissioning of new systems shall be established according to annex C.

6.3.3 Instruction for the procedure

Checks shall be made that the fixings of components to the building structure or other supports are of an appropriate type (e.g. fans may require vibration absorbent mountings) and that the structure and support are strong enough to support the component.

6.3.4 Separate checks for components

6.3.4.1 Central devices, fans

The following shall be checked:

¾ direction of rotation of fans;

¾ speed or other air flow regulations of fans;

¾ reset switch;

¾ function of control devices.

6.3.4.2 Air filters

The following shall be checked:

¾ pressure difference indication (if fitted);

6.3.4.3 Fire dampers

Fire dampers shall be checked according to design and material regulations.

6.3.4.4 Air terminal devices

The following shall be checked:

¾ smoke test for an initial evaluation of the direction of air flow (ATDs for supply and/or exhaust air);

¾ height above the floor level and area of externally mounted ATDs (exhaust and natural ventilation systems);

¾ for natural air terminal devices, the ability of pressure flow rate curve or free area according to EN 13141-1 and EN 13141-2;

¾ airflow rate from this curve at a specified pressure difference;

For demand controlled system, the functionality of the control cannot be checked.

NOTE The specified pressure difference is generally defined in national regulations or standards.

6.3.4.5 Control devices

The following shall be checked:

¾ control of air flow;

¾ interface with heating or cooling systems.

6.3.4.6 Cowls

The following shall be checked:

¾ ability of pressure drop characteristics and suction effect according to prEN 13141-5;

¾ performance from these curves.

7 Functional measurements

7.1 General

The primary purpose of a residential ventilation system is to supply air to and extract air from the rooms in a dwelling.

The system should be designed to achieve the primary purpose whilst minimizing energy use and environmental problems such as noise and thermal discomfort.

The required performance of the ventilation system is laid down by the designer in the design specifications.

The purpose of the functional measurements is to give proper assurance that the system complies with the design specifications with respect to the following aspects of performance:

¾ air flow rate and direction of flow;

¾ control and running time.

Other aspects of performance may be handled under special measurements.

7.2 Extent of functional measurements

For a system serving only one dwelling functional measurements are carried out on the entire system.

For a complex of dwellings the extent of functional measurements are to be based on carried out on a random statistical sample in addition to the worst case regarding air flow rate and sound pressure level. The worst case regarding supply air flow rate includes the far end of the branched duct lay out. The worst case regarding sound pressure level includes dwelling close to fans and the outlet.

For a complex of dwellings built identically (of the same type, on the same site, by the same contractor, and by the same installer) functional measurements are carried out on a random statistical sample in addition to the worst case, of dwellings.

For a complex of dwellings, which are not identical, functional measurements are carried out on a random statistical sample in addition to the worst case, of each type of dwellings.

Functional measurements may also be carried out in any specific dwelling(s) as part of a diagnosis of ventilation deficiency.

The statistical sample for functional measurements for commissioning of new systems is established according to annex A.

7.3 Air flow rate and direction

7.3.1 Mechanically supplied and extracted air flow rates

7.3.1.1 Principle

The flow rate is determined by any principle, such as:

- Vane anemometer placed in a hood which is fixed to the ATD.
- Pressure compensating airflow device with a hood connected to the ATD.
- Constant injection tracer gas method in a duct connected to the ATD.
- Pilot static tube or velocity probe traverse in a duct connected to the ATD.
- Bag method, for supplies only.

7.3.1.2 Test conditions

The mechanical ventilation system shall be switched on. The control setting shall be recorded. The system remain unchanged during the measurements. All conditions shall be within the range of design specification and extreme meteorological condition shall be avoided.

All internal and external doors and windows shall be closed except those to be tested when intended for ventilation.

All other ventilation provision such as externally and internally mounted air transfer devices should have intended position which shall be recorded.

7.3.1.3 Uncertainty of measurement

The total uncertainty of measurement system of the chosen device shall be less than 10% of the flow rate to be measured.

NOTE This includes any change in air flow rate due to flow resistance of the measurement device.

7.3.1.4 Description of the tests

The tests shall be carried out as follows:

- check the circumstances and conditions according to 7.3.1.2;
- assemble all measurement equipment;
- carry out the measurements at all ATDs in the dwellings;
- transform the original measurement data into air flow rate.

7.3.1.5 Results

The results shall be reported and presented with at least the following:

- description of the place of measurements (if possible give floor plan).
- the date, measured air flow rates, control settings, indoor- and outdoor temperature during test. Weather conditions such as indoor temperature, wind speed and barometric pressure should be described.
- a description of the measurement equipment used.
- the estimated inaccuracy of each of the measurements.
- a description of disturbances encountered during the measurements.

7.3.2 Naturally supplied and extracted air flow rates

7.3.2.1 Principle

The functional tests as described in this clause are needed when no pressure drop airflow curve or free area (when needed) according to EN 13141-1 and EN 13141-2 is available.

7.3.2.2 Test conditions

The control setting(s) used for the functional measurements shall be recorded.

All ATDs remain unchanged during the measurements.

All internal and external doors and windows shall be closed.

All other ventilation provision such as externally and internally mounted air transfer devices should have intended position which shall be recorded.

7.3.2.3 Uncertainty of measurement

The total uncertainty of measurement system shall be less than 20 % of the flow rate to be measured.

NOTE This includes any change in air flow rate due to flow resistance of the measurement device.

7.3.2.4 Description of the tests

The tests shall be carried out as follows:

- check the circumstances and conditions according to 7.3.2.2.
- assemble all measurement equipment, if laboratory measurements are not available or not applicable.
- determine on site the pressure/flow rate curve or free area in accordance with the principles of EN 13141-1 and EN 13141-2.
- determine from the pressure/flow rate curve at specified pressure difference the air flow rate.

NOTE The specified pressure difference is generally defined in national regulations or standards.

7.3.2.5 Results

The results shall be reported and presented with at least the following:

- description of the place of measurements (if possible give floor plan).

¾ the date, flow rates pressure curve or free area, control settings, indoor temperature, weather conditions such as indoor temperature, wind speed and barometric pressure.

¾ a description of the measurement equipment used.

¾ the estimated uncertainty of each of the measurements.

¾ a description of disturbances encountered during the measurements.

7.4 Controls and running time

7.4.1 Manual air flow rate controls

Functional measurements involving air flow rate controls apply to both natural and mechanical ventilation systems.

a) For ventilation systems and ATDs which have continuously variable controls the air flow rate shall be measured according to 7.3.1 or 7.3.2 at the maximum and the minimum control settings. Where the minimum setting is the off position (nominally zero air flow) then only the maximum flow rate shall be measured.

b) For ventilation systems and ATDs which have a number of discrete controls positions (e.g. a switch giving two particular fan speeds or a large and a small opening in an ATD) then the air flow rate shall be measured according to 7.3.1 or 7.3.2 at the maximum and the minimum (non zero) control settings. Air flow rate may also be measured at other control settings if required by agreement with the client.

7.4.2 Running time

Functional measurements of the system running times apply to both natural and mechanical ventilation systems if they incorporate devices which automatically control air flow rate by means of times switches and/or run on timers.

Where a ventilation system or ATD incorporates a time switch the running time shall be determined by reading the durations of all « on » periods from the time switch dial/display.

Where a ventilation system or ATD incorporates a run-on timer switch then the duration of the run-on time shall be determined by operating the control switch and measuring the run-on time using a watch or clock with accuracy of 15 seconds.

7.4.3 Automatic airflow rate

Specific provisions and assumptions have to be determined at national level for measurements of automatic demand controlled system.

7.4.4 Results

The results of the functional measurements for controls and running time shall be reported and presented with at least the following items:

¾ description of the locations of the components on which the measurements where carried out;

¾ description of the type and intended function of the controls and running timers.

8 Special measurements

8.1 General

Special measurements are appropriate where functional measurements are not sufficient to verify the quality of the ventilation system.

NOTE The measurements together, with the appropriate measuring instruments, may necessitate a considerable amount of work and associated costs. These require special contractual agreements which cover the nature and scope of performance.

The program of the special measurements, the parameters to be measured, the measuring instruments and the measuring points shall be agreed separately between the client and the company carrying out the measurements. The agreement should also cover the permitted uncertainty of the measuring results.

8.2 Leakage of the ductwork

8.2.1 Principle

A fan with a controllable air flow passes air through a flow measuring device into or from an installed section of the duct where the ends have been temporarily sealed. The static pressure in the air duct is measured relative to its surrounding. The air flow necessary to hold the static pressure at a certain level is measured to determine the leakage of the ductwork.

For further details, see EN 12237.

8.2.2 Test conditions

All ATDs and other intentional openings in the installed section of the duct system shall temporarily be sealed off.

NOTE Taping can be sufficient, but closing a damper does not give an adequate seal.

8.2.3 Uncertainty of measurement

The uncertainty of measurement of the static pressure shall be less than 1 Pa. The accuracy of the measurement of air leakage flow rate shall be better than 5 % of the leakage air flow rate measured.

8.2.4 Description of the tests

The tests shall be carried out as follows:

- check and record the circumstances and conditions according to 8.1.2.
- assemble all measurement equipment.
- connect the measurement equipment to the ductwork.
- establish the pressure difference between the inside of the sealed duct and the ambient of the duct by controlling the fan.
- check that there are no leaks at the sealed ATDs and other sealed openings. A smoke generating device can be used to control for leaks at the sealed positions.
- measure the pressure difference.
- measure the leakage air flow rate at least three points about 20 Pa, 60 Pa, 200 Pa pressure difference.

¾ determine the pressure versus leakage air flow rate curve by drawing a straight line through the three points on a log-log graph.

¾ determine the leakage class according to ductwork product standards (i.e. prEN 1507, …)

NOTE Due to the access conditions to the ductwork and the leakage level, it may be necessary to divide large or complex systems into several parts.

8.2.5 Results

The results shall be reported and presented with at least the following:

¾ description of the ductwork plan and the sealed section(s) of the duct during testing.

¾ the date, measured pressure(s) and leakage factor(s).

¾ description of the measurement equipment used

¾ the estimated uncertainty of the pressure difference measurement(s) and the leakage air flow rate measurement(s)

8.3 Sound pressure level

8.3.1 Principles

Measure the sound pressure level in the occupied zone of the room (using measuring equipment according to EN ISO 3747).

8.3.2 Test conditions

All internal and external doors shall be closed.

8.3.3 Uncertainty of measurement

The uncertainty of the measuring system of A-weighted sound pressure level in the room(s) shall be less than 3dB(A).

8.3.4 Description of the tests

The tests shall be carried out as follows:

¾ Check and record the circumstances and conditions according to 8.2.2.

¾ Assemble all measurement equipment.

¾ Carry out the measurements.

When air flow conditions vary, maximum conditions shall be tested. Optionally, nominal conditions may be tested.

8.3.5 Results

The results shall be reported and presented with at least the following:

¾ Description of the place of measurement.

¾ The date, measured A-weighted sound pressure level in the room.

¾ Description of the measurement equipment used.

8.4 Electric power

8.4.1 Principle

The electric power consumed is measured either directly by a power-meter (watt-meter) or indirectly from the electrical energy used by taking electricity meter (kWh-meter) readings over a period of time.

If applicable, measurements of electrical power consumption are generally only appropriate for mechanical ventilation systems.

8.4.2 Test conditions

The mechanical ventilation system or any assisting fan shall be switched on. The control setting shall be recorded. The system setting shall remain unchanged during measurements. All external doors and windows shall be closed, air transfer device shall be opened.

When air flow conditions vary, maximum conditions shall be tested. Optionally, nominal conditions may be tested.

8.4.3 Accuracy

The accuracy of the measuring system shall be better than 3 % of the electric power to be measured and better than 3 % of the electric energy to be measured.

8.4.4 Description of the tests

The tests shall be carried out as follows:

¾ Check and record the circumstances and conditions according to 8.3.2.

¾ Assemble all measurement equipment.

¾ Carry out the measurements.

8.4.5 Results

The results shall be reported and presented with at least the following:

¾ Description of the place of measurement.

¾ The date, measured electric power, control settings, indoor temperature, weather conditions, wind speed and barometric pressure.

¾ Description of the measurement equipment used.

¾ The estimated uncertainty of the electric power level measurement(s).

Annex A
(informative)

Air leakage measurements of the building envelope

The first performance requirement of an installed ventilation system is that the total air flow should agree with the design value. The second performance requirement is that the distribution of air flows between the air terminal devices is correct. The third performance requirement is that once the correct amount of air enters and leaves the dwelling it has to ventilate the individual rooms efficiently.

However, the ventilation i.e. the whole dwelling ventilation rate and the individual room ventilation rate is influenced by the airtightness of the dwelling envelope. The leakier a dwelling is the higher the unwanted air exfiltration rate will be, and the variation in total ventilation rate will also be larger. The tighter a dwelling is the easier it is to obtain "controlled" ventilation. Depending upon the ventilation system, different requirements on the airthightness should be made. Dwellings with natural ventilation should be relatively leaky (incl. outdoor air vents in the building envelope). Exhaust ventilation requires a better airtightness, in order to obtain a low air exfiltration rate. Dwellings with balanced exhaust-supply ventilation should be much tighter, if they are to have the same air exfiltration rate as with exhaust ventilation. A dwelling equipped with exhaust ventilation is most of the time depressurised by the ventilation system and is therefore less sensitive to temperature differences (inside-outside) and wind, than a balanced exhaust-supply ventilated dwelling.

The standard method for finding the leakage function of a building is fan pressurization (EN 13829). Typically all openings in the exterior envelope intended for ventilation purposes (air inlet), as well as any outlet are sealed before the test is performed. Other openings are kept closed.

All rooms which are heated are included in the test; however, rooms with separate ventilation such as boiler rooms and garages often disregarded. A door-leaf or a window is replaced by a sheet of plywood or airtight plastic film which is fixed to the frame and sealed. An air flow generating and metering system is connected through the sheet, and a tube from a micromanometer leads to the outside to measure the indoor-outdoor pressure difference. The air flow rate is recorded at a number of pressure differences, positive and negative, and the test results are presented in a diagram as pressure difference versus air flow rate on the axes.

The standard fan pressurisation is a straight-forward method of characterizing the air leakage of a building. The main disadvantage is that the result is valid for higher pressures than those occurring during air infiltration during normal conditions. The advantages are that the test itself is fairly easy to perform and it can be combined with the use of smoke sticks or an infra-red camera to locate the leaks. An additional advantage is the possibility of characterising large openings such as vertical shafts for natural ventilation.

Annex B
(informative)

Influence of ventilation systems on indoor air velocity

The ventilation system can have an influence on the air velocity within the occupied zone in a dwelling. In the case of externally mounted ATDs, during winter cold air can enter through such a device and can create discomfort within the occupied zone. Mechanically supplied air can enter the occupied zone at a velocity and temperature which creates discomfort. This discomfort is often difficult to measure in practice. If air diffusion data according to EN 13141-1 and EN 13141-2 is available for the ATD of interest, an evaluation of the comfort level can be carried out. Checks in the dwelling may have to be carried out to determine whether the ATDs are being operated within their specifications.

If measurements within the occupied zone are to be carried out the indoor air velocity should preferably be determined by means of an omnidirectional probe which is sensitive to the velocity whatever the direction is (see also EN 13182). The air velocity usually varies from place to place within the occupied zone, the variations being random with regard to magnitude and direction. Therefore, an exact measurement of the air velocity is complicated. Generally, it is sufficient to measure the mean air velocity at selected positions. The air temperature shall be measured at all measurement points. Supply air temperature should also be measured.

Annex C
(informative)

Determination of the extent of functional checks and measurements for commissioning of new systems (see EN 12599)

C.1 General

In the case of functional checks or measurements on a system the same procedure may often be repeatedly necessary at different locations.

In order to reduce the amount of work, spot checks may be used.

This annex specifies a method to determine the required number of checks or measurements which shall be carried out in the above mentioned case.

The extent of checks or measurements should be specified before installation by means of one of the four levels A, B, C or D. Otherwise, level A shall be adopted. See Figure C.1.

These levels are independent of classes which concern other items such as comfort level etc.

Unless otherwise agreed, the level for functional measurements should be the same as for functional checks.

C.2 Terms and definitions

C.2.1
parameter
state of a system component (response to controls, operating condition etc) which shall be checked, or physical quantities (e.g. temperature, air flow rate, current etc) which shall be measured.

C.2.2
similar locations
parts of the building (rooms, zones) or the components of the systems (fans, air diffusers, ducts etc) the functions of which are of the same kind and which involve actions of the same order of magnitude by the system.

C.3 Symbols

p number of measurements

n number of similar locations identified in a building

f(x) dependent function of the independent variable *x*

C.4 Determination of the total number *n* of similar locations

For systems, building elements or components to be considered as similar, it is necessary that they are identical nor that their parameters have identical values (nominal or real). E.g. all ATD of the same kind which serve rooms of comparable size and use are deemed to be similar locations for measuring the air flow rates.

If a parameter is maintained by the design of the system at the same value at a set of similar locations, one location only may be considered. For example, if the supply air temperature is controlled only by zone, it may be

measured only at one location in every zone. Therefore, locations are judged to be similar or not separately for each given parameter and depending on the design and controls of the system.

In so far a system has been installed at the same time by persons working in a similar way, the total number of similar locations identified in the building shall be taken as *n*, even though similar sub-systems may be identified within the system.

For instance, if a 10-storey building is served by a separated air conditioning system on each floor, every one having 20 ATD, the calculation shall be based on $n = 200$ ATD.

C.5 Extent of checks or measurements

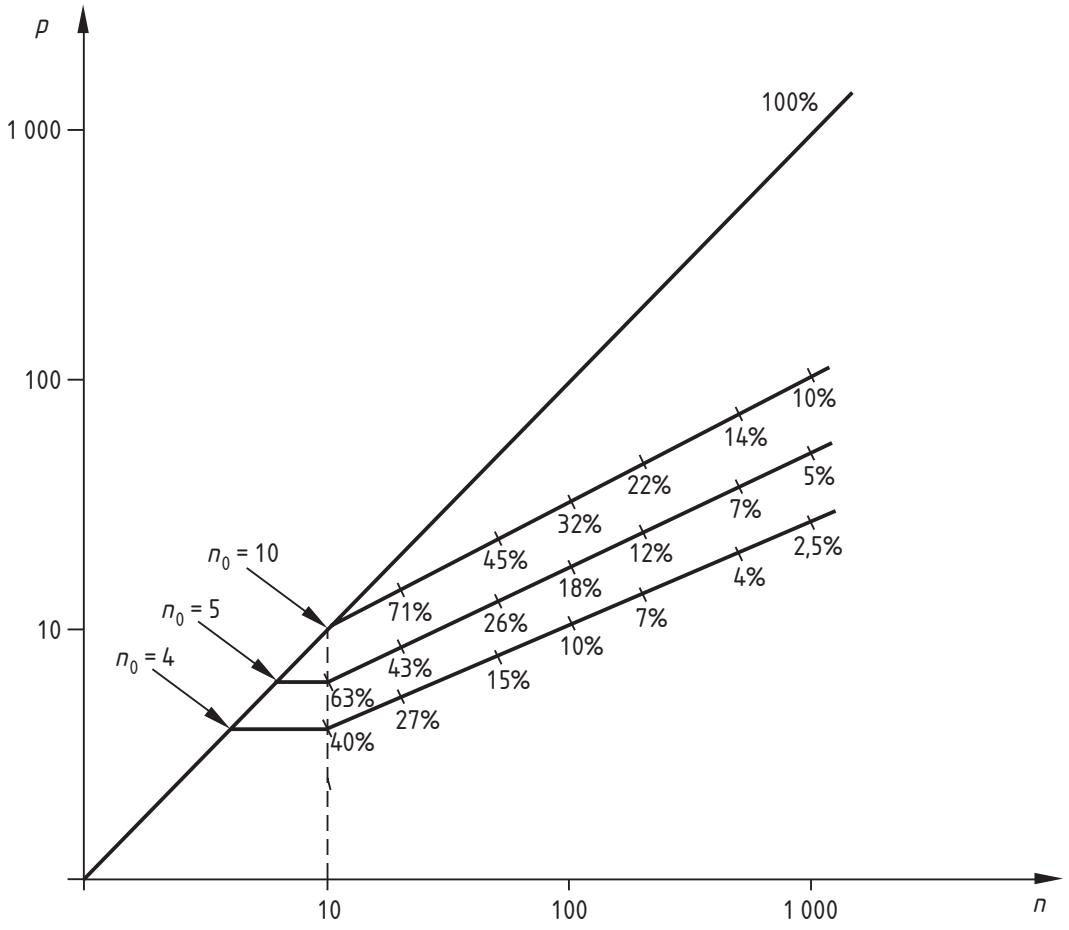
Checks and measurements shall be carried out at least on a number p, out of the total number n of similar locations. p is given by the curves in Figure C.1 as a function of n and of the levels A, B, C and D of the extent of the functional checks and measurements.

When adjustment of the systems is being checked for quality control purposes before handing over, the number of checks or measurements will generally be greater than given in Figure C.1.

If measurements are carried out in similar rooms, some parameters may be measured in a reduced number of rooms which is only a fraction of *p*. Table C.1 gives the number of the necessary measurements.

Table C.1 — Number of measurements to be carried out as a fraction of number *p*

Parameter	Number of measurements	
	Normal	minimum
Room air temperature continuously recorded over 24h	*p*/10	1
Room air humidity continuously recorder over 24h	*p*/10	1
Vertical temperature profile	*p*/10	1
Indoor air velocity	*p*/10	1
Sound pressure level	*p*/5	3



Level D : $p = n$

Level C : $p = 3{,}16 \quad n^{0{,}5}$

Level B : $p = 2{,}23 \quad n^{0{,}45}$

Level A : $p = 1{,}6 \quad n^{0{,}40}$

Figure C.1 — Number *p* of similar elements to be tested among *n*

Approximate percentage p/n are displayed on the graph. Numbers p shall be rounded off to the nearest integer. Formulae for levels A, C apply to $n \quad 10$.

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