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Prezračevanje stavb - Preskusni postopki in merilne metode za predajo klimatskih in prezračevalnih sistemov

Ventilation for buildings - Test procedures and measurement methods to hand over air conditioning and ventilation systems

Lüftung von Gebäuden - Prüf- und Messverfahren für die Übergabe raumlufttechnischer Anlagen

Ventilation des bâtiments - Procédures d'essai et méthodes de mesure pour la réception des installations de conditionnement d'air et de ventilation

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Ventilation for buildings - Test procedures and measurement methods to hand over air conditioning and ventilation systems

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Contents

Page

Foreword 5

1 Scope 6

2 Normative references 7

3 Test and check procedure 8

4 Completeness checks 10

5 Functional checks 10
5.1 General 10
5.2 Put system into use 10
5.3 Procedure 10

6 Functional measurements 11
6.1 General 11
6.2 Range of functional measurements 11
6.3 Procedure 12
6.4 Measuring methods and measuring devices 13
6.4.1 General 13
6.4.2 Measurement of the air flow rate 13
6.4.3 Measurement of the ductwork leakage 13
6.4.4 Measurement of the indoor air velocity 13
6.4.5 Measurement of air temperature 14
6.4.6 Measurement of the air humidity 14
6.4.7 Measurement of the sound pressure level 14
6.4.8 Measurement of the electrical power of the fan 14
6.4.9 Measurement of the pressure difference at the air filter 14
6.5 Accompanying measurements 14

7 Special measurements (see Annex E) 15
7.1 General 15
7.2 Parameters 15
7.3 Measurements of components 15
7.3.1 Fans 15
7.3.2 Filters 16
7.3.3 Heat exchangers 16
7.3.4 Air humidifiers 18
7.4 Check of regulating, control and switching systems 19
7.4.1 General 19
7.4.2 Controls 19

8 Uncertainty of measurements 20
8.1 General 20
8.2 Uncertainty of measuring devices 20
8.2.1 Instrument uncertainty (u_1) 20
8.2.2 Reading uncertainty (u_2) 20
8.3 Uncertainty of measurement results 21
8.4 Calculation of the error of the measuring equipment 22

9 Test Reports 22
9.1 General 22
9.2 Handing over report 22
9.3 Inspection report on the completeness check 23
9.4 Inspection report on the functional check 23

9.5 Test report on the functional measurements 24
9.6 Test report on the special measurements 24

Annex A (informative) Completeness check 25
A.1 Documents 25
A.1.1 List of agreed specifications: 25
A.1.2 Inventory documents: 26
A.1.3 Documents for operation and maintenance: 26
A.2 Tests 26
A.2.1 General inspection of: 26
A.2.2 Balancing 27
A.2.3 Separate tests of: 27
A.3 Test Report for the completeness check 30

Annex B (informative) Functional checks 31
B.1 General 31
B.2 Separate checks for components 31
B.2.1 Central devices, fans 31
B.2.2 Heat exchanger 31
B.2.3 Air filter 32
B.2.4 Humidifier 32
B.2.5 Multi leaf dampers 32
B.2.6 Fire and smoke dampers 32
B.2.7 Mixing section 32
B.2.8 Ductwork 32
B.2.9 Air flow pattern in the room as a function of the air terminal devices and geometrical obstacles 32
B.2.10 Control devices and switch cabinets 32

Annex C (normative) Determination of the extent of functional checks or measurements 34
C.1 General 34
C.2 Parameters and similar locations 34
C.2.1 Parameter 34
C.2.2 Similar locations 34
C.3 Determination of the total number n of similar locations 34
C.4 Extent of checks or measurements 35

Annex D (normative) Measuring methods and measuring devices for functional measurements 37
D.1 Measurement of the air flow rate 37
D.1.1 General 37
D.1.2 Measurement in the duct cross-section 37
D.1.3 Measurement with throttle devices 43
D.1.4 Measurement in the cross-section of a chamber, the fan-casing or device 43
D.1.5 Measurement at the air terminal devices 43
D.1.6 Measuring devices (Examples) 47
D.2 Measurement of the indoor air velocity 48
D.2.1 Measuring methods 48
D.2.2 Measuring devices 48
D.3 Measurement of air temperature 49
D.3.1 Measuring methods 49
D.3.2 Measuring devices 50
D.4 Measurement of the air humidity 50
D.5 Measurement of the sound level 51
D.6 Measurement of the electrical power of the fan 51
D.6.1 Measuring method 51
D.6.2 Measuring equipment 53
D.6.3 Measuring section 53
D.6.4 Measurement uncertainties 53
D.7 Pressure difference at the air filter 54
D.8 Air leakage 54
D.8.1 Measuring method 54

D.8.2 Measuring equipment 54
D.8.3 Measuring section 54
D.8.4 Measurement uncertainty 55

Annex E (normative) Special measurements 56
E.1 Measuring instruments 56
E.2 Measuring of parameters 56
E.2.1 Pressure 56
E.2.2 Temperature 58
E.2.3 Humidity 62
E.2.4 Air flow 62
E.2.5 Sound 69
E.2.6 Air pollution 69
E.2.7 Electric Power 72
E.3 Measurements in rooms 72
E.3.1 General 72
E.3.2 Thermal environment 72
E.3.3 Ventilation effectiveness 73
E.3.4 Acoustic environment 74

Annex F (informative) Contractual agreements 75

Annex G (informative) Examples for determination of the number of functional checks and measurements 76
G.1 Functional checks 76
G.2 Functional measurements 77

Annex H (informative) Examples for measurement uncertainty 78
H.1 Measuring equipments for measuring of the velocity and the cross-section 78
H.2 Velocity measurement by Pitot Static Tube (Prandtl tube) 78
H.3 Example as H.1 using the same references but lower velocity, larger distance 79
H.4 Example: Measurement of velocity by axial vane anemometer 79

Annex I (informative) Examples of measuring protocols for the air-flow rate 81

Bibliography 85

Foreword

This document (EN 12599:2012) 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 April 2013, and conflicting national standards shall be withdrawn at the latest by April 2013.

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

This document supersedes EN 12599:2000.

The significant technical changes between this edition and the previous one are:

— the scope was modified so that the test methods and measuring instruments can be used before, during and after handing over instead of at the stage of handing over, and also in the frame of EPBD-measurements;

— the scope was modified so that EN 12599 does not exclude dwellings;

— the normative references have been updated;

— Table 1 now includes requirements for the cleanliness and leakage of the system;

— in Table 2, the uncertainty of the air flow rate has been reduced from ± 20 % to ± 15 % for each individual room and from ± 15 % to ± 10 % for each system;

— a formula to calculate the uncertainty of the measuring location τ_u has been added to Table E.4

— methods to measure the electrical power have been added.

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

1 Scope

This European Standard specifies checks, test methods and measuring instruments in order to verify the fitness for purpose of the installed systems primarily for handing over which will be partially performed before, during and after handing over.

This European Standard enables the choice between simple test methods, when sufficient, and extensive measurements, when necessary.

This European Standard applies to mechanically operated ventilation and air conditioning systems as specified in EN 12792 and comprising any of the following:

— air terminal devices and units,

— air handling units,

— air distribution systems (supply, extract, exhaust),

— fire protection devices,

— automatic control devices.

When the system is set, adjusted and balanced measurement methods described in this European Standard apply.

This European Standard does not apply to:

— heat generating systems and their control,

— refrigerating systems and their control,

— distribution of heating and cooling medium to the air handling units,

— compressed air supplying systems,

— water conditioning systems,

— central steam generating systems for air humidifying,

— electric supply systems.

This European Standard applies to ventilation and air conditioning systems designed for the maintenance of comfort conditions in buildings. It is not applicable in the case of systems for the control of industrial or other special process environments. In the latter case, however, it may be referred to if the system technology is similar to that of the above mentioned ventilation and air conditioning systems.

This European Standard does not include any requirements concerning the installation contract. However, in order to facilitate the application of this standard, the installation contract should refer to the provisions which are listed in Annex F.

The measuring methods in this European Standard can be used in the frame of the energy inspection of air-conditioning systems according to EU Directive 2010/31/EU "Energy performance of buildings Directive" (see EN 15239, EN 15240).

This European Standard may be used for residential and dwelling ventilation systems.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 308, *Heat exchangers — Test procedures for establishing performance of air to air and flue gases heat recovery devices*

EN 1507, *Ventilation for buildings — Sheet metal air ducts with rectangular section — Requirements for strength and leakage*

EN 1822-1, *High efficiency particulate air filters (EPA, HEPA and ULPA) — Part 1: Classification, performance testing, marking.*

EN 12097, *Ventilation for buildings — Ductwork — Requirements for ductwork components to facilitate maintenance of ductwork systems*

EN 12237, *Ventilation for buildings — Ductwork — Strength and leakage of circular sheet metal ducts*

EN 12238, *Ventilation for buildings — Air terminal devices — Aerodynamic testing and rating for mixed flow application*

EN 13182, *Ventilation for buildings — Instrumentation requirements for air velocity measurements in ventilated spaces*

EN 13779, *Ventilation for non-residential buildings — Performance requirements for ventilation and room-conditioning systems*

EN 14239, *Ventilation for buildings — Ductwork — Measurement of ductwork surface area*

EN 15423:2008, *Ventilation for buildings — Fire precautions for air distribution systems in buildings*

EN 15726, *Ventilation for buildings — Air diffusion — Measurements in the occupied zone of air conditioned/ventilated rooms to evaluate thermal and acoustic conditions*

EN 15780, *Ventilation for buildings — Ductwork — Cleanliness of ventilation systems*

EN 60584-1, *Thermocouples — Part 1: Reference tables (IEC 60584-1)*

EN 60584-2, *Thermocouples — Part 2: Tolerances (IEC 60584-2)*

EN 60751, *Industrial platinum resistance thermometers and platinum temperature sensors (IEC 60751)*

EN 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications (IEC 61672-1)*

EN ISO 3740, *Acoustics — Determination of sound power levels of noise sources — Guidelines for the use of basic standards (ISO 3740)*

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

EN ISO 3746, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane (ISO 3746)*

EN ISO 3747, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering/survey methods for use in situ in a reverberant environment (ISO 3747)*

EN ISO 7726, *Ergonomics of the thermal environment — Instruments for measuring physical quantities (ISO 7726)*

EN ISO 11201, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections (ISO 11201)*

EN ISO 12569, *Thermal performance of buildings — Determination of air change in buildings — Tracer gas dilution method (ISO 12569)*

ENV 13005, *Guide to the expression of uncertainty in measurement*

CR 1752, *Ventilation for buildings — Design criteria for the indoor environment*

3 Test and check procedure

The following steps shall be carried out in the given order:

a) completeness checks;

b) functional checks;

c) functional measurements;

d) special measurements;

e) report.

Functional checks and measurements on the system can be performed to a variable extent which is specified by means of 4 levels (see Annex C). The choice of a level should be agreed upon and be part of the installation contract.

The special measurements in accordance with Clause 7 and Annex E shall only be carried out when required and especially agreed.

A summary of the different tests and measurements is included in Table 1.

Table 1 — Summary of tests, measurements and report to verify the quality of the systems

Required Steps	Purpose	Activities	Annexes
Step a Completeness checks	To ensure that the ventilating and air conditioning system has been installed entirely in accordance with contract	1. Comparison of equipment with the installation list 2. Compliance with technical rules (contract and official) 3. Accessibility 4. Cleanliness 5. Balancing 6. Air tightness 7. Documents necessary for operating	Annex A With more specified information on the activities 1 to 7
Step b Functional checks	Verifying the operation of the system	1. Put system into use 2. Operation of components and system	Annex C Determination of extent Annex B Survey of performance of components and systems
Step c Functional measurements	Verifying on a statistical basis that the system achieves the values according to design	1. Determine which measurements and recordings are necessary 2. Extent of functional measurements, specified by means of classes A, B, C and D 3. Measurements 4. Accompanying measurements (see 6.4)	Annex C Determination of extent Annex D Measuring methods and measuring devices
Step d Special measurements (if necessary)	In case of doubts concerning the quality of parts of the system after application of steps a to c or especially agreed.	1. Determine which measurements and recordings are necessary 2. Determine uncertainty of the measurements 3. Measurements	Annex D + E Measuring methods and measuring devices and Special measurements
Step e Report See chapter 9		1. Report 2. Handing over the report	Annex A Example of completeness check report Annex I Examples of measuring protocols

4 Completeness checks

The completeness check is intended to assure that installation is done according to specification and in compliance with the relevant technical rules.

The following checks are included:

— Comparison of the delivered system with the specification, both with regard to volume and material and, if necessary, also with regard to characteristics and spare parts.

— Check of compliance with legal and specified technical rules.

— Check of the accessibility of the system especially with regard to operation, cleaning and maintenance according to EN 12097.

— Check of the cleanliness of the system as specified in EN 15780 also in respect to air handling units and system if especially agreed.

— Check that all documents necessary for operation are available.

— Check that the balancing has been done.

— Check that the air tightness test has been done.

A description of the completeness check is included in Annex A.

5 Functional checks

5.1 General

The purpose of the functional check is to prove the operation of installation in different operational conditions in compliance with the relevant technical rules and the specification. The check shows whether the particular elements of the system such as filters, fans, heat exchangers, coolers, humidifiers etc. have been properly installed.

5.2 Put system into use

Put the system in running, adjusted and safe condition.

Adjustment protocols and operation instructions shall be available.

5.3 Procedure

Functional checks shall be carried out on every kind of installed equipment.

Before starting the checks, a checklist shall be drawn up.

The extent of functional checks is defined in Annex C.

The locations for the checks shall be the subject of prior agreement by the parties concerned.

Instruction for the procedure and a list of usual functional checks are given in Annex B.

6 Functional measurements

6.1 General

The purpose of the functional measurements is to give proper assurance that the system achieves the design conditions and set points as specified.

When judging the results of measurements in a ventilated or air conditioned space the influence of physical characteristics of the building should be taken into account.

Functional measurements can take place at other conditions than design conditions. The measurements are allowed to be calculated into design conditions if the calculation is possible. (e.g. possible: heat exchanger, not possible: air flow pattern)

6.2 Range of functional measurements

Table 2 indicates which measurements and recordings are necessary for each type of ventilation and air conditioning system.

The extent of functional measurements is defined in Annex C.

Table 2 — Functional measurements

Measurement at		Total System	Central System/Appliance				Duct work	Room					
Parameters		Additional cleanliness test	Current drawn and power by the motor [D.6]	air flow *) [D.1]	air temperature *) [D.3]	pressure drop across filter [D.7]	ductwork leakage test [D.8]	supply air flow [D.1]	exhaust air flow [D.1]	supply air temperature **) and air temperature in the room [D.3]	air humidity [D.4]	sound pressure level [D.5]	Indoor air velocity [D.2]
Ventilation System	(F) Z	2	1	1	0	1	2	1	2	0	0	2	0
	(F) H	2	1	1	1	1	2	1	2	2	0	2	2
	(F) C	2	1	1	1	1	2	1	2	2	2	2	2
	(F) M/D	2	1	1	1	1	2	1	2	2	1	2	2
Partial air conditioning system	(F) HC	2	1	1	1	1	2	1	2	1	2	2	2
	(F) HM/HD/ CM/CD	2	1	1	1	1	2	1	2	1	1	2	2
	(F) MD	2	1	1	1	1	2	1	2	2	1	2	2
	(F) HCM/M CD/CHD /HMD	2	1	1	1	1	2	1	2	1	1	2	2
Air conditioning system	(F) HCMD	2	1	1	1	1	2	1	2	1	1	2	2

*) Outdoor air, supply and exhaust air
**) Depending on control principles, if relevant

Explanations
0 measurement not necessary
1 to carry out in all cases
2 to carry out only in the case of contracted agreement

Figures 0-2 indicate whether there has to be a test within the stage of functional measurements during the handing over. Some of the tests are already done by the installer prior to the handing over and the documentation shall be verified in the completeness check.

C cool

D dehumidify

F filter

H heat

M humidify (moisture)

Z without any thermodynamic air handling functions (zero)

6.3 Procedure

Before starting the functional measurement, the measuring locations shall be specified and the procedures and measuring devices shall be agreed upon and given in the technical documents.

The number of measuring points in a room should take into account the floor area and the measured parameters. At least one measuring position is required for measurements in rooms of area up to 20 m² ; larger rooms should be subdivided accordingly. For the measurements in the room, the measuring positions in the occupied zone shall be agreed between the parties concerned, preferably at positions intended for intensive occupancy.

With regard to the selection of the measuring instruments the overall uncertainty shall be taken into account. Calibrated devices shall be used.

The indoor climate factors and air flow rates, heating, cooling and humidifying performances, electrical characteristics and other design data shall be measured at the ventilation system design air flow rate. The permissible uncertainties of the measured values are given in Table 3.

Table 3 — Permissible uncertainty of the measurement

Parameter	Uncertainty*)
Air flow rate, each individual room	± 15 %
Air flow rate, each system	± 10 %
Supply air temperature	± 2 °C
Relative humidity [RH]	± 15 % RH
Air velocity in occupied zone	± 0,05 m/s
Air temperature in occupied zone	± 1,5 °C
A-weighted sound pressure level in the room	± 3 dBA
*) This European Standard does not define tolerances for the design values itself. The result is accepted when the design value is in the range of the uncertainty of the measurement.	

If the performance of the system requires closer uncertainties, this shall be specially defined in the documentation of the system. If product standards, national or local regulations require closer uncertainties, this shall be adhered to. All temperatures and heating or cooling performances shall simultaneously comply with the given uncertainties.

6.4 Measuring methods and measuring devices

6.4.1 General

Annex D provides information concerning measuring methods and devices which are adequate for the functional measurement.

In the case of measurements in ducts and air conditioning systems with negative pressure, measuring errors due to an infiltration by the measuring device opening of air shall be avoided.

In any case, the openings in the ducts have to be closed after measuring.

6.4.2 Measurement of the air flow rate

The air flow rate can be evaluated by different methods. Usually, it is calculated from the air velocity and the corresponding cross-section. The air velocity can be measured by means of an appropriate anemometer, Pitot Static Tube (Prandtl tube) or a pressure drop across a throttling device.

Air flow rates should be measured at an appropriate cross-section of a duct. As air velocity is seldom uniform, it should be measured at an appropriate number of locations in the cross-section and averaged for the mean velocity.

The total air flow rate of a system should preferably be measured within the air handling unit or fan casing with integrated measurement if equipment like inlet nozzles is available.

For air terminal devices, other methods (e.g. bag method, reference pressure methods or funnel measurement) can be applied. The air terminal devices with a low pressure drop should be measured by means of the compensation method or other methods with a non-significant pressure drop.

The different measuring methods and devices are described in D.1.

6.4.3 Measurement of the ductwork leakage

The leakage of the ductwork is important for the energy efficiency of the complete air conditioning system. The tightness class according to EN 1507 and EN 12237 shall be checked.

In large and complex air duct systems, the leakage can only be measured in a part of the system. The leakage measurement shall be performed while the duct is being installed and accessible.

After start of operation a second tightness test can be necessary, only if an irregularity happens during the start up. (In the case of a malfunction e.g. of fire dampers, the pressure can exceed the allowed pressure and damage the ductwork.)

The measuring methods and devices are described in D.8.

6.4.4 Measurement of the indoor air velocity

Indoor air flow is usually a turbulent flow. The air velocity varies from place to place within the room, 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 (see D.2.1).

In rooms up to approximately 20 m² floor area, one measurement position is sufficient. Large rooms (e.g. landscaped offices) should be measured on the similar basis to the foregoing and positions in the occupied zone should be chosen where higher air velocities can be expected. Measurements should preferably be taken at positions intended for intensive occupancy, e.g. at the desk in an office.