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Ventilation for buildings - Energy performance of buildings - Guidelines for inspection of ventilation systems

Ventilation des bâtiments - Performance énergétique des bâtiments - Lignes directrices pour l'inspection des systèmes de ventilation

Lüftung von Gebäuden - Gesamtenergieeffizienz von Gebäuden - Leitlinien für die Inspektion von Lüftungsanlagen

EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This document (EN 15239:2007) 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of an identical text or by endorsement, at the latest by November 2007, and conflicting national standards shall be withdrawn at the latest by November 2007.

The connections and relations to the different draft standards developed in the EPBD project are presented in the umbrella document of the CEN BT 173.

This standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/343), and supports essential requirements of EU Directive 2002/91/EC on the energy performance of buildings (EPBD). It forms part of a series of standards aimed at European harmonisation of the methodology for the calculation of the energy performance of buildings. An overview of the whole set of standards is given in CEN/TR 15615, Explanation of the general relationship between various CEN standards and the Energy Performance of Buildings Directive (EPBD) ("Umbrella document").

Attention is drawn to the need for observance of all relevant EU Directives transposed into national legal requirements. Existing national regulations with or without reference to national standards, may restrict for the time being the implementation of the European Standards mentioned in this report.

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 United Kingdom.

Introduction

Energy Performance of Buildings Directive (EPBD) identifies clearly ventilation, in article 2 “Definitions” and 3 “Adoption of a methodology” (for the calculation of the energy performance), as a component of the energy consumption of buildings, such as heating, cooling or lighting. EPBD also mentions in article 4, “Setting of energy performance requirements” that “requirements shall take account of general indoor climate conditions, in order to avoid negative effects such as inadequate ventilation”.

Considering the impact of ventilation on the energy consumption of the buildings, CEN has decided to also develop a methodology concerning the inspection of ventilation systems, as it is made for air conditioning and heating systems, following the requirements of the articles 3, 8 and 9 of EPBD.

The inspection described here, is therefore intended to include all types of ventilation systems mechanical, natural and hybrid (including mechanical and natural ventilation). Starting from the general points that may lead to excessive energy consumption, a list of the corresponding checks according to the nature of the ventilation system is given. Other specific points depending more from the typology of the ventilation system are then detailed. Indications on the frequency of inspection and on the improvements that may appear necessary depending on the results of the diagnostic are also given.

The possibility to introduce classes is given in this standard in order to leave Member States freedom to choose between different objectives and extent of inspection, within a harmonised framework.

All inspection activities undertaken should be subject to compliance with all health and safety requirements for the persons involved.

This standard also complements EN 15240 concerning the inspection of air conditioning systems for the inspection of the ventilation part that is to be performed in relation to 4.2 dealing with mechanical exhaust and/or supply ventilation systems.

1 Scope

This standard develops the methodology required for the inspection of mechanical and natural ventilation systems in relation to its energy consumption.

This standard applies to both residential and non residential buildings.

The inspection may include the following issues, in order to determine the energy performance of the building and its associated mechanical / electrical plant:

— The system conformity related to the original and subsequent design modifications, actual requirements and the present building state.

— Correct operation of the mechanical, electrical or pneumatic components.

— Provision of an adequate and pure supply of ventilation air.

— The functioning of all the controls involved.

— Fan power absorbed and specific fan power.

— Building air tightness.

It is not the intention of the standard to provide a full ventilation system audit. Its purpose is to assess its functioning and its impact on energy consumption. It includes recommendations on possible system improvements.

NOTE The inspection, performed by an independent person to assess the system performance relating to energy consumption, is different from the maintenance that is performed to the owner's requirements to maintain the optimum system performance.

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

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

3 Terms and definitions

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

3.1
centralised ventilation
ventilation of a space or spaces within a building by means of supply ductwork, extract ductwork or a combination of both, from a centralized plant room

3.2
inspection
inspection, in the manner of this standard means to examine the ventilation systems in buildings

3.3
local ventilation
ventilation of a set area of a space by means of supply ductwork, extract ductwork or a combination of both

NOTE Local ventilation can also be achieved by means of natural wall or roof inlets or outlets or by mechanical means by a fan or fans in the perimeter wall, internal wall, or roof.

3.4
assumptions
set of descriptions to be considered by the person in charge of the inspection, if the actual requirements are difficult to identify in the analysis

3.5
building system control
measures taken in ensuring the system operates in accordance with the specified conditions

3.6
commissioning
sequence of events necessary to ensure the building and its associated heating, ventilation and air conditioning systems are functioning in accordance with the design parameters

3.7
design criteria
set of descriptions based on a particular environmental element such as indoor air quality, thermal, acoustical, and visual comfort, energy efficiency and the associated system controls to be used for assessing the plant operation

3.8
control parameters
set values of the internal environmental conditions related to the external conditions

3.9
design documentation
written description of the essential design elements of the plant

3.10
self regulating valve
terminal component (for example: self adjustable air transfer device) or aerodynamic ductwork (for example: regulator of flow rate) allowing to insure a constant flow rate on a pressure operating range in

NOTE Some valves are designed with two flow rates (a nominal flow rate and a reduced nominal flow rate).

4 Inspection

4.1 Pre –inspection and documents collection

To prepare a site survey for the inspection of a ventilation system and to provide the best available information regarding the building and its use, the following information is required:

- Last available design documents, giving the internal and external temperatures and design occupancy, heat gains and losses.
- Information regarding the areas to be ventilated naturally, mechanically, heated or humidified.
- Information regarding building use, occupancy and frequency of occupation in comparison to the notice of the manufacturer and model (type) of the ventilation system.
- System manufacturer and model (type).
- Rated operating pressure.
- Rated operating temperatures.
- Working hours.
- Air volume rates (supply and extract).
- Areas / volumes supplied.
- Technical drawings or schematics of the mechanical ventilation system.
- Copies of any log book documentation of Air Handling Unit (AHU) from the servicing organisation.
- If a building management system is installed, information regarding the equipment and controlled systems is to be supplied.
- Copies of commissioning reports and the last inspection report.
- Records on maintenance of air supply systems, including filter cleaning and exchange and cleaning of the heat exchangers.

In the case of no available documents, the minimum information regarding the ventilation shall be provided.

NOTE An example of information list is given in Annex A.

4.2 Methodology of inspection on site

4.2.1 General approach

4.2.1.1 General

There are considerable variations in the design and construction of installations and buildings. Each ventilation performance check shall therefore be adapted as far as possible for the individual building. However, the following points shall always be included in a ventilation performance check.

The number of measurements and sampling shall be noted in the test report.

Where there is clear evidence that a good practice program of maintenance is being carried out, then certain aspects of the inspections described in the standard may be simplified or reduced.

Another possible approach is to decline the inspection considering the class of the ventilation system.

NOTE 1 Annex G gives examples of criteria that can be used for classes definitions.

NOTE 2 Annex H gives examples of inspection extent for different parts of a ventilation system according to three different classes.

4.2.1.2 Operation and maintenance instructions

Depending on the different types of ventilation systems the operation and maintenance instructions shall be available.

4.2.1.3 Air change

In natural ventilation system air flow varies considerably in relation to temperature difference, wind conditions and a combination of both. It is therefore of little interest to measure the flow of air in a naturally ventilated building. It shall be sufficient to enquire about the systems design and whether alterations have been made which may have resulted in any adverse changes in air flow. It is important to check that ducts and exhaust air terminal units are not clogged.

The same applies for exhaust air systems, it is also important to determine how the outside air supply system operates.

4.2.1.4 Humidity

Particular attention shall be given to the ventilation of areas that have high moisture load.

NOTE The people in charge of the inspection should bear in mind the implication that increased humidity conditions result in an increase of bacteria, mould and fungi. These break down organic material as well as creating odours which have an adverse effect on the indoor environment.

Living and hygienic routines are of concern with regard to the indoor air humidity. This influences the ventilation requirements.

4.2.1.5 Fans and air handling units

A ventilation performance check shall commence by verifying the correct performance and operation of the air handling unit's components in accordance with inspection details. These details can refer to fans, pumps, filters and dampers. Visual checks of air tightness and cleanliness shall also be made.

4.2.1.6 Recirculated air

Check damper and control of dampers for recirculated air, and filters.

NOTE See EN 13779 for further guidance on air recirculation.

4.2.1.7 Measurement methods

When checking the performance of different parts of a ventilation system, the measurement methods employed will assist subsequent follow-ups. To make this possible, the instructions for each measurement method shall be followed and, instruments for the measurements be calibrated.

In buildings with balanced ventilation, both supply and exhaust air flows shall be measured to ensure all components in the ventilation system are covered. The method of selection shall be documented.

The same method for air flow measurements shall be applied to buildings with mechanical exhaust or supply ventilation. The report shall indicate how the outdoor air supply is designed to operate and how the actual performance has been measured and assessed.

NOTE It is also useful to refer to EN 12599.

4.2.1.8 Optional issues

4.2.1.8.1 General

Other issues concerning the ventilation system can be addressed during the inspection.

4.2.1.8.2 Gas emission from surroundings

For specific ventilation systems for the reduction in the concentration of specific gas e.g. radon within the space, the person in charge of inspection shall note if they are operating.

4.2.1.8.3 Noise/Vibration

In the cases where the ventilation system is considered to be producing discomforting noise or shows poor acoustic insulation, the system shall be checked in order to determine the causes, against the documents used for the inspection purposes.

The attenuator (position, condition of baffles, fouling…), fan speed, damper angles, grille positions and anti vibration devices shall be checked.

For excessive vibration, investigate fan bearings, and the condition of anti vibration mountings etc.

4.2.1.8.4 Deposits in ventilation ductwork

During inspection some advice can be given regarding cleaning of exhaust and supply systems to ensure a good air quality.

In the inspection report the apparent cleanliness or otherwise of the ductwork and ventilation system components shall be noted.

NOTE Deposits in ventilation duct work could represent a hygienic risk, reduce the air flow capacity, influence the fan performance and reduce heat recovery.

Efficient filtration and the associated maintenance of filters protect the duct work and other components such as heat exchangers from the build up of unwanted deposits.

The views of the occupants and of the facilities manager should also be taken into account.

4.2.2 Mechanical exhaust and/or supply systems

4.2.2.1 General

The inspection shall begin with the analysis of the documents listed in 4.1, describing the installation and its operating .requirements.

4.2.2.2 Visual inspection

4.2.2.2.1 Ductwork

The person in charge of the inspection shall note, from visual observations where possible, the standard and integrity of the ductwork. These observations shall include such factors as:

— Air tightness, regarding standard of the junctions (standard of adhesive tape, mastic, joints etc);

— Quality of the duct insulation: type of insulation, quality of the insulation surface, correct installation of the insulation over duct connections, insulation air-tightness, degradation, whether the insulation is wet;

— Cleanliness and ease of access to different areas for maintenance and cleaning (EN 12097);

— Design mistakes : critical points for pressure drop.

NOTE The comparison of ductwork layout with the plans, including dimensions, commenting on any significant differences may also be checked.

Others aspects that can be addressed are:

- Standard of the fixing methods and associated supports;

- Critical points for noise generation;

- Type of ductwork galvanised, fibre, flexible.

4.2.2.2.2 Air handling unit or fan

The following points shall be checked:

— Agreement with the designed specifications and that actually installed;

— Provision and availability of a comprehensive log book for maintenance requirements;

— Ease of access to the unit and the freedom available for adjustment, maintenance and cleaning (access openings EN 12097);

— Presence of flexible connections with the ductwork to reduce rigid ductwork vibration transmission;

— If necessary, anti vibrating supports and a base to reduce vibration transmission;

— Condition of the fan belt if applicable (alignment, tension and wear);

— Quality of the electrical supply connections: conditions of cables, and the standard of the manufacturers instructions;

— Existence and condition of the air filter sections and agreement with the design requirements;

— Existence and condition of heat exchangers and heat recovery sections;

— Existence, condition and control set point of the pre-heating system;

— Existence, condition, and control set point of the humidification system.

4.2.2.2.3 Air inlet / exhaust in rooms

The cleanliness and correct functioning of the air inlets and outlets shall be inspected.

To check correct functioning of air inlets and outlets the followings aspects shall be addressed:

— Number and dimensions of air inlet/exhaust installed considering the air flow rate required, and agreement with the design characteristics;

— Relative positioning of the inlets and outlets to avoid short circuit flows and the resulting poor ventilation efficiency;

— Good conditions of connections between the exhausts/supply devices and the ductwork, (no leackage) and the ease of removing these devices for cleaning;

— For exhaust ventilation: free area for air inlets located at windows, walls, roof or ceiling.

NOTE Other aspects that can be addressed are:

- Noise generation due to air leakage, excessive air velocity, or aerodynamic factors in ductwork;
- Occurrence of draught in the room when the installation is running;
- If demand control systems are installed: correct positioning and if they are in working conditions;
- Status of the air tightness of external doors and windows;
- Air transfer using smoke tubes or pellets in the case of separation requirement between the air of different zones.

4.2.2.2.4 Controls and settings

An important point to consider on energy savings is the agreement between the periods of use of the buildings and the running periods of the ventilation system. An important potential energy saving is possible depending on these issues.

The person in charge of the inspection shall note, where possible, the settings of control that limit the operation of the ventilation systems, and compare these with the periods when the building is in use.

4.2.2.3 Measurements

4.2.2.3.1 Air handling unit

The following points shall be checked by measurements depending on the ventilation system:

Table 1 - Measurements to perform for air handling units

Centralised ventilation	Local ventilation
total air flow rate extracted or supplied	specific air flow rate extracted or supplied
electrical power consumed	electrical power consumed
pressure before and after the unit and the filter	

The input or extract fans air flow rates and fan electrical power consumption shall be measured to estimate the specific fan characteristics.

4.2.2.3.2 Air inlet / exhausts and rooms

Airflow rates at the air exhaust or supply shall be checked by accurate measurement (for self regulating systems this is achieved by a static pressure measurement).

An example of selection of air inlet / exhausts to check is given in Annex C.

4.2.3 Natural ventilation

Natural ventilation occurs through leakage paths (infiltration) and openings (ventilation) in the building and relies on pressure differences created by thermal forces (stack effects), wind forces or a combination of both of the above without the aid of mechanical means.

The pressure differences between inlet and exhausts in this type of system are low when they are mainly due to thermal forces. Consequently measurements of air flow rates might be difficult to achieve properly. For that only a visual inspection is required.

The following points shall be observed:

— Number of air inlets/exhausts installed considering the air flow rate required;

— Correct size of the air inlets and of the free area of the apertures in walls and windows[1];

— Correct size of the air exhausts and dimensioning of the ducts free area[1];

— Ability of air inlet for noise attenuation;

— Discharge height and cross section area of the ducts installed for exhausts in order to ensure the correct air flow rate;

— Dimensioning and cleanliness of cowls;

— Possibility of the removal of the air inlets / exhausts for cleaning;

— Possibility to access inside the ducts for cleaning. Cleaning openings according to EN 12097 recommendations;

— Presence and correct dimensioning of passages to allow air circulation between different rooms.

4.2.4 Hybrid ventilation

Inspection of this type of system shall include the visual points listed in 4.2.2 and 4.2.3 and the measurements listed in 4.2.2.3 when possible, and check the correct functioning of the system (on/off) if possible.

4.3 Report of analysis

A report on the results of checking the performance of a ventilation system shall be drawn up and signed by the person responsible for the inspection. There are two parts of the report:

[1] It is essential to consider the assumptions made for the outside conditions for the system design.

- General part;
- Measurements results (detail report of measurements).

The main part of the report shall include:

- Official designation of the property;
- Name of the buildings owner;
- Date of the performance checks;
- Measurements carried out;
- Comments on faults found;
- Advice to the property owner for improvements;
- Final comment about the systems performance;
- Status of the person responsible for the inspection.

5 Advice for improvements

One of the results of inspection of ventilation systems shall be a list of proposals necessary in order to improve its energy efficiency.

The report of the analysis is to be used as a base for the proposals form.

The advice for improvements form shall contain:

- Section giving the adjustments to be made to ensure that it agrees with the design ie correct levels of thermal comfort, IAQ and energy usage;
- Section giving proposals to improve the results in terms of energy impact, including the economic justification of choices.

Examples for the content of improvements are given in Annex J.

Annex A
(informative)
Example of description form of the installation

Year:		
Area [m²]		
Area ventilated [m²]		
Volume ventilated [m³]		
Use:		
Occupancy:		
Operating hours:		
Total amount of AHU: Total fresh air volume:		

Datasheet AHU (each)

Project: ______________________

____

Project-No.: ______________________

Unit: ______________________

____

Inspection:	
Date:	
Time:	
θ_{amb} [°C] indoor/outdoor	
φ_{amb} [%] indoor/outdoor	

Location: ______________________

Motor- / Fan Data:

Supply	**quantity fans: 1 / 2**		**Exhaust/Return**	**quantity fans: 1 / 2**	
Motor:	Inverter drive	yes , no	Motor:	Inverter drive	yes , no
Make:			Make:		
Type:			Type:		
P:	[kW]	/ /	P:	[kW]	/ /
I	[A]	/ /	I	[A]	/ /
N:	$r.s^{-1}$	/ /	N:	$r.s^{-}$	/ /
Fan:			Fan:		
Make:			Make:		
Type:			Type:		
P Fan:	[kW]		P Fan:	[kW]	
Air volume flow	$l.s^{-1}$ or $m^3.s^{-1}$		Air volume flow	$l.s^{-1}$ or $m^3.s^{-1}$]	
Δp_{tot}:	[Pa]		Δp_{tot}:	[Pa]	
SFP	$kW.m^{-3}.s^{-1}$		SFP	$kW.m^{-3}.s^{-1}$	

	Commissioning summer / winter	Actual summer / winter
q_vl.s^{-1} or m^{3}s^{-1}]		
θ_{supply} [°C]	/	/
φ_{supply} [%]	/	/
Δp_{supply} [Pa]		
θ_{return} [°C]		
φ_{return} [%]		
Δp_{return} [Pa]		

Operating hours:
I
II
III

Design of AHU:

		Capacity design data		Setpoints
Fresh air damper:	yes / no	% min	% max	
Return air damper:	yes / no	% min	% max	
Exhaust air damper:	yes / no	% min	% max	
Filter – fresh air	yes / no	Pa min	Pa max	
Filter – supply air	yes / no	Pa min	Pa max	
Filter – return air	yes / no	Pa min	Pa max	
Fan.Damper:	yes / no	% min	% max	
Heat recovery:	yes / no		kW	
Preheater	yes / no		kW	
Humidifier steam:	yes / no		g/kg	
Humidifier r adiabatic	yes / no		g/kg	
Afterheater	yes / no		kW	

Schematic AHU:

Remarks:

Figure A1 - Description form

Annex B
(informative)
Example of data sheet report

REPORT
VENTILATION INSPECTION

System nr.	B

	Property identifier/Construktion nr	Internal building identifier	Type of system (N, E, ES, ESR)	tax cat(1-5)
B1				

System adherence

B2	Device	Fan type	Inst. year	Placing	Proj. flow	Measured Flow	Serves
1							
2							
3							
4							
5							
6							
7							

B3	1	Plans	Pos	Remarks/faults	Outcome
	1.1	☐ Drawings			
	1.2	☐ Operation/service instruction			
	1.3	☐ Previous inspection report			
	1.4	☐ Proj. values/airflow protocol			
	1.5	☐ Other			
	2	**Contaminations**			
	2.1	☐ outdoor air ducts			
	2.2	☐ Filter part			
	2.3	☐ Batteries			
	2.4	☐ Recuperator			
	2.5	☐ Fan part			
	2.6	☐ Ducts			
	2.7	☐ Diffuser/Grille			
	2.8	☐ Cleansing possibilities			
	2.9	☐ Fan facilities			
	2.10	☐ Other			
	3	**Functions**			
	3.1	☐ Filter part			
	3.2	☐ Batteries			
	3.3	☐ Recuperator			
	3.4	☐ Damper			
	3.5	☐ Control/Regulation/Supervision			
	3.6	☐ Fans			
	3.7	☐ Airflows			
	3.8	☐ Ducts			
	3.9	☐ Diffuser/Grille			
	3.10	☐ Other			
	4	**Climate**			
	4.1	☐ Temperature			
	4.2	☐ Odour			
	4.3	☐ Draft			
	4.4	☐ Sound			
	4.5	☐ User aspects			
	4.6	☐ Other			
	5	**Improvements**			

6	Assignment	Appendices	Quantity	Date of inspection
	☐ New installations	☐ Remarks app.		
	☐ Existing installations	☐ Airflow protocol		
	☐ Reinspection	☐ Drawings		**Signature**
	☐ Extended control	☐ Suggest. changes		
	☐ Control of own system	☐ Extended checklist		

BL B1 utg 91109

Figure B.1 - Data sheet report

Annex C
(informative)
Example of air inlets / outlets selection for measurements of airflow rates

Depending on the type of building and ventilation system, the rooms tested may be detailed as follows:

	Total ventilation (centralised ventilation)	**Specific ventilation**
Residential buildings	Each room of one flat over 10	Each room of one flat over 10
Dwellings	Each room	Each room
Non residential buildings	At least 10 % of the ventilated rooms, for each category of air handling unit type	At least 10 % of the ventilated rooms, for each category of air handling unit type

Annex D
(informative)
Example of time frequency inspection

The inspection frequency is 5 years for all the systems and the components.

Inspection including the buildings changes is recommended every 10 years.

The health aspects might influence the energy performance, of mechanically ventilated supply; therefore inspection should focus on maintenance periods for:

- filters;
- heat exchangers;
- sensors / controls where they are used.

For filters, heat exchangers and sensors/controls, a certification or a technical agreement, should give an advice on the maintenance period.

Annex E
(informative)
Main impacts on energy consumption

E.1 Introduction

Saving on the energy necessary for ventilation requires supplying (or exhausting) from each room, the exact design quantity and temperature difference of air, while avoiding energy loss in the treating and handling of air.

A distinction between local air supply (or exhaust), air distribution and air generation at this stage is necessary.

Local air supply “input or extract”, may in some instances provide the necessary design conditions. In other cases however, a local system may not be capable of providing the actual design conditions

The air distribution patterns produced within the space must ensure good air distribution over the whole of the occupied zone.

For application in existing buildings, it is relevant to make a distinction between the parameters related to design, installation, control, maintenance and any change in building design or use.

E.2 Uncontrolled ventilation due to air leakage

The air infiltration through building (air leakage) increases when outdoor temperature is low (Stack effect) and with high wind speeds (Wind Effect) and a combination of both.

This can lead to high energy penalties with a limited impact on indoor air quality (for non residential building for example, the air flow due to outdoor temperature will increase at night when the building is not occupied). It shall therefore be reduced to a low a figure as possible.

E.3 Windows opening

Two situations may occur depending on the existence or not of dedicated ventilation system:

a) if there is a specific ventilation system, window opening shall be considered as a waste of energy as IAQ is already taken into account

b) if window airing is the only way of ventilation (depending on national regulations) the energy waste depends on occupant behaviour. Windows automation, or for non residential buildings closing windows during unoccupied period, are methods of reducing the energy penalty. This reduction of energy penalty may be against indoor air quality. Windows automation should then be required to allow automatic aperture before and after occupied periods.

In any case during aperture of windows heating and air conditioning should be automatically switched off.

E.4 Local air supply and exhaust

For each room, the aim is to provide either supply or extract, or a combination of both to ensure that the requirements of the health regulations are met. Any excess over this requirement will result in energy waste.

"Wasted" air flow is related to

— Greater airflow than necessary.

— For non residential buildings, airflow maintained during non operational hours (control).

  Allowance must be made for building and furnishing material emission, a minimum ventilation rate shall nevertheless be maintained, or ventilation restarted one or two hours before occupancy commences, and continues operating after staff leave the building for a pre determined time.

  This procedure continues until predetermined level of the pollutants according to national/local standard is achieved.

— Occupancy less than planned (change in building use) will allow a reduction in the required air flow rates (Input or extract), if ventilation effectiveness and humidity conditions allow.

For existing buildings, the main issues are the control and the impact that any change in building use may have.

Further reduction can be achieved by demand control ventilation (DCV).

E.5 Ducting

The energy impact of ductwork is due to air leakage inwards or outwards, thermal gains and losses and pressure drop.

The impact of ductwork air leakages on air flows may be calculated according to EN 15242.

Reduction in air flow occurs with:

— Duct surface area (design).

— Pressure losses or gains between the inside and outside of the duct (design).

— Duct leakage due to (product + degradation + mechanical damage).

— Connection air tightness (product + installation + dilapidation).

For existing buildings, the main points to consider are the connections, and ductwork ageing.

For heat losses / gains (in systems where ductwork passes through cold or hot areas) thermal insulation is required.

The main factor is related to heat losses from preheated air flowing in ductwork located outdoors or in unheated areas of the building.

Heat losses increase with:

— Duct surface area (design).

— Poor duct thermal insulation (design + installation + degradation + wet insulation).

— Difference between the temperature of the air in the duct and external temperature (also consider radiation effects) (design + control).

E.6 Dampers

The energy impact of dampers is due to the pressure drop across them. This may be from a set control position, modulation or full closure to isolate.

A damper almost closed will create a greater pressure drop and thus waste energy.

An incorrectly closed damper (i.e.not functioning correctly) will not allow the correct design ventilation volume to pass it.

Connection airtightness should also be checked as per the attached ductwork.

NOTE Some dampers used for ventilation may not have duct work associated with them.

For existing buildings, the main points to consider are the connections, and damper ageing. Dampers should be clean and assessed for damage and whether they are working/set correctly to ensure that the ventilation system can function correctly.

E.7 Air handling unit/fan

<u>Moving the correct air quantity from the fan to the end grill of the index circuit</u>

The energy required to move the air along a run of ductwork increases with

— Air flow (design).

— Use of fan: mechanical exhaust only, balanced ….(design).

— Low Fan efficiency (product).

— Pressure drop (design + maintenance) (ductwork undersized, poor fitting design incorrect use of dampers etc).

— Duration of use (control).

— Leakage.

For existing building, the main issue is related to the period of use in providing/exhausting air from the rooms with due consideration to the increase of pressure drop due to fouling of filters or ducts.

For variable air volume system, the fan energy use can vary considerably depending on the method of flow control.

<u>Heating the air</u>

— Heat exchanger (design + product + control)

— Preheating (design + control)

— By the use of outdoor air only

— Humidifying (design + control)

Heating and preheating should be suitable to the design criteria and actual needs. If not, preheating for example can occur though the building has no heating demand.

Humidification of the air shall be kept to a minimum as defined in the design documents.

NOTE Some processes or storage requirements may require higher levels of moisture in the air, while very low levels will result in static electricity problems.

Natural precooling shall be controlled to lower the rate of dehumidification.

If possible, the heat exchanger shall be isolated (or bypassed) function of the need of cooling or heating.

Free cooling shall be used whenever the external temperature is favourable.

Annex F
(informative)
Frequency of inspection

The frequency of the ventilation inspection will depend on the system and its susceptibility to drift, fouling and ageing. It might also depend on quality of maintenance.

A simple natural ventilation system is normally very robust in terms of ageing and fouling (large apertures, simple grilles, no moving part) nevertheless; it is very sensitive to any change in the design (some grilles may be tapped for instance, or the window changed) or to improved air tightness.

Conversely, an exhaust and supply with heat recovery system is susceptible to fouling and ageing but less to any change of the building (provided the changes improve the air tightness which is the general case). The system components are not as critical when changed due to the improved thermal comfort they provide.

Mechanical exhaust / supply are usually less sensitive (fouling may be an issue).

With any type of control used (automatic or manual) the risk increases.

Some system may provide self default detection, or issue a diagnostic, a monthly or, annual, report, shall be taken into account in determining the actual frequency.

Table F.1 - Parameters influencing inspection frequency

	natural	Mechanical exhaust	Mechanical supply	Heat recovery	Controls
Building	XX	-	-	X	-
Ageing (moving parts)	-	X	X	-	-
Fouling (grilles)	X	X	X	X	-
Fouling (other)	-	-	X	XX	X
Drift	-	-	-	-	X (XX)
Modification / change	XX	X	-	-	-

Depending on building type and on the method of ventilation the proportion of units to be tested shall be defined as follows:

Table F.2 - Proportion of units to be tested

	Centralised ventilation	Local ventilation
residential multifamily dwellings	Every unit	Every unit of 1 flat over 10
single family dwelling/individual house	Every unit	Every unit
Non residential buildings	Every unit	At least one unit in each category used

Annex G
(informative)
Examples of elements for classes definitions

For example, the criteria that can be used to set the classes definitions are:

- Type of ventilation system : mechanical exhaust/supply, mechanical exhaust and supply, natural, hybrid;
- Nominal air flow rate;
- Date of installation;
- Age of the building.

Annex H
(informative)
Recommendations for the extent of the inspection

H.1 General

The list according to H.2 describes an example of the minimum recommended extent for inspection. The extent may be different for different inspection classes. In the following example of H.2, the recommended extent for three different classes are given (C for low level, B for medium level, A for high level) for a few subsystems. Additional classes and features for the inspection are possible.

H.2 List of items for inspection in each class (C, B, A)

No.	Text	Details	C	B	A
	BUILDING				
B.1	Address	....	x	x	x
B.2	Location	....	x	x	x
B.3	User name	....	x	x	x
B.4	User address	....	x	x	x
B.5	Responsible person	....	x	x	x
B.6	Building / zone type	space O office O hotel O factory O service appliances O	x	x	x
B.7	Date	erection ....changes		x	x
B.8	Relevant changes building	....			
B.9	Usage	residential O non residential O	x	x	x
	Type of usage	....	x	x	x
B.10	Required air change volume	.... m3		x	x
B.11	Required air change rate	.... m3/h	x	x	x
B.12	Required values	indoor air quality		x	x
B.13	External load outdoor air	.. ..kW	x	x	x
B.14	recirculation air	.... kW		x	x
B.15	appliances load	...............kW		x	x
	Optional				

No.	Text	Details	C	B	A
	DOCUMENTATION				
C.1.1	Inspection class determined	O O 1 O 2 O 3 O	x	x	x
C.2.1	State of the building design documentation	No O incomplete O complete O	x	x	x
C.2.2	Missing parts	....		x	x
C.3.1	Ventilation system design documentation	No O incomplete O complete O	x	x	x
C.3.2	Missing parts	....		x	x
C.4.1	Heat load estimated	............kW	x		
C.4.2	calculated	............kW		x	x
C.5	Ventilated building volume	.... m3	x	x	x
C.6	Operation mode	Natural ventilation O Mechanical ventilation O Hybrid ventilation O	x	x	x
C.7.1	Part of hybrid ventilating estimated	.........%	x		
C.7.2	calculated	.........kW		x	x
	Optional				

Mechanical ventilation system **Air supply / exhaust outlets**					
No.	**Text**	**Details**	**C**	**B**	**A**
M.1. 1.1	Documentation	No O incomplete O complete O	x	x	x
M.1. 1.2	missing parts	....		x	x
M.1. 2.1	Number/type supply outlets	....	x	x	x
M.1. 2.2	Number/type exhaust outlets	....	x	x	x
M.1. 3.1	Total air flow calculated	.... $m^3.h^{-1}$	x		
M.1. 3.2	measured	.... $m^3.h^{-1}$		x	x
M.1. 6.1	Control system	No O Yes O type	x	x	x
M.1. 6.2	setting	satisfied O not satisfied O		x	x
M.1. 4	Maintenance state	Regular O on demand O No O	x	x	x
M.1. 5	State of operation	satisfied O not satisfied O	x	x	x
	Optional				

		Supply duct system			
No.	Text	Details	C	B	A
M.2.1.1	Documentation	No O incomplete O complete O	x	x	x
M.2.1.2	missing parts	………………………………………		x	x
M.2.2	Type	Circular O rectangular O	x	x	x
M.2.3.1	Nominal length estimated	………………………………………	x		
M.2.3.2	designed	………………………………………		x	x
M.2.4	Nominal supply air flow	………… $m^3.h^{-1}$		x	x
M.2.5	Material of the duct system	………………………………………	x	x	x
M.2.6.1	Tightness	Visual satisfied O not satisfied O	x	x	x
M.2.6.2	measured	……….. Pa			x
M.2.7	Isolation	Visual satisfied O non satisfied O	x	x	x
M.2.8	Surface temperature	Measured…..oC	o	X	x
M.2.9.1	Temperature drop in /out	………..oC		x	x
M.2.9.2	measured	………..$h.a^{-1}$		x	x
M.2.10	Maintenance frequency	regular O on demand O No O	x	x	x
M.2.11	State of maintenance	satisfied O non satisfied O	x	x	x
	Optional				

		Exhaust duct system			
No.	**Text**	**Details**	**C**	**B**	**A**
M.3. 1.1	Documentation	No O non complete O complete O	x	x	x
M.3. 1.2	missing parts	………………………………………..		x	x
M.3. 2.1	Type	Round O rectangular O	x	x	x
M.3. 3.1	Nominal length estimated	………………………………………..	x		
M.3. 3.2	designed	………………………………………..		x	x
M.3. 4	Nominal exhaust air flow	…………..m3/h		x	x
M.3. 5	Material	………………………………………..	x	x	x
M.3. 6.1	Tightness	Visual satisfied O non satisfied O	x	x	x
M.3. 6.2	measured	……….. Pa			x
M.3. 7	Isolation	Visual satisfied O non satisfied O	x	x	x
M.3. 8	Surface temperature	Measured…..oC		x	x
M.3. 9.1	Temperature drop in /out	………..oC			x
M.3. 9.2	measured	……….. $h.a^{-1}$		x	x
M.3. 10	Maintenance frequency	regular O on demand O No O	x	x	x
M.3. 11	State of maintenance	satisfied O non satisfied O	x	x	x
	Optional				

		Air filter			
No.	**Text**	**Details**	**C**	**B**	**A**
M.4. 1.1	Documentation	Yes O No O necessary O	x	x	x
M.4. 1.2	missing parts	………………………………………......		x	x
M.4. 2	Type / specification	…………………………class ……….	x	x	x
M.4. 3	Outlet temperatures	………..oC		x	x
M.4. 4	Labelling	Yes O No O necessary O	x	x	x
M.4. 5	Maintenance frequency	regular O on demand O No O	x	x	x
M.4. 6	Maintenance state	regular O on demand O No O	x	x	x
M.4. 7	State of operation	satisfied O not satisfied O	x	x	x
	Optional				

		Air handling unit			
No.	Text	Details	C	B	A
M.5. 1.1	Documentation	No O incomplete O complete O	x	x	x
M.5. 1.2	missing parts	…………………………………………		x	x
M.5. 2	Type/ Specification	…………………………………………	x	x	x
M.5. 3	Application	Supply O Exhaust O Heating O Recirculation O Heat recovery O			
M.5. 4	Total air flow	…………m3.h^{-1}		x	x
M.5. 6.1	Running time estimated	………… h.a^{-1}	x		
M.5. 6.2	measured	………… h.a^{-1}		x	X
M.5. 7.1	Fan power calculated	……….. .kW	x		
M.5. 7.2	measured	…………kW		X	x
M.5. 8	Specific fan power	……….. .kWh.m^{-3}	x	x	x
M.5. 9	Isolation	Visual satisfied O not satisfied O	x	x	x
M.5. 10.1	Control system	No O Yes O type ………………	x	x	x
M.5. 10.2	setting	satisfied O not satisfied O		x	x
M.5. 11	Maintenance state	regular O on demand O No O	x	x	x
M.5. 12	State of operation	satisfied O not satisfied O	x	x	x
	Optional				

		Heat supply part			
No.	**Text**	**Details**	**C**	**B**	**A**
M.6. 1.1	Documentation	No O incomplete O complete O	x	x	x
M.6. 1.2	missing parts	………………………………………………		x	x
M.6. 2	Type of heating	Electric O Waterbased O	x	x	x
M.6. 3.1	Water flow calculated	……….. m3.h-1	x		
M.6. 3.2.	measured	……….. m3.h-1		x	x
M.6. 4.1	Pressure drop calculated	……….. Pa	x		
M.6. 4.2	measured	……….. Pa		x	x
M.6. 5	Operating temperature	supply ……… oC return ……… oC		x	x
M.6. 6	Heat exchanger capacity	…………kW	x	x	x
M.6, 7	Labelling	Yes O No O necessary O	x	x	x
M.6. 8	Isolation	visual satisfied O not satisfied O	x	x	x
M.6. 9.1	Circulating pump type	………………………………		x	x
M.6. 9.2	total nominal power	………….kW		x	x
M.6. 10	Auxiliary power rating			x	X
M.6. 11	measuring appliances	Available No O Yes O	x	x	x
M.6. 12	counting appliances	Available No O Yes O	x	x	x
M.6. 13	Running mode	modulating O on demand O	x	x	x
M.6. 14	Control system	No O Yes O type ………………	x	x	x
M.6. 15	setting	satisfied O not satisfied O		x	x
M.6. 16	Maintenance state	regular O on demand O No O	x	x	x
M.6. 17	State of operation	satisfied O not satisfied O	x	x	x
.	Optional				

		Heat recovery part			
No.	Text	Details	C	B	A
M.7. 1.1	Documentation	No O incomplete O complete O	x	x	x
M.7. 1.2	missing parts	....		x	x
M.7. 2	Type of recovery system		x	x	x
M.7. 3.1	Heat recovery capacity designed	...........kW	x		
M.7. 3.2.	measured	.... kW		x	x
M.7. 4	Operating temperature	supply .... oC return .... oC			x
M.7. 5	Labelling	Yes O No O necessary O	x	x	x
M.7. 6	Isolation	visual satisfied O not satisfied O	x	x	x
M.7. 7	Auxiliary power rating				
M.7. 8	measuring appliances	Available No O Yes O	x	x	x
M.7. 9	counting appliances	Available No O Yes O	x	x	x
M.7. 10	Operation mode	modulating O on demand O	x	x	x
M.7. 11.1	Control system	No O Yes O type	x	x	x
M.7. 11.2	setting	satisfied O not satisfied O		x	x
M.7. 12	Heat recovery rating			x	x
M.7. 13	measuring appliances	Available No O Yes O		x	x
M.7. 14	counting appliances	Available No O Yes O		x	x
M.7. 15	Maintenance state	regular O on demand O No O	x	x	x
M.7. 16	State of operation	satisfied O not satisfied O	x	x	x
	Optional				

	Natural ventilation system				
No.	**Text**	**Details**	**C**	**B**	**A**
N.1.1.	Documentation	No O incomplete O complete O	x	x	x
N.1.2.	missing parts	…………………………………………		x	x
N.2	Type of the system	…………………………………………	x	x	x
N.3	Operation mode		x	x	X
E.7.8.1	Control system	No O Yes O type ………………	x	x	X
E.7.8.2	setting	satisfied O not satisfied O		x	x
E.7.9	Maintenance state	regular O on demand O No O	x	x	x
E.7.10	State of operation	satisfied O not satisfied O	x	x	x
	Optional				

	Hybrid ventilation system				
No.	**Text**	**Details**	**C**	**B**	**A**
H.1.1.	Documentation	No O incomplete O complete O	x	x	x
H.1.2.	missing parts	…………………………………………		x	x
H.2	Type of the system	…………………………………………	x	x	x
H.3	Operation mode	…………………………………………	x	x	x
H.7.8.1	Control system	No O Yes O type ………………	x	x	x
H.7.8.2	setting	satisfied O not satisfied O		x	x
H.7.9	Maintenance state	regular O on demand O No O	x	x	x
H.7.10	State of operation	satisfied O not satisfied O	x	x	x
	Optional				

	ES-SYSTEM	Electric supply system			
No.	Text	Details	C	B	A
S.1.1.1	Documentation	No O incomplete O complete O	x	x	x
S.1.1.2	missing parts	....		x	x
S.1.2	Voltage		x	x	x
S.1.3	Starting power requirement	Available O necessary O	x	x	x
S.1.4	Measuring appliance	Available No O Yes O	x	x	x
S.1.5	Counting appliances available	Available No O Yes O	x	x	x
	Optional				

Annex I
(informative)
Description chart of the improvement process

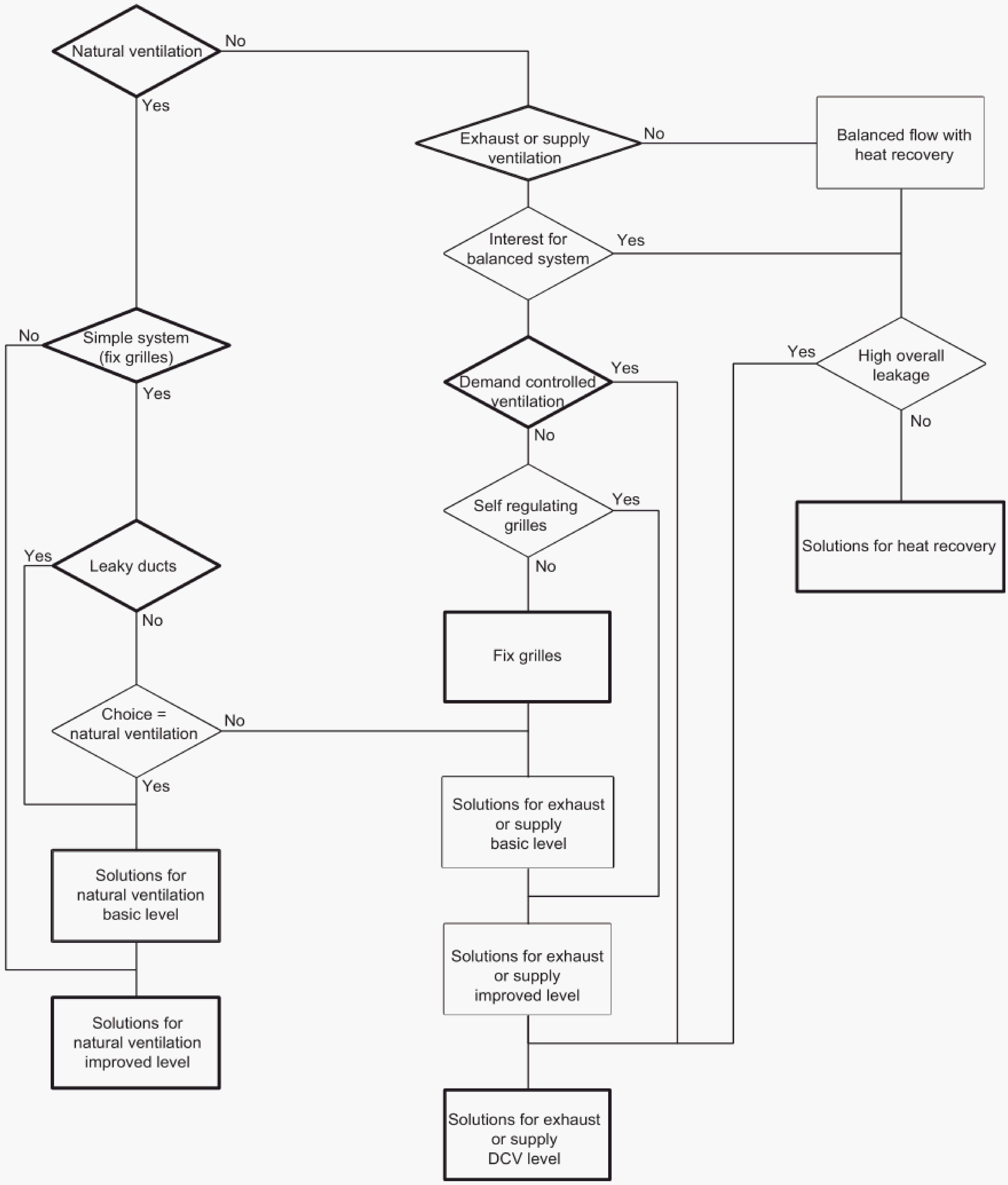

Figure I1 - Chart of the improvement process

Annex J
(informative)
Examples for advice on improvements

J.1 Basic improvements

J.1.1 General

The report of the analysis provides sorted and rated information regarding the flow rates and the energy impact of the installed solution.

The improvements must follow the required ideals and provide solutions to ensure the correct values of flow and energy are achieved.

Annex D gives guidelines for an improvement process presenting the advices in an organization shape.

J.1.2 Natural ventilation

For the heating season, the main impact derives from the size of the installed devices: transfer grilles (external and internal), exhaust grilles, ducts and cowls.

As the design of such a ventilation system relies on assumptions for outside conditions, it may be necessary to include these assumptions in the report as well as forecasted levels, if the last design is not available.

The recommended changes in this situation will mainly be on the actual free size of the components (which may have been blocked, taped, or added afterwards).

Some of them may require to be cleaned, repaired or changed.

Special attention must be paid to air inlets if the windows have been modified since the original installation.

As an open fire contributes to natural ventilation, the size of the chimney throat at the flap and its mechanism (manual or automatic closing/opening) is to be checked and declared to be repaired if necessary.

Some natural ventilation systems may be controlled (pressure, reverse flow, temperature, humidity, ...), in addition to the previous recommendations the controlling devices may have to be changed or recalibrated to achieve the designed range.

If special dispositions have been applied for the cooling season (night cooling, free cooling, ... through large apertures) the same procedure shall apply: size, control, actuators, and possible leakage that may influence the heating demand.

J.1.3 Mechanical exhaust or supply

Consider the location and suitability of accessories (such as covers cleaning hatches etc.)

Examine for excessive duct leakage which must be made good before any other action is taken this is essential for energy conservation.

The electrical energy consumption of the fan is critical.

If the fan has been changed since its first installation, the consumption has to be the same as that indicated in the design and/or be in line with the maximum desired value of Specific fan Power (in W.h m^{-3}), if not it shall be corrected to the design value.

For some fan types fouling will result in a dramatic loss in performances, regular blade cleaning may be necessary.

For adjustable exhaust air terminal device it may be that the setting has been changed by the occupants, either after a cleaning or on purpose (as a reaction against noise, condensation…).

The impact may be critical for efficient system functioning as well as the energy usage. A complete resetting / rebalancing of the installation may be necessary as well as the fan pressure which is an important factor.

For self regulating valves, the main issue is to check the mechanical parts that may have been removed and not replaced. Blockages, quality of cleaning, and pressure levels are important issues, as is the fan energy consumption.

For Demand Controlled Ventilation, (DCV) the operation of the sensors and actuators are critical and the valves shall be calibrated or changed if their setting varies widely from the design values.

The impact of a demand controlled ventilation may range from 20 % to 50 % of the average flow, the reliability of the sensors is critical for effective control.

NOTE Inspection is difficult in case of automatic calibration of CO_2 DCV sensors.

The same applies for any time control (i.e. in offices if the ventilation is supposed to be “off” at night): the impact on energy may be large and default must be repaired.

Some valves are designed with two flow rates ,one “basic” and one “booster” manually adjusted and shall be changed if they are blocked in a fixed position (either because they are mechanically blocked or because the command is inactive or the actuator is not working correctly...).

If valves are fitted with filters, these have to be cleaned or changed, (or reinstalled if they are missing) before resetting or making changes to the valves.

Special attention must be made to the air inlets if the windows have been changed since the original installation. Further more, in case of air inlet; special care shall be made to transfer grilles and opening between rooms.

For housing: if an open fire exists, the throat opening size of the flap inside the chimney and its operating mechanism (manual or automatic closing/opening) is to be checked and repaired if necessary.

J.1.4 Mechanical supply and exhaust, heat recovery

Check for the lack of accessories such as hoods cleaning hatches etc.. Excessive air leakage from the ductwork must be made good, before any other action is taken, as air wastage is critical as regards to energy use.

Duct work thermal insulation must meet the designed value, to reduce energy wastage.

The fans electricity consumption is an important factor. If the fans have been changed since its first installation, the consumption has to either meet or be less than the last design demand of Specific fan Power (in W.h.m^{-3}).

For some fan types, fouling results in performances loss, regular blade cleaning may be necessary.

In a balanced system, the result of fouling is magnified as it decreases the efficiency of the heat recovery unit.

For adjustable valves or air terminal device the design settings may have been altered by the occupants, or maintenance staff, either after cleaning or deliberately (as a reaction against draughts, noise, condensation).

The effects of this may influence the correct system functioning as well as resulting in excessive energy usage.

A complete resetting/rebalancing of the installation or part of the installation may be necessary with possible corrections to the fan pressure level as a result of any changes in system setting/balance.

For self regulating valves, the main issue is to determine if any of the mechanical parts have been removed, blocked or require cleaning, as pressure changes greatly influence the fan energy consumption.

A demand control system is seldom used with a heat recovery system, usually only some form of time control. Any defect may result in excessive energy usage and must be repaired as soon as possible.

Some valves are designed for two flows (one “basic” and one “booster” manually adjusted) and must be changed if they are locked in a fixed position (due to mechanical locking or a faulty control command or actuator, ...).

If valves are fitted with filters, these require cleaning or changing, (or reinstalled if missing) before the resetting or changing of the valves. This is particularly important in the case of a balanced system.

For housing, if an open fire exists, the chimney throat size at the level of the flap and its mechanism (manual or automatic closing/opening) is to be checked and repaired if necessary.

In addition, the heat recovery unit must be cleaned or changed, as soon as the flow rates vary considerably from the design values.

J.2 Further improvements

J.2.1 Natural and hybrid ventilation

To improve the thermal efficiency (as well as the IAQ) of a natural ventilation system the main factor is the inlet and outlet grille sizes.

Reduce the exhaust grille size for adjusting the low level ventilation and add mechanical assistance (either within the system or as an extra system) for a boost if necessary.

To optimise energy usage, the fan motor, bearings and fan blades must be a low energy consumption type.

Attention is required to the matching of the whole system in the two operational modes. Consider the fan curves and system curves and the point of intersection.

Change the exhaust grilles (and air inlets, depending on the system) for pressure controlled devices, critical if the device is designed to operate in the range of natural pressures (i.e. a few Pascal).

Change the exhaust grilles and air inlets, depending on the system, for demand controlled ventilation, especially designed for natural pressures (i.e. a few Pascal).

NOTE 1 The installation of such systems may be subjected to local regulations.

Change the exhaust grilles (and air inlets, depending on the system) and the use of a lower pressure fan.

Further more, in case of air inlet, special care shall be made to transfer grilles and opening between rooms.

To optimise energy, the fan must be a low energy model.

The fan can be rotated by the temperature difference between indoors and outdoors, the wind speed and a combination of the two. The pressure is regulated (either increasing or decreasing the pressure in the ducts) and/or connected to a demand controlled ventilation system.

NOTE 2 Avoid the use of a non regulated fan with fixed grilles, this may increase the energy cost.

The installation of such a system may be subjected to local regulations.

Improvement in the levels of ductwork thermal insulation may be desirable to reduce thermal duct losses or gains. This will ensure the correct air temperatures at the grilles improving thermal comfort.

However, any changes will require the air flow rates into the room to be altered for the same thermal comfort conditions.

The replacement of a natural ventilation system by a “high pressure” mechanical system is possible, but must be carefully checked (do not re-use existing ducts without checking the leakage level as the flow may be greater than that initially).

NOTE 3 A mechanical ventilation system provides constant air flow patterns and air flow rates regardless of the external weather conditions. A natural ventilation system is not capable of overcoming the required pressure drops in filters and as such the quality of filtration achieved is inferior.

Low energy consumption fans and/or demand controlled ventilation are preferred.

Naturally ventilated spaces could be included in old building; hence, it is recommended to take care of air tightness before changing a natural ventilation for a balanced system.

J.2.2 Mechanical exhaust or supply

Change the fan(s) to low energy consumption or use variable speed motors.

In some instances a single larger fan is more efficient than several smaller fans; it may be an opportunity to make changes if other installation constraints can be overcome at an economic cost.

In some applications, a control can be used to full advantage, to reduce or isolate night time ventilation (offices, meeting rooms).

For mechanical supply change high pressure drop filters for low pressure drop filters, if the air cleaning standard can be met, and use a different fan range (the lower the pressure, the lower the energy usage for the same air flow rate).

Replace fixed devices by demand ventilation controlled devices:

a) For non residential applications:

The use of occupant detectors shall be encouraged, as these provide a cheap solution for ventilation control (either connected to fan or terminal).

In this case, consideration of the detector efficiency is critical associated to ventilation (zone, timer…): certified products must be used if available.

This type of detector switches from a low to a higher level of ventilation, and not only from an OFF to ON position as residual pollution must be handled (IAQ) (Typical applications offices, meeting rooms, toilets…).

Control by CO_2, concentration related to the number of persons in a space, may provide greater energy savings in some situations in offices, meeting rooms, etc,

With occupational detector control, the installed system must be checked to determine if it meets the specification requirements

b) For residential application

Occupant detection and/or humidity-controlled ventilation are more frequently used systems.

Other systems recording CO_2 concentrations are also used.

The installation of such systems may be subjected to local regulations.

Used with low energy consumption fan and/or a flow adaptive fan, demand ventilation controlled systems will bring considerable energy savings.

NOTE 1 If the ductwork has a high percentage of air leakage, the impact of DCV will be reduced and to save energy it will be necessary to reduce this air loss.

If it is economically viable to improve the ductwork or to replace it the use of larger ductwork will decrease the fan pressure, and reduce the energy requirements.

NOTE 2 This will also alter the fan characteristics.

The size must be calculated, as reduced air velocity in ductwork will increase the condensation risk (especially if the ductwork passes through non heated zones).

A balanced system with heat recovery may replace a previous system; the economic value of this replacement and other factors such as outside noise, outside pollution (mainly particulates) will determine the necessary approach.

NOTE 3 A balanced system requires a building with low air leakage.

J.2.3 Mechanical supply and exhaust, heat recovery

In general, it is recommended to retain a balanced system if installed, an exception being if the overall air leakage is high and it is expensive and difficult to repair.

Ensure the duct runs are as short and as straight as possible and all section changes are aerodynamically designed.

Install the ducts in heated zones if possible.

Improve the ductwork thermal insulation if the ductwork is not located inside the heated or cooled zones.

Use larger ductwork to decrease the fan operating pressure and reduce air flow energy usage.

Calculations are necessary as reduced air velocity may increase the condensation risk.

Change the heat exchanger for a more efficient one, either static or thermodynamic.

Change the fans for a more efficient type.

Change the filters for lower pressure drop units if possible without influencing the required cleaning and filtering efficiency.

If preheating is installed, consider if it can be changed for more efficient system by the use of solar heat recovery or heat pump systems.

In the case of an individual house, it may be simpler to change the whole unit and retain the ductwork, provided they are correctly installed.

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