

Ventilation for non-residential buildings — Performance requirements for ventilation and room-conditioning systems

ICS 91.140.30

National foreword

This British Standard is the UK implementation of EN 13779:2007. It supersedes BS EN 13779:2004 which is withdrawn.

With respect to the Energy Performance of Buildings Directive (EPBD) requirements, attention is drawn to the text of the fifth paragraph of the EN foreword. This recognizes at the present time that, if there is a conflict, existing national regulations take precedence over any requirements set out in this standard.

The UK participation in its preparation was entrusted to Technical Committee RHE/2, Ventilation for buildings, heating and hot water services.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Ventilation dans les bâtiments non résidentiels - Exigences de performances pour les systèmes de ventilation et de climatisation

Lüftung von Nichtwohngebäuden - Allgemeine Grundlagen und Anforderungen für Lüftungs- und Klimaanlage

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Foreword

This document (EN 13779:2007) 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of an identical text or by endorsement, at the latest by October 2007, and conflicting national standards shall be withdrawn at the latest by October 2007.

This document supersedes EN 13779:2004.

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

This standard provides guidance especially for designers, building owners and users, on ventilation, air-conditioning and room-conditioning systems in order to achieve a comfortable and healthy indoor environment in all seasons with acceptable installation and running costs. The standard focuses on the system-aspects for typical applications and covers the following:

- Aspects important to achieve and maintain a good energy performance in the systems without any negative impact on the quality of the internal environment.
- Relevant parameters of the indoor environment.
- Definitions of data design assumptions and performances.

Relationships between this standard and related standards are the following:

building type → purpose ↓	residential	non-residential
calculation /ventilation rates	EN 15242	
calculation/ ventilation energy	EN 15241	
design; system performance	CEN/TR 14788 ^a	EN 13779rev
criteria for the indoor environment	EN 15251	
^a A new Work Item (WI 00156105) has been established to revise and upgrade into a European Standard.		

Natural ventilation systems are not covered by this standard.

1 Scope

This European Standard applies to the design and implementation of ventilation and room conditioning systems for non-residential buildings subject to human occupancy, excluding applications like industrial processes. It focuses on the definitions of the various parameters that are relevant for such systems.

The guidance for design given in this standard and its annexes are mainly applicable to mechanical supply and exhaust ventilation systems, and the mechanical part of hybrid ventilation systems.

Applications for residential ventilation are not dealt with in this standard. Performance of ventilation systems in residential buildings are dealt with in CEN/TR 14788.

The classification uses different categories. For some values, examples are given and, for requirements, typical ranges with default values are presented. The default values given in this standard are not normative as such, and should be used where no other values are specified. Classification should always be appropriate to the type of building and its intended use, and the basis of the classification should be explained if the examples given in the standard are not to be used.

NOTE Different standards may express the categories for the same parameters in a different way, and also the category symbols may be different.

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

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

EN 12599:2000, *Ventilation for buildings — Test procedures and measuring methods for handing over installed ventilation and air conditioning systems*

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

EN 13053:2006, *Ventilation for buildings — Air handling units — Rating and performance for units, components and sections*

prEN 15232, *Energy performance of buildings — Impact of Building Automation, Controls and Building Management*

EN 15239, *Ventilation for buildings — Energy performance of buildings — Guidelines for inspection of ventilation systems*

EN 15240, *Ventilation for buildings — Energy performance of buildings — Guidelines for inspection of air-conditioning systems*

EN 15241, *Ventilation for buildings — Calculation methods for energy losses due to ventilation and infiltration in commercial buildings*

EN 15242, *Ventilation for buildings — Calculation methods for the determination of air flow rates in buildings including infiltration*

EN 15251:2007, *Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics*

EN ISO 7730, *Ergonomics of the thermal environment — Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria (ISO 7730:2005)*

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

room conditioning system

system able to keep comfort conditions in a room within a defined range

NOTE Air conditioning systems as well as surface based systems are included

3.2

types of air

types of air are defined in 6.1

3.3

occupied zone

usually the term “occupied zone” is used only for areas designed for human occupancy and is defined as a volume of air that is confined by specified horizontal and vertical planes

NOTE 1 The vertical planes are usually parallel with the walls of the room. Usually there is also a limit placed on the height of the occupied zone. Thus, the occupied zone in a room is that space in which the occupants are normally located and where the requirements for the indoor environment shall be satisfied. Definitions are given in 7.2.

NOTE 2 definition of the occupied zone is dependent on the geometry and the use of the room and should be specified case by case

3.4

ventilation effectiveness

relation between the pollution concentrations in the supply air, the extract air and the indoor air in the breathing zone (within the occupied zone). It is defined as

$$\varepsilon_v = \frac{c_{\text{ETA}} - c_{\text{SUP}}}{c_{\text{IDA}} - c_{\text{SUP}}} \quad (1)$$

where: ε_v is the ventilation effectiveness

c_{ETA} is the pollution concentration in the extract air in mg.m^{-3}

c_{IDA} is the pollution concentration in the indoor air (breathing zone within the occupied zone) in mg.m^{-3}

c_{SUP} is the pollution concentration in the supply air in mg.m^{-3}

NOTE 1 The ventilation effectiveness depends on the air distribution and the kind and location of the air pollution sources in the space. It may therefore have different values for different pollutants. If there is complete mixing of air and pollutants, the ventilation effectiveness is one.

NOTE 2 Further information on ventilation effectiveness is given in Annex E and CR 1752.

NOTE 3 Another term frequently used for the same concept is “contaminant removal effectiveness”.

3.5

specific fan power

for the building or the whole system (SFP) is the combined amount of electric power consumed by all the fans in the air distribution system divided by the total airflow rate through the building under design load conditions, in $\text{W.m}^{-3}.\text{s}$. Specific power of each fan is defined as

$$P_{\text{SFP}} = \frac{P}{q_v} = \frac{\Delta p}{\eta_{\text{tot}}} \quad (2)$$

where: P_{SFP} is the specific fan power in $\text{W.m}^{-3}.\text{s}$

P is the input power of the motor for the fan in W

q_v is the design airflow through the fan in $\text{m}^3.\text{s}^{-1}$

Δp is the total pressure difference across the fan in Pa

η_{tot} is the overall efficiency of the fan

NOTE 1 The coefficient is valid for the design airflow with clean filter conditions, all components dry and any bypasses closed. It is related to an air density of $1,2 \text{ kg.m}^{-3}$. It should be taken into account that the design performance is not usually the rated maximum performance of the ventilation components, but typically between 40 and 60 % of the maximum performance.

NOTE 2 Further guidance for the applications, calculation and validation of the specific fan power is presented in Annex D.

3.6

demand controlled ventilation

ventilation system where the ventilation rate is controlled by air quality, moisture, occupancy or some other indicator for the need of ventilation

3.7

ventilation system

combination of appliances designed to supply interior spaces with outdoor air and to extract polluted indoor air

NOTE The system can consist of mechanical components (e.g. combination of air handling unit, ducts and terminal units). Ventilation system can also refer to natural ventilation systems making use of temperature differences and wind with facade grills in combination with mechanical exhaust (e.g. in corridors, toilets etc.). Both mechanical and natural ventilation can be combined with operable windows. A combination of mechanical and non-mechanical components is possible (hybrid systems).

4 Symbols and units

For the purposes of this document, the symbols and units given in Table 1 apply. The units in brackets are also in use.

Table 1 — Symbols and units

Quantity	Symbol	Unit
Pressure difference	Δp	Pa
Temperature difference	$\Delta \theta$ *)	K
Ventilation effectiveness	ϵ_v	-
Temperature	θ (theta)	K (°C)
Air temperature in the room	θ_a (theta)	K (°C)
Mean radiant temperature	θ_r (theta)	K (°C)
Operative temperature	θ_o (theta)	K (°C)
Density	ρ (rho)	kg.m ⁻³
Heat or cooling load	Φ (phi)	W (kW)
Area	A	m ²
Costs	C	€ ^a
Concentration	c	mg.m ⁻³
Specific heat capacity at constant pressure	c_p	J.kg ⁻¹ .K ⁻¹
Diameter	d	m
Energy consumption (measured)	E	J (MJ, GJ)
Energy demand (calculated)	E	J (MJ, GJ)
Specific leakage	f	l.s ⁻¹ .m ⁻²
Present value factor	f_{pv}	-
Height	h	m
Initial Investment	I	€ ^b
Thermal insulation of clothing	I_{cl}	clo
Length	L	m
Metabolic rate (activity)	M	met
Life span	n	years
n_{L50} -value	n_{L50}	h ⁻¹
Fan power	P	W
Specific fan power	P_{SFP}	W.m ⁻³ .s
Present value	PV	€ ^a

Table 1 — Symbols and units (*continued*)

Pressure	p	Pa
Mass flow rate	q_m	kg.s^{-1}
Volume flow rate	q_v	$\text{m}^3.\text{s}^{-1}$ (l.s^{-1} , $\text{m}^3.\text{h}^{-1}$)
Interest rate	r	-
Time	t	s (h)
Volume	V	m^3
Air velocity	v	m.s^{-1}
^a Or National currency		
^b EN 12792 prefers Θ but t and T may be used as well.		

5 Agreement of design criteria

5.1 General

The design criteria specify the information needed to design the system. These criteria also constitute the basis for the measurements that will be carried out during the hand-over process. They provide the common language between all the parties including the client, designer, contractor and the operation and maintenance personnel.

Information necessary to design the system is organised on the basis of various documents outlined in 5.2 to 5.10. If the method used for dimensioning the system requires more details, they shall be provided.

Calculation procedure for the energy requirements of the ventilation system is presented in EN 15241.

5.2 Principles

Although in this standard the terms “client”, “designer” or “contractor” are used to describe the function, the responsibilities are dependent on the contract. Their use does not presuppose any definition of responsibility for the information. Nevertheless, if one party does not provide the information, the other shall ask for it or make and record the necessary assumptions. All key design decisions shall be agreed and documented.

The description of the characteristics of the environment and the structure of the building shall be obtained for design. The desired results required at the time of hand-over and during normal operation shall be specified and documented.

The description of the building with construction data, use and requirements is an evolving process with an increasing degree of detail and accuracy with the evolution of the project. Therefore the use of all specifications shall always be stated clearly. The details about the information needed are also dependent on the calculation method that is employed. The introduction of a system of abbreviations for constructions, room use and requirements to be used throughout the design phase is recommended.

5.3 General building characteristics

5.3.1 Location, outdoor conditions, neighbourhood

Information about the location of the relevant building, the significant neighbourhood characteristics such as adjacent buildings, shading, reflections, emissions, roads, airfields, sea coast, special requirements and all other information that will influence the building design shall be specified in design. The reference for noise and wind exposure of facades should be given, if available. The category of outdoor air shall be defined in accordance with Table 4.

5.3.2 Climatic data outdoors

Information shall be given on climatic environment; as a minimum, design conditions for winter and summer are required. The most important climatic parameters for the design are:

- Winter: outdoor temperature and wind speed;
- Summer: outdoor temperature, humidity and solar radiation.

The reference year taken in order to estimate annual energy consumption shall be defined. Additional information about the occurrence of extreme situations is useful in some cases, especially to check the comfort situation. prEN 15243 provides more information about application.

5.3.3 Information on the operation of the building

The occupancy profile during typical days, annual periods of non-occupancy (e.g. schools etc.), and on general operational use (e.g. weekend, night etc.) shall be specified.

5.4 Construction data

All building parts shall be specified in a list with their relevant construction data.

5.5 Geometrical description

The geometrical description including information about the orientation of the elements exposed to the outdoors shall be presented, and this can be done in the form of drawings and/or tables. The specification of the net volume and floor area, room by room, is recommended.

5.6 Use of the rooms

5.6.1 General

The information about the use of each room, or group of rooms with similar use shall be given, preferably in a table. The necessary information according to A.1 of EN 12599:2000 shall also be included.

5.6.2 Human occupancy

The design condition in respect of the number of people that can be in the room for a longer period (see Table 12) shall be specified. This number constitutes a basic condition of use because the ventilation rate shall be designed for this level of occupancy. In addition the activity and clothing has to be defined.

The occupancy level shall be given as schedule, for example by specifying hourly values on typical days.

5.6.3 Other internal heat gains

Internal heat gains (persons, lighting and equipment) shall be specified for the various rooms or group of rooms. The gains shall be defined as follows:

- sensible gains, convective or radiative
- latent gains.

They shall be defined as schedules similar to occupation.

NOTE A.17 gives further information on internal loads.

5.6.4 Other internal pollution and moisture sources

Special pollution or moisture production in a room shall be defined when relevant, with reference to the limits on these pollutants that may be encountered inside the room. Each pollutant shall be defined by its schedule of production and by the limit value to be admitted.

5.6.5 Given extract airflow

In some applications the extract airflow is given by the kind of process or equipment. In this case the extract airflow shall be defined.

5.7 Requirements in the rooms

5.7.1 General

The requirements (desired results according to 7.3 to 7.6) and internal loads (A.17) shall be specified room by room. The requirements with respect to thermal conditions and draught shall be satisfied in the occupied zone, specified in accordance with 7.2.

5.7.2 Type of control

The type of control of the indoor environment shall be specified according to the definitions given in Table 7, and it shall be adapted to the use of the room.

5.7.3 Thermal and moisture conditions

The thermal conditions in the room shall be specified in accordance with 7.3, the moisture conditions in accordance with 7.5 and EN 15251.

5.7.4 Air quality for people

The level of air quality required, and the method of classification applied shall be specified. Whether smoking is allowed or not is an important input. The necessary air flow rates to achieve the specified requirements shall be calculated. If nothing is declared, the rates of outdoor air per person for Indoor Air Quality category IDA 2 can be used as a default.

5.7.5 Air velocities

The air velocity in the occupied zone shall not exceed the agreed limits.

5.7.6 Noise level

With no regulations or specific requirements the reference values in A.16 are valid as maximum allowable sound pressure level from the system in the room.

5.7.7 Lighting

The lighting shall be designed for the actual requirements in the rooms. The installed electrical power for the lighting should not be too high for reasons of energy conservation, as the energy is not only required for lighting but also for cooling in summertime. Typical values for lighting levels and lighting power requirements are given in A.17.3.

5.8 System requirements

The relevant system requirements shall be specified. The system requirements shall also conform to existing national regulations and guidelines, including those for structural fire safety and the regulations related to acoustics.

The system requirements typically include:

- location of air intake and discharge openings, see 6.2.3
- air filtering
- heat recovery
- re-use of extract air
- thermal insulation of the system
- airtightness of the system
- pressure conditions within the system and the building, taking into account the building and system airtightness
- power consumption
- space requirements for components and systems
- aspects to installation, operation and maintenance

NOTE Annex A gives further information and default values.

5.9 General requirements for control and monitoring

The method for the control and monitoring of all the systems shall be specified. In some applications it makes sense to distinguish between the first year(s) of operation and the time after.

The monitoring of the energy consumption shall allow a periodic check of the energy consumption of important individual systems and of the whole building. Therefore a measuring concept shall be identified at an early stage of the project and the necessary measuring devices installed. Changes of uses and requirements should be followed by adaptations of the system.

5.10 General requirements for maintenance and safety of operation

The system shall be designed to allow efficient service and maintenance to ensure effective operation.

NOTE 1 Further guidance is given in A.14.

The system shall be so designed that, with proper operation and maintenance, it will remain in operating condition for a reasonable period of time. The system shall be designed so as to facilitate cleaning, maintenance and service operation (see EN 12097). The equipment shall be furnished with appropriate protection and safety devices for maintenance and repair work, and for emergency stopping.

NOTE 2 National authorities may give more detailed requirements or instructions for safety in operation and maintenance.

5.11 Process from project initiation to operation

The process from the initiation of the project to the normal operation is generally characterised by the following steps. Nevertheless the definitive organisation is always in accordance with the specific contract.

NOTE 1 More details are given in Annex C in the form of checklists.

- a) Project initiation.
- b) Definition of design conditions and requirements.
- c) Check with authorities, relevant regulations.
- d) Design.
- e) Installation.
- f) Check of the installation.
- g) Start of operation, check of functions, balancing, testing with written records.
- h) Declaration of finished installation, addressed to the client.
- i) Common completeness check, functional tests, functional measurements and special measurements according to EN 12599.
- j) Hand over the system including the delivery of all relevant documents with instructions how to operate and maintain the system, to the client.
- k) Operation and maintenance.
- l) Regular inspections (see EN 15240 and EN 15239).
- m) Monitoring the energy consumption by bookkeeping or another way of recording.

NOTE 2 Every ventilation, air-conditioning or room-conditioning system requires an adequate operation and maintenance procedure in order to satisfy the guaranteed conditions in the room, to ensure energy-efficient operation in all situations, to avoid emissions from the ventilation system to the room, to provide generally a good air quality in the rooms and to protect the system from damage and premature failure. It is recommended to prepare a duty-booklet for operation, service and maintenance, to contain a description of the control, service and maintenance measures including the time intervals and responsibilities (see also EN 15240 and EN 15239).

6 Classification

6.1 Specification of types of air

The types of air in a building and in a ventilation or air-conditioning system are specified in Table 2 and illustrated in Figure 1. The abbreviations and colours given in Table 2 shall be used to mark the type of air in drawings of ventilation or air-conditioning systems. The abbreviations can also be helpful for the labelling of system parts.

Table 2 — Specification of types of air

No. (in Figure 1)	Type of air	Abbreviation	Colour	Definition
1	Outdoor air	ODA	Green	Air entering the system or opening from outdoors before any air treatment
2	Supply air	SUP	Blue	Airflow entering the treated room, or air entering the system after any treatment
3	Indoor air	IDA	Grey	Air in the treated room or zone
4	Transferred air	TRA	Grey	Indoor air which passes from the treated room to another treated room
5	Extract air	ETA	Yellow	The airflow leaving the treated room
6	Recirculation air	RCA	Orange	Extract air that is returned to the air treatment system and reused as supply air
7	Exhaust air	EHA	Brown	Airflow discharged to the atmosphere.
8	Secondary air	SEC	Orange	Airflow taken from a room and returned to the same room after any treatment
9	Leakage	LEA	Grey	Unintended airflow through leakage paths in the system
10	Infiltration	INF	Green	Leakage of air into building through leakage paths in elements of structure separating it from the outdoor air
11	Exfiltration	EXF	Grey	Leakage of air out of building through leakage paths in elements of structure separating it from the outdoor air
12	Mixed air	MIA	Streams with separate colours	Air which contains two or more streams of air
1.1	Single room outdoor air	SRO	Green	Air entering the single room air handling unit or opening from outdoors before any air treatment
2.1	Single room supply air	SRS	Blue	Airflow entering the treated room

Table 2 — Specification of types of air (*continued*)

5.1	Single room extract air	SET	Yellow	The airflow leaving the treated room into a single room air handling unit
7.1	Single room exhaust air	SEH	Brown	Airflow discharged to the atmosphere from a single room air handling unit.

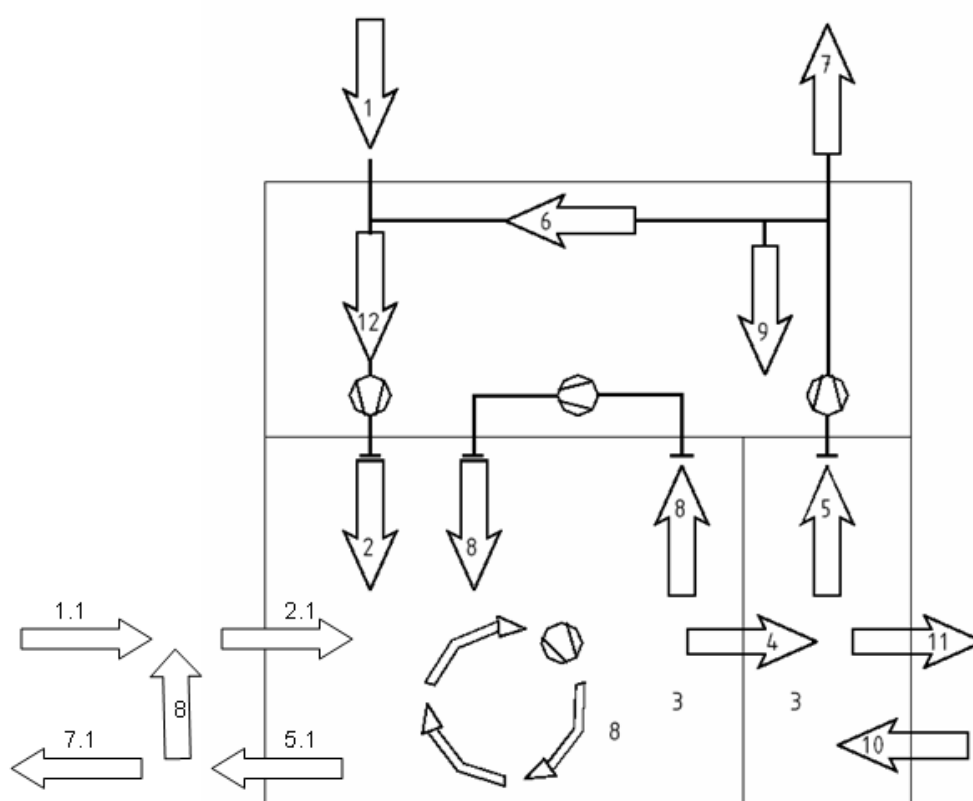


Figure 1 — Illustration of types of air using numbers given in Table 2

6.2 Classification of air

6.2.1 General

The following classifications may be used to describe the quality of the different types of air defined in 6.1. Some applications of these classifications are given in Annex A.

6.2.2 Extract air and exhaust air

The classifications of extract air and exhaust air for the application in this standard are given in Table 3. In case the extract air contains different categories of extract air from different rooms, the stream with the highest category-number determines as a default the category of the total air stream.

The categories for exhaust air apply to the air after any cleaning that is used. When exhaust air is cleaned, the method and the expected effect of the cleaning shall be stated clearly and evidence shall be provided of the initial and continuing effectiveness of the cleaning process. The cost-effectiveness shall also be considered (see Annex B for the methodology), especially if the aim is to improve the exhaust air by more than one class. Exhaust air of class EHA 1 cannot be achieved by cleaning.

Table 3 — Classification of extract air (ETA) and exhaust air (EHA)

Category	Description
ETA 1 EHA 1	Extract air with low pollution level
	Air from rooms where the main emission sources are the building materials and structures, and air from occupied rooms, where the main emission sources are human metabolism and building materials and structures. Rooms where smoking is allowed are excluded.
ETA 2 EHA 2	Extract air with moderate pollution level
	Air from occupied rooms, which contains more impurities than category 1 from the same sources and/or also from human activities. Rooms which shall otherwise fall in category ETA 1 but where smoking is allowed.
ETA 3 EHA 3	Extract air with high pollution level
	Air from rooms where emitted moisture, processes, chemicals etc. substantially reduce the quality of the air.
ETA 4 EHA 4	Extract air with very high pollution level
	Air which contains odours and impurities in significantly higher concentrations than those allowed for indoor air in occupied zones.

6.2.3 Outdoor air

In the process of system design, consideration needs to be given to the quality of the outdoor air around the building or proposed location of the building. In the design, there are two main options for mitigating the effects of poor outdoor air on the indoor environment:

- locate air intakes where the outdoor air is least polluted (if the outdoor air pollution is not uniform around the building)
- apply some form of air cleaning

NOTE 1 See A.2 and A.3 for further information about these options.

Different air filtering techniques are available, their suitability depends on whether the outdoor air is polluted with gases, particles or both (and the size of the particles of concern). There are no universally accepted definitions of acceptable levels of outdoor air quality and those that do exist are not intended primarily to support the design of ventilation systems. Design decisions will therefore depend on:

- what local regulations are in force;
- choices to adopt regulations and guidelines;

- individual choices about the importance of specific pollutants that are not regulated (e.g. pollens, fungal spores of outdoor origin).

The outdoor air classification is given in Table 4. These categories inform the decision as to whether mitigation of outdoor pollution is required, but the method of mitigation will depend on other factors, as noted above.

Table 4 — Classification of outdoor air (ODA)

Category	Description
ODA 1	Pure air which may be only temporarily dusty (e.g. pollen)
ODA 2	Outdoor air with high concentrations of particulate matter and/or gaseous pollutants
ODA 3	Outdoor air with very high concentrations of gaseous pollutants and/or particulate

Application of such a classification will depend on defining the criteria. As a starting point, the following approach is suggested.

ODA 1 applies where the WHO (1999) guidelines and any National air quality standards or regulations for outdoor air are fulfilled.

ODA 2 applies where pollutant concentrations exceed the WHO guidelines or any National air quality standards or regulations for outdoor air by a factor of up to 1,5.

ODA 3 applies where pollutant concentrations exceed the WHO guidelines or any National air quality standards or regulations for outdoor air by a factor greater than 1,5.

Since there are not guidelines of regulations for all pollutants, and those that do exist are not uniform between nations, informed interpretation is required on the part of the designer. The potential impact of mixtures of pollutants, not just individual pollutants, should be considered.

Typical gaseous pollutants to be considered in the evaluation of the outdoor air for the design of ventilation and room-conditioning systems are carbon monoxide, carbon dioxide, sulphur dioxide, oxides of nitrogen and volatile organic compounds (VOCs). The indoor impact of such outdoor pollutants will depend on how reactive they are. Carbon monoxide, for example, is relatively stable and subject to little adsorption by indoor surfaces. In contrast, ozone in the outdoor air is usually not relevant for the design of the system as ozone is highly reactive and its concentration decreases very rapidly in the ventilation system and in the room. Other gaseous pollutants are mostly intermediate between these extremes.

Particulate matter refers to the total amount of solid or liquid particles in the air, from the visible dust to submicron particles. Most outdoor air guidelines refer to PM₁₀ (particulate matter with an aerodynamic diameter up to 10 µm) but there is growing acceptance that, for the purpose of health protection, greater emphasis should be placed on smaller particles. Where biological particles need to be considered, PM₁₀ guidelines are not relevant and the more important consideration is the immunological or infectious hazard represented by the particles.

NOTE 2 Further information about outdoor air quality and how to determine the ODA class are given in A.3.

6.2.4 Supply air

The quality of the supply air for buildings subject to human occupancy shall be such that, taking into account the expected emissions from indoor sources (human metabolism, activities and processes, building materials, furniture) and from the ventilation system itself, proper indoor air quality will be achieved

NOTE 1 Annex G of EN 15251:2007 gives more guidance on the use of "low polluting materials" or "low polluting buildings"

The outdoor air rates shall be specified in design of the system. If supply air also contains recirculation air, this shall be noted in design documentation, too. In order to avoid misunderstandings, it is recommended to define the quality of the supply air also by specifying the concentration limits that will apply to named pollutants (e.g. CO₂, VOC) in the indoor air. Therefore a declaration of the expected emissions from indoor sources is also needed and, wherever possible, this should be related to concentration limits and emission standards.

NOTE 2 Extract air can be mixed to the supply air on purpose by recirculation or unintentionally by leakage. Special attention should be paid to the situation in heat recovery devices or sections, see A.4.

6.2.5 Indoor air

6.2.5.1 General

The basic classification of indoor air is given in Table 5. This classification applies to the indoor air in the occupied zone.

Table 5 — Basic classification of indoor air quality (IDA)

Category	Description
IDA 1	High indoor air quality
IDA 2	Medium indoor air quality
IDA 3	Moderate indoor air quality
IDA 4	Low indoor air quality

The values for indoor air classes can be given in national regulations. Values presented in EN 15251 may be used as default values. The exact definition of categories depends on the nature of the pollutant sources that are to be taken into account, and on the effects of these pollutants. For example, pollutant sources may be:

- localised in space or distributed through a building;
- continuous or intermittent emitters;
- emitters of particles (inorganic, viable or other organic) or gases/vapours (organic or inorganic).

The effects can be considered in terms of perception of air quality or of health effects. These effects may depend on the persons exposed, e.g. whether they are healthy adults, children or hospital patients.

Hence, a complete definition of indoor air quality categories is outside the scope of this standard. However, the intention of the categories can be illustrated by reference to the situation in which:

- people (i.e. human metabolism) are the only source of air pollution that needs to be taken into account;
- only the perception of non-adapted persons is considered.

For practical applications the four categories of indoor air quality shall be quantified by one of the methods given in 6.2.5.2 to 6.2.5.4. The choice of the method is free but shall be adapted to the use of the room and the requirements. The different methods lead for the same category of indoor air quality, but not necessarily to the same quantity of supply air. In special cases other methods may be used to quantify the indoor air quality (IAQ).

NOTE 1 Further guidance for determining the classification of IAQ is presented in EN 15251, taking also into account pollution sources other than occupant and smoking. The selection of non- or low-pollution materials for the building is strongly recommended, rather than increasing the rate of outdoor air in order to dilute avoidable emissions. This applies whatever approach is taken to defining air quality, and should include emissions from all indoor sources, e.g. furnishing, carpets and the ventilation or air-conditioning system itself.

Where emissions from materials can be estimated on a “per m²” basis, a total required ventilation rate can be calculated by combining the requirement per person and the requirements per m². Where pollutants will be present but not immediately perceived, additional allowance should be made. Alternatively, the air cleaning required to achieve acceptable concentrations (or percentage removal) can be specified. This would be common, for example, in relation to hospitals. The methods would depend on the premises, the pollutants present and the national codes that apply.

All categories and figures are informative. Normative values and ways to calculate the total ventilation rate taking into account the different pollution sources can be given on national level. Annex A presents default values.

NOTE 2 For spaces for human occupancy, the ventilation option for periods of non-occupancy shall be specified according to national regulations so that the intended quality of indoor air is achieved at the start of occupancy. The main options for ventilation outside occupancy are:

- basic ventilation rate throughout the non-occupancy period, e.g. using extract from hygiene rooms
- earlier start of ventilation before occupancy
- run the ventilation system for short periods during the period of non-occupancy

A minimum value of 0,1 to 0,2 l/s,m² is recommended if national requirements are not available.

NOTE 3 Further guidance for expressing the quality of indoor air, and how to specify the indoor environment in building design, is given in ISO/DIS 16814

6.2.5.2 Indirect classification by the rate of outdoor air per person

This method is a well-based practical method for all situations where the rooms serve for typical human occupancy. The outdoor air rates shall be specified according to national regulations and guidelines. The specified values shall be fulfilled in the occupied zone.

NOTE Values presented in Table A.10 may be used as default values.

6.2.5.3 Indirect classification by the air flow rate per floor area

This method can in some cases be used to design a system for rooms which are not for human occupancy and which do not have a clearly defined use (for example storage rooms).

NOTE Default values for these cases are given in Table A.11.

6.2.5.4 Classification by CO₂-level

Indoor air quality can be categorised by CO₂ concentration. CO₂ is a good indicator for the emission of human bioeffluents. Classification by the CO₂-level is well established for occupied rooms, where smoking is not allowed and pollution is caused mainly by human metabolism.

NOTE 1 Default values for indoor air quality categorised by CO₂ concentration are given in Table A.10 and in EN 15251:2007, Annex B.

NOTE 2 The CO₂-based categories would be nominally equivalent to outdoor airflow rates for non-smoking spaces, for a certain activity level. The rates given for non-smoking areas take into consideration the human metabolism as well as typical emissions in low-pollution buildings. In cases with high activity levels ($M > 1.2$ met), the outdoor air rates should be increased according to EN ISO 7730. If the number of occupants per square metre is known, then the air quality can also be expressed as an airflow rate per square metre. This method can in some cases be used to design a system for rooms that are not for human occupancy and do not have a clearly defined use (for example storage rooms)

6.2.5.5 Classification by concentration levels for specific pollutants

This method of classification is suitable for situations with significant emissions of specific pollutants. If there is sufficient information about all the indoor emissions, then ventilation rate requirements can be calculated as shown in 7.4.2.3. Where the emission rates are not known, the required air quality can also be indirectly specified by the ventilation rate based on experience.

6.3 System tasks and basic system types

Ventilation, air-conditioning and room-conditioning systems are intended to control the indoor air quality and the thermal and humidity conditions in the room to a specification that is agreed in advance. The specification of the indoor environment also has consequences for the price of the installation, the space requirements for the system and the running costs. Therefore a solution shall be found which is well suited to the actual requirements.

Ventilation systems consist of a supply and an extract air system and usually they are equipped with filters for the outdoor air, heaters and heat recovery devices. Extract air systems with no supply air system cannot fulfil all the given requirements. Supply air systems with no extract air system do not generally allow heat recovery and lead to an overpressure which may be in some cases hazardous to the building fabric.

The basic categories of the system type are dependant on its capability for controlling the indoor air quality and the means and degree of control of the thermodynamic properties in the room. The category and type of control, and parameters to be controlled shall be specified.

For control of the indoor air quality, possible categories are given in Table 6. Possibilities to reduce the energy consumption by Demand Controlled Ventilation are introduced in A.11.

Table 6 — Possible types of control of the indoor air quality (IDA-C)

Category	Description
IDA – C 1	The system runs constantly.
IDA – C 2	Manual control The system runs according to a manually controlled switch.
IDA – C 3	Time control The system runs according to a given time schedule.
IDA – C 4	Occupancy control The system runs dependent on the presence (light switch, infrared sensors etc.)
IDA – C 5	Demand control (number of people) The system runs dependent on the number of people in the space.
IDA – C 6	Demand control (gas sensors) The system is controlled by sensors measuring indoor air parameters or adapted criteria, which shall be specified (e.g. CO ₂ , mixed gas or VOC sensors). The used parameters shall be adapted to the kind of activity in the space.

Whichever control system is used (including manual control), better performance can generally be achieved by using some form of proactive control. Time has to be considered in the control strategy. Classes IDA-C5 and C6 have to be associated with a regulation of airflows. If the range of variation of airflows can induce large fluctuation of pressure, a system of control on pressure should be used or any airflow regulation to take it into account. The thermal environment in a room can be controlled by