SLOVENSKI STANDARD
SIST EN 13779:2005

01-januar-2005

Prezraļ evanje nestanovanjskih stavb - Zahtevane lastnosti za prezraļ evalne naprave in klimatizirne sisteme

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

Lüftung von Nichtwohngebäuden - Allgemeine Grundlagen und Anforderungen an Lüftungs- und Klimaanlagen

Ventilation des bâtiments non résidentiels - Exigences de performances des systemes de ventilation et de conditionnement d'air

Ta slovenski standard je istoveten z: EN 13779:2004

ICS:

91.140.30	Prezraļ evalni in klimatski sistemi	Ventilation and air-conditioning

SIST EN 13779:2005 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13779

September 2004

ICS 91.140.30

English version

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

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

Lüftung von Nichtwohngebäuden - Allgemeine Grundlagen und Anforderungen an Lüftungs- und Klimaanlagen

This European Standard was approved by CEN on 16 January 2004.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 13779:2004: E

Contents

Page

FOREWORD....3
INTRODUCTION....4
1. Scope....5
2. Normative References....5
3. Terms and definitions....5
3.1 General....5
3.2 Types of air....5
4 Symbols and Units....6
5 Classification....7
5.1 Specification of types of air....7
5.2 Classification of air....9
6 Indoor Environment....17
6.1 General....17
6.2 Occupied Zone....17
6.4 Indoor Air Quality....20
6.4.1 Design assumptions....20
6.4.2 Supply airflow rates....20
6.5 Indoor Air Humidity....22
6.6 Acoustic Environment....22
6.7 Internal Loads....23
6.7.1 General....23
6.7.2 Persons....23
7 Agreement of Design Criteria....25
7.1 General....25
7.2 Principles....25
7.3 General building characteristics....25
7.3.1 Location, outdoor conditions, neighbourhood....25
7.3.2 Climatic data outdoors....26
7.4 Construction data....26
7.5 Geometrical description....26
7.6 Use of the rooms....26
7.7 Requirements in the rooms....27
7.8 General Requirements for Control and Monitoring....27
7.9 General Requirements for Maintenance and Safety of Operation....28
8 Process from Project Initiation to Operation....28
Annex A (Informative) Guidelines for Good Practice....29
A.2.1 General....29
A.2.2 Requirements for Intake Openings....29
Annex B (Informative) Economic Aspects....44
B.3.1 General....44
B.3.2 Definitions....44
Annex C (Informative) Checklist for the Design and Use of Systems with Low Energy Consumption....50
Bibliography....52

FOREWORD

This document (EN 13779:2004) 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 March 2005, and conflicting national standards shall be withdrawn at the latest by March 2005.

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

INTRODUCTION

This document provides guidance 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.

- Relevant parameters of the indoor environment.
- Definitions of data design assumptions and performances.
- Communication between the various parties involved in the system completion.

1. Scope

This document applies to the design of ventilation and room conditioning systems for non-residential buildings subject to human occupancy. It focuses on the definitions of the various parameters that are relevant for such systems. Naturally ventilated buildings are outside the scope of this document.

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 document shall 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. National regulations must always be followed, even when they are out of the range given in this document.

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.

prEN 12097	*Ventilation for buildings - Ductwork - Requirements for ductwork components to facilitate maintenance of ductwork systems*
EN 12237	*Ventilation for buildings - Ductwork - Strength and leakage of circular sheet metal ducts*
EN 12464-1	*Light and lighting – Lighting of work places – Part 1: Indoor work places*
EN 12599:2000	*Ventilation for buildings - Test procedures and measuring methods for handing over installed ventilation and air conditioning systems*
CR 12792:1997	*Ventilation for buildings – Symbols and terminology*
EN ISO 7730	*Moderate thermal environments - Determination of the PMV and PPD indices and specification of the conditions for thermal comfort (ISO 7730:1994)*

3. Terms and definitions

3.1 General

For the purposes of this document, the terms and definitions given in CR 12792 apply.

3.2 Types of air

The types of air are defined in 5.1.

3.3 Occupied zone

The definition of the occupied zone is dependent on the geometry and the use of the room and shall be specified case by case. 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. 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 6.2.

3.4 Ventilation effectiveness

The ventilation effectiveness describes the relation between the pollution concentrations in the supply air, the exhaust air and the indoor air in the breathing zone (within the occupied zone). It is defined as

$$\varepsilon_{\mathrm{v}} = \frac{c_{\mathrm{EHA}} - c_{\mathrm{SUP}}}{c_{\mathrm{IDA}} - c_{\mathrm{SUP}}} \qquad (1)$$

where ε_{v} is the ventilation effectiveness
c_{EHA} is the pollution concentration in the exhaust air
c_{IDA} is the pollution concentration in the indoor air (breathing zone within in the occupied zone)
c_{SUP} is the pollution concentration in the supply air

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.

Further information on ventilation effectiveness is given in CR 1752.

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

3.5 Specific fan power

The specific power of each fan is defined as

$$P_{\mathrm{SFP}} = \frac{P}{q_{\mathrm{v}}} = \frac{\Delta p}{\eta_{\mathrm{tot}}} \qquad (2)$$

where P_{SFP} is the specific fan power in W.m^{-3}.s
P is the input power of the motor for the fan in W
q_{v} is the nominal airflow through the fan in m^{3}.s^{-1}
Δp is the total pressure difference across the fan
η_{tot} is the total efficiency of fan, motor and drive in the built-in situation.

The coefficient is valid for the nominal airflow with clean filter conditions any bypasses closed. It is related to an air density of 1,2 kg.m^{-3}.

4 Symbols and Units

For the purposes of this document, the symbols and units given in Table 1 shall 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	-
Celsius temperature	θ (theta)	°C
Air temperature in the room	θ_a (theta)	°C
Mean radiant temperature	θ_r (theta)	°C
Operative temperature	θ_o (theta)	°C
Density	ρ (rho)	$kg.m^{-3}$
Heat or cooling load	Φ (phi)	W (kW)
Area	A	m^2
Costs	C	€ *
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	€ *
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}
Power	P	W
Specific fan power	P_{SFP}	$W.m^{-3}.s$
Present value	PV	€ *
Pressure	p	Pa
Mass flow rate	q_m	$kg.s^{-1}$
Volume flow rate	q_v	$m^3.s^{-1}$ ($l.s^{-1}$, $m^3.h^{-1}$)
Interest rate	r	-
Time	t	s (h)
Volume	V	m^3
Air velocity	v	$m.s^{-1}$

* Or National currency

5 Classification

5.1 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. Where there is a free choice of the language, the use of English is recommended. The colour code of the supply air is chosen according to the system-controlled functions in accordance with Table 15.

Table 2 Specification of types of air

No. (in Figure 1)	Type of air	Abbreviation	Colour	Definition
1	Outdoor air Aussenluft Air neuf	ODA AUL ANF	Green	Air entering the system or opening from outdoors before any air treatment
2	Supply air Zuluft Air fourni	SUP ZUL FOU	See Table 13	Airflow entering the treated room, or air entering the system after any treatment
3	Indoor air Raumluft Air intérieur	IDA RAL INT	Grey	Air in the treated room or zone
4	Transferred air Überströmluft Air transféré	TRA ÜSL TRA	Grey	Indoor air which passes from the treated room to another treated room
5	Extract air Abluft Air repris	ETA ABL REP	Yellow	The airflow leaving the treated room
6	Recirculation air Umluft Air recyclé	RCA UML REC	Orange	Extract air that is returned to the air treatment system
7	Exhaust air Fortluft Air rejeté	EHA FOL RJT	Brown	Airflow discharged to the atmosphere.
8	Secondary air Sekundärluft Air brassé	SEC SEK BRA	Orange	Airflow taken from a room and returned to the same room after any treatment (example: fan coil unit)
9	Leakage Leckluft Fuites	LEA LEC FUI	Grey	Unintended airflow through leakage paths in the system
10	Infiltration Infiltration Infiltration	INF INF INF	Green	Leakage of air into building through leakage paths in elements of structure separating it from the outdoor air
11	Exfiltration Exfiltration Exfiltration	EXF EXF EXF	Grey	Leakage of air out of building through leakage paths in elements of structure separating it from the outdoor air
12	Mixed air Mischluft Air mélangé	MIA MIL MEL	Streams with separate colours	Air which contains two or more streams of air

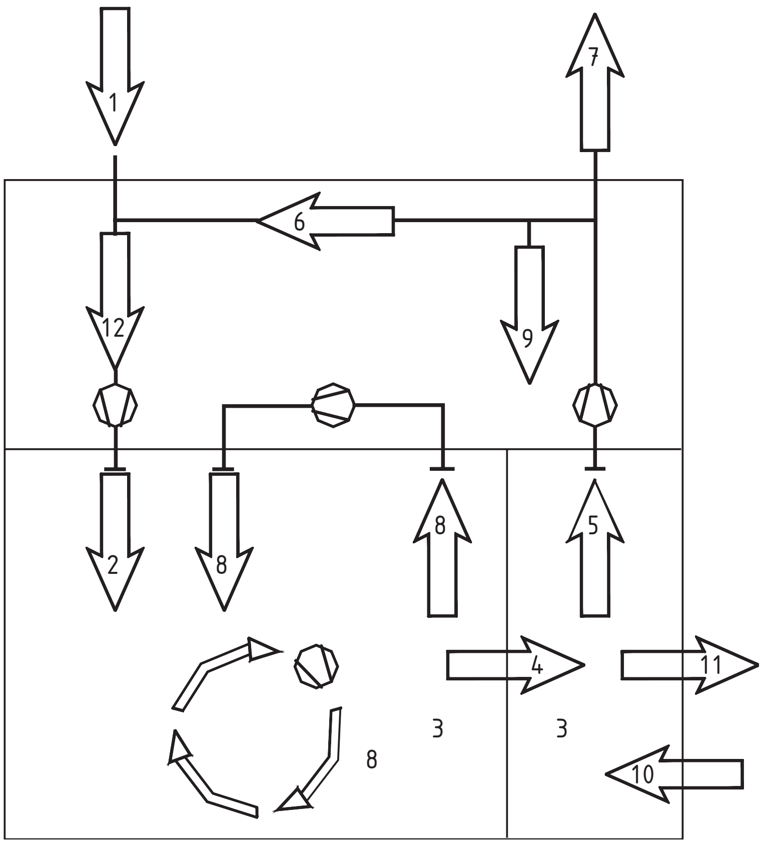

Figure 1 Illustration of types of air using numbers given in Table 2

5.2 Classification of air

5.2.1 General

All parties having an interest in the design (e.g. architects, building services engineers, owners, clients) shall agree the design assumptions and acceptable performance in relation to air quality. In doing this, the following classifications may be used to describe the quality of the different types of air defined in 5.1. Some applications of these classifications are given in the Annex A.

5.2.2 Extract Air and Exhaust Air

The classifications of extract air and exhaust air for the application in this document are given in Tables 3 and 4. In case the extract air contains different categories of extract air from different rooms, the stream with the highest category-number determines the category of the total 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 must 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 (cf Annex B), especially if the aim is to improve the exhaust air by more than one class. Exhaust air of class EHA 1 is never achieved by cleaning.

Table 3 Classification of extract air (ETA)

Category	Description	Examples of where air in each category would be found (informative)
ETA 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.	Offices, including integrated small storage rooms, spaces for public service, classrooms, stairways, corridors, meeting rooms, commercial spaces with no additional emission sources.
ETA 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.	Lunchrooms, kitchens for preparing hot drinks, stores, storage spaces in office buildings, hotel rooms, dressing rooms.
ETA 3	Extract air with high pollution level	
	Air from rooms where emitted moisture, processes, chemicals etc. substantially reduce the quality of the air.	Toilets and wash rooms, saunas, kitchens, some chemistry laboratories, copying plants, rooms specially designed for smokers.
ETA 4	Extract air with very high pollution level	
	Air which contains odours and impurities detrimental to health in significantly higher concentrations than those allowed for indoor air in occupied zones.	Exhaust hoods in professional use, grills and local kitchen exhausts, garages and drive tunnels, car parks, rooms for handling paints and solvents, rooms for unwashed laundry, rooms for foodstuff waste, central vacuum cleaning systems, heavily used smoking rooms and certain chemistry laboratories.

Table 4 Classification of exhaust air (EHA)

Category	Description	Examples (informative)
EHA 1	Exhaust air with low pollution level	
	Equivalent to ETA 1	see ETA 1
EHA 2	Exhaust air with moderate pollution level	
	Equivalent to ETA 2	see ETA 2
EHA 3	Exhaust air with high pollution level	
	Equivalent to ETA 3	see ETA 3
EHA 4	Exhaust air with very high pollution level	
	Equivalent to ETA 4	see ETA 4

5.2.3 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:

- siting air intakes where the outdoor air is least polluted (if the outdoor air pollution is not uniform around the building) – see Annex A.2;
- employing some form of air cleaning - see A.3.

Different approaches to air cleaning are appropriate, depending on the requirements to the indoor air quality and whether the outdoor air is polluted with gases, particles or both (and the size of the particles of concern).

With respect to the application in this document the outdoor air is classified as in Table 5.

Table 5 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
ODA 3	Outdoor air with high concentrations of gaseous pollutants
ODA 4	Outdoor air with high concentrations of gaseous pollutants and particulate matter
ODA 5	Outdoor air with very high concentrations of gaseous pollutants or particulate matter

The classification is made according to the most critical gaseous pollutant and particulate matter (including all kinds of solid particles and salty mist). Air is called “pure”, when the WHO (1999) guidelines and any National air quality standards or regulations for the relevant substances in the outside air are fulfilled. Concentrations are called “high”, when they exceed the above mentioned requirements by a factor of up to 1.5. Concentrations are called “very high”, when they exceed the requirements by a factor higher 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 – e.g. benzene, solvents and polyaromatic hydrocarbons). 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 PM_{10} (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, PM_{10} guidelines are not relevant and the more important consideration is the immunological or infectious hazard represented by the particles.

As a general guide, examples of levels of outdoor air quality are given in Table 6.

Table 6 Examples of pollutant concentrations in outdoor air

Description of location	Concentration					
	CO_2 ppm	CO mg m^{-3}	NO_2 µg m^{-3}	SO_2 µg m^{-3}	Total PM mg m^{-3}	PM_{10} µg m^{-3}
Rural area; no significant sources	350	< 1	5 to 35	< 5	< 0.1	< 20
Smaller town	375	1 to 3	15 to 40	5 to 15	0,1 – 0,3	10 to 30
Polluted city centre	400	2 to 6	30 to 80	10 to 50	0,2 – 1,0	20 to 50

NOTE: The given values for the air pollutants are annual concentrations and should not be used for the design of systems. Maximum concentrations are higher. For further information, use local measurements and national guidelines.

5.2.4 Supply Air

The classification of supply air is given in Table 7.

Table 7 Classification of supply air (SUP)

Category	Description
SUP 1	Supply air which contains only outdoor air
SUP 2	Supply air which contains outdoor air and recirculation air

NOTE: Recirculation air can be mixed to the supply air on purpose or by leakage. Special attention has to be paid to the situation in heat exchangers.

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, the proper indoor air quality will be achieved.

In order to avoid misunderstandings, it is recommended to define the quality of the supply air not only by using the classification given in Table 7, but also by specifying the concentration limits that will apply to named pollutants 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.

5.2.5 Indoor Air

5.2.5.1 General

The basic classification of indoor air is given in Table 8. This classification applies to the indoor air in the occupied zone.

Table 8 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 exact definition of categories such as these will depend 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 (by adapted or unadapted persons) or of health effects such as mucous membrane irritation, toxic effects, infection, allergic reactions or carcinogenesis. 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 difficult and outside the scope of this document. However, for practical applications the four categories of indoor air quality shall be quantified by one of the methods given in 5.2.5.2 to 5.2.5.6. 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 not necessarily to the same quantity of supply air. In special cases other methods than described below may be used to quantify the IAQ.

5.2.5.2 Classification by CO_2-level

Current research and practice would suggest that IAQ could be categorised by CO_2 concentration, as shown in Table 9. CO_2 is a good indicator for the emission of human bioeffluents. Classification by the CO_2-level is well established for occupied rooms, where smoking is not allowed and pollution is caused mainly by human metabolism. For comparison, typical CO_2 concentrations in outdoor air are given in Table 6.

Table 9 CO_2-level in rooms

Categorie	CO_2-level above level of outdoor air in ppm	
	Typical range	Default value
IDA 1	≤ 400	350
IDA 2	400 – 600	500
IDA 3	600 – 1,000	800
IDA 4	> 1,000	1,200

The CO_2-based categories would be nominally equivalent to outdoor airflow rates as shown in Table 11.

5.2.5.3 Classification by the perceived air quality in decipols

This method of classification is described in CR 1752. It is applicable to occupied rooms with no risk of non-perceivable hazardous air pollutants such as CO, Radon etc. Typical specifications are as follows:

Table 10 Perceived air quality in the occupied zone

Categorie	Perceived air quality in decipols	
	Typical range	Default value
IDA 1	≤ 1,0	0,8
IDA 2	1,0 – 1,4	1,2
IDA 3	1,4 – 2,5	2,0
IDA 4	> 2,5	3,0

The method is not yet fully accepted and difficult to use in practice. Therefore it should only be used in applications where all the necessary information about the emission rates is available. An estimation is given in CR 1752.

5.2.5.4 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 rates of outdoor air (supplied by the ventilation system) per person in case of normal work in an office or at home with a metabolic rate of about 1,2 met are given in Table 11. These values are often used to design the system. The values must be fulfilled in the occupied zone. The rates given for non-smoking areas take into consideration the human metabolism as well as typical emissions in low-polluting buildings. In cases with high activity levels (met >1,2), the outdoor rates should be increased by a factor of met/1,2.