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Indoor air —

Part 41: Assessment and classification

Air intérieur —

Partie 41: Évaluation et classification

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 6, *Indoor air*.

A list of all parts in the ISO 16000 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

In our society, privately and professionally, people stay indoors most of the day. Therefore, the quality of the indoor air is very decisive for the quality of life and health. This especially applies to small children, sick people and other vulnerable groups of persons.

Numerous scientific studies verify the positive effects of good indoor air on the overall performance during learning (e.g. in kindergartens and schools) and working. A consequence of improved indoor air quality can be, for example, reduced sickness rates and absenteeism.

The entitlement to high-quality indoor air does not contradict economical aspects of energy- and cost-efficiency. Improvements in the quality of indoor air are achievable with simple measures, for example, change of behaviour patterns.

This document describes a procedure to classify the air quality of indoor spaces using quality classes. These quality classes enable the allocation of the room air to a high, medium or low quality. The quality classes are based on criteria for physical, chemical and biological parameters according to the state of science and research. These criteria can be both concentration values in the room air (e.g. with formaldehyde) as well as sensory and other findings in the room itself (e.g. with mould). The basis for classifying a measured value of a parameter in a quality class is the definition of class boundaries for quality classes A to C by national institutions, using guide values from national guidelines, European and international publications and trade literature.

The most frequent pollutant sources indoors are human activities (e.g. domestic-, hobby- and cleaning activities, tobacco smoke), combustion processes as well as building materials, furnishings and interior design materials. The exception is the radioactive inert gas radon, which mostly originates from the geological subsoil and enters the interior spaces via leaks in the building envelope.

A variety of substances can emit into the indoor air from the most diverse pollution sources. For this reason, the single analysis of a source or pollutant cannot be used as a substitute for an overall assessment of the indoor air. A meaningful assessment of the indoor air is only achievable by an overall assessment of all pollutant sources and substances.

This document is intended for specialists who deal with the assessment of indoor air in the course of planning, construction, operation and use of buildings (e.g. indoor-experts, architects, specialist planners of trades, building owners, building developers and contracting authorities, maintenance engineers, lessors). Also included are producers and distributors of products, that are installed and/or operated indoors (e.g. building products), and possible users.

Indoor air —

Part 41:
Assessment and classification

1 Scope

This document specifies a procedure for the assessment of the indoor air quality that is valid for all interior rooms in residential and non-residential buildings with natural or mechanical ventilation, in which people do not only stay temporarily.

This document is applicable to indoor environments as defined in ISO 16000-1.

The assessment of working materials in workrooms or workplaces in buildings, that are subject to statutory occupational safety specifications, are excluded from this document. In these rooms, only air constituents that do not originate from working materials can be assessed according to this document.

It is not possible to define classes with exact values for the individual pollutants, as the corresponding limit and guide values differ in individual countries. In addition, the values relate to different observation periods.

Aspects concerning electromagnetic fields, noise and vibrations and their effect on the indoor air quality are not the object of this document. The classification of further consequences and measures, such as organisational steps, structural engineering measures, renovation proposals, further human medicine appraisals and the like, are not the object of this document.

NOTE This document applies to of all types of indoor environments occupied by all kinds of persons, including regular users, clients and workers.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 11665-8, *Measurement of radioactivity in the environment — Air: radon-222 — Part 8: Methodologies for initial and additional investigations in buildings*

ISO 16000 (all parts), *Indoor air*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
building product
product or building kit, that is manufactured or brought into circulation, to be installed permanently in buildings or parts of buildings and whose performance affects the performance of the building with regard to the basic requirements on buildings

[SOURCE: EU-BauPVO, Article 2 (1)[23]]

3.2
assessment value
value obtained from an assessment

Note 1 to entry: The assessment value can be an individual measured value, the arithmetic mean of individual measured values or the result of a continuous measurement over a particular time period. In the case of carbon dioxide (CO_2), the assessment value is a statistical evaluation of the individual measured values.

3.3
assessment period
period during which the investigation of the indoor air takes place

Note 1 to entry: The assessment period is adapted to the parameter to be assessed and the measuring task and linked to certain usage conditions.

3.4
emission
release of chemicals, vibration and radiation to the environment

Note 1 to entry: The emission of air constituents can be specified as mass flow. In relation to *building products* (3.1), the mass flow can be related to area, length, mass, volume or component.

Note 2 to entry: The terms “emission” and “release” basically have the same meaning.

3.5
main parameter
parameter which, during an overall assessment, is taken into consideration without fail

3.6
secondary parameter
parameter that is also taken into consideration for the overall assessment, if references to its relevance exist in the preliminary survey

3.7
guide value
default value that serves as a comparative value for the assessment

Note 1 to entry: Specific guide values for interior rooms are defined, for example, by the WHO and national/professional institutions.

4 General

4.1 Procedure

The procedure for the assessment of the indoor air quality consists of the following steps:

a) preliminary survey;

b) investigation plan;

c) investigation;

d) documentation;

e) expert opinion.

When this document is applied, it should be taken into consideration that the concentrations of substances in the room air can fluctuate greatly: spatially, time-related and usage-specific. This is particularly dependent on ventilation, the building services and the individual user behaviour.

Individual results of certain parameters cannot sufficiently characterize the indoor air, therefore the overall assessment described in this document is necessary in order to obtain a comprehensive and differentiated picture of the room air situation.

An investigation of buildings for pollutants shall be carried out in accordance with ISO 16000-32.

4.2 Parameters

Chemical, biological and physical parameters play a role in the assessment of the indoor air.

— chemical parameters and particles: gases, volatile and hardly volatile organic and inorganic compounds, fibres, dusts, dust constituents and odours;

— biological parameters: fungi, bacteria, viruses, pollen and other allergens (e.g. animal epithelia, insects/insect compounds, mites, mite excrement, plant parts/fibres);

— physical parameters: room air and environment surface temperatures, operative temperature, air humidity, air velocity, lighting, sounds and noise, electromagnetic fields and charged particles.

In the context of this document, only selected chemical and biological parameters are dealt with. The room air temperature and the humidity should be regarded as supplementary physical parameters.

NOTE Physical parameters are dealt with in, for example, ISO 7730.

5 Indoor air quality

For the assessment of the indoor air according to this document, a classification of the room air quality into three quality classes A (high), B (medium) and C (low) is performed based on prescribed main parameters (see 7.2). In addition, further secondary parameters (see 7.3) should be taken into consideration, if necessary.

The class limits of the quality classes are defined by:

— guide values in the sense of maximum permissible concentrations in the room air (e.g. with formaldehyde) or distributions of measured values (e.g. with carbon dioxide CO_2),

— sensory findings in the room itself (e.g. with mould, odours).

The use of a questionnaire can also contribute to the assessment of a room.

6 Quality classes

Table 1 provides an overview of the quality classes and describes the requirements on the room air quality on which these classes are based. The designations and descriptions of the requirements according to Table 1 are only partly applicable for the parameter "Mould – microbial infestation".

Table 1 — Indoor air quality classes

Quality class	Designation	Description
A	High room air quality	Room air with low substance concentrations
B	Medium room air quality	Room air with average substance concentrations
C	Low room air quality	Room air with above-average substance concentrations
Lowest air quality class not fulfilled		Substance concentrations above the class limits of quality class C

If any main criteria do not permanently fulfil even quality class C, the indoor air shall not be classified but is considered to be “outside all quality classes”.

During the course of an assessment, the need for different quality classes can arise for a specific interior, depending on which parameter is considered.

For the assessment, it shall be taken into consideration that many building products show a significant decrease of their emissions, especially in the first days and weeks after their manufacturing. A meaningful holistic assessment of the room air condition in the sense of this document is only possible in an actual usage stage.

7 Criteria for the definition of the quality classes

7.1 General

The basis for classifying a measured value of a parameter in a quality class is the definition of class boundaries for quality classes A to C. The limits of the quality classes can be defined on the basis of guide values from national guidelines and European and international, publications and trade literature. For the parameter "Mould – Microbial Infestation", in addition the condition of the room with regard to mould infestation is adjudged.

7.2 Main parameters

Parameters most frequently giving rise for complaints due to the quality of indoor air are defined as main parameters in this document.

In the framework of the overall assessment, the expert shall assess all these main parameters, however a measurement of every parameter is not always necessary (see 8.4.4).

Table 2 lists the main parameters as well as the corresponding clauses in annexes of this document.

Table 2 — Main parameters

Parameter	Clause
Formaldehyde	A.2
Volatile organic compounds (VOC)	A.3
Radon	A.4
Carbon dioxide	A.5
Mould - microbial infestation	A.6
Odour	A.7
Fine dust (PM1, PM2.5, PM10), ultrafine particles (UFP)	—

The criteria for the parameter carbon dioxide were derived from considerations of comfort as well as the users´ cognitive performance. Carbon dioxide levels are also used as an indicator for the concentration of emissions of the user or animals by breathing and body effluence into indoor air.

The appearance of mould is usually associated with the presence of filamentous fungi and yeast. Often bacteria are also present. In the case of air measurements, only the concentration of mould and bacteria is usually recorded.

The physical parameters “room air temperature” and “relative humidity” shall be recorded separately in the representation of the measurement results, because they influence the concentrations of pollutants in the room air and are frequently associated by users with an inadequate indoor air quality.

7.3 Secondary parameters

Secondary parameters are used, when there are indications of an occurrence of substance concentrations with a negative impact on the indoor air quality. In these cases, the investigation program shall be complemented with these secondary parameters. The consideration of secondary parameters shall be identified and justified accordingly in the overall assessment.

No quality classes are defined in this document for secondary parameters. That does not mean that quality classes cannot be defined. For some of the compounds, no effectiveness threshold or concentration can be specified, under which no health-related effects are to be expected.

The evaluation of secondary parameters is at the discretion of the expert.

In summary, secondary parameters include factors such as

— ammonia and heavy metals (e.g. mercury),

— asbestos,

— carbon monoxide,

— biocides (e.g. PCP, lindane),

— CMR substances in general,

— synthetic mineral fibres,

— nicotine,

— polychlorinated biphenyls (PCB),

— polychlorinated dioxins and furans (PCDD/PCDF),

— polycyclic aromatic hydrocarbons (PAH),

— sulfur dioxide,

— nitrogen oxides,

— other organic compounds besides VOC (VVOC, SVOC, MVOC), and

— parameters: fungi, bacteria, viruses, pollen and other allergens (e.g. animal epithelia, insects/insect compounds, mites, mite excrement, plant parts/fibres).

ISO 16000-1:2004, Annex C contains a list of sources of air impurities in interior rooms and the substances or substance groups emitted from them, that shall be used as a basis for the determination, investigation and assessment of secondary parameters.

Before the implementation of measurements of identified hazardous substances in the room, the investigation of possible sources in buildings is recommended.

8 Assessment plan

8.1 Overview

The overall assessment of the indoor air of an individual room or a building with multiple rooms shall take the individual steps of the assessment procedure into account, as listed in Table 3.

Table 3 — Phases of an overall assessment

Phase 1: Finding	
Preliminary survey	Compilation of the information and documents required for the planning of an investigation (e.g. previous test results, medical findings, data sheets)
Investigation plan	Decision, whether the sampling or investigation is to be carried out on-site; definition of the parameters to be considered in the planning of an investigation
Investigation	Implementation of the planned investigation or sampling and evaluation of the samples
Documentation	Documentation of the measurement procedure, measuring results and framework conditions of the investigation
Phase 2: Assessment	
Classification in quality classes	Assessment of the room air quality based on the quality classes according to this document

Figure 1 shows the individual steps of Table 3 and the documents resulting therefrom.