SLOVENSKI STANDARD
SIST EN 689:1998

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Zrak na delovnem mestu - Navodilo za oceno izpostavljenosti pri vdihavanju kemičnih snovi za primerjavo z mejnimi vrednostmi in načrtovanje meritev

Workplace atmospheres - Guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategy

Arbeitsplatzatmosphäre - Anleitung zur Ermittlung der inhalativen Exposition gegenüber chemischen Stoffen zum Vergleich mit Grenzwerten und Meßstrategie

Atmosphères des lieux de travail - Conseils pour l'évaluation de l'exposition aux agents chimiques aux fins de comparaison avec des valeurs limites et stratégie de mesurage

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Contents list

Foreword

This European Standard has been prepared by the Technical Committee CEN/TC 137 "Assessment of workplace exposure", the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by August 1995, and conflicting national standards shall be withdrawn at the latest by August 1995.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

0 Introduction

Assessing occupational exposure to air contaminants in a representative way is a challenging task. It is necessary however to gather information, evaluate and minimize exposure to chemical agents.

Industrial processes and agents are countless. Each manufacturing stage may apply different conditions (e.g. batch production or continuous process, temperature, pressure) and agents (e.g. a wide variety of chemical substances); in each of these stages different job functions may be necessary and be subject to different exposure conditions. Distance to emission sources and physical parameters such as rates of release, air current, meteorological variations, have also a profound influence. The resulting variability of exposure conditions is made even grater by individual practices.

All this explains why rapid fluctuations in contaminant concentration or large variations over very small distances are commonplace: site, moment and duration of sampling are decisive. Some measurements on a given day or period may give an insufficient view of the actual variability of individual polluted-air exposure characteristics.

The sampling equipment often introduces its own limitations, sometimes critical, as in aerosol fractions assessments, and the analytical steps add further difficulties or uncertainties, e.g. insufficient identification or separation of chemical species, or interferences. In this complex context, sampling strategy is responsible for representativeness at the lowest possible cost.

In this variety of situations and difficulties, assessments may be undertaken with very different motives, purposes, and practices. Schemes and guidelines are offered to harmonize basic concepts and actions. In order to guarantee the quality of assessments and, if necessary, to improve work conditions, professional judgment has to be exercised.

1 Scope

This European Standard gives guidance for the assessment of exposure to chemical agents in workplace atmospheres. It describes a strategy to compare workers' exposure by inhalation with relevant limit values for chemical agents in workplace and measurement strategy.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 482 Workplace atmospheres - General requirements for the performance of procedures for the measurement of chemical agents

3 Definitions

For the purpose of this European Standard the following definitions apply.

3.1 exposure: The presence of a chemical agent in the air within the breathing area of a worker. It is described in terms of concentration of the agent as derived from exposure measurements and referred to the same reference period as that used for the limit value.

3.2 chemical agent: Any chemical element or compound, on its own or admixed as it occurs in the natural state or as produced by any work activity, whether or not produced intentionally and whether or not placed on the market.

3.3 work pattern: The definable series of activities from the periods under consideration.

3.4 workplace: The workplace is the defined area or areas in which the work activities are carried out.

3.5 limit value: Reference figure for the concentration of a chemical agent in air.

Note:
Limit values are mostly set for reference periods of 8 h, but may also be set for shorter periods or concentration excursions.

The limit values for gases and vapours are stated in terms independent of temperature and air pressure variables in ml/m^3 (ppm V/V) and in terms dependent on those variables in mg/m^3 for a temperature of 20 °C and a pressure of 101,3 kPa.

The limit values for suspended matter are given in mg/m^3 or multiples of that for actual environmental conditions (temperature, pressure) at the workplace. The limit values of fibres are given in fibres/m^3 or fibres/cm^3 for actual environmental conditions (temperature, pressure) at the workplace.

3.6 reference period: The specified period of time stated for the limit value of a specific agent. The reference period for a long term limit is normally 8 h and for short term limit normally 10 min to 15 min.

3.7 personal sampler (or personal sampling device): A device attached to a person that samples air in the breathing area.

4 General

The strategy includes two phases:

- an occupational exposure assessment (OEA): the exposure is compared with the limit value;

- periodic measurements (PM) to regularly check if exposure conditions have changed.

The occupational exposure assessment is applied for the first evaluation and repeated after any significant change in working conditions, industrial process, products or chemicals or limit value. In this first phase no formal scheme of evaluation has to be followed, but it is left open to the professional judgment of the user to interpret and apply the guidelines. In the second phase, the frequency of the periodic measurements depends on the result of previous measurements.

The requirement for future periodic measurements should have been established as a result of the initial OEA or subsequent amendments to it. These requirements include the scope and frequency of measurements to be made. The periodic measurements follow a procedure which is defined in the occupational exposure assessment. In certain cases the periodic measurements can be omitted.

Figure 1 gives a schematic overview of the procedures described in this European Standard.

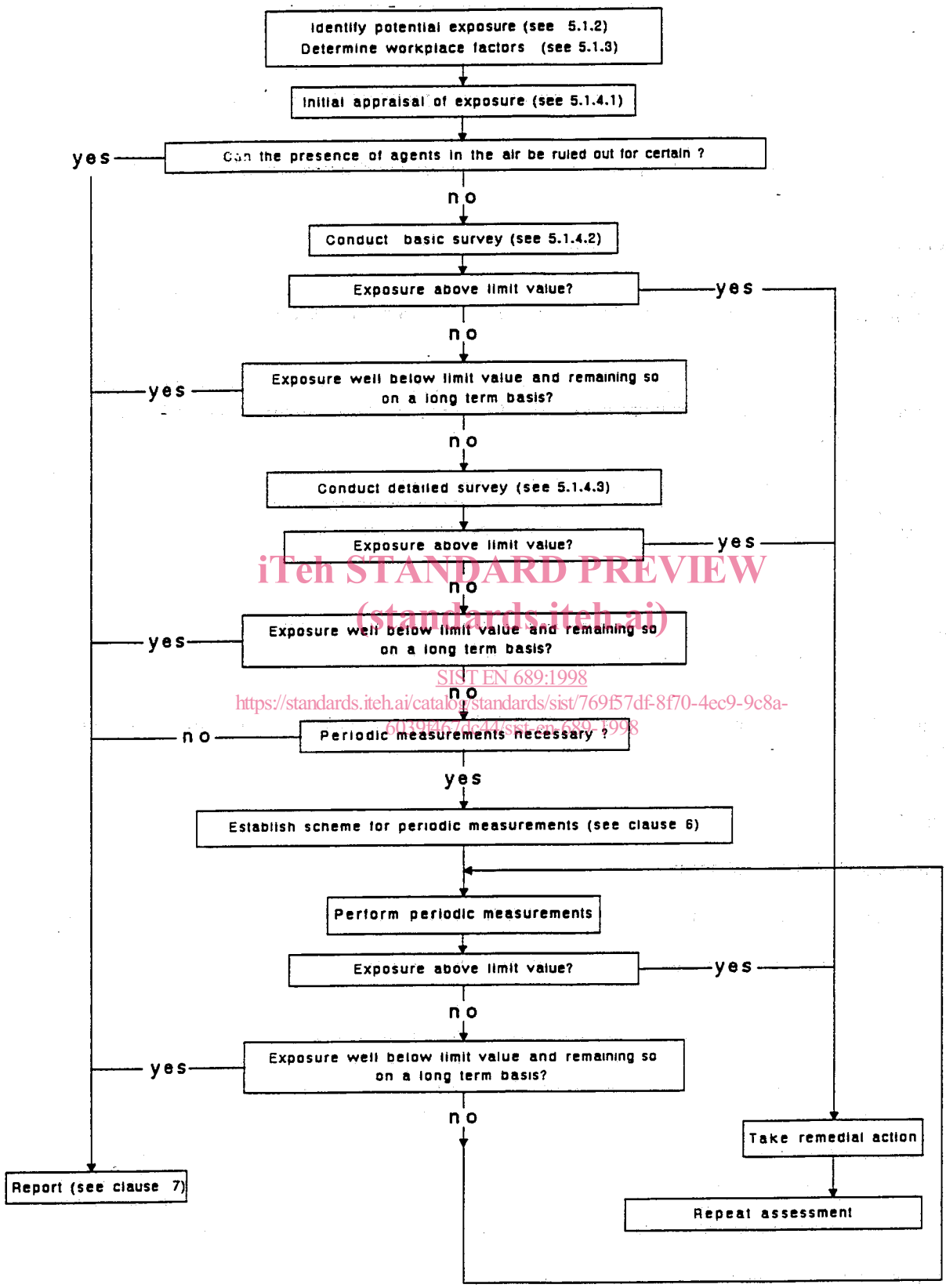

Figure 1: Schematic overview of procedure

5 Occupational exposure assessment

5.1 Assessment strategy

5.1.1 General

The workpattern and workplace under consideration have to be described within the occupational exposure assessment.

The occupational exposure assessment is in three steps :

- identification of potential exposure (list of substances);
- determination of workplace factors;
- assessment of exposures.

5.1.2 Identification of potential exposure

The preparation of a list of all chemical agents in the workplace concerned is an essential first step to the identification of the potential for hazardous exposure. The list includes, as far as any of them can contribute to exposures, primary products, impurities, intermediates, final products, reaction products and by-products.

Appropriate limit values have to be obtained and where these are not available other criteria may be used for the purpose.

In the case of a process not yet in operation this identification may be partially carried out by using relevant available data but such identification will need to be confirmed at a later stage.

5.1.3 Determination of workplace factors

In this step the work processes and procedures are evaluated to gauge the potential for exposure to chemical agents by a detailed review of e.g.:

- job functions: i.e. tasks;
- work patterns and techniques;
- production processes;
- workplace configuration;
- safety precautions and procedures;
- ventilation installations and other forms of engineering control;
- emission sources;
- exposure times;
- work load.

5.1.4 Assessment of exposure

An assessment of exposures which brings together the identification of potential exposures, the workplace factors and the links between them, requires a structured approach and may be conducted in three stages:

- an initial appraisal;
- a basic survey;
- a detailed survey.

For the comparison with the limit value the data about temporal and spatial distribution of the concentrations of the substances in the workplace air have to be collected.

However, it is not necessary to use every stage of the assessment. If it is expected that exposure exceeds the limit value or if it is clearly determined that exposure is well below the limit value then the occupational exposure assessment can be concluded and action taken in accordance with 5.5.

5.1.4.1 Initial appraisal

The initial appraisal, by referring to the list of chemical agents (see 5.1.2) and the workplace factors (see 5.1.3) yields a consideration of the likelihood of exposure.

The variables affecting the airborne concentrations of substances close to an individual are

- the numbers of sources from which agents are released;
- the production rate in relation to production capacity;

- the rates of release from each source;
- the type and position of each source;
- the dispersal of the agents by air movements;
- the type and effectiveness of exhaust and ventilation systems.

The variables related to the individual's actions and behaviour are

- how close the individual is to sources;
- length of time spent in an area;
- the individual's own work practices.

If this initial appraisal shows that the presence of an agent in the air at the workplace cannot for certain be ruled out this agent needs further consideration (see 5.1.4.2 and 5.1.4.3).

5.1.4.2 Basic survey

The basic survey provides quantitative information about exposure of workers concerned, taking particular account of tasks with high exposures. Possible sources of information are

- earlier measurements;

- measurements from comparable installations or workprocesses;

- reliable calculations based upon relevant quantitative data.

If the information obtained is insufficient to enable valid comparison to be made with the limit values, it has to be supplemented by workplace measurements.

5.1.4.3 Detailed survey

The detailed survey is aimed at providing validated and reliable information on exposure when this is close to the limit value.

5.2 Measurement strategy

Generally, for the purposes of obtaining quantitative data on exposures by measurement, an approach should be taken which enables the most efficient use of resources.

Where it is suspected that exposure levels are well below or above the limit values, these clear cases may be confirmed by the use of techniques which are easily applied and which may be less accurate. Other possibilities may be worst case measurements, sampling near emission source or screening measurements. (see 4.2 to 4.4 of EN 482 : 1994). Thus, in these cases, the occupational exposure assessment may often be completed without further investigation.

In other cases, where exposures are suspected to be close to the limit values, then it will be necessary to undertake a more accurate investigation, making full use of the capabilities of instrumental and analytical techniques, where appropriate (see 4.5 of EN 482 : 1994).

5.2.1 Selection of workers for exposure measurements

It is not possible to be precise as to the procedure for selection of a worker or group of workers for exposure measurements. However, some general guidelines can be given.

One possible approach is to sample workers randomly from within the whole exposed population. However, from a statistical standpoint this requires a relatively large number of samples. In many workplaces if this approach is used there is a considerable risk that small subgroups of highly exposed personnel will be missed.

The preferred approach is to subdivide the exposed population into homogeneous groups with respect to exposure. The variability of exposure levels is smaller for well-defined groups than for the exposed workforce as a whole. Thus, where a group of workers is performing identical or similar tasks at the same place and has a similar exposure, sampling such as representative of the group may be carried out within that group.

Groupings have the practical advantage that resources can be concentrated on those groups of workers with the highest exposure.

It is necessary to verify that groups have been properly selected by critical study of the work patterns and examination of the preliminary sampling data.

Within a homogeneous group exposure patterns will still be subject to both random and systematic variations. Professional judgment as to the homogeneity of the defined groups is essential. However, as a rule of thumb, if an individual exposure is less than half or greater than twice the arithmetic mean, the relevant work factors should be closely re-examined to determine whether the assumption of homogeneity was correct.

Professional judgment is also required when deciding on sample size, particularly when small groups are concerned. However, as a general rule, sampling should be carried out for at least one employee in ten in a properly selected homogeneous group.

The frequency at which trials should be made and the number of group, members selected for measurements will depend on how accurate the estimates of the distribution parameters such as the mean and variance need to be, on how far exposures are below the limit value, and the significance of the prevailing exposure levels and the properties of the substances. Where the arithmetic mean of exposure measurements is close to half of the limit value it is likely that some results will exceed the limit value.

If exposure is characterized by peak exposures, then these peaks have to be assessed according to the short term limit requirements, if any.

5.2.2 Fixed-point measurements

Fixed-point measuring systems may be used if the results make it possible to assess exposure of the worker at the workplace.

Samples should as far as possible be taken at breathing height and in the immediate vicinity of workers. If in doubt the point of greatest risk is to be taken as the measuring point.

5.2.3 Selection of measurement conditions

5.2.3.1 Representative measurements

Taking into account the possible influences of all relevant workplace factors, measurement conditions have to be selected in such a way that the measurement results give a representative view of exposure under working conditions.

The best estimate of an individual's exposure is obtained by taking breathing zone samples for the entire working period. Full information on the variation of exposures may be obtained with direct reading instruments or by providing fresh samples as work activities change. This optimum is not always practical and the distribution of actual sampling time should be arranged so that it mostly covers those activities about which there is least information about the likely exposures.

Measurements should be performed on sufficient days and during various specific operations in order to gain insight into the pattern of exposure. It is important to consider different episodes during which exposure conditions may vary (night and day cycles, seasonal variations).

5.2.3.2 Worst-case measurements

When it is possible to identify clearly episodes where higher exposures occur e.g. a high emission due to certain working activities - sampling periods can be selected containing these episodes. This approach is called worst case sampling.

Worst case conditions may be discovered by screening measurements which can show the variations of concentrations in time and space (see 4.2 of EN 482 : 1994).

If, for the purposes of determining the 8-hour time-weighted average exposure, the concentrations found in these cases are presumed to apply for the whole of the working period, then this presumption will err on the side of safety.

Thus, sampling efforts can be concentrated on periods with relatively unfavourable conditions.