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**Health and safety in welding and allied  
processes — Sampling of airborne  
particles and gases in the operator's  
breathing zone —**

Part 2:

**Sampling of gases**

*Hygiène et sécurité en soudage et techniques connexes —  
Échantillonnage de particules en suspension et gaz dans la zone  
respiratoire des opérateurs —*

*Partie 2: Échantillonnage des gaz*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 10882 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10882-2 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 44, *Welding and allied processes*, Subcommittee SC 9, *Health and safety*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, read "...this European Standard..." to mean "...this International Standard...".

ISO 10882 consists of the following parts, under the general title *Health and safety in welding and allied processes — Sampling of airborne particles and gases in the operator's breathing zone*:

- Part 1: *Sampling of airborne particles*
- Part 2: *Sampling of gases*

Annexes A and B of this part of ISO 10882 are for information only.

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## Foreword

The text of EN ISO 10882-2:2000 has been prepared by Technical Committee CEN/TC 121 "Welding", the secretariat of which is held by DS, in collaboration with Technical Committee ISO/TC 44 "Welding and allied processes".

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 2001, and conflicting national standards shall be withdrawn at the latest by March 2001.

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

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## Introduction

Gases encountered during welding and allied processes are so numerous that it would be impracticable to cover them all in this European Standard. Depending on the process, they can include:

- a) fuel gases which are used in gas welding and cutting which on combustion produce carbon dioxide and in some instances carbon monoxide;
- b) shielding gases such as argon, helium, carbon dioxide or mixtures of these gases, which can be toxic or asphyxiant;
- c) gases produced by the action of heat upon the welding flux or slag, e.g. carbon dioxide and carbon monoxide;
- d) gases produced by the action of heat or ultraviolet radiation upon the atmosphere surrounding the welding arc, e.g. nitric oxide, nitrogen dioxide and ozone; and
- e) vapours produced as a result of thermal degradation of surface coatings in the welding or cutting of metals treated with paint, primer, sealer or other substances. Vapours can also be produced as a result of degradation of solvent vapour from degreasing operations, but their measurement is not dealt with in this standard because good working practices will avoid their production.

The scope of this part of EN ISO 10882 has been limited to those gases which are produced by welding operations. In particular, fuel, oxidant and shielding gases used in welding and allied processes are not covered, since the hazards associated with their use (e.g. asphyxiation, explosion) are different from those arising from the gases dealt with in this guide.

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This part of EN ISO 10882 gives a generalised description of measurement methods suitable for the assessment of personal exposure to gases produced by welding and allied processes; gives details of relevant European Standards which specify required characteristics, performance requirements and test methods; augments guidance provided in EN 689 on assessment strategy and measurement strategy; lists basic sampling requirements; and provides specific information about the availability of direct reading electrical apparatus, detector tubes and indirect methods involving laboratory analysis for individual gases.

It has been assumed in the drafting of this standard that the execution of its provisions, and the interpretation of the results obtained, is entrusted to appropriately qualified and experienced people.

## 1 Scope

This part of EN ISO 10882 provides guidance for the determination of personal exposure to gases and vapours in welding and allied processes. It applies to the following thermal processes used to join, cut, surface or remove metals:

- (111) Manual metal arc welding (metal arc welding with covered electrode); shielded metal arc welding /USA/
- (114) Self-shielded tubular-cored arc welding
- (131) Metal inert gas welding; MIG welding; gas metal arc welding /USA/
- (135) Metal active gas welding; MAG welding; gas metal arc welding /USA/
- (136) Tubular-cored metal arc welding with active gas shield; flux cored arc welding /USA/
- (137) Tubular-cored metal arc welding with inert gas shield; flux cored arc welding /USA/
- (141) Tungsten inert gas arc welding; TIG welding; gas tungsten arc welding /USA/
- (15) Plasma arc welding;
- (31) Oxy-fuel gas welding; oxy-fuel gas welding /USA/
- (52) Laser beam welding;
- (912) Flame brazing; torch brazing /USA/
- (97) Braze welding;
- arc and flame gouging; [ISO 10882-2:2000](https://standards.iteh.ai/catalog/standards/sist/72ec30f2-0d4f-4a43-b559-bbb0fc6b561/iso-10882-2-2000)
- arc and laser cutting processes; [http://standards.iteh.ai/catalog/standards/sist/72ec30f2-0d4f-4a43-b559-bbb0fc6b561/iso-10882-2-2000](https://standards.iteh.ai/catalog/standards/sist/72ec30f2-0d4f-4a43-b559-bbb0fc6b561/iso-10882-2-2000)
- flame, plasma and laser and plasma cutting processes;
- metal-spraying (see EN ISO 4063).

The following gases and vapours which can be produced or be present during welding and allied processes are covered:

- ozone (O<sub>3</sub>);
- carbon monoxide (CO);
- carbon dioxide (CO<sub>2</sub>);
- nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>);
- vapours produced in the welding or cutting of metals having paint or other surface coatings.

Fuel, oxidant and shielding gases used in welding and allied processes are not covered.

The general background level of gases and vapours in the workplace atmosphere influences personal exposure, and therefore the role of fixed point measurements is also considered.

## 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 here after. For dated references, subsequent amendments to or revisions of any of these incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 175, *Personal protection — Equipment for eye and face protection during welding and allied processes.*

EN 482, *Workplace atmospheres — General requirements for the performance of procedures for the measurement of chemical agents.*

EN 689:1995, *Workplace atmospheres — Guidance for the assessment of exposure to chemical agents for comparison with limit values and measurement strategy.*

EN 838, *Workplace atmospheres — Requirements and test methods for diffusive samplers for the determination of gases and vapours.*

EN 1076, *Workplace atmospheres — Pumped sorbent tubes for the determination of gases and vapours — Requirements and test methods.*

EN 1231, *Workplace atmospheres — Short term detector tube measurement systems — Requirements and test methods.*

EN 1232, *Workplace atmospheres — Pumps for personal sampling of chemical agents — Requirements and test methods.*

EN 1540, *Workplace atmospheres — Terminology.*

EN ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers.*

EN ISO 10882-1, *Health and safety in welding and allied processes — Sampling of airborne particles and gases in the operator's breathing zone — Part 1: Sampling of airborne particles.*

prEN 45544-1, *Workplace atmospheres — Electrical apparatus for the direct detection and direct concentration measurement of toxic gases and vapours — Part 1: General requirements and test methods.*

ISO 3534-1, *Statistics — Vocabulary and symbols — Part 1: Probability and general statistical terms.*

ISO 6879, *Air quality — Performance characteristics and related concepts for air quality methods.*

ISO 8756, *Air quality — Handling of temperature, pressure and relative humidity data.*

## 3 Terms and definitions

For the purposes of this part of EN ISO 10882, the following terms and definitions apply:

### 3.1

#### air sampling

process consisting of the collection, withdrawal or isolation of a fractional part of a larger volume of air. It can include the simultaneous isolation of selected components. (EN 1540)

### 3.2

#### bias

consistent deviation of the measured value from the value of the air quality characteristic itself or the accepted reference value. (ISO 6879)



**3.3****breathing zone**

the space around the worker's face from where he takes his breath. For technical purposes a more precise definition is as follows: hemisphere (generally accepted to be 0,3 m in radius) extending in front of the human face, centred on the mid point of a line joining the ears; the base of the hemisphere is a plane through this line, the top of the head and the larynx. The definition is not applicable when respiratory protective equipment is used. (EN 1540)

NOTE This definition is not strictly applicable when a welder's face shield is used. In such circumstances the breathing zone should be considered to extend only behind the welder's face shield.

**3.4****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.

NOTE This definition is taken from the "Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work". (EN 1540)

**3.5****detector tube, diffusive; indicator tube, diffusive; colorimetric tube, diffusive**

a diffusion tube, similar in construction to a pumped detector tube. The length of the stain produced provides a measure of the exposure dose of a specified chemical agent in air, stated in ppm hours.

**3.6****detector tube, pumped; indicator tube, pumped; colorimetric tube, pumped**

a glass tube containing chemical reagents in which a colour change may be produced when a sample of the atmosphere is drawn through it. The length of the stain produced provides a measure of the concentration of a specified chemical agent in air.

**3.7****diffusion tube; diffusive tube; tube type diffusive sampler**

a diffusive sampler with a cross-sectional area which is small in relation to the internal air gap, across which the gas or vapour passes by diffusion to the sorbent.

**3.8****diffusive badge; badge type diffusive sampler; passive badge**

a diffusive sampler in which the gas or vapour passes to the sorbent by permeation through a thin solid membrane or diffusion across a porous membrane. The cross-sectional area is large in relation to the internal air gap.

**3.9****diffusive sampler; passive sampler**

a device which is capable of taking samples of gases or vapours from the atmosphere at a rate controlled by a physical process such as gaseous diffusion through a static air layer or permeation through a membrane, but which does not involve the active movement of air through the sampler. (EN 838)

**3.10****direct reading electrical apparatus; direct reading instrument**

apparatus in which the presence of a gas or vapour causes a change that is manifest as an automatically generated electrical signal. When applied to a calibrated indicating or recording meter, this gives a direct measure of the concentration of the relevant gas or vapour.

**3.11****exposure (by inhalation)**

a situation in which a chemical or biological agent is present in air which is inhaled by a person. (EN 1540)

**3.12****fixed apparatus**

an apparatus which is intended to have all parts permanently installed. (prEN 45544-1)

3.13

**harness**

An assembly that provides a means of maintaining a welder's face shield in position on the head. (EN 175)

3.14

**interferent**

any component of the air sample, excluding the constituent(s) to be measured, affecting the instrument reading. (EN 1540)

3.15

**limit value**

reference figure for the concentration of a chemical or biological agent in air (EN 1540)

3.16

**long term detector tube**

a detector tube that provides a means of obtaining a measurement of the time weighted average concentration of a specified chemical agent in air

3.17

**operator**

a person who performs welding and allied processes.

3.18

**overall uncertainty** (of a measuring procedure or of an instrument)

quantity used to characterize as a whole the uncertainty of the result given by an apparatus or a measuring procedure. It is expressed, as a percentage, by a combination of bias and precision, usually according to the formula :

$$\frac{|\bar{x} - x_{ref}| + 2s}{x_{ref}} \times 100$$

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where

- $\bar{x}$  is the mean value of results of a number (n) of repeated measurements;
- $x_{ref}$  is the true or accepted reference value of concentration;
- $s$  is the standard deviation of measurements. (EN 1540)

3.19

**personal sampler**

a device attached to a person that samples air in the breathing zone. (EN 689)

3.20

**personal sampling**

the process of sampling carried out using a personal sampler. (EN 1540)

3.21

**portable apparatus**

spot reading or continuously sensing apparatus that has been designed to be readily carried from place to place and to be used whilst being carried. Portable apparatus is battery powered. (prEN 45544-1)

3.22

**precision**

the closeness of agreement of results obtained by applying the method several times under prescribed conditions. (ISO 6879)

**3.23****reference period**

the specified period of time stated for the limit value of a specific chemical agent. (EN 1540)

**3.24****sampler**

a device for sampling.

**3.25****screening measurements of time weighted average concentration**

measurements performed to obtain relatively crude information on the exposure level in order to decide whether an exposure problem exists at all and if so to appraise its possible seriousness. They can also be used to determine if the exposure is well below or well above the limit value.

**3.26****screening measurements of variation of concentration in time/and or space**

measurements performed to provide information on the likely pattern of concentration of chemical agents. They can be used to identify locations and periods of elevated exposure and to set the duration and frequency of sampling for measurements for comparison with limit values. Emission sources can be located and the effectiveness of ventilation or other technical measures can be estimated.

**3.27****selectivity**

degree of independence from interferents. (EN 482)

**3.28****short term detector tube**

a detector tube that provides a means of obtaining a rapid measurement (typically up to 15 min) of the concentration of a specified chemical agent in air. (EN 1231)

**3.29****sorbent tube, pumped**

a tube, usually made of metal or glass, containing an active sorbent or reagent-impregnated support, through which sampled atmosphere is passed at a rate controlled by an air sampling pump. (EN 1076)

**3.30****time weighted average (TWA) concentration**

the concentration of a chemical agent in the atmosphere, averaged over the reference period.

**3.31****transportable apparatus**

an apparatus not intended to be portable, but which can be readily moved from one place to another. (prEN 45544-1)

**3.32****true value**

the value which characterizes a quantity perfectly defined in the conditions which exist when that quantity is considered. (ISO 3534-1)

**NOTE**

The true value of a quantity is a theoretical concept and, in general, cannot be known exactly.

**3.33****welder's face shield**

a welder's shield worn on the head and in front of the face, usually secured in position by a harness, to give protection to the eyes and face when fitted with appropriate filter(s). (EN 175)

**3.34****welder's hand shield**

a welder's shield held in the hand to give protection to the eyes and face when fitted with appropriate filter(s). (EN 175)