
**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

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

Partie 1: Échantillonnage des particules en suspension



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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Foreword

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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 10882-1 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 security*, 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* [ISO 10882-1:2001](https://standards.iteh.ai/catalog/standards/sist/65ce63a3-6d6b-4d1d-a058-989d25e74463/iso-10882-1-2001)
- Part 2: *Sampling of gases*

Annexes A to E of this part of ISO 10882 are for information only.

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Foreword

The text of EN ISO 10882-1:2001 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 July 2001, and conflicting national standards shall be withdrawn at the latest by July 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

This part of EN ISO 10882 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; specifies a procedure for gravimetric determination of personal exposure to welding fume; and provides information about the use of chemical analysis to determine personal exposure to specific chemical agents in welding fume.

A person who performs welding and allied processes (the operator) can be exposed to welding fume and to other airborne particles generated by welding related operations, e.g. grinding. In some instances exposure to other airborne particles can be higher than exposure to welding fume. It is therefore necessary to carefully consider this possibility when using the method described in this standard.

Welding fume consists of airborne particles generated by welding and allied processes. In general, these particles are less than 1 μm in diameter, and respirable. However, most countries currently have exposure limits for welding fume, and for specific chemical agents present in welding fume, that apply to the inhalable fraction of airborne particles. This part of EN ISO 10882 therefore specifies a procedure for sampling the inhalable fraction, but the respirable fraction should be sampled in cases where exposure limits apply to that fraction.

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.

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1 Scope

This part of EN ISO 10882 specifies a procedure for personal sampling of airborne particles in welding and allied processes.

The procedure describes determination of personal exposure to welding fume and other airborne particles generated by welding related operations.

The general background level of airborne particles in the workplace atmosphere influences personal exposure, and therefore the role of fixed point sampling is also considered.

Guidance is given on the use of chemical analysis to determine personal exposure to specific chemical agents present in welding fume, but analytical methods are not described.

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

EN 481:1993, *Workplace atmospheres — Size fraction definitions for measurement of airborne particles*

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

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

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*

prEN 13205:1998, *Workplace atmospheres - Assessment of performance of instruments for measurement of airborne particle concentrations*

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 measuring methods*

3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply:

3.1

air sampling

a 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, centered on a 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, pure or mixed, produced by welding and allied processes or welding related operations.

3.5

exposure (by inhalation)

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

3.6

filler material

consumables added during the welding process to form the weld, i.e. welding rods, wire, stick electrodes etc.

3.7

harness

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

3.8

headband

that part of the harness to which the welder's face shield is fixed and which surrounds the head, or that part of the welder's goggles or welder's spectacles which secures the goggles or spectacles onto the head. (EN 175)

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3.9

inhalable fraction

the mass fraction of total airborne particles which is inhaled through the nose and mouth. (EN 481)

NOTE The inhalable fraction depends on the speed and direction of the air movement, on breathing rate and other factors.

3.10

limit value

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

3.11

operator

a person who performs welding and allied processes.

3.12

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

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

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

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 482)

3.13

personal sampler

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

3.14

personal sampling

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

3.15

precision

the closeness of agreement between independent test results obtained under stipulated conditions. (ISO 6879)

3.16

reference period

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

3.17

respirable fraction

the mass fraction of inhalable particles penetrating to the unciliated airways. (EN 481)

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3.18

sampler

a device for air sampling.

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3.19

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.

3.20

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.

3.21

suspended matter

particles that remain airborne long enough to be detected by any physical means. (EN 1540)

3.22

time-weighted average (TWA) concentration

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

3.23

total airborne particles

all particles surrounded by air in a given volume of air. (EN 481)

3.24

true value

the value which characterises a quantity perfectly defined in the conditions which exist at the moment 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. (EN 1540)

3.25

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 the appropriate filter(s). (EN 175)

3.26

welder's goggles

a device, held in position usually by a headband, enclosing the orbital cavity, into which radiation arising from welding and allied processes can penetrate only through filter(s) and, where provided, filter cover(s). (EN 175)

3.27

welder's hand shield

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

3.28

welder's spectacles

a frame, with lateral protection, holding suitable filters in front of the eyes, to give them protection.

NOTE It may be held in position with sidearms or a headband fitting. (EN 175)

3.29

welding (and allied processes)

thermal processes used to join, cut, surface or remove metals, but excluding low temperature processes such as soldering.

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3.30

welding episode

a period during which the operator carries out welding and allied processes. For practical purposes this may include welding related operations, except when these generate a significant quantity of airborne particles e.g. during lengthy periods of grinding.

3.31

welding fume

airborne particles generated during welding episodes.

3.32

welding protector

a device which provides protection to the wearer against harmful optical radiation and other specific hazards generated by welding and allied processes.

NOTE: It may be a welder's shield, welder's goggles or welder's spectacles. (EN 175)

3.33

welding related operations

operations other than welding and allied processes carried out by the operator.

3.34

work pattern

the sequence of activities carried out by the worker during the period under consideration. (EN 1540)

3.35

workplace

the defined area or areas in which the work activities are carried out. (EN 689)

3.36**worst case measurements**

screening measurements of time-weighted average concentration made to identify work activity during which highest exposure occurs.

4 Principle

Welding fume is collected by drawing a known volume of air through a preweighed filter or filter cassette, mounted in a sampler designed to collect the inhalable fraction of airborne particles (or the respirable fraction of airborne particles, if appropriate - see the introduction). For personal sampling, the sampler is positioned in the operator's breathing zone, which is inside the welder's face shield, when one is worn. It will be necessary for the operator to wear special apparatus that enables the sampler to be maintained in position in the breathing zone throughout the sampling period without impeding normal work activity.

At the end of the sampling period, the mass of welding fume collected is determined by reweighing the filter or filter cassette. The mass concentration of welding fume in air is calculated by dividing this by the volume of air sampled.

Exposure to specific chemical agents in welding fume may be determined by chemical analysis of the sample. Alternatively, it may be estimated from the mass concentration of welding fume in air using fume analysis data for filler materials, e.g. from fume analysis data sheets.

5 Requirement

Procedures used for assessment of personal exposure to welding fume and other airborne particles generated by welding related operations shall comply with the provisions of EN 482.

6 Equipment

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6.1 Sampling equipment**6.1.1 Samplers**

The samplers used shall collect the inhalable fraction of airborne particles, as defined in EN 481. They shall comply with the provisions of prEN 13205:1998 and shall be compatible with the filters (6.1.2) and the sampling pumps (6.1.3) used.

If chemical analysis of welding fume is to be carried out (see 10.1) the samplers used shall not be constructed from material which could influence the analytical result.

NOTE 1 If measurements are made for comparison with an exposure limit which applies to the respirable fraction of airborne particles, as defined in EN 481, a sampler that collects that fraction should be used.

NOTE 2 A number of different terms are used to describe samplers designed for collection of the inhalable fraction of airborne particles e.g. sampling heads, filter holders, filter cassettes and air monitoring cassettes.

NOTE 3 In general, the collection characteristics of aerosol samplers are such that particulate matter collected on the filter constitutes the sample, and any particulate matter deposited on the internal surfaces of the sampler is not of interest. The filter is removed from such samplers for weighing. However, some samplers are designed such that airborne particles which pass through the entry orifice(s) constitute the sample, in which case this includes particulate matter deposited on the internal surfaces of the sampler. In most cases, such samplers incorporate an internal filter cassette or cartridge which is removed from the sampler for weighing.

NOTE 4 Samplers manufactured in non-conducting material have electrostatic properties which can influence representative sampling. Electrostatic influences should be reduced, where possible, by using samplers manufactured from conducting material.

NOTE 5 In general, personal samplers for collection of the inhalable fraction of airborne particles do not exhibit the same size selective characteristics if used for fixed point sampling.

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NOTE 6 Personal samplers that separately determine the respirable and inhalable fractions of airborne particles could be useful to distinguish between exposure to submicron particles generated by welding and allied processes and larger particles generated by welding related operations. If such samplers become available their use would be an alternative to collection of separate samples to discriminate between welding fume and other airborne particles, as advocated in 8.4.3.2.

6.1.2 Filters

The filters used shall be of a diameter suitable for use in the selected sampler (6.1.1), and shall meet the following requirements:

- a) The filters shall have a retentivity not less than 99,5 % for particles with a 0,3 μm diffusion diameter (see note to 2.2 of EN 481:1993);
- b) The filters shall be suitable for use in the gravimetric method described. In particular, they shall be sufficiently resistant to moisture retention and shall not be excessively friable;
- c) If chemical analysis of the sample is to be carried out, the filters shall not be of a type that can react with the chemical agents to be determined and shall be compatible with the analytical method.

6.1.3 Sampling pumps

The sampling pumps used shall comply with the provisions of EN 1232. They shall have an adjustable flow rate, incorporate a flowmeter or a flow fault indicator, and be capable of maintaining the required flow rate to within ± 5 % of the nominal value throughout the sampling period. For personal sampling the pumps shall be capable of being worn without impeding the operator's normal work activity. The pumps shall give a pulsation-free flow (if necessary a pulsation damper shall be incorporated between the sampler and the pump, as near to the pump as possible).

NOTE Flow-stabilised sampling pumps might be required to maintain the flow rate within the limits specified in 6.1.3.

6.1.4 Flowmeter

The flowmeter used shall be portable, capable of measuring the flow rate (see 9.2.3) to within ± 5 %, and calibrated against a primary standard i.e. a flowmeter whose accuracy is traceable to national standards.

NOTE 1 The flowmeter incorporated in the sampling pump should not be used unless it has been shown to have adequate sensitivity, has been calibrated against a primary standard with a loaded sampler in line, and is read whilst in a vertical orientation if it is of the supported float type. If such a flowmeter is used, it is particularly important to ensure that there are no leaks in the sampling train between the sampler and the flowmeter, since in this event a flowmeter in the sampling pump or elsewhere in line will give an erroneous flow rate.

NOTE 2 A soap bubble flowmeter may be used as a primary standard, provided its accuracy is traceable to national standards.

NOTE 3 If appropriate (see 9.2.4.2), the atmospheric temperature and pressure at which the flowmeter was calibrated should be recorded.

6.1.5 Ancillary equipment

A variety of ancillary equipment is required including

- flexible tubing, which shall be of a diameter suitable for making a leakproof connection from the samplers (6.1.1) to the sampling pumps (6.1.3);
- belts, to which the sampling pumps can conveniently be attached, unless they are small enough to fit in the operator's pockets;
- flat-tipped tweezers for loading and unloading filters into samplers; and
- filter transport cassettes or other suitable containers, to hold filters or filter cassettes while filters are conditioned (see 9.1.2) and for transport of samples to the weighing room.