

---

---

**Health and safety in welding and allied  
processes — Laboratory method for  
sampling fume and gases generated by  
arc welding —**

Part 2:

**Determination of emission rates of gases,  
except ozone**

iTeh STANDARD PREVIEW  
(standards.iteh.ai)

*Hygiène et sécurité en soudage et techniques connexes — Méthode de  
laboratoire d'échantillonnage des fumées et des gaz émis par le  
soudage à l'arc —*

*Partie 2: Détermination du taux d'émission des gaz, à l'exception de  
l'ozone*



**PDF disclaimer**

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[ISO 15011-2:2003](#)

<https://standards.iteh.ai/catalog/standards/sist/fba5b5e5-15cd-4e02-9e98-7a73d6c80a64/iso-15011-2-2003>

© ISO 2003

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

## 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 2.

The main task of technical committees is to prepare International Standards. 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 the member bodies casting a vote.

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

ISO 15011-2 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/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 document, read "...this European Standard..." to mean "...this International Standard...".

ISO 15011 consists of the following parts under the general title *Health and safety in welding and allied processes — Laboratory method for sampling fume and gases generated by arc welding*:

- *Part 1: Determination of emission rate and sampling for analysis of particulate fume*
- *Part 2: Determination of emission rates of gases, except ozone*
- *Part 3: Determination of ozone concentration using fixed point measurements*

# Contents

	page
Foreword .....	v
Introduction .....	vi
1 Scope .....	1
2 Normative references .....	1
3 Terms and definitions .....	2
4 Principle .....	2
5 Measurement methods .....	2
5.1 Gases .....	2
5.2 Fume box air flow rate .....	3
6 Equipment .....	3
6.1 Fume box .....	3
6.2 Ventilator or pump .....	3
7 Sampling .....	3
7.1 Sampling position .....	3
7.2 Sampling equipment .....	3
7.3 Sample filtration .....	4
7.4 Multiple sampling .....	4
7.5 Volume of sampling line .....	4
7.6 Sampling flow rate .....	4
7.7 Fume box ventilation air flow rate .....	4
7.8 Handling of temperature, pressure and humidity data .....	4
8 Measurement of individual gases .....	5
8.1 General .....	5
8.2 Carbon monoxide .....	5
8.3 Carbon dioxide .....	5
8.4 Nitrogen oxide and nitrogen dioxide .....	5
9 Test report .....	6
Annex A (informative) Organic gases .....	7
Annex B (informative) Examples of fume box arrangements for determination of emission rates of gases in arc welding, except ozone .....	8
Annex C (informative) Test report .....	10
Bibliography .....	11

iTeh STANDARD PREVIEW

(standards.iteh.ai)

ISO 15011-2:2003

[https://standards.iteh.ai/catalog/standards/sist/fba5b5e5-15cd-4e02-9e98-](https://standards.iteh.ai/catalog/standards/sist/fba5b5e5-15cd-4e02-9e98-7a73d6c80a64/iso-15011-2-2003)

[7a73d6c80a64/iso-15011-2-2003](https://standards.iteh.ai/catalog/standards/sist/fba5b5e5-15cd-4e02-9e98-7a73d6c80a64/iso-15011-2-2003)

## Foreword

The text of EN ISO 15011-2:2003 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 November 2003, and conflicting national standards shall be withdrawn at the latest by November 2003.

This standard consists of the following parts:

- Part 1: Determination of emission rate and sampling for analysis of particulate fume;
- Part 2: Determination of emission rates of gases and vapours, except ozone;
- Part 3: Determination of ozone concentration using fixed point measurements.

The annexes A, B and C are informative.

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

[ISO 15011-2:2003](https://standards.iteh.ai/catalog/standards/sist/fba5b5e5-15cd-4e02-9e98-7a73d6c80a64/iso-15011-2-2003)

<https://standards.iteh.ai/catalog/standards/sist/fba5b5e5-15cd-4e02-9e98-7a73d6c80a64/iso-15011-2-2003>

## Introduction

Welding and allied processes produce airborne particles and gaseous by-products, which can be harmful to human health. Knowledge of the quantity and composition of the airborne particles and gases emitted can be useful for occupational hygienists in assessing workplace atmospheres and in determining appropriate control measures. Emission rates cannot be used directly to assess the welder's exposure, but it is expected that processes, consumables and welding parameters giving low emission rates will result in lower welder exposures than processes with high emission rates used in the same working situation.

The laboratory procedure described in this standard can be used to determine the emission rate of gases generated by arc welding and provides a method of sampling the gases for chemical analysis. The gases generated and their emission rates depend upon the welding process, welding parameters, work piece surface, coatings, etc.

In the context of this standard emission rate means the total amount of a substance per unit time that is produced under defined process conditions, by different reactions in the system defined in this standard.

Gases encountered in arc welding are so numerous that it would be impracticable to cover them all in this standard. The scope of this standard has therefore been limited to those gases, which are commonly generated during arc welding.

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

[ISO 15011-2:2003](https://standards.iteh.ai/catalog/standards/sist/fba5b5e5-15cd-4e02-9e98-7a73d6c80a64/iso-15011-2-2003)

<https://standards.iteh.ai/catalog/standards/sist/fba5b5e5-15cd-4e02-9e98-7a73d6c80a64/iso-15011-2-2003>

## 1 Scope

This European Standard provides guidance on the determination of emission rates of gases generated by arc welding using a fume box technique. It describes the test principle, gives a possible fume box arrangement and considers methods for sampling and analysis.

The following gases that can be produced during arc welding are covered:

- Carbon monoxide (CO);
- Carbon dioxide (CO<sub>2</sub>);
- Nitrogen oxide (NO);
- Nitrogen dioxide (NO<sub>2</sub>).

The fume box described in this standard can also be used for the determination of organic gases produced in the arc welding of coated metals, e.g. primed, painted or plastic coated material (see annex A for further information).

Ozone is considered in EN ISO 15011-3.

## 2 Normative references

This European Standard incorporates by dated or undated references, 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 (including amendments).

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

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

EN 1540, *Workplace atmospheres – Terminology.*

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

EN ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers (ISO 4063:1998).*

EN ISO 10882-2, *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 (ISO 10882-2:2000).*

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

ISO 5167-1, *Measurements of fluid flow by means of pressure differential devices - Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross sections conduits running full.*

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

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

### 3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 1540, ISO 6879, EN ISO 10882-2, EN 482, EN 1076, ISO 3534-1, EN ISO 4063 and the following apply.

#### 3.1

##### **fume box**

closed or semi-closed ventilated chamber used for sampling and determination (emission rate and composition) of fume and gases in welding and allied processes

### 4 Principle

Arc welding is performed in a fume box suitable for the process. During testing the gases produced are captured and continuously extracted from the fume box using a ventilator or pump. The emission rates of gases are calculated by multiplication of the gas concentration in the outlet air and the air flow rate.

### 5 Measurement methods

#### 5.1 Gases

##### 5.1.1 General

A complex mixture of particulates and gases is produced by most arc welding processes, and, whatever method of sampling and analysis is selected, it is necessary to confirm that techniques, which have been used successfully for other applications, are suitable for use with emission rate measurements. Particular attention shall be paid to the possibility of interference with the determination of one gas by the presence of another.

For fume box testing of arc welding processes, the concentrations of gases can be determined using either direct or indirect methods.

Direct reading electrical apparatus is generally most appropriate for the measurement of gases. Indirect methods, which involve laboratory analysis of samples collected using a suitable solid or liquid sorbent, are most appropriate for the determination of organic gases, which can be produced in the arc welding of metals having paint or other coatings.

##### 5.1.2 Direct methods

Direct reading instruments, that can be accurately calibrated, are available for the measurement of gases covered by this standard.

Analysis is usually performed on an air sample drawn through the instrument using a pump. Measurements that involve the use of spectrometry or an electrochemical sensor, can be made directly or indirectly following reaction of the sample with solids, liquids or gases.

Both pumped and diffusive detector tubes provide a direct method of gas analysis but they are not sufficiently accurate for measurements involving fume box testing.

##### 5.1.3 Indirect methods

Indirect methods have separate sampling and analysis stages and involve the use of sorbent tubes and liquid sorbent methods. They are widely applicable to the measurement of organic gases, such as those emitted in the welding of coated metals. Generally they exhibit low relative overall uncertainty and good selectivity but are seldom appropriate to measurement of other gases covered in this standard.



Sorbent tubes are available for some of the gases and for most of the organic gases produced when welding metals having paint or other coatings. The associated analytical technique used varies according to which gases and organic gases are to be determined.

In liquid sorbent methods the sample is drawn through a liquid contained in a bubbler and the resultant solution analysed.

## 5.2 Fume box air flow rate

It is important to measure accurately the flow rate (see ISO 5167-1).

The airflow rate through the fume box can be measured directly using a flow meter or indirectly as the product of the air velocity and the area of the ventilation tube.

## 6 Equipment

### 6.1 Fume box

The fume box should consist of a process chamber, a ventilation outlet section containing probes for gas sampling and, if appropriate, an air inlet section.

Examples of possible fume box arrangements for sampling and determining the emission rate of gases in arc welding are given in annex B.

NOTE 1 The process chamber should be suitable for the process, i.e. it should enclose the process and be large enough to allow complete capture of the gases emitted.

NOTE 2 The ventilation airflow through the process chamber should reinforce the thermal air movement, i.e. the ventilation outlet section should be positioned above the process and the air inlet beneath.

### 6.2 Ventilator or pump

The airflow capacity of the pump or ventilator shall be sufficient to ensure complete capture of the emitted gases inside the fume box, but should not affect the integrity of the process.

## 7 Sampling

### 7.1 Sampling position

Sampling of gases shall be performed in the fume box outlet section or in the ventilation line in a position where gases are uniformly mixed with the air. The sampling distance, from the outlet of the fume box, should be approximately 5 times the diameter of this outlet.

### 7.2 Sampling equipment

#### 7.2.1 Direct reading electrical apparatus

Direct reading electrical apparatus for fume box measurements of gases in arc welding should comply with the provisions of EN 45544-1.

#### 7.2.2 Sorbent tubes

Sorbent tube methods used for fume box measurements of gases should comply with the provisions of EN 1076.