INTERNATIONAL STANDARD

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

Part 3: Determination of ozone concentration using fixed point measurements

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 3: Détermination de la concentration en ozone à l'aide d'une mesure à points fixes

Reference number
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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.

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 part of ISO 15011 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15011-3 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*

— *Part 4: Fume data sheet for risk assessment*

Annex A forms a normative part of this part of ISO 15011. Annexes B and C are for information only.

Contents

Foreword

The text of EN ISO 15011-3:2002 as 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 EN ISO 15011-3:2002 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2003, and conflicting national standards shall be withdrawn at the latest by May 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.

Annex A is normative. The annexes 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, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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 lower emission rates will result in lower welder exposures than processes with high emission rates used in the same working situation.

The purpose of this standard is not to measure the emission rate of ozone but to measure ozone concentrations around a welding arc. In this case, the measurement of lower ozone concentrations is expected to correlate with lower exposure to ozone in the work place under similar work conditions.

Thus, this standard allows the effect of changes in welding conditions on exposure to ozone, under similar conditions in the workplace, to be predicted and best practice with regard to ozone reducing measures to be defined.

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.

1 Scope

This European Standard specifies a laboratory method for evaluating ozone emissions generated during arc welding by measuring ozone concentrations at fixed points around a stationary welding arc.

The results can be used to compare the effect of welding parameters, processes, etc. on ozone generation and hence to predict changes in workplace exposure under similar working conditions.

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 revisions. 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 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).*

EN ISO 15011-1, *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 (ISO 15011-1:2001).*

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 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, EN ISO 15011–1 and the following apply.

3.1
Fixed Point (FP)
point of measurement at defined distances from the arc

4 Principle

Arc welding is performed, on a test piece, in a chamber or room and ozone concentrations are measured at a Fixed Point relative to the arc.

Additional measurements shall be made at other Fixed Points (see clause 5), if required.

5 Procedure

5.1 Position of Fixed Points

It is mandatory to perform a measurement at the following Fixed Point:

— FP1 at a distance of 250 mm horizontally and vertically from the arc.

FP1 corresponds to a typical position for the breathing zone of a welder.

For further information, other measurements may be performed at the following Fixed Points:

— FP2 at a distance of 300 mm vertically above the arc; this is normally expected to be the area of maximum ozone concentration.

— FP3 at a distance of 500 mm horizontally and vertically from the arc.

These Fixed Points are illustrated in annex A.

If measurements are made at several Fixed Points, the points shall be in the same vertical plane.

5.2 Welding test

A welding test shall involve a welding period of at least 1 minute during which the arc remains stationary and the test piece traverses underneath.

During welding, ozone concentrations shall be measured and recorded and the average stable concentration calculated.

5.3 Test location

The test shall be completed in a chamber or a room, such that the welding column can rise in an undisturbed way and does not give a continual increase in the measured concentration data.

Placing a small extracted hood (see Figure A.2) at a defined distance above the arc (see Figure A.1) may reduce variations in the ozone concentrations measured at FP2.

Before each further test, the test room shall be ventilated until the ozone concentration reaches background level.

6 Measurement methods

Because of the instability of ozone, only direct reading apparatus is appropriate.

Direct reading electrical instruments used for the measurement of ozone most commonly work on one of the following principles:

a) chemiluminescence;

b) absorption of ultraviolet radiation;

An alternative measurement method, the UV radiation tube, may also be used (see annex B). This equipment does not take into account any effects from chemical reactions with ozone or convection currents.

Instrument response shall be checked before and after each test using a calibrated ozone generator.

These three methods are expected to provide different absolute ozone concentrations but to provide a similar ranking of the measured values.

7 Sampling equipment and procedure

7.1 Sampling system

The sampling line/s and probe/s shall be made of stainless steel or PTFE or a combination of both.

Particulate fumes shall be prevented from entering the sampling line/s using filters.

Filters shall be changed frequently to prevent the build up of particulate deposits, which may react with ozone and reduce the measured concentration.

To ensure that the sample collection system will not reduce the ozone concentration in the sampled air, it is necessary to pass air containing at least 1 ppm ozone from an ozone generator through the collection system for at least 1 min, before sampling commences and after each filter change.

7.2 Ozone generator

The ozone generator shall be calibrated using a suitable reference method.

7.3 Test pieces

Welding shall be performed on a test piece.

All details concerning the test piece shall be recorded on the test report (see annex C).

7.4 Analysis and results

Five tests shall be carried out at each Fixed Point evaluated.

The individual average stable ozone concentration for each of the five tests shall be calculated and the overall average stable ozone concentration calculated from those five values.

The individual average stable ozone concentrations shall not differ from the overall average value by more than 25 %.

If any of the individual average results do not fulfil this requirement, then five further tests shall be performed.

The highest and the lowest individual average values shall then be discarded and a new overall average stable ozone concentration for the remaining eight tests shall be calculated.

Each individual average value shall not differ from the new overall average for the eight tests by more than 25 %.

If any of the individual average results of the remaining eight tests do not fulfil this requirement, then the tests shall be deemed as inappropriate for that situation.

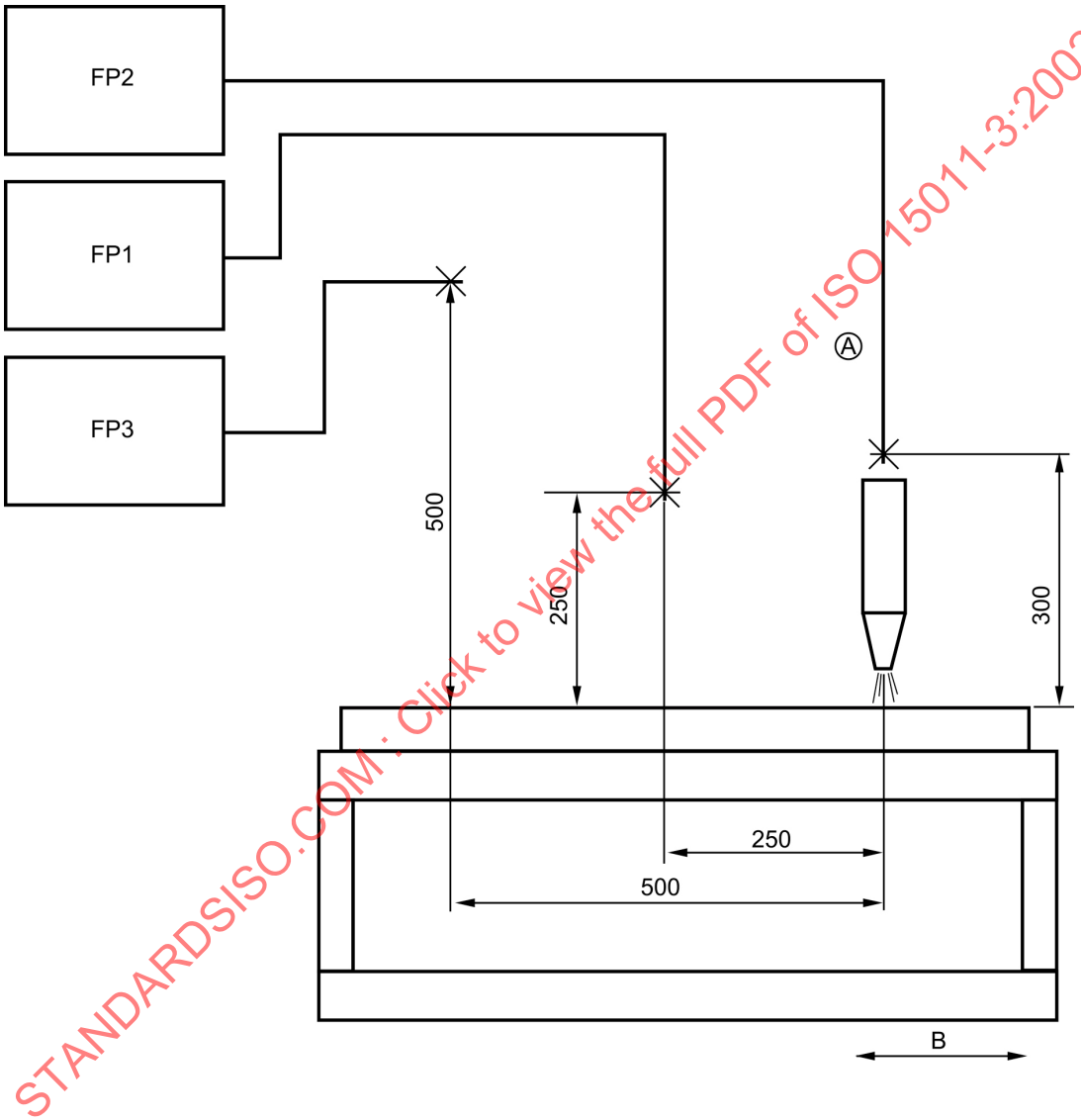
8 Test report

An example of a test report is given in annex C.

Annex A
(normative)

Location of Fixed Points

Dimensions in millimetres



Key

FP1 Ozone detector connected to Fixed Point 1

FP2 Ozone detector connected to Fixed Point 2

FP3 Ozone detector connected to Fixed Point 3

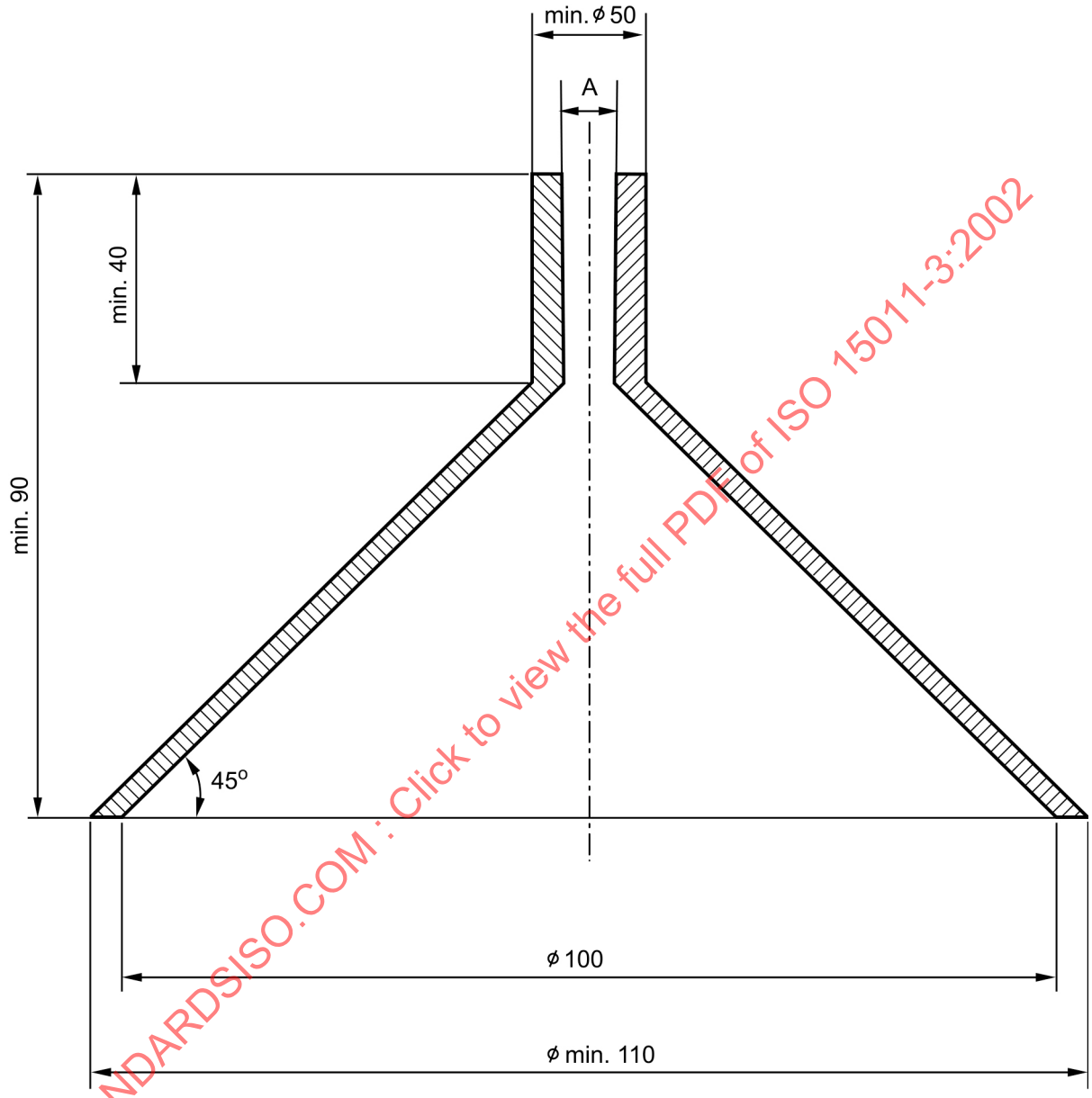
A Location of hood

B Welding direction of the plate

Figure A.1 — Location of Fixed Points

The torch may be inclined in either direction but the direction shall be noted in the test report. The welding direction shall also be recorded.

Dimensions in millimetres



Key

A Diameter for sampling line

Figure A.2 — Small hood placed at FP2

Annex B
(informative)

Description of the UV radiation tube

The UV radiation tube (see Figure B.1) can be characterised as follows:

— The UV-radiation enters the tube through a window made either from fused silica or CaF_2.

— A constant flow of synthetic air or pure oxygen should be introduced into the tube through a sintered-powder metal insert which produces a laminar flow.

— The synthetic air or oxygen should comply with the following specification:

H_20 < 10 ppm

$N0_x$ < 0,1 ppm

Hydrocarbon < 0,5 ppm

$C0_2$ < 0,5 ppm.

The outlet of the tube should be connected to the inlet of the ozone meter.

Ozone formation in the tube is independent of the tube dimensions. Ozone generation is only dependent on the window area and the location of the window relative to the arc.

Ozone concentrations are inversely proportional to the flow rate.