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

Part 5:

**Identification of thermal-degradation  
products generated when welding or  
cutting through products composed  
wholly or partly of organic materials**

ISO/TS 15011-5:2006

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*Hygiène et sécurité en soudage et techniques connexes — Méthode de  
laboratoire d'échantillonnage des fumées et des gaz —*

*Partie 5: Identification des produits de dégradation thermique générés  
lors du soudage ou du coupage de produits entièrement ou  
partiellement constitués de matériaux organiques*



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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 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.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

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/TS 15011-5 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 44, *Welding and allied processes*, 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).

ISO/TS 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*:

- *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 sheets*
- *Part 5: Identification of thermal-degradation products generated when welding or cutting through products composed wholly or partly of organic materials* [Technical Specification]

## Introduction

Welding and cutting activities generate fumes and gases that can be harmful to health and that must be controlled within limits laid down in regulations. To assess the risks to health arising from such activities it is necessary to acquire knowledge of the quantity and composition of the fumes and gases emitted.

ISO 15011-1<sup>[1]</sup> and ISO 15011-2<sup>[2]</sup> have been promulgated to generate these data when welding with consumables comprised mainly of metals and other inorganic substances. However, it is now common practice in the welding industry to weld or cut through a range of products including coatings such as shop primers, paints, oils, waxes and pressing lubricants, and inter-weld materials such as adhesives and sealants.

When heated, these products, which can be composed wholly or partly of organic materials, typically give rise to a wide range of thermal degradation products, the composition of which is difficult to predict from a knowledge of the product composition. It is expected that the composition of these degradation products will depend upon the temperatures encountered during welding and cutting activities and that a range of temperatures will exist for every activity due to the existence of temperature profiles within the material being processed.

As a result, several fume generation methods, providing temperatures and temperature profiles similar to those generated by welding processes and parameters used in the workplace, will be required to provide the data. Therefore, the purpose of this Technical Specification is to describe procedures that may be used to make semi-quantitative measurements of the organic components generated when welding and cutting through the products mentioned above, with a view to identifying those components that are significant hygienically. The data generated may be used to provide information on degradation products for use in safety data sheets. The degradation products identified in these tests may then be measured quantitatively using existing standards for measuring emission rate or by monitoring workplace atmospheres directly.

Requests for official interpretations of any aspect of this Technical Specification should be directed to the Secretariat of ISO/TC 44/SC 9 via your national standards body, a complete listing of which can be found at [www.iso.org](http://www.iso.org).

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# Health and safety in welding and allied processes — Laboratory method for sampling fume and gases —

## Part 5: Identification of thermal-degradation products generated when welding or cutting through products composed wholly or partly of organic materials

### 1 Scope

This Technical Specification specifies procedures for obtaining information about thermal degradation products generated when welding, cutting through, preheating and straightening products composed wholly or partly of organic substances, e.g. shop primers, paints, adhesives, waxes, sealants, pressing lubricant, oils, etc. It is aimed primarily at test laboratories performing such procedures. The data generated may be used by product manufacturers to provide information for inclusion in safety data sheets and by occupational hygienists to identify thermal degradation products of significance in the performance of risk assessments and/or workplace exposure measurements. The data cannot be used to estimate workplace exposure directly.

This Technical Specification is applicable to all products composed partly or wholly of organic materials that could be heated, during welding and cutting, to temperatures at which thermal degradation products are generated and where it is not apparent what those degradation products will be.

### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14327, *Resistance welding — Procedures for determining the weldability lobe for resistance spot, projection and seam welding*

ISO 14373, *Resistance welding — Procedure for spot welding of uncoated and coated low carbon steels*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

#### 3.1

##### **chemical agent**

any chemical element or compound, on its own or admixed as it occurs in the natural state or as produced, used or released, including release as waste, by any work activity, whether or not produced intentionally and whether or not placed on the market

[Council Directive 98/24/EC<sup>[3]</sup>

**3.2**

**limit value**

reference figure for the concentration of a chemical or biological agent in air

**3.3**

**welding primer**

film material that is applied to an unpainted steel surface for protective purposes which does not have to be removed prior to welding and does not prevent the making of an acceptable weld

**3.4**

**weld-through sealant**

mastic, gap-filling material that is applied prior to welding to an unpainted steel surface for non-pressure sealing purposes and does not prevent the making of an acceptable weld

**3.5**

**weld-through adhesive**

polymer that is applied prior to welding to a primed or unpainted steel surface for the purpose of bonding but does not prevent the making of an acceptable weld

**3.6**

**weld-through waxes**

material composed of esterified fatty acids that is applied to afford protection and act as a lubricant during pressing operations and which does not prevent the making of an acceptable weld

**4 Principle**

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The product under investigation, or a test piece to which the product under investigation has been applied, is heated using one of a number of test procedures and the thermal degradation products generated are collected and analysed using a range of sampling and analysis techniques. The test is carried out inside a sampling chamber (see Annex C) where appropriate in order to isolate the thermal degradation products from other airborne contaminants. Enclosing the sampling operation also serves to concentrate the products generated, reducing sampling times and improving analytical detection limits.

**5 Procedure**

**5.1 Screening tests to identify thermal degradation products**

Perform screening tests to identify thermal degradation products of interest using the pyrolysis procedure specified in A.1 or the heating procedure specified in A.2. Use the results to establish a measurement strategy to be used in the laboratory welding and cutting tests specified in 5.2.

**5.2 Production of safety data sheet information**

Weld or cut test pieces using the relevant procedure(s) for the product under test.

- For arc and plasma welding and cutting processes, use the procedure given in B.1.
- For resistance welding, use the procedure given in B.2.
- For flame processes, use the procedure given in B.3.

Sample and analyse the resulting thermal degradation products using appropriate techniques selected from those described in Annex D, according to the measurement strategy derived in 5.1.



### 5.3 Production of user-specific risk assessment data

Generate thermal degradation products for analysis by simulating, as far as possible, the process, conditions and materials used in the workplace. Sample and analyse the thermal degradation products using appropriate techniques selected from those described in Annex D, according to the measurement strategy derived in 5.1.

### 5.4 Data handling

Evaluate the data to identify the thermal degradation products of the greatest hygienic significance. Refer to ISO 16000-6<sup>[4]</sup> for guidance.

## 6 Use and comprehensiveness of data on thermal degradation products

### 6.1 Use of data on thermal degradation products

Information on the use of data on thermal degradation products generated using the procedures described in this Technical Specification is given in Annex G.

### 6.2 Comprehensiveness of data on thermal degradation products

The required comprehensiveness of the data to be generated is determined by the use for the product that can reasonably be anticipated.

Data for use in safety data sheets shall be generated under conditions, i.e. temperature, product thickness, etc that are representative of the products intended use.

When data are required to perform a risk assessment for a specific workplace activity or to identify thermal degradation products requiring exposure measurement, generation of thermal degradation products shall be carried out using test conditions that mimic the workplace conditions as closely as possible. Such data are only valid for the specific conditions used for their generation.

## 7 Test report

The test report shall contain the following information:

- a) a reference to this Technical Specification, i.e. ISO/TS 15011-5:2006;
- b) the name and address of the product manufacturer or supplier;
- c) the type of product and/or the trade name of the product tested;
- d) the test method used;
- e) the name and address of the test laboratory;
- f) the date the test report was issued;
- g) the lot number of the product tested;
- h) any deviation from the procedures specified in this Technical Specification, unusual occurrences or other notable observations;
- i) full details of each set of conditions under which the product was tested; and

- j) semi-quantitative data on the chemical composition of the thermal degradation products generated under each set of test conditions, expressed relative to the principal degradation product.

An example of a test report sheet is given in Annex E.

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## Annex A (normative)

### Screening tests to identify thermal degradation products

#### A.1 Pyrolysis

##### A.1.1 Heat source

Generate thermal degradation products from the product under evaluation by heating in a high frequency induction furnace coupled to a gas chromatography - mass spectrometry system. Other suitable furnaces may also be used, but the test pieces, test conditions and sampling and analysis procedure might need to be varied from those specified in A.1.2, A.1.3 and A.1.4.

##### A.1.2 Test pieces

Prepare a series of test pieces which, when heated in a high frequency induction furnace, will produce a range of different test temperatures. Apply small samples of the product under evaluation to range of sample carriers made of ferromagnetic alloys with different Curie temperatures.

##### A.1.3 Test conditions

Carry out a series of tests in which the product under evaluation is heated to a number of different temperatures within the scope of the pyrolysis technique, e.g. up to about 900 °C. Achieve this by using a series of test pieces prepared by applying the product under evaluation to a range of sample carriers with different Curie temperatures (see A.1.2).

##### A.1.4 Sampling and analysis

Heat the test pieces (A.1.2) in the induction furnace (A.1.1) by applying a high frequency field and pass the resulting thermal degradation products directly into a suitable analytical instrument, e.g. a gas chromatograph with a mass spectrometer detector, through a heated transfer line. Carry out the tests specified in A.1.3 and record the test conditions used.

#### A.2 Thermal decomposition in a furnace

##### A.2.1 Heat source

Generate thermal degradation products from the product under evaluation by heating in a furnace equipped with semi-embedded elements that offer fast heat-up to temperatures of 500 °C or above.

##### A.2.2 Test pieces

Manufacture test pieces by applying the product under evaluation to small circles of aluminium foil, e.g. 20 mm in diameter. Use application procedures, application rates and drying times that are typical for the product when in commercial use. Alternatively, produce test pieces by taking samples of suitable dimensions from an article to which the product has already been applied, using a process that does not lead to the test pieces becoming excessively hot.