

Third Revision of Draft – 19 June 2007

ISO Technical Report

Health and safety aspects of welding

Arc welding fume components related to welding processes and consumable type

Drafted by Commission VIII - Rapporteur Grant McMillan (UK)

Submitted by the Rapporteur for discussion at the Annual Assembly Meeting in Dubrovnik July 07

Abstract

At the request of the IIW Standardisation Officer, Commission VIII is to embark on the preparation of a series of ISO Technical Reports. Initially these will be based on existing Commission documents. This document is the third draft of the second of these reports. It provides guidance, based on the experiences of Commission experts, on the components of fume emitted from a range of arc welding processes and consumables. It is derived from Documents VIII-1876-99 and VIII.2011-06, the latter being a first draft which was discussed at the Commission's Intermediate Meeting in May 2006 and a second draft VIII-2025-06 which was considered at the Annual Assembly in Quebec in August 2006 and sent back for further revision.

Key words

Welding, fume components

This document is submitted to Commission VIII for study and commits only the person or persons under whose signature it appears.

Draft ISO Technical Report

Health and safety aspects of welding

Arc welding fume components related to welding processes and consumable type

**Drafted by Commission VIII
Rapporteur G McMillan (UK)**

| Contents | Page |
|---|-------------|
| Foreword | 4 |
| Introduction..... | 5 |
| Scope | 6 |
| Fume components related to welding process and consumable type | 7 |

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 exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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/TR (reference to be entered) was prepared by Commission VIII (Health and Safety), a Working Unit of the International Institute of Welding.

Introduction

This ISO Technical Report was prepared by the International Institute of Welding, Commission VIII Health and Safety. It constitutes the considered judgement of experts on the range of principal components of fume which can be emitted from arc welding processes and identifies, as key components, those which are of greatest occupational hygiene significance and therefore require the most stringent control measures to ensure that a welder is not exposed to an excessive level of the substance concerned

The Report is intended to assist in hazard appreciation, risk assessment and risk control and thus contribute to improving the health and safety of welders and those working with them. It is also intended to assist medical professional in their care of welders and others exposed to welding fume.

The constituent components of particular consumables and the fume arising from their use should be gained from the Safety Data Sheet produced by the manufacturer and supplied with the consumables.

Scope

This Technical Report provides guidance, based on the experiences of experts, on the components of fume emitted from a range of arc welding processes and consumable types.

Background

Arc welding processes emit fume. This is a complex, dynamic mixture of particulates derived mainly from the welding consumable but also the metal and any coatings and contaminants present. Most of the particles are in the respirable range which means that they can penetrate to the innermost area of the lung where they have the greatest potential to do harm. Many particles contain metal compounds, often as complex oxides and sometimes within a core surrounded by a shell. Some of the components of the fume are at least potentially biologically active. It is essential to be aware of these components when undertaking health and safety risk assessments of welding processes.

The table which follows seeks only to provide a general awareness to those responsible for making assessments or for the health care of welders and those who work with them. It identifies the principal and key components likely to be contained within the fume from a range of welding processes and consumable types. In this context a principal component is a component that is of some occupational hygiene significance while the key component is the one that has the greatest occupational hygiene significance and therefore requires the most stringent control measures to ensure that a welder is not exposed to an excessive level of the substance concerned, i.e. it is the component whose limit value is exceeded at the lowest welding fume concentration.

DRAFT FOR DEVELOPMENT – NOT FOR PUBLICATION

**Principal¹ and key² components
of commonly encountered arc welding fumes³**

| Type of process | Type of consumable | Typical principal components | Other possible principal components | Typical key component |
|---|--|--------------------------------|-------------------------------------|-------------------------------|
| MMA (SMAW) 111 | Unalloyed and low alloy steel ¹ | Fe, Mn, Cr, Cr(VI) Ni, Cu | F | Mn, Cr or Cr(VI) ³ |
| | High alloy steel ² | Cr, Cr(VI), Fe, Mn, Ni | F | Cr(VI) or Ni |
| | Aluminium | Al, Cu, Mg, Mn, Zn | Be, Cl, F | Al, Mn or Zn |
| | Cast iron | Ni, Cu, Fe, Mn | Ba, F | Ni or Cu |
| | Hardfacing | Co, Cr, Cr(VI), Fe, Ni, Mn | V | Co, Cr, Cr(VI) Ni or Mn |
| | Work hardening | Fe, Mn, Cr | | Mn |
| | Nickel-based | Co, Cr, Cr(VI), Fe, Ni, Mn | Fe | Cr, Cr(VI) or Ni |
| | Copper-based | Cu, Ni | | Cu or Ni |
| MIG/MAG/TIG (GMAW/GTAW) 131, 135, 141 | Unalloyed and low alloy steel ¹ | Fe, Mn, Cr, Cr(VI) Ni, Cu | | Mn, Cr or Cr(VI) ³ |
| | High alloy steel ² | Cr, Cr(VI), Fe, Mn, Ni | | Cr, Cr(VI) or Ni |
| | Aluminium alloys | Al, Mg, Mn, Zn | | Al, Mn or Zn |
| | Nickel-based | Co, Cr, Cr(VI), Mn, Ni | Fe | Cr, Cr(VI) or Ni |
| | Copper-based | Cu, Ni | | Cu or Ni |
| Gas-shielded tubular cored arc welding (FCAW) 132, 133, 136, 137, 143 | Unalloyed and low alloy steel ¹ | Fe, Mn, Cr, Cr(VI) Ni, Cu | F | Mn, Cr or Cr(VI) |
| | High alloy steel ² | Cr, Cr(VI), Fe, Mn, Ni | F | Cr(VI) or Ni |
| | Hardfacing | Co, Cr, Cr(VI), Fe, Ni, Mn | V | Co, Cr, Cr(VI) Ni or Mn |
| | Nickel-based | Co, Cr, Cr(VI), Mn, Ni | Fe | Cr, Cr(VI) or Ni |
| Self-shielded tubular cored arc welding (FCAW) 114 | Unalloyed and low alloy steel ¹ | Fe, Mn, Cr, Ni, Cu, Al | Ba, F | Mn |
| | High alloy steel ² | Cr, Cr(VI), Fe, Mn, Ni, Al | Ba, F | Cr(VI) or Ni |
| | Hardfacing | Co, Cr, Cr(VI), Fe, Ni, Mn, Al | V | Co, Cr, Cr(VI) Ni or Mn |
| <p>1 Unalloyed and low alloyed steels are here considered to have < 5 % combined alloying elements</p> <p>2 High alloyed steels are here considered to have ≥ 5 % combined alloying elements</p> <p>3 For the unalloyed and low alloyed steels Cr(VI) amount can be considered negligible compared to Cr(VI) from high alloyed steels (e.g. Cr(VI) in high alloyed steels is 3-6 % and in low alloyed steel 0,05 % in the fume box, see ISO 15011-1)</p> | | | | |

1. A principal component is a component of occupational hygiene significance.

2. Key components have the greatest occupational hygiene significance and therefore require the most stringent control measures to ensure that a welder is not exposed to an excessive level of the substance(s) concerned, i.e. a component whose limit value is exceeded at the lowest welding fume concentration.

3. The table is derived from that shown in ISO 15011-4 Health and safety in welding and allied processes - Laboratory method for sampling fume and gases - Part 4: Fume data sheets.

DRAFT FOR DEVELOPMENT – NOT FOR PUBLICATION