
**Health and safety in welding and allied
processes — Equipment for capture
and separation of welding fume —**

**Part 1:
General requirements**

iTeh STANDARD PREVIEW
*Hygiène et sécurité en soudage et techniques connexes —
Equipements de captage et de filtration des fumées —
Partie 1: Exigences générales*
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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 9, *Health and safety*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Official interpretations of ISO/TC 44 documents, where they exist, are available from this page: <https://committee.iso.org/sites/tc44/home/interpretation.html>.

A list of all parts in the ISO 21904 series can be found on the ISO website.

This first edition cancels and replaces ISO 15012-4.

Introduction

Welding and allied processes generate fumes and gases which, if inhaled, can be harmful to human health. Therefore, control of the fumes and gases generated is to be exercised to minimize worker exposure.

The most effective method of control is to capture the fumes and gases close to their source before they enter a worker's breathing zone or the general workplace environment.

Ventilation equipment used to capture the fumes and gases is to be fit for purpose because inefficient capture can result in high exposure and can be detrimental to workers' health. Therefore, it is important that it adheres to defined manufacturing, materials and design requirements and gives warning of malfunction.

This document is a type-C standard as stated in ISO 12100.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organisations, market surveillance etc.);

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, e. g. for maintenance (small, medium and large enterprises);
- consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

In addition, this document is intended for standardization bodies elaborating type-C standards.

The requirements of this document can be supplemented or modified by a type-C standard.

For machines which are covered by the scope of a type-C standard and which have been designed and built according to the requirements of that standard, the requirements of that type-C standard take precedence.

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Health and safety in welding and allied processes — Equipment for capture and separation of welding fume —

Part 1: General requirements

1 Scope

This document defines the general requirements for ventilation equipment used to capture and separate fumes generated by welding and allied processes, e.g. arc welding and thermal cutting.

This document also specifies the test data to be marked on the capture devices.

It applies to the design and manufacture of parts of the equipment including hoods for welding, ducting, filter units, air movers, systems that inform of unsafe operation and workplace practices to ensure safe working with regard to exposure.

Significant hazards are listed in [Clause 4](#). It does not cover electrical, mechanical and pneumatic hazards.

This document is applicable to:

- local exhaust ventilation systems (LEV) excluding draught tables;
- mobile and stationary equipment; [ISO 21904-1:2020](https://standards.iteh.ai/catalog/standards/sist/231e953e-32a1-4b7a-9b38-2020/iso-21904-1-2020)
- separation equipment used for welding and allied processes;

This document is not applicable to:

- general ventilation, air make up or air movement systems;
- air conditioning systems;
- grinding dust.

This document applies to systems designed and manufactured after its publication.

NOTE Specific safety requirements for thermal cutting machines are defined in ISO 17916.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 21904-2:2020, *Health and safety in welding and allied processes — Equipment for capture and separation of welding fume — Part 2: Requirements for testing and marking of separation efficiency*

ISO 21904-1:2020(E)

ISO 21904-4:2020, *Health and safety in welding and allied processes — Requirements, testing and marking of equipment for air filtration — Part 4: Determination of the minimum air volume flow rate of captor hoods and nozzles*

IEC 60204-1:2005, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60335-2-69:2012, *Household and similar electrical appliances — Safety — Part 2-69: Particular requirements for wet and dry vacuum cleaners, including power brush, for commercial use*

IEC 60695-2-12:2010+A1:2014, *Fire hazard testing — Part 2-12: Glowing/hot-wire based test methods — Glow-wire flammability index (GWFI) test method for materials*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100:2010 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 welding fume separation equipment
air filtration equipment, the purpose of which is to separate particles generated by welding and allied processes from workplace atmosphere

Note 1 to entry: Some separation equipment is designed to also remove gases generated by welding, but the ISO 21904 series does not address the efficiency of gas separation.

3.2 filter cleaning system
system designed to clean the filter of *welding fume separation equipment* (3.1) in order to restore the air flow rate through the filter when it is reduced by an accumulation of *welding fume* (3.13) particles

3.3 on-line filter cleaning system
filter cleaning system, either automatically or manually initiated, operating while *welding fume separation equipment* (3.1) is running

3.4 off-line filter cleaning system
filter cleaning system, either automatically or manually initiated, operating after the air mover of the filtration equipment is switched off

3.5 separation efficiency by mass
ratio of the mass of particles retained by *welding fume separation equipment* (3.1) to the mass of particles entering the equipment during a given period

Note 1 to entry: General information on test methods for determination of separation efficiency is described in EN 1093-6 and EN 1093-7.

3.6 local exhaust ventilation
LEV
use of extraction to remove contaminated air at or near to its source

3.7

filter protector

device normally positioned at the intake of the *welding fume separation equipment* (3.1), used to minimize the possibility of damaging impacts of sparks or large particles on filter media

Note 1 to entry: Filter media can also be protected against sparks and large particles by the internal design of the welding fume separation equipment.

Note 2 to entry: Examples of filter protectors are cyclones, spin separators, baffles or sieves. A filter protector may be designed to also protect against flame damage.

3.8

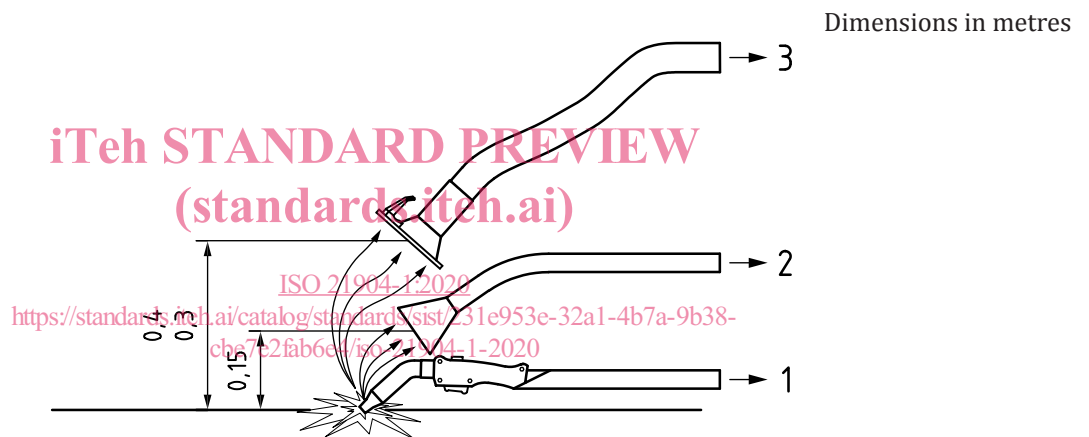
on-torch extraction device

on-gun extraction device

equipment, integrated or attached, on torch used for capturing *welding fume* (3.13), when connected to an extraction source

Note 1 to entry: Due to the state of the art, on-torch extraction devices for TIG welding are not covered by this definition.

Note 2 to entry: For an overview of the different extraction devices, see [Figure 1](#).



Key

- 1 on-torch extraction (3.8), 50 m³/h to 100 m³/h, 5 kPa to 18 kPa
- 2 high vacuum extraction (3.9), 100 m³/h to 150 m³/h, 5 kPa to 10 kPa
- 3 low vacuum extraction (3.9), 700 m³/h to 1500 m³/h, 800 Pa to 2 000 Pa

Figure 1 — Overview of extraction devices and common air volume flow rates and pressure

3.9

captor hood

captor nozzle

equipment, movable or static, used for capturing *welding fume* (3.13), when connected to an extraction source

Note 1 to entry: For an overview of the different extraction devices, see [Figure 1](#).

3.10

receiving hood

canopy

equipment, movable or static, normally positioned above a hot process, where the contaminated air is propelled into it by process-induced air movement

3.11 enclosure chamber

fully or partially enclosed space where the process takes place, designed to contain and prevent the escape of hazardous substances into the workshop air

3.12 suction equipment

unit with air mover and with or without a filter

3.13 welding fume

airborne particles typically with diameter smaller than 1 µm generated by welding and allied processes

3.14 minimum air volume flow rate

air volume flow rate required for acceptable capture of *welding fume* (3.13)

Note 1 to entry: The minimum air volume flow rate depends on the type and the geometric dimensions of the capture device and the test positions selected to demonstrate the extent of the capture zone (see 7.3).

3.15 suction field

volume around a capture device, in which the air velocity required to capture *welding fume* (3.13) is exceeded

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4 Significant hazards

Exposure to welding fumes and gases generated by welding and allied processes can be detrimental to health. Control of exposure can usually be achieved using ventilation equipment but any failure of this equipment, such as poor design and the use of parts made of unsuitable materials, can result in reduced extraction efficiency and hence over exposure and ill health.

Common health effects include respiratory disease, but exposure to carcinogenic substances during the welding can occur and shall be considered.

The requirements of the ventilation equipment are dependent on the level of control necessary.

5 Requirements and verifications

5.1 General

The general requirements and corresponding verifications are given in [Table 1](#).

Table 1 — General requirements and verifications

	Requirement	Verification
1.1 Requirements for all equipment	<p>Machinery shall comply with the safety requirements and/or protective/risk reduction measures in Clause 5. In addition, the machine shall be designed according to the principles of ISO 12100:2010 for relevant but not significant hazards which are not dealt with by this document.</p> <p>All parts and materials used in the manufacture of welding fume ventilation equipment shall withstand the conditions (thermal, mechanical, UV radiation) present in the environment in which they are intended to be used.</p> <p>Equipment used for capturing of welding fume shall be fitted with indicators and control units showing correct operation or malfunction of the device, as malfunctions can cause hazardous operation conditions for the user. Malfunction of equipment shall be indicated by a clear visual or acoustic warning signal. Two types of malfunctions are possible and are shown in Annex A together with their most common causes.</p> <p>Visual warning signals shall work with a pulse frequency between 2 Hz and 0,2 Hz, emitting yellow or yellow-orange light. Visible warning signals shall be installed inside or nearby the working area of welders in order to be recognized when the light is on.</p> <p>NOTE EN 842 provides additional guidance for visual danger signals. This document can also be part of national legislation.</p> <p>If an acoustic warning device is installed, it shall work within an audio-frequency between 500 Hz and 3 000 Hz and have a pulse time between 0,5 s and 5 s. The A-weighted sound pressure level shall be between 8 dB and 20 dB higher than the 1 m-surface sound pressure level of the welding fume separation equipment.</p> <p>Signals/indicators for normal operation</p> <ul style="list-style-type: none"> — For LEV: Proper operation of a LEV shall be indicated by a control lamp emitting green light. — For dampers on devices for capturing: Capture equipment fitted with a manual shut off damper, the handle shall be aligned with the damper position. For automatic dampers, the position shall be indicated clearly visible to the user as open or closed. <p>Warning signals for malfunction</p>	<p>Verification shall be performed by examining the manufacturer's datasheets, the instruction manual, and by referring to the manufacturer's long-term experience with respective devices.</p> <p>Conformity shall be checked by visual and/or audible inspection.</p> <p>Conformity shall be checked by simulating a malfunction in order to test the function of the warning signal.</p>

Table 1 (continued)

	Requirement	Verification
	<p>— Separation equipment shall be fitted with a device that indicates that the filter needs service (either cleaning or replacement). When any malfunction exists, the control lamp shall not emit green light and the warning signals shall be active.</p> <p>NOTE There is currently no reliable system for monitoring the filter efficiency. It is therefore excluded.</p>	
<p>1.2 Additional requirements for separation of carcinogenic substances</p>	<p>Carcinogenic substances require checking of airflow rate in the extraction duct at each individual work place.</p> <p>NOTE The airflow rate is measured indirectly, usually by measuring the duct pressure except for on-torch extraction devices where a direct measurement of airflow at the nozzle is required.</p> <p>The required Performance Level, PL_p, according to ISO 13849-1:2015 is level a.</p> <p>Warning signal for malfunction: if the airflow rate in the extraction duct is insufficient, it shall be indicated by a clear visual or acoustic warning signal.</p>	<p>Conformity shall be checked by simulating a malfunction in order to test the function of the warning signal.</p>
<p>1.3 Flammability</p>	<p>Non-metallic parts (especially hoods, hoses and ducting properties) shall be made of materials of low flammability.</p>	<p>Verification shall be performed by examining compliance with the following:</p> <p>a) For hoods and hoses: GWIT: 550 according to IEC 60695-2-12:2010+A1:2014 (glow-wire test temperature of 550 °C)</p> <p>b) For ducting properties: GWIT: 960 according to IEC 60695-2-12:2010+A1:2014 (glow-wire test temperature of 960 °C)</p> <p>NOTE The use of materials of higher flammability can result in damage to the hose leading to reduced airflow at the extraction point and hence poor extraction efficiency.</p>