INTERNATIONAL STANDARD

ISO 15012-2

First edition
2008-04-01

Health and safety in welding and allied processes — Requirements, testing and marking of equipment for air filtration —

Part 2: Determination of the minimum air volume flow rate of captor hoods and nozzles

Hygiène et sécurité en soudage et techniques connexes — Exigences, essais et marquage des équipements de filtration d'air —

Partie 2: Détermination du débit volumique minimal d'air des bouches de captage

Reference number
ISO 15012-2:2008(E)

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
Web 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 15012-2 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding*, 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 15012 consists of the following parts, under the general title *Health and safety in welding and allied processes — Requirements, testing and marking of equipment for air filtration*:

— *Part 1: Testing of the separation efficiency for welding fume*

— *Part 2: Determination of the minimum air volume flow rate of captor hoods and nozzles*

The following part is under preparation:

— *Part 3: Determination of the capture efficiency of welding fume extraction devices using tracer gas*

Requests for official interpretations of any aspect of this part of ISO 15012 should be directed to the Secretariat of ISO/TC 44/SC 9 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

Introduction

Welding and allied processes generate fume and gases, which, if inhaled, can be harmful to human health. Control is often required to maintain exposure at acceptable levels and this can be achieved by capturing the fume and gases using local exhaust ventilation (LEV), which consists of a capture device, such as a captor hood or nozzle, connected, via ducting, to an exhaust system.

The plume of welding fume rises at a velocity of about 0,3 m/s and the air draughts commonly encountered in workshops are of the same order and can be higher. Effective capture of welding fume and gases can only be achieved when the extracted air velocity at the emission point exceeds the resulting velocity of the draught and the plume, so a velocity of 0,4 m/s has been selected for testing. For a particular capture device, this capture velocity can only be achieved by applying a minimum air volume flow rate, which is dependent upon the aspect ratio, the cross-sectional area of the device and its distance from the emission point. Consequently, capture devices need to be used with exhaust systems that provide, at least, the minimum air volume flow rate.

The design of capture devices can be very different. Aspect ratios range from those applicable to circular hoods to those of slots, so the size and shape of the area (capture zone) where fume and gases are captured, while using the minimum air volume flow rate, also varies considerably. Therefore, this part of ISO 15012 requires manufacturers of capture devices to measure the minimum air volume flow rate at measurement points selected to give an estimate of the size and shape of the capture zone.

Health and safety in welding and allied processes — Requirements, testing and marking of equipment for air filtration —

Part 2: Determination of the minimum air volume flow rate of captor hoods and nozzles

1 Scope

This part of ISO 15012 specifies a method for establishing the minimum air volume flow rate required for captor hoods and nozzles to effectively capture fume and gases from welding and allied processes. The method can be used with capture devices of any aspect ratio and cross-sectional area, but it is not applicable to on-gun extraction systems and down draught tables.

This part of ISO 15012 also specifies the test data to be marked on the capture devices.

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 12100-1, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology*

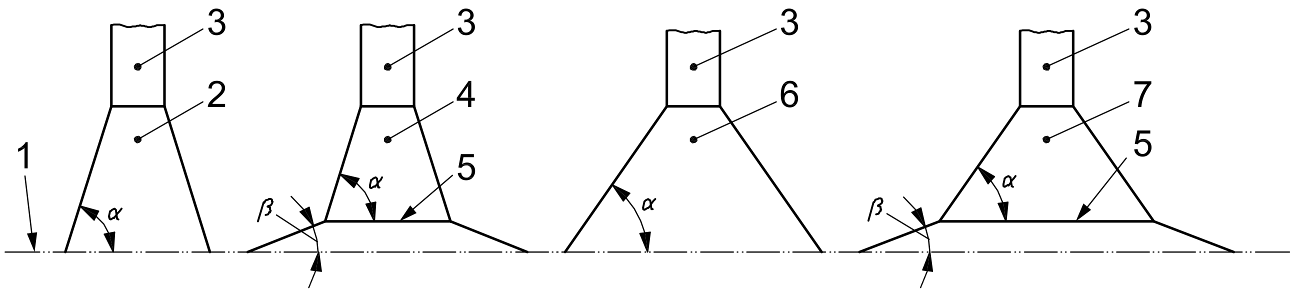
ISO 12100-2, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100-1 and ISO 12100-2 and the following apply.

3.1
capture device
equipment for capturing welding fume at source

See Figure 1.



Key

1 entry plane (cross-sectional area for capture devices without flange)
2 nozzle
3 duct
4 nozzle with flange
5 cross-sectional area of a flanged capture device ($\beta \geqslant 30°$)
6 hood
7 hood with flange

α angle between entry plane and nozzle/hood
β angle between entry plane and flange

Figure 1 — Entry plane and cross-sectional area of different designs of capture device

3.2
capture zone
three-dimensional space in front of the entry plane of a capture device in which the air velocity is greater than or equal to the minimum air velocity required for effective capture of welding fume

3.3
entry plan
outermost area of a capture device

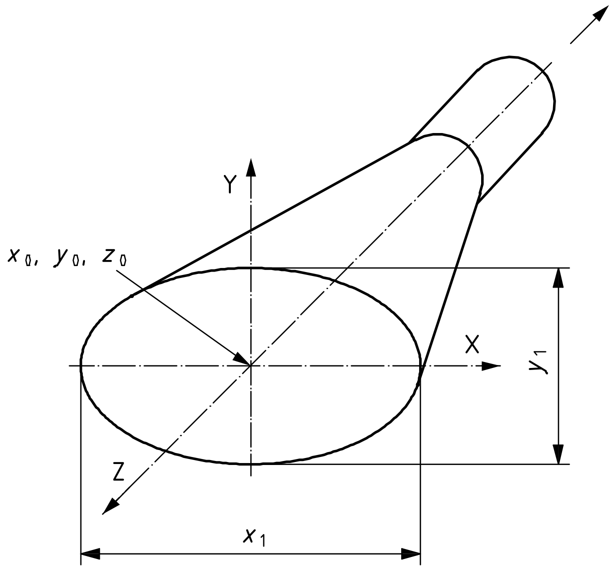
3.4
cross-sectional area
area of the opening of a capture device in the entry plane (for a nozzle or hood without a flange), or, area of a capture device in the plane in which the flange is attached, excluding the area of any obstructions in the entry plane (for a nozzle or hood with a flange)

See Figure 1.

3.5
aspect ratio
ratio of the lengths, x and y, in the entry plane, with $x_1 \geqslant y_1$

See Figure 2.

NOTE The aspect ratio is 1 for a circular device and greater than 1 for other shapes.



Key

x_0, y_0, z_0 centre point of the entry plane and origin for the measurement point co-ordinates

x_1 length of the entry plane of the capture device in the x-direction ($x_1 \geqslant y_1$)

y_1 length of the entry plane of the capture device in the y-direction ($x_1 \geqslant y_1$)

Figure 2 — Schematic layout for a capture device

3.6
measurement plane
plane, parallel to the entry plane, in which measurements of air velocity are made

See Figure 1.

3.7
nozzle
capture device with an angle, α, smaller than 60° between the side of the device and the entry plane

See Figure 1.

3.8
flange
surface extending outwards from, and almost parallel to ($\beta < 30°$), the entry plane of a capture device, providing a barrier to unwanted air flow from behind

See Figure 1.

3.9
hood
capture device with an angle, α, greater than or equal to 60° between the side of the device and the entry plane

See Figure 1.

3.10
minimum air volume flow rate
air volume flow rate required for effective capture of welding fume

NOTE 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 7.2).

4 Principle

Tests are performed to determine the air volume flow rate required to achieve an air velocity of 0,4 m/s at a minimum of two measurements points in front of the capture device on a measurement plane parallel to the entry plane of the capture device.

Three tests are performed at each measurement point with air volume flow rates that provide approximate velocities of 0,3 m/s, 0,4 m/s and 0,5 m/s. The air volume flow rate that provides a velocity of exactly 0,4 m/s at each measurement point is calculated from linear regression of the results. The minimum air volume flow rate of the capture device is taken to be the highest of the values obtained at the different measurement points.

NOTE The minimum air volume flow rate is determined in this manner because it is difficult to set an air volume flow rate that gives an air velocity of exactly 0,4 m/s at a given measurement point.

5 Requirement

The manufacturer of a hood or nozzle shall use the results of these tests to specify and mark the device with the minimum air volume flow rate required to achieve an air velocity of 0,4 m/s in the measurement plane, the distance of the measurement plane from the entry plane and the position of the measurement points selected to demonstrate the extent of the capture zone of the device. The measurement points shall be identified by their (x, y)-co-ordinates projected from the entry plane.

NOTE A hood or nozzle is expected to achieve effective capture of welding fume if it is operated with an air volume flow rate greater than or equal to the determined minimum air volume flow rate and, in addition, if it is positioned at a distance less than or equal to the distance between the measurement plane and the entry plane of the device.

6 Equipment

6.1 Anemometer, suitable for measuring air velocities in the range 0,3 m/s to 0,5 m/s with a maximum uncertainty of ±0,02 m/s, with a response time less than or equal to 1 s and having a calibration that is traceable to national standards.

6.2 Flow meter, or **other suitable device**, capable of measuring air volume flow rate with a maximum uncertainty of ±5 % and having a calibration that is traceable to national standards.

6.3 Measure, suitable for measuring distances with an uncertainty of ±1 mm.

7 Test method

7.1 Test conditions

Position the hood or nozzle so that it is free standing and sited away from any obstructions. Take care to minimise the influence of any disturbing air draughts.

7.2 Position of the measurement plane

7.2.1 Hoods and nozzles with an aspect ratio of less than or equal to 4

Determine the required distance, z_i, in centimetres, between the measurement plane and the entry plane of the hood or nozzle of the capture device using Equation (1):

$$z_i = \sqrt{A} + 7{,}5 \qquad (1)$$

where A is the cross-sectional area, in centimetres squared, of the hood or nozzle.

7.2.2 Hoods and nozzles with an aspect ratio of greater than 4

Determine the required distance, z_i, in centimetres, between the measurement plane and the entry plane of the hood or nozzle of the capture device using Equation (2):

$$z_i = (\sqrt{A}/4) + 10 \quad (2)$$

where A is the cross-sectional area, in centimetres squared, of the hood or nozzle.

7.3 Measurement points

Select a minimum of two points on the measurement plane (see 7.2) that are sufficient to adequately demonstrate the size and shape of the capture zone.

7.4 Procedure

7.4.1 Set up the capture device under the test conditions specified in 7.1.

7.4.2 Adjust the air volume flow rate through the capture device to give an air velocity of approximately 0,4 m/s at one of the selected measurement points (see 7.3) and then measure the air velocity at that point over a period of 10 min using the anemometer (6.1). Measure the air volume flow rate at the beginning and at end of the test using the flow meter (6.2) and record the air velocity at intervals of $\leqslant$10 s.

7.4.3 Calculate the mean and standard deviation of the measured air velocity and, if twice the standard deviation is greater than 20 % of the mean, repeat the test (7.4.2).

7.4.4 Repeat the procedures specified in 7.4.2 and 7.4.3 with the air volume flow rate adjusted to give air velocities of approximately 0,3 m/s and 0,5 m/s at the measurement point.

7.4.5 Repeat the procedures specified in 7.4.2, 7.4.3 and 7.4.4 at the other selected measurement points (see 7.3).

7.4.6 For each measurement point, plot the mean air velocities against the mean air volume flow rates and, using linear regression, determine the air volume flow rate at which the air velocity is 0,4 m/s. Report the highest of the values obtained at the different measurement points as the minimum air volume flow rate.

8 Marking

The capture device shall be marked with the following information:

a) the minimum air volume flow rate;

b) the distance from the entry plane of the capture device to the measurement plane;

c) the position of the points on the measurement plane at which an air velocity of 0,4 m/s is achieved;

d) reference to this part of ISO 15012.

NOTE A pictogram might be helpful to present the data.

9 Test report

The test report shall include at least the following information:

a) a reference to this part of ISO 15012;

b) a description of the capture device tested, including details of:

- the manufacturer,
- the model number and, if appropriate, the serial number,
- the design, size, etc.;

c) details of the test carried out:

- the distance from the entry plane of the capture device to the measurement plane,
- the (x, y)-co-ordinates of the measurements points on the measurement plane,
- the measuring equipment used;

d) the test results:

- the air volume flow rate, in cubic metres per hour, required to achieve an air velocity of 0,4 m/s at each of the selected measurement points,
- the minimum air volume flow rate, in cubic metres per hour, as determined in 7.4.6;

e) any operation not specified in this part of ISO 15012, or regarded as optional;

f) the name(s) of person(s) responsible for the test(s);

g) the date(s) of the test(s); and

h) any inadvertent deviations, unusual occurrences, or other notable observations.

Bibliography

[1] ISO 2602, *Statistical interpretation of test results — Estimation of the mean — Confidence interval*

[2] ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 1: General principles and requirements*

[3] ISO 5167-2, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 2: Orifice plates*

[4] ISO 5167-3, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 3: Nozzles and Venturi nozzles*

[5] EN 626-2, *Safety of machinery — Reduction of risk to health from hazardous substances emitted by machinery — Part 2: Methodology leading to verification procedures*

[6] EN 1093-1, *Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 1: Selection of test methods*

ICS 25.160.30

Price based on 7 pages