INTERNATIONAL STANDARD

ISO 29042-9

First edition
2011-01-15

Safety of machinery — Evaluation of the emission of airborne hazardous substances —

Part 9:
Decontamination index

Sécurité des machines — Évaluation de l'émission de substances dangereuses véhiculées par l'air —
Partie 9: Indice d'assainissement

Reference number
ISO 29042-9:2011(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 29042-9 was prepared by Technical Committee ISO/TC 199, *Safety of machinery*.

ISO 29042 consists of the following parts, under the general title *Safety of machinery — Evaluation of the emission of airborne hazardous substances*:

- *Part 1: Selection of test methods*
- *Part 2: Tracer gas method for the measurement of the emission rate of a given pollutant*
- *Part 3: Test bench method for the measurement of the emission rate of a given pollutant*
- *Part 4: Tracer method for the measurement of the capture efficiency of an exhaust system*
- *Part 5: Test bench method for the measurement of the separation efficiency by mass of air cleaning systems with unducted outlet*
- *Part 6: Test bench method for the measurement of the separation efficiency by mass of air cleaning systems with ducted outlet*
- *Part 7: Test bench method for the measurement of the pollutant concentration parameter*
- *Part 8: Room method for the measurement of the pollutant concentration parameter*
- *Part 9: Decontamination index*

Introduction

The structure of safety standards in the field of machinery is as follows:

a) Type-A standards (basic safety standards) giving basic concepts, principles for design, and general aspects that can be applied to all machinery;

b) Type-B standards (generic safety standards) dealing with one safety aspect or one type of safeguard that can be used across a wide range of machinery:

— type-B1 standards on particular safety aspects (e.g. safety distances, surface temperature, noise);

— type-B2 standards on safeguards (e.g. two-hand controls, interlocking devices, pressure-sensitive devices, guards);

c) Type-C standards (machine safety standards) dealing with detailed safety requirements for a particular machine or group of machines.

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

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.

ISO/TC 199 has a mandate in this area to produce type-A and type-B standards, which will allow verification of conformity with the essential safety requirements.

ISO 29042-9 is based on EN 1093-11:2001, amended by Amendment 1:2008, published by the European Committee for Standardization (CEN).

Safety of machinery — Evaluation of the emission of airborne hazardous substances —

Part 9: **Decontamination index**

WARNING — It should be observed that during the test, especially during the shutdown or the removal of the pollutant control system, the concentration of hazardous substances, if present, can reach levels which are liable to incur a risk to the health of the operators or other occupants present in the room.

This part of ISO 29042 does not deal with the protective measures required to control these risks.

1 Scope

This part of ISO 29042 specifies a method for the measurement of the decontamination index of pollutant control systems, e.g. capture devices including local exhaust ventilation, water spray systems and, when appropriate, separation equipment installed on a machine. This method uses the real pollutant (see ISO 29042-1:2008, 4.2) and can be operated in room or field environments.

Measurement of the decontamination index of a pollutant control system can serve for the:

a) evaluation of the performance of a pollutant control system of a machine;

b) evaluation of the improvement of a pollutant control system;

c) comparison of pollutant control systems for machines of similar design;

d) ranking of pollutant control systems according to their decontamination efficiency;

e) determination of the air flow rate in the case of an exhaust system to achieve a given level;

f) determination of the state of the art of pollutant control systems for machines with respect to the decontamination efficiency.

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, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

3 Terms and definitions

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

3.1
decontamination index
I_A
average of the ratio, obtained at a number of specified locations in the surroundings, of the ambient air quality improvement to the real pollutant mean concentration with the pollutant control system not in operation

NOTE 1 Corrections can be necessary to take into account air pollution caused by other operations ("the background level").

NOTE 2 The ambient air quality improvement is given by the difference between the real pollutant concentrations measured in these surroundings with and without the pollutant control system in operation.

NOTE 3 When particle size distribution is determined at the same time as pollutant concentration, a decontamination index for each size fraction can be determined. See, for example, ISO 7708.

4 Principle

The principle of this measurement method consists in determining the decontamination index as defined in 3.1, the concentrations being measured at predetermined points around the machinery under inspection and in interpreting the value of this index, taking into account its range of variation and the influencing factors.

5 Determination of concentration measurement points

The measurement points shall be determined by pre-testing to ensure that they are in zones of measurable emission. The number and precise positions shall be specified in type-C standards.

6 Test method

6.1 General

The measurement is more accurate and the interpretation more reliable if the background level concentration is low. Whenever possible, the concentration measurements should be taken with the surrounding machinery and other processes shut down.

Once the locations of the measurement points have been selected, the measurement procedure takes place in three phases (see 6.2 to 6.4). These three phases are repeated twice. An example with two measurement points is given in Figure 1.

The measurement procedures used for the determination of the pollutant concentration shall comply with the appropriate International Standards. For the measurement of the air flow rate see ISO 3966, ISO 4006, ISO 5167-1 and ISO 5168[1)].

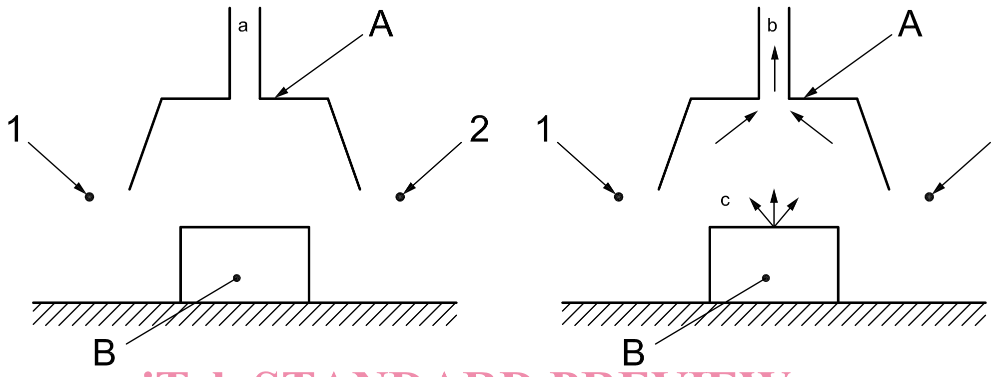
1) EN 1093-11:2001+A1:2008 also refers to ISO 4053-1:1977 and ISO 7145:1982 which, however, have been withdrawn.

6.2 Phase 1: Measurement of C_{fi}

For the determination of the concentration level, C_{fi}, resulting from the pollutant emission of the surrounding machinery and other processes (background level), the machine under test is shut down as well as its pollutant control system, if already installed. The operating conditions of the surrounding machinery and other processes are recorded.

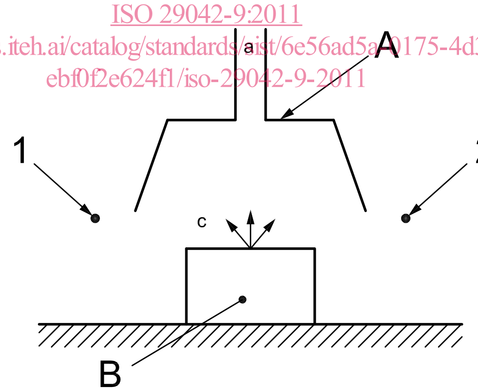
When stable conditions are reached, the concentrations are measured at the selected measurement points (see Figure 1). The sampling duration at each measurement point shall correspond to a representative fraction of the duration of the pollutant emission of the surrounding machinery and other processes.

At each measurement point at least three measurements shall be made.



a) Phase 1: measurement of C_{fi} (see 6.2)

b) Phase 2: measurement of C_{mi} (see 6.3)



c) Phase 3: measurement of C_{ai} (see 6.4)

Key

A capture device

B machine

1, 2 measurement points

[a] Air flow rate at zero.

[b] Air flow rate as specified.

[c] Pollutant emission.

Figure 1 — Example of measurement procedure

6.3 Phase 2: Measurement of C_{mi}

For this phase, the machine under test is in operation. Its pollutant control system is installed and in operation. The operating conditions of the machine and its associated pollutant control systems shall be specified.

The measurements of concentration are carried out following the same specifications as in phase 1: stable conditions, location of the measurement points, sampling duration, operating conditions of the surrounding machinery and other processes.

Checks shall be carried out to confirm that, as closely as possible, the same conditions prevail as in phase 1.

The sampling duration at each measurement point shall correspond to a representative fraction of the duration of the pollutant emission from the machine under test.

At each measurement point at least three measurements shall be made.

6.4 Phase 3: Measurement of C_{ai}

The machine under test remains in operation in the same conditions as in phase 2, but with its pollutant control system shut down or removed. The test cannot be performed where blockage of the extraction is likely to occur.

WARNING — Switching off or altering the pollutant control system can, in some instances, lead to exposures of operators or occupants in the room to hazardous pollutant levels. In these instances, appropriate preventive measures shall be taken to minimize the risk to which people are exposed.

The measurements of concentration are carried out in a similar way to the two other phases. However, it should be observed that it can require a long stabilization time before stable conditions are established in the room.

At each measurement point at least three measurements shall be made.

7 Application to specific groups of machines

Given the variety of situations encountered (e.g. types of rooms, machinery, working methods, type of product, type of activity, nature of pollutant), it does not seem possible to define a completely fixed method, independent of the different factors mentioned.

If in type-C standards additional information on specific conditions is given, the locations of air sampling points, the test and sampling duration, and the operating conditions of the machine should be specified.

8 Influencing factors

Many factors are likely to influence the measurement results. An attempt should be made to identify and, if possible, to evaluate them. In particular, the following should be recorded:

- data relative to the machine under test, type of working process, type of product processed, type of operation (continuous, batch, cyclic), duration of operation;
- data relative to the surrounding machinery and other processes;
- data relative to the pollutant control system, especially the exhaust air flow rate in case of a capture device;
- data relative to the separation system, especially the flow rates;

— the dimensions of the room;

— data relative to the room geometry (e.g. location of the machine);

— data relative to the general ventilation system, especially the characteristics of the air input and exhaust equipment, including disturbing cross-draught velocities. It can be useful, as well, to record the ambient air temperature and humidity.

Some methodological difficulties can limit the field of application of this method, for instance:

— it can be necessary to carry out a large number of measurements to take into account the heterogeneity of the pollution in space and/or time;

— special attention should be paid to the minimization of the fluctuations of the exhaust air flow rate or of the air flow pattern, particularly inside the premises during the periods when the machine or associated ventilation are on or off.

9 Expression of results

The decontamination index is calculated by Equation (1):

$$I_{\mathrm{A}} = \frac{1}{n}\sum_{i=1}^{n}\frac{C_{\mathrm{a}i} - C_{\mathrm{m}i}}{C_{\mathrm{a}i} - C_{\mathrm{f}i}} \quad (1)$$

where

$C_{\mathrm{a}i}$ is the real pollutant concentration measured at a specified location i in the surroundings under the following conditions: machine in operation, pollutant control system not in operation;

$C_{\mathrm{m}i}$ is the real pollutant concentration measured at a specified location i in the surroundings under the following conditions: machine and pollutant control system in operation;

$C_{\mathrm{f}i}$ is the real pollutant concentration measured at a specified location i in the surroundings under the following conditions: machine and pollutant control system not in operation (“the background level”);

n is the number of specified locations (measurement points).

When the “background level” is negligible, the decontamination index reduces to:

$$I_{\mathrm{A}} = 1 - \frac{1}{n}\sum_{i=1}^{n}\frac{C_{\mathrm{m}i}}{C_{\mathrm{a}i}} \quad (2)$$

For each measurement point and for each of the three measurements, the decontamination index is calculated. Then the mean value of the decontamination index is calculated for each measurement point. The test result is each mean value of the decontamination index at one measurement point.

All other factors remaining constant, the higher the decontamination index, the more efficient is the pollutant control system.

EXAMPLE When $I_{\mathrm{A}} = 0$, i.e. $C_{\mathrm{a}} = C_{\mathrm{m}}$, the decontamination system has no effect on air quality improvement. However, when $I_{\mathrm{A}} = 1$, i.e. $C_{\mathrm{m}} = C_{\mathrm{f}}$, the decontamination system is so efficient as to bring down the indoor air pollution to the background level.