BRITISH STANDARD

BS EN
1093-11:2001
+A1:2008

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

Part 11: Decontamination index

ICS 13.040.40; 13.110

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 1093-11:2001+A1:2008. It supersedes BS EN 1093-11:2001, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by ⟩A1⟨.

The UK participation in its preparation was entrusted to Technical Committee MCE/3, Safeguarding of machinery.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Committee and comes into effect on 15 July 2001

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Date	Comments
31 January 2009	Implementation of CEN amendment A1:2008

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1093-11:2001+A1

July 2008

ICS 13.040.40

Supersedes EN 1093-11:2001

English Version

Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 11: Decontamination index

Sécurité des machines - Évaluation de l'émission de substances dangereuses par l'air - Partie 11 : Indice d'assainissement

Sicherheit von Maschinen - Bewertung der Emission von luftgetragenen Gefahrstoffen - Teil 11: Reinigungsindex

This European Standard was approved by CEN on 19 April 2001 and includes Amendment 1 approved by CEN on 6 June 2008.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This document (EN 1093-11:2001+A1:2008) has been prepared by Technical Committee CEN/TC 114 "Safety of machinery", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2009, and conflicting national standards shall be withdrawn at the latest by January 2009.

This document includes Amendment 1, approved by CEN on 2008-06-06.

This document supersedes EN 1093-11:2001.

The start and finish of text introduced or altered by amendment is indicated in the text by tags [A1] 〈A1〉.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EC Directive(s).

[A1] For relationship with EC Directive(s), see informative Annexes ZA and ZB, which are integral parts of this document. 〈A1〉

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This is a type B standard as specified in EN 1070. This standard is a part of EN 1093. Part 1 " Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 1: Selection of test methods" of this standard presents a selection of different methods for the evaluation of the emission of airborne hazardous substances from machines.

1 Scope

This standard describes a method for the measurement of the decontamination index of pollution 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 4.2 of EN 1093-1 : 1998 *" Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 1: Selection of test methods"*) and can be operated in room or field environments.

It should be observed that during the test, especially during the shutdown or the removal of the pollution 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.

Warning: This standard does not deal with the protective measures required to control these risks.

Measurement of the decontamination index of pollution control system can serve for the:

- evaluation of the performance of a pollution control system of a machine;
- evaluation of the improvement of a pollution control system;
- comparison of pollution control systems for machines of similar design;
- ranking of pollution control systems according to their decontamination efficiency;
- determination of the air flow rate in the case of an exhaust system to achieve a given level;
- determination of the state of the art of pollution control systems for machines with respect to the decontamination efficiency.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 1070, *Safety of machinery - Terminology*

ISO 3966:1977, *Measurement of fluid flow in closed conduits - Velocity area method using Pitot static tubes*

ISO 4006:1991, *Measurement of fluid flow in closed conduits - Vocabulary and symbols*

ISO 4053-1:1977, *Measurement of gas flow in conduits - Tracer methods - Part 1 : General*

ISO 5167-1:1991, *Measurement of fluid flow by means of pressure differential devices - Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full*

ISO/TR 5168:1998, *Measurement of fluid flow - Evaluation of uncertainties*

ISO 7145:1982, *Determination of flowrate of fluids in closed conduits of circular cross-section - Method of velocity measurement at one point of the cross-section*

3 Terms and definitions

For the purposes of this European Standard the definitions of EN 1070 and the following definition applies:

3.1
decontamination index I_A
the average of the ratios, obtained at a number of specified locations in the surroundings, of the ambient air quality improvement[1]) to the real pollutant mean concentration with the pollution control system not in operation. Corrections can be necessary to take into account of air pollution caused by other operations ("the background level")

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 EN 481 " Workplace atmospheres - Size fraction definitions for measurement of airborne particles").

4 Principle

The principle of this measurement method consists in determining the decontamination index as defined in clause 3, 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 will have been 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

The measurement will be 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 measurement points have been selected, the measurement procedure takes place in three phases. These three phases are repeated further two times. 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 or European Standards. For the measurement of the air flow rate see ISO 3966:1977, ISO 4006:1991, ISO 4053-1:1977, ISO 5167-1:1991, ISO/TR 5168:1998 and ISO 7145:1982.

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 pollution 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 points. The sampling duration at each 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.

[1]) Expressed as the difference between the real pollutant concentrations measured in these surroundings with and without the pollution control system in operation.

Phase 2 Measurement of [C_{mi}]

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

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 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.

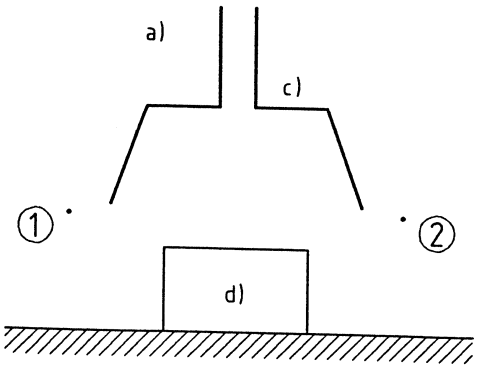
Phase 3 Measurement of [C_{ai}]

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

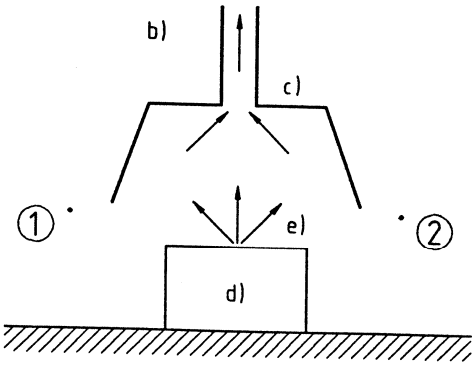
Warning Switching off or altering the pollution control system can, in some instances, lead to exposures of operators or occupants in the room to hazardous pollutant levels. In these instances take appropriate preventive measures to minimize the risk to which the people are exposed.

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.

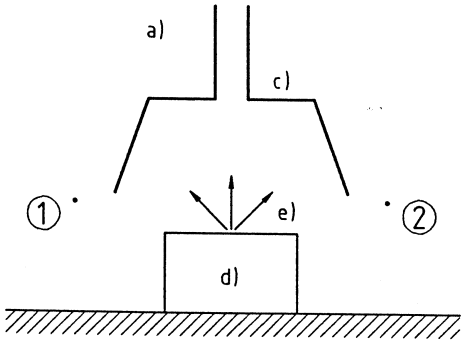
At each measurement point at least three measurements shall be made.



Phase 1: Measurement of [C_{fi}]



Phase 2: Measurement of [C_{mi}]



Phase 3: Measurement of [C_{ai}]

Key

a) Airflow = 0 m^3/h

b) Airflow = Q m^3/h

c) Capture device

d) Machine

e) Pollutant emission

1,2 measurement points

Figure 1 — Example of measurement procedure

7 Application to specific group 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 are 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 points 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 pollution 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 might 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 minimize the fluctuations of the exhaust air flow rate or of the air flow pattern, particularly inside the premises during the periods which the machine or associated ventilation are on or off.

9 Expression of results

The decontamination index is calculated as follows:

$$I_{\mathrm{A}} = \frac{1}{\mathrm{n}} \sum_{\mathrm{i=1}}^{\mathrm{n}} \frac{C_{\mathrm{ai}} - C_{\mathrm{mi}}}{C_{\mathrm{ai}} - C_{\mathrm{fi}}} \qquad (1)$$

where

C_{ai}, C_{mi} and C_{fi} are real pollutant concentrations measured at a specified location in the surrounding under the conditions below;

C_{ai} machine in operation, pollution control system not in operation;

C_{mi} machine and pollution control system in operation;

C_{fi} machine and pollution control system not in operation ("the background level") [2];

n number of specified sampling points.

For each measurement points 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 the each mean value of the decontamination index at one measurement point

All other things remaining constant, the higher the decontamination index, the more efficient is the pollution control system.

For instance,

- when $I_A = 0$ ie $C_a = C_m$, the decontamination system has no effect on air quality improvement;
- when $I_A = 1$ ie $C_m = C_f$, the decontamination system is so efficient as to bring down the indoor air pollution to the background level.

10 Test report

The test report shall include at least the following information:

a) reference to this standard and appropriate type C-standards;

b) description of the machine tested and pollution control system tested (e. g. manufacturer, model, type, version, design, size, year of manufacture, serial number) for the machine itself and for each additional piece of equipment;

c) operational data during tests, including tools used with the machine and material processed on the machine and air flow rates;

d) description of the general ventilation system;

e) description of measurement procedures, particularly:

- methods;
- location of the emission and sampling points;
- measurement duration;

f) measuring instruments used and their most recent calibration dates;

g) environmental data (temperature, humidity, atmospheric pressure);

h) description of procedures used (e. g. list of standards) for concentration and flow rate measurements

i) test results this includes mean value at the different points, 95% confidence interval;

j) comments on the deviations from any relevant standard;

k) test laboratory;

l) name of the test person responsible;

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[2])When the background level is negligible, the decontamination index is reduced to: $I_A = 1 - \frac{1}{n}\sum_{i=1}^{n}\frac{C_{mi}}{C_{ai}}$

m) date(s) of testing;

n) additional comments, if necessary.

Annex ZA
(informative)

A1 Relationship between this European Standard and the Essential Requirements of EU Directive 98/37/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive Machinery 98/37/EC, amended by 98/79/EC.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 98/37/EC

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ERs) of Directive 98/37/EC	Qualifying remarks/Notes
All clauses	Annex I, 1.5.13	Emissions of dust, gases, etc.

WARNING — Other requirements and other EC Directives may be applicable to the product(s) falling within the scope of this standard. A1

Annex ZB
(informative)

A1 Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive Machinery 2006/42/EC.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard given in Table ZB.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZB.1 — Correspondence between this European Standard and Directive 2006/42/EC

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ERs) of Directive 2006/42/EC	Qualifying remarks/Notes
All clauses	Annex I, 1.5.13	Emissions of hazardous materials and substances

WARNING — Other requirements and other EC Directives may be applicable to the product(s) falling within the scope of this standard. 〈A1

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