



SLOVENSKI STANDARD
SIST EN 1093-7:2000
01-junij-2000

**Varnost strojev - Vrednotenje emisije nevarnih snovi, ki jih prenaša zrak - 7. del:
Učinkovitost ločitve po masi, kanaliziran izpuh**

Safety of machinery - Evaluation of the emission of airborne hazardous substances -
Part 7: Separation efficiency by mass, ducted outlet

Sicherheit von Maschinen - Bewertung der Emission von luftgetragenen Gefahrstoffen -
Teil 7: Masseabscheidegrad, definierter Auslaß

Sécurité des machines - Evaluation de l'émission de substances dangereuses
véhiculées par l'air - Partie 7: Efficacité massique de séparation, sortie raccordée

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Ta slovenski standard je istoveten z: EN 1093-7:1998

ICS:

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| 13.040.40 | Emisije nepremičnih virov | Stationary source emissions |
| 13.110 | Varnost strojev | Safety of machinery |

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EUROPEAN STANDARD

EN 1093-7

NORME EUROPÉENNE

EUROPÄISCHE NORM

September 1998

ICS 13.040.40; 23.120

Descriptors: safety of machines, air pollution, emission, hazardous substances, air cleaners, measurements, efficiency, separation methods, cleaning equipment for gases, dust collectors

English version

Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 7: Separation efficiency by mass, ducted outlet

Sécurité des machines - Evaluation de l'émission de substances dangereuses véhiculées par l'air - Partie 7: Efficacité massique de séparation, sortie raccordée

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This European Standard was approved by CEN on 4 September 1998.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This European Standard 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 March 1999, and conflicting national standards shall be withdrawn at the latest by March 1999.

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

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

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

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0 Introduction

This European Standard is a type B standard as stated in ENV 1070 : 1993.

This European standard is a part of EN 1093. Part 1 of this standard presents a selection of different methods for the evaluation of the emission of airborne hazardous substances from machines.

1 Scope

This European Standard specifies a test rig method for the measurement of the separation efficiency by mass of air cleaning systems, operating under defined conditions. The method shall apply to systems that clean air of aerosols (smoke, dust, fume, mist), vapour or gas with defined air inlet and air outlet which can be connected to measurement ducts.

Measurement of the separation efficiency by mass of an air cleaning system for an intended use can serve for the:

- a) evaluation of the performance of an air cleaning system;
- b) evaluation of the improvement of the air cleaning system;
- c) comparison of air cleaning systems;
- d) ranking of air cleaning systems according to their separation efficiency by mass;
- e) determination of the state of the art of air cleaning systems of the same intended use with respect to their separation efficiency by mass.

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.

| | |
|--------------------|---|
| EN 292-1 : 1991 | Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology |
| EN 292-2 : 1991 | Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles and specifications |
| EN 292-2/A1 : 1995 | Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles and specifications; Amendment A1 |
| ENV 1070 : 1993 | Safety of machinery - Terminology |
| EN 1093-1 | Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 1: Selection of test methods |

3 Definitions

For the purposes of this European Standard the definitions of ENV 1070 : 1993 and the following definition applies:

separation efficiency by mass η_s : The separation efficiency of an air cleaning system for a specified pollutant is the ratio of the mass of pollutant retained by the air cleaning system (m_3) to the mass of pollutant entering the air cleaning system (m_1) during a given period .

The separation efficiency of air cleaning systems in percentage is expressed as follows:

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$$\eta_s = \frac{m_3}{m_1} \cdot 100 \quad \dots (1)$$

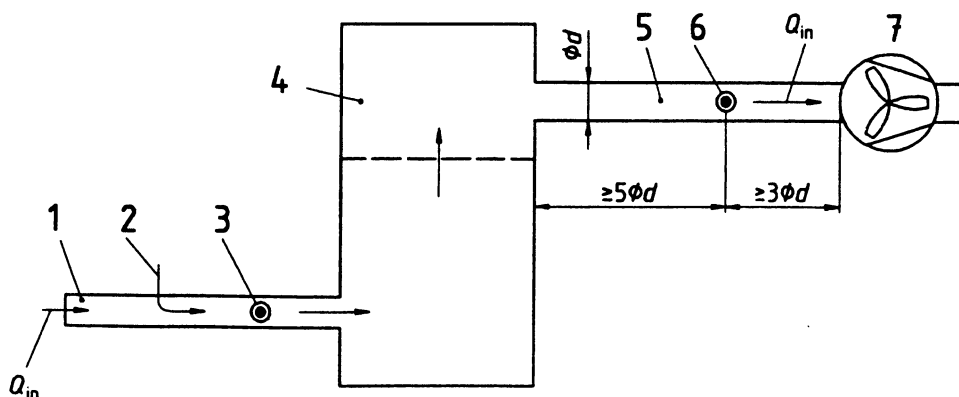
4 Principle

The principle of the measurement method is to operate the air cleaning system under defined conditions and to determine the mass of the test substance in the air upstream and downstream of the air cleaning system.

NOTE: The test substance, which may be the real pollutant or a surrogate, should preferably be of low toxicity and compatible with the objectives of the method.

5 Description of the test arrangement

The test arrangement consists of the air cleaning system fitted with suitable inlet and outlet ducts (see figure 1). If it is necessary to use an additional air mover, it shall be connected to the outlet duct. The air volume flow rate shall be set in accordance with the air cleaning system manufacturer's instructions for use.



| | | | |
|---|--------------------------------------|---|---------------------|
| 1 | inlet duct | 5 | outlet duct |
| 2 | injection point(s) of test substance | 6 | measurement plane 2 |
| 3 | measurement plane 1 | 7 | air mover |
| 4 | air cleaning system under test | | |

Figure 1: Test arrangement (schematic layout)

The air flow rate of the air cleaning system is measured in the inlet and outlet ducts. The test substance is introduced into the inlet duct by a suitable method.

The air in the inlet duct shall be filtered so that it contains no substance that may influence the test result.

6 Operation of the air cleaning system

The air cleaning system shall be operated according to its intended use and with a specified test substance. For given categories of air cleaning systems the test substance (e. g. nature, particle size distribution) and its upstream concentration shall be defined in the type C standards.

Air cleaning system shall be operated in accordance with the manufacturers instructions for use.

7 Procedure

The mass flow rate of the test substance shall be measured or determined in the inlet measurement planes 1 and 2 (see figure 1) during the test period from times t_1 to t_2 . The measurement procedures used shall comply with 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 5168:1978 and 7145:1982. The same type of instrument should be used upstream and downstream of the air cleaning system. If this is not possible, the relationship between the two instruments shall be established for each test substance used.

For certain applications it is useful to determine the separation efficiency according to particle size distribution (see EN 481).

The separation efficiency of some air cleaning systems changes with time e. g. filters. The sampling procedure shall take into account these changing efficiencies in order to obtain valid information about the efficiency of the separator in use.

The measurement time shall be of sufficient duration to collect samples of the substance emitted during the representative use of the air cleaning system including e. g. several cycles of the operations of a filter cleaning mechanism.

Detailed test conditions and statistical analysis of the results shall be specified in appropriate type C standards.

8 Expression of results

The mean value of the separation efficiency of an air cleaning system is calculated according to the following formula:

$$\eta_s = \frac{m_3}{m_1} \cdot 100 = \left[1 - \frac{m_2}{m_1} \right] \cdot 100 = \left[1 - \frac{\int_{t_1}^{t_2} C_2 dt}{\int_{t_1}^{t_2} C_1 dt} \right] \cdot 100 \quad \dots (2)$$

where:

- m_1 is the mass of the test substance entering the air cleaning system;
- m_2 is the mass of the test substance not retained by the air cleaning system;
- m_3 is the mass of the test substance retained by the air cleaning system;
- C_1 is the concentration of the test substance entering the air cleaning system;
- C_2 is the concentration of the test substance at the measurement plane 2.

When the separation efficiency is required as a function of particle size distribution, m_1 and m_2 are measured for each particle size range of interest.

9 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 test environment,
- c) description of the air cleaning system tested (e. g. manufacturer, model, type, version, design, size, year of manufacture, serial number);
- d) operational data during tests including air flow rates;
- e) test substance (e. g. nature, concentration, and for dusts: particle size distribution, moisture content);
- f) description of measurement procedures;
- g) measuring instruments used and their most recent calibration dates;
- h) environmental data (temperature, humidity, atmospheric pressure);
- i) description of the procedures used (e. g. list of standards) for concentration and flow rate measurements;
- j) test results;
- k) comments on deviations from any relevant standards;
- l) test laboratory;
- m) name of the test person responsible;
- n) date of testing;
- o) additional comments (if necessary).

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Annex A (informative)

Bibliography

| | |
|-----------------|--|
| EN 481 | Workplace atmospheres - Size fraction definitions for measurement of airborne particles |
| 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 I : General |
| ISO5167-1:1991 | 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 5168:1978 | Measurement of fluid flow - Estimation of uncertainty of a flow-rate measurement |
| 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 |

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