SLOVENSKI STANDARD
SIST EN 1093-6:2000

01-junij-2000

Varnost strojev - Vrednotenje emisije nevarnih snovi, ki jih prenaša zrak - 6. del: Učinkovitost ločitve po masi, nekanaliziran izpuh

Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 6: Separation efficiency by mass, unducted outlet

Sicherheit von Maschinen - Bewertung der Emission von luftgetragenen Gefahrstoffen - Teil 6: Masseabscheidegrad, diffuser Auslaß

Sécurité des machines - Evaluation de l'émission de substances dangereuses véhiculées par l'air - Partie 6: Efficacité massique de séparation, sortie libre

Ta slovenski standard je istoveten z: **EN 1093-6:1998**

ICS:

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

SIST EN 1093-6:2000 **en**

EUROPEAN STANDARD
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English version

Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 6: Separation efficiency by mass, unducted outlet

Sécurité des machines - Evaluation de l'émission de substances dangereuses véhiculées par l'air - Partie 6: Efficacité massique de séparation, sortie libre

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

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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.

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

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Contents

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of an identical text or by endorsement, at the latest by March 1999, and conflicting national standards shall be withdrawn at the latest by March 1999.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.

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 with unducted outlet, operating under defined conditions. The method shall apply to systems that clean air of aerosols (smoke, dust, fume, mist), vapour or gas.

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
prEN 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 an air cleaning system as a percentage is expressed as follows:

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

4 Principle

The principle of the measurement method is to operate the air cleaning system under defined conditions in a test rig 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 rig

The test rig consists of a cabin symmetrically connected to a measurement duct through which air is drawn (see figures 1 and 2).

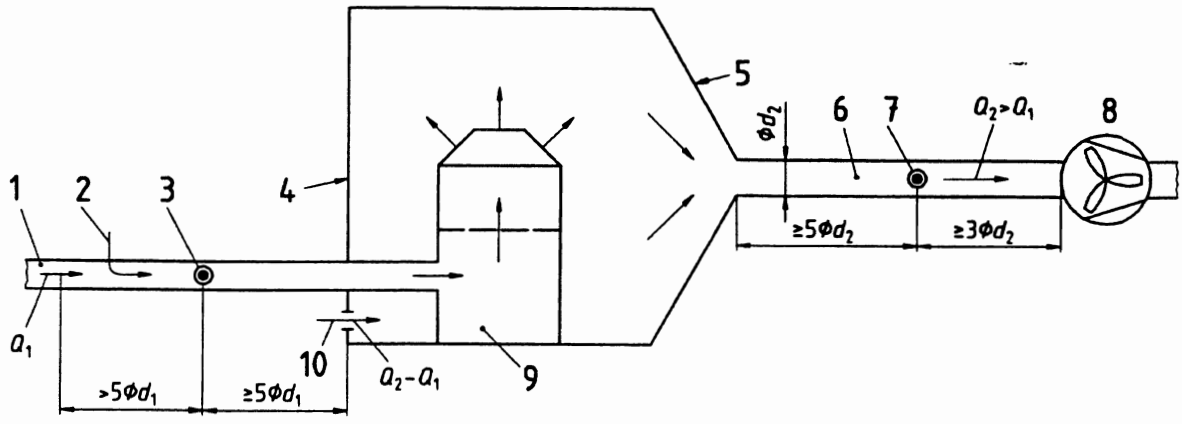

Figure 1: Test rig with secondary air inlet

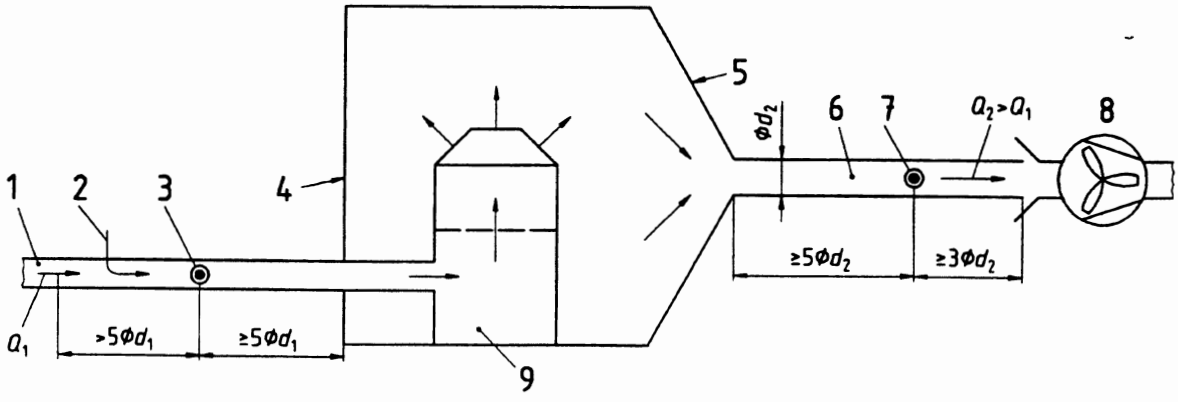

Figure 2: Test rig without secondary air inlet

1	inlet duct	6	outlet duct
2	injection point(s) of test substance	7	measurement plane 2
3	measurement plane 1	8	air mover
4	cabin	9	air cleaning system under test
5	funnel	10	secondary air inlet

For measurement of the concentration in the inlet duct, an even distribution of the test substance shall be achieved.

The air flow rate of the air cleaning system Q_1, and the exhaust air flow rate, Q_2, shall remain constant during the test within stated limits. The cross section of the cabin shall be chosen according to the requirements of the air cleaning system.

6 Position and operation of the air cleaning system

To optimise the transport of any pollutant emitted from the air cleaning system to the measuring plane 2 in the outlet duct, the air cleaning system should normally be positioned in the cabin in such a way, that the emission from the air cleaning system is in the region of the vertical plane of the longitudinal axis of the outlet duct.

Attention shall be given to the aerodynamic conditions in the cabin and duct to ensure that there is no significant deposition of pollutant between the air cleaning system and the measurement plane 2.

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, properties of the test substances (e. g. nature, particle size distribution) and its upstream concentration shall be defined in appropriate type C standards.

The 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 in the inlet duct from times t_1 to t_2 and in the outlet duct from times t_1 to t_3. In the inlet duct this mass flow rate can be determined from the mass of test substance feed and the air flow rate. Time t_3 shall be later than time t_2 and shall take into account the time constants of air cleaning system, cabin and outlet duct. In practical terms the difference between times t_2 and t_3 may be very short in comparison with the measurement time and may have no effect on the measurement result.

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.

In general the separation efficiency of a system is dependent on the amount of retained pollutant and the air volume flow rate. Tests shall therefore be carried out with the various combinations of pollutant amounts and air flow rates which are expected in operation.

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:

$$\eta_s = \frac{m_3}{m_1} \cdot 100 = \left[1 - \frac{m_2}{m_1}\right] \cdot 100 = \left[1 - \frac{\int_{t_1}^{t_3} Q_2 \cdot C_2 \, dt}{\int_{t_1}^{t_2} Q_1 \cdot C_1 \, dt}\right] \cdot 100 \qquad \text{... (2)}$$

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;

Q_1 is the air volume flow rate in the inlet duct;

Q_2 is the air volume flow rate in the outlet duct.

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 air cleaning system tested (e. g. manufacturer, model, type, version, design, size, year of manufacture, serial number);

c) operational data during tests including air flow rates;

d) test substance, (e. g. nature, concentration; and for dusts: particle size distribution, moisture content);

e) description of measurement procedures including type of test rig used;

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

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

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

i) test results;

j) comments on deviations from any relevant standards;

k) test laboratory;

l) name of the test person responsible;

m) date of testing;

n) additional comments, if necessary.

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 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 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