SLOVENSKI STANDARD
SIST EN 1093-6:2000+A1:2008

01-december-2008

Varnost strojev - Vrednotenje emisije nevarnih snovi, ki jih prenaġa zrak - 6. del: Uļ inkovitost loļ itve 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

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ICS:

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

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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

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This European Standard was approved by CEN on 4 September 1998 and includes Amendment 1 approved by CEN on 8 June 2008.

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN 1093-6:1998+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of an identical text or by endorsement, at the latest by January 2009, and conflicting national standards shall be withdrawn at the latest by December 2009.

This document includes Amendment 1, approved by CEN on 2008-06-08.

This document supersedes EN 1093-6:1998.

The start and finish of text introduced or altered by amendment is indicated in the text by tags ⟨A1⟩ ⟨A1⟩.

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).

⟨A1⟩ For relationship with EU 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 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:

3.1
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:

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

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).

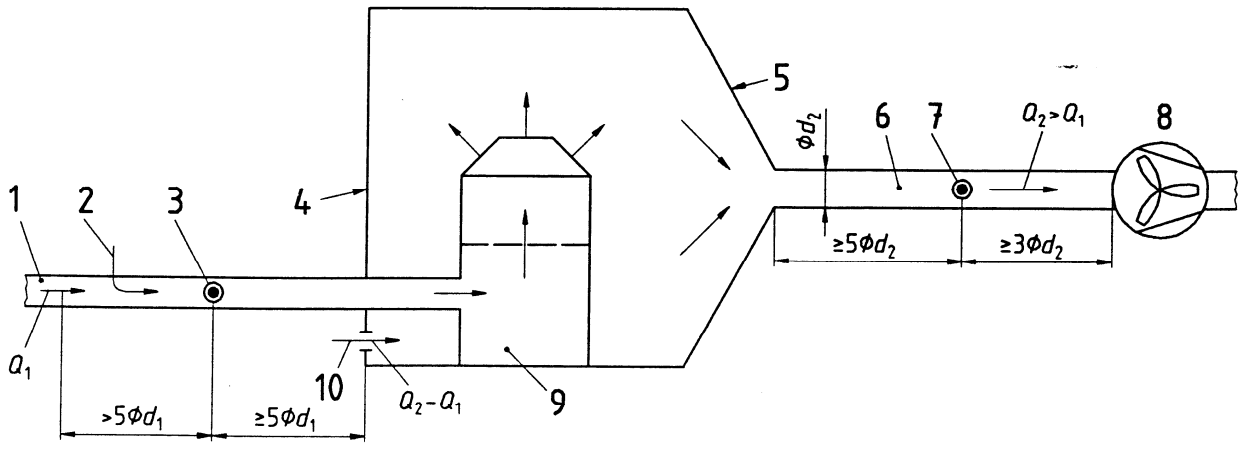

Figure 1 — Test rig with secondary air inlet

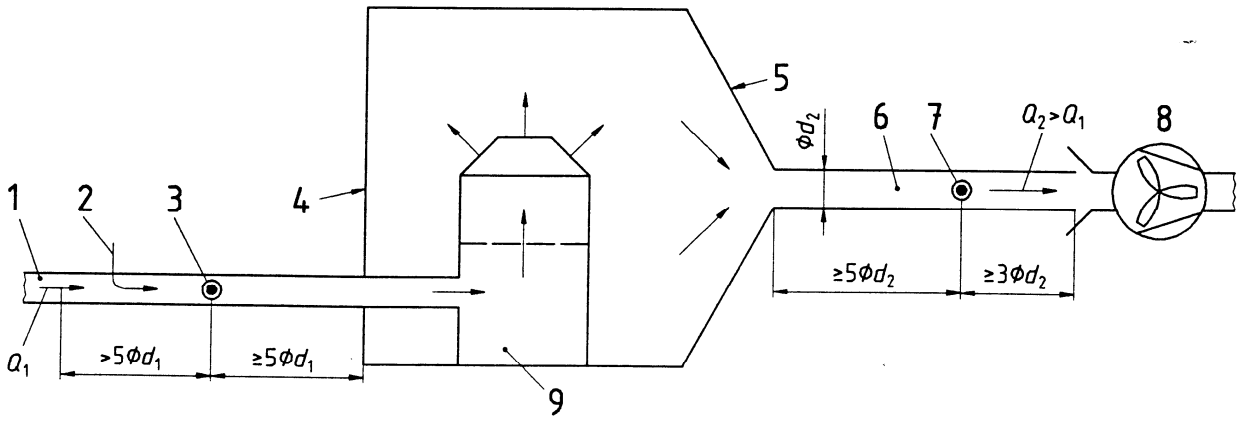

Figure 2 — Test rig without secondary air inlet

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 manufacturer's 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:

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

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;