SLOVENSKI STANDARD
SIST EN 1093-4:1998+A1:2008

01-oktober-2008

Varnost strojev - Vrednotenje emisije nevarnih snovi, ki jih prenaġa zrak - 4. del: Uļ inkovitost zajemanja odsesovalnega sistema - Metoda sledenja

Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 4: Capture efficiency of an exhaust system - Tracer method

Sicherheit von Maschinen - Bewertung der Emission von luftgetragenen Gefahrstoffen - Teil 4: Erfassungsgrad eines Absaugsystems - Tracerverfahren

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Sécurité des machines -Evaluation de l'émission de substances dangereuses véhiculées par l'air - Partie 4 : Efficacité de captage d'un système d'aspiration - Méthode par traçage

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Ta slovenski standard je istoveten z: **EN 1093-4:1996+A1:2008**

ICS:

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

SIST EN 1093-4:1998+A1:2008 **en,fr,de**

2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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EUROPEAN STANDARD

NORME EUROPÉENNE

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EN 1093-4:1996+A1

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Supersedes EN 1093-4:1996

English Version

Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 4: Capture efficiency of an exhaust system - Tracer method

Sécurité des machines -Evaluation de l'émission de substances dangereuses véhiculées par l'air - Partie 4 : Efficacité de captage d'un système d'aspiration - Méthode par traçage

Sicherheit von Maschinen - Bewertung der Emission von luftgetragenen Gefahrstoffen - Teil 4: Erfassungsgrad eines Absaugsystems - Tracerverfahren

This European Standard was approved by CEN on 10 February 1996 and includes Amendment 1 approved by CEN on 14 May 2008.

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Foreword

This document (EN 1093-4:1996+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of an identical text or by endorsement, at the latest by December 2008, and conflicting national standards shall be withdrawn at the latest by December 2008.

This document includes Amendment 1, approved by CEN on 2008-05-14.

This document supersedes EN 1093-4:1996.

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]

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1 Scope

This standard describes a method for the measurement of the capture efficiency of an exhaust system installed on a machine. This method is based on a tracer technique and may be operated in all types of test environment (bench, room and field, see ENV 1093-1).

This technique is applicable only if the tracer shows aerodynamic behaviour comparable with the real pollutant (see 7.1.1).

The measurement of the capture efficiency of an exhaust system can serve for:

a) The evaluation of the performance of an exhaust system of a machine;

b) The evaluation of the improvement of an exhaust system

c) The comparison of exhaust systems for machines of similar design;

d) The ranking of exhaust systems according to their capture efficiency;

e) The determination of the air flow rate of an exhaust system to achieve a given level of capture efficiency;

f) The determination of the state of the art of exhaust systems for machines with respect to the capture efficiency,

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2 Normative references

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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, *Safety of machinery – Basic concepts - General principles for design – Part 1: Basic terminology, methodology.*

EN 292-2, *Safety of machinery – Basic concepts - General principles for design – Part 2: Technical principles and specifications.*

ENV 1093-1, *Safety of machinery – Evaluation of the emission of airborne hazardous substances – Part 1: Selection of test methods.*

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

3 Terms and definitions

For the purpose of this European Standard the following definitions apply:

3.1
capture efficiency of an exhaust system η_c
the ratio of the mass-flowrate of a specified pollutant directly collected by the exhaust system to the uncontrolled mass-flowrate of this pollutant emitted from the machine

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3.2
tracer technique
the use of substances with an aerodynamic behaviour comparable to the hazardous substance under consideration and which can be reliably measured

4 Principle

The principle of the measurement method consists of:

a) Emitting a tracer simulating the aerodynamic behaviour of the real pollutant, with the tracer flow rate (q_E);

b) Measuring the flow rate (q_c) of the tracer collected by the exhaust system.

5 Simplified expression of the capture efficiency

The capture efficiency expressed as a percentage is:

$$\eta_c = \frac{q_c}{q_E} \times 100 \quad (1)$$

The tracer flow rate (q_E) is determined by emitting the tracer at constant flow rate directly into the exhaust duct and by measuring the average tracer concentration in a cross section of the duct then:

$$q_E = Q(C_2 - C_1) \quad (2)$$

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where:

Q is the average air flow rate in the duct during the measurement period of (q_E);

C_1 is the average ambient concentration of the tracer before the measurements (background level);

C_2 is the average concentration of the tracer in the duct (emission of tracer in the duct).

The tracer flow rate (q_c) is determined by emitting the tracer at constant flow rate (q_E) at a characteristic point or zone of the emission of the real pollutant (e.g. at the furthest locations in the emission zone from the exhaust system) and by measuring the average concentration of tracer in the same points of the duct:

$$q_c = Q'(C_3 - C'_1) \quad (3)$$

where:

Q' is the average air flow rate in the duct during the measurement period of (q_c);

C'_1 is the average ambient concentration of the tracer after the background level is stabilised;

C_3 is the average concentration of the tracer in the duct (emission at a selected location).

The capture efficiency is expressed as a percentage as follows:

$$\eta_c = \frac{q_c}{q_E} \times 100 = \frac{Q'(C_3 - C'_1)}{Q(C_2 - C_1)} \times 100 \quad (4)$$

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If the exhaust flow rate can be considered as being constant, then Q = Q', and the expression can be simplified:

$$\eta_c = \frac{C_3 - C'_1}{C_2 - C_1} \times 100 \qquad (5)$$

The capture efficiency is then determined by measuring only concentrations in the exhaust duct.

6 Test method

6.1 General procedure

The measurement procedure is illustrated by figures 1 and figure 2 shows a typical test record.

To measure the concentration by sampling the air in the duct, it is assumed that the tracer is well mixed with the air. In the case of straight ducts the procedures described in ISO 4053-1 shall be used.

NOTE Devices can be added to the duct to reduce the mixing length

At least three tests shall be performed.

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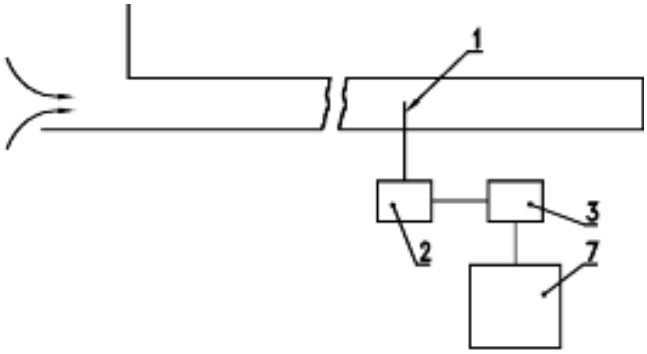
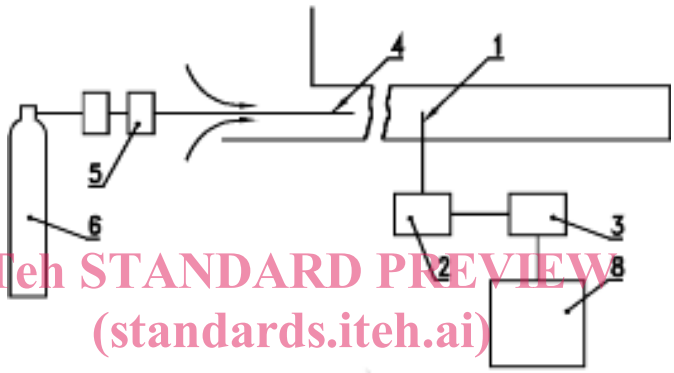


Phases 1 and 4: Measurement without tracer emission



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Phase 2: Measurement with tracer emission in the duct

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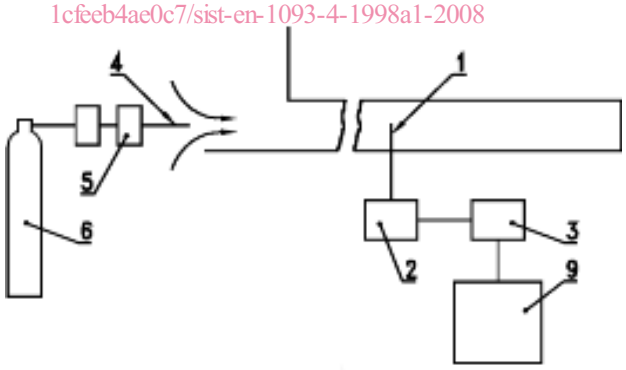

Phase 3: Measurement with tracer emission simulating the real pollutant

1	sampling	5	tracer gas flow meter	7	ambient concentration C_1 or C'_1
2	pump	6	tracer gas cylinder (pure or diluted tracer gas)	8	concentration C_2
3	analyser			9	concentration C_3
4	injection				

Figure 1 — Measurement procedure for a simple exhaust system using a tracer gas