SLOVENSKI STANDARD
SIST EN 1093-1:2000

01-junij-2000

Varnost strojev - Vrednotenje emisije nevarnih snovi, ki jih prenaša zrak - 1. del: Izbor preskusnih postopkov

Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 1: Selection of test methods

Sicherheit von Maschinen - Bewertung der Emission von luftgetragenen Gefahrstoffen - Teil 1: Auswahl der Prüfverfahren

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Sécurité des machines - Evaluation de l'émission de substances dangereuses véhiculées par l'air - Partie 1: Choix des méthodes d'essai

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Ta slovenski standard je istoveten z: EN 1093-1:1998

ICS:

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

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EUROPEAN STANDARD
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EN 1093-1

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English version

Safety of machinery - Evaluation of the emission of airbone hazardous substances - Part 1: Selection of test methods

Sécurité des machines - Evaluation de l'émission de substances dangereuses véhiculées par l'air - Partie 1: Choix des méthodes d'essai

Sicherheit von Maschinen - Bewertung der Emission von luftgetragenen Gefahrstoffen - Teil 1: Auswahl der Prüfverfahren

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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

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of an identical text or by endorsement, at the latest by March 1999, and conflicting national standards shall be withdrawn at the latest by March 1999.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

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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.

The concentration level of substances resulting from emission of airborne hazardous substances from machines depends upon factors including:

– the emission rate of airborne hazardous substances (in this European Standard called: pollutant) from the machine under examination, depending on the type of process and the production rate of the machine;

– the performance of the pollution control system associated with the machine and, in the case of air recirculation, the performance of the separation system;

– the surrounding conditions, especially the air flow pattern, which may reduce the pollution (efficient general ventilation) or increase it (disturbing air, crossdraughts);

– the worker's location in relation to the machine and its pollution control system, and taking into account the workers movements;

– the quality of maintenance; poor quality has generally an adverse effect on the performance of the pollution control and the separation systems.

This European Standard concerns the first two points in this list and forms only part of a comprehensive risk assessment. It is not for a risk assessment of the work place. Evaluating the parameters defined in this European Standard leads to an evaluation of the performance of the machine and its associated pollution control system.

This European Standard can be used as a part of verification described in EN 626-2.

1 Scope

This European Standard

– specifies parameters which may be used for the assessment of the emission of pollutants from machines or the performance of the pollution control systems integrated in machines;

– gives guidance on the selection of appropriate test methods according to their various fields of application and types of machines including the effects of measures to reduce exposures to pollutants. The test methods are given in additional parts of this standard (see table 1 and annex A).

Other test methods for parameters may be included at a later stage (e. g. fume boxes).

This European Standard is not applicable for certain types of off-the-road vehicles powered by internal combustion engines which are subject to the Machinery Directive.

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.

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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
EN 626-2	Safety of machinery - Reduction of risks to health from hazardous substances emitted by machinery - Part 2: Methodology leading to verification procedures.
ENV 1070 : 1993	Safety of machinery - Terminology
EN 1093-3	Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 3: Emission rate of a real specified pollutant - Bench test method using the real pollutant

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EN 1093-4	Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 4: Capture efficiency of an exhaust ventilation system - Tracer method
EN 1093-6	Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 6: Separation efficiency by mass, unducted outlet
EN 1093-7	Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 7: Separation efficiency by mass, ducted outlet
EN 1093-8	Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 8: Pollutant concentration parameter, test bench method
EN 1093-9	Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 9: Pollutant concentration parameter, room method
prEN 1093-11	Safety of machinery - Evaluation of the emission of airborne hazardous substances - Part 11: Decontamination index

3 Definition of assessment parameters

3.1 General

When particle size distribution is determined at the same time as pollutant concentration, an assessment parameter for each size fraction may be defined.

3.2 Emission rate of a specified pollutant

3.2.1 uncontrolled emission rate of a specified pollutant ($\dot{m}_u$): The mass of pollutant emitted from the machine into the space around the machine per unit of time. Any measures to reduce the air pollution around the machine (e. g. capture devices, containment equipment, wetting process) are not in use or activated.

3.2.2 controlled emission rate of a specified pollutant ($\dot{m}_k$): The mass of pollutant emitted from the machine into the space around the machine per unit of time, taking into account the effects of measures to reduce the air pollution.

3.3 capture efficiency (η_c): The capture efficiency of a pollution control system (η_c) is defined as the ratio of the mass-flowrate of a specified pollutant directly collected by the pollutant control system to the uncontrolled mass-flowrate of this pollutant emitted from the machine.

The capture efficiency, in terms of a percentage, is expressed at follows:

$$\eta_c = \frac{\dot{m}_u - \dot{m}_k}{\dot{m}_u} \cdot 100 \qquad \text{... (1)}$$

NOTE: This equation is applicable only if $\dot{m}_u$ - $\dot{m}_k$ represents the pollutant mass-flowrate directly captured. This parameter is not usable when the amount of emission is effected by the control system.

Where the pollution control system is an exhaust ventilation system and provided comparable discharge and flow patterns of the real pollutant can be simulated by a tracer technique the equation becomes:

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$$\eta_c = \frac{q_k}{q_u} \cdot 100 \qquad \text{... (2)}$$

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where:

q_u is the uncontrolled mass-flowrate of tracer material generated;

q_k is the mass-flowrate of tracer material directly collected by the exhaust ventilation system.

3.4 separation efficiency by mass (η_s): The separation efficiency of an air cleaning system for a specified pollutant, is the ratio of the mass[1]) of pollutant retained by the air cleaning system (m_3) to the mass[1]) of pollutant entering the air cleaning system (m_1) during a given period.

[1]) For special applications to measure the number of fibres or particles instead of the mass.

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The separation efficiency of an air cleaning system as a percentage, is expressed as follows:

$$\eta_s = \frac{m_3}{m_1} \cdot 100 \qquad \text{... (3)}$$

NOTE: In certain cases it may be necessary to consider only that part of pollutants (e. g. size of particles) which is actually hazardous for exposed persons; e. g. separation efficiency of a separation system against hazardous dust is measured as a function of particle size - otherwise the results may not be reliable for health and safety purposes.

3.5 pollutant concentration parameter *(P_c)*: The measured concentration of a specified pollutant in defined position(s) near the machine.

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

The decontamination index is expressed as follows:

$$I_A = \frac{1}{n}\sum_{i=1}^{n} \frac{C_{ai}-C_{mi}}{C_{ai}-C_{fi}} \qquad \text{... (4)}$$

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 locations.

When particle size distribution is determined at the same time as pollutant concentration, a decontamination index for each size fraction may be determined.

4 Types of test methods

4.1 General

For the determination of each assessment parameter defined in clause 3, different test methods can be considered. The test methods should be selected according to the following criteria:

- the nature of "pollutant" used;
- the nature of the test environment.

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4.2 Nature of "pollutant" used

As far as possible the real pollutant should be used for the testing. However, in some cases tracer techniques allow a more convenient testing. The addition of tracer material to the real pollutant requires several conditions to be met, in particular comparable discharge and flow patterns of the real pollutant and the tracer material, respectively.

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[2]) When the "background level" is negligible, the decontamination index reduces to:

$$I_A = 1 - \frac{1}{n}\sum_{i=1}^{n} \frac{C_{mi}}{C_{ai}}$$

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Depending on the test method, two types of "pollutants" shall be considered :

- the real pollutant which may be particulate, liquid or gas;
- a tracer material simulating the real pollutant.

When determining the emission rate of real pollutant without any air flow measurement, the real pollutant and the tracer material are used simultaneously.

The measurements of concentrations can be carried out:

- in ducts together with air flow rate measurements;
- at locations surrounding the machine under examination.

4.3 Nature of the test environment

Two main types of environmental test conditions may be considered, and, in some cases, can lead to different test methods.

4.3.1 Laboratory methods

4.3.1.1 Bench test method

The tests are performed in a specially designed cabin of known and limited dimensions.

The cabin contains a single machine in order to avoid any interference from other machines on the pollution around the tested machine and on the air flow rate through the pollution control system.

The air flow pattern around the machine should be maintained by the provision of specified general ventilation of the cabin.

It should be noted that, in this type of method, the conditions of general ventilation, as well as the operating conditions of the machine, are fixed and, to some extent, arbitrary. Consequently, most of the time they are not representative of the actual situations encountered in practice.

4.3.1.2 Room method

The tests are performed in a room located in laboratory or factory premises, specially devoted to these tests during the measurements.

Only one machine should be run at the time. More precise control of the general and local ventilation can be achieved than in the field. Since the location of the machine is not fixed, the air flow pattern around the machine shall be checked to determine the influence of crossdraughts.

It should be noted that, in this type of method, the conditions of general ventilation, as well as the operating conditions of the machine, are fixed and, to some extent, arbitrary. Consequently, they are not in general representative of the actual situations encountered in practice.

4.3.2 Field method

Many machines cannot be tested in a cabin (see 4.3.1.1) or a room (see 4.3.1.2) because they are too large, too difficult to handle or have special installation or process requirements. Tests may be performed on machines in the places where they are installed.

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Performing field tests on machines in their usual working environment is of particular importance because disturbances occurring in real situations will be taken into account (e. g. crossdraughts).

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Care should be taken prior and during the test to determine the operating conditions of the machine under examination and of its pollution control system, as well as operating conditions of the other machinery the pollution of which may affect the results [3]).

A record shall be taken of the operating conditions of the machine under examination and the other equipment.

Additional measurements may also be needed to evaluate the characteristics of the general ventilation including air crossdraughts. These crossdraughts, due for instance to opening of door, may disturb drastically the air flow pattern around the machine.

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[3]) This effect can be avoided by using a suitable tracer method.

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4.4 Summary table

Table 1 presents the different methods dealt with in this European Standard.

Each identified method is described in detail in the part of this European Standard indicated in table 1. Additional information about more specific test conditions will be provided in each new type C standard dealing with a specific category of machinery.

Table 1: Summary table

Assessment parameters		Nature of "pollutant"	Bench test method	Room method	Field method
Emission	Emission rate	Tracer and Pollutant	[1])		
		Pollutant	EN 1093-3	/	/
	Pollutant concentra-tion	Pollutant	EN 1093-8	EN 1093-9	/
Capture	Efficiency	Tracer	EN 1093-4		
		Pollutant	/	/	/
	Decontamination index	Pollutant	/	prEN 1093-11	
Separation	Efficiency	Pollutant	EN 1093-6	EN 1093-7	/
[1]) May be prepared at a later stage.					

5 Basis for selection of test methods

5.1 General

Where several methods appear applicable, the selection should be made based on considerations including:

– determination of assessment parameters providing comparison between machines and between pollution control systems;

– relevance of the chosen methods to the foreseeable working situations of the machine.

5.2 Selection relative to the assessment parameter

The selection of the most suitable assessment parameter depends upon the type of information that is required. This requirement may be satisfied by the determination of one or more of the assessment parameters.

a) A requirement may be the overall evaluation of the emission of a specified pollutant for a defined machine including its pollution control system.

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This is given by:

– the controlled emission rate of this specified pollutant ($\dot{m}_k$),

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or indicated by:

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– the pollutant concentration parameter (P_c).

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b) When the information concerns either the capture device, or the separation equipment or, more generally, the pollution control system, a single parameter is sufficient to assess the performance:

– for capture device, the capture efficiency η_c;

– for separation equipment, the separation efficiency η_s;

– for the pollutant control system of a given machine and without air recirculation, the decontamination index I_A.