SLOVENSKI STANDARD
SIST EN 1032:2004+A1:2009

01-februar-2009

Mehanske vibracije - Preskušanje mobilnih strojev za ugotavljanje vrednosti oddajanja vibracij

Mechanical vibration - Testing of mobile machinery in order to determine the vibration emission value

Mechanische Schwingungen - Prüfverfahren für bewegliche Maschinen zum Zwecke der Bestimmung des Schwingungsemissionswertes

Vibrations mécaniques - Essai des machines mobiles dans le but de déterminer la valeur d'émission vibratoire

Ta slovenski standard je istoveten z: **EN 1032:2003+A1:2008**

ICS:

13.160	Vpliv vibracij in udarcev na ljudi	Vibration and shock with respect to human beings

SIST EN 1032:2004+A1:2009 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1032:2003+A1

November 2008

ICS 13.160

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English Version

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This European Standard was approved by CEN on 28 February 2003 and includes Amendment 1 approved by CEN on 5 October 2008.

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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 CEN Management Centre has the same status as the official versions.

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Contents

Foreword

This document (EN 1032:2003+A1:2008) has been prepared by Technical Committee CEN/TC 231 “Mechanical vibration and shock”, 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of an identical text or by endorsement, at the latest by May 2009, and conflicting national standards shall be withdrawn at the latest by December 2009.

This document includes Amendment 1, approved by CEN on 2008-10-05.

This document supersedes ⟨A1⟩ EN 1032:2003 ⟨A1⟩.

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

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

⟨A1⟩ For relationship with EU Directive(s), see informative Annexes ZA and ZB, which are integral parts of this document. ⟨A1⟩

Annexes A to F are informative.

This document includes a Bibliography.

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

Exposure to mechanical vibration from mobile machinery can interfere with comfort, working efficiency and, in some circumstances, health and safety. The EC Machinery Directive, supported by the basic safety standards [A1] EN ISO 12100 [A1], requires that machinery is designed and constructed so that the risks resulting from vibration emissions are minimized and that where risks remain, despite such measures, the manufacturer shall supply warnings. It also states that the magnitudes of vibration generated by mobile machinery shall be noted in the relevant instruction handbook in terms of root-mean-square (r.m.s.) value of frequency-weighted acceleration. This European Standard is limited to test methods and measurements related to fulfilment of the second statement. Knowledge of whole-body and hand-transmitted vibration emission values will aid the selection of low-vibration machinery.

The vibration emission determined by a test code should be in proportion to the magnitude of the vibration hazard. In some cases (for example, where the vibration emission at the seat contains shocks) the r.m.s. values determined by the test code cannot adequately represent the vibration hazard. Test codes should provide guidance on how to warn of vibration risk (residual risk) in these cases.

However, the EC Machinery Directive does not require specific declaration of the magnitude of shocks. Therefore in this European Standard, only requirements for evaluation of r.m.s. values are given, together with general requirements for testing and evaluating whole-body and hand-transmitted vibration emissions of mobile machinery as a basis for technical committees responsible for the preparation of vibration test codes.

Standardized vibration test codes are required for many purposes, e.g. to fulfil legal requirements, as well as for trade agreements, aspects of work environment, vibration control, planning of process and work.

In order to prepare a vibration test code for a specific family of machinery it is essential to establish additional requirements for that family, e.g. installation and mounting conditions, operating conditions, measurement positions, measurement directions, vibration declaration, information to be reported.

It is essential when developing a test code for declaration of vibration emission to define a procedure to collect representative vibration values for the machine, to identify causes of variability, to validate the test method and to evaluate the reproducibility of results.

1 Scope

This European Standard specifies the determination of whole-body and hand-arm vibration emissions at operator position(s) during testing of mobile machinery. The purpose of this European Standard is to assist technical standardization committees responsible for specific types of machinery in preparing vibration test codes to ensure that such vibration test codes

— are as homogeneous as possible with each individual test code having the same basic structure;

— are in full accordance with basic standards on measurement of vibration emission;

— reflect the latest technical knowledge of methods of determining the vibration emission from the specific family of machinery under consideration;

— provide manufacturers with a standardized method for the determination and declaration of the vibration emission value(s) of their machinery;

— enable the user of the machinery or the member of an inspection body to compare the vibration emission values of different machinery and to verify the vibration emission values provided by the manufacturer.

This European Standard provides requirements for the preparation of vibration test codes, including guidelines for the conditions under which the measurements shall be made (e.g. operating conditions). Information to be included in a typical vibration test code is summarized in Annex A.

Vibration test codes based on this European Standard should define measuring procedures which provide accurate and reproducible results which are as far as possible in agreement with values measured under real working conditions. For determination of the magnitude of the vibration to be noted in the instruction handbook, this European Standard requires operating conditions enabling the determination of the 75-percentile of the vibration experienced at the operator's position during the mode of operation causing the highest vibration.

This European Standard applies to sitting and standing positions. It is applicable to all mobile machinery producing periodic or random vibration with or without transients. Rotational vibration is not dealt with in this European Standard.

This European Standard contains sufficient guidance for designing an appropriate test for machinery for which no vibration test codes exist. It can also be used for the determination of vibration emission values of individual machines.

This European Standard does not present limits or recommended vibration values.

In general, the emission values should not be used for assessment of the health risk. This European Standard does not give any guidance or recommendations for determination of human exposure to vibration and shock.

NOTE For such information, reference is made to ISO 2631-1 and EN ISO 5349-1.

2 Normative references

[A1] The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. [A1]

EN 12096, *Mechanical vibration — Declaration and verification of vibration emission values*

[A1] EN ISO 8041, *Human response to vibration — Measuring instrumentation (ISO 8041:2005)* [A1]

EN 30326-1, *Mechanical vibration — Laboratory method for evaluating vehicle seat vibration — Part 1: Basic requirements (ISO 10326-1:1992)*

ISO 2041:1990, *Vibration and shock — Vocabulary*

ISO 5347 (all parts), *Methods for the calibration of vibration and shock pick-ups*

ISO 5348, *Mechanical vibration and shock — Mechanical mounting of accelerometers*

ISO 5805:1997, *Mechanical vibration and shock — Human exposure — Vocabulary*

ISO 16063 (all parts), *Methods for the calibration of vibration and shock transducers*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in ISO 2041:1990 and ISO 5805:1997 and the following apply.

3.1
vibration test code
type-C standard relative to a specified family or sub-family or type of machinery, which gives all the information necessary to carry out efficiently the determination, declaration and verification of the vibration emission values, with the purpose of ensuring compatibility and allowing comparison of test results.

NOTE Data produced using a vibration test code may be used as a means of warning of residual risk from vibration.

3.2
mode of operation
task performed by a mobile machine, for which a vibration emission value is determined

EXAMPLE travelling, towing, lifting, excavating

3.3
operating conditions
parameters which affect the vibration emission of a mobile machine for a particular mode of operation

EXAMPLE travelling speed, travelling surface, weight of load, material being excavated

4 Basic standards

This European Standard together with EN 12096 shall be considered as basic standards when preparing a vibration test code for mobile machinery.

EN 12096 gives guidance on how to declare the vibration emission values of machinery, and specifies requirements for verification of declared values.

Those responsible for preparing a vibration test code for a specific family of mobile machinery shall follow the requirements of these two European Standards.

5 Description of a family of machines

The family or type of machinery covered by the vibration test code shall be described unambiguously and in detail. In describing the configuration of the machinery, a vibration test code shall

— identify any additional equipment, e.g. tools, used in the operation of the machine under test and which may influence the vibration emission;

— specify the selection of optional components, devices or sub-assemblies, e.g. tyres or seats, which may influence the vibration emission and which shall be used during the determination of vibration emission values.

It may be appropriate to divide a family of machinery into sub-families requiring different conditions of testing.

6 Characterization of vibration

6.1 Direction of vibration

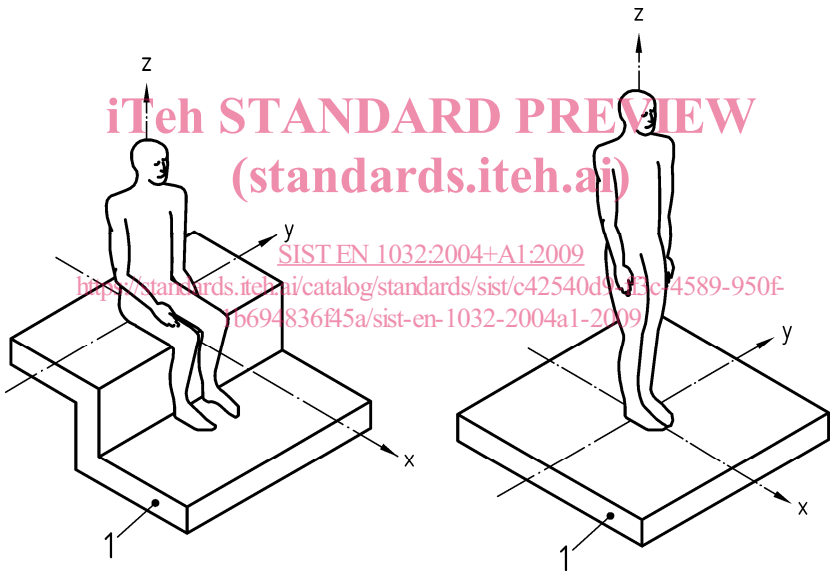
6.1.1 Translational whole-body vibration transmitted to the human body is related to the appropriate directions of an orthogonal coordinate system (see Figure 1).

The terminology commonly used in biodynamics relates the coordinate systems to the human skeleton in a normal anatomical position. The directions are as follows:

— x-direction: back to chest,

— y-direction: right side to left side,

— z-direction: foot (or buttocks) to head.



Key

1 Supporting surface

NOTE For description of the directions, see 6.1.1.

Figure 1 — Directions of the basicentric coordinate system for mechanical whole-body vibration influencing human beings

6.1.2 Translational hand-transmitted vibration from a steering wheel is related to the steering wheel as follows:

— x-direction: the radial direction,

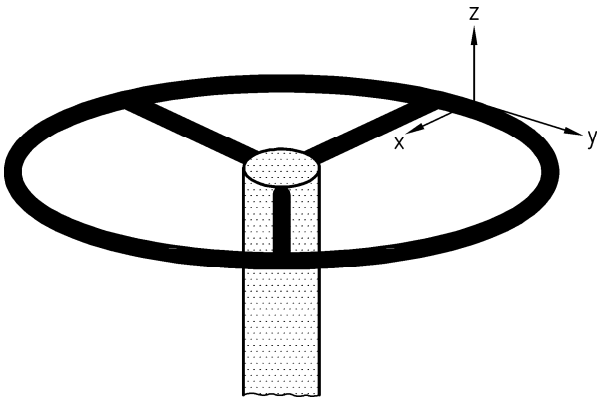
— y-direction: the direction tangential to the rim of the steering wheel,

— z-direction: the direction orthogonal to both the x-direction and the y-direction.

These directions are illustrated in Figure 2.

NOTE 1 For some machines, a steering control is used instead of a steering wheel. In such cases the directions should be specified in the vibration test code.

NOTE 2 If measurements are to be made also in controls other than those for steering (e.g. levers), the vibration test code should specify the directions.



NOTE For description of the directions, see 6.1.2.

Figure 2 — Directions of measurement on steering wheels

6.2 Location of measurement

6.2.1 For whole-body vibration measurements, vibration should be determined as close as possible to the point or area through which the vibration is transmitted to the body.

a) In the case where the exposed persons are sitting, the transducer mounted in a semi-rigid disc (see 7.2) shall be placed on the surface of the seat such that the transducer is located midway between the ischial tuberosities of the seated person. For comfort reasons, it is acceptable if the centre of the disc is located slightly in front (up to 5 cm) of the ischial tuberosities.

b) In the case where the exposed persons are standing on a driving or a working platform, the transducer shall be located with the operator standing as in Figure 1 with the transducer midway between the arches of the feet.

NOTE Backrest vibration is not dealt with in this European Standard.

6.2.2 For hand-transmitted vibration measurements, vibration should be determined as close as possible to the point or area through which the vibration is transmitted to the hand.

Measurements on the steering wheel shall be carried out adjacent to the normal position of a hand guiding the steering wheel.

If the test code also requires measurements to be made on controls (e.g. levers), they shall be carried out as close as possible to the hand which touches the control in a normal way.

6.3 Magnitude of vibration

The quantity used to describe the magnitude of vibration shall be frequency-weighted acceleration in m/s^2, expressed as a root-mean-square (r.m.s.) value a_w.

Frequency weightings to be used are defined in 7.3.

The acceleration a_w in accordance with this European Standard is defined as the r.m.s. value of the frequency-weighted acceleration signal $a_w(t)$:

$$a_w = \left[\frac{1}{T} \int_0^T a_w^2(t)\ \mathrm{d}t \right]^{1/2} \qquad (1)$$

Requirements for the integration time T are given in 7.4.

NOTE 1 Frequency analysis is recommended in order to check the validity of the measurements and to provide information for the improvement of designs.

NOTE 2 The measurement of hand-transmitted vibration should be inspected for the effects of operator-induced movements and either these effects removed from the signal or a period selected for analysis which is free of these artefacts.

6.4 Multi-axial vibration measurements

The measurements shall normally be made in three directions. The following values shall be determined.

For whole-body vibration: a_{wx}, a_{wy}, a_{wz} (2a)

$$a_{w\,max} = \max\{1{,}4\ a_{wx},\ 1{,}4\ a_{wy},\ a_{wz}\} \qquad (2b)$$

For hand-transmitted vibration: a_{hwx}, a_{hwy}, a_{hwz} (3a)

$$a_{hv} = \left[a_{hwx}^2 + a_{hwy}^2 + a_{hwz}^2 \right]^{1/2} \qquad (3b)$$

where

a_{wx}, a_{wy} and a_{wz} (for hand-transmitted vibration a_{hwx}, a_{hwy} and a_{hwz}) are the r.m.s. values of the frequency-weighted acceleration in the x-direction, y-direction and z-direction, respectively.

NOTE Where it is shown that there is a dominant direction, the vibration test code can specify that the vibration be measured in one direction only, which needs to be stated. For hand-transmitted vibration, in this case the value a_{hv} is the r.m.s. value of the weighted acceleration in that direction.

A direction can be regarded as dominant when the r.m.s. value of the frequency-weighted acceleration in each of the other directions, in the case of whole-body vibration multiplied by 1,4 for x- and y-directions, is less than 66 % of that in the dominant direction.

7 Instrumentation requirements

7.1 General

Unless otherwise specified by the relevant vibration test code the dynamic range, sensitivity, accuracy, linearity and overload capacity of the vibration measuring system shall be in accordance with [A1] EN ISO 8041 [A1].

Measuring equipment may comprise

— transducers (usually accelerometers),

— conditioning amplifiers and filters,

— telemetry set (optional),

— recorders and/or meters.

[A1] The tolerances of the vibration measuring instrumentation are specified in EN ISO 8041. [A1]