SLOVENSKI STANDARD
SIST EN 1032:2000

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

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Mechanische Schwingungen - Prüfverfahren zur Ermittlung der Ganzkörper-Schwingungen von beweglichen Maschinen - Allgemeines

Vibrations mécaniques - Essai des machines mobiles dans le but de déterminer l'intensité vibratoire transmise a l'ensemble du corps - Généralités

Ta slovenski standard je istoveten z: **EN 1032:1996**

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

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English version

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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

Foreword

This European Standard 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of an identical text or by endorsement, at the latest by April 1997, and conflicting national standards shall be withdrawn at the latest by April 1997.

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).

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Exposure to mechanical vibration from mobile machinery can interfere with comfort, working efficiency and, in some circumstances, health and safety. Clause 3.6.3.a of the amended annex I (see EN 292-2) of the Machinery Directive 89/392/EEC as appearing in 91/368/EEC states that the magnitudes of vibration generated by mobile machinery shall be noted in the relevant instruction handbook in terms of weighted root-mean-square (r.m.s.) acceleration values. The requirements for evaluation of r.m.s. values are given in this European Standard, together with general requirements for testing and evaluating whole-body vibration emission of mobile machinery as a basis for Technical Committees responsible for the elaboration of machinery related (Type Test) standards.

Knowledge of whole-body vibration emission value will aid the selection of low-vibration machinery.

1 Scope

This European Standard specifies the evaluation of vibration emission at operator's place during testing and operation of mobile machinery. It is intended to be used for defining magnitudes of whole-body vibration transmitted from supporting surfaces to the human body in the frequency range 1 Hz to 80 Hz. According to this standard, the magnitudes are stated as r.m.s. values of representative vibration.

This European Standard provides requirements for the vibration test codes to be incorporated in the machinery related standards, including the conditions under which the measurements shall be made (e. g. operating conditions).

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.

Only rectilinear vibrations are dealt with in this standard.

The purpose of this European Standard is to ensure consistency and compatibility of test and evaluation methods. It does not present limits or recommended vibration values.

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.

ENV 28041	Human response to vibration – Measuring instrumentation (ISO 8041:1990)
ISO 2041	Vibration and shock – Vocabulary
ISO 5347	Methods for the calibration of vibration and shock pick-ups
ISO 5805	Mechanical vibration and shock affecting man – Vocabulary

3 Definitions

For the purposes of this European Standard, the definitions given in ISO 2041 and ISO 5805 apply together with the following.

A **vibration test code** is a type-C standard relative to a specified family or sub-family or type of machinery. It gives all the information necessary to carry out efficiently the determination, declaration and verification of the vibration emission characteristics. It shall ensure compatibility and allow comparison of test results.

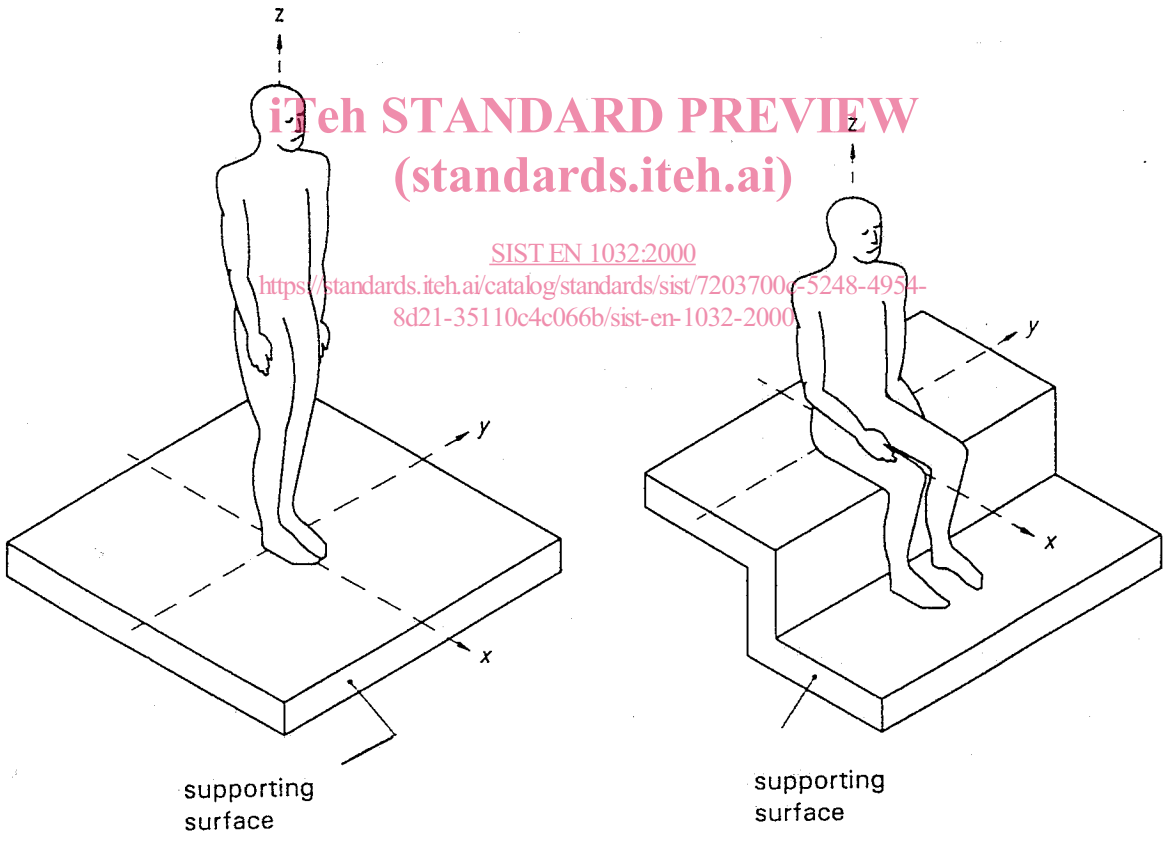
4 Characterization of vibration

4.1 Direction of vibration

4.1.1 Rectilinear vibrations transmitted to the human body are 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. Accelerations (motion) in the foot-(or buttocks-)to-head axis are designated $+a_z$; accelerations in the postero-anterior or back-to-chest axis, $+a_x$; and in the lateral (right-to-left side) axis, $+a_y$. These axes are illustrated in figure 1.

4.1.2 In some circumstances there are other axes of vibration (e. g. rotational motion, backrest vibration) which may contribute to human response. Evaluation of these is not dealt with in this European Standard.



x-axis = back-to-chest
y-axis = right side to left side
z-axis = foot-(or buttocks-)to-head

Figure 1: Directions of basicentric coordinate systems for mechanical vibration influencing humans

4.2 Location of measurement

Vibration shall be determined as close as possible to the point or area through which the vibration is transmitted to the body.

a) Where there is a soft surface, such as a cushion, the transducers should be placed between the subject and the area of contact; this should be done by mounting the transducers in a semi-rigid interface so designed that it does not interfere with the distribution of pressure over the soft surface.

b) If the vibrating surface is hard, the transducer should be rigidly coupled and located as close as possible to the area of contact between body and surface.

c) Should it prove impractical to determine vibration at the point of input to the subject, then it is necessary to determine the transmission characteristics of the intermediate structures.

4.3 Magnitude of vibration

4.3.1 Quantity used to describe the magnitude

The quantity used to describe the magnitude of vibration shall be acceleration in metres per second squared (m/s^2) for translational vibrations, expressed as a root-mean-square (r.m.s.) value.

4.3.2 Frequency weighting of the acceleration signal

Before squaring and integrating for determination of the r.m.s. values, the acceleration signal shall be transformed into the frequency weighted acceleration signal $a_w(t)$. Details on the weighting procedure are given in ENV 28041.

Different weighting functions are used in the longitudinal and in the transverse directions. The weighting filter frequency characteristics are given in figure 2 for the x and y axes, and in figure 3 for the z-axis. Tolerances of the weighting filters are shown in the figures.

4.3.3 Definition of the r.m.s. value

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

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

Requirements on the integration time T are given in 5.4.

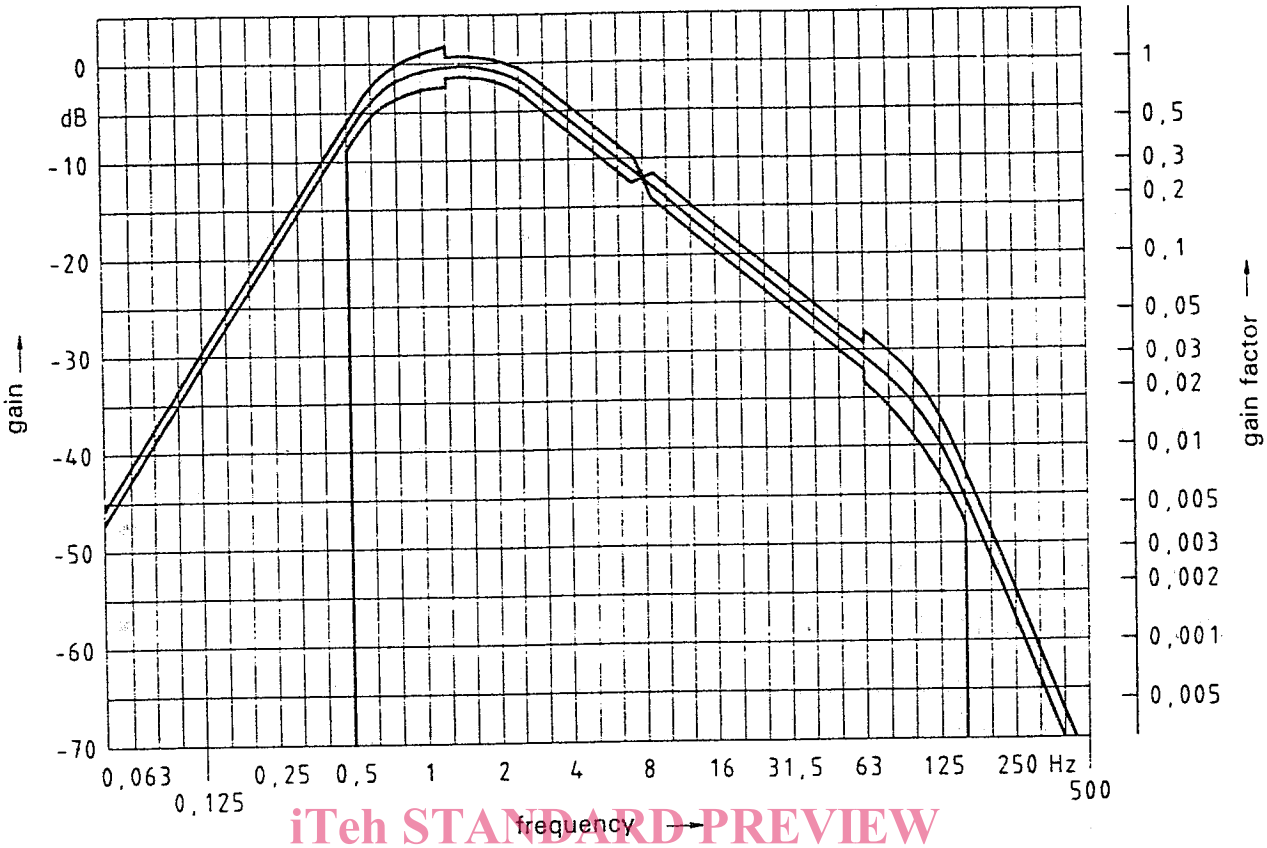


Figure 2: Frequency weighting (magnitude) for whole body, x-axis and y-axis, 1 Hz to 80 Hz

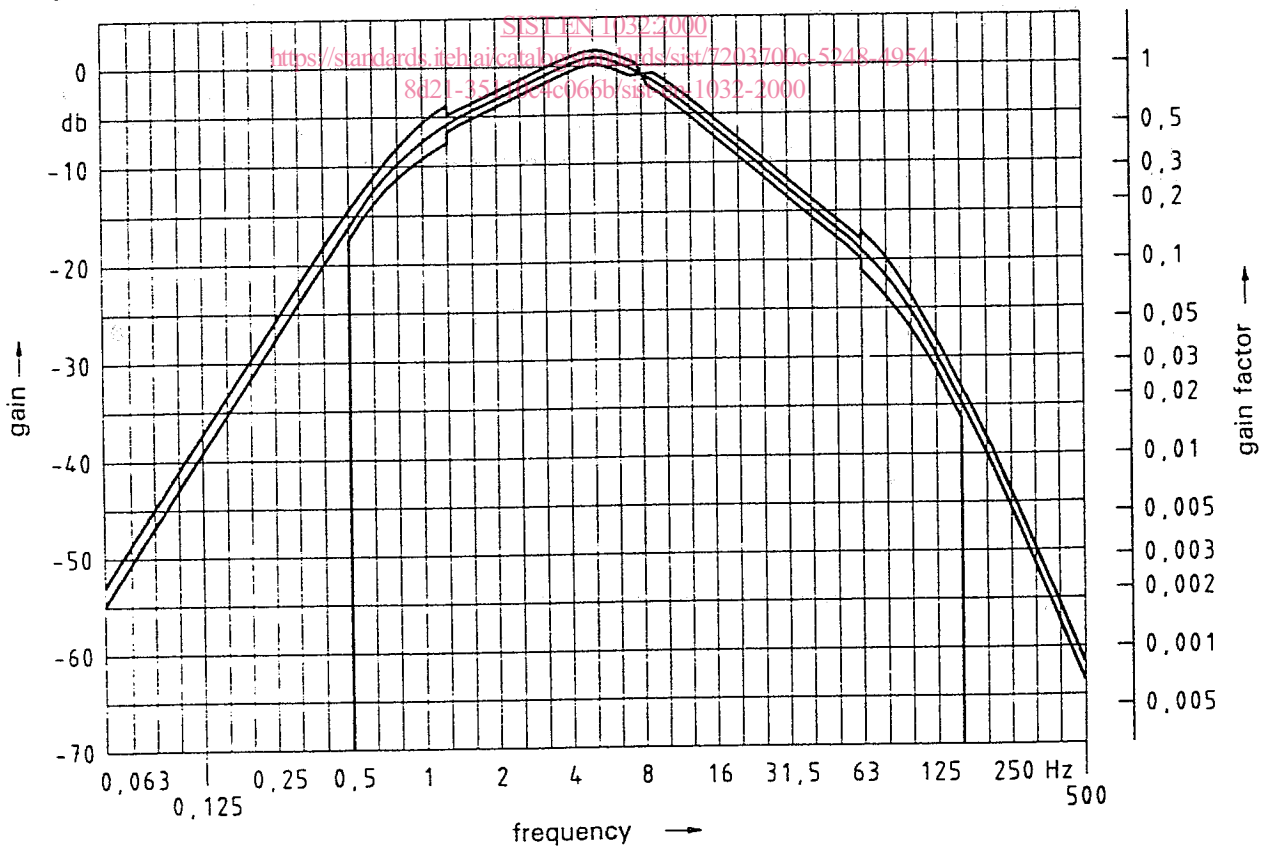


Figure 3: Frequency weighting (magnitude) for whole body, z-axis, 1 Hz to 80 Hz

5 Instrumentation requirements

5.1 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 ENV 28041.

A typical measuring equipment comprises:

- transducers (usually accelerometers);
- conditioning amplifiers and filters;
(- telemetry set);
- recorders and/or meters.

The tolerances of the vibration measuring instrumentation are specified into two types in ENV 28041. Type 2 instrumentation can normally be used for determination of the emission value.

If the use of type 1 instrumentation is required, this shall be specified in the relevant vibration test code.

In view of the complexity of situations in which humans are exposed to vibration, instrumentation whose characteristics are not covered by ENV 28041 may be specified in the vibration test code. The justification for use of such instrumentation shall be given, together with a detailed specification of the instrumentation. This shall also include requirements on dynamic range, sensitivity, accuracy, linearity and overload capacity.

5.2 Transducers

Accelerometers shall normally be used for measurement of vibration emissions. In cases where measurements in more than one direction are prescribed, transducers oriented in different axes at a single measurement location shall be as close together as possible.

In the case where the exposed person is standing on a working platform or other surface, the transducers shall be rigidly mounted in points immediately adjacent to the feet of the standing operator.

In the case where the exposed persons are sitting, the transducers shall be mounted in a semi-rigid disc described as follows (see figure 4).

Dimensions in millimetres

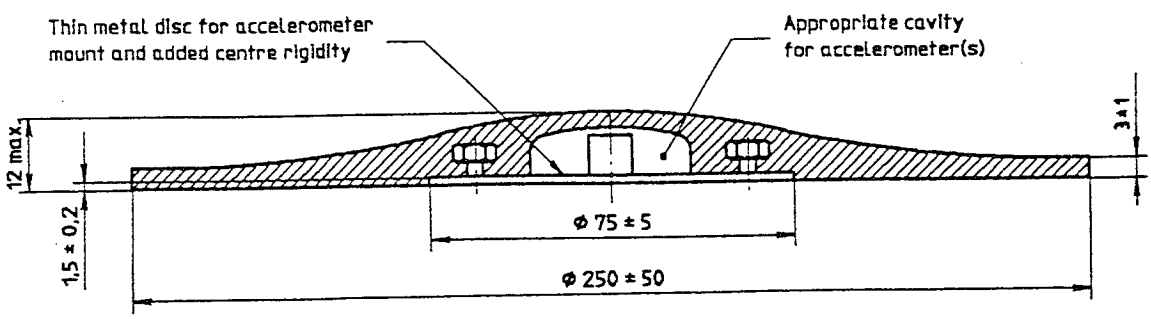


Figure 4: Design of a semi-rigid mounting disc