SLOVENSKI STANDARD
SIST ENV 25349:2000

01-december-2000

Mechanical vibration - Guidelines for the measurement and the assessment of human exposure to hand-transmitted vibration (ISO 5349:1986)

Mechanical vibration - Guidelines for the measurement and the assessment of human exposure to hand-transmitted vibration (ISO 5349:1986)

Mechanische Schwingungen - Leitfaden zur Messung und Beurteilung der Einwirkung von Schwingungen auf das Hand-Arm System des Menschen (ISO 5349:1986)

Vibrations mécaniques - Principes directeurs pour le mesurage et l'évaluation de l'exposition des individus aux vibrations transmises par la main (ISO 5349:1986)

Ta slovenski standard je istoveten z: **ENV 25349:1992**

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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

Mechanical vibration - Guidelines for the measurement and the assessment of human exposure to hand-transmitted vibration (ISO 5349:1986)

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This European Prestandard (ENV) was approved by CEN on 1992-10-19 as a prospective standard for provisional application. The period of validity of this ENV is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into an European Standard (EN).

CEN members are required to announce the existance of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

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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

Following consideration of the result of a Primary Questionnaire among members, the CEN Technical Board decided in October 1991 to submit the International Standard :

ISO 5349:1986 "Mechanical vibration - Guidelines for the measurement and the assessment of human exposure to hand-transmitted vibration"

to the formal vote for approval as European Prestandard.

The result of the formal vote was positive.

The Technical Committee CEN/TC 231 "Mechanical vibration and shock" is of the opinion that the International Standard ISO 5349:1986 shall be revised, especially to take into account the following :

- to check validity of dose-effect relationship in Annex A
- to better explain the differences between field measurements and type test measurements (see the Introduction to the European Prestandard)
- to study the possibility to include informations on influence of factors such as mass of the machine, feed and grip forces, ergonomic design of the machine, etc.
- to propose a procedure to evaluate the exposure time.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to announce this European Prestandard :

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

Endorsement notice

The text of the International Standard ISO 5349:1986 was approved by CEN as a European Prestandard without any modification.

Introduction to the European Prestandard

There are two primary reasons for measuring the vibration on hand held or hand guided machinery.

The first is to determine the vibration dose by combining the measured vibration accelerations with the time history over which the tool is used during a typical working day. The measured vibration values should be obtained in such a way as to represent in as realistic way as possible the actual working situation. They should be measured over a sufficient time period to allow a good average value to be measured representing the actual daily exposure. It may be necessary to use a number of transducer locations in order to take account on different vibration levels over the grip surface or handle. The vibration dose can then be converted to an equivalent level which would be considered to be constant over a reference period (eg. 4 hours). This equivalent vibration value can then be used to evaluate the risk of damage due to the vibration exposure using agreed damage risk criteria.

The second reason would be to compare the vibrations from different tools or machinery or different models of the same tool. The machinery safety directive 89/392/EEC requires that measurements be made and values put into the instructions and sales literature if the values are greater than 2,5 ms^{-2}, and if the value is lower than 2,5 ms^{-2} that fact shall be stated.

The first measurements are called field measurements and the second are called type test measurements.

Field measurements require accurate vibration measurements coupled with the appropriate time history and the result is very dependent on the particular process or way in which the tool is being used. This means that field measurements cannot be used to type test tools.

Type test measurements require accurate and reproducible measurements. It is essential that different laboratories obtain the same results within specified limits. This requires that the process or way in which the tool or machinery is used during the measurement is precisely defined. Normally this process will be typical of the way the tool or machine is used in practice. Unfortunately in some cases, in order to obtain sufficient accuracy, an artificial process, which is not typical of the way the tool is used in the field, has to be used. Vibration magnitude in type tests should be within the range of measurements made in the field, but with less variability. It is clear that type test measurements cannot replace field measurements to assess vibration exposure at the workplace.

ENV 25 349 defines the parameters and gives general guidance on how field measurements and assessment of risk may be made. In specific standards guidance will be given as to how to perform field tests for different types of machinery.

EN 28 662-1 defines the general requirements that are needed for type test measurements and the tool specific parts of EN 28 662 define precise methodologies for the type testing of specific tools.

International Standard 5349

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Mechanical vibration — Guidelines for the measurement and the assessment of human exposure to hand-transmitted vibration

Vibrations mécaniques — Principes directeurs pour le mesurage et l'évaluation de l'exposition des individus aux vibrations transmises par la main

First edition — 1986-05-15

UDC 534.1 : 614.872.5 **Ref. No. ISO 5349-1986 (E)**

Descriptors: human body, exposure, vibration, measurement, ergonomics, measuring instruments, safety requirements.

Price based on 12 pages

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 5349 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Printed in Switzerland

Mechanical vibration — Guidelines for the measurement and the assessment of human exposure to hand-transmitted vibration

0 Introduction

Intensive vibration can be transmitted to the hands and arms of operators from vibrating tools, vibrating machinery or vibrating workpieces. Such situations occur, for example, when a person handles tools such as pneumatic, electric, hydraulic or engine-driven chain saws, percussive tools or grinders. Depending on the type and place of work, vibration can enter one arm only or both arms simultaneously, and may be transmitted through the hand and arm to the shoulder. The vibration of body parts and the perceived vibration are frequently the source of discomfort and possibly reduced proficiency. Continued, habitual use of many vibrating tools has been found to be connected with various patterns of diseases affecting the blood vessels, nerves, bones, joints, muscles or connective tissues of the hand and forearm.

The vibration exposures required to cause these disorders are not known exactly, either with respect to vibration intensity and frequency spectrum, or with respect to daily and cumulative exposure duration. In view of the complexity of the problem and the shortage of quantitative data concerning the occupational health effect of hand-transmitted vibration, it is difficult to propose a comprehensive method for assessing vibration exposure. However, based on the limited data available and on experience with current exposure conditions, the information proposed in this International Standard together with its annexes represents the best guidance available to protect the majority of workers against serious health impairment and to assist in the development of hand-operated tools the use of which will reduce the risk of disorders in man caused by vibrations.

The purpose of this International Standard is to further the gathering of consistent data in order to improve occupational safety. In particular, it is hoped that the data will serve to extend the present knowledge on the dose-effect relationship.

1 Scope and field of application

This International Standard applies to periodic and to random or non-periodic vibration. Provisionally, this International Standard may also be applied to repeated shock type excitation.

This International Standard specifies general methods for measuring and reporting hand-transmitted vibration exposure in three orthogonal axes for the one-third octave bands, having centre frequencies from 6,3 to 1 250 Hz, the octave bands, having centre frequencies from 8 to 1 000 Hz and a frequency-weighted measure which covers the frequency range from 5,6 to 1 400 Hz.

This International Standard, together with its annexes, provides guidance for the evaluation of hand-transmitted vibration specified in terms of a frequency-weighted vibration acceleration and daily exposure time. It does not define the limits of safe exposure.

The guidance proposed in this International Standard is derived from a consensus of opinion based upon data available from both practical experience and laboratory experimentation concerning human response to hand-transmitted vibration. It cannot be taken to define completely safe exposure ranges in which vibration diseases cannot occur.

This International Standard does not specify the risk factor of health impairment for different operational processes, tools and machines.

To facilitate further progress in this field and to allow the quantitative comparison of exposure data, uniform methods for measuring and reporting exposure of human beings to hand-transmitted vibration are desirable. Additional standards are to be considered for the vibration measurement of specific tools and processes.

2 References

ISO 2631, *Evaluation of human exposure to whole-body vibration.*

ISO 5347, *Methods for the calibration of vibration and shock pick-ups.* [1)]

ISO 5348, *Mechanical vibration and shock — Mechanical mounting of accelerometers.* [1)]

ISO 5805, *Mechanical vibration and shock affecting man — Vocabulary.*

ISO 8041, *Human-response vibration measuring instrumentation.* [1)]

1) At present at the stage of draft.

IEC Publication 184, *Methods for specifying the characteristics of electro-mechanical transducers for shock and vibration measurements.*

IEC Publication 222, *Methods for specifying the characteristics of auxiliary equipment for shock and vibration measurement.*

IEC Publication 225, *Octave, half-octave and third-octave band filters intended for the analysis of sounds and vibrations.*

3 Characterization of hand-transmitted vibration

3.1 General considerations

The severity of the biological effects of hand-transmitted vibration in working conditions is influenced by

a) the frequency spectrum of vibration;

b) the magnitude of vibration;

c) the duration of exposure per working day;

d) the temporal exposure pattern and working method, that is the length and frequency of work and rest spells; whether the tool is laid aside or held idling during breaks, etc.;

e) the cumulative exposure to date;

f) the magnitude and direction of forces applied by the operator through his hands to the tool or the workpiece;

g) the posture of the hand, arm and body position during exposure (angles of wrist, elbow and shoulder joints);

h) the type and condition of vibrating machinery, hand-tool or workpiece;

i) the area and location of the parts of the hands which are exposed to vibration.

The severity of the biological effects of hand-transmitted vibration in working conditions may be influenced by

a) the direction of the vibration transmitted to the hand;

b) the method of working and the operator's skill;

c) any predisposing factors in the individual's health.

The following factors may specifically affect the circulation changes caused by hand-arm vibration:

a) climatic conditions;

b) diseases which affect the circulation;

c) agents affecting the peripheral circulation, such as smoking, certain medicines or chemicals in the working environment;

d) noise.

Although the importance of all the factors listed with respect to the generation of vibration disorders is not yet known in sufficient detail, reporting of all factors is considered desirable in order to enable the collection of meaningful exposure histories. It is also important to report the measurement procedure and the statistical techniques used to evaluate the vibration data.

3.2 Direction of vibration

The directions of vibration transmitted to the hand should be reported in the appropriate directions of an orthogonal co-ordinate system as suggested in figure 1.

For vibration measurements, the orientation of the coordinate system may be defined with reference to an appropriate basicentric coordinate system [see figure 1a)] originating, for example, in a vibrating appliance, workpiece, handle or control device gripped by the hand.

NOTE — Current methods of vibration assessment are based on the directional component with the largest weighted vibration acceleration.

In order to avoid a conflict between the terminology proposed here and that used generally in biodynamics to define human whole-body vibration exposure (see ISO 2631), it is proposed that the motions of the hand for the various directions of the coordinate system be designated by the parenthetical word "(hand)" or the subscript "h". (The acceleration of the hand in the z direction would be designated $a_{z\,(\text{hand})}$ or $a_{z,\,\text{h}}$, and similarly for directions x and y. Whole-body acceleration in the longitudinal axis is designated by a_z, and similarly for directions x and y.)

3.3 Magnitude of vibration

3.3.1 The primary quantity used to describe the magnitude of the vibration shall be acceleration which should normally be expressed in metres per second squared (m/s^2). The magnitude of the vibration should be expressed as a root-mean-square (r.m.s.) acceleration value. The acceleration may also be measured with a weighting network as defined in 3.4.5 and table 1.

Acceleration measured in conjunction with frequency analysis equipment (for example one-third octave band filters) should not be weighted.

The weighting characteristics of the filter described in table 1 require that the attenuation of the filter be zero up to a frequency of 16 Hz and then increase at 6 dB/octave above that frequency.

The data for these weighting characteristics are derived from laboratory studies of human response to hand-transmitted vibration.

3.3.2 The magnitude of the vibration may also be expressed in terms of an acceleration level, in decibels (dB). This is defined as

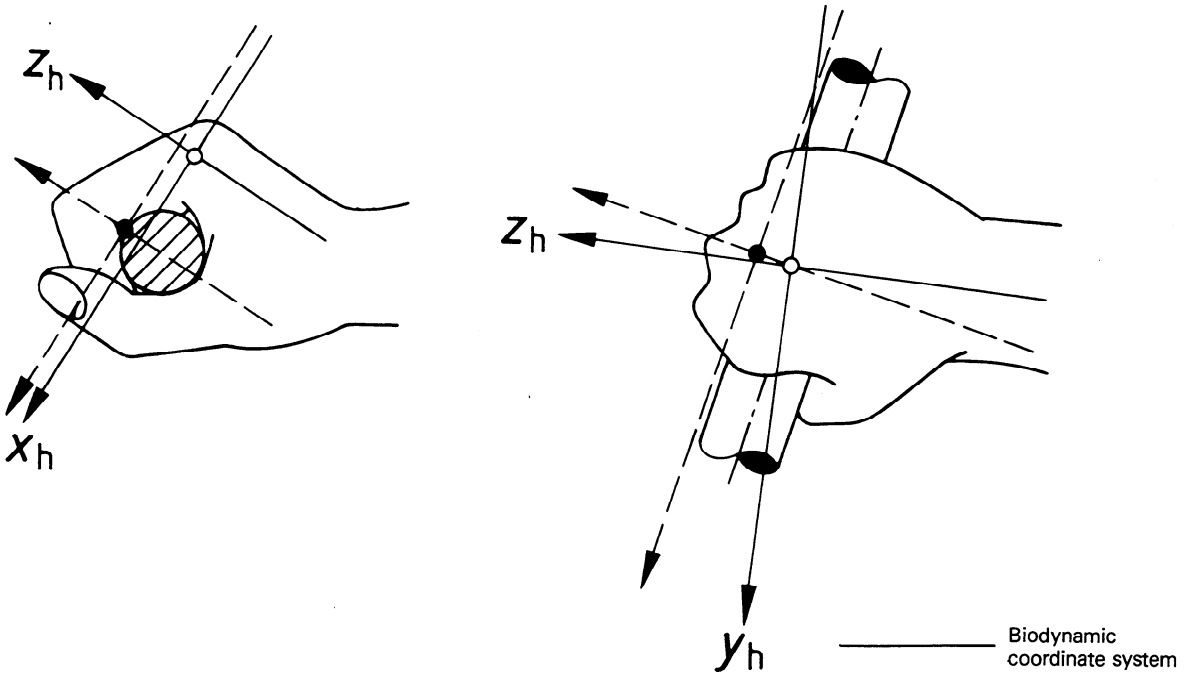
$$L_{\text{h}} = 20 \lg \left(\frac{a}{a_{\text{o}}} \right)$$

where

a is the r.m.s. acceleration, in metres per second squared;

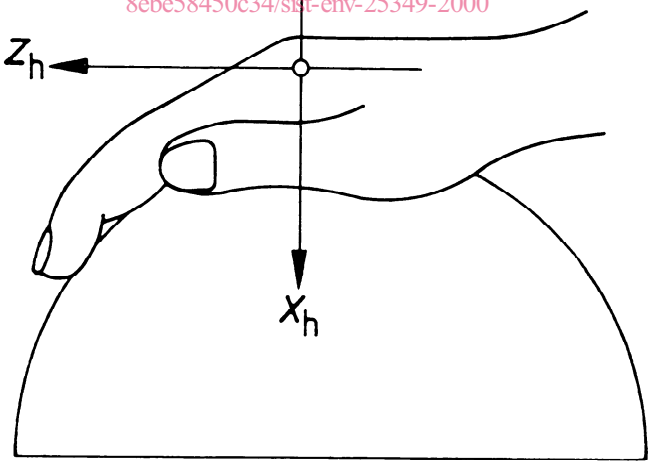
a_{o} is the reference acceleration of 1 $\mu m/s^2$.

The acceleration level may also be measured with the weighting network described in 3.4.5 and table 1 and is called the weighted acceleration level $L_{\text{h,w}}$ (see 4.4). Acceleration levels measured in conjunction with frequency analysis equipment (for example one-third octave band filters) should not be weighted.



In this position, the hand adopts a standardized grip on a cylindrical bar of radius 2 cm.

a) "Handgrip" position



In this position, the hand presses down onto a sphere of radius 10 cm.

b) "Flat palm" position

NOTE — The origin of the system is deemed to lie in the head of the third metacarpal and the $z_{(hand)}$-axis to be defined by the longitudinal axis of that bone.

The x-axis is perpendicular to the palm area, being positive in the direction of the back of the palm, when the hand is in the normal anatomical position (palm facing forwards). The y-axis passes through the origin and is perpendicular to the x-axis.

When the hand is gripping a cylindrical handle, the system may be rotated so that the y_h-axis is parallel to the axis of the handle.

Figure 1 — Coordinate system for the hand