SLOVENSKI STANDARD
SIST EN 1033:2000

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Hand-arm vibration - Laboratory measurement of vibration at the grip surface of hand-guided machinery - General

Hand-arm vibration - Laboratory measurement of vibration at the grip surface of hand-guided machinery - General

Hand-Arm Schwingungen - Laborverfahren zur Messung mechanischer Schwingungen an der Greiffläche handgeführter Maschinen - Allgemeines

Vibrations main-bras - Mesurage en laboratoire des vibrations au niveau des surfaces de préhension des machines guidées a la main - Généralités

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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

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Foreword

This European Standard has been prepared by the Technical Committee CEN/TC 231 "Mechanical vibration and shock" of which the secretariat 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of an identical text or by endorsement, at the latest by February 1996, and conflicting national standards shall be withdrawn at the latest by February 1996.

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 EC Directive(s).

According to the CEN/CENELEC Internal Regulations, 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 United Kingdom.

Introduction

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

The first reason 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 the actual working situation in a way as realistic as possible. 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 of different vibration levels over the grip surface or handle. The vibration dose can be converted to an equivalent level which would be considered to be constant over a reference period (e. g. four 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 vibration from different tools or machinery or different models of the same tool. The machine directive requires that measurements be made and values put into the instructions and technical documentation if the values are greater than 2,5 m/s^2, and if the value is lower than 2,5 m/s^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 magnitudes 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 25349 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.

For hand-guided machinery, EN 1033 defines the general requirements that are needed for type test measurements and machinery specific standards define precise methodologies for type testing of specific tools.

This European Standard specifies the general approach to be used in the preparation of test codes for the measurement of vibration on the gripping zones of hand-guided machinery. For hand-held machinery the reader must consult EN 28662-1.

Codes based on this European Standard should define laboratory measuring procedures which provide accurate and reproducible results which are as far as possible in agreement with results measured under real working conditions. The results of such test procedures should accurately reflect real differences in those aspects of machine design which influence the vibration on the gripping zones. Tests carried out in accordance with these codes serve to establish information on the vibration characteristics of a given piece of machinery, enabling comparison of the same type or of different types of machinery to be made.

This European Standard does not give any guidelines or recommendations for assessing the risk of damage due to the vibration exposure. However, the magnitude of the vibration measured is as far as possible a realistic measure of the vibration magnitude to be expected in a normal working situation.

This European Standard contains general requirements for the measurement of vibration in all types of hand-guided machinery. Machinery specific standards specify type test procedures for the measurement of vibration at the machine-hand contact surface of specific hand-guided machinery. The type test is designed to give information on the vibration characteristic of a given machine, making it possible to compare various machines. As far as possible, the operating conditions specified will represent typical machine work situations with the operating procedures being defined in sufficient detail to ensure satisfactory reproducibility of measurement. Because of the inevitable variability which arises when the hands and arms of human beings become part of the equipment support and guidance system, for reasons of better reproducibility, artificial operating procedures are to be preferred for type test.

Vibration of a machine in a working situation may contain components generated in the machine itself, or in the inserted tool, or in the attached equipment. Other factors, e. g. the workpiece and the process, have an important influence on the vibration magnitudes encountered. It is not the purpose of this standard to separate the influences of these various factors.

1 Scope

This European Standard specifies the basic requirements for evaluating vibration at the machine-hand contact surface of hand-guided machines, e. g. lawn mowers, single axis tractors, vibratory rollers, and other types of machines which are provided with handles, guiding beams or similar means of control. Test codes are designed to give information on the vibration characteristics of a specific type of machinery, enabling comparisons to be made between similar machinery, but of different manufacturers.

The standard does not apply to hand-held power tools (see EN 28662-1) and to fixed machinery in which the vibration is transmitted to the hands of the user through the workpiece, nor does it apply to the measurement of vibration to the hands of the user via steering wheels or similar controls of vehicles.

This standard is not intended for assessment of human exposure to vibration. The measurement and assessment of human exposure to hand-transmitted vibration in the workplace is given in ENV 25349.

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 25349	Mechanical vibration — Guidelines for the measurement and the assessment of human exposure to hand-transmitted vibration (ISO 5349:1986)
ENV 28041	Human response to vibration — Measuring instrumentation (ISO 8041:1990)
EN 28662-1	Hand-held portable power tools — Measurement of vibrations at the handle — Part 1: General (ISO 8662-1:1988)
ISO 5347	Methods for the calibration of vibration and shock pick-ups
ISO 5348	Mechanical vibration and shock — Mechanical mounting of accelerometers
ISO 5805	Mechanical vibration and shock affecting man — Vocabulary
IEC 225	Octave, half-octave and third-octave band filters intended for the analysis of sounds and vibrations

3 Quantities to be measured

3.1 Weighted r.m.s. acceleration value

Vibration shall be measured as the frequency weighted acceleration on the hand-machine contact surfaces of the machinery under test and shall be expressed as the root-mean-square (r.m.s.) acceleration, a_{hw}, in metres per second squared.

Weighted acceleration values, a_{hw}, can be obtained either by measurement using the weighting filter for hand-arm vibration measurements defined in ENV 28041 or by calculation from one-third octave band data or narrow band data using the weighting factors specified in ENV 25349.

NOTE: These methods can produce slightly different results owing to differences in the curves, the tolerances, and the filter characteristics in the electronic filtering networks.

3.2 Frequency analysis

It can be necessary to make measurements in one-third octave bands with centre frequencies of at least 6,3 Hz to 1250 Hz.

NOTE 1: A frequency analysis is regarded to be helpful in order to judge the validity of the measurement of the weighted value, e. g. high values in frequency bands below the repetition frequency of the tool may indicate the presence of non-linear effects.

NOTE 2: The preferred method of analysis is one-third octave analysis but a narrow band analysis method is also acceptable.

3.3 Other quantities to be measured

Any other parameters which are important to the achievement of adequate test accuracy and reproducibility should be specified and appropriate control measures incorporated in the test code, such as:

a) grip force;
b) feed force;
c) rotational speed or striking frequency.

4 Instrumentation

4.1 Specification of transducer

The vibration values specified in 3.1 should be measured using transducers and other appropriate measurement equipment conforming to ENV 28041.

The total mass of the vibration transducer and its mounting shall be small enough not to influence the measurement result; it shall preferably be less than 10 g.

Specifications such as the transverse sensitivity (less than 10 %), the ambient temperature range, the typical temperature transient sensitivity and the maximum shock acceleration shall be considered in the selection of accelerometers.

4.2 Fastening of transducer

The transducer and the mechanical filter, if used, shall be mounted firmly, for example by using adhesive, threaded stud or clamp. Further details are given for individual machines in the machinery specific standards. In all cases, the mounting shall be in accordance with the transducer manufacturer's instructions. For accelerometers, the mounting shall be in accordance with ISO 5348.

If the handle has a soft resilient cover, this shall be removed, or a clamp shall be tightened securely around it on which the transducer is mounted, or a special adaptor may be used.

If the machinery has a resilient handle, the test report shall state the action taken, e. g. solid clamping, removal or use of adaptor.

4.3 Mechanical filter

High acceleration in the high-frequency components of the vibration can cause the accelerometer to generate false signals in the frequency range of interest because of excitation of the resonance of the transducer itself. Other measurement errors can be, for example, periodic d. c. shifts which contribute to the vibration signal in the frequency range of interest.

Where it cannot be shown that such errors are negligible, mechanical filters or other appropriate means shall be used to minimise measurement error likely to occur when measuring vibration containing impulsive elements.

Mechanical filters can be used to reduce the high-frequency components of the vibration input into the accelerometer.

The mechanical filter, if used, shall be suitable for the mass of the accelerometer and shall ensure a flat response from 6,3 Hz up to 1500 Hz. The cut-off frequency of the mechanical filter shall be at least a factor of five below the resonance frequency of the accelerometer.

4.4 Frequency filters

If one-third octave band filters are used they shall be as specified in IEC 225.

4.5 Weighting filter and r.m.s. detector

If a r.m.s. detector and a weighting filter for hand-arm vibration are used they shall be as specified in ENV 28041.

4.6 Signal recording

The vibration signal can be stored for later evaluation using a suitable instrumentation recorder.

Equipment used for the purpose of recording vibration signals shall conform to ENV 28041.

The vibration spectrum shall be corrected for any deviation from a flat frequency response of the recorder. The corrections to the octave band centre frequencies or the one-third octave band centre frequencies shall be recorded in the test report.

4.7 Calibration

The calibration of the measuring chain including the transducer shall be checked before and after use (e. g. by using a vibration calibrator), and when necessary to ensure accuracy, during any sequence of measurements in accordance with ENV 28041 and ISO 5347.

4.8 Auxiliary equipment

The auxiliary equipment for monitoring the running condition (electrical conditions, power, air pressure, rotational speed, etc.) and the working conditions of specific machines are specified in machinery specific standards.

5 Measurement direction and measurement location

5.1 Measurement direction

A basicentric coordinate system (see ISO 5805) shall be used. Preferably, measurements shall be made in the dominant axis. The weighted r.m.s. acceleration in one axis is considered to be dominant if the weighted r.m.s. accelerations in each of the other axes do not exceed 50 % of that in the first. This axis is defined for specific machines in the machinery specific standards. If no dominant axis exists, then measurements shall be made in all three axes.

5.2 Measurement location

Measurements shall be carried out preferably at a point half-way along the length of the grips or at such places where an operator normally holds the machine during a typical operation. The specification of measurement positions on individual tools is given in the machinery specific standards.

Exceptionally, it can be necessary to carry out measurements at other locations along — or even outside — the grip surface.

NOTE: The location of the accelerometer should not interfere with the proper use of the machine.