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Mechanical vibration — Hand-held and hand-guided machinery — Principles for evaluation of vibration emission

Vibration mécanique — Machines tenues et guidées à la main — Évaluation d'émission de vibration

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 20643 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 118, *Compressors, pneumatic tools and pneumatic machines*, Subcommittee SC 3, *Pneumatic tools and machines*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

For the purposes of this International Standard, the CEN annex regarding fulfilment of European Council Directives has been removed.

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Foreword

This document (EN ISO 20643:2005) has been prepared by Technical Committee CEN/TC 231 "Mechanical vibration and shock", the secretariat of which is held by DIN, in collaboration with Technical Committee ISO/TC 118 "Compressors, pneumatic tools and pneumatic machines".

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of an identical text or by endorsement, at the latest by July 2005, and conflicting national standards shall be withdrawn at the latest by July 2005.

This document supersedes EN 1033:1995.

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).

For relationship with EC Directive(s), see informative Annex ZA, which is an integral part of this document.

This document provides concrete rules for the application of EN 12786 in relation to vibration test codes. It is complementary to EN 12096.

New or revised vibration test codes in the standards series EN 28662/EN ISO 8662 for portable hand-held machines will be based on this document. All currently existing parts of EN 28662/EN ISO 8662, however, are based on EN 28662-1:1993. It is envisaged that EN 28662-1:1993 will be withdrawn when all parts of the series EN 28662/EN ISO 8662 have been revised in accordance with this document.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

Human exposure to mechanical vibration from hand-held or hand-guided machinery can interfere with comfort, working efficiency and, in some circumstances, health and safety. According to EN ISO 12100-2 the risks created by vibrating machinery need to be minimized and the residual risk from vibration need to be noted in the relevant instruction handbook. This, ideally, will be based on the vibration emission magnitude reported in accordance with this document or the relevant vibration test code, but additional information for use may be required (see Clause 6 in EN ISO 12100-2:2003).

It is possible that the type test method may not identify all the mechanisms that generate vibration when the machine is used in the real operational environment. Factors such as the workpiece, the process and the operator can have an important influence on the vibration magnitudes. For this reason the type test measurements cannot replace field measurements to evaluate vibration exposure at the workplace, but should be sufficiently representative to be able to be used for preliminary assessment of risk.

Vibration magnitudes in type tests shall be within the range of measurements made in the field, but with less variability. Type tests require accurate and reproducible conditions. It is essential that different laboratories obtain the same results within specified limits. This requires that the process or way in which the machine is measured is precisely defined. The operating conditions should be well defined, they should preferably be a real process, typical of that for which the machine is designed. If it is intended to be used for a variety of tasks and the vibration is affected significantly by the task, then more than one task might be used in determination of vibration emission. In some cases an artificial process may be used which is not in line with the typical use of the machine in the field but which provides equivalent data. If two machines produce significantly different magnitudes of vibration under real conditions, then the test should be capable of demonstrating this difference.

This document is intended to assist technical standardization committees responsible for specific types of machinery in preparing vibration test codes to ensure that such vibration test codes:

— enable users to make comparisons and to check the declared vibration emission values;

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

— are in full accordance with basic type-B standards on measurement of vibration emissions;

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

A vibration test code for a family of machinery prepared in accordance with this document:

a) produces vibration emission data which allow the determination of the vibration state-of-the-art for a family of machinery and the identification of a machine which has significantly greater or smaller vibration emission;

b) produces vibration emission values and uncertainties suitable for comparing the emissions of machinery of the same type irrespective of the date or location of the testing;

c) produces vibration emission values and uncertainties corresponding to the upper quartile of vibration magnitudes resulting from intended uses of the machinery;

d) specifies the operating conditions of the machine during testing that are, so far as practicable, representative of normal use;

e) identifies parameters that have a significant influence on the vibration emission of the machinery;

f) specifies installation and mounting conditions of transducers, measurement positions and measurement directions;

g) prescribes equipment used during testing and

h) requires recording of the values of machinery operating parameters that may influence vibration emission.

This document can be used, in the absence of an agreed vibration test code, as a guide to determine vibration emission values and to define test parameters that may influence vibration emission to be recorded.

This document is a type-B standard as stated in EN ISO 12100-1.

The provisions of this document may be supplemented or modified by a type-C standard. However, for machines which are covered by the scope of a type-C standard and which have been designed and built according to the provisions of that standard, the provisions of that type-C standard take precedence over the provisions of this type-B standard.

1 Scope

This document provides the basis for the drafting of vibration test codes for hand-held and hand-guided power-driven machinery. It specifies the determination of hand-transmitted vibration emission in terms of frequency-weighted root-mean-square (r.m.s.) acceleration during type testing. For machines where vibration test codes do not exist, it may also be used for determination of emission values and contains sufficient guidance for designing an appropriate test.

NOTE Vibration test codes based on this document should define measuring procedures which provide controlled, repeatable and reproducible results which are, as far as possible, in agreement with the vibration values measured at the machine-hand contact surfaces under real working conditions and for which the uncertainties of measurement are quantified.

This document is applicable to hand-held power tools (e.g. chipping hammers, sanders), hand-guided powered machines (e.g. lawn mowers, single-axle tractors, vibratory rollers) and other types of powered machines fitted with handles, guiding beams or similar means of control. It is applicable to machinery of all power sources (electrical, hydraulic, pneumatic, internal combustion engine, etc.).

It does not apply to fixed machinery in which the vibration is transmitted to the hands of the user through the workpiece.

This document is not applicable to vibration transmitted from steering wheels or control levers of mobile machinery where the operator's position is on the machine, see EN 1032.

It is restricted to translational vibration measured in three orthogonal directions at the hand-machine interface.

This document should be applied with caution to machines producing single and repetitive shocks with a frequency of occurrence lower than 5 Hz. For such machines, it is not known whether frequency-weighted root-mean-square acceleration values are related to the risks to health and additional measurements may be required. When developing vibration test codes for such machines the information in CEN ISO/TS 15694 should be considered.

This document is not applicable to vibration test codes published before the date of publication of this document by CEN and, when used as test code, to hand-held and hand-guided machinery manufactured before that date.

This document does not present limits or recommended vibration values. It does not give any guidance or recommendations for determination of human exposure to vibration at the workplace. For such information, reference is made to EN ISO 5349-1 and EN ISO 5349-2.

2 Normative references

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.

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

ENV 28041, *Human response to vibration — Measuring instrumentation (ISO 8041:1990).*

EN ISO 5349-1, *Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 1: General requirements (ISO 5349-1:2001).*

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

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

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, definitions and symbols

3.1 Terms and definitions

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

3.1.1
family of machinery
machines of similar design to fulfil the same functions

EXAMPLE chain saws

3.1.2
hand-guided machine
machine which is guided by the operator with his hands, such that the vibration exposure is obtained through the handles, steering wheel or tiller

[EN ISO 5349-2]

EXAMPLE walk-behind cutting machine, swing grinder

3.1.3
hand-held power tool
powered tool which is held in the hand and for which a feed force is necessary to fulfil a task

EXAMPLE electric drill, pneumatic chisel, chain-saw

3.1.4
inserted tool
interchangeable or replaceable attachment which fits into or onto a hand-held power tool or hand-guided machine for performing the intended operation

EXAMPLE drill bit, chisel, saw chain, saw blade, abrasive wheel

3.1.5
equipment
specific interchangeable attachment other than an inserted tool to complete the machine

EXAMPLE guards, side handles

3.1.6
operation
identified task for which a representative vibration magnitude measurement is made; this may be for a single phase of a task or a working cycle, that means a set of tool operations which are necessary to fulfil a task

3.1.7
operator
person using a power tool

3.1.8
tool operation
any period during which a power tool is operating and the operator is being exposed to hand-transmitted vibration

[EN ISO 5349-2]

3.1.9
workpiece
item being operated upon by a power tool

[EN ISO 5349-2]

3.2 Symbols

In this document, the following symbols are used.

$a_{hw}(t)$	instantaneous single-axis acceleration value of the frequency-weighted hand-transmitted vibration at time t, in m/s²
a_{hw}	root-mean-square (r.m.s.) single-axis acceleration value of the frequency-weighted hand-transmitted vibration, in m/s²
a_{hwx}, a_{hwy}, a_{hwz}	values of a_{hw} in m/s², for the axes denoted x, y and z respectively
a_{hv}	vibration total value of frequency-weighted r.m.s. acceleration, in m/s²; it is the root-sum-of-squares of the a_{hw} values for the three measured axes of vibration
a_h	arithmetic mean value of the measurement results of runs and operators, in m/s²; this is the result of the test
a_{hd}	declared vibration value in m/s² (the quantity denoted a in EN 12096)
σ_R	standard deviation of reproducibility
K	uncertainty in m/s² of a_{hd} as defined in EN 12096
C_V	coefficient of variation of a test series, defined as the ratio of the standard deviation of a series of measurement values and the mean value of the series:

$$C_V = \frac{s_{N-1}}{\bar{a}_{hw}}$$

where