SLOVENSKI STANDARD
SIST EN ISO 8041:2005

01-oktober-2005

Nadomeģļa:
SIST ENV 28041:2002

Odzivanje ļloveka na vibracije ï Merilni instrumentarij (ISO 8041:2005)

Human response to vibration - Measuring instrumentation (ISO 8041:2005)

Schwingungseinwirkung auf den Menschen - Messeinrichtung (ISO 8041:2005)

Réponse des individus aux vibrations - Appareillage de mesure (ISO 8041:2005)

Ta slovenski standard je istoveten z: EN ISO 8041:2005

ICS:

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

SIST EN ISO 8041:2005 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN ISO 8041

April 2005

ICS 13.160

Supersedes ENV 28041:1993

English version

Human response to vibration - Measuring instrumentation (ISO 8041:2005)

Réponse des individus aux vibrations - Appareillage de mesure (ISO 8041:2005)

Schwingungseinwirkung auf den Menschen - Messeinrichtung (ISO 8041:2005)

This European Standard was approved by CEN on 21 February 2005.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. 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.

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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of 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.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN ISO 8041:2005: E

Foreword

This document (EN ISO 8041:2005) has been prepared by Technical Committee ISO/TC 108 "Mechanical vibration and shock" in collaboration with 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 October 2005, and conflicting national standards shall be withdrawn at the latest by October 2005.

This document supersedes ENV 28041:1993.

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.

Endorsement notice

The text of ISO 8041:2005 has been approved by CEN as EN ISO 8041:2005 without any modifications.

INTERNATIONAL STANDARD

ISO 8041

Second edition
2005-04-01

Human response to vibration — Measuring instrumentation

Réponse des individus aux vibrations — Appareillage de mesure

Reference number
ISO 8041:2005(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 8041 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock*, Subcommittee SC 3, *Use and calibration of vibration and shock measuring instruments*.

This second edition cancels and replaces the first edition (ISO 8041:1990), which has been technically revised, and incorporates its Amendment, ISO 8041:1990/Amd.1:1999, and Technical Corrigendum ISO 8041:1990/Cor.1:1993.

The reasons for the main changes introduced in this edition are as follows:

— to improve the specifications for human response to vibration measuring instrumentation;

— to incorporate into one document the specifications introduced by the 1999 amendment to ISO 8041:1990, which themselves were required following the introduction of new frequency weightings in ISO 2631-1:1997;

— to recognise changes in the frequency weighting specification introduced in ISO 5349-1:2001 that allows frequencies outside the one-third octaves from 6,3 Hz to 1250 Hz to be excluded from the weighted acceleration calculation (this is achieved by changing the frequencies at which the tolerance is extended to −100 % to be the lower boundary of the 6,3 Hz one-third-octave bands and the upper boundary of the 1 250 Hz one-third-octave band);

— to introduce allowances for the uncertainties of testing the conformance of the human vibration measuring instruments;

— to introduce a hierarchy of testing requirements (pattern evaluation, periodic verification and *in-situ* check) with tests defined according to the needs of this hierarchy;

— to recognise the needs for the specification and testing of new parameters such as maximum transient vibration value (MTVV) and vibration dose value (VDV);

— to recognise the need to test multi-axis instrumentation and to test combined results from these multi-axis inputs;

— to introduce informative tests for mounting methods.

Human response to vibration — Measuring instrumentation

1 Scope

This International Standard specifies the performance specifications and tolerance limits for instruments designed to measure vibration values, for the purpose of assessing human response to vibration. It includes requirements for pattern evaluation, periodic verification and *in-situ* checks, and the specification of vibration calibrators for *in-situ* checks.

Vibration instruments specified in this International Standard can be single instruments, combinations of instrumentation or computer-based acquisition and analysis systems.

Vibration instruments specified in this International Standard are intended to measure vibrations for one or more applications, such as

— hand-transmitted vibration (see ISO 5349-1),

— whole-body vibration (see ISO 2631-1, ISO 2631-2, ISO 2631-4), and

— low-frequency whole-body vibration in the frequency range from 0,1 Hz to 0,5 Hz (see ISO 2631-1).

Vibration instruments can be designed for measurement according to one or more of the frequency weightings defined within each of these applications.

Three levels of performance testing are defined in this International Standard:

a) pattern evaluation, i.e. a full test of the instrument against the specifications defined in this International Standard;

b) periodic verification, i.e. an intermediate set of tests designed to ensure that an instrument remains within the required performance specification, and

c) *in-situ* checks, i.e. a minimum level of testing required to indicate that an instrument is likely to be functioning within the required performance specification.

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.

ISO 2041, *Vibration and shock — Vocabulary*

ISO 2631-1, *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 1: General requirements*

ISO 2631-2, *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 2: Vibration in buildings (1 Hz to 80 Hz)*

ISO 2631-4, *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 4: Guidelines for the evaluation of the effects of vibration and rotational motion on passenger and crew comfort in fixed-guideway transport systems*

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

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

IEC 61000-4-2:2001, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test*

IEC 61000-4-3:2002, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques —Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) — Part 4-6: Testing and measurement techniques — Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-6-2:1999, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments*

CISPR 22:2003, *Information technology equipment — Radio disturbance characteristics — Limits and methods of measurement*

GUM, *Guide to the expression of uncertainty in measurement*. BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, OIML, 1993

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041, together with the following, apply.

3.1.1
vibration acceleration
component of acceleration, where the axis of measurement is specified by application standards

3.1.2
band-limiting frequency weighting
component of a frequency weighting defined by the high and low pass band-limiting filters

3.1.3
band-limited frequency range
frequency range defined by the band-limited component of a frequency weighting

3.1.4
nominal frequency range
frequency range of interest, as defined in the relevant measurement standard

3.1.5 Frequency-weighted values

3.1.5.1
time-averaged weighted acceleration value
frequency-weighted r.m.s. vibration acceleration value in a specified axis, a_w, in metres per second squared or radians per second squared, as defined by the expression:

$$a_w = \left(\frac{1}{T} \int_0^T a_w^2(\xi) \, \mathrm{d}\xi \right)^{1/2} \tag{1}$$

where

$a_w(\xi)$ is the translational or rotational, weighted vibration acceleration in a specified axis as a function of the instantaneous time, ξ, in metres per second squared (m/s^2) or radians per second squared (rad/s^2), respectively;

T is the duration of the measurement

3.1.5.2
time-averaged weighted acceleration level
frequency-weighted r.m.s. vibration acceleration level expressed in decibels, as defined by

$$L_w = 20 \lg \frac{a_w}{a_0} \text{ dB} \quad (2)$$

where

a_w is defined in 3.1.5.1;

a_0 is the reference acceleration (defined as 10^{-6} m/s^2 in ISO 1683)

3.1.5.3
running r.m.s. acceleration value
frequency-weighted running r.m.s. vibration acceleration, in metres per second squared, defined by the expression

$$a_{w,\theta}(t) = \left(\frac{1}{\theta} \int_{t-\theta}^{t} a_w^2(\xi) \, d\xi \right)^{1/2} \quad (3)$$

where

$a_w(\xi)$ is the frequency-weighted instantaneous vibration acceleration at time ξ, in metres per second squared;

θ is the integration time of the measurement;

t is the instantaneous time

NOTE Exponential averaging may be used for the running r.m.s. method, as an approximation of the linear averaging. The exponential averaging is defined as follows:

$$a_{w,\tau}(t) = \left(\frac{1}{\tau} \int_{-\infty}^{t} a_w^2(\xi) \exp\left(\frac{\xi - t}{\tau} \right) d\xi \right)^{1/2} \quad (4)$$

where τ is the time constant.

3.1.5.4
maximum transient vibration value
MTVV
maximum value of the running r.m.s. vibration acceleration value when the integration time is equal to 1 s

3.1.5.5
motion sickness dose value
MSDV
integral of the squared weighted instantaneous vibration acceleration $a_w(t)$ in m/s^{1,5} as defined by the expression:

$$\mathrm{MSDV} = \left(\int_0^{\Phi} a_{\mathrm{w}}^2(\xi)\,\mathrm{d}\xi \right)^{1/2} \tag{5}$$

where Φ is the total period during which motion could occur

NOTE 1 The motion sickness dose value may be obtained from the frequency weighted r.m.s. vibration acceleration through multiplication by $\Phi^{1/2}$.

NOTE 2 For measurement instrumentation, the exposure period Φ is likely to be assumed to be equal to the measurement period, T, unless otherwise indicated.

3.1.5.6
vibration dose value
VDV
integral of the fourth power of the weighted instantaneous vibration acceleration $a_{\mathrm{w}}(t)$ in m/s^{1,75} as defined by the expression

$$\mathrm{VDV} = \left(\int_0^{\Phi} a_{\mathrm{w}}^4(\xi)\,\mathrm{d}\xi \right)^{1/4} \tag{6}$$

where Φ is the total (daily) period for which exposure occurs

NOTE 1 The vibration dose value is more sensitive to peaks than is the r.m.s. value.

NOTE 2 For measurement instrumentation, the exposure period Φ is likely to be assumed to be equal to the measurement period, T, unless otherwise indicated.

3.1.5.7
vibration total value
combined vibration from three axes of translational vibration, as defined by the expression

$$a_{\mathrm{wv}} = \sqrt{k_x a_{\mathrm{wx}}^2 + k_y a_{\mathrm{wy}}^2 + k_z a_{\mathrm{wz}}^2} \tag{7}$$

where

a_{wx}, a_{wy} and a_{wz} are the vibration values in the three orthogonal axes x, y and z;

k_x, k_y and k_z are multiplying constants whose values depend on the measurement application

3.1.5.8
peak vibration value
maximum modulus of the instantaneous (positive and negative) peak values of the frequency-weighted acceleration

3.1.5.9
crest factor
parameter for a measurement period, given by the peak vibration value divided by the r.m.s. acceleration value, with both values having the same frequency weighting

3.1.6
linear operating range
on each measurement range, the range between lower and upper boundaries over which the linearity errors are within the applicable tolerance limits specified in this International Standard

3.1.7
overload
condition that occurs when the upper boundary of the linear operating range is exceeded

3.1.8
under-range
condition that occurs when the vibration value is below the lower boundary of the linear operating range

3.1.9
reference measurement range
level range specified for testing the characteristics of the vibration instrumentation

NOTE This range is that used for measuring the reference vibration.

3.1.10
reference vibration signal
sinusoidal vibration signal, the magnitude and frequency of which is specified in this International Standard for testing the electromechanical performance of a human-vibration meter

NOTE Different reference vibration signals are specified according to the application of the instrumentation.

3.1.11
calibration check frequency
frequency specified for providing a check of the vibration sensitivity of the instrument

3.1.12
tone burst
one or more complete cycles of a sinusoidal signal that start and end at a zero crossing of the waveform

3.1.13
signal burst
one or more complete cycles of a periodic signal (such as saw-tooth) that start and end at a zero crossing of the waveform

3.1.14
vibration measuring instrumentation
combination of a vibration transducer, signal processor and display, being any single instrument, or a collection of instruments, which is capable of measuring parameters relating to human response to vibration

NOTE See Figure 1.

3.1.15
instrument documentation
instruction manual, operating procedure, or other documentation provided for the use of users of the vibration measurement instrument

3.2 Symbols

For the purposes of this document, the following symbols and abbreviated terms are used:

a_w	time-averaged frequency-weighted single-axis vibration acceleration
$a_w(t)$, $a_w(\xi)$	instantaneous frequency-weighted translational or rotational single-axis acceleration at time t, or time ξ
f	frequency
H	overall frequency weighting function
k_i	multiplying constants applied to the whole-body frequency-weighted acceleration value for axis i
n	one-third-octave band number