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**Navodilo za podatkovne baze o človeških vibracijah**

Guidance on data bases for human vibration

Leitfaden für Datenbanken für Schwingungseinwirkung auf den Menschen

Guide sur les bases de données pour les vibrations sur l'homme

**Ta slovenski standard je istoveten z: FprCEN/TR 17506**

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# Guidance on data bases for human vibration

Guide sur les bases de données pour les vibrations sur l'homme

Leitfaden für Datenbanken für Schwingungseinwirkung auf den Menschen

This draft Technical Report is submitted to CEN members for Vote. It has been drawn up by the Technical Committee CEN/TC 231.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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# European foreword

This document (FprCEN/TR 17506:2020) has been prepared by Technical Committee CEN/TC 231 “Mechanical vibration and shock”, the secretariat of which is held by DIN.

This document is currently submitted to the Vote on TR.

# Introduction

European legislation — especially the Physical Agents Directive 2002/44/EC (Vibrations at work) — requires that employers assess workplace risks to the health and safety of their employees. EU Machinery Directive (2006/42/EC), Annex I, 1.7.4.3, requires that manufacturers provide information on vibration emission in commercial documents.

There are different types of databases (declared values = emission values, magnitude vibration data = imission values, physiological or epidemiological data).

Generally magnitude vibration databases are splitted into two parts according to the type of exposure: hand-arm or whole-body vibration.

According to their content, databases are assumed to be for:

a) research (epidemiology, comparison of methods for vibration analysis;

b) control of exposure (risk assessment, reduced risk);

c) enforcement;

d) market surveillance;

e) compensation cases;

f) impact analysis for legal regulations;

g) performance of seat suspension systems.

According to their purpose, databases are elaborated for vibration experts, hygienists or machines users.

# 1 Scope

The purpose of this document is to give guidelines for elaborating databases on human vibration for different purposes (emission or immission) and types of exposure (hand-arm vibration or whole-body vibration).

This document is restricted to cases where vibration affects persons at work. It is mainly addressed to competent services for the assessment of vibration exposure at the workplace and to national authorities and industrial organizations.

It defines basic requirements to get databanks respecting quality criteria (information to be given regarding exposure, reference standards, machines, persons, key parts, data origin and traceability) taken into account the type of exposure (HAV, WBV).

Although this document has been mainly designed to facilitate the exchange of data between experts, a section explains the minimum information to be provided and precautions to be taken for databases opened to public. The way the data should be formatted to facilitate the exchange between developers of databases is covered.

Also this document provides proper terminology to qualify the different families of vibration sources e.g. tools, machines and working conditions (see Annex B). This document provides a method for classifying the quality of vibration data.

# 2 Normative references

There are no normative references in this document.

# 3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp



# 4 Requirements for databases

Vibration exposure data recorded in databases should follow the measurement methods recommended by EN ISO 5349-1 and EN ISO 5349-2 for hand-arm vibration, and series ISO 2631 and EN 14253 for whole-body vibration.

Declared values should be made in accordance with EN ISO 20643.

Annex B provides for the different categories of tools and mobile machines the corresponding standards on vibration declared values. Tables 1 and 2 list respectively tools and mobile machines main characteristics and measurement parameters. According to the object and quality of data, parameters are hierarchized into 3 types:

Type I:

a) Field measurement (e.g. $a_{\mathrm{wmax}}$ or $a_{\mathrm{hv}}$): Basic data are provided to help employers for estimating vibration exposure at a workplace.

b) Declared value (A): Basic data (laboratory measurements, emission values) are provided to help employers for comparing vibration.

Type II: In addition to the parameters listed in Type I, detailed data or analysis are provided, such as determining parameters which may affect vibration exposure.

Type III: In addition to the parameters listed in Type II, more detailed data are provided, e.g. for research. They are also useful for the construction of the database. These data are more intended for experts.

**Table 1 — Hand-arm vibration: list of hierarchized parameters**

| Parameters | Tool and environment | Measurement |
|---|---|---|
| Type I | Workplace, tasks, material worked, tool category, model, energy (battery, electric, pneumatic, thermic, hydraulic), inserted tool and ancillary equipment | Field measurement: $a_{hv}$, (m/s$^2$) uncertainty if possible<br>Identification and qualification of providers<br>Declared value: Test code reference + year. $a_{hd}$ (m/s$^2$) + $K$ value, operating condition(s), if declared |
| Type II | Photograph (machine, task);<br>Weight (kg), power (W) in the case of drills, cutters, planers, nibblers, mixers, rivers, saws, polishers and grinders, cutting;<br>Impact rate (strikes/min) in the case of hammers, surface cleaners, compactors;<br>Revolution per minute (min$^{-1}$);<br>Equipment dimensions (mm) in the case of fixing equipment;<br>Torque (N·m) in the case of screwdrivers. | Duration of measurements (s)<br>Data origin (literature, specialized technical report) |
| Type III (non exhaustive list) | Condition: year of tool purchase<br>Maintenance: regularly checked according to a formal program, no check<br>Instruction manual year/edition (where declared data were found)<br>Instruction manual (e.g. as PDF file) | $a_{hx}$, $a_{hy}$, $a_{hz}$ (m/s$^2$)<br>Other frequency weightings<br>Unweighted frequency spectra, signal time history<br>Date of measurement,<br>Measurement strategy (see EN ISO 5349-2:2001, Annex E)<br>Noise immission value.<br>Traceability: measurement reports (see EN ISO 5349-2)<br>Coupling force |

**Table 2 — Whole-body vibration: list of hierarchized parameters**

| Parameters | Machine and environment | Measurement |
|---|---|---|
| Type I | Work cycle, tasks, quality of travelling surfaces, machine category, model, model of seat suspension, attached equipment | Max $a_{wS}$ with seated operator or $a_{wF}$ with standing operator + uncertainty, if possible<br>$a_{wx}$, $a_{wy}$, $a_{wz}$ (m/s$^2$)<br>Identification and qualification of providers<br>Location of measurement |
| | | Test code reference + year<br>Declared value $a_{hd}$ (m/s$^2$) + $K$ value, operating condition(s), if declared |
| Type II | Photograph (machine, task, surface)<br>Mass (t), loaded capacity (t or m$^3$)<br>Loaded or unloaded<br>Speed (loaded/unloaded) | Data origin (literature, specialized technical report<br>SEAT<br>Seat test code reference + year<br>Duration (h) |
| Type III (non exhaustive list) | Number of used hours<br>Maintenance: regularly checked according to a formal program, no check<br>Driver weight<br>Type of tires<br>Instruction manual year/edition (where declared data were found)<br>Instruction Manual (e.g. as PDF file) | Unweighted frequency spectra, signal time history<br>VDV<br>ISO 2631-5<br>Duration of measurements, date of measurement<br>Frequency spectrum<br>Noise immission value<br>Traceability: measurement reports |



Lists of tools and mobile machines with international names and schema are given in Annex B to assist database developers. Additional tables characterized the different working conditions such as:

1) For tools. Worked materials, activity and attached equipments.

2) For mobile machines. Surface type, surface quality, working cycle and equipments.

# 5 Policy and quality criteria for data

## 5.1 Skills and competencies of measurement technicians

Planning and performance of vibration measurements and interpretation of their results is often complex.

The quality of the measurement results is dependent upon the persons performing measurement being capable of doing so in accordance with the rules and current good practice, by virtue of their training and additional expertise or their experience.

Measurement errors caused for example by non-representative operating conditions or failure to recognize disturbance variables can be avoided if measurement technicians are adequately qualified.

Equally, measurement uncertainty can be reduced to a minimum by proper application of the measurement methods, such as the location of the measurement point, and adequate duration of measurement and number of repeat measurements.

Owing to differences between the impact of hand-arm and whole-body vibration, knowledge of the relevant standards (EN ISO 5349-2 and EN 14253, including the further standards to which they make reference) is recommended.

The knowledge of the individuals performing measurement may vary; for example, the laboratory manager shall specify a suitable instrument and quality assurance of traceable calibration. On site, the measurement technician shall for example recognize disturbance factors and errors in recording of the data. Participation in appropriate interlaboratory proficiency tests is recommended for accredited vibration data providers.

The following list provides an overview of the essential issues relating to expertise and skills:

a) physical principles of vibration;

b) implementation of standards and measurement methods;

c) analysis methods for the identification of measurement methods and disturbance factors;

d) development of a measurement strategy (number of measurement points, repeat measurements, duration of measurement);

e) consideration of additional parameters (e.g. coupling forces, machine speed);

f) selection of suitable instruments including calibrators and accessories, and verification of the measurement equipment;

g) estimation of the measurement uncertainty in accordance with the ISO/IEC Guide 98-3 (GUM, Guide to the Expression of Uncertainty in Measurement).



## 5.2 Quality of data collection procedure

Confidence of data depends on the expertise of personnel, quality safety system, number of measurements done for each machine, measurement protocol, representativeness of operator using the machine. The source of data should be clearly identified:

a) data from any available sources such as literature, exchange of data between laboratories, manufacturers;

b) data through organized campaigns of measurements with a well-defined protocol;

c) data from laboratories with trained technicians (see 5.3).

Data may be classified into eight categories as shown in Table 3 according to the way they were collected. It is preferable that data are provided together with a copy of the measurement report with all information regarding the conditions of measurement, see Annex C.

**Table 3 — Quality criteria classification according to the source of data**

| **Classification of data** | |
|---|---|
| 1 | a) Vibration meter to EN ISO 8041-1 (with regular verification, e.g. every 2 years and regular checks using an *in situ* calibrator scheduled to cover the gaps between calibrations)<br>b) Measurements were confirmed by several measuring bodies<br>c) The measurements were performed at several machines with several test subjects |
| 2 | a) Vibration meter to EN ISO 8041-1 (with regular verification, e.g. every 2 years and regular checks using an *in situ* calibrator scheduled to cover the gaps between calibrations)<br>b) Measured values were obtained by a single measuring body<br>c) The measurements were performed at several machines with several test subjects |
| 3 | a) Vibration meter to EN ISO 8041-1 (with regular verification, e.g. every 2 years and regular checks using an *in situ* calibrator scheduled to cover the gaps between calibrations)<br>b) Measured value was obtained by a single measuring body<br>c) The measurements were performed at a single machine with several test subjects |
| 4 | a) Vibration meter to EN ISO 8041-1 (with regular verification, e.g. every 2 years and regular checks using an *in situ* calibrator scheduled to cover the gaps between calibrations),<br>b) Measured value was obtained by a single measuring body,<br>c) The measurements were performed at a single machine with a single test subject with several repeat measurements or<br>d) The measurements were performed at a single machine with several test subjects and several repeat measurements, but with a simulated work cycle, e.g. also substitute processes |
| 5 | a) Vibration meter to EN ISO 8041-1 (with regular verification, e.g. every 2 years and regular checks using an *in situ* calibrator scheduled to cover the gaps between calibrations)<br>b) Measured value was obtained by a single measuring body<br>c) The measurements were performed at a single machine with a single test subject with several repeat measurements but with a simulated work process or manufacturer's instructions (unless precisely specified) |
| 6 | Vibration meter to EN ISO 8041-1 (with regular verification, e.g. every 2 years and regular checks using an *in situ* calibrator scheduled to cover the gaps between calibrations) |
| 7 | a) Vibration meter with a weighting curve to EN ISO 8041-1<br>b) One measurement taken at random |
| 8 | a) Guide measurement<br>b) Literature details (unless precisely specified) |

NOTE The procedure to measure vibration transmitted to the operators by mobile machines and most energised tools is relatively reliable. This is not the case for vibration transmitted by manual hammers or some highly impulsive hand-held machines such as powered actuated gas nail gun.

## 5.3 Uncertainty

For data measurement at workplaces, repeat measurements should be used to provide a mean and standard deviation value, or an indication of the range of results (e.g. median, 25$^{th}$ and 75$^{th}$ percentile) where this is more appropriate[1]. However, these values primarily provide an indication of the natural range of vibration values at different times.

For vibration emission data the database should provide the declared value and the uncertainty ($K$ value) as well as the measurement procedure, see Annex C.

In each case information providing an indication of measurement uncertainty should be provided (see Annex C).

Measurement uncertainty is related to many factors, which may be summarized as:

a) experience of the person or persons performing out the measurement (see 5.1),

b) nature of the task being studied (measurement for some machines is relatively simple compared to others, e.g. push grass mower compared to chain saw),

c) co-operation of the operator(s) being studied,

d) quality of instrumentation (including transducers),

e) suitability of the transducer to the task,

f) location and mounting of the transducer and

g) quality of post measurement data processing.



Instrumentation uncertainties may be quantified, and are controlled by the relevant instrumentation standard, EN ISO 8041-1. Other uncertainties are much more difficult to assess. Some uncertainty factors will introduce systematic errors (e.g. a transducer unsuited to very high vibration may generally provide vibration measurements that are too low when used on impactive machines). Other factors will be difficult to predict (e.g. an inexperienced operator may mount the transducer in poorly selected or inconsistent positions which in some cases will give a higher measurement result than the true vibration, while others will give a lower result).

## 5.4 Sharing of data

Consideration of the practical aspects of sharing of data from databases is given in Annex D, including:

a) clearance of data (data protection);

b) data formatting (database tables, spread sheets, delimited text files);

c) presentation of data related to the human vibration measures.

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1) Standard deviation is appropriate where there are repeated measurements of the same task, such that the objective is an average value for that task. For comparison of similar tasks, or similar tools (e.g. typical use of a 180 mm grinder) median and percentile values are more appropriate.