

**MEHAANILINE VIBRATSIOON JA LÖÖGID**  
**Hinnang kogu keha vibratsiooni mõjust inimesele**  
**Osa 1: Üldnõuded**

Mechanical vibration and shock  
Evaluation of human exposure to whole-body vibration  
Part 1: General requirements

**EESTI STANDARDI EESSÕNA****NATIONAL FOREWORD**

Käesolev Eesti standard EVS-ISO 2631-1:2002 "Mehaaniline vibratsioon ja löögid. Hinnang kogu keha vibratsiooni mõjust inimesele. Osa 1: Üldnõuded" sisaldab rahvusvahelise standardi ISO 2631-1:1997 "Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration - Part 1: General requirements" identset ingliskeelset teksti.

Standard EVS-ISO 2631-1:2002 on kinnitatud Eesti Standardikeskuse 03.05.2002 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.

Standard on kättesaadav Eesti Standardikeskusest.

This Estonian Standard EVS-ISO 2631-1:2002 consists of the identical English text of the International Standard ISO 2631-1:1997 "Mechanical vibration and shock - Evaluation of human exposure to whole-body vibration - Part 1: General requirements".

This standard is ratified with the order of Estonian Centre for Standardisation dated 03.05.2002 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.

The standard is available from Estonian Centre for Standardisation.

**Käsitlusala**

Käesolev ISO 2631 osa defineerib meetodid perioodilise, juhusliku ja lühiaegse kogu keha vibratsiooni mõõtmiseks. See toob välja põhitegurid, mis määravad, milline on vibratsiooni mõju aktsepteeritav hulk. Informatiivsed lisad toovad välja praeguse arvamuse ja prognoosivad vibratsiooni võimalikke mõjusid tervisele, mugavusele ning tajule ja peapööritusele. Vaadeldav sagedusvahemik on:

- 0,5 Hz kuni 80 Hz tervise, mugavuse ning taju osas ja
- 0,1 Hz kuni 0,5 Hz peapöörituse osas.

Kuigi potentsiaalsed mõjud inimeste sooritusvõimele pole kajastatud, kehtib ka selles valdkonnas enamik kogu keha vibratsiooni mõõtmise juhiseid. See ISO 2631 osa määrab ühtlasi, millised on eelistatud meetodid, et paigaldada energiamuundurid, mis on vajalikud, et teha kindlaks, milline vibratsiooni mõju inimesele. See ei kehti ekstreemse ulatusega ühekordsete löökide hindamisel, näiteks autoõnnetuste puhul.

Käesolev ISO 2631 osa on rakendatav liikumiste puhul, mis mõjuvad inimkehale tervikuna tugipindade kaudu: seisva isiku jalad, istuva isiku tuharad, selg ja jalad ning lamava isiku tugiala. Seda tüüpi vibratsiooni kohtab sõidukites, masinates, ehitistes ja töötavate masinate läheduses.

**Scope**

This part of ISO 2631 defines methods for the measurement of periodic, random and transient whole-body vibration. It indicates the principal factors that combine to determine the degree to which a vibration exposure will be acceptable. Informative annexes indicate current opinion and provide guidance on the possible effects of vibration on health, comfort and perception and motion sickness. The frequency range considered is

- 0,5 Hz to 80 Hz for health, comfort and perception, and
- 0,1 Hz to 0,5 Hz for motion sickness.

Although the potential effects on human performance are not covered, most of the guidance on whole-body vibration measurement also applies to this area. This part of ISO 2631 also defines the principles of preferred methods of mounting transducers for determining human exposure. It does not apply to the evaluation of extrememagnitude single shocks such as occur in vehicle accidents.

This part of ISO 2631 is applicable to motions transmitted to the human body as a whole through the supporting surfaces: the feet of a standing person, the buttocks, back and feet of a seated person or the supporting area of a recumbent person. This type of vibration is found in vehicles, in machinery, in buildings and in the vicinity of working machinery.

This document is a preview generated by EVS

**ICS 13.160** Vibratsiooni ja löögi toime inimesele**Standardite reprodutseerimis- ja levitamise õigus kuulub Eesti Standardikeskusele**

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonilisse süsteemi või edastamine ükskõik millises vormis või millisel teel on keelatud ilma Eesti Standardikeskuse poolt antud kirjaliku loata.

Kui Teil on küsimusi standardite autorikaitse kohta, palun võtke ühendust Eesti Standardikeskusega:  
Aru 10 Tallinn 10317 Eesti; [www.evs.ee](http://www.evs.ee); Telefon: 605 5050; E-post: [info@evs.ee](mailto:info@evs.ee)

**Right to reproduce and distribute belongs to the Estonian Centre for Standardisation**

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without permission in writing from Estonian Centre for Standardisation.

If you have any questions about standards copyright, please contact Estonian Centre for Standardisation:  
Aru str 10 Tallinn 10317 Estonia; [www.evs.ee](http://www.evs.ee); Phone: 605 5050; E-mail: [info@evs.ee](mailto:info@evs.ee)

This document is a preview generated by EVS

## Contents

## Page

<b>1</b>	<b>Scope</b>	<b>1</b>
<b>2</b>	<b>Normative references</b>	<b>1</b>
<b>3</b>	<b>Definitions</b>	<b>2</b>
<b>4</b>	<b>Symbols and subscripts</b>	<b>2</b>
<b>4.1</b>	<b>Symbols</b>	<b>2</b>
<b>4.2</b>	<b>Subscripts</b>	<b>2</b>
<b>5</b>	<b>Vibration measurement</b>	<b>4</b>
<b>5.1</b>	<b>General</b>	<b>4</b>
<b>5.2</b>	<b>Direction of measurement</b>	<b>4</b>
<b>5.3</b>	<b>Location of measurement</b>	<b>4</b>
<b>5.4</b>	<b>General requirements for signal conditioning</b>	<b>5</b>
<b>5.5</b>	<b>Duration of measurement</b>	<b>5</b>
<b>5.6</b>	<b>Reporting of vibration conditions</b>	<b>5</b>
<b>6</b>	<b>Vibration evaluation</b>	<b>5</b>
<b>6.1</b>	<b>Basic evaluation method using weighted root-mean-square acceleration</b>	<b>5</b>
<b>6.2</b>	<b>Applicability of the basic evaluation method</b>	<b>6</b>
<b>6.3</b>	<b>Additional evaluation of vibration when the basic evaluation method is not sufficient</b>	<b>6</b>
<b>6.4</b>	<b>Frequency weighting</b>	<b>10</b>
<b>6.5</b>	<b>Combining vibrations in more than one direction</b>	<b>12</b>
<b>6.6</b>	<b>Guide to the use of the vibration evaluation methods</b>	<b>13</b>
<b>7</b>	<b>Health</b>	<b>13</b>
<b>7.1</b>	<b>Application</b>	<b>13</b>
<b>7.2</b>	<b>Evaluation of the vibration</b>	<b>13</b>
<b>7.3</b>	<b>Guidance on the effects of vibration on health</b>	<b>14</b>
<b>8</b>	<b>Comfort and perception</b>	<b>14</b>
<b>8.1</b>	<b>Application</b>	<b>14</b>
<b>8.2</b>	<b>Comfort</b>	<b>14</b>
<b>8.3</b>	<b>Perception</b>	<b>16</b>
<b>8.4</b>	<b>Guidance on the effects of vibration on perception and comfort</b>	<b>16</b>
<b>9</b>	<b>Motion sickness</b>	<b>16</b>
<b>9.1</b>	<b>Application</b>	<b>16</b>
<b>9.2</b>	<b>Evaluation of the vibration</b>	<b>17</b>

© ISO 1997

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Organization for Standardization  
Case postale 56 • CH-1211 Genève 20 • Switzerland  
Internet central@iso.ch  
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

Printed in Switzerland

<b>9.3</b> Guidance on the effects of vibration on the incidence of motion sickness .....	<b>17</b>
---	-----------

#### **Annexes**

<b>A</b> Mathematical definition of the frequency weightings .....	<b>18</b>
<b>B</b> Guide to the effects of vibration on health .....	<b>21</b>
<b>C</b> Guide to the effects of vibration on comfort and perception .....	<b>24</b>
<b>D</b> Guide to the effects of vibration on the incidence of motion sickness .....	<b>27</b>
<b>E</b> Bibliography .....	<b>28</b>

This document is a preview generated by EVS

## 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.

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.

International Standard ISO 2631-1 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock*, Subcommittee SC 4, *Human exposure to mechanical vibration and shock*.

This second edition cancels and replaces the first edition (ISO 2631-1:1985) and ISO 2631-3:1985.

ISO 2631 consists of the following parts, under the general title *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration*:

- *Part 1: General requirements*
- *Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)*

Annex A forms an integral part of this part of ISO 2631. Annexes B to E are for information only.

The revision of this part of ISO 2631 incorporates new experience and research results reported in the literature which made it desirable to

- reorganize the parts of this International Standard;
- change the method of measurement and analysis of the vibration environment;
- change the approach to the application of the results.

Increasing awareness of the complexity of human physiological/pathological response as well as behavioral response to vibration and the lack of clear, universally recognized dose-response relationships made it desirable to give more quantitative guidance on the effects of vibration on health and comfort as well as on perception and the incidence of motion sickness (see annexes B to D).

The frequency range in this revision is extended below 1 Hz and the evaluation is based on frequency weighting of the r.m.s. acceleration rather than the rating method. Different frequency weightings are given for the evaluation of different effects.

Based on practical experience, r.m.s. methods continue to be the basis for measurements for crest factors less than 9 and consequently the integrity of existing databases is maintained. Studies in recent years have pointed to the importance of the peak values of acceleration in the vibration exposure, particularly in health effects. The r.m.s. method of assessing vibration has been shown by several laboratories to underestimate the effects for vibration with substantial peaks. Additional and/or alternative measurement procedures are presented for vibration with such high peaks and particularly for crest factors greater than 9, while the r.m.s. method is extended to crest factors less than or equal to 9.

For simplicity, the dependency on exposure duration of the various effects on people had been assumed in ISO 2631-1:1985 to be the same for the different effects (health, working proficiency and comfort). This concept was not supported by research results in the laboratory and consequently has been removed. New approaches are outlined in the annexes. Exposure boundaries or limits are not included and the concept of "fatigue-decreased proficiency" due to vibration exposure has been deleted.

In spite of these substantial changes, improvements and refinements in this part of ISO 2631, the majority of reports or research studies indicate that the guidance and exposure boundaries recommended in ISO 2631-1:1985 were safe and preventive of undesired effects. This revision of ISO 2631 should not affect the integrity and continuity of existing databases and should support the collection of better data as the basis for the various dose-effect relationships.



## Introduction

The primary purpose of this part of ISO 2631 is to define methods of quantifying whole-body vibration in relation to

- human health and comfort;
- the probability of vibration perception;
- the incidence of motion sickness.

This part of ISO 2631 is concerned with whole-body vibration and excludes hazardous effects of vibration transmitted directly to the limbs (e.g. by power tools).

Vehicles (air, land and water), machinery (for example, those used in industry and agriculture) and industrial activities (such as piling and blasting), expose people to periodic, random and transient mechanical vibration which can interfere with comfort, activities and health.

This part of ISO 2631 does not contain vibration exposure limits. However, evaluation methods have been defined so that they may be used as the basis for limits which may be prepared separately. It contains methods for the evaluation of vibration containing occasional high peak values (having high crest factors).

Three annexes provide current information on the possible effects of vibration on health (annex B), comfort and perception (annex C) and on the incidence of motion sickness (annex D). This guidance is intended to take into account all the available data and to satisfy the need for recommendations which are simple and suitable for general application. The guidance is given in numerical terms to avoid ambiguity and to encourage precise measurements. However, when using these recommendations it is important to bear in mind the restrictions placed on their application. More information may be obtained from the scientific literature, a part of which is listed in annex E.

This part of ISO 2631 does not cover the potential effects of intense vibration on human performance and task capability since such guidance depends critically on ergonomic details related to the operator, the situation and the task design.

Vibration is often complex, contains many frequencies, occurs in several directions and changes over time. The effects of vibration may be manifold. Exposure to whole-body vibration causes a complex distribution of oscillatory motions and forces within the body. There can be large variations between subjects with respect to biological effects. Whole-body vibration may cause sensations (e.g. discomfort or annoyance), influence human performance capability or present a health and safety risk (e.g. pathological damage or physiological change). The presence of oscillatory force with little motion may cause similar effects.

# **Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration —**

## **Part 1:**

### **General requirements**

#### **1 Scope**

This part of ISO 2631 defines methods for the measurement of periodic, random and transient whole-body vibration. It indicates the principal factors that combine to determine the degree to which a vibration exposure will be acceptable. Informative annexes indicate current opinion and provide guidance on the possible effects of vibration on health, comfort and perception and motion sickness. The frequency range considered is

- 0,5 Hz to 80 Hz for health, comfort and perception, and
- 0,1 Hz to 0,5 Hz for motion sickness.

Although the potential effects on human performance are not covered, most of the guidance on whole-body vibration measurement also applies to this area. This part of ISO 2631 also defines the principles of preferred methods of mounting transducers for determining human exposure. It does not apply to the evaluation of extreme-magnitude single shocks such as occur in vehicle accidents.

This part of ISO 2631 is applicable to motions transmitted to the human body as a whole through the supporting surfaces: the feet of a standing person, the buttocks, back and feet of a seated person or the supporting area of a recumbent person. This type of vibration is found in vehicles, in machinery, in buildings and in the vicinity of working machinery.

#### **2 Normative references**

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 2631. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 2631 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO 5805:1997, *Mechanical vibration and shock — Human exposure — Vocabulary*.

ISO 8041:1990, *Human response to vibration — Measuring instrumentation*.

IEC 1260:1995, *Electroacoustics — Octave-band and fractional-octave-band filters*.