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Human response to vibration — Guidance and terminology for instrumentation and equipment for the assessment of daily vibration exposure at the workplace according to the requirements of health and safety

Réponse des individus aux vibrations — Lignes directrices et terminologie pour l'instrumentation et l'équipement d'évaluation de l'exposition journalière aux vibrations sur le lieu de travail selon les exigences de santé et de sécurité

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 108, *Mechanical vibration, shock and condition monitoring*.

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Introduction

Several kinds of device can be used to measure or estimate the vibration magnitude and exposure duration needed for the assessment of daily vibration exposure at the workplace.

Measuring instrumentation conforming to the requirements of ISO 8041-1 allows the user to perform good quality repeatable measurements. Measurements using a general-purpose vibration meter are typically undertaken when equipment (like a hand-held machine or a fork-lift truck) is in operation allowing attended, direct readings to be taken providing information regarding possible errors and transient acceleration artefacts. Unattended measurements can be taken using a personal vibration exposure meter, logging readings taken, for example, over a full working day to provide information regarding work patterns including transient acceleration artefacts. Using such instrumentation, the result is always a vibration value or a vibration dose based on vibration readings as taken by the instrumentation.

In addition, there exists auxiliary equipment which can support risk assessment. Such equipment might measure the duration of exposure or estimate the instantaneous vibration dose, using, for example, the information given by the manufacturer on the vibration emission of the machinery used, and might give information when vibration limits are approached or exceeded. Even though such auxiliary equipment does not constitute measuring instrumentation conforming to ISO 8041-1, it is currently used and can be advantageous for keeping occupational vibration limits and for systematic health and safety monitoring. When using such equipment, usually vibration is not really measured.

However, the differences between the instrumentation and equipment features lead to results of varying reliability. By giving guidance and explaining terminology, this document provides clarity regarding the limitations that can be expected when using different instrumentation and equipment for the assessment of daily vibration exposure at the workplace.

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Human response to vibration — Guidance and terminology for instrumentation and equipment for the assessment of daily vibration exposure at the workplace according to the requirements of health and safety

1 Scope

The assessment of human exposure to vibration, to both the hand-arm system and the whole body, at the workplace relies on the combined evaluation of both vibration magnitudes and exposure times. Determining these values can employ various instrumentation types and data sources. This document provides guidance and explanation of concepts used for the following:

— measurement processes;

— instrumentation types;

— vibration magnitude source.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *Mechanical vibration, shock and condition monitoring — Vocabulary*

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

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

ISO 8041-1, *Human response to vibration — Measuring instrumentation — Part 1: General-purpose vibration meters*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041, ISO 2631-1, ISO 5349-1 and ISO 8041-1 and the following apply.

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

3.1
assessment
<vibration exposure> process of determining whether a worker (machine user) is at risk from exposure to vibration

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3.2
evaluation
<vibration exposure> process of determining a value of vibration exposure

Note 1 to entry: This process is often specified in standards.

3.3
estimation
<vibration exposure> process of evaluating a worker's (machine user's) exposure where estimates and assumptions are made about vibration magnitudes and exposure durations

4 Explanation of concepts used for the measurement process

The measurement of human exposure to vibration requires evaluation of vibration magnitudes (weighted acceleration values) and vibration exposure times. The daily vibration exposure $A(8)$ is defined as:

$$A(8) = \sqrt{\frac{1}{T_0}\int_0^T a_{\mathrm{w}}^2 \,\mathrm{d}t} \tag{1}$$

where

a_{w} is the relevant weighted acceleration value as a function of time (for hand-arm vibration, a_{w} is as defined in ISO 5349-1; for whole-body vibration, a_{w} is as defined in ISO 2631-1 or ISO 2631-2);

t is the time;

T is the total daily duration of exposure to vibration;

T_0 is the reference exposure duration of 8 h (28 800 s).

For most practical measurements, the value of $A(8)$ is determined as a series of distinct evaluations, e.g. for different hand-held machines, different operating conditions, different vehicles. $A(8)$ is then determined as:

$$A(8) = \sqrt{\frac{1}{T_0}\sum_{i=1}^{N} a_{\mathrm{w}i}^2 \, T_i} \tag{2}$$

where

$a_{\mathrm{w}i}$ is the relevant weighted r.m.s. acceleration value for operation i (for hand-arm vibration, $a_{\mathrm{w}i}$ is as defined in ISO 5349-1, for whole-body vibration, $a_{\mathrm{w}i}$ is as defined in ISO 2631-1 or ISO 2631-2);

N is the number of operations, i;

T_i is the daily duration of exposure to vibration, $a_{\mathrm{w}i}$;

T_0 is the reference exposure duration of 8 h (28 800 s).

It should be ensured that the exposure time represents the period over which the measurement is made, for example, a measurement that includes breaks in operation represents a longer period of working time than one which only measures during machine operation (see ISO 5349-2 or EN 14253).

NOTE Additional quantities are possible, e.g. for whole-body vibration, the vibration dose value (root-mean-quad; see ISO 2631-1) is as follows:

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