INTERNATIONAL STANDARD

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Mechanical vibration and shock — Hand-arm vibration — Method for measuring the vibration transmissibility of resilient materials when loaded by the hand-arm system

Vibrations et chocs mécaniques — Vibrations main-bras — Méthode pour mesurer le facteur de transmission des vibrations par les matériaux résilients chargés par le système main-bras

Reference number
ISO 13753:1998(E)

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 13753 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock*, Subcommittee SC 4, *Human exposure to mechanical vibration and shock*, in close collaboration with CEN/TC 231, *Mechanical vibration and shock*.

Annex A forms an integral part of this International Standard. Annexes B to F are for information only.

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Introduction

This International Standard was developed in response to the growing demand to protect people from the risks of vibration damage caused by exposure to hand-transmitted vibration.

Various standards refer to measurement and assessment of risk to vibration exposure and to methods of type testing specific tools and processes.

Resilient materials are used to cover handles and make gloves. It is hoped that both of these will reduce the magnitude of the vibration exposure. This International Standard describes a method of measuring the vibration attenuation of a sample of the material in the form of a flat sheet or layer. In some cases the material may be of two or more layers forming a sheet. It is a laboratory measurement and offers a reproducible and reliable procedure.

This International Standard assumes that the material behaves in a linear way and that it has negligible mass compared with the mass loading. (A correction could be made for the material mass if required.) The method determines the impedance of the material when loaded by a mass providing a compression force equivalent to that found when the material is gripped by the hand. This is done by measuring the transfer function of the mass-loaded material at all the required frequencies. The vibration transmission when loaded by the hand is computed using standard values of hand-arm impedance and the measured values of the material impedance. The impedances used in this International Standard are for the palm of the hand when gripping a circular handle. The resulting transmissibility may not be applicable to the fingers. The impedance for the z_h direction of the hand-arm system where the material is under compression is used. The mathematical basis of the method is contained in annex B.

If the results of this measurement procedure show transmissibilities greater than 0,6 at all frequencies up to 500 Hz, then the material would probably not provide greater attenuation in the practical situation in the same frequency range. In the practical situation, the transmissibility as a function of frequency should be appropriate to the frequency spectrum of the source.

Mechanical vibration and shock — Hand-arm vibration — Method for measuring the vibration transmissibility of resilient materials when loaded by the hand-arm system

1 Scope

This International Standard specifies a procedure to determine the vibration transmissibility of a resilient material when loaded by the hand-arm system.

The method is applicable to all materials which behave in a linear way. It is expected that this is realized in most elastic foam and rubber materials and, provisionally, in woven cloths. The method can be applied to mixed systems, e.g. a cloth material attached to a foam or rubber base.

It is expected that the results of this laboratory test will be used in screening materials used for vibration attenuation on the handles of tools and for gloves. This will enable rank ordering of materials for gloves, but will not necessarily predict the transmissibility of the gloves fabricated from these materials (for this purpose, see ISO 10819).

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard 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 5349:1986, *Mechanical vibration — Guidelines for the measurement and the assessment of human exposure to hand-transmitted vibration.*

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

ISO 10068:—[1], *Mechanical vibration and shock — Free, mechanical impedance of the human hand-arm system at the driving point*.

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 2041, ISO 5349 and ISO 5805 apply.

NOTE For hand-transmitted vibration, see ISO 5805. For transmissibility, see ISO 2041.

1) To be published.

4 Symbols

The following symbols are used:

a_1 acceleration measured on the shaker

a_2 acceleration measured on the mass m loading the material

real subscript used to denote the real part of a complex quantity

imag subscript used to denote the imaginary part of a complex quantity

$|\ |$ denotes modulus of a complex quantity

m mass loading the resilient material

T transmissibility

Z_M impedance of the resilient material

Z_H impedance of the hand-arm system. This value is obtained from ISO 10068 (see annex A).

ω angular frequency

j denotes the square root of minus one

$A_i(j\omega)$ or in short A_i: Fourier transform of a_i.

EXAMPLE:

$\left[\frac{A_1(j\omega)}{A_2(j\omega)}\right]_{real}$ denotes the real part of the complex ratio $A_1(j\omega)$ and $A_2(j\omega)$.

5 Principle

The method uses a vibration excitation system (shaker) on which the resilient material is placed with the loading mass m on the top. Accelerometers measure the vibration on the shaker, a_1, and the vibration of the mass m, a_2. The shaker may be driven by a wide-band random signal or a sinusoidal signal.

6 Measuring equipment

6.1 General requirements

A frequency analyser (preferably twin-channel), two transducers and two channels of measuring equipment are required.

The measuring setup is shown in figure 1.

6.2 Acceleration transducers and preamplifiers

The transducers (accelerometers) and preamplifiers chosen shall be suitable for the frequency range 5 Hz to 1 000 Hz. An overload indication shall be provided.

6.3 Transducer mounting

The two transducers shall be rigidly mounted to flat surfaces on the shaker and the loading mass m. The mounting may be achieved using a screw, glue or beeswax. The mounting shall be such that the transfer function between the two transducers is unity up to at least 1 000 Hz without the material sample.