

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Electroacoustics – Simulators of human head and ear –
Part 6: Mechanical coupler for the measurement of bone vibrators**
(standards.iteh.ai)

**Electroacoustique – Simulateurs de tête et d'oreille humaines –
Partie 6: Coupleur mécanique destiné à la mesure des ossivibrateurs**

<https://standards.iteh.ai/catalog/standards/sist/5a6ce1d7-66dd-4576-9d06-8c80fcb57e72/iec-60318-6-2007>





THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2007 IEC, Geneva, Switzerland

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 either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

www.iec.ch/online_news/justpub

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch

Tel.: +41 22 919 02 11

Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,...). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:

Email: csc@iec.ch

Tél.: +41 22 919 02 11

Fax: +41 22 919 03 00



IEC 60318-6

Edition 1.0 2007-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Electroacoustics – Simulators of human head and ear –
Part 6: Mechanical coupler for the measurement of bone vibrators**

**Electroacoustique – Simulateurs de tête et d'oreille humaines –
Partie 6: Coupleur mécanique destiné à la mesure des ossivibrateurs**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

P

ICS 17.140.50

ISBN 2-8318-9470-0

CONTENTS

| | |
|---|----|
| FOREWORD..... | 3 |
| 1 Scope..... | 5 |
| 2 Normative reference..... | 5 |
| 3 Terms and definitions..... | 5 |
| 4 Construction..... | 6 |
| 4.1 General..... | 6 |
| 4.2 Mechanical impedance level..... | 7 |
| 4.3 Phase angle of mechanical impedance..... | 8 |
| 4.4 External geometry..... | 8 |
| 5 Calibration..... | 8 |
| 5.1 Reference environmental conditions..... | 8 |
| 5.2 Calibration procedure..... | 8 |
| 5.3 Force sensitivity level..... | 8 |
| 5.4 Mechanical impedance level..... | 9 |
| 5.5 Temperature dependence..... | 9 |
| 6 Marking and instruction manual..... | 9 |
| 6.1 Marking of the mechanical coupler..... | 9 |
| 6.2 Instruction manual..... | 9 |
| 7 Coupling of bone vibrator to the mechanical coupler..... | 9 |
| 8 Maximum permitted expanded uncertainty of measurements..... | 10 |
| Annex A (informative) Example of a specific construction of a mechanical coupler..... | 11 |
| Annex B (informative) Guidance on the testing and calibration of mechanical couplers..... | 14 |
| Bibliography..... | 15 |
| Figure A.1 – Dimensions of mechanical impedance element base..... | 12 |
| Figure A.2 – Dimensions of tungsten loading insert..... | 12 |
| Figure A.3 – Assembly of the mechanical coupler..... | 13 |
| Table 1 – Mechanical impedance level..... | 7 |
| Table 2 – Values of U_{\max} for basic measurements..... | 10 |

ITeH STANDARD PREVIEW
(standards.iteh.ai)

[IEC 60318-6:2007](https://standards.iteh.ai/catalog/standards/sist/5a6efd67-8bdd-4390-9d0b-88585c717c26/iec-60318-6-2007)

[https://standards.iteh.ai/catalog/standards/sist/5a6efd67-8bdd-4390-9d0b-](https://standards.iteh.ai/catalog/standards/sist/5a6efd67-8bdd-4390-9d0b-88585c717c26/iec-60318-6-2007)

[88585c717c26/iec-60318-6-2007](https://standards.iteh.ai/catalog/standards/sist/5a6efd67-8bdd-4390-9d0b-88585c717c26/iec-60318-6-2007)

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTROACOUSTICS –
SIMULATORS OF HUMAN HEAD AND EAR –**

Part 6: Mechanical coupler for the measurement of bone vibrators

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60318-6 has been prepared by IEC technical committee 29: Electroacoustics.

This standard cancels and replaces IEC 60373 published in 1990. This first edition constitutes a technical revision.

The text of this standard is based on the following documents:

| | |
|------------|------------------|
| CDV | Report on voting |
| 29/615/CDV | 29/628A/RVC |

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

A list of all parts of the IEC 60318 series under the general title: *Electroacoustics – Simulators of human head and ear*, can be found on the IEC website.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[IEC 60318-6:2007](#)

<https://standards.iteh.ai/catalog/standards/sist/5a6efd67-8bdd-4390-9d0b-8c80fcb57e72/iec-60318-6-2007>

ELECTROACOUSTICS – SIMULATORS OF HUMAN HEAD AND EAR –

Part 6: Mechanical coupler for the measurement of bone vibrators

1 Scope

This part of IEC 60318 describes a mechanical coupler for the measurement of the output force of bone vibrators. The mechanical impedance of the coupler is specified in the frequency range 125 Hz to 8 000 Hz. The coupler is intended for calibration of audiometers using bone vibrators having a plane circular tip area of $175 \text{ mm}^2 \pm 25 \text{ mm}^2$ and for determining the performance of bone conduction hearing aids.

The vibratory force developed by a bone vibrator is not, in general, the same on the coupler as on a person's mastoid. However, the IEC recommends its use as a means for the calibration of specified vibrators used in audiometry and for the exchange of specifications and of data on bone conduction hearing aids.

NOTE Some bone vibrators of hearing aids and some non-standardised bone vibrators still used in audiometry have a curved surface. Users should be aware that those vibrators in general will not be loaded on the mechanical coupler with the same mechanical impedance as the one specified in Table 1 of this standard.

2 Normative reference (standards.iteh.ai)

The following referenced document is 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.

BIPM, IEC, ISO, IFCC, IUPAC, IUPAP and OIML:1995, *Guide to the expression of uncertainty in measurement (GUM)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

bone-conduction vibrator

bone vibrator

electro-mechanical transducer that transforms electric oscillations into mechanical vibrations and is intended to be coupled to the bony structure of the head, most commonly the mastoid apophysis

3.2

mechanical coupler

device for calibrating bone-conduction vibrators designed to present a specified mechanical impedance to a vibrator applied with a specified static force, and equipped with an electromechanical transducer to enable the vibratory force level at the surface of contact between vibrator and mechanical coupler to be determined

3.3

alternating force level

ten times the logarithm to the base 10 of the ratio of the squared r.m.s. value of the alternating force transmitting the vibration to the square of the reference value of one micronewton

NOTE 1 The unit of the level re $1\mu\text{N}$ is decibel (dB).

NOTE 2 The alternating force level is also called force level.

3.4

mechanical impedance

for a sinusoidal signal, the complex quotient of the alternating force transmitting the vibration by the component of velocity of the object in the direction of the force

NOTE The unit is newton second per meter (N·s/m).

3.5

mechanical impedance level

ten times the logarithm to the base 10 of the ratio of the squared absolute value (modulus) of the mechanical impedance to the square of the reference value of one newton second per meter (Ns/m)

NOTE The unit of the level re $1\text{ N}\cdot\text{s}/\text{m}$ is decibel (dB).

3.6

mechanical resistance

real part of the mechanical impedance

NOTE The unit is newton second per meter (N·s/m).

3.7

mechanical reactance imaginary part of the mechanical impedance

NOTE The unit is newton second per meter (N·s/m).

3.8

force sensitivity

quotient of output voltage of the mechanical coupler by the applied alternating force

NOTE The unit is volt per newton (V/N).

3.9

force sensitivity level

ten times the logarithm to the base 10 of the ratio of the squared force sensitivity to the square of the reference force sensitivity of one volt per newton (V/N)

NOTE The unit of the level re $1\text{ V}/\text{N}$ is decibel (dB).

4 Construction

4.1 General

The mechanical coupler shall consist of a rigid mass of approximately 3,5 kg containing a force-sensing element which is surmounted by visco-elastic material having an external profile as specified in 4.4. The mechanical impedance of the assembly for uniaxial vibration which is coincident with its major axis of symmetry shall comply with the specifications in 4.2 and 4.3. The whole assembly shall be supported in such a way as to be capable of sustaining a static force of up to 6 N (including the weight of the vibrator under test, if mounted on a vertical axis) with a frequency of natural oscillation on the supports not greater than 12,5 Hz.

NOTE 1 It is recommended to include a temperature-sensing device in intimate contact with the bulk mass of the mechanical coupler, to permit correct measurement of its temperature during use and calibration (see 5.5).

NOTE 2 An example of a mechanical coupler complying with this part of IEC 60318 is described in Annex A.

In the following, the specified tolerance shall be reduced by an amount equal to the actual expanded measurement uncertainty of the test laboratory before deciding if a device conforms to this specification (see Clause 8).

4.2 Mechanical impedance level

The mechanical coupler shall present a mechanical impedance at a temperature of 23 °C having the levels specified in Table 1 within the specified tolerances, when driven by a vibrator having a plane circular tip area of 175 mm² and applied with a static force of 5,4 N ± 0,5 N including (when the apparatus is mounted with its axis vertical) the weight of the vibrator and of any unsupported components of the force-delivery device.

The frequencies shall be equal to the stated values in Table 1 within 1 %.

Table 1 – Mechanical impedance level

| Frequency Hz | Mechanical impedance level (reference: 1 N·s/m) dB | Tolerance dB |
|--------------------|--|-----------------|
| 125 | 48,9 | ± 2,5 |
| 160 | 47,4 | ± 2,5 |
| 200 | 45,8 | ± 2,5 |
| 250 | 44,3 | ± 2,5 |
| 315 | 42,9 | ± 2,5 |
| 400 | 41,3 | ± 2,5 |
| 500 | 39,9 | ± 2,5 |
| 630 | 38,5 | ± 2,5 |
| 750 ^a | 37,4 | ± 2,5 |
| 800 | 37,0 | ± 2,5 |
| 1 000 | 35,5 | ± 3,2 |
| 1 250 | 34,0 | ± 3,2 |
| 1 500 ^a | 32,4 | ± 3,2 |
| 1 600 | 31,9 | ± 3,2 |
| 2 000 | 29,8 | ± 3,2 |
| 2 500 | 27,8 | ± 3,2 |
| 3 000 ^a | 27,2 | ± 3,2 |
| 3 150 | 27,3 | ± 3,2 |
| 4 000 | 29,5 | ± 3,2 |
| 5 000 | 32,6 | ± 3,5 |
| 6 000 ^a | 34,4 | ± 3,5 |
| 6 300 | 34,6 | ± 3,5 |
| 8 000 | 35,1 | ± 3,5 |

^a These frequencies are used in audiometry but are not included in the preferred series specified in ISO 266 [4] 1).

NOTE 1 Values of the mechanical impedance level and tolerances are derived from experimental data on samples of mechanical couplers.

Under similar conditions but with the static force reduced to 2,5 N ± 0,5 N, the mechanical impedance level at 250 Hz shall be 2,0 dB ± 0,9 dB below the value measured with the static force of 5,4 N.

NOTE 2 This constitutes a performance specification and the lower value of static force is not necessarily recommended to be used when testing any particular hearing-aid device.

1) The figures in square brackets refer to the Bibliography.

4.3 Phase angle of mechanical impedance

The phase angle of the mechanical impedance of the mechanical coupler at a frequency of 250 Hz and a temperature of 23 °C shall be $-63,0^\circ \pm 6,0^\circ$, when driven under the same conditions as specified in 4.2, with a static force of 5,4 N.

4.4 External geometry

The contact surface of the mechanical coupler, without an applied external static force, shall be spherical with a nominal radius of 96 mm. The exposed portion of the sphere shall be circular in shape with a minimum diameter of 35 mm. Within this diameter the surface shall be smooth and the tolerance on the spherical radius shall be ± 17 mm. Outside this diameter the external profile of the mechanical coupler shall be such as to avoid interference with any bone vibrator which it is intended to test.

5 Calibration

5.1 Reference environmental conditions

Reference temperature: 23 °C

Reference relative humidity: 50 %

NOTE The mechanical impedance and the force sensitivity of mechanical couplers designed according to this part of IEC 60318 do not depend on ambient pressure.

5.2 Calibration procedure (standards.iteh.ai)

The manufacturer shall describe method(s) for calibrating and determining the overall stability of the mechanical coupler in an instruction manual.

The calibration shall be performed for the reference environmental conditions given in 5.1 with the following tolerances:

Temperature: ± 1 °C

Relative humidity: ± 20 %

NOTE For the purpose of calibration and elsewhere in this part of IEC 60318 where temperature is specified, the stated temperature is that of the mechanical coupler. Due to the large thermal capacity of the mass comprising the body of the device, it may take several hours to attain thermal equilibrium. It is not adequate to rely on a measurement of room temperature.

5.3 Force sensitivity level

The mechanical coupler shall be calibrated by the manufacturer in terms of its force sensitivity level at the frequencies listed in Table 1.

The electrical load conditions shall be stated.

A calibration table or a graph, together with a statement defining the uncertainty, shall be supplied with each mechanical coupler. The calibration uncertainty shall not exceed 0,4 dB for frequencies up to and including 800 Hz and 0,5 dB above 800 Hz up to and including 4 kHz nor shall it exceed 1,0 dB for frequencies up to and including 8 kHz.

NOTE 1 The mechanical impedance of an external surface at a specified location is usually measured by means of an impedance head. This device consists of an acceleration transducer and a force transducer and is driven by an external exciter (shaker). It is pressed against the surface under test with a specified static application force.

NOTE 2 Measurement of the applied alternating force usually requires compensation for the mass of material in the driving stylus of the impedance head between the calibrated force transducer and the external surface, and the instructions of the transducer manufacturer should be followed.

5.4 Mechanical impedance level

The manufacturer shall supply a table or a graph with each mechanical coupler giving the results of measurements of the mechanical impedance level at the frequencies listed in Table 1 under the conditions specified in 5.2 and 5.3.

5.5 Temperature dependence

In addition, measurements specified in 5.3 and 5.4 shall be carried out over a temperature range of at least 18 °C to 28 °C at a sufficient number of frequencies to characterise the temperature dependence of the force sensitivity level and mechanical impedance level. At each temperature the device shall be allowed to reach thermal equilibrium. The temperature of the mechanical coupler shall be measured by means of a contact thermometer at the surface of the coupler body.

NOTE These data are required purely as indicators of temperature dependence. In general, the values for the temperature dependence cannot be used directly to correct data measured at other temperatures to the reference temperature of 23 °C, as the effect of the change in mechanical impedance level on the alternating force output of the bone vibrator under test will not be known.

6 Marking and instruction manual

6.1 Marking of the mechanical coupler

Mechanical couplers complying with this standard shall be marked with the manufacturer's name or trade mark, a serial number, and reference to this part of IEC 60318 by number.

[IEC 60318-6:2007](http://standards.iteh.ai/catalog/standards/sist/5a6efd67-8bdd-4390-9d0b-8c80fcb57e72/iec-60318-6-2007)

6.2 Instruction manual

The mechanical coupler shall be provided with an instruction manual which, as a minimum, shall contain the information required by Clause 5.

Notwithstanding it shall also contain the following:

- detailed instructions which need to be followed to ensure that in use the coupler meets the requirements of this part of IEC 60318;
- details of the recommended calibration procedure(s);
- the limits of temperature and humidity beyond which permanent damage to the mechanical coupler may result.

7 Coupling of bone vibrator to the mechanical coupler

Means shall be provided for applying the vibrator under test to the mechanical coupler with the specified static force (see 5.3). This device shall permit the calibration of vibrators mounted on a headband or of unmounted vibrators without causing a spurious response of the vibrator.

NOTE 1 It is recommended that the mechanism for applying the static force (e.g. springs or gravity-loading mechanism) provided on the mechanical coupler be decoupled from the vibrator under test by means of elastic bands applied symmetrically to the back of the vibrator, the elastic bands having negligible stiffness in the direction of the vibration.

NOTE 2 For measurements on headband-mounted vibrators it is recommended that provision be made to open the headband so as to develop the required static force. The free end of the headband should bear on a resilient material to reduce spurious resonance effects and the headband should not act in parallel with the springs used to resiliently mount the mechanical coupler. An example of one form of mounting is shown in Figure A.2 of IEC 60118-9:1985 [1].

NOTE 3 Means should be provided for locating the vibrator symmetrically on the mechanical coupler.

8 Maximum permitted expanded uncertainty of measurements

The following table specifies the maximum permitted expanded uncertainty for a probability of approximately 95 % equivalent to a coverage factor of $k = 2$, associated with the measurements undertaken in this part of IEC 60318, see the *Guide to the expression of uncertainty in measurement*. One set of values for U_{\max} is given for basic type approval measurements.

The expanded uncertainties of measurements given in Table 2 are the maximum permitted for demonstration of conformance to the requirements of this standard. If the actual expanded uncertainty of a measurement performed by the test laboratory exceeds the maximum permitted value in Table 2, the measurement shall not be used to demonstrate conformance to the requirements of this standard.

Table 2 – Values of U_{\max} for basic measurements

| Measured quantity | Relevant clause number | Basic U_{\max} ($k = 2$) |
|--|--|------------------------------|
| Mechanical impedance level 125 Hz to 800 Hz | 4.2 | 0,5 dB |
| Mechanical impedance level >800 Hz to 4 000 Hz | 4.2 | 0,7 dB |
| Mechanical impedance level >4 000 Hz to 8 000 Hz | 4.2 | 1,0 dB |
| Mechanical impedance phase at 250 Hz | 4.3 IEC 60318-6:2007 | 1,0 ° |
| Difference in mechanical impedance level with reduced static force of 2,5 N | 4.2 https://standards.iteh.ai/catalog/standards/sis/5a6ef167-8bdc-4390-9d0b-8c80fcb57e72/iec-60318-6-2007 | 0,1 dB |
| Static force | 4.2, 5.3 | 0,25 N |
| Frequency | 4.2 | 0,5 % |
| Linear dimensions | 4.4 | 1 mm |
| Force sensitivity level 125 Hz to 800 Hz | 5.3 | 0,4 dB |
| Force sensitivity level >800 Hz to 4 000 Hz | 5.3 | 0,5 dB |
| Force sensitivity level >4 000 Hz to 8 000 Hz | 5.3 | 1,0 dB |
| Temperature | 5.2, 5.5 | 0,3 °C |