

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Underwater acoustics – Hydrophones – Properties of hydrophones in the frequency range 1 Hz to 500 kHz

Acoustique sous-marine – Hydrophones – Propriétés des hydrophones dans la bande de fréquences de 1 Hz à 500 kHz





THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2017 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 l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
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.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

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 It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

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

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) 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 IEC

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

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Underwater acoustics – Hydrophones – Properties of hydrophones in the frequency range 1 Hz to 500 kHz

Acoustique sous-marine – Hydrophones – Propriétés des hydrophones dans la bande de fréquences de 1 Hz à 500 kHz

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 17.140.50

ISBN 978-2-8322-4049-6

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

| | |
|--|----|
| FOREWORD..... | 3 |
| 1 Scope..... | 5 |
| 2 Normative references | 5 |
| 3 Terms and definitions | 5 |
| 4 Symbols | 11 |
| 5 Hydrophone characteristics | 12 |
| 5.1 General..... | 12 |
| 5.2 Basic requirements | 12 |
| 5.3 Sensitivity | 12 |
| 5.4 Frequency response | 13 |
| 5.4.1 Stated operating frequency band | 13 |
| 5.4.2 Frequency dependence | 13 |
| 5.5 Directional response | 13 |
| 5.6 Dynamic range..... | 13 |
| 5.6.1 Linearity and overload sound pressure level | 13 |
| 5.6.2 Equivalent noise pressure spectral density level | 14 |
| 5.6.3 Conditions required | 14 |
| 5.7 Electrical requirements | 14 |
| 5.7.1 Electromagnetic interference | 14 |
| 5.7.2 Electrical characteristics | 14 |
| 5.8 Mechanical requirements | 14 |
| 5.9 Environmental aspects..... | 15 |
| 5.10 Stability of the sensitivity | 15 |
| 5.10.1 Temperature stability | 15 |
| 5.10.2 Depth stability..... | 15 |
| 5.10.3 Time stability | 15 |
| 6 Information to be supplied by the manufacturer | 16 |
| Annex A (informative) Recommendations for selecting hydrophones..... | 18 |
| A.1 General..... | 18 |
| A.2 Sensitivity | 18 |
| A.3 Self-noise performance | 19 |
| A.4 Frequency response | 19 |
| A.5 Directional response | 20 |
| A.6 Dynamic range..... | 20 |
| A.7 Electrical connection..... | 21 |
| A.8 Stability of the sensitivity | 21 |
| A.8.1 Temperature stability | 21 |
| A.8.2 Depth stability..... | 21 |
| A.8.3 Time stability | 21 |
| Bibliography..... | 22 |
| Figure 1 – Angular co-ordinate system..... | 6 |

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**UNDERWATER ACOUSTICS – HYDROPHONES – PROPERTIES OF
HYDROPHONES IN THE FREQUENCY RANGE 1 Hz TO 500 kHz**

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 itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 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 60500 has been prepared by IEC technical committee 87: Ultrasonics.

This second edition cancels and replaces the first edition published in 1974. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition.

- a) The format and scope of IEC 60500 have been changed to be compatible with IEC 62127-3:2007 in accordance with ISO/IEC Directives, and has a good conformity with IEC 60565:2006, making the suite of available standards for underwater sound a more coordinated and coherent system.
- b) The upper limit of the frequency range of hydrophones has been expanded from 100 kHz to 500 kHz.
- c) Technical requirements of hydrophone selecting are provided in Annex A, and the depth range of the static pressure range of hydrophones has been expanded from 10 m to 100 m.

The text of this International Standard is based on the following documents:

| | |
|-------------|------------------|
| FDIS | Report on voting |
| 87/644/FDIS | 87/649/RVD |

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

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

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

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

UNDERWATER ACOUSTICS – HYDROPHONES – PROPERTIES OF HYDROPHONES IN THE FREQUENCY RANGE 1 Hz TO 500 kHz

1 Scope

This document specifies the relevant characteristics and properties of hydrophones in the frequency range 1 Hz to 500 kHz, and specifies how to report these characteristics. It does not cover performance requirements for specific hydrophone types, or for specific hydrophone applications. However, guidance on the choice of a hydrophone with appropriate performance for a specific application is given in an informative annex.

This document is applicable to:

- hydrophones employing piezoelectric sensor elements, designed to respond to sound pressure in water and measure underwater acoustical signals;
- hydrophones with or without an integral pre-amplifier.

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 266:1997, *Acoustics – Preferred frequencies*

3 Terms and definitions

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

3.1

angular co-ordinate system
system used to designate the directional response pattern of the hydrophone

Note 1 to entry: The terms “horizontal directional response” and “vertical directional response” are often used for representation of directional response in the xy -plane, and xz - (or yz -) planes respectively.

Note 2 to entry: “+ z ” is coincident with an axis of the hydrophone, and “- z ” is in the direction of the hydrophone cable.