SLOVENSKI STANDARD
SIST EN IEC 60565-2:2020

01-januar-2020

Podvodna akustika - Hidrofoni - Kalibracija hidrofonov - 2. del: Postopki kalibracije z nizkimi frekvencami (IEC 60565-2:2019)

Underwater acoustics - Hydrophones - Calibration of hydrophones - Part 2: Procedures for low frequency pressure calibration (IEC 60565-2:2019)

Wasserschall - Hydrophone - Kalibrierung von Hydrophonen - Teil 2: Verfahren für niederfrequente Druckkalibrierung (IEC 60565-2:2019)

Acoustique sous-marine - Hydrophones - Étalonnage des hydrophones - Partie 2: Procédures pour l'étalonnage à basse pression de fréquence (IEC 60565-2:2019)

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ICS:

17.140.50	Elektroakustika	Electroacoustics

SIST EN IEC 60565-2:2020 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN IEC 60565-2

November 2019

ICS 17.140.50

English Version

Underwater acoustics - Hydrophones - Calibration of hydrophones - Part 2: Procedures for low frequency pressure calibration (IEC 60565-2:2019)

Acoustique sous-marine - Hydrophones - Étalonnage des hydrophones - Partie 2: Procédures pour l'étalonnage à basse pression de fréquence (IEC 60565-2:2019)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 87/720/FDIS, future edition 1 of IEC 60565-2, prepared by IEC/TC 87 "Ultrasonics" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60565-2:2019.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2020-07-24
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2022-10-24

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Endorsement notice

The text of the International Standard IEC 60565-2:2019 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 60565:2006 NOTE Harmonized as EN 60565:2007 (not modified)

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60050-801	-	International Electrotechnical Vocabulary - Chapter 801: Acoustics and electroacoustics	-	-
IEC 60500	2017	Underwater acoustics - Hydrophones - Properties of hydrophones in the frequency range 1 Hz to 500 kHz	EN 60500	2017

IEC 60565-2

Edition 1.0 2019-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Underwater acoustics – Hydrophones – Calibration of hydrophones – Part 2: Procedures for low frequency pressure calibration

Acoustique sous-marine – Hydrophones – Étalonnage des hydrophones – Partie 2: Procédures pour l'étalonnage à basse pression de fréquence

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UNDERWATER ACOUSTICS – HYDROPHONES – CALIBRATION OF HYDROPHONES –

Part 2: Procedures for low frequency pressure calibration

FOREWORD

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International Standard IEC 60565-2 has been prepared by IEC technical committee 87: Ultrasonics.

This first edition of IEC 60565-2, together with IEC 60565-1, replaces the second edition of IEC 60565 published in 2006. This edition constitutes a technical revision.

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

1) IEC 60565 has been divided into two parts:
   - Part 1: Procedures for free-field calibration;
   - Part 2: Procedures for low frequency pressure calibration (this document).
2) A relative calibration method has been added to Clause 8: Calibration by piezoelectric compensation.

3) A relative calibration method has been added to Clause 11: Calibration by **vibrating column**.
4) Clause 12: Calibration by static pressure transducer, has been added.
5) Annex A: Equivalent circuit of the excitation system for calibration with a **vibrating column**, has been deleted.
6) Subclauses 9.6, 9.7 and 9.8 have been moved to form a new Annex A: Advanced acoustic coupler calibration methods.

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

FDIS	Report on voting
87/720/FDIS	87/723/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.

NOTE Words in **bold** in the text are terms defined in Clause 3.

A list of all parts in the IEC 60565 series, published under the general title *Underwater acoustics – Hydrophones – Calibration of hydrophones*, can be found on the IEC website.

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.

INTRODUCTION

The purpose of this document is to establish the procedures for low frequency pressure calibrations of **hydrophone**s in the frequency range from 0,01 Hz to several kilohertz.

To ensure the correctness of the calibrations, the **hydrophone**s to be calibrated are "rigid" **hydrophone**s with small size compared to the acoustic wavelength, and are not sensitive to vibration when calibrated.

Principles, procedures, and **uncertainties** of physical calibrations such as hydrostatic excitation, piezoelectric compensation, **pistonphone**, **vibrating column**, static pressure transducer, etc., and reciprocity calibrations in acoustic **coupler**s are given in this document. Calibrations are carried out using one of these methods, depending on the different principles to be used, and its limitations to the sound field and the frequency range.

UNDERWATER ACOUSTICS – HYDROPHONES – CALIBRATION OF HYDROPHONES –

Part 2: Procedures for low frequency pressure calibration

1 Scope

This part of IEC 60565 specifies the methods for low frequency pressure calibration of **hydrophone**s at frequencies from 0,01 Hz to several kilohertz depending on calibration method.

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.

IEC 60050-801, *International Electrotechnical Vocabulary – Chapter 801: Acoustics and electroacoustics* (available at http://www.electropedia.org/)

IEC 60500:2017, *Underwater acoustics – Hydrophones – Properties of the hydrophone in the frequency range 1 Hz to 500 kHz*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-801, IEC 60500:2017 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
coupler
apparatus comprising a rigid fluid-filled chamber into which transducers and **hydrophone**s can be inserted whose largest dimension is small compared to the wavelength

Note 1 to entry: In this document, the term small chamber is used interchangeably with **coupler**.

[SOURCE: IEC 60565:2006 [1][1], 3.3, modified – In the definition, "small dimensions" has been replaced by "whose largest dimension is small compared to the wavelength".]

1 Numbers in square brackets refer to the Bibliography.

3.2
diffraction factor
ratio of the root-mean-square value of the sound pressure, averaged over the part of the **hydrophone** designed to receive an incident plane wave sound pressure from a given direction to the free-field root-mean-square sound pressure that would exist at the position of the reference centre of the **hydrophone** if the **hydrophone** was removed

Note 1 to entry: Spatial average is undertaken first and then time average.

[SOURCE: IEC 60500:2017, 3.3, modified – In the definition, "the root-mean-square sound pressure" has been replaced by "the root-mean-square value of the sound pressure,", and "the position of" has been added after "that would exist at".]

3.3
electrical transfer impedance
$\underline{Z}_{\mathrm{PH}}$
<of a transducer pair in a coupler> quotient of the Fourier transform of the open circuit voltage $\Im(U_{\mathrm{H}}(t))$ across the **hydrophone** electrical terminals, to the Fourier transform of the electrical current $\Im(I_{\mathrm{P}}(t))$ through the **projector**, when **projector** and **hydrophone** are mounted in a **coupler**

$$\underline{Z}_{\mathrm{PH}} = \frac{\Im\left(U_{\mathrm{H}}(t)\right)}{\Im\left(I_{\mathrm{P}}(t)\right)} \tag{1}$$

Note 1 to entry: The **electrical transfer impedance** is a complex-valued parameter. The modulus of the **electrical transfer impedance** is expressed in ohm, Ω. The phase angle is expressed in degrees, and represents the phase difference between the **hydrophone** voltage and the **projector** current.

Note 2 to entry: Because the **electrical transfer impedance** depends on the field conditions, the hydrostatic pressure, water temperature and the length of the cable attached to the transducer, these parameters, as well as the frequency and the electrical terminals where the electrical impedance is measured, are specified.

[SOURCE: IEC 60565:2006 [1], 3.10, modified – In the term, "transducer pair" has been deleted. The domain "<of a transducer pair in a coupler>" has been added. In the definition, "complex ratio of the open circuit instantaneous voltage U_{H}" has been replaced by "quotient of the Fourier transform of the open circuit voltage $\Im(U_{\mathrm{H}}(t))$", "the instantaneous current I_{P}" has been replaced by "Fourier transform of the electrical current $\Im(I_{\mathrm{P}}(t))$", and "if **projector** and **hydrophone** are mounted in a free field with their principal axes in line and directed towards each other" has been replaced by "when **projector** and **hydrophone** are mounted in a **coupler**".]

3.4
hydrophone
electroacoustic transducer that produces electrical voltages in response to water borne pressure **signal**s

Note 1 to entry: A **hydrophone** is designed to respond principally to underwater sound pressure.

Note 2 to entry: In general, a **hydrophone** can also produce a **signal** in response to non-acoustic pressure fluctuations (for example, those existing in a turbulent boundary layer during conditions of high water flow).

Note 3 to entry: **Hydrophone** types include reference **hydrophone**s and measuring **hydrophone**s. Measuring **hydrophone**s are used in general measurements of sound fields, and reference **hydrophone**s are principally used for calibration purposes (for example in comparison calibrations with measuring **hydrophone**s).

Note 4 to entry: **Hydrophone**s are principally used as listening devices, but in reciprocity calibration, a **hydrophone** is used as **reciprocal transducer**, not only acting as a **hydrophone**, but also as a **projector** (sound source).

Note 5 to entry: A **hydrophone** which is integrated with a digital acquisition system is sometimes termed a "digital **hydrophone**", but the combination is best considered as a measuring system, not a **hydrophone** alone.