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Underwater Acoustics - Calibration of acoustic wave vector receivers in the frequency range 5 Hz to 10 kHz

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ESTONIAN CENTRE FOR STANDARDISATION AND ACCREDITATION

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NORME EUROPÉENNE

EUROPÄISCHE NORM

EN IEC 63305

April 2024

ICS 17.140.50

English Version

Underwater acoustics - Calibration of acoustic wave vector receivers in the frequency range 5 Hz to 10 kHz (IEC 63305:2024)

Acoustique sous-marine - Étalonnage des récepteurs vectoriels d'ondes acoustiques dans la plage de fréquences de 5 Hz à 10 kHz (IEC 63305:2024)

Unterwasserakustik - Kalibrierung von Schallwellenvektorempfängern im Frequenzbereich 5 Hz bis 10 kHz (IEC 63305:2024)

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The text of document 87/839/FDIS, future edition 1 of IEC 63305, prepared by IEC/TC 87 "Ultrasonics" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 63305:2024.

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IEC 60565-1:2020 NOTE Approved as EN IEC 60565-1:2020 (not modified)

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IEC 63305

Edition 1.0 2024-02

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Underwater acoustics – Calibration of acoustic wave vector receivers in the frequency range 5 Hz to 10 kHz

Acoustique sous-marine – Étalonnage des récepteurs vectoriels d'ondes acoustiques dans la plage de fréquences de 5 Hz à 10 kHz

IEC 63305:2024-02(en-fr)

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UNDERWATER ACOUSTICS – CALIBRATION OF ACOUSTIC WAVE VECTOR RECEIVERS IN THE FREQUENCY RANGE 5 Hz TO 10 kHz

FOREWORD

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Draft	Report on voting
87/839/FDIS	87/843/RVD

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

The language used for the development of this International Standard is English.

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INTRODUCTION

Unlike traditional piezoelectric **hydrophones** which are sensitive to sound pressure, **vector receivers** measure **sound particle** motion (velocity, acceleration or displacement) or **sound pressure gradient**, and have strongly **directional response** in their working frequency range. The calibration of these **vector receivers** which measure **sound particle** motion or **sound pressure gradient** is considered in this document.

The output voltage of a **vector receiver** channel to be calibrated is proportional to the **sound particle** motion or **sound pressure gradient** at the reference centre of the receiver. The directivity of the **vector receiver** channel is independent of acoustical frequency, and the ratio of the output voltage of the receiver channel at angle θ to the maximum output voltage on the axial direction is equal to $|\cos\theta|$ [1][1].

Recent developments of **acoustic wave vector receivers** for ocean acoustics, such as those that measure **sound particle velocity**, have led to a number of commercial systems being made available on the market. In addition to providing sensors which possess some useful directivity for low-frequency applications, they are increasingly used for measurement of underwater noise exposure for marine fauna that are sensitive to sound particle motion rather than sound pressure (for example, fish and invertebrates). However, calibration of such sensors poses technical challenges, and is not covered by the existing international standards such as IEC 60565 [2], [3]. Building on work begun in China and Russia [4], where a successful bilateral comparison has recently been concluded, this work establishes an International Standard on calibration of **vector receivers** in the frequency range 5 Hz to 10 kHz.

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[1] Numbers in square brackets refer to the Bibliography.

UNDERWATER ACOUSTICS – CALIBRATION OF ACOUSTIC WAVE VECTOR RECEIVERS IN THE FREQUENCY RANGE 5 Hz TO 10 kHz

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1 Scope

Usually, **acoustic wave vector receivers** are designed and constructed based on one of two principles. One is the sound pressure difference (gradient) principle. When measuring with this sensor, the **vector receiver** is rigidly fixed on a mount and supported in water. The other is the co-vibrating (**inertial**) principle. When measuring with this sensor, the **vector receiver** is suspended on a mount and supported in water in a non-rigid manner, which allows the **vector receiver** co-vibrate in the same direction as the **sound particle** in the sound wave field.

Many methods have been used to calibrate **vector receivers**, such as free-field calibration, calibration in standing wave tube and calibration in a travelling wave tube. This document specifies methods and procedures for calibration of **vector receivers** in the frequency range 5 Hz to 10 kHz, which are applicable to **vector receivers** based on the two different principles. In addition, it describes an absolute method of **inertial vector receiver** calibration in air using optical interferometry.

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

IEC 60565-1:2020, *Underwater acoustics – Hydrophones – Calibration of hydrophones, Part 1: Procedures for free-field calibration of hydrophones*

ISO 80000-8:2020, *Quantities and units – Part 8: Acoustics*

ISO 18405:2017, *Underwater acoustics – Terminology*

ISO/IEC Guide 98-3, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60500:2017, IEC 60565-1:2020, ISO 80000-8:2020, ISO 18405:2017 and the following apply.

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