FINAL DRAFT

INTERNATIONAL STANDARD

ISO/FDIS 17208-1

ISO/TC **43**/SC **3**

Secretariat: ANSI

Voting begins on:
2015-12-14

Voting terminates on:
2016-02-14

Underwater acoustics — Quantities and procedures for description and measurement of underwater sound from ships —

Part 1: Requirements for precision measurements in deep water used for comparison purposes

Acoustique sous-marine — Grandeurs et modes de description et de mesurage de l'acoustique sous-marine des navires —

Partie 1: Exigences pour les mesurages en eau profonde utilisées pour des besoins de comparaison

Reference number
ISO/FDIS 17208-1:2015(E)

Contents

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 43, *Acoustics*, Subcommittee SC 3, *Underwater acoustics*.

This first edition cancels and replaces ISO/PAS 17208-1:2012, which has been technically revised.

ISO 17208 consists of the following parts, under the general title *Underwater acoustics — Quantities and procedures for description and measurement of underwater sound from ships*:

— *Part 1: Requirements for precision measurements in deep water used for comparison purposes*

The following part is under preparation:

— *Part 2: Determination of source levels*

A third part on measurement of radiated noise levels in shallow water is planned.

Introduction

This part of ISO 17208 was developed to provide a standardized measurement method for the quantification and qualification of a ship's underwater radiated noise level. This procedure measures a sector average for a certain beam aspect. It promotes the consistency of reported sound measurements from shipping sources. This part of ISO 17208 provides users with the necessary procedure to compare a ship's radiated noise level to criteria established by others or to contract specifications.

Reduction of all types of ship emissions, most notably ballast water and engine emissions, became an issue in the decade prior to publication of ISO/PAS 17208-1:2012. ISO/PAS 17208-1:2012 was developed in response to growing international concerns about underwater noise and its impact on marine animals.

Excessive underwater noise has the potential to interfere with a marine animal's ability to perform a variety of critical life functions, including navigation, communication and finding food. Because of this, the environmental impact statements of underwater projects such as pile driving, pipe laying and oil exploration now include assessments of underwater noise impact.

This part of ISO 17208 converts the PAS to an International Standard and limits its focus to a precision grade of measurement.

Underwater acoustics — Quantities and procedures for description and measurement of underwater sound from ships —

Part 1: Requirements for precision measurements in deep water used for comparison purposes

1 Scope

This part of ISO 17208 specifies the general measurement system, procedure, and methodology used for the measurement of underwater sound from ships under a prescribed operating condition. It does not specify or provide guidance on underwater noise criteria or address the potential effects of noise on marine organisms.

The resulting quantities are based on the root-mean-square sound pressure levels (SPL), herein used synonymously with sound pressure level or SPL measured in the far-field of the ship and normalized to a distance of 1 m and reported in one-third octave bands (see 4.3). In this part of ISO 17208, the result of these measurements is called "radiated noise level." The underwater sound pressure level measurement is performed in the geometric far field and then adjusted to the 1 m normalized distance for use in comparison with appropriate underwater noise criteria.

This part of ISO 17208 is applicable to any and all underway surface vessels, either manned or unmanned. It is not applicable to submerged vessels or to aircraft. The method has no inherent limitation on minimum or maximum ship size. It is limited to ships transiting at speeds no greater than 50 kn (25,7 m/s).

The measurement method mitigates the variability caused by Lloyd's mirror surface image coherence effects, but does not exclude a possible influence of propagation effects like bottom reflections, refraction and absorption. No specific computational adjustments for these effects are provided in this part of ISO 17208. A specific ocean location is not required to use this part of ISO 17208, but the requirements for an ocean test site are provided.

The intended uses of the method described in this part of ISO 17208 are: to show compliance with contract requirements or criteria, for comparison of one ship to another ship, to enable periodic signature assessments, and for research and development. The intended users include government agencies, research vessel operators, and commercial ship owners.

Additional post-processing would be required to use the data obtained from this measurement method for determination of the ship source levels to perform far-field noise predictions such as needed for most environmental impact studies or for creating underwater noise contour maps.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 18405:—[1)], *Underwater acoustics — Terminology*

1) To be published.

IEC 60565, *Underwater acoustics — Hydrophones — Calibration in the frequency range 0,01 Hz to 1 MHz*

IEC 61260, *Electroacoustics — Octave-band and fractional-octave-band filters*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18405 and the following apply.

3.1
background noise
noise from all sources (biotic and abiotic) other than the ship being measured, including self noise

Note 1 to entry: See 6.2 for background noise adjustments.

[SOURCE: ISO 11202:2010, 3.17, modified – in the definition, added "(biotic and abiotic)" and changed "source under test" to "ship being measured".]

3.2
beam aspect
direction to either side of the ship under test perpendicular to the vertical plane through the middle of the ship from front to back

Note 1 to entry: Beam aspect refers to the location of the hydrophone(s) with respect to the ship under test and is typically referred to as port or starboard directions. Another approach for hydrophone measurement (not applied here) is *keel aspect* where the hydrophone(s) are mounted at or near the sea floor.

3.3
closest point of approach
CPA
point where the horizontal distance (during a test run) from the ship reference point of the ship under test to the hydrophone(s) is the smallest

Note 1 to entry: The distance to the hydrophone at the closest point of approach is defined by the symbol d_{CPA} as used in Formula (1).

3.4
commence exercise
COMEX
start test range location
position of the ship reference point of the ship under test at least twice (2x) the distance of the "start data" location ahead of the closest point of approach

Note 1 to entry: See Figure 3.

3.5
data window angle
angle subtended at the hydrophone, between the start data location and the end data location

Note 1 to entry: The data window angle is expressed as a value in degrees as shown in Figure 3.

Note 2 to entry: The data window angle is ±30°.

3.6
data window length
DWL
l_{DW}
distance between the start data location and end data location

Note 1 to entry: The DWL is defined by the distance at closest point of approach and the data window angle of ±30° as given in Formula (1) and shown in Figure 3.

3.7
data window period
DWP
t_{DWP}
time it takes the ship under test to travel the data window length at a certain speed

Note 1 to entry: See Formula (2) and Figure 3.

3.8
end data location
position of the ship reference point of the ship under test where data recording is ended

Note 1 to entry: End data location is one data window length after the start data location. See Figure 3.

3.9
field calibration
method of using known inputs, possibly using physical stimuli (such as a known, calibrated and traceable acoustic or vibration source) or electrical input (charge or voltage signal injection) at the input (or other stage) of a measurement system in order to ascertain that the system is, in fact, responding properly (i.e. within the system's stated uncertainty) to the known stimulus

3.10
finish exercise
FINEX
end test range location
position of the ship reference point of the ship under test twice (2x) the distance to the "start data" location past the closest point of approach

Note 1 to entry: See Figure 3.

3.11
frequency response
frequency range a system is able to measure, for a given uncertainty and repeatability, from the lowest frequency to the highest stated frequency

3.12
geometric far field
horizontal distance from the ship under test at which the assumption of source co-location causes less than 1 dB difference between the actual measurement and the hypothetical result when adjusting to the reference far-field distance

Note 1 to entry: The definition for *acoustic far field* in ISO 18405 also applies.

3.13
hydrophone cable drift angle
angle between the vertical axis and the line created between the fixed support of the hydrophone cable and the hydrophone

3.14
insert voltage calibration
known, calibrated and traceable input stimulus in the form of an electrical input injected at the input (or other stage) of a measurement system in order to ascertain that the system is, in fact, responding properly (i.e. within the system's stated uncertainty and repeatability) to a known stimulus

3.15
Lloyd's mirror surface image coherence effects
alteration of radiated noise levels caused by the presence of a free (pressure release) surface

Note 1 to entry: Radiation from the surface image constructively and destructively influences the source's direct radiation. For this part of ISO 17208, these effects are considered as part of the source's radiation, causing it to exhibit a vertical directivity and necessitating the acquisition angle(s) is defined.

Note 2 to entry: Lloyd's mirror effects are reduced but not removed from the final radiated noise level determined herein.

3.16
measurement repeatability
expected dispersion of radiated noise levels resulting from successive measurements on the same ship at the same operating condition, carried out under the same conditions of measurement with the same equipment at the same location

Note 1 to entry: Measurement repeatability is stated in decibels and in one-third-octave bands.

3.17
measurement system
data acquisition system consisting of, but not limited to, one or more transducer(s), conditioning amplifier(s), analogue-to-digital converter(s), digital signal processing computer and ancillary peripherals

3.18
measurement uncertainty
expected dispersion of the measured radiated noise level values

Note 1 to entry: Measurement uncertainty is stated in decibels for one-third-octave bands using a given measurement method (averaging time, bandwidth-time product, etc.).

Note 2 to entry: See Clause 7.

3.19
omni-directional hydrophone
underwater sound pressure transducer that responds nearly equally to sound from all directions with a variation in sensitivity with horizontal direction not exceeding ±2 dB within the frequency range of the measurements.

3.20
overall ship length
longitudinal distance between the forward-most and aft-most part of a ship

3.21
radiated noise level
RNL
L_{RN}
level of the product of the distance from a ship reference point of a sound source, d, and the far-field root-mean-square sound pressure, $p_{RMS}(d)$, at that distance for a specified reference value

Note 1 to entry: LRN = 20 log10 (p_{RMS}/p_0) dB + 20 log10 (d/d_0) dB.

Note 2 to entry: Radiated noise level is expressed in decibels (dB).

Note 3 to entry: The reference value for pressure (p_0) is 1 µPa. The reference value for distance (d_0) is 1 m. The combined RNL reference value is p_0d_0 is 1 µPa·m.

Note 4 to entry: The resulting level is denoted "LRN, dB re 1 µPa·m". This designation replaces the past use of "Lp, dB re 1 µPa @ 1 m".

Note 5 to entry: RNL varies in both horizontal and vertical aspect in the far-field. This procedure determines an azimuthal sector averaged about the hydrophone position; and vertical-elevation averaged quantity in the beam aspect about the ship reference point.