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EXPERIENCE-BUILDING PHASE FOR THE REDUCTION OF UNDERWATER RADIATED NOISE FROM SHIPPING

IACS Recommendation No.181 on the measurement of underwater radiated noise

Submitted by IACS

SUMMARY

Executive summary:	This document informs about the publication of IACS Recommendation No.181 on the *Measurement of Underwater Radiated Noise from Ship*s.
Strategic direction, if applicable:	1
Output:	1.16
Action to be taken:	Paragraph 10
Related documents:	MEPC 82/17 and MEPC.1/Circ.906/Rev.1

Background

1 MEPC 82 approved the *Revised guidelines for the reduction of underwater radiated noise from shipping to address adverse impacts on marine life* (MEPC.1/Circ.906/Rev.1) and agreed to continue with the three-year experience-building phase (EBP) for the revised guidelines.

2 This document supports the EBP by informing the Sub-Committee about the publication of IACS Recommendation No.181 on the *Measurement of Underwater Radiated Noise from Ships*.

Discussion

3 The measurement of underwater radiated noise (URN) from ships is imperative to assess the impact of noise pollution on marine organisms, mammals and fish. IACS recognizes the importance of establishing international standards to ensure that measurements are consistent and reliable, which is essential for comparing data, identifying trends and assessing the impact of URN.

4 ISO 17208-1:2016 and ISO 17208-2:2019 standards are considered the established standards for measurements of URN in deep waters. For ships without direct access to deep waters (typically 150 m or more), such measurements may, however, be resource-demanding, requiring more specialized equipment and extended time at sea.

5 Measurements of URN in shallow waters may, depending on the circumstances, be highly applicable and more cost-effective for some ships, for example due to the limited access to deep waters for measurements of URN, reduced time at sea and alternative geometries for measuring URN in shallow waters. IACS appreciates the extensive work being performed by ISO and industry stakeholders to address these conditions by developing the Draft International Standard ISO/DIS 17208-3 on measurements in shallow waters.

6 To make measurements of URN as available as possible to the global fleet and thereby contribute to the overall reduction of underwater noise pollution from ships, IACS has based its recommendation on the established and draft ISO standards: an aligned industry is considered paramount to making comparable URN measurements available to a larger part of the world fleet.

7 Therefore, as a stepping stone towards an internationally aligned approach, IACS has published Recommendation No.181 on the measurement of URN from ships. This recommendation aims to harmonize the methods used to measure URN from ships amongst IACS members, ensuring consistency and comparability across different class notations.

8 Using the established and progressing ISO and industry initiatives as a basis, the new IACS recommendation establishes:

.1 common definitions and terminologies to be used for measurements of URN;

.2 relevant measurement methodologies for URN, taking into account the latest industry and ISO developments;

.3 appropriate methodologies for post processing of data from the URN measurements; and

.4 parameters to be included in the URN measurement reports to support the comparison of results.

9 IACS Recommendation No.181 makes reference to ISO/DIS17208-3 and will, therefore, be revisited upon finalization of the ISO standard.

Action requested of the Sub-Committee

10 The Sub-Committee is invited to note the information provided above and the publication of IACS Recommendation No.181, as set out in the annex.

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ANNEX

IACS RECOMMENDATION NO.181 ON MEASUREMENT OF UNDERWATER RADIATED NOISE

1 Introduction

These recommendations are intended to harmonize the methodologies for the measurement of underwater radiated noise from ships amongst IACS Members and to establish consistent post processing of data and reporting standards.

2 References

ISO 17208-1:2016 "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".

ISO 17208-2:2019 "Underwater acoustics — Quantities and procedures for description and measurement of underwater sound from ships — Part 2: Determination of source levels from deep water measurements."

ISO/DIS 17208-3:2023 "Underwater acoustics — Quantities and procedures for description and measurement of underwater sound from ships — Part 3: Requirements for measurements in shallow water."

ISO 18405:2017 "Underwater acoustics — Terminology."

3 Terminology

The terminology in ISO 18405:2017 should be used as a basis.

4 Measurement of underwater radiated noise in deep waters

Deep water is water of depth greater than the larger of 150 m and 1.5 x overall ship length.

Measurements in deep waters should be conducted in accordance with ISO 17208-1:2016 and ISO 17208-2:2019.

5 Measurement of underwater radiated noise in shallow waters

Shallow water is water of depth less than the larger of 150 m and 1.5 x overall ship length.

Measurements of underwater radiated noise from ships in shallow waters should be based on ISO/DIS 17208-3, taking the recommendations outlined below into account:

5.1 Terms and definitions

Cite ISO/DIS 17208-3, paragraph 3.2.4:

> "Acoustic ship length L: user defined length L of which the ship is assumed to radiate the dominant sound over the frequency range of interest."

IACS recommendation:

The acoustic ship length will typically be located in the rear 1/3 of the ship length.

Regardless of the choice of the acoustic ship length L the user should include the total ship length for the purpose of the data recording window.

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Cite ISO/DIS 17208-3, paragraph 3.2.5:

> "Ship reference point: point on the ship from which the distances are defined".

IACS recommendation:

Generally, the acoustic centre is often considered to be the longitudinal midpoint between the centre of the engine-room and the propulsors, transversely at the ship centre line and vertically at the nominal source depth. This is referred to in ISO/DIS 17802-3 paragraph 3.2.5 as the ship reference point.

The offset between the user-mounted GPS track should be known relative to the acoustic centre.

5.2 General measurement requirements

5.2.1 Test ship parameters

Cite ISO/DIS 17208-3, paragraph 4.2b):

> "The user selects the configuration (machinery lay-out and propeller shaft rotation rate, or speed through water, or propulsion power) for which the radiated sound is to be measured".

IACS recommendation:

Power and machinery operation should be held constant throughout reciprocals runs. See paragraph 5.3 of ISO/DIS 17208-3 for further details.

Ships testing condition(s), including loading, should be representative of the normal/typical operating condition(s).

5.2.2 Frequency range

Cite ISO/DIS 17208-3 paragraph 4.3:

> "The user selects the frequency range of interest over which SL is required. Ideally the user follows ISO 17208-1, which specifies a minimum frequency range that covers the decidecade bands from 10 Hz to 20 000 Hz".

IACS recommendation:

Underwater noise measurements in very shallow waters may limit the achievable accuracy at the lower frequency range and the cut-off frequency should be noted in the report.

5.2.3 CPA distance

IACS recommendation:

With respect to ISO/DIS 17208-3, paragraph 4.4, careful consideration must be paid in case of small vessels and high-speed craft. The CPA distance should be the greater of 100 m or the acoustic ship length. The data recording window should be a minimum of 10 s to ensure data integrity.

5.2.4 Test site selection

Cite ISO/DIS 17208-3, paragraph 4.5:

> "The user selects a measurement site, that fulfils the following requirements:
>
> […]"

IACS recommendation:

Careful consideration should be made when choosing the site location. Ideal site selection would avoid frequency cut-off due to water depth and minimize the background noise due to weather conditions, traffic lanes etc., as reasonably as possible.

5.3 Acoustic measuring instrumentation

5.3.1 Frequency range and sampling rate

Cite ISO/DIS 17208-3, paragraph 4.6.2, Note 2:

> "It is desirable that the system sensitivity be invariant with frequency over the frequency range of interest (i.e. that it possess a 'flat response'), to within a tolerance of 2 dB. Note that it is possible to correct for the variation in the sensitivity with frequency with better accuracy than the above tolerance if the hydrophone and measuring system is calibrated over the full frequency range of interest".

IACS recommendation:

It is desirable that the system sensitivity be invariant with frequency over the frequency range of interest (i.e. that it possess a "flat response"), to within a tolerance of 2 dB, but not more than 3 dB at a frequency range of 10 Hz – 20 kHz.

5.3.2 Field calibration checks

Cite ISO/DIS 17208-3, paragraph 4.6.7:

> "In-situ field checks on the system calibration should be undertaken just before and after deployment and in between any repeated deployments".

IACS recommendation:

In-situ field calibrations should be performed pre-deployment and post instrument recovery, after the measurements are obtained. Frequent background noise measurements should be taken over the course of the survey period. The data should be preserved and provided on demand as part of the test survey.

5.4 Measurement configurations

5.4.1 Number of hydrophones

Cite: ISO/DIS 17208-3, paragraph 5.1:

> "A single hydrophone can be used for ship radiated sound measurements. For reduced uncertainty, however, the use of three hydrophones is preferred, so that the signals recorded by the different hydrophones correspond with difference sin propagation loss, leading to a more robust estimation of source level (see Clause 7). The use of more than one hydrophone offers redundancy as well: if one hydrophone or measurement channel fails, there is a back-up".

IACS recommendation:

The use of three hydrophones is recommended.

5.4.2 Hydrophone deployment configuration

With respect to ISO/DIS 17208-3, paragraph 5.2, while it is desirable to meet the nominal hydrophone angles (15, 30, 45) for all three hydrophones at CPA relative to the ship track, it is recognized that this is not always achievable.

5.4.3 Test course and ship operation

With reference to ISO/DIS 17208-3, paragraph 5.3, for shallow waters it is particularly important to pay attention to the acoustic ship length and the overall ship length for the purpose of proper data window length (DWL).

5.4.4 Source level calculations

Source level calculations should be done according to ISO/DIS 17208-3, paragraph 7. Other available methods summarized in Annex C are considered to be informative only.

5.5 Reporting of results

IACS recognizes that both Source Level (SL) and Radiated Noise Level (RNL) are standard metrics for end-reporting of levels for underwater noise.

RNL: The intended use of the radiated noise level is 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. It is also important for evaluating the actual impact on marine life by comparing radiated noise levels with established biological thresholds.

SL: The intended use of source level, with associated source depth, is to perform far-field sound predictions such as needed for environmental impact studies or for creating underwater sound contour maps. It could also be used to show compliance with contract requirements or criteria and for comparison of one ship to another ship.

Both are established metrics and considered to complement each other.

Logging of necessary parameters and storage of raw data should be encouraged to facilitate the future conversion of measurement results between SL and RNL for the end users' needs on demand.

5.5.1 Records required from vessel under test

5.5.1.1 General vessel information

In addition to the parameters under paragraph 9.1.3, the following parameters should be reported:

.1 Hull and propeller condition (clean, fouled, etc.); and

.2 Date of last dry dock.

5.5.1.2 General information / environmental conditions

Cite ISO/DIS 17208-3, paragraph 9.1.6c):

"c) Observed current direction & speed (kn)"

IACS recommendation:

Current direction & speed (kn) should be recorded.

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In addition to the parameters under paragraph 9.1.6, sound profile or Conductivity Temperature Depth (CTD) readings should be taken.

5.5.1.3 Additional information required during each run

In addition to the parameters under paragraph 9.1.7, the following should be reported:

The ship's speed through water (STW) should be logged.

Heading [degrees] and ship aspect (port/starboard) when passing the hydrophone(s) should be documented for each passage.

5.5.2 Records required from fixed range or deploying vessel

5.5.2.1 Data required post ranging

In addition to the parameters under paragraph 9.2.3, each set of results should be compared to the relevant background noise measurements, either pre or post recording.

The averaged values should be of appropriately grouped runs.

5.5.3 Special considerations

Special considerations should be noted in the report, e.g. cut-off frequencies in very shallow waters, sudden change in or unusual test conditions, marine traffic, in-situ field calibrations etc.