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Acoustics — Measurement of noise emitted by vessels on inland water-ways and harbours

Acoustique — Mesurage du bruit émis par les bateaux de navigation intérieure et portuaire

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2922 was drawn up by Technical Committee ISO/TC 43, *Acoustics*, and circulated to the Member Bodies in December 1972.

It has been approved by the Member Bodies of the following countries :

Australia	Germany	Romania
Austria	Hungary	South Africa, Rep. of
Belgium	India	Switzerland
Canada	Israel	Thailand
Czechoslovakia	Mexico	U.S.A.
Egypt, Arab Rep. of	Netherlands	U.S.S.R.
Finland	New Zealand	
France	Portugal	

The Member Body of the following country expressed disapproval of the document on technical grounds :

Sweden

Acoustics — Measurement of noise emitted by vessels on inland water-ways and harbours

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the conditions for obtaining reproducible and comparable measurements of the noise level and the noise spectrum emitted by vessels of all kinds on inland water-ways and harbours. This International Standard can also be applied to small sea-going vessels, harbour vessels and dredgers.

In the annex, specifications for intake or exhaust noise measurement and measurements with stationary vessels are given.

NOTES

1 The test procedures specified in this International Standard are engineering methods as defined in ISO 2204, *Acoustics — Guide to the measurement of airborne acoustical noise and evaluation of its effects on man*. Note, however, that frequency band analysis is only required for type tests.

2 Measurements may be made on sources emitting noise of an impulsive character with an impulse sound level meter (see clause 5).

2 REFERENCES

IEC Publication 179, *Precision sound level meters*.

IEC Publication 225, *Octave, half-octave and third-octave band filters intended for the analysis of sound and vibrations*.

3 NATURE OF TESTS

3.1 type tests : Measurements performed to prove that the vessel delivered by the manufacturer corresponds to noise specifications.

The conditions prescribed for each test shall be complied with as closely as possible, but if unavoidable variations have to be made, these must be stated in the test report.

3.2 monitoring tests : Measurements performed in order to check that the noise of the vessel is still within prescribed limits and that no noticeable changes have occurred since the acceptance on initial delivery or after modification, as applicable.

For monitoring tests, slight deviation from the test conditions specified for type tests may be tolerated in respect of the test site, the background noise, the distance between the microphone and the vessel, and the operating conditions.

Any variation shall be described in the test report.

4 MEASURED QUANTITIES

4.1 All readings of the sound level meter are to be taken with the dynamic characteristic "fast".

4.2 The values to be measured at all microphone positions in type and monitoring tests are A-weighted sound pressure levels L_A expressed in decibels (dB).

NOTE — If the weighting curve used is not otherwise stated, the measured values shall be expressed in dB (A).

4.3 For spectral analysis in type tests or for the determination of some special acoustical characteristics of vehicles, the values to be measured are octave band or 1/3 octave band sound pressure levels in decibels (dB).

5 MEASUREMENT EQUIPMENT

5.1 The sound level meter shall comply with IEC Publication 179.

5.2 If additional measuring equipment, including, for example, a tape recorder and/or level recorder is used, its overall electro-acoustic performance shall conform to the relevant clauses of IEC Publication 179.

5.3 For the measurement of noise spectra, the filters shall correspond to IEC Publication 225.

5.4 The overall acoustic performance of the measurement equipment shall be checked according to the instructions of the manufacturer, preferably with a standard sound source (for example pistonphone), at the beginning and at the end of each series of measurement.

At time-intervals no longer than 2 years, the sound level meter shall be calibrated for compliance with IEC Publication 179.

NOTES

1 A suitable wind-shield may be used to reduce the influence of wind on the reading.

2 If an impulse sound level meter in accordance with the amendment¹⁾ of IEC Publication 179 is available, it is recommended that, in addition, the values read with A-weighting and the "impulse" dynamic characteristics, symbol L_{AI} , be stated and that the values be expressed in decibels (dB), when measuring impulsive noises. The values shall be expressed in dB (AI) if the weighting curve and the "impulse" dynamic characteristics are not otherwise stated.

6 ACOUSTICAL ENVIRONMENT, METEOROLOGICAL CONDITIONS, BACKGROUND LEVEL

6.1 The test site shall be such that sufficient free sound propagation exists.

This condition may be considered as fulfilled if the surroundings of the microphone up to 100 m are free of large, sound-reflecting objects like barriers, hills, rocks, bridges or buildings.

In the vicinity of the microphone, there shall be no obstacles which could disturb the sound field. Therefore, no person shall be between the microphone and the noise source, and the observer shall be in such a position that influences on the reading of the meter are avoided.

The area between the vessel under test and the measuring microphone shall be open water or land surface as free as possible from sound-absorbing covering such as high grass or snow.

6.2 At wind velocities above 10 m/s, the sound propagation may be disturbed and measurements shall not be performed. Meteorological conditions with wind velocities below 5 m/s are to be preferred.

6.3 For type tests, the A-weighted sound level due to other noise sources (for example waves splashing on the measuring boat or ashore, other vessels, industrial or harbour plants) and due to wind shall be at least 10 dB below the A-weighted sound pressure level of the noise of the vessel.

If the noise is analysed, this difference shall be at least 10 dB in the required filter bands.

In the case of monitoring tests, the A-weighted sound pressure level of the background noise shall be at least 3 dB below the A-weighted sound pressure level of the reading obtained during the passage of the vessel. The reading shall then be corrected as follows :

Increase of the indication of the A-weighted sound pressure level obtained during the passage of the vessel	Correction to be applied to the reading of the A-weighted sound pressure level obtained during the passage of the vessel
dB	dB
≥ 10	0
6 to 9	- 1
4 to 5	- 2
3	- 3

7 TEST COURSE AND MEASUREMENT OF DISTANCE

7.1 At the test course, the depth of water must be sufficient for normal operation of the vessel.

7.2 During the test, the course of the vessel shall be as straight as possible at the distance from the microphone specified in clause 9.

Vessels being tested on inland water-ways shall run either against the stress or tide or in slack water.

7.3 The distance between the microphone and the side of the vessel shall be measured by optical means, for example by range finders or photographic techniques unless this distance is measured by running the vessel on a prescribed course past a microphone placed in a prescribed position. In this latter case, permanent test sites with appropriate direction markers are recommended.

8 OPERATING CONDITIONS FOR THE VESSEL DURING THE TEST

8.1 Distance from microphone

The test run shall start at a sufficient distance from the microphone to obtain stabilized engine conditions when the vessel passes the microphone.

8.2 Loading condition

The loading condition of the ship shall be stated in the test report.

8.3 Main engines

During type tests, the main engines shall run at at least 95 % of their rated speed.

8.4 Controllable-pitch and Voith-Schneider propellers — if any

In full power position.

1) In preparation.

8.5 Auxiliary engines

All auxiliary engines necessary for continuous service shall run at their normal speed.

8.6 Doors and windows

During type tests, measurements shall first be performed with windows and doors of the engine rooms shut; the sound pressure level with the windows and doors of the engine rooms open shall be stated separately.

During monitoring tests, the ship shall run under normal driving conditions. Windows and doors of the engine rooms shall be open if this is usual during normal operating.

9 MICROPHONE POSITION

The microphone shall be placed on a boat, on a pier or on the bank, at a height between 1,2 and 1,5 m above the mounting surface and preferably at a height not less than 3 m but not more than 6 m above the water surface. The microphone shall be directed perpendicularly to the course of the vessel under test.

When the vessel passes the microphone, the distance between the side of the vessel and microphone should preferably be 25 m.

NOTE — The highest indication of the sound level meter may occur after the passage of the vessel when the distance is larger than 25 m, depending on the directivity of noise radiation.

If during the passage of the vessel the distance between the microphone and the vessel deviates from the reference distance of 25 m, the results shall be corrected according to 10.3; however, distances of more than 35 m and less than 20 m shall be avoided if possible, especially for type tests.

10 TEST PROCEDURE

10.1 The maximum A-weighted sound pressure level indicated during the passage of the vessel shall be retained. Any peak which is obviously out of character with the general sound pressure level being read shall be ignored.

10.2 For type tests, at least two passages shall be made and the mean value of the measurements rounded to the nearest integral decibel.

If the sound radiation of the vessel is obviously asymmetrical with respect to the longitudinal axis of the vessel, then measurement shall be performed at the side with the higher sound pressure level.

NOTE — Generally, the spread between the results of measurements made during the two passages shall not be larger than 3 dB. Otherwise, a new series of measurements shall be made.

For monitoring purposes, it is sufficient to perform one measurement.

10.3 If the distance d between the microphone and the side of the vessel deviates from the reference value of 25 m during the passage, the A-weighted sound pressure level $L_{A,d}$ measured at a distance d shall be corrected according to the following relation to obtain the A-weighted sound pressure level $L_{A,25}$ for the reference distance 25 m :

$$L_{A,25} = L_{A,d} + 20 \log \frac{d}{25} = L_{A,d} + \Delta L$$

($L_{A,25}$, $L_{A,d}$ and ΔL in decibels, d in metres)

TABLE — Values of ΔL corresponding to rounded values of d

Distance d , m	20	22	25	28	32	35
ΔL , dB	-2	-1	0	1	2	3

10.4 The presence of easily audible pure tones or noise of a distinctly impulsive character shall be stated in the test report.

11 TEST REPORT

The test report shall include a reference to this International Standard and all relevant details concerning :

11.1 The nature of the tests.

11.2 The test site, water conditions, meteorological conditions, for example temperature, barometric pressure and wind velocity, if relevant.

11.3 The measurement equipment.

11.4 The background noise level.

11.5 The vessel, its main engines, the engine and shaft speeds during the test, and the setting of controllable-pitch or Voith-Schneider propellers.

11.6 The auxiliary engines and equipment and their operating conditions.

11.7 The loading of the vessel.

11.8 The microphone position.

11.9 The A-weighted sound pressure levels $L_{A,d}$ and $L_{A,25}$ and, if necessary, the noise spectrum.

11.10 The presence of pure tones or noise of an impulsive character.

11.11 Position open or shut of windows and doors of the engine room.

ANNEX

ADDITIONAL TESTS

A.1 MEASUREMENT ON STATIONARY VESSELS

For noise measurements outside vessels at anchor or on special vessels, for example dredgers, salvage ships, diving ships, it is recommended that the microphone be placed 25 m from the side at several points around the vessel. The engines on board the vessel under test shall run at their normal speed when the vessel is at anchor or is working.

A.2 INTAKE OR EXHAUST NOISE MEASUREMENT

When measuring the sound power levels at the intake and exhaust of the engine or the air-conditioning and cooling system, it is recommended that the microphone be placed outside the gas stream at a distance of 1 m from the edge of the intake or exhaust opening at an angle of 30° to the direction of the gas stream (see the figure) and as far as possible from reflecting surfaces.

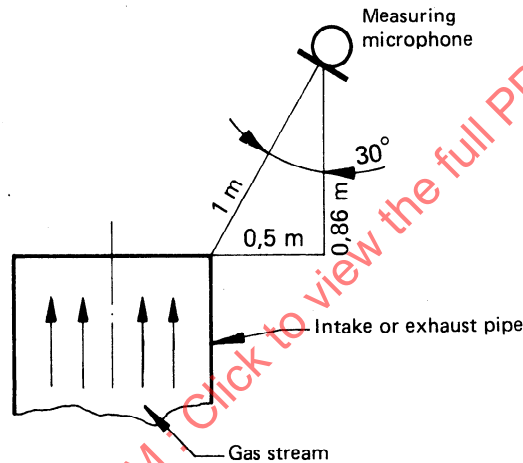


FIGURE – Positioning of the measuring microphone at the intake or exhaust apertures