INTERNATIONAL STANDARD

ISO 9875

Third edition
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Ships and marine technology — Marine echo-sounding equipment

Navires et technologie maritime — Appareils de sondage par écho

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 9875 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 6, *Navigation*.

This third edition cancels and replaces the second edition (ISO 9875:1996), which has been technically revised.

Annex A forms a normative part of ISO 9875. Annex B is for information only.

Ships and marine technology — Marine echo-sounding equipment

1 Scope

This International Standard specifies the minimum operational and performance requirements, methods of testing and test results of marine echo-sounding equipment required to comply with the performance standards adopted by the IMO Resolution A.224(VII). In addition, it takes account of IMO Resolution A.694(17) and is associated with IEC 60945.

When a requirement in this International Standard is different from IEC 60945, the requirement in this International Standard takes precedence.

The purpose of echo-sounding equipment is to provide reliable information on the depth of water under a ship to aid navigation in particular in shallow water.

This International Standard is *applicable for ship speeds from 0 kn to 30 kn.*

Any text in this International Standard with wording identical to that in the IMO Resolution A.224(VII) and IMO Res. A.694(17) is printed in italics.

NOTE Resolution A.224(VII) represents Resolution A.224(VII) as amended by Resolution MSC.74(69), annex 4.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

IEC 60945:1996, *Maritime navigation and radiocommunication equipment and systems — General requirements, methods of testing and required test results.*

IEC 61162, *Maritime navigation and radiocommunication equipment and systems — Digital interfaces*.

IMO Resolution A.224(VII), *Performance standards for echo-sounding equipment*.

IMO Resolution A.694(17), *General requirements for shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) and for electronic navigational aids*.

International Convention of Safety of Life at Sea (SOLAS) Chapter V, Regulation 12, Shipborne navigational equipment.

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
source level
S
maximum root mean square (r.m.s) sound pressure level at a point on the principal axis of the transducer, as measured in the far field but referred to the distance of 1 m

NOTE This value is expressed in decibels.

3.2
receiving directivity index
D
ratio of the acoustic power density at a distant point on the principal axis of the transducer, when used as a transmitter, to that of an omnidirectional transducer, with the same total radiated acoustic power

NOTE This value is expressed in decibels.

3.3
receiving bandwidth
B
bandwidth at which the response of the overall system, measured through water, is 3 dB below the maximum response of the system

$B = 10 \lg(f_1 - f_2)$

where f_1 and f_2 are respectively the upper and lower frequencies expressed in hertz

NOTE This value is expressed in decibels.

3.4
minimum detectable signal-to-noise ratio
E

ratio of the signal level, expressed in decibels, to the background noise level, expressed in decibels, in the bandwidth of the receiver required to give a minimum detectable signal on the display

3.5
speed of sound in water
1 500 m/s in the context of this International Standard

3.6
transducer
substance or device, such as a piezoelectric element, that converts an input electrical energy into an acoustic energy and vice versa, installed on the ship's hull and exposed to the sea water

3.7
performance test
test to confirm full compliance with the requirements of the equipment standard

3.8
performance check
short test to confirm compliance with the essential requirements specified in the equipment standards

NOTE In this International Standard, a performance check means non-quantitative visual check that the system is still operative for the purpose of IEC 60945.

3.9
inspection
visual check of the equipment or documentation

3.10
pre-conditioning
treatment of a specimen with the objective of removing or partly counteracting the effects of its previous history

4 Abbreviated terms

For the purposes of this International Standard, the following abbreviated terms apply.

DPT depth

ECDIS electronic chart display and information system

EMC electromagnetic compatibility

EUT equipment under test

VDR voyage data recorder

5 Performance requirements

5.1 General

Echo-sounding equipment shall comply with the following performance requirements and with the general requirements of IEC 60945, where applicable.

5.2 Functionality

5.2.1 Range performance

Under normal propagation and sea bed reflectibility conditions, the equipment shall *be capable of measuring any clearance under the transducer between 2 m and 200 m.*

5.2.2 Range scales

5.2.2.1 *The equipment* shall *provide a minimum of two range scales one of which, the shallow range,* shall *cover a range of 20 m, and the other, the deep range, shall cover a range of 200 m.*

5.2.2.2 Where an automatic range is provided, a device to select these ranges manually shall be available to override the automatic range.

5.2.2.3 Where phased ranges, not starting from zero, are available, an indication shall be provided to show that such a range is in use.

5.2.2.4 Positive indication of the range in use shall be provided in all cases.

5.2.2.5 Where depth measurement relative to the sea surface is provided, in addition to measurement of the depth of water under the ship, there shall be a positive indication of an offset (draught) value.

5.2.3 Main display

5.2.3.1 *The primary presentation* shall *be a suitable graphical display which provides the immediate depth and a visible record of soundings*.

5.2.3.2 *The displayed record* shall *show at least 15 minutes of soundings* on the deep range scale.

5.2.3.3 Multi-colour display may be used. In this case, the colour assignment shall be clearly explained in the manual.

5.2.4 Other displays

Other forms of display may be added, but these shall *not affect the normal operation of the main display.*

5.2.5 Pulse repetition rate

The pulse repetition rate shall *not be slower than 12 pulses per minute on the deep range and 36 pulses per minute on the shallow range.*

5.2.6 Roll and pitch

The performance of the equipment shall *be such that it will meet the requirements of* this International Standard *when the ship is rolling ±10° and/or pitching ±5°.*

5.3 Multiple installation

5.3.1 *More than one transducer and associated transmitter-receiver may be fitted*.

5.3.2 If more than one transducer is used:

— *means* shall *be available to display the depths from the different transducers separately; and*

— *a clear indication of the transducer(s) in use* shall *be provided.*

5.4 Data storage

It shall *be possible to record on paper recording or other means the information about:*

— *the depth(s), and*

— *the associated time for 12 hours*.

There shall *be means to retrieve the recorded information.* The information may be recorded and retrieved in the form of graphics or digital readouts at intervals of 1 min.

5.5 Accuracy

5.5.1 Accuracy of measurement

Based on a sound speed in water of 1 500 m/s, the tolerance of the indicated depth shall *be either:*

— *±0,5 m on the* shallow *range scale, respectively ±5 m on the* deep range *scale; or*

— *±2,5 % of the indicated depth,*

whichever is the greater.

NOTE These tolerances take no account of the ship's roll and pitch.

5.5.2 Discrimination

The scale of display shall *not be smaller than 5,0 mm per metre depth on the shallow range scale and 0,5 mm per metre depth on the deep range scale.*

5.6 Malfunctions, alarms and indications

5.6.1 Depth alarm

An alarm signal — both visual and audible with mute function — shall *be provided when the water depth is below a pre-set value.* If the pre-set alarm depth is not referenced to the transducer position, there shall be an indication of the reference position.

5.6.2 Failure or reduction in power supply

Alarm signals, both visual and audible (with mute function) to the navigator on the watch, shall *be provided to indicate failure or a reduction in the power supply to the echo sounder which would affect the safe operation of the equipment.* This facility may be integrated into a switchboard or elsewhere; it need not necessarily be an integral part of the equipment.

5.7 Ergonomic criteria

5.7.1 Operational controls

The function of range scale selection shall *be directly accessible*. Other functions shall be directly accessible and immediately effected by dedicated controls or primary access in an associated menu.

The settings for the following functions shall *be recognizable in all light conditions:*

— *range scale; and*

— *preset depth alarm.*

5.7.2 Presentation of information

5.7.2.1 Marks

The graphical display shall *be capable of showing:*

— *depth marks at intervals not larger than one-tenth of the range/scale in use; and*

— *time marks at intervals not exceeding 5 min.*

5.7.2.2 Paper recording

If paper is used for recording either by marks on the recording paper or by other means, there shall *be a clear indication when the paper remaining is less than 1 m.*

5.8 Design and installation

The equipment shall *comply with IMO resolution A.694(17).*

5.9 Interfacing

Output(s) shall *be available from which depth information may be supplied to other equipment such as remote digital displays, voyage data recorder and a track control system.*

These outputs shall include depth under keel, the depth scale currently being displayed, the transducer in use in multiple installations and other status information where available.

These outputs shall *be digital, serial communication, facilities which* shall *comply with the relevant International Standards* (IEC 61162).

5.10 Safety precautions

In the case of equipment using a high voltage electrosensitive recording medium and/or a moving writing mechanism, and where access to the record is possible while the echo-sounding equipment is operating, the equipment shall provide for operator safety.

5.11 Marking

The equipment shall be provided with an indication of the manufacturer, type and serial number.

Each unit of equipment normally to be installed in the vicinity of a standard compass or a magnetic steering compass shall *be clearly marked with the safe distance at which it may be mounted from such compasses.*

5.12 Information

Information shall be provided to enable competent members of a ship's crew to operate and maintain the equipment efficiently.

6 Methods of testing and required test results

6.1 General

Any requirement in clause 5 for which no test is specified in this clause or in IEC 60945, shall be checked by inspection of the equipment, the manufacturer's drawing or the relevant documents. The results of the inspection shall be stated in the test report.

6.2 General conditions of measurement

All the general requirements of IEC 60945 shall be carried out before tests to verify whether the Equipment Under Test (EUT) meets these technical requirements. The equipment shall comply with those requirements of IEC 60945 appropriate to its category, that is "protected" (from the weather), "exposed" (to the weather), or "submerged" (in continuous contact with sea water).

The manufacturer shall declare which equipment or units are "protected", "exposed" or "submerged". The manufacturer shall declare the "pre-conditioning" required before environmental checks.

Where pre-conditioning is called for, it is the first process in the test procedure. It may be effected by subjecting the specimen to climatic, electrical, or any other conditions required by the relevant specification in order that the properties of the specimen may be stabilized before measurements and test.

6.3 General underwater test conditions

The equipment transducer in its housing, complete with acoustic window if provided, shall be attached underwater to a clamp calibrated in degrees to enable the transducer to be rotated to any required angle about the major axis of the face of its element (that is about the longer axis, which will run parallel to the ship fore-and-aft line) and about the minor axis (the athwartships axis) where the element is rectangular or elliptical, or about any facial axis where the element is circular.

A calibrated hydrophone, which can be replaced by a calibrated projector (or, alternatively, a single instrument capable of being used in either role as required) shall be mounted under the water at a suitable known distance, d, from the transducer and directed towards it. Initially, the transducer shall be directed towards the calibrated hydrophone.

NOTE See [5], [6] and [7] in the bibliography for details.

In order to minimize near-field effects, distance d, in metres, shall not be less than

$$1{,}25a^2 f/c$$

where

- a is the largest active dimension of the transducer element, in metres, appropriate to the mode of use, that is transmission or reception (usually the same figure for either);
- f is the highest operation frequency of the echo-sounding equipment, in hertz;
- c is the speed of sound in water, equal to 1 500 m/s (see 3.5).

Precautions shall be taken to minimize the effects of reverberation in the water. These precautions shall include the use of gated pulse measurement techniques. These techniques are essential in the case of some echo-sounding equipment receivers that operate in a non-linear mode.

6.4 Functionality

6.4.1 Range performance

6.4.1.1 Minimum depth test method

The transducer in its housing, complete with an acoustic window if provided, shall be immersed in water with its axis of maximum response directed towards a test target such as the bottom or side of the tank holding the water. It shall be possible to adjust the physical distance between the transducer and the target.

The test shall be conducted such that no other object or discontinuity shall be capable of affecting the result significantly.

The equipment shall be set to the shallow scale with the longest pulse length available on that scale, and the physical distance between the transducer and the test target shall be adjusted until the echo from the target is displayed separately and distinctly. This physical distance shall be measured and noted as the minimum depth indication.

6.4.1.2 Result required

The minimum depth shall not be greater than 2 m.

6.4.1.3 Maximum required measurable depth detection using the figure of merit system

The equipment shall be tested by the assessment, under laboratory conditions, of the system figure of merit for a water depth of 200 m.

The figure of merit, L', expressed in decibels, is defined as

$$L' = S - 2r + D - B - E \quad (1)$$

and shall exceed L_0 as indicated by the following relationship:

$$L_0 = L + 2\alpha R + K + N + x + y + z \quad (2)$$

