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N-08

SOUNDER

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Foreword:

This Guide is a part of CCS Rules, which contains technical requirements, inspection and testing criteria related to classification and statutory survey of marine products.

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Comments or suggestions can be sent by email to ps@ccs.org.cn .

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Main changes and effective date:

Two modifications on Normative references. ISO 9875:2000 is updated to ISO 9875:2000 and Technical Corrigendum 1:2006; IEC 60945:2002 is updated to IEC 60945:2002 and Corrigendum 1:2008

Editing modification

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SOUNDER

1 Application

1.1 This guideline is applicable to the echo sounders on sea-going ships (including high speed ships).

1.2 The performance standards specified in this guideline are applicable to the ships having a navigation speed of 0~30kn.

1.3 The echo sounder is used to provide reliable navigational information of the water depth below the ship, especially in shallow waters.

2 Normative references

2.1 The reference documents for approval and inspection used in this guideline are as follows:

2.1.1 Amendment to Resolution A.224 (VII), Annex 4 of IMO MSC.74 (69) –“Performance Standards for Echo-sounding Equipment”;

2.1.2 IMO A.694(17) General Requirements for Ship-borne Radio Communication Equipment and Electronic Navigational Aids Forming Part of the Global Maritime Distress and Safety System (Distress and Safety System);

2.1.3 IMO MSC/Circ.982 Guidelines on Ergonomic Criteria for Bridge Equipment and Layout;

2.1.4 IMO A.1021(26) Code for Alerts and Indicators;

2.1.5 ISO 9875:2000 and Technical Corrigendum 1:2006 Ships and Marine Technology – Marine Echo-sounding Equipment;

2.1.6 IEC 60945:2002 and Corrigendum 1:2008 Maritime Navigation and Radio Communication Equipment and Systems-Methods of Testing and Required Test Results;

2.1.7 IEC 61162 Maritime Navigation and Radio Communication Equipment and Systems –Digital interfaces.

3 Terms and definitions

3.1 In this guideline, the sound velocity in water is set at1500m/s.

3.2 For the purpose of this guideline, the terms and definitions are as follows:

3.2.1 Receiving band width: a frequency band width at which the system’s output response is to be 3dB lower than its maximum response, expressed in decibels (dB). Receiving band width is calculated with the formula below:

$$B = 10 \lg (f1-f2)$$

Where, f1 and f2 respectively denote the upper limit frequency and lower limit frequency at a response drop of 3dB, expressed in hertz (Hz).

3.2.2 Receiver sensitivity: the minimum intensity of the signal that the receiver is able to receive while operating properly, expressed in decibels (dB).

3.2.3 Pulse width: the duration of impulse level, expressed in millisecond (ms).

3.2.4 Pulse repetition rate: times of pulse emission per minute, expressed in pulses per minute (pulses/min).

4 Drawings and documentation to be submitted

4.1 The following drawings and documentation to be submitted are to be submitted to CCS for approval:

4.1.1 Product technical specifications;

4.1.2 Overall external structure plan (including panel and back plate arrangement plan);

4.1.3 Diagram of main parts such as junction box, transducer, etc.;

4.1.4 Electrical circuit diagram;

4.1.5 Electrical system connection diagram;

4.1.6 Manufacturer test program;

4.1.7 Prototype test plan.

4.2 The following drawings and documentation to be submitted are to be submitted to CCS for review:

4.2.1 Operation manual (including description of failure treatment);

4.2.2 External wiring diagram;

4.2.3 List of devices and parts;

4.2.4 Key production process;

4.2.5 Product identification or nameplate.

5 Design objectives

5.1 System components

An echo sounder consists of operation controller, display unit, recorder, emission system, receiving system, transducer, etc. The operation controller, display unit, recorder, emission system and receiving system are normally integrated as a main sounder unit.

5.2 Structural design

5.2.1 The equipment is to be capable of operating properly under the vibration, shock, humidity and temperature conditions created during normal ship operation.

5.2.2 The equipment is to be so designed that inadvertent use of the operation controller will not cause damage to the equipment or personnel.

5.2.3 The quantity, design, function type, position, arrangement and sizing of operation controllers are to follow a simple, fast and effective principle. The operation controllers are to be so arranged as to minimize the possibility of inadvertent operation.

5.2.4 The action of the operation controller in the forward, upward or clockwise directions is to switch on the equipment or component or increase the quantity.

5.2.5 Operation controllers and display units are to be provided with adjustable illuminating

appliances, which have such a range of light adjusting control as to ensure the display unit is clearly visible under all environmental illumination conditions. The illumination of equipment is to be capable of being adjusted to zero continuously or by multiple stages.

5.2.6 Means of setting zero depth, if provided to the equipment, are to be designed as a calibrating and adjusting device instead of an operating and controlling knob.

5.2.7 If the equipment has heat radiation components such as ventilation port, shutter, etc., protective screens are to be installed.

5.2.8 When the instantaneous value of the combined DC and AC voltage (except radio-frequency voltage) in the circuit exceeds 50V, protections are to be provided in the locations where contact with human body is likely to occur and warning signs are to be posted at easily visible locations.

5.2.9 All exposed metal parts of the equipment, including the metal knob of the control device, are to be earthed but such earthing is not to cause any end of the AC power to be earthed. The enclosure is to be fitted with a dedicated and identified earthing post.

5.2.10 The level of mechanical noise of the equipment installed in the bridge, chart room and other noise sensitive areas is not to exceed 60dB(A).

5.3 Power supply to system

5.3.1 The equipment is to be capable of operating reliably under the power fluctuation conditions specified below: when AC power supply is used, the steady-state voltage is +6% ~ -10% of the rated value, and the frequency is $\pm 5\%$ of the rated value; the transient voltage is $\pm 20\%$ of the rated value with recovery time of 1.5s, and the frequency is $\pm 10\%$ of the rated value with recovery time of 5s. When the storage battery power supply is used, for the equipment wired to the storage battery being charged, the voltage is to be +30% ~ -25% of the rated value; for the equipment not wired to the storage battery being charged, the voltage is to be +20% ~ -25%. Where the equipment cannot operate within the above power fluctuation range, voltage stabilizing devices are to be used.

5.3.2 The equipment is to be provided with protections against over current, over voltage, power transient and accidental reversion of current polarity.

5.3.3 Indication is to be available when the equipment is energized.

5.4 Technical parameters

The equipment technical specifications are generally to cover the following technical parameters:

5.4.1 Consumed power, in watt (W) or volt-ampere (VA).

5.4.2 Emitted signal frequency, in kilohertz (kHz).

5.4.3 Emitted pulse width, in millisecond(ms).

5.4.4 Emission power, in watt (W).

5.4.5 Receiving band width, in decibel (dB).

5.4.6 Receiver sensitivity, in decibel (dB).

5.5 Functional requirements

5.5.1 Depth range

The minimum and maximum measurable depth of the equipment is to be specified in the technical specifications. The equipment is to be capable of measuring any water depth 2m~200m below the sensor under normal transmission and seabed reflection conditions.

5.5.2 Measuring range scale

- (1) The equipment is to provide at least two measuring ranges/scales, one with a measuring range of 20m for use in shallow waters and the other with a measuring range of 200m for use in deep waters.
- (2) When an automatic range is provided, the switchover of manual range is to prevail over automatic range.
- (3) If the equipment is provided with range phasing, when the phasing range, which does not start from zero, is used, the range being used is to be indicated.
- (4) When the equipment is operating, the range being currently used is to be expressly indicated.
- (5) The measuring depth is normally calculated from the face of the transducer mounted on ship bottom. When the measuring depth needs to be calculated from the water surface, means to indicate the draft depth of the transducer are also to be provided in addition to measurement of the depth beneath the ship.

5.5.3 Display

- (1) The main display is to be an appropriate graphic display and be capable of providing direct water depth and visible sound wave records. The displayed records are to show at least the measured depth of 15min.
- (2) When colored display is employed, the color configuration is to be indicated in the user's manual.
- (3) Display in other forms may be added, which, however, is not to affect the normal operation of the main display.

5.5.4 Pulse repetition rate

The pulse repetition rate is not to be lower than 12 pulses per minute in deep waters and not lower than 36 pulses per minute in shallow waters.

5.5.5 Rolling and pitching

The performance of the equipment is to meet the requirements of these performance standards when the ship is rolling at $\pm 10^\circ$ and/or pitching at $\pm 5^\circ$.

5.5.6 Multiple sets of equipment

- (1) More than one set of transducer and related emission receiver may be installed.
- (2) If more than one set of transducer is used, means are to be provided to indicate the water depth of different transducers respectively and clearly indicate the transducer and indicator being used.

5.5.7 Data storage

The equipment is to record the depth data measured in the latest 12 hours and the corresponding times of measurement by paper or by other recording means and is to be capable of playing back

the recorded data. Data may be recorded or played back in the form of graph or digit at an interval of at least one minute.

5.5.8 Measuring accuracy

- (1) Based on a sound wave velocity in water of 1500m/s, the error of the indicated depth is to be:

—— ± 0.5 m for 20m measuring range, and similarly, ± 5 m for 200m measuring range; or

—— $\pm 2.5\%$ of the indicated water depth,

whichever is greater.

Indication error does not consider the ship's rolling and pitching.

- (2) The equipment is to be provided with means of preventing interference so as to suppress false readings caused by the reflective bodies in water (e.g. fish, organic matter, residues, etc.).

5.5.9 Resolution

The corresponding measuring range of the display scale is to be not less than 5.0mm per meter in shallow waters, and not less than 0.5mm per meter in deep waters.

5.5.10 Alarm indication

- (1) Visual and audible alarms are to be given when the water depth is less than the preset alarm depth. If the preset alarm depth is not positioned on the face of the transducer, the reference position is to be indicated.
- (2) Audible and visual alarms are to be given to the watch officer when power fails or decreases to a level which affects safe operation of the equipment. This alarm function may be incorporated in any other alarm panel and is not necessarily to form part of the sounding equipment.
- (3) The two kinds of alarms mentioned above are to have sound silencing function, and the sound pressure level of these alarms, at a location 1m away from the sound source, under normal operating conditions, is to be at least 75dB(A) but not to exceed 85dB(A). The audible alarm signal frequency is to be within the range between 200Hz and 2500Hz, preferably between 500Hz and 1500Hz.

5.5.11 Operational control

- (1) The range selection function is to be directly operated and other operational functions are to be selected from relevant operation menu.
- (2) The settings of the following functions are to be identifiable under all illumination conditions:
- Range scale, and
- Preset alarm depth.

5.5.12 Information display

Graphic display is to be capable of indicating:

——Depth marking at an interval not larger than 1/10 of the range scale being used; and

—Time marking at an interval not exceeding 5min.

5.5.13 Paper recording

If the paper is used to record data, express indication is to be available when the remaining paper is less than 1m, either by means of marking on the recording paper or by other means.

5.5.14 Interface

- (1) The equipment is to be capable of providing the water depth information to other equipment, such as remote digital display, voyage data recorder and course trajectory control system.
- (2) The output parameters of the interface are to include depth, measuring range being used, transducer being used (when multiple transducers are provided) and other status information.
- (3) The outputs are to be contiguous digital communication and comply with relevant international standard (IEC 61162).

5.6 Marks and identification

5.6.1 The equipment is to be identified with legible marks of the following:

- (1) Name or logo of the manufacturer;
- (2) Equipment type;
- (3) Equipment code or serial number.

5.6.2 For equipment normally installed in the locations adjacent to standard magnetic compass or steering magnetic compass, the minimum safe distance from such compasses is to be expressly identified.

5.7 Maintenance

5.7.1 The equipment is to be so manufactured and installed as to facilitate inspection and maintenance.

5.7.2 Adequate data is to be provided to allow for proper operation and maintenance of the equipment, including:

- (1) Detailed circuit diagrams, elements arrangement plan and elements list are to be provided if the failure identification and repair of the equipment is based on such elements;
- (2) Adequate data is to be provided to allow for determination, identification and replacement of the malfunctioning modules if the equipment is modularized, rendering the failure identification and repair based on elements impractical.

6 Type test

6.1 Environmental conditions for type test

The test location is to be maintained within the following atmospheric condition ranges:

- 6.1.1 Ambient temperature: 15 °C~35 °C;
- 6.1.2 Relative humidity: 30%RH~90%RH;
- 6.1.3 Atmospheric pressure: 86~106 kPa.

6.2 Selection of typical test specimens

6.2.1 The test specimens used for prototype test are to be sampled from the manufacturer’s qualified products by CCS surveyor.

6.2.2 At least one set (may be increased as required for the test) of the product ready for delivery, including all system components and all software installed, is to be selected as the test specimen.

6.3 Testing organization

6.3.1 For initial type approval, the organization undertaking the test is to be an appropriate testing organization holding the corresponding CCS Approval Certificate for Product Inspection and Testing Organizations.

6.3.2 For renewal of type approval certificate, upon the approval of CCS, the option of conducting prototype test in the manufacturer’s lab under the witness of CCS surveyor may be considered, provided that the equipment manufacturer has the test environment and equipment specified by relevant standard and has competent inspection and testing personnel.

6.4 Prototype test items

6.4.1 The equipment is to be type tested in accordance with Table 6.4.1.

6.4.2 For various test methods and standards quoted in this section, other equivalent standards or standards acceptable to CCS may be employed where appropriate.

Table 6.4.1

No.	Test item	Technical requirements	Test methods
I	General tests		
1	Inspection of appearance, structure and marking	5.2, 5.3.3. and 5.6 of the Guideline	Visual inspection. The results of inspection of appearance, structure and marking are to comply with approved drawings; the assembly and wiring process is to comply with the manufacturer’s process documents.
II	Power test		
1	Maximum steady-state power fluctuation	IEC60945 5.2.2	IEC60945 7.1
2	Power anomaly	IEC60945 4.3.2, 5.2.3	IEC60945 7.2
3	Instantaneous power fluctuation	IEC60945 4.3.3, 10.7	IEC60945 7.3, 10.7
4	Power failure	IEC60945 4.3.3, 10.8	IEC60945 7.4, 10.8

Continued Table 6.4.1

No.	Test item	Technical requirements	Test methods
III	Environmental conditions test		
1	Dry heat test	IEC60945 8.2	IEC60945 8.2
2	Humid heat test	IEC60945 8.3	IEC60945 8.3
3	Low temperature test	IEC60945 8.4	IEC60945 8.4
4	Vibration test	IEC60945 8.7	IEC60945 8.7
5	Water immersion (transducer) test	IEC60945 8.9.1	IEC60945 8.9.1
6	Salt fog (corrosion) test	IEC60945 8.12	IEC60945 8.12
7	High voltage test (Suitable for power supply unit / part)	2.14 of CCS <Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version)	2.14 of CCS <Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version)
8	Insulation resistance measurement (Suitable for power supply unit / part)	2.3 of CCS <Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version)	2.3 of CCS <Guidelines for Type Approval Test of Electric and Electronic Products> (current valid version)
9	Test of degree of protection provided by enclosure	Table 1.3.2.2, Chapter 1, PART Four of the Rules for Classification of Sea-going Steel Ships (2012)	IEC60529
VI	Electromagnetic compatibility test		
1	Conducted emission	IEC60945 9.2	IEC60945 9.2
2	Shell port radiated emission	IEC60945 9.3	IEC60945 9.3
3	Immunity to conducted disturbances, induced by radio-frequency field	IEC60945 10.3	IEC60945 10.3

Continued Table 6.4.1

No.	Test item	Technical requirements	Test methods
4	Radiated, radio-frequency electromagnetic field immunity	IEC60945 10.4	IEC60945 10.4
5	Electric fast transient/burst immunity	IEC60945 10.5	IEC60945 10.5
No.	Test item	Technical requirements	Test methods
6	Surge (shock) immunity	IEC60945 10.6	IEC60945 10.6
7	Electrostatic discharge immunity	IEC60945 10.9	IEC60945 10.9
V	Special test		
1	Noise and audible signals	5.5.10 of the Guideline, IEC60945 11.1	IEC60945 11.1
2	Magnetic compass safe distance	IEC60945 11.2	IEC60945 11.2
No.	Test item	Technical requirements	Test methods
VI	Personal safety test		
1	Prevention of contact with dangerous voltage	IEC60945 12.1	IEC60945 12.1
2	Radio-frequency electromagnetic radiation	IEC60945 12.2	IEC60945 12.2
3	Emission of visual display unit (VDU)	IEC60945 12.3	IEC60945 12.3
4	X-ray radiation	IEC60945 12.4	IEC60945 12.4
VII	Performance test (technical parameters verification test)		
1	Consumed power	Technical specifications are to be met. See 5.4 of the Guideline.	Measure the voltage and current of the electrical circuit using voltage meters in parallel and current meters in series. Calculate the power using formula $P=UI$.

Continued Table 6.4.1

No.	Test item	Technical requirements	Test methods
2	Emitted signal frequency	Technical specifications are to be met. See 5.4 of the Guideline and ISO 9875 6.4.3.2.2.	<p>ISO 9875 6.4.3.2.1</p> <p>Measure the carrier frequency of the signal emitting source using digital oscilloscope or other instruments capable of measuring frequency.</p> <p>The emitted signal frequency is to be measured upon completion of the tests required by IEC60945.</p>
3	Emitted pulse width	Technical specifications are to be met. See 5.4 of the Guideline.	Measure the emitted pulse width using digital oscilloscope or time interval measuring instrument.
4	Emission power	Technical specifications are to be met. See 5.4 of the Guideline and ISO 9875 6.4.3.2.2.	<p>ISO 9875 6.4.3.2.1, 6.4.3.4.1</p> <p>During measurement, the emitter output end is to be loaded equivalent to the transducer load. The emitter and the transducer are to be parallel-tuned.</p> <p>Measure the effective value (root mean square) of the voltage output by the emitter and calculate the emission power using formula $P=U^2/R$.</p> <p>The emission power is to be measured upon completion of the tests required by IEC60945.</p>
No.	Test item	Technical requirements	Test methods
5	Receiving band width	Technical specifications are to be met. See 5.4 of the Guideline.	ISO 9875 6.4.1.4.4

Continued Table 6.4.1

No.	Test item	Technical requirements	Test methods
6	Receiver sensitivity	Technical specifications are to be met. See 5.4 of the Guideline.	ISO 9875 6.4.2 The simulated receiving test is to be carried out after the tests required by IEC60945 with reference to the test method specified in ISO 9875 6.4.3.3.1.
VIII	Functional test		
1	Depth range	Technical specifications are to be met. See 5.5.1 of the Guideline and ISO 9875 6.4.1.2 and 6.4.1.3.	ISO 9875 6.4.1.1, 6.4.1.4 The minimum measurable depth may be tested and measured in test pool; the maximum measurable depth is normally determined through optimum value calculation during type approval. Refer to ISO 9875 6.4.1.3 for the methods of optimum value calculation.
2	Range scale	See 5.5.2 of the Guideline.	Visual inspection
3	Display	See 5.5.3 of the Guideline.	Visual inspection and review of user's manual.
4	Pulse repetition rate	See 5.5.4 of the Guideline.	ISO 9875 6.4.7.1
5	Inclining and swaying	See 5.5.5 of the Guideline and ISO 9875 5.2.6.	ISO 9875 6.4.8
6	Multiple sets of equipment	See 5.5.6 of the Guideline.	Visual inspection
7	Data storage	See 5.5.7 of the Guideline.	ISO 9875 6.6.1
8	Measuring accuracy	See 5.5.8 of the Guideline.	ISO 9875 6.7.1
9	Resolution	See 5.5.9 of the Guideline.	Visual inspection

Continued Table 6.4.1

No.	Test item	Technical requirements	Test methods
10	Alarm indication	See 5.5.10 of the Guideline.	Alarm items and silencing function are to be visually inspected. Measurement of sound pressure level and sound frequency: place the sound pressure meter transducer, which has been set to zero, in a position 1m straight forward of the sounding equipment, inside a laboratory where the ambient noise is of a relatively lower sound pressure level and relatively stable. The measured sound pressure level and the sound frequency within 1/3 frequency band adjacent to the base band are to meet the requirements.
11	Operational control	See 5.5.11 of the Guideline.	Visual inspection
12	Information display	See 5.5.12 of the Guideline.	Visual inspection
13	Insufficient paper (applicable to paper recording)	See 5.5.13 of the Guideline.	Visual inspection
14	Interface	See 5.5.14 of the Guideline.	Simulate the signals output by the receiving sound meter using computer or other receiving equipment. Output interface is to meet the requirements of IEC61162.

7 Unit/path inspection

7.1 After the CCS type approval certificate has been obtained, unit/path inspection of each batch of products is to be carried out at the premise of the manufacturer.

7.2 Random sampling method may be employed for unit/path inspection at a sampling ratio not less than 10% and at least two sets are to be sampled. The following test items are to be conducted:

7.2.1 Inspection of appearance, structure and marking;

7.2.2 Power test;

7.2.3 Electric strength test;

7.2.4 Insulation resistance measurement;

7.2.5 Performance test;

7.2.6 Function test (except the measurement of sound pressure level and sound frequency during maximum measurable depth test, inclining and swaying test and alarm indication test).