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Maritime navigation and radiocommunication equipment and systems – Marine speed and distance measuring equipment (SDME) – Performance requirements, methods of testing and required test results

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MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – MARINE SPEED AND DISTANCE MEASURING EQUIPMENT (SDME) – PERFORMANCE REQUIREMENTS, METHODS OF TESTING AND REQUIRED TEST RESULTS

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International Standard IEC 61023 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems.

This third edition cancels and replaces the second edition published in 1999. It constitutes a technical revision.

The main technical changes with regard to the previous edition are listed below:

- amendments resulting from changes to the IMO performance standards for SDME agreed in resolution MSC.96(72) in 2000. The amendments reduce the minimum depth of water under the keel for correct operation of the SDME to 2 m for a ground based equipment, reduce the accuracy required of analogue displays and add a requirement for a serial interface.

The text of this standard is based on the following documents:

FDIS	Report on voting
80/478/FDIS	80/484/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this standard may be issued at a later date.

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – MARINE SPEED AND DISTANCE MEASURING EQUIPMENT (SDME) – PERFORMANCE REQUIREMENTS, METHODS OF TESTING AND REQUIRED TEST RESULTS

1 Scope

This International Standard specifies the minimum performance requirements, methods of testing and required test results of devices to indicate speed and distance – speed and distance measuring equipment (SDME) required by Regulation 19 of Chapter V of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, and which is associated with IEC 60945.

This standard is based upon the requirements of IMO Resolution MSC.96(72). The clause numbering of that resolution is indicated in parentheses in Clause 4 and all subclauses whose meaning is identical to that in the resolution are printed in italics.

In the tests of Clause 5, the corresponding requirement of Clause 4 is indicated in parentheses. The cross-references between the IMO performance standards in Resolution MSC.96(72) and the tests of this standard are summarized in Annex A.

2 Normative references

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

IEC 60945:2002, *Maritime navigation and radiocommunication equipment and systems – General requirements – Methods of testing and required test results*

IEC 61162-1, *Maritime navigation and radiocommunication equipment and systems – Digital interfaces – Part 1: Single talker and multiple listeners*

IMO 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*

IMO MSC.96(72), *Performance standards for devices to measure and indicate speed and distance*

3 Abbreviations

IMO International Maritime Organization

VBW Dual ground/water speed

VLW Distance travelled through the water

4 Minimum performance requirements

4.1 General

a) (MSC.96(72)/A1.1/2) *Devices to measure and indicate speed and distance are intended for general navigational and ship manoeuvring use. The minimum requirement is to provide information on the distance run and the forward speed of the ship through the water or over the ground. Additional information on ship's motions other than in the forward axis may be provided. The equipment shall fully comply with this performance standard at forward speeds up to the maximum speed of the ship. Devices measuring speed and distance through the water shall meet the performance standard in water of depth greater than 3 m beneath the keel. Devices measuring speed and distance over the ground shall meet the performance standard in water of depth greater than 2 m beneath the keel.*

Radar plotting aids/track control equipment require a device capable of providing speed through the water in the fore-and-aft direction.

b) (MSC.96(72)/A1.3) *In addition to the general requirements in Resolution A.694(17)* as detailed in IEC 60945, *devices to indicate speed and distance* shall *comply with the minimum performance requirements of this standard.*

c) Where SDME information is generated by one unit of equipment and is displayed on another unit, the combination of the two units shall be regarded as forming the SDME and shall be tested as an entity.

d) Any facility provided by the equipment which is additional to the minimum requirements of this standard shall be tested to ensure that its operation (and, as far as is reasonably practicable, its malfunction) does not degrade the performance of the equipment.

e) The system shall consist of a sensor and the necessary processing unit to convert the output signal of the sensor to speed and distance for display and for transmission to other equipment.

4.2 Methods of presentation

a) (MSC.96(72)/A2.1) *Speed information may be presented in either analogue or digital form. Where a digital display is used, its incremental steps* shall *not exceed 0,1 knots. Analogue displays* shall *be graduated at least every 0,5 knots and be marked with figures at least every 5 knots. If the display can present the speed of the ship in other than the forward direction, the direction of movement* shall *be indicated unambiguously.*

b) (MSC.96(72)/A2.2) *Distance run information* shall *be presented in digital form. The display* shall *cover the range from 0 to not less than 9 999,9 nautical miles and the incremental steps* shall *not exceed 0,1 nautical miles. Where practicable, means* shall *be provided for resetting a read-out to zero.*

c) (MSC.96(72)/A2.3) *The display* shall *be easily readable by day and by night.*

d) (MSC.96(72)/A2.4) *Means* shall *be provided for transmitting measured speed and distance run information to other equipment fitted on board.*

(i) (MSC.96(72)/A2.4.2) *When the equipment is used for measuring forward speed, then the information may be transmitted using closing contacts and, if so, this* shall *be in the form of one contact closure each 0,005 nautical miles run.*

The minimum contact closure time or equivalent pulse width shall be 50 ms.

(ii) (MSC.96(72)/A2.4.1) *The information on all speed and distance parameters, including direction,* shall *be transmitted in accordance with the relevant international marine interface standards.*

The equipment shall support at least the sentences VBW and VLW to IEC 61162-1.

e) (MSC.96(72)/A2.5) *If equipment is capable of being operated in either the "speed through the water" or "speed over the ground" mode, mode selection and mode indication* shall *be provided.*

Where automatic mode selection is provided, the mode in use shall be indicated.

f) (MSC.96(72)/A2.6) *If the equipment has provision for indicating speeds other than on a single fore-and-aft direction, then both the forward and athwart speeds* shall *be provided*

either through the water or over the ground. Resultant speed and direction information may be provided as a display-selectable option. All such information shall *clearly indicate the direction, mode and validity status of the displayed information.*

4.3 Accuracy of measurement

a) (MSC.96(72)/A3.1) *Errors in measured and indicated speed, when the ship is operating free from shallow-water effect and from the effects of wind, sea bottom type, current and tide,* shall *not exceed the following:*

- *for a digital display – 2 % of the speed of the ship, or 0,2 knots whichever is greater;*
- *for an analogue display – 2,5 % of the speed of the ship, or 0,25 knots, whichever is greater; and*
- *for output data transmission – 2 % of the speed of the ship, or 0,2 knots, whichever is greater.*

b) (MSC.96(72)/A3.2) *Errors in the indicated distance run, when the ship is operating free from shallow water effect and from the effects of wind, sea bottom type, current and tide,* shall *not exceed 2 % of the distance run by the ship in 1 h or 0,2 nautical miles in each hour whichever is the greater.*

c) (MSC.96(72)/A3.3) *If the accuracy of devices to indicate speed and distance run can be affected by certain conditions (e.g. sea state and its effects, water temperature, salinity, sound velocity in water, depth of water under the keel, heel and trim of ship), details of possible effects* shall *be included in the equipment handbook.*

4.4 Roll and pitch

(MSC.96(72)/A4) *The performance of the equipment* shall *be such that it will meet the requirements of this standard when the ship is rolling up to ±10° and pitching up to ±5°.*

Any degradation of performance at roll and pitch angles greater than those above shall be included in the equipment handbook.

4.5 Construction and installation

(MSC.96(72)/A5.1) *The system* shall *be so designed that neither the method of attachment of parts of the equipment to the ship nor damage occurring to any part of the equipment which penetrates the hull could result in the ingress of water to the ship.*

(MSC.96(72)/A5.2) *Where any part of the system is designed to extend from and retract into the hull of the ship, the design shall ensure that it can be extended, operated normally and retracted at all speeds up to the maximum speed of the ship. Its extended and retracted positions shall be clearly indicated at the display position.*

The handbook shall include the manufacturer's recommendations on the installation of the SDME, in particular the positioning of the sensor, as it affects the overall accuracy of the SDME.

5 Methods of testing and required test results

5.1 General

The manufacturer shall, unless otherwise agreed, set up the equipment and ensure that it is operating normally before testing commences.

5.2 Test arrangements

The general arrangements for the tests shall be as follows:

a) where applicable, the units of the equipment shall be inter-connected by the longest electrical links for which the equipment has been designed. A link may be real or simulated;

b) for tests to determine speed and distance measurement accuracy, the signals normally received from the sensor shall be simulated as applicable to the particular type of device being tested. Where practicable, the output of the sensor shall be measured to determine the characteristics of its output signal;

c) where realistic simulation is not practicable, the manufacturer shall demonstrate, to the satisfaction of the laboratory or test house, that the equipment shall satisfy the accuracy requirements. At the discretion of the laboratory or test house, this may be carried out by demonstration or by installation on a ship at sea.

5.3 Minimum depth

(See 4.1.a).)

If the sensor technology used is sensitive to the water depth, the test signals used to verify speed and distance measurement accuracy of the equipment shall be created in such a way that the influence of water depth is simulated.

The speed and distance accuracy tests shall be carried out at non-critical depth conditions (depending upon the sensor type) and at various depths greater than and including 3 m beneath the keel for devices measuring speed and distance through the water and if applicable, 2 m for devices measuring speed and distance over the ground.

5.4 General requirements

(See 4.1.b).)

The equipment shall be tested to fulfil all applicable requirements of IEC 60945.

The relevant clauses/subclauses are the following:

– General – Operational (Clause 6), power supply (Clause 7)
– Environment – Dry heat (8.2), damp heat (8.3), low temperature (8.4), vibration (8.7)
  - For exposed units of the equipment – Rain (8.8)
  - For transducers – Immersion (8.9.1)
– EMC – Conducted (9.2), radiated (9.3), immunity (10.2 to 10.9)

  NOTE Not 9.3, 10.4 and 10.9 for transducers.
– Special purpose (acoustic, etc.) (Clause 11), safety (Clause 12), maintenance (Clause 13), manuals (Clause 14), marking (Clause 15)

5.5 SDME configuration

(See 4.1.c).)

By inspection.

5.6 Optional facilities

(See 4.1.d).)

All components of the possible six speed components that are sensed (see Figure 1) by any specific SDME shall be tested for speed and distance accuracy as defined in 4.3 according to the table below.

Component (see explanation of symbols in Figure 1)	Speed accuracy	Distance accuracy (sailed distance)
V_{xg}	0,2 kn or 2 % of V_g	0,2 nm or 2 % over the ground
V_{yg}	0,2 kn or 2 % of V_g	0,2 nm or 2 % over the ground
V_g	0,2 kn or 2 % of V_g	0,2 nm or 2 % over the ground
V_{xw}	0,2 kn or 2 % of V_w	0,2 nm or 2 % through the water
V_{yw}	0,2 kn or 2 % of V_w	0,2 nm or 2 % through the water
V_w	0,2 kn or 2 % of V_w	0,2 nm or 2 % through the water

Any restrictions for the availability (for example water depth) of combinations of the optional speed/distance components shall be clearly stated in the manufacturer's handbook.

5.7 System configuration

(See 4.1.e).)

By inspection.

5.8 Methods of presentation

(See 4.2.)

5.8.1 Speed

(See 4.2.a).)

By inspection and during the tests for accuracy of measurement.

5.8.2 Distance run

(See 4.2.b).)

By inspection and during the tests for accuracy of measurement.

5.8.3 Display

(See 4.2.c).)

By inspection and during the tests for accuracy of measurement.

5.9 Distance run external output

(See 4.2.d).)

5.9.1 Contact closure

(See 4.2.d) (i).)

5.9.1.1 Method of test

The equipment shall be set up in accordance with 5.2 and the closures of each set of output contacts shall be recorded accurately while the simulated sensor signals are applied. A constant forward speed of at least 10 kn shall be applied during which a series of not less than 10 consecutive contact closures shall be recorded.

5.9.1.2 Results required

The contact closure time or equivalent pulse width shall be not less than 50 ms. The interval in distance between the occurrence of the leading edge of one contact closure and the next for at least 10 consecutive contact closures shall be within 2 % of 0,005 nautical miles.

5.9.2 Digital interface

(See 4.2.d) (ii).)

5.9.2.1 Method of test

The equipment shall be set up in accordance with 5.2. Test equipment fulfilling the requirements of IEC 61162-1 and capable of decoding correct messages and indication of all deviations from the correct message syntax shall be provided. A constant forward speed of at least 10 kn shall be applied, during which at least 1 000 consecutive messages shall be recorded.

If any operational status affects the message type or adds any proprietary message for instance for diagnostics, all relevant combinations of such status shall be used.

5.9.2.2 Results required

All characters of all received messages shall comply with VBW of IEC 61162-1. For systems where the total distance through the water counter value is stored in a central processing unit, the VLW message shall also be used for setting any connected distance counter(s).

If additional proprietary messages are generated in any operational mode, these messages shall comply with the proprietary message syntax of IEC 61162-1 and the composition be specified in detail in the equipment manual. The addition of such messages shall not in any way degrade the standard message(s).

5.10 Mode selection and indication

(See 4.2.e).)

By inspection.

5.11 Additional speed indications

(See 4.2.f).)

By inspection.

5.12 Accuracy of measurement

(See 4.3.)

5.12.1 Indication of speed

(See 4.3.a).)

5.12.1.1 Method of test

The equipment shall be set up in accordance with 5.2, and all outputs indicating speed shall be monitored while the sensor simulated signals are applied. A constant forward speed of 1 kn shall be applied for a period of not less than 15 min. This procedure shall then be repeated with the simulated speed being increased by increments of 1 kn up to a speed of 5 kn and thereafter by increments of 5 kn up to the maximum speed for which the equipment is designed.

Where equipment is designed to indicate the speed of the ship in the reverse direction, the above procedure shall be repeated up to the maximum speed for which the equipment is designed to operate in the reverse direction.

5.12.1.2 Results required

When the test is carried out in accordance with 4.3 a) and 5.2, no reading of the speed indicator shall differ from the constant speed being applied at the time by more than the requirements of 4.3 a).

Where alternative modes of operation are provided in equipment, the correct operation of the change-over facility shall be checked during this test.

5.12.2 Indication of distance run

(See 4.3.b).)

5.12.2.1 Method of test

The equipment shall be set up in accordance with 5.2, and all outputs indicating distance run shall be monitored while the sensor simulated signals are applied. A constant forward speed of 5 kn shall be applied for a period of at least 60 min, and the indicated distance run during the period and the time duration shall be recorded. This procedure shall be repeated at constant speeds by increments of 5 kn up to the maximum speed for which the equipment is designed. The time duration at each speed above 5 kn may be reduced but shall ensure that a distance run of at least 5 nautical miles is recorded.

Where practicable, the simulated input shall be stopped immediately after an incremental addition has registered on the distance run indicator.

Where this is not practicable, the time duration at each speed shall be such that the distance run is a multiple of the incremental step used by the indicator.

5.12.2.2 Results required

No recorded reading of the distance run indicator shall differ from the distance run, calculated from the constant speed applied and the recorded time duration, by more than 2 % of the distance run or the equivalent of 0,2 nautical miles per hour, whichever is the greater.

5.13 Effects of environment

(See 4.3.c).)

The compliance with the requirements of 4.3.c shall be checked by inspection of the text proposed by the manufacturer for inclusion in the equipment handbook.

5.14 Roll and pitch

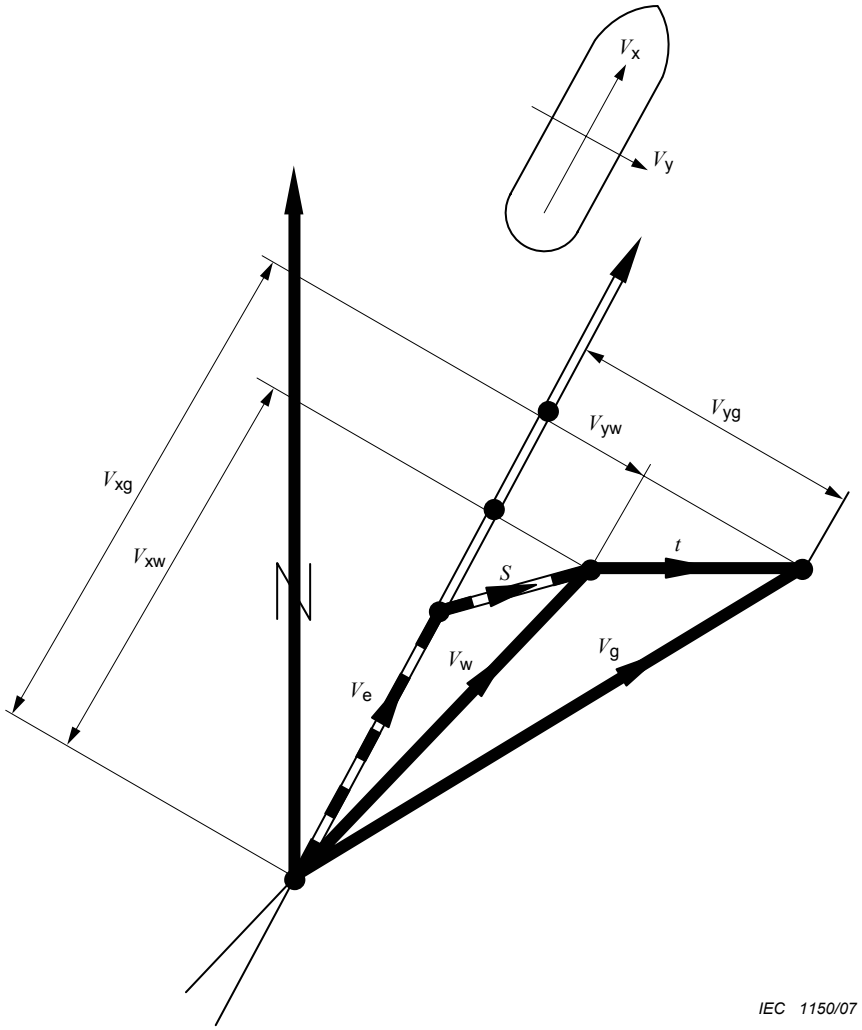
(See 4.4.)

Where the technique used by the sensor might influence significantly the performance of the equipment under conditions of roll and pitch, an assessment of the possible effects on performance shall be made and any installation limitations given in the equipment handbook shall be checked by inspection of the proposed text.

5.15 Construction and installation

(See 4.5.)

The compliance with the requirements of 4.5 shall, as far as is practicable, be checked by inspection.



Wake

x,y	=	ship coordinates	V_e	=	speed due to propeller thrust
V_g	=	speed over the ground	V_{xg}	=	forward speed over the ground
V_w	=	speed through the water	V_{yg}	=	athwart speed over the ground
S	=	speed due to wind	V_{xw}	=	forward speed through the water
t	=	speed due to current	V_{yw}	=	athwart speed through the water

Figure 1 – Ship speed velocity vectors

In Figure 1, the direction of the vectors is referred to North. The direction of V_e is the ship heading (true compass course).

Figure 1 can be applied at any point of a ship, all vectors being equal and constant in time, as long as no parameter influencing the movement (own ship's course and speed, wind and current) changes. During, for example a course change, the vectors for various sensor locations are different and vary with time. In this case, the output of the SDME depends upon the location of the sensors.

Annex A
(informative)

Cross-references – IMO Resolution MSC.96(72) and the tests in this standard

IMO Resolution MSC.96(72) annex	IEC 61023 requirement	IEC 61023 test
Clause/subclause		
1.1	4.1 a)	5.3
1.3	4.1 b)	5.4
–	4.1 c)	5.5
–	4.1 d)	5.6
–	4.1 e)	5.7
2.1	4.2 a)	5.8.1
2.2	4.2 b)	5.8.2
2.3	4.2 c)	5.8.3
2.4	4.2 d)	5.9
2.4.2	4.2 d) (i)	5.9.1
2.4.1	4.2 d) (ii)	5.9.2
2.5	4.2 e)	5.10
2.6	4.2 f)	5.11
3.1	4.3 a)	5.12.1
3.2	4.3 b)	5.12.2
3.3	4.3 c)	5.13
4	4.4	5.14
5	4.5	5.15

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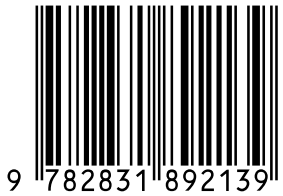

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