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Global Maritime Distress and Safety System
Search and rescue radar transponder performance and test r

Global maritime distress and safety system – Performance and test requirements for marine search and rescue radar transponder

[IEC 61097-1 Global maritime distress and safety system (GMDSS) – Part 1:Radar transponder – Marine search and rescue (SART) – Operational and performance requirements,MOD]

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Preface

This document was drafted in accordance with the rules given in GB/T 1.1-2009.

This document replaces GB 15216-1994 "Global Maritime Distress Safety System (GMDSS) Search and Rescue Radar Transponder (SART) Performance Requirements". Compared with GB 15216-1994, the main technical contents of this standard are as follows except for editorial changes:

-Modified the scope of application of the standard (see Chapter 1, Chapter 1 of the 1994 edition);

-Added terms, definitions, and abbreviations (see Chapter 3);

——Modified the "general requirements" (see 4.1, 3.1 in 1994 edition);

——Modified "Operation Requirements" (see 4.2, 3.2 in 1994 edition);
-Modified the antenna height requirements (see 4.5, 3.5 in 1994 edition);

-Modified the requirements of antenna characteristics (see 4.6, 3.6 in 1994 edition);

——Modified the requirements of distance performance (see 4.7, 3.7 of 1994 edition);

-Modified the labeling requirements (see Chapter 5, Chapter 4 of the 1994 edition);

——Modified the requirements of polarization mode (see 6.2, 5.2 of 1994 edition);

——Modified the requirements for the effective sensitivity of the receiver (see 6.8, 5.8 in the 1994 edition);

——Added "temperature range" and "effective antenna height" (see 6.10, 6.12);

--- Added "Test Method and Result Requirements" (see Chapter 7).

This document uses the redrafting method to modify and adopt IEC 61097-1:2007 "Global Maritime Distress and Safety System (GMDSS)-Part 1 Search and rescue radar transponder (SART)—operation and performance requirements, test methods and required test results".

Compared with IEC 61097-1:2007, the structure of this document has the following adjustments:

——Added terms and definitions, abbreviations chapters (see Chapter 3).

Compared with IEC 61097-1:2007, this document has the following technical differences:

——Added Chinese requirements for label content (see Chapter 5).

Compared with IEC 61097-1:2007, this document has also made the following editorial changes:

——Added the next level headings of the general requirements in the test methods and result requirements (see 7.1.1, 7.1.2, 7.1.3, 7.1.4, IEC 61097-1: 6.1 of 2007);

——The chapter number of the test result requirement for dry heat has been added (see 7.4.1.2, 6.4.1 of IEC 61097-1: 2007);

——The test method and result requirement chapter number of antenna height have been added (see 7.5.1, 7.5.2, 6.5 of IEC 61097-1:2007).

——The distance performance in the test method and result requirements (see 7.6) is combined to avoid repeated description (see IEC 61097-1: 2007 6.7.1, 6.7.2, 6.7.3 and 6.7.4);

——The antenna characteristics in the test methods and result requirements (see 7.8.6) are combined to avoid duplication of descriptions (see IEC 61097-1: 6.6 and 6.9.6 of 2007);

This document was proposed and managed by the Ministry of Transport of the People's Republic of China.

The previous releases of the standards replaced by this document are:

——GB 15216—1994.

Global Maritime Distress and Safety System
Search and rescue radar transponder performance and test requirements

1 Scope

This document specifies the performance requirements, labels, technical characteristics, test methods, and test methods of maritime search and rescue radar transponders operating i Result requirements.

This document is applicable to the design, manufacture and inspection of search and rescue radar transponders required by global maritime distress and safety systems.

2 Normative references

The following documents are indispensable for the application of this document. For dated reference documents, only the dated version applies to this document. For undated references, the latest version (including all amendments) applies to this document.

GB/T 16162 Global Maritime Distress and Safety System (GMDSS) terminology

IEC 60936-1 Shipborne radar-Operational and performance requirements-Test methods and required test results (IEC 60936-1, Shipborne radar – Operational and performance requirements – Methods of tests and required test results)

IEC 60945:2002 Marine navigation equipment-General requirements-Test methods and required test results (Marine navigational equipment – General requirements – Methods of testing and required test results.)

ITU-R Report 1036-1 Frequency for search and positioning in the Global Maritime Distress and Safety System (GMDSS) (Frequencies for homing and locating in the global maritime distress and safety system (GMDSS))

ITU RR Radio Regulations (Radio Regulations)

IMO A.222(VII) resolution of navigation radar equipment performance standards (Performance standards for navigational radar equipment.)

IMO A.477(XII) resolution of radar equipment performance standards (Performance standards for radar equipment.)

IMO Resolution A.694(17) is applied to the general requirements of shipborne radio equipment for global maritime distress and safety systems and electronic navigation equipment 求（General requirements for shipborne radio equipment forming part of the Global maritime distress and safety system and for electronic navigational aids)

IMO Res.MSC.192(79) Adoption of the Revised Performance Standards For Radar Equipment)

IMO SOLAS Convention (1974) International Convention for the Safety of Life at Sea (1974) of Life at Sea(SOLAS), 1974)

IMO SOLAS Convention (1974) Amendment (1988) International Convention for the Safety of Life at Sea (1974) on the Global Maritime Distress and Safety System (GMDSS) Amendments to Radio Communication (1988) (Safety of Life at Sea (SOLAS) Convention (1974)-Amendments concerning Radio communications for the Global maritime distress and safety system (GMDSS) (1988))

3 Terms and definitions, abbreviations

3.1 Terms and definitions

The terms and definitions defined in GB/T 16162 apply to this document.

3.2 Abbreviations

The following abbreviations apply to this document.

EIRP: Equivalent Isotropic Radiated Power

GMDSS: Global Maritime Distress and Safety System (Global Maritime Distress and Safety System)

SART: Search and Rescue Radar Transponder

4 Performance requirements

4.1 General requirements

SART should be able to display a series of equally spaced points on the rescuer's radar to indicate the location of the person in distress.

The operating frequency of SART should always remain within the range specified by ITU RR.

4.2 Operational requirements

SART should meet the following operational requirements:

a) It is convenient for unskilled personnel to start;

b) There are devices to prevent accidental activation;

c) There are audible or optical indicators, or both, to indicate whether the work is normal and to remind the person in distress that SART has been triggered by the search and rescue

d) It can be started and closed manually, and can also have an automatic start function;

e) It has a standby state (started but not triggered) indication function;

f) Falling into the water from a height of 20 m will not cause damage;

g) Able to stay at a depth of 10 m for at least 5 minutes and still remain watertight;

h) When subjected to a thermal shock of 45 °C under the specified immersion conditions, it remains watertight;

i) When falling into the water alone, it can float forward;

j) A short floatable rope (not shorter than 10 m) is provided as a tether;

k) Resistant to sea water or oil erosion;

l) Can withstand long-term sunlight exposure without degradation of performance;

m) The surface color is very obvious yellow or orange;

n) The external structure is smooth to avoid damage to the lifeboat;

o) It is compatible with the antenna bracket on the survival craft and meets the requirements described in 4.5.

4.3 Battery capacity

SART should have sufficient battery capacity to ensure 96 hours of operation in standby mode, and after standby, when using 1 kHz pulse Under continuous interrogation at repetition frequency, it can provide 8 h of transponder transmission.

4.4 Environment (temperature)

The design of SART should be able to work in the ambient temperature of -20 °C ~ +55 °C, and can be stored at the temperature of -30 °C ~ +65 °C without Cause damage.

4.5 Antenna height

The height of the installed SART antenna should be at least 1 m above sea level.

4.6 Antenna characteristics

SART's antenna vertical directivity pattern and its hydrodynamic characteristics should allow SART to respond to search radars under strong surge conditions. day The linear horizontal directional pattern should be omnidirectional, and horizontally polarized waves or circularly polarized waves should be used for both transmission and reception.

4.7 Distance performance

When complying with IMO A.477(XII) resolution, IMO A.222 (VII) resolution, IMO MSC.192(79) resolution and IEC 60936-1 The required antenna height of the navigation radar is 15 m, and the SART should be able to work normally when interrogating the SART at a distance of at least 5 n mile.

When an airborne radar with a peak output power of not less than 10 kW, it is used to interrogate SART at a distance of at least 30 n mile over 900 m, SART It should work normally.

5 tags

In addition to the items that meet the requirements of IMO A.694(17), the outside of SART equipment should be clearly marked with simple operating instructions (in Chinese And English) and the expiry date (in Chinese and English) of the original battery used, which is easy for people in distress to operate correctly.

6 Technical characteristics

6.1 Frequency Range

9200 MHz ~ 9500 MHz.

6.2 Polarization mode

Horizontal polarization or circular polarization.

6.3 Sweep rate

Every 200 MHz sweep, the nominal time is 5 μs.

6.4 Response signal

12 sweeps.

6.5 Sweep frequency form (sawtooth wave)

The forward sweep time is 7.5 μs ± 1 μs; the reverse sweep time is 0.4 μs ± 0.1 μs; the response starts from the reverse sweep.

6.6 Pulse duration

100 μs, nominal value.

6.7 Equivalent isotropic radiated power

Not less than 400 mW (equivalent to +26 dBm).

6.8 Receiver effective sensitivity

Better than -50 dBm (equivalent to 0.1 mW/m ^{2}).

Note 1: The effective sensitivity of the receiver includes antenna gain;

Note 2: The effective sensitivity of the receiver is better than -50 dBm, which is suitable for shipborne radar with interrogation pulse (medium/long pulse) greater than 400 ns;

Note 3: The effective sensitivity of the receiver is better than -37 dBm, which is suitable for shipborne radar with an interrogation pulse (short pulse) not greater than 100 ns.

When subjected to shipborne radar that complies with IMO A.477 (XII) resolution and IMO Res.MSC.192(79) resolution at any distance greater than 20 m
The receiver should be able to operate normally under the influence of the emitted radiation field (28 dBW/m ^{2}).

6.9 operating hours

After running for 96 hours in the standby state, it can still provide 8 hours of transponder transmission under continuous interrogation at the repetition frequency of 1kHz pulse.

6.10 Temperature range

Working environment temperature range: -20 °C ~ +55 °C, storage temperature range: -30 °C ~ +65 °C.

6.11 Recovery time after excitation

Less than or equal to 10 μs.

6.12 Effective antenna height

SOLAS Convention (1974) Amendment (1988) Chapter III 6.2.2 and Chapter IV 7.1.3, 8.3.1 SART effective antenna height
The degree should be greater than or equal to 1m.

6.13 The delay time between the reception of the radar signal and the start of transmission

Less than or equal to 0.5 μs.

6.14 Antenna vertical beam width

Relative to the horizontal plane of the radar transponder at least ±12.5°.

6.15 Antenna horizontal beam width

All directions are within ±2 dB.

7 Test methods and result requirements

7.1 General requirements

7.1.1 It should be carried out at the test site designated by the type inspection agency. Unless otherwise agreed, SART assembled as a finished product shall be used at the beginning of the
The test setup should be carried out before and to ensure its normal operation;
7.1.2 During the performance test, the SART battery should normally be powered. Some test items can use external power supply instead of battery power supply.
The source requires the agreement of the manufacturer and the type inspection agency;
7.1.3 The function test shall include the tests specified in 7.8.4 ~ 7.8.9;
7.1.4 Within 5 minutes after turning on the power, SART shall meet the requirements of Chapter 4 and Chapter 6.

7.2 Operation requirements

The operating requirements in 4.2 should be confirmed by the following methods (corresponding items are given in brackets):

a) [See 4.2 a)] Confirmed by inspection;

b) [See 4.2 b)] Confirm by inspection. Usually need not less than two manual activation, each operation should be simple and independent of each other;

c) [See 4.2 c)] Check and confirm when SART starts transmission;

d) [See 4.2 d)] Confirmed by inspection;

e) [See 4.2 e)] Check while SART is in standby state;

f) [See 4.2 f)] SART is set to be normally available and freely released into the water from a height of 20 m. When finished, check SART
Whether it is damaged and conduct a functional test;

g) [See 4.2 g)] Immerse the SART in 100 kPa water for 5 min. After completion, check if SART is damaged
And perform functional tests;

h) [See 4.2 h)] Put the SART in the pressure test container, the pressure test container should have sufficient capacity to ensure SART
When immersed in water for testing, the water temperature in the container is constant between 10 °C and 20 °C. Respectively at two temperatures (above 45 °C ± 2 °C
And below 30 °C±2 °C), hot-dip the SART for at least 3 hours, and then immerse the SART in 100 kPa water at a pressure
Lasts for 1 h. After completion, check SART for leaks and deformities, and perform functional tests;

Note: 7.2 h) and 7.2 g) can be combined, especially when testing for leakage.

i) [See 4.2 i)] If the SART is designed to be independent of the survival craft, after placing it in the water for 5 minutes, check whether it can float From

j) [see 4.2 j)] confirmed by inspection;

k) [See 4.2 k)] According to IEC 60945:2002 in 8.11.3 and 8.12.3 for testing, the results should comply with IEC 60945:2002 The requirements of 8.11.4 and 8.12.4;

l) [See 4.2 l)] Confirm by inspection. The manufacturer provides certification to ensure that the materials used, including the color coating on the outside of the device The layer will not be adversely affected by long-term sun exposure;

m) [see 4.2 m)] confirmed by inspection;

n) [see 4.2 n)] confirmed by inspection;

o) [See 4.2 o)] Confirm by inspection.

7.3 Battery capacity

7.3.1 Test method

By providing an external power supply to the SART, determine its minimum voltage during normal operation. Perform function test at the lowest voltage, Can test requirements.

Measure the average current (I_1, milliampere level) required for SART to work in standby mode at the nominal battery voltage , The average current (I_2, milliampere level) required to work in the response state when the complex frequency is continuously interrogated . The battery of the tested SART is connected Resistive load, providing I_1 mA current, working continuously for 96 h. Then, readjust the false resistance load, provide I_2 mA of current, and work continuously for 8 hours.

7.3.2 Result requirements

In the last 15 minutes of measuring the battery capacity, the measured voltage across the load shall not be less than the lowest voltage value tested in 7.3.1.

Test within the normal and extreme operating temperature range (-20 °C, normal temperature, +55 °C), the battery capacity of the tested SART should be full Meet the requirements of 4.3.

7.4 Ambient temperature

7.4.1 Dry heat

7.4.1.1 Test method

The test is carried out in accordance with the dry heat test in IEC 60945, and the maximum temperature is 65 °C.

7.4.1.2 Result requirements

Within 2 h, the tested SART should meet the requirements of the functional test.

7.4.2 Low temperature

7.4.2.1 Test method

Place SART in a room at normal room temperature, reduce the temperature to -30 °C ± 3 °C and keep it for at least 10 h. After the end of the time period, Raise the temperature to -20 °C ± 3 °C within 30 min. Then turn on SART for at least 2 h.

7.4.2.2 Result requirements

Within 2 h, the tested SART should meet the requirements of the functional test.

7.5 Antenna height

7.5.1 Test method

When the SART is floating, measure and record the distance from the water line to the center of the antenna as the antenna height of the tested SART.

7.5.2 Result requirements

The tested SART should meet 4.5 requirements.

7.6 Distance performance

7.6.1 Test method

According to the measurement results of 7.5, 7.8.3, 7.8.5 and 7.8.6, according to the similar figure in ITU-R Report 1036-1, the floating The distance performance of SART and survival craft SART.

If the testing organization has the ability to increase the measurement cost, one or more radars can be used according to 4.7 to determine the maximum distance of SART under floa

from.

7.6.2 Result requirements

The distance performance shall meet the requirements of 4.7 and be recorded in the type inspection certificate. If the radar is used for testing, the display on the radar screen Should meet the requirements in 4.1.

7.7 Label

Test method and result requirements: Confirmed by inspection.

7.8 Technical characteristics

7.8.1 General requirements for testing

The SART under test should be measured using field radiation technology at the test site, and there should be no reflection within the range that does not affect the test result. Test s See Figure 1 for the connection diagram.

The functional test signal in 7.8.2 adopts horizontal polarization to simulate various actual search and rescue radar signals.

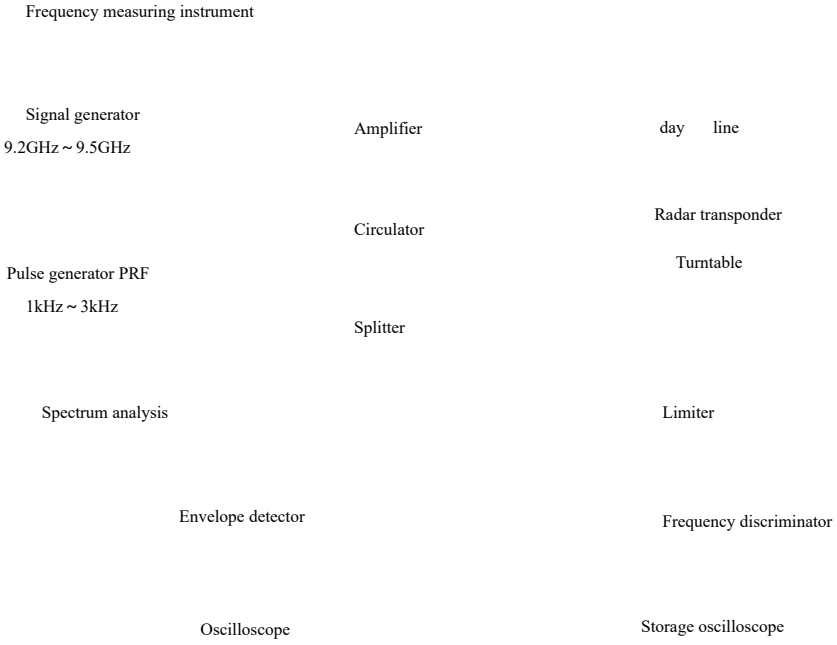

Figure 1 Connection diagram of test equipment

7.8.2 Function test signal

7.8.2.1 Test signal 1

The signal is a pulse carrier with a repetition frequency of 3 kHz. The duration of the rising and falling edges between 10% and 90% of the pulse amplitude is 20 ns ± 5 ns. The pulse width between 90% is 80 ns ± 10 ns.

7.8.2.2 Test signal 2

The signal is a pulse carrier with a repetition frequency of 1 kHz. The duration of the rising and falling edges between 10% and 90% of the pulse amplitude is 20 ns ±5 ns. The pulse width between 90% is 500 ns ± 50 ns.

7.8.2.3 Test signal 3

The signal is a pulse carrier with a repetition frequency of 1 kHz. The duration of the rising and falling edges between 10% and 90% of the pulse amplitude is 20 ns ±5 ns. The pulse width between 90% is 1 μs ± 0.1 μs.

7.8.3 Receiver sensitivity

7.8.3.1 Test method

Use test signal 1 and test signal 2 to interrogate the device under test at frequencies of 9200 MHz, 9350 MHz and 9500 MHz. Increase signal generation The power level of the device until SART responds at the corresponding frequency.

7.8.3.2 Result requirements

The effective receiver sensitivity (including antenna gain) using test signal 1 should be better than -37 dBm.

The effective receiver sensitivity using test signal 2 should be better than -50 dBm (equivalent to a power density of 0.1 mW/m² at the antenna input end).

7.8.4 Scan Features

7.8.4.1 Test method

Use test signal 2 to test SART. Measure SART scan frequency/scan time.

7.8.4.2 Result requirements

The tested SART should send 12 scanning frequencies, and the coverage of each scanning frequency is 9140 MHz ~ 9560 MHz.

The forward scan time should be 7.5 μs ± 1 μs, and the reverse scan time should be 0.4 μs ± 0.1 μs. Scanning frequency is 9200 MHz ~ 9500 MHz The intersection of the linear sweep should not exceed ±20 MHz.

7.8.5 Equivalent isotropic radiated power

7.8.5.1 Test method

Use test signal 2 to test SART. Rotate SART 360° on the horizontal plane and record the received signal level.

7.8.5.2 Result requirements

The minimum received signal level should not be lower than +26 dBm (400 mW).

The difference between the maximum signal level and the minimum signal level should be within 4 dB.

7.8.6 Antenna characteristics

7.8.6.1 Test method

Confirm the antenna vertical beam width and antenna horizontal beam width by checking the design file data of the equipment manufacturer; confirm the antenna by checking Polarization mode.

Or use test signal 2 to test SART. Rotate SART 360° on the horizontal plane to test the maximum signal power received by the SART antenna Level and minimum signal level. When the line of sight of the test antenna is at ±12.5° from the horizontal, it shall be recorded.

7.8.6.2 Result requirements

The signal level recorded when the angle relative to the horizontal plane should be ±12.5° should be -2 dB greater than the equivalent isotropic radiation power level.

7.8.7 Recovery time after excitation

7.8.7.1 Test method

Use test signal 3 to test SART. The signal level should be at least 3 dB higher than the sensitivity level recorded in 7.8.3.1. Add test letter The pulse repetition frequency of the signal until SART responds to transmission failure under two consecutive queries.

7.8.7.2 Result requirements

The difference between the pulse repetition interval (the reciprocal of the pulse repetition frequency) and the transmission duration of the tested SART should be less than or equal t

7.8.8 The delay time from receiving the search and rescue radar signal to the start of transmitting the response signal

7.8.8.1 Test method

Use test signal 3 to test SART. The SART signal level should be at least 3dB higher than the sensitivity level recorded in 7.8.3.1. measuring The delay time from receiving the search and rescue radar signal to the start of transmitting the response signal (10% of the envelope).

7.8.8.2 Result requirements

The delay time should be less than or equal to 0.5 μs.

7.8.9 Receiver front-end protection

7.8.9.1 Test method

Place the working SART in a radiation field (28 dBW/m ^{2}) that complies with the resolution of IMO A.477 (XII). The working frequency band is 9 GHz, The distance is 20 m, and the SART signal should be seen on the radar display.

7.8.9.2 Result requirements

The SART under test should continue to operate normally.

references

[1] Maritime Safety Administration of the People's Republic of China. Technical Rules for Statutory Inspection of Domestic Ships

[2] IMO Res. A. 530 (13) Use of Radar Transponders for Search and Rescue Rescue Purposes)

[3] IMO Res. A.802(19) Performance standards for survival craft radar transponders used for search and rescue operations (Performance Standards for Survival Craft Radar Transponders for Use in Search and Rescue Operations)

[4] IMO Res. MSC.247(83) Amendment to the performance standard of survival craft radar transponders in search and rescue operations (Adoption of Amendments to Performance Standards for Survival Craft Radar Transponders for Use in Search

and Rescue Operations)