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Radio Equipment and Systems;

Maritime Emergency Position Indicating Radio Beacons (EPIRBs) intended for use on the frequency 121,5 MHz or the frequencies 121,5 MHz and 243 MHz for homing purposes only

Technical characteristics and methods of measurement

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Foreword

This European Telecommunication Standard (ETS) has been produced by the Radio Systems and Equipment (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI) and has undergone the ETSI approvals procedure.

This standard lays down the minimum requirements for maritime Emergency Position Indicating Radio Beacons (EPIRBs) operating on certain frequencies, and incorporates the relevant provisions of the International Telecommunication Union (ITU) Radio Regulations and the relevant standards of the International Civil Aviation Organization (ICAO).

Every ETS prepared by ETSI is a voluntary standard. This ETS contains text concerning the type approval of the equipment to which it relates. This text should be considered only as guidance and does not make this ETS mandatory.

Annex A to this ETS is normative.

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1 Scope

This European Telecommunication Standard (ETS) states the minimum requirements for maritime Emergency Position-Indicating Radio Beacons (EPIRBs), and incorporates the provisions of the ITU Radio Regulations and the relevant standards of the International Civil Aviation Organisation.

EPIRBs are defined as stations in the maritime mobile service, the emissions of which are intended to facilitate search and rescue operations.

The EPIRBs described in this ETS are intended only for transmission of radio signals on the frequency 121,5 MHz or the frequencies 121,5 MHz and 243 MHz for locating vessels and survival craft in distress.

This ETS also applies to EPIRBs intended for very short range man-overboard location applications. For this application, both the radiated power and the length of time for operation are reduced to enable the equipment to be sufficiently small and light to be worn comfortably at all times.

2 General requirements

2.1 Construction

In all respects, the mechanical and electrical design and the construction and finish of the equipment shall conform with good engineering practice.

The equipment shall be designed to minimise the risk of internal and external damage during use or stowage.

The exterior of the equipment shall have no sharp edges or projections which could easily damage inflatable rafts or injure personnel.

The general construction and method of operation shall provide a high degree of proof against inadvertent operation due to magnetic influences, handling, stowage and transit, whilst still providing a simple means of operation in an emergency.

The equipment shall be portable, lightweight, and compact and be designed as one integral unit. The EPIRB shall derive its energy from a battery forming a part of the equipment and incorporate a permanently attached antenna which may be either fixed length or extendable.

The EPIRB may be fitted with a test facility by which the functioning of the transmitter and battery can be easily tested without the use of any external equipment.

The equipment shall be capable of being used by an unskilled person and only be capable of manual activation and deactivation.

The EPIRB shall be watertight and buoyant.

The equipment shall be provided with an indication that signals are being emitted. The indication to the user shall be either an audible or visual indication, clearly discernible under all ambient conditions.

A substantial part of the equipment shall be of highly visible yellow or orange colour to assist visual location.

The equipment shall not be unduly affected by sea water or oil and shall be resistant to deterioration by prolonged exposure to sunlight.

Necessary operating instructions shall be provided with the equipment.

2.2 Controls

The equipment shall be initially activated by the use of two simple, but independent mechanical actions, neither of which on its own shall activate the equipment. For equipment relating solely to man-overboard location applications, the second mechanical action may be replaced by a total immersion sensor.

The equipment shall not be capable of automatic activation, except in the case of the second operation for man-overboard devices only.

Initial activation shall break a seal which shall not be replaceable by the user. This seal shall not be broken when using the test facility.

After activation it shall be simple to de-activate the equipment.

The switch which operates any test facility (subclause 2.1, sixth paragraph), shall be so designed that it returns automatically to the off-position when released.

2.3 Labelling

The equipment shall be provided with a label, or labels, permanently affixed to the exterior of the equipment, containing the following information:

- type designation of the equipment;
- adequate instructions to enable the equipment to be activated and de-activated;
- the type of battery as specified by the manufacturer of the EPIRB;
- a warning to the effect that the EPIRB should not be operated except in an emergency.
- the date on which the battery will need to be replaced. Simple means shall be provided for changing this date when the battery is replaced.

2.4 Requirements for conformity testing purposes

To assist the testing authority, complete technical and operational documentation shall be provided with the equipment.

For the purpose of conformity testing, 3 sets of batteries shall be submitted.

2.5 Battery

The battery provided as a power source shall have sufficient capacity to operate the equipment for an uninterrupted period of at least 24 hours, or for man-overboard devices only, at least 6 hours, under all temperature conditions, (see subclause 3.6.1), within the requirements of this ETS.

The type of battery specified by the manufacturer for use in the equipment shall be clearly stated on the equipment.

The battery shall be clearly and durably marked with the expiry date.

Provisions shall be made for protecting the equipment from damage due to accidental reversal of polarity of the battery.

3 Test conditions, power sources and ambient temperatures

3.1 Test frequencies

For the purpose of conformity testing, the EPIRB shall be provided with the frequencies specified by the administration of the country in which the test is carried out.

3.2 Test fixture

The manufacturer shall supply a test fixture permitting relative measurements to be made on the submitted sample. This test fixture shall provide a 50 ohm radio frequency terminal at the working frequencies of the equipment.

The performance characteristics of the test fixture, under normal and extreme conditions, shall be subjected to the approval of the testing authority. The following characteristics shall apply:

- the coupling loss shall be as low as possible and in no case greater than 30 dB;
- the variation of coupling loss with frequency shall not cause measurement errors exceeding 2 dB;
- the coupling device shall not incorporate any non-linear elements;
- the power consumption of the EPIRB shall not change substantially when fitted in the test fixture.

Any connections provided on the equipment in order to facilitate relative measurements shall not affect the performance of the equipment, neither in the test fixture nor when making measurements involving the use of radiated fields.

3.3 Normal and extreme test conditions

Conformity testing shall be carried out under normal and extreme test conditions, unless otherwise stated.

3.4 Test power source

Where stated, the battery of the equipment shall be replaced by a test power source capable of producing normal and extreme test voltages as specified in subclauses 3.5.2 and 3.6.2.

3.5 Normal test conditions

3.5.1 Normal temperature

Normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity, within the following ranges:

Temperature:	+ 15 °C to + 35 °C
Relative humidity:	20 % to 75 %

3.5.2 Normal test voltage

The normal test voltage shall be determined in each case and shall be the voltage corresponding to the voltage which the battery gives at normal temperature and humidity at a load equal to that of the equipment.

3.6 Extreme test conditions

3.6.1 Extreme temperatures

For tests at extreme temperatures, measurements shall be made in accordance with the procedure specified in subclause 3.8 at the lower and upper temperatures of - 10 °C and + 55 °C except when installed within other equipment subject to more stringent temperature requirement, in which case the more stringent requirement shall apply.

3.6.2 Extreme test voltages

3.6.2.1 Upper extreme test voltage

The upper extreme test voltage shall be determined in each case and shall be the voltage corresponding to the voltage which the battery gives at the upper extreme temperature with a load equal to that of the equipment.

3.6.2.2 Lower extreme test voltage

The lower extreme test voltage shall be determined in each case and shall be the voltage corresponding to the voltage which the battery gives at the extreme lower temperature with a load equal to that of the equipment, after 24 hours of operation.

3.7 Procedure for tests at extreme temperatures

The equipment shall be switched off during the temperature stabilization period.

Before tests are carried out, the equipment shall have obtained thermal balance in the test chamber and have been switched on for a period of 5 minutes.

3.8 Environmental tests

Environmental tests shall be carried out before tests in respect of the other requirements in this standard are performed on the same equipment. Where electrical tests are required, these shall be carried out with the normal test voltage.

The term performance check as used in this standard shall be taken to mean a check of the output power, frequencies, and modulation of the equipment.

The following tests shall be made under environmental conditions as detailed in Annex VI to CEPT Recommendation T/R 34-01: "Environmental Testing of Maritime Radio Equipment":

Vibration,	Paragraph 4
Dry heat cycle,	Paragraph 5.1
Damp heat cycle,	Paragraph 6
Low temperature cycle,	Paragraph 7.1

The equipment shall be placed in an atmosphere with a temperature of 70 °C +/- 3 °C for one hour. It shall then be immersed in water, with a temperature of + 20 °C +/- 3 °C, to a depth of 10 cm, measured from the highest point of the equipment to the surface of the water excluding the antenna, when extended, for a period of one hour.

Drop test: Before any electrical tests are commenced, a drop test shall be performed.

3.8.1 Drop Test

3.8.1.1 Definition

The immunity against the effects of dropping is the ability of the equipment to maintain the specified mechanical and electrical performance after being subjected to a series of drops on a hard wooden test surface.

3.8.1.2 Test conditions

During the test, the equipment shall be fitted with a suitable set of batteries and antenna but it shall be switched off. The test shall be carried out under normal temperature and humidity conditions as detailed in subclause 3.5.1.

The hard wooden test surface shall consist of a piece of solid hard wood with a minimum thickness of 15 cm and a mass of at least 30 kilograms.

The height of the lowest part of the equipment under test, relative to the test surface at the moment of release, shall be 1 m.

Equipment shall be subjected to this test in the configuration as it is normally used in operational circumstances.

3.8.1.3 Method of measurement

The test shall consist of six drops, once on each face.

3.8.1.4 Requirements

Inspection for mechanical damage, both internal and external, shall be carried out after completion of tests. Any damage shall not impair the operation of the equipment. In particular, parts like knobs, switches and the antenna shall operate in the normal manner. The act of dropping shall not cause the equipment to operate.

3.8.1.5 Post completion state

On completion of the tests in subclauses 3.8.1.2, 3.8.1.3, and 3.8.1.4, the equipment shall not show any sign of significant external damage or harmful penetration of water.

4 Frequencies, class of emission, and radiation characteristics

4.1 Frequencies

When activated, the EPIRB shall continuously or intermittently transmit on either the frequency 121,5 MHz or the frequencies 121,5 MHz and 243 MHz.

Intermittent transmissions shall have a duty cycle of not less than 2:1 ON/OFF, and the ON period shall have a duration of not less than 2 seconds and not more than 5 seconds.

4.2 Frequency error

4.2.1 Definition

The frequency error is the difference between the measured carrier frequency and its nominal value (see subclause 3.1).

4.2.2 Method of measurement

The carrier frequency shall be measured with the equipment placed in the test fixture (see subclause 3.2).

The measurement shall be made using the test power source (see subclause 3.4).

4.2.3 Limit

The frequency error under both normal and extreme test conditions or at any intermediate condition shall not exceed +/- 3,5 kHz for the frequency 121,5 MHz and +/- 7 kHz for the frequency 243 MHz.

4.3 Class of emission

The radio frequency transmission shall be amplitude modulated with full carrier and both sidebands (A3X).

The emission shall consist of a signal obtained by amplitude modulation of the carrier frequencies with a downward audio-frequency sweep within a range of not less than 700 Hz between 1600 Hz and 300 Hz, and with a sweep repetition rate of 2 to 4 times per second.

The signal may include information of the identity of the ship. If included, this information should be transmitted automatically and should not occupy a substantial part of the transmission time.

4.4 Modulation characteristics

4.4.1 Depth of modulation

Definition:

the depth of modulation is calculated from the formula: $\frac{A-B}{A+B}\times 100\%$

where A and B are respectively the maximum and minimum value of the envelope curve.

4.4.2 Modulation duty-cycle

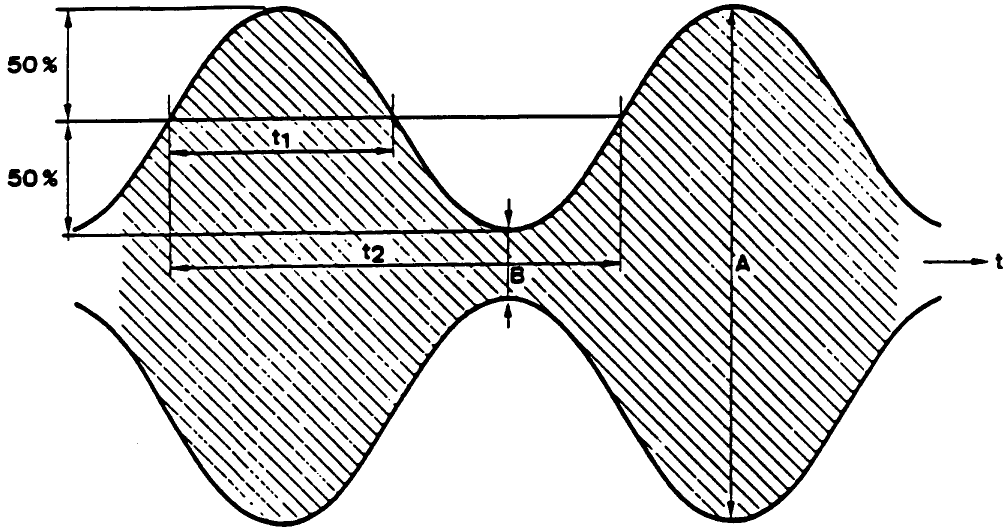
Definition:

the modulation duty cycle is the ratio: $\frac{t1}{t2}\times 100\%$

where t1 is the duration of the positive half cycle of the audio modulation measured at the half amplitude points of the modulation envelope, and t2 is the period of the fundamental of the audio modulation.

4.4.3 Method of measurement

The depth of modulation and the modulation duty cycle shall be measured with the EPIRB placed in the test fixture (see subclause 3.2). The emission is applied to the input of a storage oscilloscope. A display of the type shown in figure 1 can be obtained on the storage oscilloscope. The modulation duty cycle and the depth of modulation are calculated as represented in Figure 1.



Modulation depth: $\frac{A-B}{A+B}$ *x 100%*

Modulation duty cycle: $\frac{t1}{t2}$ *x 100%*

NOTE: This example displays a figure with a modulation of a sinusoidal type. Low modulation duty cycle may occur by over-modulation.

Figure 1

4.4.4 Limits

The depth of modulation shall be at least 85 %.

The modulation duty cycle shall be between 50 % and 70 %

4.5 Radiation characteristics

The radiation from the antenna shall be vertically polarised.

The radiation shall be omnidirectional in the horizontal plane.

In the case of equipment intended to operate whilst floating in water, the radiation from the equipment shall predominate at small angles of elevation.

The conditions specified in the above paragraphs may be satisfied with a vertical whip antenna having an electrical length of between one quarter and five eighths of the wavelength at the operating frequencies.

4.6 Radiated peak envelope power

4.6.1 Definition

The peak envelope power is the average power during one radio frequency cycle at the crest of the modulation envelope. The radiated peak envelope power is the peak envelope power required at the input of a quarter wave monopole antenna normal to a horizontal earth plane to produce at the same distance in a horizontal direction, the same field strength as produced by the equipment in the direction of maximum field strength under specified conditions.

4.6.2 Method of measurement

The radiated peak envelope power shall be measured by means of a substitution method.

On a test site fulfilling the requirements of Annex A, the equipment shall be placed on the support with that axis vertical which is closest to vertical in normal use.

The test antenna shall be orientated for vertical polarisation and shall be raised or lowered through the specified height range until a maximum signal level is detected on the test receiver.

The transmitter shall then be rotated through 360° until the minimum signal is received.

The transmitter shall be replaced by the substitution antenna and the test antenna raised or lowered as necessary to ensure that the maximum signal is received.

The input signal to the substitution antenna shall be adjusted in level until an equal or known related level to that detected from the transmitter, is obtained in the test receiver.

The peak envelope power is equal to the power supplied to the substitution antenna increased by the known relationship between the peak envelope power and the power delivered to the substitution antenna.

4.6.2.1 Method of measurement under extreme test conditions

The equipment shall be placed in the test fixture connected to the artificial load with a means of measuring the power delivered to this load.

The measurement shall be made under normal test conditions and repeated under extreme test conditions (subclauses 3.6.1 and 3.6.2 applied simultaneously).

4.6.3 Limit

The radiated peak envelope power shall, for all temperature conditions, be at least 75 mW on each frequency used during and at the end of 24 hours continuous operation.

For man-overboard devices only, this is reduced to 25 mW and 6 hours respectively.

4.7 Radiation produced by operation of the test facility

4.7.1 Definition

Radiation produced by operation of the test facility is the radiation at the nominal frequencies when the equipment is being tested.

4.7.2 Method of measurement

The EPIRB shall be held with the switch in the test position.

The method of measurement described in subclause 4.6 shall be used. However, the test shall be performed at normal test temperature only.

The transmitter shall be turned in all directions until the maximum radiation is found.

4.7.3 Limit

The test facility provided to indicate the correct functioning of the EPIRB shall not produce a peak effective radiated power, on each carrier frequency, greater than 25 nW.

4.8 Spurious emissions

4.8.1 Definition

Emission(s) on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products, and frequency conversion products, but exclude out-of-band emissions.

4.8.2 Method of measurement

Spurious emissions shall be measured using a test site described in Annex A.

The measurement shall be performed with the EPIRB in its normal operating position.

The method of measurement described in subclause 4.6 shall be used to search for spurious emissions in the frequency bands 108 - 137 MHz, 156 - 162 MHz, 406,0 - 406,1 MHz, and 450 - 470 MHz.

The measuring receiver shall have a bandwidth of 10 kHz.

The measurement shall only be performed under normal temperature conditions.

4.8.3 Limit

The power of any spurious emission component shall not exceed 25 mW, on any frequency.

4.9 Protection of the transmitter

4.9.1 Definition

When operating, the EPIRB transmitter shall not be damaged due to antenna mismatching.

4.9.2 Method of measurement

With the transmitter operating, the equipment shall be completely immersed in water for a period of 5 minutes. For equipment fitted with an extendable antenna, the test shall be carried out with the antenna fully extended, and repeated with the antenna fully retracted.

4.9.3 Requirement

The equipment shall operate normally upon completion of tests.

Annex A (normative): Test site and general arrangements for measurements involving the use of radiated fields

A.1 Test site

The test site shall be located on a surface or ground which is reasonably level. At one point of the site, a ground plane of at least 5 metres diameter shall be provided. In the middle of this ground plane a non-conducting support capable of rotation through 360° in the horizontal plane shall be used to support the test sample at 1,5 metres above the ground plane.

The test site shall be large enough to allow the erection of a measuring or a transmitting antenna at a distance of not less than half the wavelength corresponding to the lowest frequency to be considered.

The distance actually used shall be recorded with the results of the tests carried out on the test site. Sufficient precautions shall be taken to ensure that reflections from extraneous objects adjacent to the site and ground reflections do not degrade the measurements.

A.2 Test antenna

The test antenna shall be used to detect the radiation from both the test sample and the substitution antenna when the site is used for radiation measurements. When necessary it is used as a transmitting antenna when the site is used for the measurement of receiver characteristics. This antenna shall be mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarisation and for the height of its centre above ground to be varied over the range 1 to 5 metres. Preferably a test antenna with pronounced directivity should be used. The size of the test antenna along the measurement axis shall not exceed 20 % of the measuring distance.

For radiation measurements, the test antenna is connected to a test receiver capable of being tuned to any frequency under investigation and measuring accurately the relative levels of signals at its input. When necessary (for receiver measurements), the test receiver is replaced by a signal source.

A.3 Substitution antenna

The substitution antenna shall be a quarter wave monopole with quarter wave ground plane, resonant at the frequency under consideration. The centre of this antenna shall coincide with the reference point of the test sample it has replaced. This reference point shall be the volume centre of the sample when its antenna is mounted inside the cabinet or the point where an external antenna is connected.

The substitution antenna shall be connected to a calibrated signal generator when the site is used for radiation measurements and to a calibrated measuring receiver when the site is used for measurement of receiver characteristics. The signal generator and the receiver shall operate at the frequencies under investigation and shall be connected through suitable matching and balancing networks.

A.4 Alternative indoor site

For measurements when the frequency of the signal being measured is greater than 80 MHz, use may be made of an indoor site. If this alternative site is used this shall be recorded in the test report.[1)]

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1) The requirements for an indoor test site are under review. The details given are an example of such a site, which it is considered, will give acceptable results.

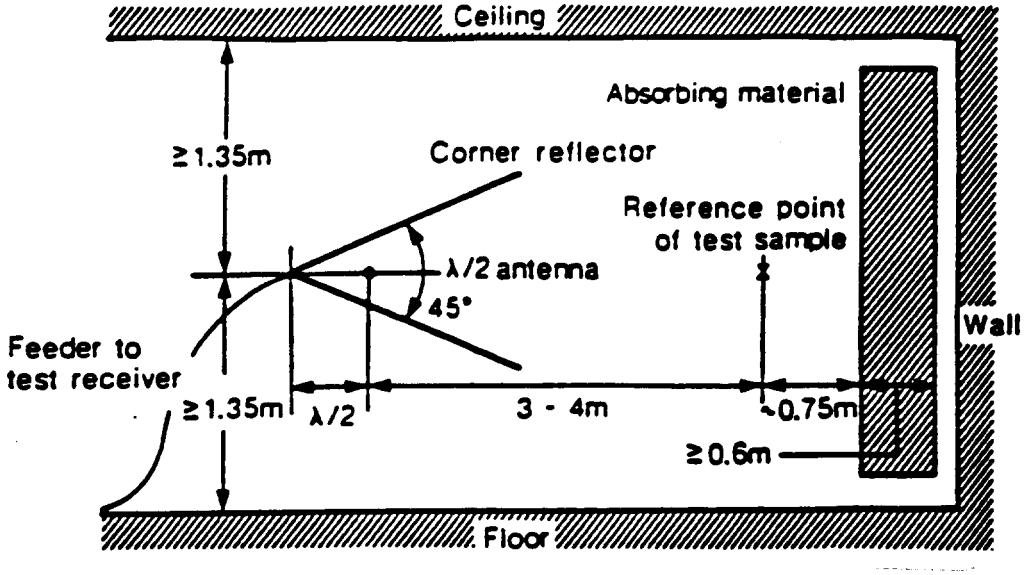

Figure A.1: Indoor site arrangement (shown for horizontal polarisation)

The measurement site may be a laboratory room having a minimum area of 6 metres by 7 metres and a height of at least 2,7 metres. Other than the measuring apparatus and the operator, the room shall be as free as possible from reflecting objects other than the walls, floor and ceiling.

NOTE: The requirements for an indoor test site are under review. The details given are an example of such a site, which it is considered, will give acceptable results.

The site arrangement is shown in principle by figure A.1. The potential reflections from the wall behind the equipment under test are reduced by placing a layer of absorbent material in front of it. The corner reflector around the test antenna is used to reduce the effect of reflections from the opposite wall and from the floor and ceiling in the case of horizontally polarised measurements. Similarly, the corner reflector reduces the effects of reflections from the side walls for vertically polarised measurements.

For the lower part of the frequency range (below approximately 175 MHz), no corner reflector or absorbing wall is needed.

For practical reasons, the half-wave test antenna in figure A.1 may be replaced by an antenna of constant length allowing it to be used at frequencies corresponding to between a quarter and one wavelength, as long as the sensitivity is sufficient. In the same way, the distance of a half-wave to the apex may be varied. The test antenna, test receiver, substitution antenna, and calibrated signal generator are used in a similar way to that in the general method.

To ensure that errors are not caused by the propagation path approaching the point at which phase cancellation between direct and remaining reflected signals occurs, the test sample shall be moved through a distance of +/- 0,1 m in the direction of the test antenna as well as in the two directions perpendicular to this first direction. If these changes of distance cause a signal change of greater than 2 dB the test sample should be re-sited until a change of less than 2 dB change is obtained.

History

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