IEC 61097-2

Edition 3.0 2008-01

INTERNATIONAL STANDARD

Global maritime distress and safety system (GMDSS) – Part 2: COSPAS-SARSAT EPIRB – Satellite emergency position indicating radio beacon operating on 406 MHz – Operational and performance requirements, methods of testing and required test results

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM (GMDSS) –

Part 2: COSPAS-SARSAT EPIRB – Satellite emergency position indicating radio beacon operating on 406 MHz – Operational and performance requirements, methods of testing and required test results

FOREWORD

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International Standard IEC 61097-2 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 2002, of which it constitutes a technical revision.

The significant changes in this edition include revised characteristics for the low duty cycle light in 3.3.3 c), together with a revised test in 5.3.3.3, to allow the use of white LEDs. Requirements for retro-reflecting material and the lanyard have been clarified in 3.3 noting the ever decreasing size of EPIRBs, and requirements for equipment manuals and labelling clarified in 3.11 and 3.12. Battery life requirements have been clarified in 4.6.2.

The test methods have been generally revised to align with the latest editions of COSPAS-SARSAT T.001 and T.007 and IEC 60945. An extra test requirement for a drop onto a hard

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surface has been added, together with further frequency bands for the measurement of spurious emissions to protect aeronautical communications.

Annex B, which reproduced some COSPAS-SARSAT material has been deleted and replaced with a new annex giving requirements for EPIRBs associated with navigation devices.

Annex C, concerning EPIRBs without a float free mechanism, has been expanded and Annex D, concerning the homing device, includes a new radiated power test “off ground plane” and clarification to the measurement of spurious emissions.

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

CDV	Report on voting
80/480/CDV	80/514/RVC

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.

A list of all parts of the IEC 61097 series, under the general title *Global maritime distress and safety system* (GMDSS), can be found on the IEC website.

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 publication may be issued at a later date.

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GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM (GMDSS) –

Part 2: COSPAS-SARSAT EPIRB – Satellite emergency position indicating radio beacon operating on 406 MHz – Operational and performance requirements, methods of testing and required test results

1 Scope

This part of IEC 61097 specifies the minimum performance requirements, technical characteristics and type-testing requirements of the satellite emergency position-indicating radio beacon used in the COSPAS-SARSAT satellite system (satellite EPIRB), as required by Regulation IV/7.1.6 of the 1988 amendments to the 1974 International Convention for Safety of Life at Sea (SOLAS), and which is associated with IEC 60945. When a requirement in this standard is different from IEC 60945, the requirement in this standard takes precedence.

This standard incorporates the performance standards of IMO Resolution A.810(19), the International Telecommunication Union (ITU) Radio Regulations as well as the technical characteristics for such transmitters contained in Recommendation ITU-R M.633, and takes account of the general requirements contained in IMO Resolution A.694(17). This standard further takes account of IMO Resolution A.696(17) concerning the type approval of satellite EPIRBs.

This standard also includes minimum performance standards for a non-float-free satellite EPIRB without float-free release mechanism (see Annex C).

NOTE 1 Although a number of the requirements and tests may be similar this standard is not intended to be used with 406 MHz Ship Security Alert System (SSAS) Beacons.

All texts of this standard, whose wording is identical to that in the IMO SOLAS Convention 1974 as amended and Resolutions A.662(16), A.694(17), A.702(17) and A.810(19) and Recommendation ITU-R M.633 will be printed in italics and the Resolution/Recommendation and paragraph number indicated between brackets.

NOTE 2 Classes of satellite EPIRB's considered in this document are:
– Class 1: Float-free (–40 °C to +55 °C). The float-free release mechanism (A.662(16)) should be capable of operating throughout the temperature range of –30 °C to +65 °C.

This class is not required by IMO Resolutions but may be applied at the discretion of each Administration.

– Class 2: Float-free (–20 °C to +55 °C). The float-free release mechanism (A.662(16)) should be *capable of operating throughout the temperature range of –30 °C to +65 °C.*

NOTE 3 Non float-free, satellite EPIRB's in both classes are considered in Annex C.

NOTE 4 All classes include a 121,5 MHz homing device, described in Annex D.

NOTE 5 All classes may include beacon position data, obtained from a navigation device internal or external to the satellite EPIRB as described in Annex B.

NOTE 6 User experience of COSPAS-SARSAT satellite EPIRB operation leading to some clarification of IMO performance standards, and providing some useful information for satellite EPIRB users is included in Annex E.

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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, *Marine navigation and radiocommunication equipment and systems – General Requirements – Methods of testing and required test results*

IEC 61108-1, *Maritime navigation and radiocommunication equipment and systems – Global Navigation Satellite Systems (GNSS) – Part 1: Global Positioning System (GPS) – Receiver equipment – Performance standards, methods of testing and required test results*

ISO 15734:2001, *Ships and marine technology – Hydrostatic release units*

IMO Resolution A.658(16):1989, *Use and fitting of retro-reflective materials on life-saving appliances*

IMO Resolution A.662(16):1989, *Performance standards for float-free release and activation arrangements for emergency radio equipment*

IMO Resolution A.694(17):1991, *General requirements for shipborne radio equipment forming part of the global maritime distress and safety system (GMDSS) and for electronic navigational aids*

IMO Resolution A.696(17):1991, *Type approval of satellite emergency position-indicating radio beacons (EPIRBs) operating in the COSPAS-SARSAT system*

IMO Resolution A.702(17):1991, *Radio maintenance guidelines for the global maritime distress and safety system (GMDSS) related to sea areas A3 and A4*

IMO Resolution A.810(19):1995, *Performance standards for float-free satellite emergency position-indicating radio beacons (EPIRBs) operating on 406 MHz,* as amended by IMO Resolution MSC.56(66) and IMO Resolution MSC.120(74)

IMO Resolution MSC.48(66):1996, *International life-saving appliance code*

IMO Resolution MSC.81(70):1998, *Revised recommendation on testing of life-saving appliances,* as amended by IMO Resolution MSC.200(80)

ITU-R Recommendation M.585, *Assignment and use of maritime mobile service identities*

ITU-R Recommendation M.633, *Transmission characteristics of a satellite emergency position-indicating radio beacon (satellite EPIRB) system operating through a satellite system in the 406 MHz band*

ITU-R Recommendation M.690, *Technical characteristics of emergency position indicating radio beacons (EPIRBs) operating on the carrier frequencies of 121,5 MHz and 243 MHz*

COSPAS-SARSAT
C/S T.001, *Specification for COSPAS-SARSAT 406 MHz Distress Beacons*
C/S T.007, *COSPAS-SARSAT 406 MHz Distress Beacon Type Approval Standard* (as applicable to satellite EPIRBs)
C/S T.012, as amended, *COSPAS-SARSAT 406 MHz Frequency Management Plan*

IMO Safety of Life at Sea (SOLAS) Convention 1974, as amended.

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United Nations *Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, Fourth Revised Edition, PART III, Section 38.3 (ST/SG/AC.10/11/Rev.4).*

3 Performance requirements

3.1 Compliance

(A.810(19)/A.1) *The satellite emergency position-indicating radio beacon (EPIRB)* shall, *in addition to meeting the requirements of the Radio Regulations, the relevant ITU-R Recommendations and the general requirements set out in resolution A.694(17) comply with the following performance Standard.*

In addition to this performance Standard, the satellite EPIRB shall comply with the requirements of COSPAS-SARSAT documents C/S T.001, C/S T.007 and C/S T.012.

The radio frequency of operation of the equipment shall at all times be within the limits defined by the Radio Regulations.

3.2 General

The following are general requirements for the satellite EPIRB.

a) The satellite EPIRB shall be (IV/7.1.6.3) *ready to be manually released and capable to be carried by one person into a survival craft*.

b) (A.810(19)/A.2.1) *The satellite EPIRB* shall *be capable of transmitting a distress alert to* the satellites comprising the COSPAS-SARSAT system operating in the 406 MHz band*.*

c) The satellite EPIRB shall be designed to operate according to this standard when floating in the sea and shall also be capable of operating on board a ship and on a survival craft.

d) (A.810(19)/A.2.2) *The* satellite *EPIRB* shall *be of an automatic float-free type. The equipment, mounting and releasing arrangements* shall *be reliable and operate satisfactorily under the most extreme conditions likely to be met with at sea.*

e) (A.662(16)/1) *Float-free release and activation arrangements* shall *enable the automatic release of the satellite EPIRB from a sinking ship and its automatic activation*. Table 1 shows the correct combination of control functions to prevent or enable activation.

Table 1 – EPIRB control functions

Control position		EPIRB condition		EPIRB-mount or release mechanism status		Transmitter status	
ON	**READY**	**WET***	**DRY**	**OUT**	**IN**	**ON**	**OFF**
X		X		X		X	
X		X			X	X	
X			X	X		X	
X			X		X	X	
	X	X		X		X	
	X	X			X		X
	X		X	X			X
	X		X		X		X
* Floating or immersed in water.							

f) (A.694(17)/1.2) *Where a unit of equipment provides a facility which is additional to the minimum requirements of this* standard, such as an internal navigation device (Global Navigation Satellite System (GNSS) receiver) or the possibility of connecting external

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navigation data, *the operation, and as far as is reasonably practicable, the malfunction of such additional facility* shall *not degrade the performance of the equipment below those minimum standards.* The additional facility shall, as a minimum, meet the appropriate requirements of IEC 60945, as applicable. Where such an additional facility exists, it shall not prevent the satellite EPIRB fully conforming to the requirements of this standard during normal combined operation. Any internal or external navigation device connected to, or forming part of, the satellite EPIRB shall comply with the requirements of Annex B.

g) The satellite EPIRB shall be a single integral unit. No part of it shall be detachable without the use of tools.

3.3 Operational

3.3.1 Prevention of inadvertent activation

The satellite EPIRB shall:

a) (A.810(19)/A.2.3.1) *be fitted with adequate means to prevent inadvertent activation* and deactivation;

b) not automatically activate when water washes over it while in its release mechanism. See Table 1;

c) be designed to limit any inadvertent continuous 406 MHz transmission to a maximum of 45 s.

3.3.2 Immersion, buoyancy and drop into water

The satellite EPIRB shall:

a) (A.810(19)/A.2.3.2) *be so designed that the electrical portions are watertight at a depth of 10 m for at least 5 min. Consideration* shall *be given to a temperature variation of 45 °C during transitions from the mounted position to immersion. The harmful effects of a marine environment, condensation and water leakage* shall *not affect the performance of the beacon;*

b) (A.810(19)/A.2.3.6) *be capable of floating upright in calm water and have positive stability and sufficient buoyancy in all sea conditions*;

c) (A.810(19)/A.2.3.7) *be capable of being dropped into the water without damage from a height of 20 m.*

3.3.3 Activation

The following describes the activation of the satellite EPIRB.

a) The satellite EPIRB shall (A.810(19)/A.2.3.3) *be automatically activated after floating free* or when floating in the water, irrespective of the settings of any control. See Table 1.

b) The satellite EPIRB shall (A.810(19)/A.2.3.4) *be capable of* repetitive *manual activation and manual deactivation*.

   Manual deactivation shall not prevent automatic activation of the satellite EPIRB when automatically released from its release mechanism or when floating in the water.

c) The satellite EPIRB shall (A.810(19)/A.2.3.11) *be provided with a low-duty cycle* white *light* (of at least effective *0,75 cd) active during darkness* and all other lighting conditions, and flashing at a rate of 20 to 30 times per minute, with a flash duration of between 10^{-6} s and 10^{-1} s *to indicate its position for the nearby survivors and rescue units.*

   The light shall be mounted so that it produces effective 0,75 cd or greater over as great a portion of the upper hemisphere as is practical. The arithmetic mean of the light output over the entire upper hemisphere shall not be less than effective 0,50 cd.

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NOTE Note that there can be areas of lower intensity at spots around the satellite EPIRB and as the elevation increases to allow for mounting bushes, controls and the antenna etc and for the fact that at higher elevation angles the range to rescue units is reduced.

d) When the satellite EPIRB is manually activated, the low-duty cycle light (see 3.3.3 c)) shall begin flashing within 2 s, in any lighting condition, and no distress signal shall be emitted until at least 47 s and at most 5 min after the satellite EPIRB has been manually activated.

e) After start of transmission of the distress signal, the operation of the low-duty cycle light should be in accordance with 3.3.3 c).

f) The satellite EPIRB shall (A.810(19)/A.2.3.5) *be provided with means to indicate that signals are being emitted*. The low-duty cycle light operating in accordance with 3.3.3 c), is an acceptable indication.

g) The satellite EPIRB shall (A.810(19)/A.2.3.14) *be provided with a 121,5 MHz beacon primarily for homing by aircraft.*

3.3.4 Self-test

The satellite EPIRB shall (A.810(19)/A.2.3.8) *be capable of being tested, without using the satellite system, to determine that the* satellite *EPIRB is capable of operating properly.*

When the self-test mode (see C/S T.001) is activated, the satellite EPIRB shall emit a single modulated burst which shall always provide the beacon 15 Hex ID. The frame synchronization pattern shall be "011010000" (i.e. the last eight bits are complemented so that this test burst will not be processed by the satellite equipment and the burst duration shall be 440 ms or 520 ms).

For location protocol beacons, the content of the encoded position data field of the self-test message should be the default values specified in C/S T.001. Successful completion of the test shall be indicated. Activation of the test facility shall reset automatically. The 121,5 MHz auxiliary radio-locating device signal shall also be transmitted during the self-test, but it shall not exceed 3 audio sweeps or 1 s, whichever is greater. The self-test function shall perform an internal check and indicate that RF power is being emitted at 406 MHz and at 121,5 MHz.

3.3.5 Colour and retro-reflecting material

The satellite EPIRB shall (A.810(19)/A.2.3.9) *be of highly visible yellow/orange colour and be fitted with retro-reflecting material.*

The minimum area of retro-reflective material visible above the water-line of the satellite EPIRB shall be at least 25 cm^2. This shall be achieved by retro-reflective material, at least 25 mm wide, with at least 5 cm^2 viewable from every angle on the horizon.

The retro-reflective material shall also meet the performance requirements of IMO Resolution A.658(16) Annex 2.

3.3.6 Lanyard

The satellite EPIRB shall (A.810(19)/A.2.3.10) *be equipped with a buoyant lanyard*, firmly attached to it, suitable for use as a tether for survivors or from a survival craft in the water. It shall *be so arranged as to prevent its being trapped in the ship's structure when floating free*.

The buoyant lanyard shall have a length of 5 m to 8 m. The breaking strength of the lanyard and its attachment to the satellite EPIRB shall be at least 25 kg.

3.3.7 Exposure to the marine environment

The satellite EPIRB shall *not* (A.810(19)/A.2.3.12), including the labelling, *be unduly affected by sea water or oil or both;* and (A.810(19)/A.2.3.13) *be resistant to deterioration in prolonged exposure to sunlight.*

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3.3.8 Ergonomics

The satellite EPIRB shall have all controls of sufficient size for simple and satisfactory operation and also be capable of being operated by a person wearing an immersion suit as defined in the IMO Lifesaving Appliance Code (Resolution MSC.48(66), section 2.3). This shall include removing the EPIRB from its bracket, manual activation and deactivation of the control function and deployment of th lanyard.

3.3.9 Indication of previous activation

The satellite EPIRB shall be provided with means to indicate that the satellite EPIRB has been previously activated, to advise the users of a possible reduction of the required battery capacity. These means shall not be capable of reset by the user.

For example, manual activation of the satellite EPIRB requires the breaking of a seal, which shall not be replaceable by the user.

This indication of operation shall not be activated when using the self-test facility.

3.4 Distress function

(A.810(19)/A.3.1) *When the satellite EPIRB is manually operated a distress alert* shall *be initiated only by means of a dedicated distress alert activator (*see Table 1).

The dedicated activator shall:

a) (A.810(19)/A.3.2.1) *be clearly identified; and*

b) (A.810(19)/A.3.2.2) *be protected against inadvertent operation.*

(A.810(19)/A.3.3) *Manual distress alert initiation* shall *require at least two independent actions* neither of which on its own shall activate the satellite EPIRB.

The following actions shall not be counted as one of the two independent actions required to activate the satellite EPIRB

– breaking a seal or other means provided to comply with 3.3.9;

– manual removal from the bracket; or

– inversion.

(A.810(19)/A.3.4) *The satellite EPIRB* shall *not be automatically activated after being manually removed from the release mechanism* (dry EPIRB condition).

3.5 Float-free arrangements

3.5.1 General

The float-free arrangement shall:

a) (A.662(16)/2.1) *be designed so that the release mechanism* shall *operate before reaching a water depth of 4 m in any orientation.* Any hydrostatic release unit used in the float-free release mechanism shall comply with IMO Lifesaving Appliance Code (IMO Resolution MSC.48(66)) paragraph 4.1.6.3 and ISO 15734.

b) (A.662(16)/2.4) *be constructed to prevent release when seas wash over the unit.*

c) have its release mechanism fitted with adequate means to prevent its inadvertent activation (see Table 1).

d) (A.662(16)/2.3) *be constructed of non-corrosive compatible materials, so as to prevent deterioration which may cause any malfunction of the unit. Galvanizing or other forms of metallic coating on parts of the float-free release mechanism* shall *not be accepted*.

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e) (A.662(16)/2.5) including the labelling*, not be unduly affected by seawater or oil or prolonged exposure to sunlight.*

3.5.2 External power or data connection

(A.662(16)/3) For the satellite EPIRB *requiring external power or data connection, or both, the means of connection* shall *not inhibit the release from the release mechanism or activation of the satellite* EPIRB.

3.5.3 Ability to check the automatic release

(A.662(16)/4) With the exception of disposable hydrostatic release units, *it* shall *be possible to assess the proper functioning of the automatic release mechanism by a simple method without activation of the* satellite EPIRB.

3.5.4 Manual release

(A.662(16)/5) *It* shall *be possible to release the* satellite EPIRB *manually from the float-free mechanism*, without tools.

3.6 Environment for satellite EPIRB

(A.810(19)/A.2.5) *The satellite EPIRB* shall *be so designed as to operate under any of the following environmental conditions:*

3.6.1 Temperature and icing

a) Ambient temperatures of –40 °C to +55 °C for class 1.

b) *Ambient temperatures of –20 °C to +55 °C* for class 2.

c) *Icing.*

3.6.2 Wind speed

(A.810(19)/A.2.5.3) *Relative wind speeds up to 100 knots* (52 m/s).

3.6.3 Stowage

After stowage at temperatures between –40 °C and +70 °C for class 1 and between *–30 °C and +70 °C* for class 2.

NOTE In this standard the term “Stowage” is generally used when referring to non-operational equipment temperature ranges. However, in some standards such as IEC 60945 the alternative term “Storage” is used. These terms are to be considered interchangeable in the context of their use in this standard.

3.6.4 Shock and vibration

(A.810(19)/A.2.6.2) *Be capable, while mounted on board, of operating properly over the ranges of shock and vibration and other environmental conditions normally encountered above deck on sea-going vessels*.

3.7 Environment for float-free arrangement

The float-free arrangement shall:

a) (A.662(16)/2.2) *be capable of operating throughout the temperature range of* –30 °C to +65 °C for all classes of satellite EPIRB.

b) (A.662(16)/2.6) *be capable of operating properly after exposure to shock and vibration and other severe environmental conditions encountered above deck on seagoing vessels.*

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c) (A.662(16)/2.7) *if the ship navigates in areas where icing may be expected, be so designed as to minimize the formation of ice and prevent its effects from hindering the release of the* satellite EPIRB *as far as practicable*.

d) not be damaged in stowage throughout the temperature range of –30 °C to +65 °C for all classes of satellite EPIRB.

NOTE It should be noted that the Stowage and Operating temperature ranges for the satellite EPIRB are different to those of the float-free arrangement.

3.8 Interference – electromagnetic compatibility

(A.694/6.1) *All reasonable and practicable steps* shall *be taken to ensure electromagnetic compatibility between the equipment concerned and other radiocommunication and navigational equipment carried on board in compliance with the relevant requirements of chapters III, IV and V of the SOLAS Convention.*

Refer to the appropriate subclauses of Clause 5 of this standard and IEC 60945 for the requirements.

3.9 Maintenance

(A.702(17)/3.2) *It should be recognized that, despite the use of other methods, some reliance on shore-based maintenance to ensure the availability of the functional requirements of the GMDSS will always be necessary*.

As defined in 3.2 g), the satellite EPIRB is a single integral unit, which is not suited for on-board repairs.

As a consequence, the equipment shall be so constructed that it is readily accessible for inspection and testing purposes only, access to the interior of the satellite EPIRB shall only be possible with the use of tools.

3.10 Safety precautions

All practicable steps shall be taken to ensure that the equipment is in accordance with the appropriate clauses of IEC 60945.

In addition, the battery shall not release toxic or corrosive products outside the satellite EPIRB during or subsequent to storage at temperatures between –55 °C and +75 °C, and:

a) during a full or partial discharge at any rate up to and including an external short circuit;

b) during a charge or forced discharge of a cell or cells by another cell or cells within the battery;

c) after a full or partial discharge.

The satellite EPIRB shall include measures to protect the batteries from reversal of polarity, shorting, and the effects of self-heating, cell-to-cell charging, and forced discharging.

Moreover, care shall be taken that the satellite EPIRB and specially the battery shall not be hazardous to any person handling, using or performing manufacturer approved servicing of the device or to any vehicle or equipment in which it is transported, housed or installed under any of the conditions specified in this standard.

3.11 Equipment manuals

Adequate information, as needed to comply with 3.9 and 3.13, shall be provided to enable the equipment to be properly stowed, installed, operated and tested.

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The information supplied with the satellite EPIRB shall include pictorial operating instructions on a waterproof placard, suitable for mounting on a bulkhead. Numerals may be used to indicate the order of the illustrated operations, but words should not be used as part of the instructions.

The equipment manual shall also include:

– an overview of the COSPAS-SARSAT system;
– complete instructions for the operation and the self testing of the satellite EPIRB;
– cautions and recommendations to prevent false alerts;
– instructions for licensing and registration, registration renewal and a discussion on the importance of accurate registration;
– battery information including replacement instructions, battery type, and safety information regarding battery use and disposal;
– an instruction to replace the battery after the satellite EPIRB is operated for any purpose other than a test;
– the minimum operating life-time and operating and stowage temperatures;
– the purpose of the lanyard and a precaution against using it to secure the satellite EPIRB to the ship;
– a recommendation against attempting to operate the satellite EPIRB inside a life raft or under any similar cover or canopy;
– the servicing and/or replacement of any hydrostatic release unit and any associated components subject to ageing, such as release rods;
– manufacturer recommendations, if any, on periodic functional testing, possibly in connection with battery replacement;
– a note to keep the original satellite EPIRB packaging, since it may be needed if the EPIRB has to be shipped for servicing. UN requirements for shipping some batteries as hazardous goods require certain packaging standards and labelling;
– instructions for the safe transportation or shipping of the satellite EPIRB or the location where such information can be obtained by the user;
– warranty information;
– a warning to the effect that the Satellite EPIRB shall not be operated except in an emergency;
– a warning against installation near strong magnetic fields, if that might activate the satellite EPIRB;
– a recommendation to mounting the satellite EPIRB as high as possible, especially on small vessels. This will help ensure operation of the hydrostatic float-free release unit, in the event the vessel capsizes without sinking;
– a recommendation to limit self-testing to the minimum necessary to ensure confidence in the operation of the satellite EPIRB;
– a warning to limit testing to the first five minutes of the hour, as the satellite EPIRB emits a 121,5 MHz signal during self-test;
– if appropriate a list of approved external GNSS Receivers for those satellite EPIRBs accepting external navigation inputs together with instructions for connecting and setting up the external devices;
– if appropriate for those satellite EPIRBs with an integral GNSS receiver or that can be interfaced with an external GNSS receiver, information to guide the operator towards maximizing self-locating performance including a warning not to obstruct the GNSS antenna's view of the sky.

The equipment manual shall include information explaining the necessity to report satellite EPIRB false alarms by the most expedient means to the nearest search and rescue

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authorities. The information that should be reported includes the satellite EPIRB 15-Hex ID; date, time, duration and cause of activation; and location at time of deactivation.

3.12 Labelling

3.12.1 Equipment labelling

The label or labels shall be placed on the satellite EPIRB itself and on its container, if any, as needed.

(A.810(19)/A.4) *In addition to the items specified in IMO Resolution A.694(17)* 6.3 and 9 (see appropriate clauses of IEC 60945) *on general requirements, the following shall be clearly indicated on the exterior of the equipment*:

a) (A.810(19)/A.4.1) *brief operating instructions* at least in English, to enable manual activation, deactivation and self-test (see 3.3.4);

b) a warning to the effect that the satellite EPIRB shall not be operated except in an emergency;

c) type designation and class (see Clause 1, note) as specified by the manufacturer, type of battery and (A.810(19)/A.4.2) *expiry date for the primary battery used* (see 4.6). Means shall be provided to change this date when the battery is replaced;

d) the name of the ship and beacon identification data:

   1) (A.810(19)/A.4.3) *the identity code programmed into the transmitter* of the satellite EPIRB (i.e. hexadecimal representation of bits 26 to 85 of the digital message, as described in C/S T.001), together with the call sign or MMSI of the ship as required by the Administration and the MID;

   2) country (i.e. name of country as programmed in the MID);

   3) a space for registration information (for instance Decals) as required by administrations;

e) if applicable, for those satellite EPIRBs with an integral GNSS receiver or that can be interfaced with an external GNSS receiver, a statement that the device either contains a GNSS receiver or may be interfaced to one and, if necessary, brief operating instructions relevant to this feature;

f) a warning to limit testing to the first five minutes of the hour, as the satellite EPIRB emits a 121,5 MHz signal during self-test.

3.12.2 Float-free arrangement labelling

(A.662(16)/2.9) *The float-free arrangement* shall *carry a label* or labels *indicating clearly* at least in English:

a) *the operating instructions for manual release*;

b) the type designation;

c) the satellite EPIRB class;

d) the maintenance and/or replacement date for the release mechanism, if applicable.

If this label or labels are not readily visible in the installed arrangement, they shall be provided in addition, for installation close to the float-free arrangement. These instructions may in addition be shown in pictorial form.

3.13 Installation

The equipment manual shall contain instructions to ensure that *the installed satellite EPIRB* shall:

a) (IV/7.1.6.2) *be installed in an easily accessible position*;

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b) (A.694(17)/2) *be installed in such a manner that it is capable of meeting the requirements of this standard*;

c) (A.810(19)/A.2.6.1) *have local manual activation; remote activation may also be provided from the navigating bridge, while the device is installed in the float-free mounting*;

d) (A.810(19)/A.2.6.3) *release itself and float-free before reaching a* water *depth of 4 m at a list or trim of any angle*;

e) (A.662(16)/2.8) *be mounted in such a way that, after being released,* it *is not obstructed by the structure of the sinking ship.*

4 Technical characteristics

4.1 Transmitted frequency

The satellite EPIRB distress alerting signal shall be transmitted on a frequency in the 406 MHz band as specified in the COSPAS-SARSAT 406 MHz Channel Assignment table in C/S T.012.

4.2 Signal and message format

(A.810(19)/B.1) *The technical characteristics of the transmitted signal and the message format* shall *be in accordance with the requirements of the COSPAS-SARSAT System document C/S T.001.*

4.3 Distress message memory

(A.810(19)/B.2) *Provisions* shall *be included for storing the fixed portion of the distress message in the satellite EPIRB using non-volatile memory*.

4.4 Beacon identification code

(A.810(19)/B.3) *A unique beacon identification code* shall *be made part of all messages.*

This identification code shall *include a 3-digit code for the country in which the beacon is registered, followed by either*

a) *the trailing 6 digits of the ship station identity in accordance* with ITU-R Recommendation M.585 or

b) *a unique serial number or*

c) *a radio call sign.*

4.5 121,5 MHz homing signal

(A.810(19)/B.4) *The 121,5 MHz homing signal* shall:

a) *have a continuous duty cycle except that it may be interrupted for up to a maximum of 2 s during the transmission of the 406 MHz signal;*

b) with the exception of the sweep direction, meet the technical characteristics from ITU-R Recommendation M.690-1*. The sweep may either be upward or downward.*

4.6 Power source

4.6.1 General

(A.810(19)/A.2.4) *The battery* shall *have sufficient capacity to operate the satellite EPIRB for* an uninterrupted *period of at least 48 h,* under the extreme operating temperature conditions corresponding to the class of the satellite EPIRB.

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The satellite EPIRB shall be designed so that the electronic and electrical components are not damaged in the event of a leaking battery.

4.6.2 Battery life and expiry date

The life of the battery as defined by its expiry date shall be at least three years.

The expiry date of the battery shall be the battery manufacturing date plus no more than half the useful life of the battery.

The useful life of the battery is defined as the period of time after the date of battery manufacture that the battery will continue to meet the input power requirements of the satellite EPIRB for at least 48 hours under worst case conditions, after allowing for all losses over the useful life of the battery.

To define the useful life of the battery, the following losses at the temperature of +20 °C ± 5 °C shall be included, in addition to the power required to operate the satellite EPIRB:

a) self-testing (including any special self test modes (for instance GPS self test)), as recommended by the manufacturer or as required by the Administration, whichever is more demanding;

b) self-discharge of the battery;

c) stand-by loads.

NOTE For example a battery that has a useful life of 10 years from the date of manufacture, cannot have an expiry date that exceeds 5 years from the date of manufacture and would have to be capable of providing enough power for 10 years of self-testing, self-discharge and stand-by loads in addition to the operational power requirement of the satellite EPIRB.

4.6.3 Expiry date indication

The satellite EPIRB shall be clearly and durably marked with the battery expiry date (see 3.12.1 c)).

4.6.4 Reverse polarity protection

It shall not be possible to connect the battery with the polarity reversed.

4.7 Antenna characteristics

The antenna shall meet the requirements of C/S T.001, paragraph 2.3.3.

5 Methods of testing and required test results

5.1 General

5.1.1 COSPAS-SARSAT type approval

The requirements of this clause are in addition to the COSPAS-SARSAT requirements for type approval, as per COSPAS-SARSAT documents C/S T.001 and C/S T.007. Tests shall be normally carried out at test sites accepted by the type approval authority. The manufacturer shall, unless otherwise agreed, set up the equipment and ensure it is operating normally before testing commences. If the test site accepted by the type approval authority is also an accepted COSPAS-SARSAT test facility, both series of tests may be combined.

The COSPAS-SARSAT tests consist of the following:

a) electrical and functional tests at constant temperatures (minimum, normal test conditions and maximum);

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b) thermal shock test;

c) operating lifetime at minimum temperatures;

d) frequency stability test with temperature gradient;

e) satellite qualitative tests;

f) beacon antenna tests;

g) navigation system test (if applicable);

h) beacon coding software.

5.1.2 Power supply

Electrical power shall be supplied during performance tests normally by the batteries which form a part of the equipment. For type-approval tests, a minimum of three sets of batteries shall be submitted.

5.1.3 Warm-up period

The requirements of this standard shall be met (C/S T.001) after a maximum warm-up period of 15 min.

5.1.4 Instructions

Adequate information shall be provided to enable the equipment to be properly set up, maintained and operated during the type testing.

5.1.5 Additional facilities

(See 3.2 f))

If the equipment contains any additional facilities such as an internal navigation device (Global Navigation Satellite System (GNSS) receiver) or the possibility of connecting external navigation data, they shall be operational in the manner that causes worst case loading on the battery (for example internal GNSS receiver not allowed to achieve a position fix) for the duration of all tests, except if specified otherwise herein.

5.1.6 Audible and visual indications

During testing, all audible and visual indications including the low-duty cycle light shall be operational.

5.1.7 Preparation of satellite EPIRB for type-approval testing

For the purpose of performance testing, the satellite EPIRB shall be specially programmed to transmit data bursts encoded using (C/S T.007) the test protocol of appropriate type and format, when the satellite EPIRB is activated:

Evidence of compliance with all the requirements of this sub-clause shall be submitted by the manufacturer before testing commences.

(C/S T.007- 4.3 test units) The satellite EPIRB shall be configured so that the antenna port can be connected to the test equipment by a coaxial cable terminated by a 50 Ω load. All necessary signal or control devices shall be provided by the beacon manufacturer to simulate nominal operation of all ancillary devices of the beacon, such as external navigation input signals and manual control, in accordance with C/S T.007 Annexes A.3.7 and A.3.8 (if applicable), while in an environmental test chamber. The means to operate these devices in an automated and programmable way shall also be provided by the manufacturer. The configuration of the antenna port can be prepared by the manufacturer before the first test or before test of the list of tests A.1.12 given in Annex A. All tests up to A.1.14, except test

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A.1.10 shall be performed with the antenna in place. (See Annex A for the required sequence of tests.) Test A.1.10 is to be performed with the beacon operating into 50 Ω load.

All homing devices shall be prepared for test transmission as required by the national authority. Care shall be taken not to transmit distress signals on distress and safety frequencies, for example, by frequency offset of the 121,5 MHz homing signal to a maximum frequency of 121,65 MHz.

5.1.8 Test conditions

Tests shall be carried out under normal test conditions, unless otherwise stated.

5.1.8.1 Normal test conditions

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 %

5.1.8.2 Extreme test conditions

For tests at extreme temperatures, measurements shall be made in accordance with the procedure specified in IEC 60945.

Applicable temperature ranges:

For class 1 satellite EPIRBs:	–40 °C to +55 °C
For class 2 satellite EPIRBs:	–20 °C to +55 °C
For float-free arrangements:	–30 °C to +65 °C

5.1.9 Test sequence

All tests shall be performed on a single equipment, configured as indicated in 5.1.7. The tests shall be carried out in the order defined in Annex A of this standard. Alternatively, one equipment configured as indicated in 5.1.7 may be used for tests A.1.1 to A.1.14 of Annex A and another or other ones for tests A.2.1 to A.2.12.

5.1.10 Performance check

For the purpose of this standard, a performance check consists in activating the satellite EPIRB (see 5.1.7) and checking, using suitable test equipment (for example a hand held Beacon Tester), the 406 MHz transmitted frequency (single burst only), the 406 MHz digital message (15 Hex ID and all 112 or 144 Hex message bits as appropriate) and the presence of Auxiliary Radio-Location Device transmissions (Homing Transmitter output).

5.1.11 Performance test

For the purpose of this standard, a performance test consists in activating the satellite EPIRB (see 5.1.7) and measuring the following as defined in C/S T.007 Annex A.2.1:

a) 406 MHz transmitted power output;

b) 406 MHz digital message;

c) 406 MHz digital message generator (Bit Rate and Stability (T.007 A.3.1.3) only);

d) 406 MHz modulation;

e) 406 MHz transmitted frequency; and

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f) 406 MHz spurious output.

5.2 General tests

(See 3.2)

The requirements of 3.2 a) shall be verified by inspection.

The requirements of 3.2 b) are considered verified by successful completion of the COSPAS-SARSAT type approval tests specified in 5.1.1.

The requirements of 3.2 c) are considered verified by successful completion of all tests in Annex A.

If the equipment contains any additional facilities the manufacturer shall provide evidence that, as a minimum, they meet the appropriate requirements of IEC 60945 to satisfy the requirements of 3.2 f). In addition any internal navigation device (Global Navigation Satellite System (GNSS) receiver) or external navigation data input shall meet the requirements of Annex B.

The requirements of 3.2 g) shall be verified by inspection.

5.2.1 Tests for float-free arrangements

(See 3.2 d) and 3.2 e))

The satellite EPIRB installed in the automatic release mechanism shall be submerged in water, at normal temperature for all tests. The water temperature shall be noted. The following tests may be performed in any sequence.

The test at normal temperature shall be performed six times with the equipment rotated each time as follows:

– normal mounting position (as defined in the equipment manual, see 3.11);
– rolling 90° to starboard;
– rolling 90° to port;
– pitching 90° bow down;
– pitching 90° stern down;
– upside-down position.

The satellite EPIRB shall be automatically released and float-free of the mounting before reaching, at any orientation, a depth of 4 m or, at a water pressure equivalent to that depth, namely 40 kPa.

The tests at the extreme temperatures shall be performed in the normal mounting position(s) only, as defined in the equipment manuals.

NOTE Where the tests required at extreme temperatures cannot be carried out within the environmental chamber, other methods may be used which approximate the required conditions.

Any climatic control devices provided in the equipment may be switched on before or during the test.

An inspection test for mechanical deterioration and/or water penetration shall be carried out after each release of the satellite EPIRB from its float-free mechanism. Subject to satisfactory performance checks, as defined below, opening of the satellite EPIRB to check for water ingress may be delayed until the completion of all tests.

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The performance check as described in 5.1.10 shall be carried out after each series of releases and at each specified temperature.

5.3 Operational tests

The requirements of 3.3 shall be verified as follows.

5.3.1 Prevention of inadvertent activation

a) (3.3.1 a)) By inspection

b) (3.3.1 b)) Tests are included in 5.5.1.1

c) (3.3.1 c)) By inspection

5.3.2 Immersion, buoyancy and drop into water

5.3.2.1 Immersion test

(See 3.3.2 a))

The test is included in 5.17.4 and 5.17.8.

5.3.2.2 Buoyancy test

(See 3.3.2 b))

With the antenna deployed in its normal operating position, the satellite EPIRB shall, when rotated to a horizontal position about any axis, be submerged in fresh water just below the surface, and when released pass through an upright position within 2 s.

NOTE Fresh water is defined as normal domestic tap water.

In calm fresh water, the satellite EPIRB shall float upright with the base of the antenna a minimum of 40 mm above the water-line.

The reserve buoyancy of the satellite EPIRB shall be at least 5 % when determined by one of the following methods:

a) the complete unit shall be submerged and the buoyant force shall be measured with a scale. The buoyant force shall be divided by the weight of the unit. The result shall be at least 0,05;

b) the location of the water-line shall be determined on the floating satellite EPIRB. The calculated or measured volume of the unit above the water-level shall be divided by the calculated or measured volume below the water-level. The result shall be at least 0,05.

5.3.2.3 Drop test

(See 3.3.2 c))

The test is included in 5.17.5.

5.3.3 Activation

5.3.3.1 Test for salt water activation

(See 3.3.3 a))

The satellite EPIRB shall be floated in a 0,1 % salt solution and shall activate irrespective of the settings of any control. The test shall be repeated for all combinations of settings of controls.

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The salt used for the test shall be sodium chloride (NaCl) containing, when dry, not more than 0,1 % sodium iodide and 0,03 % total impurities.

The salt solution concentration shall be (0,1 ± 0,01) % by weight.

The solution shall be prepared by dissolving (1 ± 0,1) parts by weight of salt in 1 000 parts by weight of distilled or demineralized water.

In addition, all other combinations of satellite EPIRB, float free release mechanism and controls as listed in Table 1 not already tested, shall be checked for correct performance in accordance with Table 1.

This test may be combined with the test in 5.2.1.

5.3.3.2 Test for repetitive manual activation and deactivation

(See 3.3.3 b))

By inspection.

5.3.3.3 Test of low-duty cycle light

(See 3.3.3 c))

The effective luminous intensity, flash duration and flash rate shall be checked at the normal temperature and at the extreme temperatures. The effective luminous intensity shall be defined by the following formula as indicated in IMO Resolution MSC.81(70) – Testing of life-saving appliances, 10.4.9:

$$\frac{\int_{t_1}^{t_2} i \cdot \mathrm{d}t}{0{,}2 + (t_2 - t_1)}$$

where

i is the instantaneous intensity;

0,2 is the Blondel-Rey constant;

$t_2 - t_1$ are the time limits of integration in seconds at which the intensity is i or greater.

The effective luminous intensity shall be at least an arithmetic mean of 0,5 cd over the entire upper hemisphere as determined below. The flash rate shall be 20 to 30 times per minute. The flash duration shall be between 10^{-6} s and 10^{-1} s.

The effective luminous intensity shall be measured at 49 points over the upper hemisphere of the satellite EPIRB. The satellite EPIRB shall be floated in a container of fresh water to determine its waterline, which shall then be marked on the body of the satellite EPIRB and used as the baseline for the following tests. This line represents the 0° elevation plane used as a reference point for the following measurements. The effective luminous intensity shall be measured in accordance with the following table. The arithmetic mean effective luminous intensity of all 49 points shall be at least 0,50 cd. No points shall have an effective luminous intensity of less than 0,2 cd.

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Table 2 – Effective luminous intensity

Azimuth °	Elevation °								
	10	20	30	40	50	60	70	80	90
0									
45									
90									
135									
180									
225									
270									
315									
NOTE Where the tests required at extreme temperature cannot be carried out within the environmental chamber, other methods may be used which approximate the required conditions.									

5.3.3.4 Tests for 3.3.3 d) to 3.3.3 f)

By inspection.

5.3.3.5 Tests for 3.3.3 g) and 4.5

The 121,5 MHz beacon shall comply with the requirements of Annex D.

5.3.4 Self-test

(See 3.3.4)

The self-test mode of the satellite EPIRB shall be activated. The digital message generated shall be in accordance with the requirements of 3.3.4 (self-test frame synchronization).

The automatic reset of the test facility and the indication of the self-test mode shall be checked by inspection.

The 121,5 MHz auxiliary radio-locating device signal shall be checked to ensure it does not exceed 3 audio sweeps or 1 s, whichever is greater, during self test.

5.3.5 Colour and retro-reflecting material

(See 3.3.5)

By inspection of the fitting and of evidence of compliance with IMO Resolution A.658(16) for the performance requirements of the retro-reflecting material.

5.3.6 Lanyard

(See 3.3.6)

By inspection of evidence submitted by the manufacturer that the lanyard meets the specified requirements.

5.3.7 Exposure to marine environment

(See 3.3.7)

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By test (see 5.17.9, 5.17.10 and 5.17.11) or by inspection of the evidence submitted by the manufacturer that the materials used, including any coloured external coating, have been previously tested and are unlikely to be affected adversely by seawater or oil or prolonged exposure to sunlight.

5.3.8 Ergonomics

(See 3.3.8)

By inspection.

5.3.9 Indication of previous activation

(See 3.3.9)

By inspection of the evidence submitted by the manufacturer and of the satellite EPIRB.

5.4 Distress function

(See 3.4)

The requirements of 3.4 shall be verified as follows.

By inspection and by checking that the items listed in 3.4 as those items not counted as one of the two independent actions required to activate the satellite EPIRB, do not cause activation on their own and that two independent actions are required to activate the EPIRB.

If appropriate remove the satellite EPIRB from the bracket and ensure that it is not activated by this action.

5.5 Float-free arrangements

(See 3.5)

5.5.1 General

The requirements of 3.5.1 a) shall be verified during 5.2.1.

5.5.1.1 Test to prevent release when sea water washes over the unit

(See 3.5.1 b), 3.5.1 c) and 3.3.1 b))

The unit consisting of the satellite EPIRB and its release mechanism installed in its bracket, if any, shall be mounted, on a suitable test fixture, successively in each method intended for mounting on a ship, as described in the equipment manual. A stream from a hose shall be directed at the unit for a period of 5 min. The nozzle of the hose shall have a nominal diameter of 63,5 mm and a water-delivery rate of approximately 2 300 l of water per minute. The end of the nozzle shall be 3,50 m away from the satellite EPIRB and 1,50 m above the base of the antenna. The nozzle or the unit shall be moved during the test, so that water strikes the satellite EPIRB in an arc of at least 180° perpendicular to the normal mounting position of the unit.

The satellite EPIRB shall not release from its bracket nor shall it automatically activate as a result of the water from the hose stream.

5.5.1.2 Construction materials

(See 3.5.1 d) and 3.5.1 e))

By test (see 5.17.11) or by inspection of the evidence submitted by the manufacturer that the materials used, including any coloured external coating, have been previously tested and are unlikely to cause any malfunction of the unit.

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By test (see 5.17.9, 5.17.10 and 5.17.11) or by inspection, including the labelling, of evidence submitted by the manufacturer that the materials used have been previously tested and are unlikely to be duly affected by seawater or oil or prolonged exposure to sunlight.

5.5.2 External power or data connection

(See 3.5.2)

By inspection during 5.2.1.

5.5.3 Ability to check the automatic release

(See 3.5.3)

By inspection.

5.5.4 Manual release

(See 3.5.4)

By inspection.

5.6 Environment

(See 3.6)

5.6.1 Temperature

By testing during 5.17.

5.6.2 Icing

If the manufacturer declares conformance with 3.6.1 c) and 3.7 c) by successful completion of 5.2.1 at the extreme temperature, and by inspection of the equipment manual to confirm fitting of heaters, or suitable alternatives, to the float-free arrangement.

5.6.3 Wind speed

By inspection of the evidence submitted by the manufacturer, and by successful completion of 5.5.1.1.

5.6.4 Stowage

By testing during 5.17.

5.6.5 Shock and vibration

By testing during 5.17.

5.7 Environment for float-free arrangement

(See 3.7 a) and b))

By testing during 5.17.

5.8 Interference – Electromagnetic compatibility

(See 3.8)

By testing during 5.17.

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5.9 Maintenance

(See 3.9)

By inspection of the equipment manuals (see 5.11).

5.10 Safety precautions

(See 3.10)

By test and inspection of the evidence submitted by the manufacturer that the satellite EPIRB and the battery shall function safely under the conditions stated in 3.10. The manufacturer shall provide evidence that the battery and the cells making up the battery are either exempt from testing or have been tested to the United Nations Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, Fourth Revised Edition, PART III, Section 38.3 (ST/SG/AC.10/11/Rev.4).

5.11 Equipment manuals

(See 3.11)

By inspection.

5.12 Labelling

5.12.1 Equipment labelling

(See 3.12.1)

By inspection.

5.12.2 Float-free arrangement labelling

(See 3.12.2)

By inspection.

5.13 Installation

(See 3.13)

By inspection of the equipment manuals and, if provided, by activation of the satellite EPIRB from the remote system, set up according to manufacturer's instructions.

5.14 Technical characteristics

(See 4.1 to 4.4)

By testing to C/S T.007 in accordance with Annex A.1.12.

5.15 Power source

(See 4.6)

5.15.1 Battery capacity and low-temperature test

Using a fresh battery pack, the satellite EPIRB shall be activated (at the ambient temperature) for a period of time as stated by the manufacturer to be equivalent to the loss of battery capacity due to self-testing, stand-by loads as well as battery-pack self-discharge during the useful life of the battery pack (as defined in 4.6.2). The manufacturer shall substantiate the method used to determine this time.

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Alternatively, at the manufacturer's discretion the pre-discharge of the battery (as outlined above) may be replaced by the equivalent extension beyond 48 h of the following battery capacity and low-temperature test. If using this test method the satellite EPIRB manufacturer shall apply a compensation figure to allow for the fact that the extension period due to loss in battery capacity is being carried out at the minimum operating temperature rather than at ambient temperature. This compensation figure shall be substantiated by the manufacturer.

The satellite EPIRB shall be placed in a chamber of normal room temperature. Then the temperature shall be reduced to and maintained at –40 °C ± 3 °C for class 1 or –30 °C ± 3 °C for class 2 equipment for a period of 10 h or some such period as may be determined by the type approval authority.

Any climatic control device provided in the equipment may be switched on and for class 2 equipment the chamber heated to –20 °C ± 3 °C, at the conclusion of the period specified above. The action of the climatic control device and for class 2 equipment, the heating of the chamber shall be completed within 20 min.

The equipment shall be activated in its mode of maximum current draw (for instance long message not short (if applicable), GNSS device / interface drawing maximum current (if applicable)) 30 min after the end of the period at the applicable stowage temperature of the satellite EPIRB and shall then be kept working continuously for a period of 48 h. The temperature of the chamber shall be maintained as specified above for the whole of the period of 48 h.

The equipment shall be subjected to the test as specified in C/S T.007, Annex A, A.2.3 (Operating lifetime at minimum temperature) at intervals of not more than 6 h and at the end of the period of 48 h. In addition, at the end of the 48 h period, a performance test (see 5.1.11) shall be performed.

NOTE If employing the alternative test method described above all references to 48 h shall be extended by the appropriate period.

The satellite EPIRB shall meet the requirements of C/S T.007, Annex A, A.2.3 (–40 °C for class 1 and –20 °C for class 2) for 48 h.

This test may be combined with the test as described in C/S T.007, Annex A, A.2.3 (see Annex A.1.12).

5.15.2 Expiry date indication

By inspection.

5.15.3 Reverse polarity protection

By inspection.

5.16 Antenna characteristics

(See 4.7)

By testing to C/S T.007 in accordance with A.1.12.

5.17 Environment

Environmental tests are intended to assess the suitability of the construction of the equipment for its intended physical conditions of use.

After each environmental test, the equipment shall be inspected for any mechanical deterioration and/or for water penetration.

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Before commencing the first environmental test and after each environmental test, a performance check shall be made (see 5.1.10).

The following tests shall be made under environmental conditions, as detailed in IEC 60945. All these tests, except 5.17.5, Drop test for portable equipment, 5.17.9, Solar radiation, 5.17.10, Oil resistance, and 5.17.11 Corrosion test, shall be performed with the satellite EPIRB installed in the release mechanism.

5.17.1 Dry heat cycle, of IEC 60945

(See 3.6.1, 3.6.3 and 3.7 a))

A performance test (see 5.1.11) shall be performed at the end of the functional test soak period.

NOTE It maybe necessary to remove the satellite EPIRB from the float-free release mechanism in order to carry out the performance test at the end of the soak period. If necessary and this involves opening the environmental chamber care shall be taken to ensure that the temperature of the satellite EPIRB is re-stabilised before carrying out the test.

5.17.2 Damp heat cycle, of IEC 60945

(See 3.6.1, 3.6.3 and 3.7 a))

5.17.3 Low-temperature cycle

This test is covered by successful completion of the test in 5.15.

5.17.4 Thermal shock test, of IEC 60945

(See 3.3.2 a))

NOTE This test is different to the thermal shock test required by C/S T.007, Annex A, A.2.2, *Thermal shock test.*

Subject to a satisfactory performance check, the opening of the satellite EPIRB to check for water ingress may be delayed until the completion of all tests.

5.17.5 Drop test for portable equipment, of IEC 60945

(See 3.3.2 c))

5.17.5.1 Drop on hard surface

This test shall be performed on the satellite EPIRB removed from the float-free release mechanism.

5.17.5.2 Drop into water

This test shall be performed on the satellite EPIRB removed from the float-free release mechanism.

The three drops shall be initiated from a different orientation, namely antenna vertically up, antenna vertically down and antenna horizontal.

Subject to a satisfactory performance check, the opening of the satellite EPIRB to check for water ingress may be delayed until the completion of all tests.

5.17.6 Vibration test, of IEC 60945

(See 3.6.4, 3.7 b))

The performance check as required in IEC 60945 shall be carried out at the completion of the vibration test, rather than during it.

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5.17.7 Ruggedness test

(See 3.6.4, 3.7 b))

The ruggedness test is conducted to give a measure of confidence that the equipment will meet service conditions. The satellite EPIRB shall be secured to the testing equipment through its normal attachments or mounting intended for use in service conditions and mounted in the normal operating position(s). Additional straps or other holding means shall not be used.

The satellite EPIRB shall be subjected to the ruggedness test according to the following profile:

Peak acceleration:	98 m/s^2 ± 10 %
Pulse duration:	16 ms or 20 ms ± 10 %
Wave shape:	Half-cycle sinewave
Test axis:	Vertical
Number of bumps:	4 000

After completion of the ruggedness test a performance check shall be carried out.

5.17.8 Immersion test, of IEC 60945

(See 3.3.2 a))

The satellite EPIRB shall be subjected to the immersion test for portable equipment (IEC 60945, 8.9.2).

Subject to a satisfactory performance check, the opening of the satellite EPIRB to check for water ingress may be delayed until the completion of all tests.

This test may be combined with the test in 5.17.4.

5.17.9 Solar radiation test, of IEC 60945

(See 3.3.7 and 3.5.1 e))

The satellite EPIRB shall be removed from the float-free release mechanism for this test and both the EPIRB and the release mechanism shall be separately subjected to the test.

The solar radiation test shall be waived where the manufacturer is able to produce evidence that the components, materials and finishes employed in the satellite EPIRB and the release mechanism would satisfy the test.

5.17.10 Oil resistance test, of IEC 60945

(See 3.3.7 and 3.5.1 e))

The satellite EPIRB shall be removed from the float-free release mechanism for this test and both the EPIRB and the release mechanism shall be separately subjected to the test.

The oil resistance test shall be waived where the manufacturer is able to produce evidence that the components, materials and finishes employed in the satellite EPIRB and the release mechanism would satisfy the test.

5.17.11 Corrosion test, of IEC 60945

(See 3.3.7, 3.5.1 d) and 3.5.1 e))

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The satellite EPIRB shall be removed from the float-free release mechanism for this test and both the EPIRB and the release mechanism shall be separately subjected to the test.

The corrosion test shall be waived where the manufacturer is able to produce evidence that the components, materials and finishes employed in the satellite EPIRB and the release mechanism would satisfy the test.

5.18 Interference testing

(See 3.8)

All these tests shall be performed with the satellite EPIRB installed in the release mechanism. In addition the electrostatic discharge test shall also be performed directly on the satellite EPIRB.

The satellite EPIRB shall be subjected to the immunity to radiated interference and the electrostatic discharge tests, as detailed in IEC 60945. The performance check requirement for all tests shall be performance criterion B.

5.19 Spurious emissions

The measurement shall be performed only between bursts.

The measurements shall be made at the transmitter output at 50 Ω using a receiver or a spectrum analyzer with its bandwidth set to between 100 kHz and 120 kHz or its nearest setting thereto, over the following frequency bands:

108 MHz to 121 MHz,

122 MHz to 137 MHz,

156 MHz to 162 MHz, and

1 525 MHz to 1 610 MHz

No signal level within these bands shall exceed 25 μW.

This test may be combined with the test required by C/S T.007, Annex A, A.3.2.2.4 (Annex A.1.12) and with the test required by Annex D.3 e) of this standard.

This test replaces the radiated emissions test required by IEC 60945.

5.20 Compass safe distance

This test shall be performed with the satellite EPIRB installed in the release mechanism. The test will be in accordance with IEC 60945 with the satellite EPIRB not activated.

5.21 Conducted interference

These tests shall be performed with the satellite EPIRB installed in the release mechanism.

If there is a connection between the ship's power system and the satellite EPIRB or its release mechanism, the equipment shall, in addition, be tested for compliance with the conducted emissions requirements of IEC 60945.

In addition if the satellite EPIRB has any signal or control ports, such as an external navigation data input or a remote activation system operable from the navigating bridge, then the equipment shall, in addition, be tested for compliance with the conducted radio frequency interference and fast transients (bursts) requirements of IEC 60945.

The performance check requirement for all tests shall be performance criterion B.

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Annex A
(normative)

Sequence of tests

The following environmental and operational tests shall be conducted in the sequence as stated here below. All tests shall be performed on a single unit as defined in 5.1.7.

Alternatively, all tests numbered A.1.1 to A.1.14 shall be performed on the unit defined in 5.1.7 and all tests numbered A.2.1 to A.2.12 shall be performed on one or more other unit(s) as defined in 5.1.9. These tests numbered A.2.1 to A.2.12 may be carried out independently in any sequence.

Tests marked "x" may be performed in the indicated sequence or moved in the sequence and combined with the related COSPAS-SARSAT tests (A.1.12).

A performance check (see 5.1.10) shall be performed before the first test and during or after each test.

A.1 Compulsory sequence of tests

	A.1.1	Message format and homing devices (see 5.1.7)
x	A.1.2	Dry heat test (see 5.17.1 of this standard and IEC 60945)
	A.1.3	Damp heat test (see 5.17.2 of this standard and IEC 60945)
	A.1.4	Vibration test (see 5.17.6 of this standard and IEC 60945)
	A.1.5	Ruggedness test (see 5.17.7)
	A.1.6	Drop on hard surface (see 5.17.5.1 of this standard and IEC 60945)
	A.1.7	Drop into water (see IEC 60945 as modified in this standard, 5.17.5.2)
	A.1.8	Thermal shock test (see 5.17.4 of this standard and IEC 60945)
	A.1.9	Immersion test (see 5.17.8 of this standard and IEC 60945)
x	A.1.10	Spurious emissions (see 5.19)
	A.1.11	Battery capacity and low-temperature test (see 5.15.1)
	A.1.12	COSPAS-SARSAT type-approval test procedure
	A.1.13	Interference testing (see 5.18 of this standard and IEC 60945)
	A.1.14	Conducted interference test (if applicable) (see 5.21 of this standard and IEC 60945)

A.2 Additional tests

A.2.1 Test of operational requirements

Subclauses of this part:

5.3.1, 5.3.3.2, 5.3.3.4, 5.3.4, 5.3.5, 5.3.6, 5.3.7, 5.3.8, 5.4, 5.5.1.1, 5.5.1.2, 5.5.2, 5.5.3, 5.5.4, 5.15.2, 5.15.3

A.2.2 Automatic release mechanism and automatic activation test for class 1 and class 2 satellite EPIRBs (see 5.2.1).

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This test may be combined with the test required in 5.17.4.

A.2.3 Stability and buoyancy test (see 5.3.2.2).

A.2.4 Float-free activation test (see 5.3.3.1).

A.2.5 Safety (see 5.10 of this standard and IEC 60945).

A.2.6 Compass safe-distance test (see 5.20 of this standard and IEC 60945).

A.2.7 Solar radiation test (see 5.17.9 of this standard and IEC 60945).

A.2.8 Oil resistance test (see 5.17.10 of this standard and IEC 60945).

A.2.9 Corrosion test (see 5.17.11 of this standard and IEC 60945).

A.2.10 Signal light test (see 5.3.3.3).

A.2.11 GNSS Receiver requirements (if applicable) (see Annex B of this standard)

A.2.12 121,5 MHz homing device tests (see Annex D of this standard)

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Annex B
(normative)

Internal and external navigation devices
GNSS receivers

Satellite EPIRBs may include beacon position data, obtained from a navigation device internal or external to the satellite EPIRB. EPIRBs providing one or both of these features shall meet the requirements of this annex.

B.1 External navigation devices

If a satellite EPIRB includes the facility to be interfaced to an external navigation device then it shall comply with the following requirements.

a) The manufacturer shall provide a list of all the approved external GNSS receivers that he has tested with the satellite EPIRB to ensure correct operation of the interface. This list shall be included in the equipment manual.

b) The manufacturer shall provide instructions for connecting and setting up the external GNSS receivers in the equipment manual. This information shall include:

   1) details of the electrical connections to the satellite EPIRB;

   2) the specification of the interface (for instance IEC 61162-1);

   3) details of the communications protocol to be used (for instance Baud rate, Data bits, parity bits, etc) which shall comply with IEC 61162;

   4) a list of the IEC 61162 sentences that the satellite EPIRB can handle, which shall as a minimum include (GGA, GLL, GNS, and RMC) and

   5) instructions on the key settings and parameters of the GNSS receiver (for instance map datum (WGS84/GTRF), I/O formats, mode of operation, etc).

c) The equipment manual shall also provide information to guide the operator towards maximizing self-locating performance, including a warning not to obstruct the GNSS antenna's view of the sky.

d) The manufacturer shall provide evidence that any malfunction of the navigation interface (for example a short circuit) does not damage, degrade or prevent the satellite EPIRB from operating correctly while the malfunction is present.

e) The manufacturer shall detail what measures have been taken within the satellite EPIRB software to ensure that erroneous position data is not encoded into the beacon message (see T.001 4.5.5.4).

f) If a simulated data stream is used (as permitted by C/S T.007 A.2.7) for the tests in C/S T.007 A.3.8 instead of a GNSS receiver, then in addition, the manufacturer shall demonstrate the correct operation of at least one of the approved external GNSS receivers in a typical operational configuration with the satellite EPIRB by successfully completing test T.007 A.3.8.2.1 with the receiver. During this test the satellite EPIRB shall be fully operational (radiating both 406 MHz and 121,5 MHz signals via the antenna) to ensure that any interference from the EPIRB does not interfere with the operation of the GNSS receiver.

B.2 Internal navigation receivers

If a satellite EPIRB includes an internal navigation device (GNSS receiver) then it shall comply with the following requirements.

a) The internal navigation device shall comply with the requirements of C/S T.001, 4.5.5.3.

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b) The manufacturer shall provide evidence in the form of a test report from an approved test house that the GNSS receiver in the satellite EPIRB has been tested to the following subclauses of IEC 61108-1 (2003) as amended:

static position accuracy (5.6.4.1.1)

static position accuracy under angular movement (5.6.4.2)

dynamic position accuracy (5.6.4.3)

acquisition times (cold start, warm start and reacquisition) (5.6.5)

short circuit protection (5.6.6)

receiver sensitivity (during both acquisition and tracking) (5.6.8)

interference immunity (5.6.9)

position update (5.6.10)

c) Compliance with the requirement in b) above shall be taken as satisfying the C/S requirement in T.001 4.5.5.3 that the internal navigation device conforms to an applicable international standard.

d) The manufacturer shall provide evidence that an internal navigation device cold start is forced at every beacon activation (cold start refers to the absence of time dependent or position dependent data in memory, which might affect the acquisition of the GNSS position).

e) The manufacturer shall detail what self-check measures have been taken within the satellite EPIRB software to ensure that erroneous position data is not encoded into the beacon message (see T.001 4.5.5.3). This shall include a limit to the acceptable range of horizontal dilution of precision (HDOP) to ensure that positions with an error of greater than 500 m are not encoded into the beacon message.

f) The equipment manual shall also provide information to guide the operator towards maximizing self-locating performance including a warning not to obstruct the GNSS antenna's view of the sky.

g) The manufacturer shall clearly mark the position of the internal navigation device antenna on the exterior of the satellite EPIRB casing together with a warning not to cover or obstruct this area during use.

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Annex C
(normative)

Standard for a satellite EPIRB without a float-free mechanism

C.1 Requirements

A non-float-free satellite EPIRB shall meet all the requirements of this standard with the exception of the following sub-clauses and replacement text:

3.2 d) Not applicable.

3.2 e) Not applicable.

3.3.3 a) The satellite EPIRB shall be automatically activated when floating in the water, irrespective of the settings of any control (see Table 1).

3.3.3 b) The satellite EPIRB shall be capable of repetitive manual activation and manual deactivation.

Manual deactivation shall not prevent automatic activation of the satellite EPIRB when manually released from its release mechanism or when floating in the water.

3.5 Manual release arrangements

3.5.1 General

The satellite EPIRB shall be provided with a manual release mounting arrangement which shall

a) be constructed to prevent release when seas wash over the unit,

b) have its release mechanism fitted with adequate means to prevent the satellite EPIRBs inadvertent activation (see Table 1),

c) be constructed of non-corrosive compatible materials, so as to prevent deterioration which may cause any malfunction of the unit. Galvanizing or other forms of metallic coating on parts of the mounting and release mechanism shall not be accepted,

d) including the labelling, not be unduly affected by seawater or oil or prolonged exposure to sunlight.

3.5.2 External power or data connection

For the satellite EPIRB requiring external power or data connection, or both, the means of connection shall not inhibit removal from the release mechanism or activation of the satellite EPIRB.

3.5.3 Not applicable.

3.5.4 Manual release

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It shall be possible to release and replace the satellite EPIRB manually in the mounting mechanism, without tools.

3.7 a) Not applicable.

3.7 c) Not applicable.

3.12.2 Manual release arrangement labelling

The manual release arrangement shall carry a label or labels indicating clearly at least in English.

3.12.2 a) the operating instructions for manual release.

3.12.2 b) Not applicable.

3.12.2 c) Not applicable.

3.12.2 d) Not applicable.

If this label or labels are not readily visible in the installed arrangement, they shall be provided in addition, for installation close to the manual release arrangement. In addition, these instructions may be shown in pictorial form.

3.13 c) have local manual activation; remote activation may also be provided from the navigating bridge, while the device is installed in the manual release arrangement.

3.13 d) Not applicable.

3.13 e) Not applicable.

C.2 Tests

If the satellite EPIRB has already (or is at the same time being) tested to this standard with a float free arrangement as well as the manual release then it shall only be necessary to perform the following additional tests on the manual release with a satellite EPIRB fitted in it (unless otherwise indicated):

5.3.1 a), 5.5.1.1, 5.5.1.2 (Manual release only, not EPIRB), 5.5.2 if applicable, 5.5.4, 5.12.2, 5.17.6, 5.17.7, 5.17.9 (Manual release only, not EPIRB), 5.17.10 (Manual release only, not EPIRB), 5.17.11 (Manual release only, not EPIRB), 5.20.

If, however, the satellite EPIRB has not already (or is not at the same time being) tested to this standard with a float free arrangement then the manual release and the satellite EPIRB shall be subjected to all of the tests in Clause 5 of this standard except for 5.2.1 and 5.5.3.

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Annex D
(normative)

Technical standard for 121,5 MHz homing device

D.1 General

This annex specifies the operational and performance requirements, technical characteristics and methods of testing of a shipborne 121,5 MHz homing device, which forms part of the satellite emergency indicating radio beacon used in the COSPAS-SARSAT satellite system (satellite EPIRB) and described in this standard.

D.2 Performance requirements

D.2.1 (A.810(19), annex, Part A, 2.3.14) *Be provided with a 121,5 MHz homing beacon*.

D.2.2 (A.810(19), annex, Part B, 5) *The 121,5 MHz homing signal* shall:

a) *have a continuous duty cycle except that it may be interrupted for up to a maximum of 2 s during the transmission of the 406 MHz signal;*

b) *with the exception of the sweep direction, meet the technical characteristics from* ITU-R Recommendation M.690-1. *The sweep may be either upward or downward*.

D.3 Technical characteristics

a) Carrier frequency 121,5 MHz ± 50 ppm

b) Peak effective radiated power (PERP) +17 dBm (50 mW) ± 3 dB[1]

c) Transmitter duty cycle 100 % (see D.2.2.a))

d) Modulation Amplitude modulated (3K20A3X)

1) The A3X emission shall include a clearly defined carrier frequency distinct from the modulation sideband components; in particular, at least 30 % of the total power emitted during any transmission cycle with or without modulation shall be contained within ±30 Hz of the carrier frequency. Additionally, if the type of emission is changed during transmission, the carrier frequency shall not shift more than ±30 Hz from the carrier frequency.

2) Modulation frequency An audio signal swept upward or downward ≥700 Hz within the range 300 Hz to 1 600 Hz

3) Modulation duty cycle 33 % to 55 %

4) Modulation factor Between 0,85 and 1,0

5) Sweep repetition rate 2 Hz to 4 Hz

e) Spurious emissions See Figure D.1

f) Antenna

1) Pattern Essentially omni-directional in the horizontal plane

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[1] Peak-effective radiated power (PERP) is the power supplied to the antenna by the transmitter (measured at the highest crest of the modulation envelope) multiplied by the relative gain of the antenna in a given direction.

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2) Polarization Vertical

g) Environment Shall meet the requirements of 3.3 of this standard

h) Minimum operating lifetime 48 h throughout the specified operating temperature range

D.4 Methods of testing and required test results

Unless otherwise specified, all transmitter signal characteristics shall be measured at the minimum and maximum operating temperatures.

For the purpose of testing outside a screened room, the equipment shall be prepared as required by 5.1.7.

The tests may be performed in any sequence and in conjunction with other electrical tests. In all cases, the tests shall be conducted after the satellite EPIRB has been temperature stabilized for at least 1 h and has been ON for at least 15 min. Unless otherwise specified, the test shall be performed with modulation present.

D.4.1 Carrier frequency

(See D.3 a))

The carrier frequency test may be performed with a frequency counter or a spectrum analyzer. The carrier frequency, measured at the minimum and maximum operating temperatures, shall be 121,5 MHz ± 50 ppm.

D.4.2 Peak effective radiated power

(See D.3 b)/D.3 c) and D.3 h))

This test is only required to be performed at ambient temperature and shall use a satellite EPIRB whose battery has been ON for a minimum of 44 h.

If the test exceeds 4 h, the battery may be replaced by another which has been pre-conditioned with at least 44 h of ON time.

The measurement procedure consists in a determination of 12 values of PERP made by direct measurement of radiated power.

The measurements are taken every 30° ± 3° in azimuth from 0° to 360°. All PERP measurements shall be made at the same elevation angle; the elevation used shall be the angle between 5° and 20° for which the satellite EPIRB exhibits a maximum antenna gain. The median value of PERP shall be between 25 mW and 100 mW; the ratio of maximum to minimum of the 11 highest values of PERP shall not exceed 4 to 1 (6 dB).

D.4.2.1 Radiated power test condition

The test site shall be on level ground, which has uniform electrical characteristics. The site shall be clear of metal objects, overhead wires, etc., and as free as possible from undesired signals such as ignition noise or RF carriers. The distance from the satellite EPIRB, or the search antenna shall be at least 30 m. The satellite EPIRB shall be placed in the centre of a ground plane with a radius of no less than 75 cm ± 5 cm.

It shall be positioned vertically so that the ground plane is at the nominal waterline. The ground plane shall be resting on ground level and shall be extended so that it completely encloses and presents a snug fit to the portion of the satellite EPIRB which is below the water-line.

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Measurement of the radiated signals shall be made at a point 5 m or more from the satellite EPIRB. At this point, a wooden pole or insulated tripod with a movable horizontal boom shall be arranged so that a search antenna can be raised and lowered through an elevation angle of 5° to 20°. The search antenna shall be mounted on the end of the boom with its cable lying horizontally on the boom and run back to the supporting mast. The other end of the search antenna cable shall be connected to a spectrum analyzer located at the foot of the mast.

D.4.2.2 Method of measurement

The elevation angle between 5° and 20° which produces a maximum gain is determined with the satellite EPIRB at an arbitrary azimuth. The PERP shall be measured and the elevation angle noted and shall remain fixed for the remainder of the test. The remaining 11 measurements of PERP may be obtained by rotating the satellite EPIRB in increments of 30° ± 3°. For each measurement, the satellite EPIRB PERP shall be computed using the following equation:

$$\text{PERP} = 10^{\frac{P_{\text{REC}} - G_{\text{REC}} + L_{\text{c}} + L_{\text{p}}}{10}}$$

where

P_{REC} is the measured power level from spectrum analyser (dBm);

G_{REC} is the antenna gain of search antenna (dB);

L_{c} is the receive system attenuator and cable loss (dB);

L_{p} is the free space propagation loss (dB).

D.4.3 Off ground plane radiated power test

This test is effectively a repeat of the peak effective radiated power test in D.4.2 except that the satellite EPIRB is raised off the ground plane.

This test is only required to be performed at ambient temperature and shall use a satellite EPIRB whose battery has been ON for a minimum of 44 h. If the test exceeds 4 h, the battery may be replaced with another which has been preconditioned with at least 44 h of ON time.

The measurement procedure includes a determination of four values of PERP made by direct measurement of radiated power. Four measurements are taken every 90° ± 3° in azimuth. The four azimuth PERP measurements shall be made at the same elevation angle; the elevation used shall be the angle between 5° and 20° for which the EUT exhibits a maximum antenna gain (it should be noted that this may not be the same elevation angle as that determined in D.4.2). The starting point for the four azimuth measurements shall be the centre of the forward face (front) of the satellite EPIRB (0°). The minimum value of PERP measured at each of the four azimuth angle increments shall be 2 mW.

D.4.3.1 Off ground plane radiated power test conditions

The test site shall be the same as used in C/S T.007, Figure B.5 except that the distance between the beacon under test and the RF receiver shall be 10 m (not 3 m). The RAM material shall be positioned in such a way that the centre of the 3,6 m by 2,4 m section of RAM is positioned at the specular reflection point for the ground reflected path signal between the beacon under test and the RF receiver positioned at the elevation angle between 5° and 20° for which the EUT exhibits a maximum antenna gain. The satellite EPIRB shall be placed upright on a non-conductive stand (for example a wooden or strong cardboard box) that raises the height of the base of the EPIRB 450 mm ± 25 mm above ground level.

D.4.3.2 Off ground plane method of measurement

The method of measurement is the same as in D.4.2.2 except that only four azimuth measurements are made at 90° ± 3° intervals.

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D.4.4 Transmitter duty cycle

(See D.3 c))

The transmitted signal shall be observed on a suitable test instrument and it shall be determined that the signal is not interrupted, with the exception of up to 2 s during transmission of the 406 MHz signal.

D.4.5 Modulation characteristics

(See D.3 d))

The transmitter duty cycle, modulation frequency, modulation duty cycle, modulation factor, and sweep repetition rate shall be determined by the method now described, by observing the detected RF signal with a storage oscilloscope. All measurements shall be made at the minimum and maximum operating temperatures.

D.4.5.1 Modulation frequency and sweep repetition rate

(See D.3 d) 2))

The modulation envelope shall be observed and the upper and lower audio-frequency sweep limits and sweep repetition rate shall be determined. The limits and rate shall meet the requirements of D.3.d) 2) and D.3.d) 5) respectively.

D.4.5.2 Modulation duty cycle

(See D.3 d) 3))

Modulation duty cycle is the ratio of the positive modulation peak duration to the period of the instantaneous fundamental audio-modulation frequency, observed at the half-amplitude points on the modulation envelope using the following formula (see Figure D.2a):

$$\text{duty cycle} = \frac{A}{B} \times 100\ \%$$

The modulation duty cycle shall be measured near the start, midpoint, and end of the modulation period.

The duty cycle shall meet the requirements of D.3 d) 3).

D.4.5.3 Modulation factor

(See D.3 d) 4))

The modulation factor shall be defined with respect to the maximum and minimum amplitudes of the modulation envelope by the following formula (see Figures D.2b and D.2c):

$$\text{modulation factor} = \frac{A - B}{A + B}$$

The modulation factor shall meet the requirements of D.3 d) 4).

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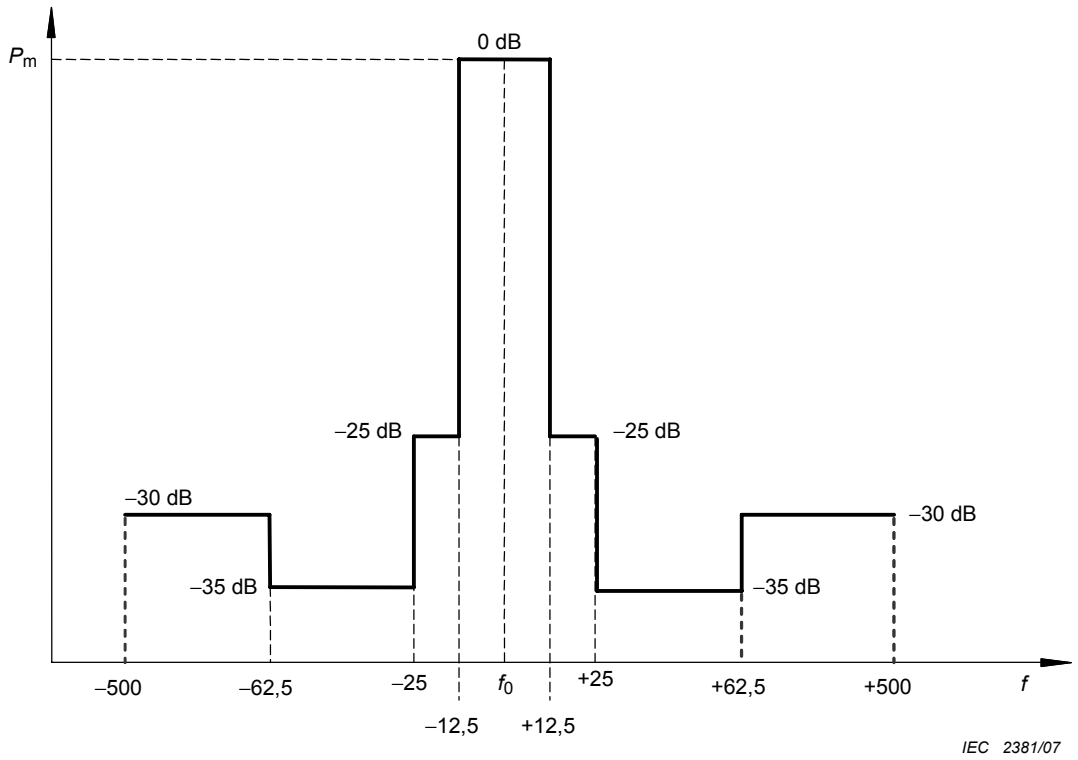

Relative frequency to 121,5 MHz homing device in kHz

P_m = mean power

P_m = D(PERP) power output of 121,5 MHz homing device

D = modulation duty cycle

PERP = peak effective radiated power

Measurement resolution bandwidth 100 Hz

Figure D.1 – Spurious emission mask for 121,5 MHz signal

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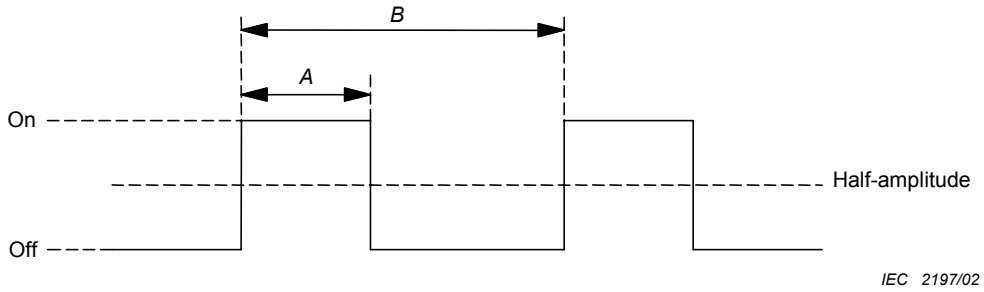

Figure D.2a – Typical modulation waveform

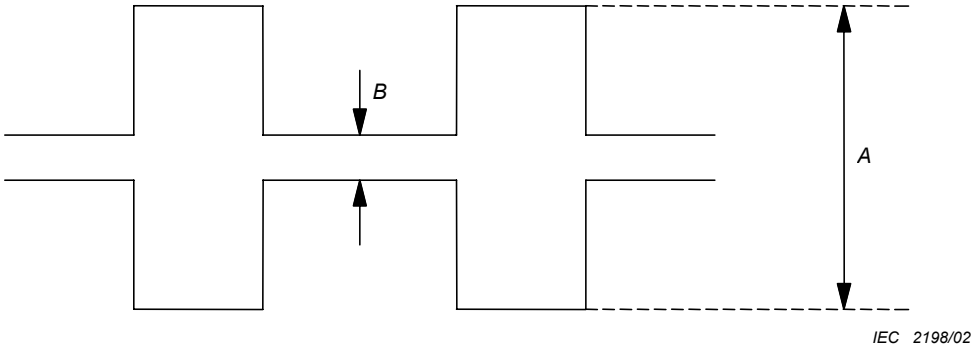

Figure D.2b – Typical full-wave modulation envelope

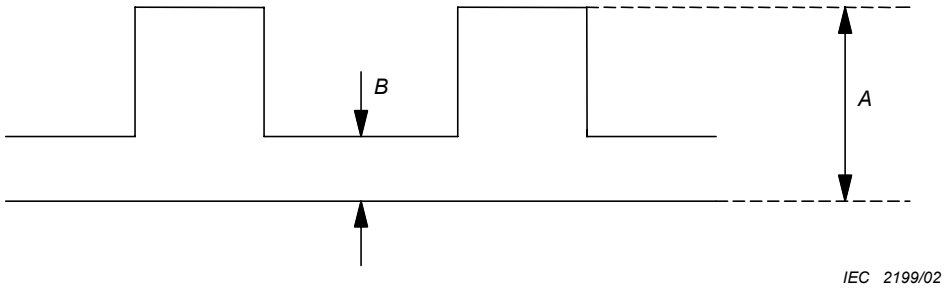

Figure D.2c – Typical one-half-wave modulation envelope

Figure D.2 – Typical modulation waveforms

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Annex E
(informative)

User experience of COSPAS-SARSAT satellite EPIRB operation

Since the GMDSS amendments to the SOLAS Convention were agreed in 1988, considerable experience has been gained at sea in the use of various components of the system.

This standard had been developed with the experience of some years of operation of COSPAS-SARSAT satellite EPIRBs aboard ships. The IMO requirement that the satellite EPIRB be automatically activated after floating free has been interpreted to mean "automatic activation" whenever the satellite EPIRB is floating in the water, irrespective of the settings of any controls. This is in response to numerous accidents that have occurred around the world where satellite EPIRBs have successfully floated free, but then not operated as they have been switched off or otherwise disarmed. The IMO requirement that the satellite EPIRB be capable of being tested is interpreted to mean that the satellite EPIRB emits the C/S T.001 defined self-test signal. This enables ship surveyors and shore based maintenance providers to take advantage of portable receiver/decoders to attain greater confidence that the satellite EPIRB is fully operational. It is considered that this then satisfies the IMO requirement that means are provided to indicate that signals are being emitted. An audible or visual indicator on the satellite EPIRB for this purpose would not give a very positive indication to a survivor unaware of the workings of COSPAS-SARSAT, as this indicator would only operate for a half-second every 50 s or so. However, this standard requires that the strobe light fitted begins flashing within 2 s of satellite EPIRB activation, whether by manual or automatic means, to give immediate warning of inadvertent activation or immediate confidence of successful activation.

Experience has shown that satellite EPIRBs are often not robust enough in service to remain operational between the life of the battery (typically changed every four to five years). As a consequence, a ruggedness test has been included consisting of 4000 bumps of 98 m/s^2 (10 *g*) each. Additionally, the hose test called up by IMO for life-raft canopy closure (MSC.81(70), 5.12) has been included to test the strength of the release bracket. The lanyard required by IMO is defined to have a length of between 5 m and 8 m. It is hoped that this will restrict the use of the lanyard to the intended purpose of a towing-line from a survival craft in the water. There have been numerous cases of the lanyard being used to tether the satellite EPIRB to the vessel which then has prevented the automatic float-free operation.

Satellite EPIRBs are designed to operate floating in water; where satellite EPIRBs are operated in their brackets, or inside a survival craft, the satellite EPIRB may have reduced performance.

A recommended practice is that:

– the satellite EPIRB should be placed in the water and tethered to the survival craft;

– in the case of satellite EPIRBs incorporating an internal navigation device, the EPIRB should be operated outside enclosures, such as a carbon-fibre vessel hull, which could prevent acquisition of navigational satellite signals by the satellite EPIRB’s navigation receiver.

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