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INTERNATIONAL STANDARD

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

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Part 2: Cospas-Sarsat EPIRB – 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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IEC 61097-2 has been prepared by IEC technical committee 80: Maritime navigation and radiocommunication equipment and systems. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2008. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) revision of the Scope to incorporate new IMO performance standards published in 2019;
b) addition of requirements and tests for second generation beacons designed for operation with the Cospas-Sarsat medium earth orbit (MEO) satellite constellation;
c) addition of an AIS locating device, a night vision light and an optional return link service (RLS);

d) reduction of the minimum duty cycle of the 121,5 MHz homing signal;

e) addition of requirements for an internal GNSS receiver including a related range of additional GNSS tests in Annex B;

f) inclusion of a new Clause 3 for terms, definitions and abbreviated terms;

g) addition of a new Annex E for the AIS locating signal specification, a new Annex F for symbols and a new Annex G for IEC 61162-1 RLM sentence notes;

h) deletion of the original Annex E which is now of historic interest.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
80/999/FDIS	80/1002/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 61097 series, published 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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM (GMDSS) –

Part 2: Cospas-Sarsat EPIRB – 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 emergency position-indicating radio beacon used in the Cospas-Sarsat satellite system (EPIRB), as required by the International Convention for Safety of Life at Sea (SOLAS) as amended, and which is associated with IEC 60945. When a requirement in this document is different from the requirements in IEC 60945 or other standards, the requirement in this document takes precedence.

This document incorporates the performance standards of IMO Resolution MSC.471(101), 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 document also includes minimum performance standards for a non-float-free EPIRB without float-free release mechanism (see Annex C).

NOTE 1 Although a number of the requirements and tests can be similar, this document is not intended to be used with 406 MHz ship security alert system (SSAS) beacons.

All texts of this document, whose wording is identical to that in the IMO Resolutions A.662(16), A.694(17), and MSC.471(101) will be printed in *italics* and the Resolution/Recommendation and paragraph number indicated between brackets.

NOTE 2 Classes of EPIRBs considered in this document are:

– Class 0: Category 1 Float-free (−55 °C to +70 °C). The float-free release mechanism (A.662(16)) is capable of operating throughout the temperature range of −30 °C to +65 °C and of surviving a stowage temperature range of −55 °C to +70 °C.

– Class 1: Category 1 Float-free (−40 °C to +55 °C). The float-free release mechanism (A.662(16)) is capable of operating throughout the temperature range of −30 °C to +65 °C and of surviving a stowage temperature range of −40 °C to +65 °C.

  These classes are not required by IMO Resolutions but can be applied at the discretion of each Administration.

– Class 2: Category 1 Float-free (−20 °C to +55 °C). The float-free release mechanism (A.662(16)) is capable of being stowed and of operating throughout the temperature range of −30 °C to +65 °C.

NOTE 3 Category 2 Non float-free, EPIRBs in all 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 include an AIS locating signal, described in Annex E.

NOTE 6 All classes include beacon position data, obtained from a navigation device internal to the EPIRB and can also provide an external navigation input as described in Annex B.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 61097-14:2010, *Global maritime distress and safety system (GMDSS) – Part 14: AIS search and rescue transmitter (AIS-SART) – Operational and performance 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*

IEC 61108-2, *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS) – Part 2: Global navigation satellite system (GLONASS) – Receiver equipment – Performance standards, methods of testing and required test results*

IEC 61108-3, *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS) – Part 3: Galileo receiver equipment – Performance requirements, methods of testing and required test results*

IEC 61108-5:2020, *Maritime navigation and radiocommunication equipment and systems – Global navigation satellite systems (GNSS) – Part 5: BeiDou navigation satellite system (BDS) – Receiver equipment – Performance requirements, methods of testing and required test results*

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

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

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

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

IMO Resolution MSC.48(66):1996, *Adoption of the International life-saving appliance (LSA) code, as amended by IMO Resolutions MSC.207(81), MSC.218(82) and MSC.272(85)*

IMO Resolution MSC.471(101):2019, *Performance standards for float-free emergency position-indicating radio beacons (EPIRBs) operating on 406 MHz*

ITU Radio Regulations

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

ITU-R Recommendation M.1371-5:2014, *Technical characteristics for an automatic identification system using time-division multiple access in the VHF maritime mobile band*

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*
C/S T.012, *Cospas-Sarsat 406 MHz Frequency Management Plan*
C/S T.018, *Specification for Second-Generation Cospas-Sarsat 406 MHz Distress Beacons*
C/S T.021, *Cospas-Sarsat Second Generation 406 MHz Distress Beacon Type Approval Standard*

United Nations, *Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria, 7th Revised Edition, PART III, Section 38.3 (ST/SG/AC.10/11/Rev.7)*, as amended

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
Hex ID
hexadecimal characters that uniquely identify each 406 MHz beacon

Note 1 to entry: First generation beacons use 15 hexadecimal characters. Second generation beacons use 23 hexadecimal characters.

3.2 Abbreviated terms

AIS	automatic identification system
AIS 1	channel 2087 (161,975 MHz)
AIS 2	channel 2088 (162,025 MHz)
COG	course over ground
EIRP	effective isotropic radiated power
EPIRB	emergency position-indicating radio beacon
FGB	first generation beacon
GNSS	global navigation satellite system
PERP	peak effective radiated power
RLM	return link message
RLS	return link service
RF	radio frequency
SGB	second generation beacon
SOG	speed over ground
SOTDMA	self-organizing time division multiple access
TTFF	time to first fix
TTFFT	time to first fix transmission (that is the time until the first GNSS fix is encoded into and transmitted in a 406 MHz signal)
UTC	coordinated universal time

4 Performance requirements

4.1 Compliance

(MSC.471(101)/A.1) *The 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 performance standards given in MSC.471(101).

In addition to MSC.471(101) the EPIRB shall also comply with the applicable requirements in either Cospas-Sarsat documents C/S T.001, and C/S T.012 or Cospas-Sarsat document C/S T.018.

NOTE Compliance with documents C/S T.001 or C/S T.018 is demonstrated by testing to documents C/S T.007 or C/S T.021 respectively (see 6.1.2).

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

4.2 General

(See 6.1.6, 6.2.1, 6.2.2, 6.3.2, 6.3.4 and 6.3.7)

The following are general requirements for the EPIRB.

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

b) (MSC.471(101)/A.2.1) *The EPIRB shall be capable of transmitting a distress alert, including encoded position information from a receiver using a recognised global navigation satellite system (GNSS) with global coverage, to satellites equipped with a search and rescue 406 MHz processor or repeater.*

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

d) (MSC.471(101)/A.2.2) *The 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 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 [a]	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

[a] 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* document, such as return link service (RLS) functionality or the possibility of connecting external 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 EPIRB fully conforming to the requirements of this document during normal combined operation. Any internal or external navigation device connected to, or forming part of, the EPIRB shall comply with the requirements of Annex B. Any EPIRB with optional RLS functionality shall comply with the appropriate requirements of C/S T.001 or C/S T.018 as applicable and 5.8.

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

h) The EPIRB shall (MSC.471(101)/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, *visible to the human eye* 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 for the operating lifetime of the EPIRB to indicate its position for the nearby survivors and rescue units.

   This 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. No measured points (see Table 2) shall have an effective luminous intensity of less than 0,2 cd.

   NOTE 1 There can be areas of lower intensity at non measured points around the 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.

i) The EPIRB shall (MSC.471(101)/A.2.3.11) *be provided with a low-duty cycle light* active during all lighting conditions *detectable by all types of night vision devices* for the operating lifetime of the EPIRB.

   The night vision low-duty cycle light shall have a dominant wavelength between 770 nm to 890 nm and shall have an average radiant intensity of at least 2,5 mW/sr, flashing at a rate of 20 to 30 times per minute, with a flash duration between 66 ms and 500 ms for the operating lifetime of the EPIRB.

   This night vision low-duty cycle light shall be mounted so that it produces light output over as great a portion of the upper hemisphere as is practical. The arithmetic mean of the light output over the upper hemisphere above 20° elevation shall not be less than 2,5 mW/sr. No measured points (see Table 3) shall have a radiant intensity of less than 0,25 mW/sr.

   NOTE 2 There can be areas of lower intensity at non measured points around the 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.

j) The flashes of the low-duty cycle white light and the low-duty cycle night vision light may be synchronous or asynchronous with respect to each other. The low-duty cycle white light and the low-duty cycle night vision light may be a combined light, provided all the conditions in h) and i) are complied with.

k) The EPIRB shall (MSC.471(101)/A.2.3.14) *be provided with a 121,5 MHz beacon primarily for homing by aircraft*.

l) The EPIRB shall (MSC.471(101)/A.2.3.15) *be provided with an* internal *GNSS receiver for position fixes and an associated indication that GNSS signal reception is satisfactory or unsatisfactory*.

m) The EPIRB shall (MSC.471(101)/A.2.3.16) *be provided with an automatic identification system (AIS) locating signal in accordance with the Recommendation ITU-R M.1371, Technical characteristics for an automatic identification system using time division multiple access in the VHF maritime mobile frequency band*.

n) The EPIRB should have an exterior design that precludes sharp edges to prevent damage to inflatable survival craft.

4.3 Operational

4.3.1 Prevention of inadvertent activation

(See 6.3.1 and 6.5.2)

The EPIRB shall:

a) (MSC.471(101)/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.

4.3.2 Immersion, buoyancy and drop into water

(See 6.3.2 and 6.17)

The EPIRB shall:

a) (MSC.471(101)/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) (MSC.471(101)/A.2.3.6) *be capable of floating upright in calm water and have positive stability and sufficient buoyancy in all sea conditions;*

c) (MSC.471(101)/A.2.3.7) *be capable of being dropped into the water without damage from a height of 20 m* and of being dropped onto a hard surface from 1m.

4.3.3 Activation

(See 6.3.3)

The following describes the activation of the EPIRB.

NOTE Beacon activation is defined as the point in time at which the initiation of the activation event of the beacon occurs e.g. the activation event is either pressing of the "ON" button, or water sensor immersion.

a) The EPIRB shall (MSC.471(101)/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 EPIRB shall (MSC.471(101)/A.2.3.4) *be capable of repetitive manual activation and* manual *deactivation*.

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

d) When the EPIRB is manually activated, the low-duty cycle lights (see 4.2 h), i) and j)) shall begin flashing within 2 s, in any lighting condition and when automatically activated it shall begin flashing within 15 s or prior to the first 406 MHz transmission if this is sooner, in any lighting conditions.

e) Distress, homing and locating signals shall comply with 5.2, 5.5 and 5.6.

f) The EPIRB shall (MSC.471(101)/A.2.3.5) *be provided with means to indicate that signals are being emitted*. The low-duty cycle light operating in accordance with 4.2 h), is an acceptable indication.

g) Once automatically activated, when the EPIRB is removed from the water and allowed to dry, it shall cease activation.

4.3.4 Self-test

(See 6.3.4)

4.3.4.1 General

The EPIRB shall (MSC.471(101)/A.2.3.8) *be capable of being tested, without using the satellite system, to determine that the EPIRB is capable of operating properly*.

Activation of the test facility shall reset automatically.

The transmitted signals shall be emitted in order of ascending frequency. If the EPIRB radiates both 121,5 MHz and 243 MHz simultaneously, then these signals shall be transmitted twice in the sequence to cover both frequencies.

The self-test shall comply with either 4.3.4.2 and 4.3.4.4 or 4.3.4.3 and 4.3.4.4 below as applicable.

4.3.4.2 First generation beacons (FGBs)

The self-test transmission shall comply with C/S T.001. When the self-test mode is activated, the EPIRB shall emit a single modulated burst at nominal power which shall always provide the beacon 15 Hex ID.

The 121,5 MHz auxiliary radio locating device signal shall also be transmitted during the self-test, but it shall not exceed three audio sweeps or 1 s, whichever is greater.

The AIS locating signal shall also be transmitted during the self-test and shall consist of two single VHF pulses lasting no more than 26,6 ms each, one transmitted on AIS 1 and the other on AIS 2. The pulse shall be coded as Message 14 containing the Hex ID of the EPIRB on one channel and "EPIRB TEST" on the other channel. Valid AIS slot timing is not required for this test.

The self-test function shall also check the battery in accordance with 4.3.9 and the functioning of the GNSS receiver (it is not necessary to obtain a GNSS position during this test), and if the EPIRB has RLS functionality and has been programmed with an RLS protocol then indicate the RLS capability (see 5.8.1).

An indication shall be provided to indicate that all parts of the self-test were passed successfully or that there was a failure.

4.3.4.3 Second generation beacons (SGBs)

When the self-test mode (see C/S T.018) is activated, the EPIRB shall emit a single 406 MHz modulated burst at nominal power with the self-test pseudo-random noise (PRN) sequence. It shall be possible to create the 23 Hex ID of the beacon from the transmitted message. The encoded position bits in the message shall be set to their default values. The bits in rotating field #0 shall be set as follows.

- Elapsed time since activation — Zero
- Time from last encoded position — 2047
- Altitude of encoded position — All 1's
- Dilution of precision — All 1's
- Automated/Manual activation notification — Manual activation by user
- Remaining battery capacity — Actual value at time of test if capable, if not All 1's
- GNSS status — No Fix

The 121,5 MHz auxiliary radio locating device signal shall not exceed three audio sweeps or 1 s, whichever is greater.

The AIS locating signal shall also be transmitted during the self-test and shall consist of two single VHF pulses lasting no more than 26,6 ms each, one transmitted on AIS 1 and the other on AIS 2. The pulse shall be coded as Message 14 containing the Hex ID of the EPIRB on one channel and "EPIRB TEST" on the other channel. Valid AIS slot timing is not required for this test.

The self-test function shall also check the battery in accordance with 4.3.9 and the functioning of the GNSS receiver (it is not necessary to obtain a GNSS position during this test), and if the EPIRB has RLS functionality and has been programmed with an RLS protocol then indicate the RLS capability (see 5.8.1).

An indication shall be provided to indicate that all parts of the self-test were passed successfully or that there was a failure.

4.3.4.4 GNSS self-test

All EPIRBs shall provide for a GNSS self-test and related indicator in accordance with either C/S T.001 or C/S T.018 as appropriate. In addition, during the GNSS self-test, if a position is acquired, the EPIRB shall transmit a single self-test burst at 406 MHz containing the location data and an AIS burst in accordance with E.2.7.2.

EPIRBs shall provide for a minimum of at least 10 GNSS self-tests over the life of the battery, from its manufacturing date to its expiry date (see 5.9.2).

4.3.5 Colour and retro-reflecting material

(See 6.3.5)

The EPIRB shall (MSC.471(101)/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 waterline of the 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.

4.3.6 Lanyard

(See 6.3.6)

The EPIRB shall (MSC.471(101)/A.2.3.10) *be equipped with a buoyant lanyard*, firmly attached to it, *suitable for use as a tether (to a liferaft, lifeboat or person in the water but not to the ship), which* 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 EPIRB shall be at least 245 N. The lanyard shall be of a highly visible yellow/orange colour and shall not rot or deteriorate in a marine environment.

4.3.7 Exposure to the marine environment

(See 6.3.7 and 6.17)

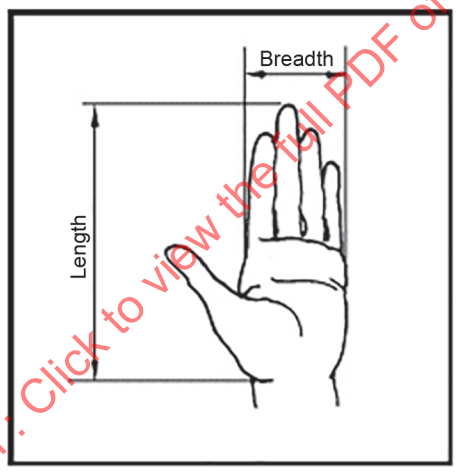
The EPIRB shall not (MSC.471(101)/A.2.3.12), including the labelling, *be unduly affected by sea water or oil or both*; and (MSC.471(101)/A.2.3.13) *be resistant to deterioration in prolonged exposure to sunlight*.

4.3.8 Ergonomics

(See 6.3.8)

The EPIRB shall have all controls of sufficient size for simple and satisfactory operation.

Each individual control or operation necessary to deploy or activate the EPIRB, including, but not limited to, removing the EPIRB from its bracket, manual activation and deactivation, transfer to a survival craft, deploying the lanyard and deploying (de-stowing) any other retention (carriage) means, shall be able to be readily and easily accomplished with a single hand (while if necessary the EPIRB is supported by some means). The design shall encompass a range of hand sizes (as defined in Figure 1) from a bare small hand to a large hand wearing an immersion suit mitten or glove (complying with the IMO Life-Saving Appliance Code Resolution MSC.48 (66), section 2.3) of appropriate size.



Hand sizes	Small	Large
Breadth	< 69 mm	> 96 mm
Length	< 158 mm	> 206 mm

Figure 1 – Hand sizes

The EPIRB shall be provided with some means to facilitate secure hands-free carriage (e.g. for transfer to a survival craft). The carrying means shall be determined by the manufacturer and sized so as to accommodate persons as defined in Figure 1 ranging from a person with a small bare hand to a person with a large hand wearing the gloves from an immersion suit (complying with the IMO Life-Saving Appliance Code Resolution MSC.48 (66), section 2.3) of appropriate size. The method of carriage shall not depend on any external interface or means which is not an integral part of the EPIRB (e.g. depending upon a pocket, pouch, loop, clip or hook and loop tape installed on clothing or an immersion suit is not acceptable).

Where the EPIRB is supplied with a float free release mechanism, the carrying means shall be designed to minimise the possibility of snagging when the EPIRB floats free.

The minimum breaking force of any handle, loop or other hands-free retention means shall be 245 N.

4.3.9 Indication of insufficient battery energy

(See 6.3.9)

The EPIRB shall be provided with means to indicate that the beacon battery may not have sufficient energy to support beacon operation for the manufacturer-declared minimum operating lifetime in accordance with C/S T.001 or C/S T.018 as applicable.

NOTE The intent of this indication is to indicate to the user during a self-test if the beacon has been previously activated for an extended period of time, such that it can no longer meet the minimum operating lifetime requirement.

4.4 Control and indicator functions

(See 6.4)

4.4.1 Control functions

(MSC.471(101)/A.3.1) *When the 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) (MSC.471(101)/A.3.2.1) *be clearly identified; and*

b) (MSC.471(101)/A.3.2.2) *be protected against inadvertent operation.*

(MSC.471(101)/A.3.3) *Manual distress alert initiation* shall *require at least two independent actions* in sequence to activate the EPIRB.

The two or more independent means of activation shall be capable of multiple use.

The following actions shall not be counted as one of the two independent actions required to manually activate the EPIRB by use of the controls:

– manual removal from the bracket; or

– inversion (e.g. turning the EPIRB upside down).

(MSC.471(101)/A.3.4) *The EPIRB shall not be automatically activated after being manually removed from the release mechanism* (dry EPIRB condition).

4.4.2 Indicator functions

The following indications are required on the EPIRB.

a) Low-duty cycle white light (see 4.2 h), 4.3.3 c) and 4.3.3 e))

The function of this light is to indicate when the EPIRB is active/on and may also indicate that signals are being emitted.

b) Self-test and GNSS self-test indicator(s) (see 4.3.4.1, 4.3.4.2, 4.3.4.3, 4.3.4.4 and 4.3.9)

The function of this indicator(s) is to inform the user if the EPIRB passes or fails the self-test or GNSS self-test and if the battery has insufficient energy.

c) GNSS indicator (see 4.2 l))

The function of this indicator is to inform the user if the EPIRB GNSS reception is satisfactory or unsatisfactory (i.e. if a current position is available to encode into the EPIRB message, or is not available, or fails to meet accuracy requirements).

d) Transmitter indicator

The function of this indicator is to inform the user that signals are being emitted (e.g. at 406 MHz). The low-duty cycle light may be used to provide such indication.

e) RLS indicator (if applicable)

This indicator provides a unique distinct indication of the RLS function in the EPIRB in accordance with C/S T.001 or C/S T.018 as applicable. Examples of means of compliance include a separate indicator, or a distinct indication such as a different colour used only for RLS in a combined indicator.

Indicators b), c), and e) above, may all be separate indicators on the EPIRB or their functions may be combined into fewer indicators at the discretion of the manufacturer, provided that in all cases each function is clearly defined and easily distinguishable from other functions.

4.5 Float-free arrangements

4.5.1 General

(See 6.5.1, 6.5.2, 6.5.3, 6.6.5 and 6.17)

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) allow the EPIRB to function in accordance with the requirements of 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;*

e) to the maximum extent possible prevent inadvertent activation of the EPIRB in the bracket due to movement. The design shall allow for the effects of a normal marine environment, (e.g. motion, vibrations, bumping) and any potential normal wear and tear and aging of flexible and elastic parts of the bracket (e.g. cushions, spacers, back-stops);

f) to the maximum extent possible be so designed as to ensure that the EPIRB cannot be placed in its mounting bracket incorrectly such that the automatic activation disabling feature of the bracket is rendered inoperable allowing the EPIRB to be activated when water washes over it and thus give rise to false alerts;

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

4.5.2 External power or data connection

(See 6.5.4)

(A.662(16)/3) For the 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 EPIRB.*

4.5.3 Ability to check the automatic release

(See 6.5.5)

(A.662(16)/4) If the hydrostatic release unit is resettable or capable of being tested, *it* shall *be possible to assess the proper functioning of the automatic release mechanism by a simple method without activation of the* EPIRB.

4.5.4 Manual release

(See 6.5.6)

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

4.6 Environment for EPIRB

4.6.1 General

(MSC.471(101)/A.2.5) *The EPIRB* shall *be so designed as to operate under any of the following environmental conditions.*

4.6.2 Temperature and icing

(See 6.2.2, 6.6.1 and 6.17)

a) Ambient temperatures of −55 °C to +70 °C for class 0.

b) Ambient temperatures of −40 °C to +55 °C for class 1.

c) (MSC.471(101)/A.2.5.1) *Ambient temperatures of −20 °C to +55 °C* for class 2.

d) (MSC.471(101)/A.2.5.2) *Icing*, which may occur when a cold EPIRB is submerged in water.

4.6.3 Wind speed

(See 6.6.3)

(MSC.471(101)/A.2.5.3) *Relative wind speeds up to 100 knots (52 m/s).*

4.6.4 Stowage

(See 6.6.4 and 6.17)

(MSC.471(101)/A.2.5.4) *After stowage at temperatures between* −55 °C and +70 °C for class 0, between −40 °C and +70 °C for class 1 and between *−30 °C and +70 °C* for class 2.

NOTE In this document 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 considered interchangeable in the context of their use in this document.

4.6.5 Shock, vibration and other environmental conditions

(See 6.6.5 and 6.17)

The installed EPIRB shall *(MSC.471(101)/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.*

4.7 Environment for float-free arrangement

(See 6.6.2, 6.7 and 6.17)

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 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;*

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* EPIRB *as far as practicable;*

d) not be damaged in stowage throughout the following temperature ranges

ambient temperatures of −55 °C to +70 °C for Class 0;

ambient temperatures of −40 °C to +65 °C for Class 1;

ambient temperatures of −30 °C to +65 °C for Class 2.

NOTE The stowage and operating temperature ranges for the EPIRB are different to those of the float-free arrangement.

4.8 Interference – Electromagnetic compatibility

(See 6.8, 6.18, 6.19 and 6.21)

(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 6 and IEC 60945 for the requirements.

4.9 Maintenance

(See 6.9)

Shore-based maintenance of EPIRBs should be carried out in accordance with IMO guidelines as set out in MSC/Circ.1039 as amended.

Annual testing of EPIRBs should be carried out in accordance with IMO guidelines as set out in MSC.1/Circ.1040/Rev.1 as amended.

The design of the EPIRB shall allow annual testing and shore-based maintenance to be performed in accordance with the above requirements.

As defined in 4.2 g), the 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 EPIRB shall only be possible with the use of tools.

4.10 Safety precautions

(See 6.10 and 6.20)

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

In addition, the battery shall not release toxic or corrosive products outside the EPIRB during or subsequent to stowage at temperatures between −55 °C and +75 °C, and shall comply with the United Nations Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, 7th Revised Edition, PART III, Section 38.3 (ST/SG/AC.10/11/Rev.7 as amended).

Moreover, the 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 document.

4.11 Equipment manuals

(See 6.11)

The equipment manual shall provide adequate information to enable the equipment to be properly stowed, installed, operated, tested and maintained, in this respect it shall include:

- an overview of the current Cospas-Sarsat system;
- complete instructions for the operation, the self-test of the EPIRB, including the GNSS self-test and testing of the AIS locating signal, to provide guidance to the operator towards maximizing radio transmissions and self-locating performance, including a warning not to obstruct the GNSS antenna's view of the sky;
- cautions and recommendations to prevent false alerts;
- instructions for licensing and registration (including either in the manual or separately the Hex ID of the EPIRB and the AIS User ID), 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;
- a warning such as the following – *If this Beacon is kept above room temperature for prolonged periods of time then the Battery Capacity will be degraded and either the Battery should be replaced earlier than the date stated on the beacon, or the quoted 48 hour operating life of the beacon may be reduced. The effect is more pronounced as the temperature increases;*
- guidance on the expected life of the EPIRB and its mounting bracket;
- instructions on reregistration or recoding of the EPIRB when transfer of ownership or change of vessel occurs;
- instructions on disposal of the EPIRB at the end of life, including measures to prevent false alerts during disposal and deregistration;
- an instruction to replace the battery when the battery status indicator informs the user that the beacon may not have sufficient energy to support beacon operation for the declared operating lifetime of the EPIRB;
- the minimum operating life-time and operating and stowage temperatures;
- the purpose of the lanyard and a precaution against using it to secure the EPIRB to the ship in distress;
- a recommendation against attempting to operate the EPIRB inside a covered life raft or lifeboat or under any similar cover or canopy;
- the servicing and/or replacement of any hydrostatic release unit and any associated components subject to aging, such as release rods;
- manufacturer recommendations, if any, on periodic functional testing;
- a recommendation to limit self-testing to that recommended by the beacon manufacturer;
- information on how to maintain the EPIRB as required by 4.9;
- a note to keep the original 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 EPIRB or the location where such information can be obtained by the user;
- warranty information;
- a warning to the effect that the EPIRB shall not be operated except in an emergency;
- (A.694(17)/2) instructions to ensure that the EPIRB is *installed in such a manner that it is capable of meeting the requirements of all applicable IMO performance standards*, which can be achieved by meeting all the requirements of this specification. The installation instructions shall, as a minimum, include the following guidance:

- (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* in a location that is not exposed to strong magnetic or electromagnetic fields, if these might activate the EPIRB;
- (IV/7.1.6.2) *be installed in an easily accessible position* to facilitate manual operation and testing;
- if possible, also be installed in a location that will provide as clear a view of the sky as is practical, orientated to facilitate satellite reception;
- not to install or operate the EPIRB in a location subject to high intensity RF fields (e.g radar or communications antennas);
- if the ability of the GNSS receiver in the EPIRB to obtain a fix can be impaired on the deck of a vessel due to interference from a GMDSS approved satellite communications system at a distance of 10 m, then an appropriate warning to this effect shall be included in the manual.

The equipment manual shall include information explaining the necessity to report EPIRB false alarms by the most expedient means to the nearest search and rescue authorities. The information that should be reported includes the EPIRB 15-Hex ID; date, time, duration and cause of activation; and position at time of deactivation.

4.12 Labelling

(See 6.12)

4.12.1 Equipment labelling

The label or labels shall be placed on the EPIRB itself, as needed.

(MSC.471(101)/A.5.1) *Labelling for operation controls and indicators* shall*, as far as possible, be understood through graphical images and symbols without the need for text.* The symbols provided in Annex F are recommended for this purpose. Text may be used in addition to symbols if required.

(MSC.471(101)/A.5.2) *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) (MSC.471(101)/A.5.2.1) *brief operating instructions*, to enable manual activation, deactivation and self-test (see 4.3.4), with any text used provided in at least English;

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

c) class (see Clause 1, as specified by the manufacturer, type of battery and (MSC.471(101)/A.5.2.2) expiry date for the primary battery used (see 5.9). Means shall be provided to change this date when the battery is replaced. The manufacturer shall make it clear by some means as to what day of the month the battery expires (e.g. text in the manual, day as well as month on the label, using 'end' before month);

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

   1) (MSC.471(101)/A.5.2.3) the identity codes programmed into the transmitters of the EPIRB (i.e. the 15 Hex ID, as described in C/S T.001, or the 23 Hex ID as described in C/S T.018), together with the call sign or MMSI of the ship as required by the Administration and the maritime identification digits (MID) code and additionally the AIS user ID;

   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) the location of the GNSS antenna and to provide this with a clear view of the sky during operation and if applicable information that the EPIRB may be interfaced to an external GNSS receiver.

4.12.2 Float-free arrangement labelling

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

a) *the operating instructions for manual release in pictorial form*;

b) the category (see Clause 1);

c) the stowage and operating temperature ranges of the float-free arrangement;

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

If the operating instructions label is not readily visible and readable in the installed arrangement, the instructions shall be provided in addition in pictorial form, on a waterproof placard suitable for installation close to the float-free arrangement.

4.12.3 Battery labelling

The battery shall be marked indelibly and legibly with the battery type, voltage, expiration date (month and year) and as appropriate, precautions associated with handling and disposal.

Additionally, a label shall be applied to either the interior of the EPIRB in a conspicuous place or on the battery pack itself warning that unauthorized battery replacement may lead to failure such as the following.

WARNING! Regulated lifesaving device. Unauthorized battery replacement may lead to failure.

4.13 Installation

(See 6.2.2 and 6.13)

The installed EPIRB shall:

a) (MSC.471(101)/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;*

b) (MSC.471(101)/A.2.6.3) *be designed to release itself and float-free before reaching a water depth of 4 m at a list or trim of any angle.*

5 Technical characteristics

5.1 Transmitted frequency

(See 6.14.1)

C/S T.001 first generation EPIRBs 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.

The second generation EPIRBs distress alerting signal shall be transmitted at the frequency specified in C/S T.018.

5.2 Signal and message format

(See 6.14.1)

(MSC.471(101)/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 or C/S T.018* as applicable.

For FGBs, the first 406 MHz transmission (with or without encoded position) shall not occur prior to the requirements of C/S T.001 but within no more than 2 min of activation of the EPIRB.

For SGBs, 406 MHz transmissions shall commence in accordance with C/S T.018.

Measures shall be taken to ensure that 406 MHz transmissions take priority and do not clash with either 121,5 MHz or AIS transmissions. 406 MHz and AIS transmissions shall be interleaved. The EPIRB software shall monitor projected transmission timings and in the event that the software sees a potential clash occurring, the 406 MHz transmission shall take precedence over the AIS transmission. It is acceptable to either shift the 406 MHz signal within the randomization requirements of Cospas-Sarsat, or omit a single AIS pulse from the sequence of eight pulses in order to avoid the clash.

For second generation beacons, when the cancellation function is initiated, the 121,5 MHz homing signal and the AIS locating signal may be stopped immediately or may continue until the beacon shuts off.

5.3 Distress message memory

(See 6.14.1)

(MSC.471(101)/B.2) *Provisions* shall *be included for storing the fixed portion of the distress message in the EPIRB using non-volatile memory.*

5.4 Beacon identification code

(See 6.14.1)

(MSC.471(101)/B.3) *A unique beacon identification code* shall *be made part of all 406 MHz messages. For EPIRBs compliant with C/S T.001 this identification code* shall *include a 3-digit maritime identification digits (MID) code to denote the country in which the beacon is registered, followed by either*

a) *the trailing 6 digits of the ship station identity in accordance with Recommendation ITU-R M.585, Assignment and use of identities in the maritime mobile service, or*

b) *a unique serial number, or*

c) *a radio call sign.*

Preference is given to the method in sub-paragraph a) above.

For EPIRBs compliant with C/S T.018 this identification code shall *include a 3-digit maritime identification digits (MID) code to denote the country in which the beacon is registered, followed by a unique serial number and either the maritime mobile service identity or a radio call sign.*

5.5 121,5 MHz homing signal

(See 6.14.2 and Annex D)

(MSC.471(101)/B.4) *The 121,5 MHz homing signal* shall:

a) *have a 121,5 MHz transmitting duty cycle not less than 50 % (1,125 s on, 1,125 s off) and if more than 50 %, the on time* shall *be increased beyond 1,125 s and the off time reduced accordingly.* In addition the signal may also be interrupted for up to a maximum of 2 s during the transmission of the 406 MHz signal and if applicable for the transmission of a Morse letter or an AIS burst (see Figure 2);

The following formula shall be used to determine the minimum 121,5 MHz swept tone transmission time. In any time period 'T' seconds

Minimum 121,5 swept tone transmission time in time 'T' = (T – (($X1$ × (T_m + 2)) + (0,05 × $X2$))) / 2 s

where

$X1$ is the number of 406 transmissions in time 'T';

$X2$ is the number of AIS messages in time 'T' (an AIS message is a single transmission of duration 26,7 ms, thus there are 8 of these messages in a burst, which occurs once per minute);

T_m is the total Morse character transmission time (including gaps) in seconds (0 if no Morse character transmitted);

b) *with the exception of the sweep direction* and if applicable the transmission of a Morse letter, *meet the technical characteristics of Appendix 15 of the* ITU *Radio Regulations. The sweep may be either upward or downward;*

c) if the 121,5 MHz homing signal in the EPIRB is required to include a Morse letter, transmitted as a series of tones modulated on the 121,5 MHz carrier, then the modulating frequency shall be 1 000 Hz ± 50 Hz, the dot duration shall be 115 ms ± 5 %, the dash duration shall be three times the dot duration and the Morse letter shall be transmitted after each 406 MHz signal transmission, prior to the start of the swept tone transmission. The Morse transmission shall contain the relevant number of dots, dashes and gaps applicable to the Morse letter required to be transmitted by the relevant related regulation or standard;

d) not commence 121,5 MHz transmissions until after the first 406 MHz transmission, but within 5 min of activation of the EPIRB;

e) be interrupted for the transmission of the AIS signal when the AIS signal coincides with a scheduled 121,5 MHz homing signal (or Morse letter tone transmission), for a maximum period of 50 ms. After the interruption for the AIS transmission the 121,5 MHz transmission shall continue as if it had not been interrupted (see Figure 2); and

f) comply with Annex D.

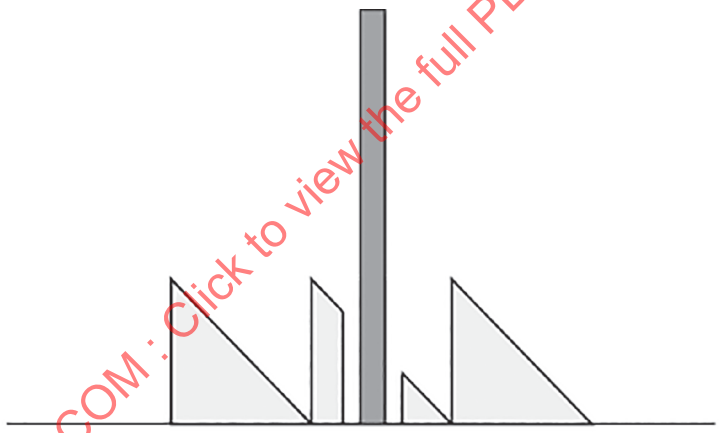


Figure 2 – AIS and 121,5 MHz signal interleaving

5.6 AIS locating signal

(See 6.14.3 and Annex E)

(MSC.471(101)/B.5) *The AIS locating signal* shall:

a) *transmit in accordance with recommendation ITU-R Rec M.1371*;

b) *start after the first 406 MHz satellite message*, but within 5 min of activation of the EPIRB *and ensure the AIS signal does not conflict with a scheduled 406 MHz satellite signal*;

c) *broadcast the Cospas-Sarsat beacon 15 HEX-ID in the AIS message 14, alternating with the text "EPIRB ACTIVE" on AIS1 and AIS2*;

NOTE For SGBs this is the 15 Hex ID truncated version of the 23 Hex ID.

d) *indicate in the transmitted AIS locating signal when the included position fix is more than 5 min old*;

e) comply with Annex E and the requirements of 5.2.

5.7 GNSS receiver and position reporting

(See 6.14.4 and Annex B)

The GNSS receiver used in the EPIRB shall comply with the requirements of Annex B and the following.

When the EPIRB is activated:

a) (MSC.471(101)/A.4.1) *the GNSS position fix* shall *be updated at intervals of no more than 5 min* and shall then be encoded into the next 406 MHz and AIS transmissions;

NOTE If the GNSS position fix is obtained within 2 s of the next 406 MHz or AIS transmission, it is acceptable to delay updating the position until the next transmission.

b) (MSC.471(101)/A.4.2) *when an updated fix*, obtained with a clear view of the sky, *is transmitted in the AIS message for the first time*, after each updated position fix, *the error between the transmitted and the actual position shall not exceed 30 m assuming a drift rate of 3 kn*. However if this requirement cannot be met for 5 consecutive burst sequences (5 min), then provide the best available position in the next AIS message. If no updated position is available then continue to send the last available position until either an updated position is available, or 4 h have elapsed, at which time revert to sending default position.

5.8 RLS

(See 6.14.5)

5.8.1 RLS capability

EPIRBs may optionally be provided with return link service (RLS) functionality. If provided, the RLS function shall comply with the RLS requirements of C/S T.001 or C/S T.018 as applicable. Communication of return link messages between the GNSS receiver and the EPIRB can be achieved using the IEC 61162-1 RLM sentence (see Annex G) or a proprietary sentence.

First generation EPIRBs with RLS capability should have provision for encoding with at least one other location protocol, in addition to the RLS location protocol, for use in countries that do not support or permit the use of RLS. Second generation EPIRBs with RLS capability should have provision for encoding with just rotating field #0, in addition to rotating fields #2 and #0, for use in countries that do not support/permit the use of RLS.

5.8.2 RLS self-test

When a self-test of the EPIRB is performed (see 4.3.4.1 or 4.3.4.2 as applicable) the RLS indicator shall operate in addition to other pass/fail indicators, to indicate to the user that the EPIRB is programmed with an RLS location protocol and that the indicator is functioning correctly. If an RLS EPIRB is programmed with any protocol other than the RLS location protocol, then the RLS indicator should not provide an indication.

5.9 Power source

5.9.1 General

(See 6.15.1, 6.15.3 and 6.15.4)

(MSC.471(101)/A.2.4) *The battery* shall *have sufficient capacity to operate the EPIRB* in conjunction with all other features and functions (for instance the low-duty cycle light, the 121,5 MHz beacon, the internal GNSS receiver and the AIS locating signal) *for an uninterrupted period of at least 48 h*, under the extreme operating temperature conditions corresponding to the class of the EPIRB.

Battery connections shall be such as to prevent reversed polarity or incorrect installation when connected to the EPIRB.

If the EPIRB battery is declared user-replaceable by the manufacturer, it should not be possible without the use of tools. In addition, provision shall be made to ensure watertight integrity of the beacon and the battery during and upon replacement of the user-replaceable battery.

5.9.2 Battery life and expiry date

(See 6.15.1)

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 EPIRB for at least 48 h 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 EPIRB:

a) self-testing (including any special self-test modes (for instance the GNSS self-test required in 4.3.4.4), 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.

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 EPIRB.

5.9.3 Expiry date indication

(See 6.15.2)

The EPIRB shall be clearly and durably marked with the battery expiry date (see 4.12.1 c)).

5.9.4 Reverse polarity protection

(See 6.15.3)

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

5.10 Antenna characteristics

(See 6.16)

The EPIRB shall meet the EIRP and antenna requirements and characteristics of C/S T.001 and C/S T.007 or C/S T.018 and C/S T.021 as applicable.

6 Methods of testing and required test results

6.1 General

6.1.1 Purpose

The EPIRB shall be tested to confirm that it meets the environmental and other requirements of Clauses 3 and 4, which can be achieved by testing it in accordance with Annex A. In addition, it shall also comply with the requirements of 6.1.2.

6.1.2 Type approval of EPIRBs operating in the Cospas-Sarsat system

(MSC.471(101)/C.1) *EPIRBs forming an integral component of the global maritime distress and safety system and operating through the Cospas-Sarsat satellite system in the frequency band 406 MHz to 406,1 MHz shall be type approved to ensure the integrity of the Cospas-Sarsat satellite system, avoid harmful interference to the spaceborne equipment, exclude unauthorized transmissions, and to provide reliable data to rescue coordination centres*.

National administrations should:

a) (MSC.471(101)/C.2.1) *ensure, as part of national type approval procedures, that any new type of EPIRB to be deployed on board ships is tested to confirm that it is in accordance with the performance standards for EPIRBs; confirmation that the EPIRB meets part B of this performance standard* (IMO MSC.471(101)) *can be achieved by either*:

   1) *performing, or having performed, under national procedures, all appropriate tests; and/or*

   2) *accepting type approval test results obtained through the Cospas-Sarsat type approval procedure for first generation beacons (Cospas-Sarsat document C/S T.007) or the Cospas-Sarsat type approval procedure for second generation beacons (Cospas-Sarsat document C/S T.021) and confirmed by the delivery of a Cospas-Sarsat Type Approval Certificate; and*

b) (MSC.471(101)/C.2.2) *encourage national type approval authorities to develop test procedures compatible, to the extent possible, with Cospas-Sarsat system document C/S T.007 or C/S T.021 as appropriate and, if necessary, in consultation with the Cospas-Sarsat Secretariat.*

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);

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;

h) beacon coding software; and

i) miscellaneous tests.

6.1.3 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.

6.1.4 Warm-up period

Warm-up periods, or their absence, prior to making measurements to determine compliance with the requirements of this document, are defined in C/S T.001, Section A.2 or C/S T.018, Section A.2 as appropriate.

6.1.5 Instructions

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

6.1.6 Additional facilities

(See 4.2 f))

If the equipment contains any additional facilities such as RLS functionality 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.

6.1.7 Audible and visual indications

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

6.1.8 Preparation of EPIRB for type-approval testing

For the purpose of performance testing, the EPIRB shall be specially programmed to transmit data bursts encoded using (C/S T.007 or C/S T.021 as applicable) the test protocol of appropriate type and format, when the EPIRB is activated.

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

EPIRB(s) shall be configured for testing in accordance with either C/S T.007 or C/S T.021 as applicable. Both fully packaged EPIRBs with antenna attached (radiated test samples) and 50 Ω antenna port EPIRBs (conducted test samples) shall be provided and shall be tested as required by Clause A.1 and Clause A.2. All homing devices shall be prepared for test transmission as required by the national authority. Transmission of distress signals on distress and safety frequencies shall be avoided, for example, by frequency offset of the 121,5 MHz homing signal in accordance with either C/S T.007 or C/S T.021 as applicable.

6.1.9 Test conditions

6.1.9.1 Normal test conditions

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

air temperature: +15 °C to +35 °C;

water temperature +15 °C to +25 °C;

relative humidity: 20 % to 75 %.

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

NOTE Unless specifically stated otherwise, water means domestic tap water or its equivalent.

6.1.9.2 Extreme test conditions

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

Applicable operating temperature ranges:

For class 0 EPIRBs:	−55 °C to +70 °C
For class 1 EPIRBs:	−40 °C to +55 °C
For class 2 EPIRBs:	−20 °C to +55 °C
For float-free arrangements:	−30 °C to +65 °C (all classes)

Applicable stowage temperature ranges:

For class 0 EPIRBs:	−55 °C to +70 °C
For class 1 EPIRBs:	−40 °C to +70 °C
For class 2 EPIRBs:	−30 °C to +70 °C)
Float-free arrangements class 0:	−55 °C to +70 °C
Float-free arrangements class 1:	−40 °C to +65 °C
Float-free arrangements class 2:	−30 °C to +65 °C

6.1.10 Test sequence

All tests shall be performed on one or more radiated and conducted test samples as defined in Clause A.1 and Clause A.2.

6.1.11 Performance check

For the purpose of this document, a performance check consists in activating the EPIRB (see 6.1.8) 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 144 message bits (FGBs) or 23 Hex ID and all 250 message bits (SGBs) as appropriate), the presence of auxiliary radio-location device transmissions (homing transmitter output) and the presence of an AIS locating device transmission.

6.1.12 Performance test

For the purpose of this document, a performance test consists in activating the EPIRB (see 6.1.8) and:

For FGBs measuring the following, over at least 18 bursts, as defined in C/S T.007 Annex A:

a) 406 MHz transmitted power output;
b) 406 MHz digital message;
c) 406 MHz digital message format and structure (bit rate and stability only);
d) 406 MHz modulation;
e) 406 MHz transmitted frequency; and
f) 406 MHz spurious output.

For SGBs measuring the following, over at least 35 bursts, as defined in C/S T.021 Annex A:

a) 406 MHz transmitted power output;
b) 406 MHz carrier frequency stability (short term only);
c) 406 MHz chip characteristics;
d) 406 MHz error vector magnitude (EVM);
e) 406 MHz spurious output;
f) 406 MHz first burst delay and repetition period; and
g) 406 MHz message structure and content.

6.2 General tests

6.2.1 EPIRB

(See 4.2)

The requirements of 4.2 a) shall be verified by the tests in 6.3.8.

The requirements of 4.2 b) are considered verified by successful completion of the Cospas-Sarsat type approval tests specified in 6.1.2.

The requirements of 4.2 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 and C/S T.007 or C/S T.021 if applicable to satisfy the requirements of 4.2 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 4.2 g) shall be verified by inspection.

6.2.2 Float-free arrangements

(See 4.2 d), 4.2 e) and 4.6.2)

The EPIRB installed in the automatic release mechanism shall be subjected to a test at normal temperature in each orientation below and to a test at the extreme operating temperatures of the float-free mechanism in only the normal mounting position, before being 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 4.11);
– rolling 90° to starboard;
– rolling 90° to port;
– pitching 90° bow down;
– pitching 90° stern down;
– upside-down position.

The 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 39,2 kPa.

The tests at the extreme temperatures shall be performed, after storage at the float-free mechanism extreme operating temperature for a minimum period of one hour, in the normal mounting position(s) only, as defined in the equipment manuals. The EPIRB and float-free mechanism shall be taken from the storage temperature and shall immediately be placed in the water and shall be rapidly subjected to a depth of 4 m or an equivalent water pressure. If the EPIRB is not released from the float-free mechanism before a depth of 4 m is reached, then the EPIRB shall be held at a depth of 4 m for a maximum period of 10 min, during which time, if the EPIRB is released, the test shall be considered passed.

In addition, during the tests at extreme temperatures the EPIRB shall activate, as indicated by the light on the EPIRB flashing, within 10 min of the point at which the EPIRB is released from the float-free mechanism or reaches a depth of 4 m (or its equivalent), whichever occurs first.

Where there is some delay between removing the EPIRB from the environmental chamber and submerging it in water, precautions shall be taken to minimise changes in the EPIRB temperature (for example by insulating the EPIRB from the surrounding air).

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 EPIRB from its float-free mechanism. Subject to satisfactory performance checks, as defined below, opening of the EPIRB to check for water ingress may be delayed until the completion of all tests.

The performance check as described in 6.1.11 shall be carried out after each series of releases and at each specified temperature.

6.3 Operational tests

(See 4.3)

6.3.1 Prevention of inadvertent activation

a) (4.3.1 a)) By inspection.

b) (4.3.1 b)) By the tests that are included in 6.5.2.

c) (4.3.1 c)) By successful completion of the Cospas-Sarsat type approval specified in 6.1.2.

6.3.2 Immersion, buoyancy and drop into water

6.3.2.1 Immersion test

(See 4.3.2 a))

The test is included in 6.17.5 and 6.17.9.

6.3.2.2 Buoyancy test

(See 4.3.2 b))

With the antenna deployed in its normal operating position, the 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 EPIRB shall float upright with the lowest part of any antenna outside of the EPIRB body a minimum of 40 mm above the waterline.

The reserve buoyancy of the 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 waterline shall be determined on the floating 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.

6.3.2.3 Drop test

(See 4.3.2 c))

The test is included in 6.17.6.

6.3.3 Activation

6.3.3.1 Test for salt water activation

(See 4.3.3 a))

The EPIRB shall be floated in a 0,1 % salt solution and shall then activate, within 15 s.

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 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, including after being automatically activated and removed from the water and allowed to dry, the EPIRB then deactivates within one minute.

This test may be combined with the test in 6.2.1.

6.3.3.2 Test for repetitive manual activation and deactivation

(See 4.3.3 b))

By inspection and demonstration.

6.3.3.3 Test of low-duty cycle light

(See 4.2 h) and 4.3.3 c))

The time from EPIRB activation to the commencement of the first flash of the low-duty cycle light shall be checked at the normal temperature, when the EPIRB is both manually and automatically activated (this part of the test may be combined with the test in 6.3.3.1), to be within 2 s (manual activation) and 15 s or prior to the first 406 MHz transmission if sooner (automatic activation).

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 EPIRB. The EPIRB shall be floated in a container of fresh water to determine its waterline, which shall then be marked on the body of the 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 at the azimuth and elevation angles required by Table 2. 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.

Table 2 – Effective luminous intensity

Azimuth °	Elevation °								
	10	20	30	40	50	60	70	80	90
0									
45					NR	NR	NR	NR	NR
90									NR
135					NR	NR	NR	NR	NR
180									NR
225					NR	NR	NR	NR	NR
270									NR
315					NR	NR	NR	NR	NR

Key

NR Measurement not required

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

The colour of the light shall be determined to be white by visual inspection.

6.3.3.4 Test of the night vision light

(See 4.2 i))

The average radiant intensity, flash duration and flash rate shall be checked at the normal temperature and at the extreme temperatures.

The data sheet(s) for the indicator(s) used to generate the night vision light shall be inspected to ensure that the wavelength of the light is between 770 nm and 890 nm.

The arithmetic mean of the radiant intensity over the upper hemisphere above 20° shall not be less than 2,5 mW/sr. The flash rate shall be 20 to 30 times per minute. The flash duration shall be between 66 ms and 500 ms.

The radiant intensity shall be measured at 41 points over the upper hemisphere of the EPIRB. The EPIRB shall be floated in a container of fresh water to determine its waterline, which shall then be marked on the body of the 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 radiant intensity shall be measured at the azimuth and elevation angles required by Table 3. The arithmetic mean radiant intensity of all 41 points shall be not be less than 2,5 mW/sr. No points shall have a radiant intensity of less than 0,25 mW/sr.

Table 3 – Radiant intensity

Azimuth °	**Elevation** °							
	20	30	40	50	60	70	80	90
0								
45				NR	NR	NR	NR	NR
90								NR
135				NR	NR	NR	NR	NR
180								NR
225				NR	NR	NR	NR	NR
270								NR
315				NR	NR	NR	NR	NR

Key

NR Measurement not required

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

6.3.3.5 Tests for 4.2 l) and 5.7

The internal GNSS receiver shall comply with the requirements of Annex B.

6.3.3.6 Tests for 4.2 k), 5.2 and 5.5

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

6.3.3.7 Tests for 4.2 m), 5.2 and 5.6

The AIS locating signal shall comply with the requirements of Annex E.

6.3.4 Self-test

(See 4.3.4)

6.3.4.1 EPIRB self-test

The self-test mode of the EPIRB shall be activated. The digital message generated shall be in accordance with the requirements of 4.3.4.2 or 4.3.4.3 as applicable.

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

The self-test shall comply with either C/S T.007 A.3.6.1 and A.3.6.2 or C/S T.021 B.13 as applicable.

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

The AIS locating signal shall be checked to ensure that it transmits two single VHF pulses lasting no more than 26,7 ms each, one transmitted on AIS 1 and the other on AIS 2. The pulse shall consist of an AIS Message 14 containing the Hex ID of the EPIRB on one channel and "EPIRB TEST" on the other channel. Valid AIS slot timing is not required.

The self-test transmissions shall be checked to ensure that they are transmitted in ascending order of frequency.

The manufacturer shall provide documented evidence that self-test failures are correctly indicated.

6.3.4.2 GNSS self-test

The GNSS self-test shall comply with either C/S T.007 A.3.6.3 or C/S T.021 B.13 as applicable.

The AIS locating signal shall be checked to ensure it complies with E.2.7.2.

6.3.5 Exterior, colour and retro-reflecting material

(See 4.2 n) and 4.3.5)

By inspection of the EPIRB, verify:

a) that there are no sharp edges that may damage an inflatable survival craft;

b) its colour;

c) the area and placement of the retro-reflective material.

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

6.3.6 Lanyard

(See 4.3.6)

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

6.3.7 Exposure to marine environment

(See 4.3.7)

By test (see 6.17.10, 6.17.11 and 6.17.12) 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.

By inspection of the evidence submitted by the manufacturer that the method used protects from corrosion the mechanism used in the bracket, which prevents the EPIRB activating while in the bracket.

6.3.8 Ergonomics

(See 4.3.8)

The following tests are designed to demonstrate that the EPIRB can be removed from its bracket, safely carried to a survival craft and then operated by a wide range of human subjects.

These tests may be performed by the manufacturer or the test facility. If they are performed by the manufacturer, then reasonable supporting video evidence shall be provided to the test facility demonstrating compliance.

The tests shall be performed by subjects who meet the requirements of 4.3.8. The person with small hands shall carry out the tests with bare hands and the person with large hands shall carry out the tests while wearing the gloves from an immersion suit of appropriate size (complying with the IMO Life-Saving Appliance Code Resolution MSC.48 (66), section 2.3).

Actions a) to c) and e) below shall be demonstrated and shall be readily and easily accomplished with a single hand (while if necessary the EPIRB is supported by some means) by both the test person with small hands and the test person with large hands. Action d) shall be demonstrated and shall be readily and easily accomplished with both hands kept free (so that they can, if required, grip or hold the ladder) by the same test persons.

a) The EPIRB can be removed from its bracket.

b) Each individual control on the EPIRB can be activated and deactivated.

c) Any hands free carriage means can be deployed (destowed), then can be fitted (attached) to the person and if necessary adjusted to ensure a good fit.

d) After being prepared as in c) above the EPIRB can be securely carried hands-free while climbing up and down a vertical ladder at least 3 m in height.

e) The lanyard can be deployed.

If instructions for deployment and use of the hands-free carriage means are provided either on the product or in the manual, these shall be easily understood. The test facility shall use its best judgement to determine that the instructions provide adequate guidance to an inexperienced user.

The minimum breaking force of any hands-free retention means shall be demonstrated by the inspection of evidence submitted by the manufacturer that it meets the specified requirements of at least 245 N.

6.3.9 Indication of insufficient battery energy

(See 4.3.9)

This requirement is demonstrated by satisfactory completion of testing in accordance with C/S T.007 or C/S T.021 as applicable.

6.4 Control and indicator functions

(See 4.4)

The requirements of 4.4.1 shall be verified by inspection and demonstration.

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

The requirements of 4.4.2 are verified by 6.3.3.3, 6.3.4, 6.3.9 and Clause B.4.

6.5 Float-free arrangements

6.5.1 Release

(See 4.5.1 a) and 4.5.1 f))

The requirements of 4.5.1 a) shall be verified during 6.2.2.

The requirements of 4.5.1 f) shall be verified by inspection and demonstration of the mounting of the EPIRB in the float-free mechanism.

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

(See 4.5.1 b), 4.5.1 c) and 4.3.1 b))

The unit consisting of the 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 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 EPIRB in an arc of at least 180° perpendicular to the normal mounting position of the unit.

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

6.5.3 Construction materials

(See 4.5.1 d) and 4.5.1 g))

By test (see 6.17.12) 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.

By test (see 6.17.10, 6.17.11 and 6.17.12) 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.

6.5.4 External power or data connection

(See 4.5.2)

By inspection during 6.2.2.

6.5.5 Ability to check the automatic release

(See 4.5.3)

By inspection and/or demonstration.

6.5.6 Manual release

(See 4.5.4)

By inspection and demonstration.

6.6 Environment

(See 4.6)

6.6.1 Temperature

By testing during 6.17.

6.6.2 Icing

(See 4.7 c))

If the manufacturer declares conformance with 4.7 c), compliance can be demonstrated by inspection of the equipment manual to confirm suitable guidance on installation and use under icing conditions of the float-free arrangement.

6.6.3 Wind speed

By successful completion of 6.5.2.

6.6.4 Stowage

By testing during 6.17.

6.6.5 Shock, vibration and other environmental conditions

By testing during 6.17.

6.7 Environment for float-free arrangement

(See 4.7 a), b) and d))

By testing during 6.2.2 and 6.17.

6.8 Interference – Electromagnetic compatibility

(See 4.8)

By testing during 6.17.

6.9 Maintenance

(See 4.9)

By inspection of the equipment and the equipment manuals (see 6.11).

6.10 Safety precautions

(See 4.10)

By test and inspection of the evidence submitted by the manufacturer that the EPIRB and the battery shall function safely under the conditions stated in 4.10. 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, 7th Revised Edition, PART III, Section 38.3 (ST/SG/AC.10/11/Rev.7 as amended).

6.11 Equipment manuals

(See 4.11)

By inspection.

6.12 Labelling

6.12.1 Equipment labelling

(See 4.12.1)

By inspection.

6.12.2 Float-free arrangement labelling

(See 4.12.2)

By inspection.

6.12.3 Battery labelling

(See 4.12.3)

By inspection.

6.13 Installation

(See 4.13)

By inspection of the equipment manuals and, if provided, by activation of the EPIRB from the remote system, set up in accordance with the manufacturer's instructions.

Automatic release and float-free operation is verified during 6.2.2.

6.14 Technical characteristics

6.14.1 406 MHz signal characteristics

(See 5.1 to 5.4)

By testing to C/S T.007 or C/S T.021 as applicable in accordance with A.2.12.

In addition, the 406 MHz and AIS transmissions shall be monitored for a period of at least 15 min after activating the EPIRB at normal temperature to ensure that there are no clashes between the signals. The timing of all 406 MHz transmissions shall comply with C/S T.001 or C/S T.018 as applicable and the timing of each sequence of 8 AIS pulses shall comply with Annex E, except that occasionally, if required, it is permissible to omit a single AIS pulse out of a sequence of eight pulses, if this one pulse would have clashed with a 406 MHz transmission.

This test may be combined with the test in D.4.4.

6.14.2 121,5 MHz homing signal

(See 5.5)

The 121,5 MHz homing signal shall be tested to and comply with Annex D.

6.14.3 AIS locating signal

(See 5.6)

The AIS locating signal shall be tested to and comply with Annex E.

6.14.4 GNSS receiver and position reporting

(See 5.7)

The GNSS receiver shall be tested to and comply with Annex B.

The frequency of position update intervals, of no more than every 5 min, shall be demonstrated during testing to either C/S T.007 or C/S T.021 as applicable.

6.14.5 RLS

(See 5.8)

If the EPIRB includes return link service (RLS) functionality, it shall be tested to and comply with the RLS tests in C/S T.007 or C/S T.021 as applicable.

6.15 Power source

6.15.1 Battery capacity test

(See 5.9.2)

Using a fresh battery pack, the 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 5.9.2). The manufacturer shall substantiate the method used to determine this time.

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 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 EPIRB shall be placed in a chamber of normal room temperature. Then the temperature shall be reduced to and maintained at −55 °C ± 3 °C for class 0, −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 GNSS device or interface drawing maximum current, homing and locating signals drawing maximum current) 30 min after the end of the period at the applicable stowage temperature of the 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 either the test as specified in C/S T.007, Annex A, A.2.3 or the test as specified in C/S T.021, Annex A, A.2.3 (Operating lifetime at minimum temperature) as applicable 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 6.1.12) shall be performed.

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

The EPIRB shall meet the requirements of either C/S T.007, Annex A, A.2.3 (−55 °C for class 0, −40 °C for class 1 or −20 °C for class 2) or C/S T.021, Annex A, A.2.3 (−55 °C for class 0, −40 °C for class 1 or −20 °C for class 2) as applicable for 48 h.

This test may be combined with the test as described in either C/S T.007, Annex A, A.2.3 or C/S T.021, Annex A, A.2.3 as applicable (see A.2.12 of this document).

6.15.2 Expiry date indication

(See 5.9.3)

By inspection.

6.15.3 Reverse polarity protection

(See 5.9.4)

By inspection.

6.15.4 User-replaceable battery

(See 5.9.1)

For EPIRBs declared by the manufacturer to have a user replaceable battery it shall be determined that:

a) by inspection the battery cannot be replaced without the use of tools;

b) with the battery removed from the EPIRB both the EPIRB and the battery shall be subjected to the temporary immersion test for portable equipment (IEC 60945:2002, 8.9.3).

6.16 Antenna characteristics

(See 5.10)

By testing to either C/S T.007 or C/S T.021 as applicable, in accordance with A.2.12.

6.17 Environment

6.17.1 General

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.

Before commencing the first environmental test and after each environmental test, a performance check shall be made (see 6.1.11).

The following tests shall be made under environmental conditions, as detailed in IEC 60945. All these tests, except 6.17.5, 6.17.6, 6.17.10, 6.17.11, and 6.17.12 shall be performed with the EPIRB installed in the release mechanism.

6.17.2 Dry heat cycle, of IEC 60945

(See 4.6.2, 4.6.4 and 4.7 a))

Both the dry heat storage test and the dry heat functional test in IEC 60945 shall be carried out, at the appropriate temperatures for the declared class of the EPIRB and float-free release mechanism (i.e. 0, 1 or 2) as specified in 4.6.2, 4.6.4 and 4.7.

A performance test (see 6.1.12) shall be performed at the end of the functional test soak period.

NOTE 1 It can be necessary to remove the 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 if this involves opening the environmental chamber, the temperature of the EPIRB can be re-stabilized before carrying out the test.

NOTE 2 Where the extreme stowage and/or operating temperature of the float-free mechanism and the EPIRB are different, the manufacturer can voluntarily elect to test the float-free mechanism and the EPIRB at the same temperature, provided that this is the more extreme of the two, in which case both items can be tested together.

6.17.3 Damp heat cycle, of IEC 60945

(See 4.6.2, 4.6.4 and 4.7 a))

6.17.4 Low-temperature cycle, of IEC 60945

(See 4.6.2, 4.6.4 and 4.7 a))

Both the low temperature storage test and the low temperature functional test in IEC 60945 shall be carried out, at the appropriate temperatures for the declared class of the EPIRB and float-free release mechanism (i.e. 0, 1 or 2) as specified in 4.6.2, 4.6.4 and 4.7.

A performance test (see 6.1.12) shall be performed at the end of the functional test soak period.

NOTE 1 It can be necessary to remove the 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 if this involves opening the environmental chamber, the temperature of the EPIRB can be re-stabilized before carrying out the test.

NOTE 2 Where the extreme stowage and/or operating temperature of the float-free mechanism and the EPIRB are different, the manufacturer can voluntarily elect to test the float-free mechanism and the EPIRB at the same temperature, provided that this is the more extreme of the two, in which case both items can be tested together.

6.17.5 Thermal shock tests

(See 4.3.2 a))

6.17.5.1 IEC 60945 test

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

Perform the thermal shock test for portable equipment as defined in IEC 60945.

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

6.17.5.2 Low temperature thermal shock test

The thermal shock test for portable equipment as defined in IEC 60945 shall be repeated but this time the EPIRB shall be placed in an atmosphere of −20 °C ± 3 °C for one hour prior to being immersed in water at +25 °C ± 3 °C.

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

This test may be combined with the test in 6.17.9.

6.17.6 Drop test for portable equipment, of IEC 60945

(See 4.3.2 c))

6.17.6.1 Drop on hard surface

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

6.17.6.2 Drop into water

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

Three drops shall be initiated from a different orientation, namely antenna vertically up, antenna vertically down and antenna horizontal on one face. A further three drops shall be performed with the antenna horizontal on the remaining three faces (if the device is spherical, then it shall be rotated 90° for each drop), these tests may be performed on the same EPIRB or a second EPIRB at the manufacturer's discretion. When the EPIRB is released for each drop, every effort shall be made to release it without imparting a spin to the EPIRB.

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

6.17.7 Vibration test, of IEC 60945

(See 4.5.1 e), 4.6.5 and 4.7 b))

Prior to the commencement of the vibration test the EPIRB shall have its water sensor mechanism shorted out for the duration of the test by a means defined by the manufacturer that is acceptable to the test laboratory. The purpose of this is to simulate conditions on board a vessel where the EPIRB in its bracket may be subject to both wave wash over and vibrations and should still not activate. The EPIRB shall not activate during this test.

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

6.17.8 Ruggedness test

(See 4.5.1 e), 4.6.5 and 4.7 b))

The ruggedness test is conducted to give a measure of confidence that the equipment will meet service conditions. The EPIRB shall be secured to the testing equipment through its normal attachments that would be used for mounting it on a vessel and shall be mounted in the nominal orientation recommended by the manufacturer in the equipment manual. In addition, the EPIRB shall also be tested in all other mounting orientations recommended by the manufacturer in the equipment manual, these tests may be performed on the same EPIRB or additional EPIRBs at the manufacturer's discretion. Additional straps or other holding means shall not be used.

The EPIRB(s) shall have its water sensor mechanism shorted out for the duration of the test by a means defined by the manufacturer that is acceptable to the test laboratory. The purpose of this is to simulate conditions in service (e.g. transportation) where the EPIRB in its bracket may be both wet and subject to being bumped around and should still not activate. The EPIRB(s) shall not activate during this test.

The EPIRB(s) shall be subjected to the ruggedness test according to the following profile in each recommended mounting orientation:

Peak acceleration:	98 m/s^2 with a tolerance of ±10 %
Pulse duration:	16 ms or 20 ms with a tolerance of ±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.

6.17.9 Immersion test, of IEC 60945

(See 4.3.2 a))

The EPIRB shall be subjected to the immersion test for portable equipment (IEC 60945:2002, 8.9.2).

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

This test may be combined with the test in 6.17.5.2.

6.17.10 Solar radiation test, of IEC 60945

(See 4.3.7 and 4.5.1 g))

The 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.

If a placard, as defined in 4.12.2 is provided, it shall be included in this 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 EPIRB and the release mechanism would satisfy the test.

6.17.11 Oil resistance test, of IEC 60945

(See 4.3.7 and 4.5.1 g))

The 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.

If a placard, as defined in 4.12.2 is provided, it shall be included in this 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 EPIRB and the release mechanism would satisfy the test.

6.17.12 Corrosion test, of IEC 60945

(See 4.3.7, 4.5.1 d) and 4.5.1 g))

The 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.

If a placard, as defined in 4.12.2 is provided, it shall be included in this test.

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

6.18 Interference testing

(See 4.8)

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

The EPIRB shall be subjected to the immunity to radiated interference and the electrostatic discharge tests, as detailed in IEC 60945:2002, 10.4 and 10.9. The performance check requirement for all tests shall be performance criterion B.

6.19 Spurious emissions

(See 4.8)

The measurement shall be performed only between 406 MHz and AIS bursts.

The measurements shall be made at the transmitter output at 50 Ω using a receiver or a spectrum analyser 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 162,1 MHz, and

1 525 MHz to 1626,5 MHz.

No signal level within these bands shall exceed 25 µW (−16 dBm).

This test may be combined with the test required by either C/S T.007, Annex A, A.3.2.2.4 or C/S T.021, Annex B, B.5 as applicable (A.1.11 of this document) and with the tests required by Clause D.3, item e) and IEC 61097-14:2010, 7.8.

This test replaces the radiated emissions test required by IEC 60945:2002, 9.3.

6.20 Compass safe distance

(See 4.10)

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

6.21 Conducted interference

(See 4.8)

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

If there is a connection between the ship's power system and the 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 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.

Annex A
(normative)

Sequence of tests

A.1 Compulsory 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 unless stated otherwise.

Tests marked "x" may be performed in the indicated sequence or moved in the sequence and combined with the related Cospas-Sarsat tests (A.2.12).

A performance check (see 6.1.11) shall be performed before the first test and during or after each test.

	A.1.1	Set up EPIRBs in accordance with the message format and homing devices requirements (see 6.1.8)
	A.1.2	Dry heat test (see 6.17.2 and IEC 60945)
	A.1.3	Damp heat test (see 6.17.3 and IEC 60945)
	A.1.4	Low temperature test (see 6.17.4 and IEC 60945)
	A.1.5	Vibration test (see 6.17.7 and IEC 60945)
	A.1.6	Ruggedness test (see 6.17.8)
	A.1.7	Drop on hard surface (see 6.17.6.1 and IEC 60945)
	A.1.8	Drop into water (see IEC 60945 as modified by 6.17.6.2)
	A.1.9	Thermal shock test (see 6.17.5 and IEC 60945)
	A.1.10	Immersion test (see 6.17.9 and IEC 60945)
x	A.1.11	Spurious emissions (see 6.19)
x	A.1.12	Battery capacity test (see 6.15.1)
	A.1.13	Interference testing (see 6.18 and IEC 60945)
	A.1.14	Conducted interference test (if applicable) (see 6.21 and IEC 60945)
	A.1.15	Limited Cospas-Sarsat type-approval tests

NOTE 1 The purpose of the limited Cospas-Sarsat type- approval tests is to ensure that the EPIRB still complies with Cospas-Sarsat requirements after the completion of all the environmental tests.

For tests A.1.2, A.1.3 and A.1.4 both a radiated test sample and a conducted test sample shall be tested, such that a performance check can be carried out on the radiated sample and a performance test can be carried out on the conducted sample. For all the other tests above a single radiated sample shall be used for all tests.

A subset of the Cospas-Sarsat tests shall be repeated on the radiated test sample at the end of the test sequence as follows:

FGBs – C/S T.007, Test A.2.1 (except transmitter power output and VSWR) at ambient temperature, Tests A.2.5 and A.3.8.2 in Configuration 5 only.

SGBs – C/S T.021, Test A.2.1 (except transmitter power output and VSWR) at ambient temperature, Tests A.2.5 and B.14.2.4 in Configuration SN-ON only.

NOTE 2 The manufacturer will agree a method of performing the limited C/S tests on the radiated test sample with the relevant approval authorities and the test facility prior to commencing the tests.

A.2 Additional tests

The following additional tests may be performed in any order and at any time.

A.2.1 Test of operational requirements (see 6.3.1, 6.3.3.2, 6.3.4, 6.3.5, 6.3.6, 6.3.8, 6.4, 6.5.2, 6.5.4, 6.5.5, 6.5.6, 6.15.2, 6.15.3)

A.2.2 Automatic release mechanism and automatic activation test for class 0, class 1 and class 2 EPIRBs (see 6.2.2). This test may be combined with the test required in 6.17.5.

A.2.3 Stability and buoyancy test (see 6.3.2.2)

A.2.4 Salt water activation test (see 6.3.3.1)

A.2.5 Safety (see 6.10 and IEC 60945)

A.2.6 Compass safe-distance test (see 6.20 and IEC 60945)

A.2.7 Solar radiation test (see 6.3.7, 6.5.3, 6.17.10 and IEC 60945)

A.2.8 Oil resistance test (see 6.3.7, 6.5.3, 6.17.11 and IEC 60945)

A.2.9 Corrosion test (see 6.3.7, 6.5.3, 6.17.12 and IEC 60945)

A.2.10 Signal light tests (see 6.3.3.3 and 6.3.3.4)

A.2.11 Ergonomics tests (see 6.3.8)

A.2.12 Cospas-Sarsat type approval test procedure in accordance with C/S T.007 or C/S T.021 as applicable (see 6.14.1)

A.2.13 GNSS receiver requirements (see 6.14.4 and Annex B)

A.2.14 121,5 MHz homing device tests (see 6.14.2 and Annex D)

A.2.15 AIS locating signal device tests (see 6.14.3 and Annex E)

A.2.16 RLS (if applicable) (see 6.14.5)

A.2.17 Maintenance, installation, equipment manuals and labelling (see 6.9, 6.11, 6.12 and 6.13)

For tests A.2.2 to A.2.11 and test A.2.13 one or more radiated test samples shall be used for testing. For tests A.2.12, A.2.14 and A.2.15 one or more conducted or radiated samples shall be used for testing as required.

Annex B
(normative)

Internal and external navigation devices GNSS receivers

B.1 General

EPIRBs shall include beacon position data, obtained from an internal navigation device and may also additionally obtain position data from a source external to the EPIRB. All EPIRBs shall meet the requirements of Clauses B.3 and B.4. Additionally, those with an external navigation input shall also meet the requirements of Clause B.2.

B.2 External navigation devices

(See 4.5.2, 6.1.6, 6.5.4 and 6.21)

If an EPIRB includes the facility to be interfaced to an external navigation device, in addition to the internal navigation receiver, then it shall comply with the following requirements.

a) The manufacturer shall provide a list of all the approved external GNSS receivers that have been tested with the 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 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) which shall comply with IEC 61162-1;

   4) a list of the IEC 61162-1 sentences that the EPIRB can handle, which shall as a minimum include (GGA, 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).

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 EPIRB from operating correctly while the malfunction is present.

e) The manufacturer shall detail what measures have been taken within the EPIRB software to ensure that erroneous position data is not encoded into the beacon message (see either C/S T.001, 4.5.5.5 or C/S T.018, 4.5.5.4 as applicable).

f) If a simulated data stream is used (as permitted by either C/S T.007, A.2.7 c) or C/S T.021, B.14.4.2.2 as applicable) for the tests in either C/S T.007, A.3.8 or C/S T.021, B.14.4.2.2 as applicable, 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 EPIRB by successfully completing test T.007, A.3.8.2.1 with the external receiver, while the EPIRB's internal receiver antenna is masked to prevent it from acquiring navigation signals. For SGBs the test in T.007, A.3.8.2.1 still applies, but verify that a position accurate to within 100 m is encoded within the transmitted message within 5 s of activation. During this test the EPIRB shall be fully operational (radiating both 406 MHz, 121,5 MHz and AIS signals via the antenna) to ensure that any interference from the EPIRB does not interfere with the operation of the GNSS receiver.

B.3 Internal navigation receivers

(See 5.7 and 6.14.4)

The internal navigation device (GNSS receiver) shall comply with the following requirements.

a) The internal navigation device shall comply with the requirements of either C/S T.001, 4.5.51, 4.5.5.2, 4.5.5.3 and 4.5.5.4 or C/S T.018, 4.5.5.1 and 4.5.5.2 as applicable.

b) The manufacturer shall provide evidence in the form of a test report from an approved test house that the GNSS receiver in the EPIRB has been subjected to the tests below, to at least one of the following standards: IEC 61108-1, IEC 61108-2, IEC 61108-3 or IEC 61108-5 as applicable. If the EPIRB includes RLS capability, then the standard selected shall be the one related to that of the RLS service provider. If the EPIRB does not include RLS capability, then the manufacturer should select the latest dated relevant standard that the GNSS receiver within the EPIRB is programmed to receive and used to encode position into its digital message. The following test items of the relevant standard shall be applied:

   – accuracy (static accuracy, angular movement of the antenna and dynamic accuracy);
   – acquisition;
   – protection (antenna and input/output connections);
   – sensitivity and dynamic range (acquisition and tracking);
   – protection from other shipborne transmitters (L band interference from Inmarsat terminals and S band interference from marine radars);
   – position update (slow speed and high speed).

   Consideration shall also be given to the ability of the GNSS receiver to obtain valid position updates, while onboard a vessel, when subjected to typical interference from shipboard L band transceiver sources (e.g. Inmarsat Fleet Broadband). Compliance can be achieved either by including a specific warning in the installation and user instructions or by testing to IEC 61108-5:2020, 5.6.9.3, at the discretion of the manufacturer.

c) Compliance with the requirement in b) above shall be taken as satisfying the requirement in either C/S T.001, 4.5.5.3 or C/S T.018, 4.5.5.2 as applicable 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 EPIRB software to ensure that erroneous position data is not encoded into the beacon message (see either C/S T.001, 4.5.5.3 or C/S T.018, 4.5.5.2 as applicable). This shall include a limit to the acceptable range of horizontal dilution of precision (HDOP) with a maximum of 50. The intent is to use locations with a much lower HDOP to provide positions with an error of no greater than 500 m (FGBs) or 30 m (SGBs) in beacon messages. However, if only less accurate positions with a higher HDOP (still less than 50) are available, these shall be used in favour of not providing a position at all.

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 EPIRB casing together with a warning not to cover or obstruct this area during use.

h) The EPIRB shall be subjected to the internal navigation device tests in Clause B.4.

B.4 Internal navigation device tests

B.4.1 General

This test procedure applies to all EPIRBs designed to meet the requirements of this document. The following test procedure is considered satisfactory for performing the subject tests; however, it is recognized that alternate procedures may be performed. Such alternate procedures may be used if the test provider can show that they provide equivalent information.

The tests specified herein are designed to simulate a range of typical operational scenarios in which EPIRBs could be activated and required to obtain a GNSS fix for inclusion in a transmitted location protocol message. The tests measure how quickly the EPIRB is able to obtain a GNSS location (time to first fix (TTFF)) and how accurate that transmitted position is (location accuracy).

The scenarios may be performed in any sequence and in conjunction with other electrical tests and shall be treated as additional tests (see A.2.13) and may be performed on a separate EPIRB if required. In all cases, the tests shall be conducted after the EPIRB has been temperature stabilized at ambient temperature for at least one hour. The tests shall be performed on a fully packaged EPIRB, similar to the proposed production beacons, operating on its normal power source and equipped with its proper antenna as defined in 6.1.8. The tests shall be performed with the 406 MHz, 121,5 MHz and AIS transmitters radiating normally. The EPIRB shall be specially programmed to transmit data bursts encoded using a test location protocol of appropriate type and format (see C/S T.001 or C/S T.018 as applicable).

A test chamber with the appropriate level of RF shielding (see B.4.3) shall be used, such that the EPIRB may radiate normally on 121,5 MHz and AIS. The beacon coding and test chamber shielding shall ensure that distress signals are not transmitted on distress and safety frequencies. Frequency offsetting of the 121,5 MHz homer shall not be permitted.

B.4.2 Test description

B.4.2.1 General

The tests specified herein are designed to simulate typical operational scenarios in which EPIRBs could be activated and required to obtain a GNSS fix for inclusion in a transmitted location protocol message. Because of variations in GNSS satellite coverage in different locations and at different times of the day, testing can only be reliably and repeatably carried out in an anechoic chamber using a GNSS simulator. As well as the "typical" condition, various parameters of the GNSS simulator are then varied to provide a range of scenarios around the "typical" condition. Some of these scenarios are less arduous and other more so to provide a range of tests that together provide an assessment of the capability of the GNSS receiver in the EPIRB under test. In addition, other test scenarios are also included to check for issues such as GNSS week rollover, change of beacon location around the world and change of GNSS date, as may be seen by a beacon that is not activated for several years.

Each applicable scenario is run one after the other (the beacon being turned off in between scenarios to force it to "cold start" each time) and the time to first fix transmission (TTFFT) and transmitted location are recorded in each case. The results are then analysed and an assessment of the performance of the GNSS receiver in the EPIRB under test is made.

B.4.2.2 Scenarios

The scenarios are based around a beacon floating in the open sea with a clear view of the sky from 0° above the horizon with wind force 5 and sea state 4, which represents typical sea conditions. Movement rates for the beacon in the water due to large waves and for wave wash over effects are then introduced to provide a range of operational conditions.

The key parameters that are varied in these simulations are:

- the rate of change (i.e. the speed the beacon bobs at);
- the degree of change (i.e. the amount the beacon tilts);
- "wash over" effects causing corruption of the ephemeris data download and reduction in received signal strength.

The motion that has been created to simulate the movement of the 406 MHz beacon in the sea is a repeating sequence of: axial pitch up – roll right – pitch down – roll left. Note that in some simulators, the maritime conditions may be best simulated using an aviation type scenario where roll and pitch excursions and rate can be exactly specified.

Table B.1 provides a list of the maritime scenarios for testing the EPIRB. Each scenario runs for approximately 12 min and there are 26 scenarios in total. In the worst case, if it takes 12 min to complete each scenario and then 3 min to set up for the next one, it would take 6,5 h (almost one day) to complete all the tests. However an average TTFFT of less than 5 min is expected and thus it should typically be possible to complete all the tests in around 3,5 h (half a day).

B.4.2.3 Multi-constellation GNSS receivers

The scenarios in Table B.1 shall be run for all the different configurations of GNSS receiver functionality programmed into the EPIRB. For example, an EPIRB that is capable of being programmed to receive different GNSS constellation configurations due to varying national requirements around the world such as the following:

a) just GPS signals,

b) just Galileo signals,

c) combined Galileo and GPS signals,

shall be tested three times, once in each of the above configurations.

Likewise if a GNSS receiver is programmed to, for example, just work with Galileo signals, then the scenarios in Table B.1 would be to run just once.

In each case the satellites used to generate the scenarios in Table B.1 shall be those forming the relevant GNSS constellation. For EPIRBs programmed to work with multiple GNSS constellations (e.g. Galileo and GPS) then the scenarios shall be generated by using a combination of satellites (SVs) from all the relevant constellations.

Table B.1 – Maritime scenarios

Scenario #	Min. No of SVs	HDOP	Signal level at earth's surface dBm	Pitch/Roll (°)	Rate (°/s)	Data corrupt	GNSS location	GNSS year
1	5	< 3	Nom	±15	5	No	0N, 0E	2016
2	5	< 3	Nom	±15	15	No	0N, 0E	2016
3	5	< 3	Nom	±30	60	No	80N, 0E	2016
4	5	< 3	Nom	±60	5	No	0N, 0E	2016
5	5	< 3	Nom	±60	15	No	0N, 0E	2016
6	5	< 3	Nom	±60	60	No	0N, 0E	2016
7	5	< 3	Nom	±15	50	No	80N, 0E	2016
8	5	< 3	Nom	±30	5	No	80N, 0E	2016
9	5	< 3	Nom	±30	15	No	80N, 0E	2016
10	5	< 3	Nom	±60	5	No	80N, 0E	2016
11	5	< 3	Nom	±60	15	No	80N, 0E	2016
12	5	< 3	Nom	±60	60	No	80N, 0E	2016
13	5	< 3	Nom	±15	5	Ephemeris	0N, 0E	2016
14	5	< 3	Nom	±15	5	Ephemeris	0N, 0E	2016
15	5	< 3	Nom	±15	5	Almanac	0N, 0E	2016
16	5	< 3	Nom	±15	5	Time	0N, 0E	2016
17	5	< 3	Nom	±15	5	E + A	0N, 0E	2016
18	5	< 3	Nom	±15	5	E + T	0N, 0E	2016
19	5	< 3	Nom	±15	5	A + T	0N, 0E	2016
20	5	< 3	Nom −5dB	0	0	No	0N, 0E	2016
21	5	< 3	Nom −5dB	±15	5	No	0N, 0E	2016
22	5	< 3	Nom −5dB	0	0	Ephemeris	0N, 0E	2016
23	5	< 3	Nom −5dB	±15	5	Ephemeris	0N, 0E	2016
24	5	< 3	Nom	±15	5	No	44S, 174E	2016
25	5	< 3	Nom	±15	5	No	47N, 8W	2019
26	5	< 3	Nom −5dB	±15	5	No	0N, 0E	2019

B.4.3 Test facility requirements, test set-up and calibration

B.4.3.1 Test facility requirements

The tests shall be performed in an independent test facility that meets the following requirements:

1) First, that the selected facility shall provide shielding of external RF signals at the relevant GNSS frequencies. At least 35 dB of shielding shall be provided. This is to keep signals from any operational GNSS constellation at least 25 dB below the nominal signal level at sea level of the relevant GNSS constellation(s) signal level specified in some test scenarios. This will ensure that GNSS signals from orbiting GNSS satellites are not received by the beacon's GNSS receiver and corrupt the test results.

2) Second, the facility should have radiation absorbing material on the walls, ceilings and floor to prevent signal reflections from distorting the direct path of the GNSS signals from the re-radiating antenna. Sufficient attenuation shall be provided to ensure that reflected signals off any surfaces are at least 20 dB below the direct path signal level measured at the beacon's GNSS receiver's antenna location.
3) Third, that there is a way to calibrate the facility to obtain the desired level of the GNSS received signal strength as seen by the GNSS receiver antenna in the EPIRB, using a standard horn antenna mounted in the position where the EPIRB antenna would be and that the GNSS signal level is stable over time.
4) Fourth, the facility shall provide at least 80 dB of attenuation at 406 MHz to prevent beacon transmissions not using a test protocol from impacting the operational Cospas-Sarsat system.
5) Fifth, the facility shall provide at least 50 dB of attenuation at 121,5 MHz and 160 MHz to ensure that the beacon's 121,5 MHz homer signal and AIS signal cannot be picked up as a 121,5 MHz distress signal by an over flying aircraft or an AIS distress signal by a nearby ship. Since the beacon's homer and AIS transmitters are activated for these navigation tests, it is not permissible to simply turn off the homer or AIS.

Examples of such facilities are an anechoic chamber, a TEM cell (also known as a Crawford cell), and an EMI or RFI quiet room (a screen room with radiation absorbing material on the floor, ceiling and walls). Other types of test facilities could be used, provided that the above requirements are satisfied.

B.4.3.2 Test set-up

A typical test set-up is shown in Figure B.1. Depending on the output power of the GNSS simulator used, an external amplifier and/or attenuator may be required. A suitable antenna transmitting at the relevant GNSS frequency shall be used to radiate the GNSS simulator signals in the chamber. This procedure calls it a re-radiating antenna. Alternative set-ups may be used if the test provider can show that they are equivalent to the set-up shown.

The re-radiating antenna and the EPIRB under test shall be placed in direct line with one another such that the normal to the EPIRB's GNSS patch antenna is collinear with the bore sight of the re-radiating antenna at a spacing that puts the beacon under test in the far field of both antennas. If an anechoic chamber or EMI quiet room is used, the actual distance between the antennas is not critical as long as the beacon under test is in the far field of both antennas.

A beacon tester capable of decoding the 406 MHz location protocol bursts transmitted by the EPIRB shall be sited near the EPIRB but shall not interfere with the direct path between the re-radiating antenna and the EPIRB's GNSS antenna.

The manufacturer shall provide evidence of the time it takes all of the power supplies within the EPIRB to drop to 0 V (in this case 0 V means less than 0,1 V). The minimum time between tests that the EPIRB shall remain off for is the above time plus one minute. This is to ensure that no GNSS data from previous tests is stored in the receiver and that it cold starts for each test scenario.

Prior to commencing testing, the test set-up shall be calibrated (see B.4.3.3) to ensure that the signal levels at the surface of the EPIRB are correct.

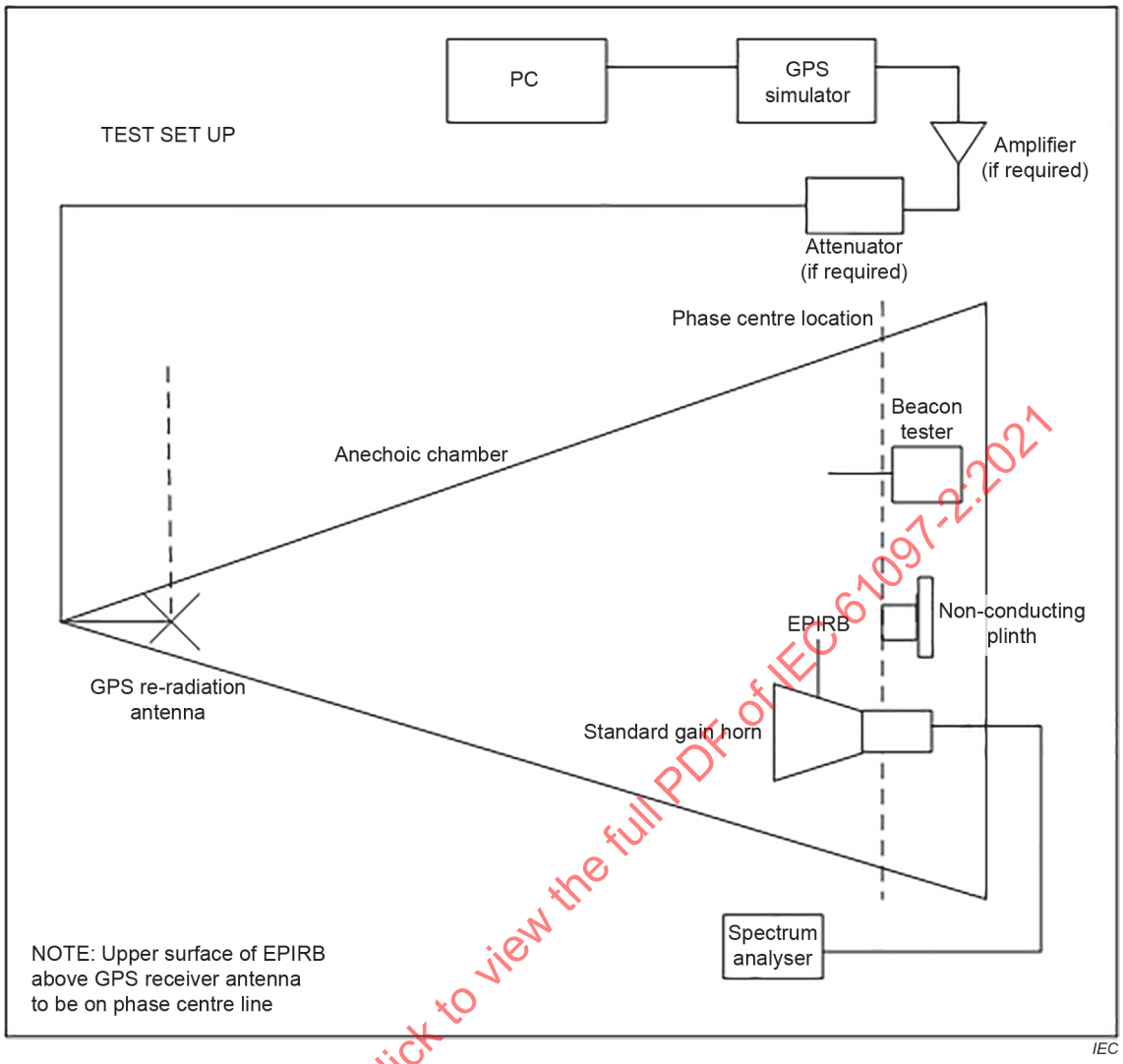


Figure B.1 – Test set-up

B.4.3.3 Calibration of the test set-up

The test set-up shall be calibrated on a received signal level basis as detailed below.

Figure B.2 illustrates a calibration set-up. A power meter is shown although a calibrated spectrum analyser could be used as well. A standard gain horn is shown although any reference antenna (where the gain, phase centre location and polarization is known) could be used. The equations below refer to a RefAnt (reference antenna). The top figure illustrates calibration of the external amplifiers and/or attenuators. Note that some GNSS simulators have a high power port that may be used for the test and the port's gain relative to the true output power port may be dependent on the number of satellites in the scenario. If this is the case, one should have the capability of adjusting the signal level by means of an external attenuator and/or amplifier.

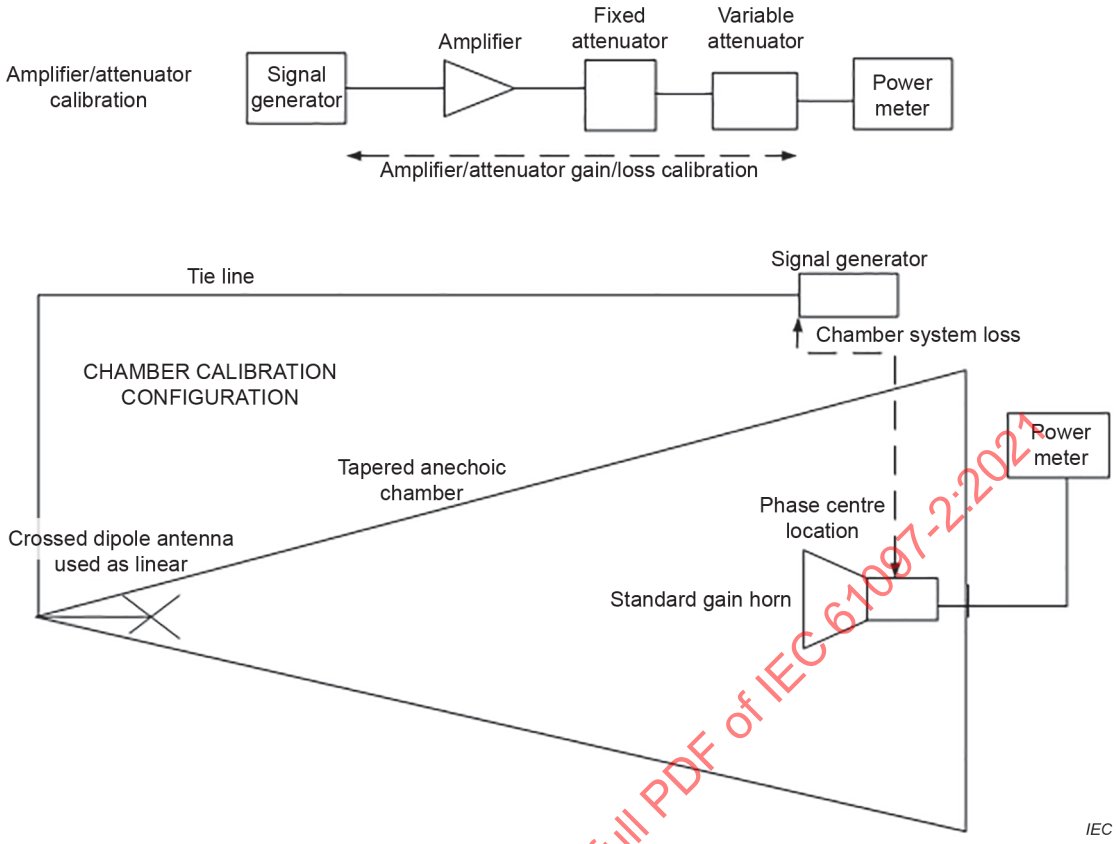


Figure B.2 – Calibration set-up

The EPIRB shall be substituted with a standard gain horn or equivalent antenna (of known gain at the relevant GNSS frequency and known phase centre location) connected to a spectrum analyser or power meter, and positioned such that the focal point (phase centre) of the horn or equivalent antenna is on the phase centre line of the EPIRB's GNSS antenna when under test.

A calibrated signal generator shall be used as the signal source to calibrate the system. For the purposes of calibration, the signal generator shall replace the GNSS simulator in Figure B.2. A strong CW signal is needed in order for the spectrum analyser (or power meter) to see the signal. The "chamber system loss" is the loss one is trying to find and it is defined as the loss measured from the output of the calibrated signal generator to the phase centre of the standard gain horn or equivalent antenna. This loss will be exactly the same as the loss from the output port of the GNSS simulator in the test configuration to the phase centre of the EPIRB's GNSS antenna. All losses or gains of all elements including any polarization mismatch losses in both the calibration configuration and the actual test configuration shall be accounted for in a link calculation.

The link equation for determining the chamber gain/loss (G_{Chamber}) in dB is defined as follows:

$$P_{\text{transmit}} + G_{\text{Chamber}} + G_{\text{RefAnt}} + G_{\text{line}} + G_{\text{Pol}} = P_{\text{received}}$$

where:

P_{transmit} is the signal generator transmit power level;

G_{Chamber} is the gain from the output of the signal generator to the EIRP incident on the reference antenna (will be a negative number if it is a loss). In the diagram in this calibration section, this term is shown as a chamber system loss;

G_{RefAnt} is the gain of a reference antenna such as a standard gain horn (a positive number if there is a gain);

G_{line} is the reference antenna to receiver (power meter or spectrum analyser) cable gain (a negative number if a loss – a positive number if there is an LNA in the system);

G_{Pol} is a polarization gain (non zero if there is a polarization mismatch between the Ref Ant and the EPIRB's GNSS antenna). The polarization of the transmit antenna (re-radiating antenna is taken into consideration in the chamber gain number;

$P_{received}$ is the received power level in a power meter or spectrum analyser.

It should be noted that depending on the reference used for $P_{transmit}$ and $P_{received}$ either or both of these terms could be negative, thus it is important to include the signs of these terms in the following equations.

Table B.2 illustrates the G_{Pol} values.

Table B.2 – G_{Pol} values

Reference antenna polarization	EPIRB's GNSS antenna polarization	G_{Pol}
CP	CP	0
Linear	CP	−3
CP	Linear	+3

Rewriting the above equation and solving for the chamber gain

$$G_{Chamber} = P_{received} - P_{transmit} - (G_{RefAnt} + G_{line} + G_{Pol})$$

The required EIRP level into the EPIRB under test is defined as follows:

$$EIRP_{EPIRB} = P_{Scenario} + G_{Simulator\ high\ power\ port} + G_{Chamber} + G_{Amp/Attn}$$

where:

$P_{Scenario}$ is the scenario's power level coming out of the GPS simulators normal power port;

$G_{Simulator\ high\ power\ port}$ is the gain of the high power port relative to the normal simulators power output port (scenario will usually require use of a high power port – otherwise the losses in the chamber will have to be made up by amplification);

$G_{Chamber}$ is the number calculated above;

$G_{Amp/Attn}$ is any other gain/loss required by the link. It may be an external amplifier or attenuator or both;

$EIRP_{EPIRB}$ is the EIRP incident upon the EPIRB's GNSS antenna. This number will be equivalent to the power number specified for the GNSS signal level in the scenario in Table B.1. Where this is stated to be "Nom" this is the typical signal level at the earth's surface for the GNSS constellation in question (e.g. for GPS this is −130 dBm).

For some GNSS simulators there may be a difference between the GNSS simulator's normal output port and a higher power monitor port which is dependent on the number of SVs (GNSS satellites) in the scenario. This number will be available from the vendor of the GNSS simulator. If this is the case, then different amplifier or attenuator settings are required and a calculation of the amplifier or attenuator setting should be done for the system when there are 7 SVs present.

Once the desired EIRP levels into the EPIRB are calculated, the set-up is now calibrated and the reference antenna can be removed and replaced with the EPIRB under test and the signal generator can be replaced with the GNSS simulator.

It should be noted that once the system has been calibrated no further adjustments to the simulator output power levels shall be made during any of the simulator tests. If for some reason, the level is adjusted or the set-up is changed or there is reason to query the results obtained, then the set-up shall be re-calibrated as described herein before carrying out any further tests.

B.4.4 Method of measurement

With the equipment set-up as described in B.4.3.2 and after the set-up has been calibrated, maritime test scenario 1 should be loaded into the simulator. The scenario should then be started and within 10 s of the scenario starting, the EPIRB shall be switched on. At the same time as the EPIRB is activated a stop watch or similar timer shall be started.

The scenario is then left to run until either a GNSS fix is obtained and a location protocol message containing position is received by the beacon tester or the scenario runs to completion plus one minute (to allow for just missing a 406 MHz burst) and no message containing position has been received by the beacon tester (i.e. only default locations have been received).

If a location is received on the beacon tester then the stop watch or timer shall immediately be stopped and the time and received location shall be recorded in the test results tables (see B.4.6). Note that the first transmitted location as received by the beacon tester is the one that shall be recorded; any subsequent updated locations should be ignored. If a location is not received within 13 min of starting the scenario then a "Fail" shall be indicated for that scenario in Table B.1, in which case the scenario is not repeated and the next scenario is loaded as described below.

The GNSS indicator (see 4.4.2 c)) on the EPIRB shall be observed and this shall provide a visual indication that the GNSS reception is either satisfactory or unsatisfactory. On obtaining a GNSS fix this indicator shall provide a satisfactory indication, if during the test no position is obtained then this indicator shall provide an unsatisfactory indication. This can be used as an indicator that the next burst from the EPIRB should contain the location. Note that the TTFFT is the time until the EPIRB transmits a burst containing location data, not necessarily the time until the GNSS indicator on the EPIRB indicates that a GNSS fix has been obtained.

The EPIRB is then switched off and left turned off for at least the specified time interval (see B.4.3.2). During this period the next scenario is loaded into the simulator and the beacon tester and stop watch are reset. Once the specified EPIRB off period has elapsed this procedure should be repeated.

Once all the results have been obtained they shall be analysed as specified in B.4.5 to determine if the EPIRB has passed the tests.

B.4.5 Required results

The TTFFT for each scenario along with the transmitted location shall be recorded in Table B.3. If no location is obtained for a particular scenario then a "Fail" shall be recorded in both the TTFFT and the EPIRB location columns.

The correct functioning of the GNSS indicator shall be checked.

Once all the scenarios have been run, the delta location error (i.e. the difference between the simulator position and the EPIRB reported position) for each scenario shall be calculated and recorded in Table B.3 using the following formula:

$$\text{Location Error (m)} = (((SL_{\text{Lat}} - TL_{\text{Lat}}) \times 11\,000)^2 + ((SL_{\text{Long}} - TL_{\text{Long}}) \times 111\,320 \times \cos SL_{\text{Lat}})^2)^{1/2}$$

where:

SL_{Lat} is the simulator location latitude in decimal degrees (e.g. 39,600 00° N instead of 39° 36' N) to 5 decimal places;

TL_{Lat} is the EPIRB transmitted location latitude in decimal degrees to 5 decimal places;

SL_{Long} is the simulator location longitude in decimal degrees to 5 decimal places;

TL_{Long} is the EPIRB transmitted location longitude in decimal degrees to 5 decimal places.

The number of successful maritime TTFFT tests (those in which a location was obtained within 13 min) shall each be added up and the percentage pass rate shall be calculated. The EPIRB shall be deemed to have passed the TTFFT test if the pass rate for the maritime scenarios is ≥ 70 %.

The number of successful maritime location accuracy tests (those with a location error of less than 650 m) shall each be added up and the percentage pass rate shall be calculated. The EPIRB shall be deemed to have passed the location accuracy test if the pass rate for the maritime scenarios is ≥ 70 %.

The EPIRB shall be required to pass both parts of the test (TTFFT and location accuracy) in order to demonstrate compliance with this test procedure. All results shall be recorded in Table B.3.

B.4.6 Test results

B.4.6.1 Test results sheets

The results of the testing shall be documented on the following test results sheets and the necessary calculations (using the formula in B.4.5) shall then be carried out to determine the location error for each scenario.

Table B.3 – Maritime scenarios test results

Scenario #	TTFFT (minutes:seconds)	Simulator Location	EPIRB transmitted location	Location error (m)
1		0N, 0E		
2		0N, 0E		
3		80N, 0E		
4		0N, 0E		
5		0N, 0E		
6		0N, 0E		
7		80N, 0E		
8		80N, 0E		
9		80N, 0E		
10		80N, 0E		
11		80N, 0E		
12		80N, 0E		
13		0N, 0E		
14		0N, 0E		
15		0N, 0E		
16		0N, 0E		
17		0N, 0E		
18		0N, 0E		
19		0N, 0E		
20		0N, 0E		
21		0N, 0E		
22		0N, 0E		
23		0N, 0E		
24		44S, 174E		
25		47N, 8W		
26		0N, 0E		

B.4.6.2 Results analysis tables

Calculate the following data and enter it in the results columns of Table B.4 and Table B.5.

Table B.4 – Maritime scenarios results analysis

Criteria	Limit/Condition	Result
Number of successful tests	TTFFT ≤ 13 min	
Total number of maritime scenarios	26	N/A
TTFFT percentage success rate	(No success tests / 26) × 100	
TTFFT pass/fail limit	≥ 70 %	N/A
Number of locations with errors	[≤ 650 m]	
Number of scenarios with locations	Enter result	
Location accuracy percentage pass rate	(No locations errors ≤ 650 m / No scenarios with location) × 100	
Location accuracy pass/fail limit	≥ 70 %	N/A

Table B.5 – Pass/Fail analysis

	EPIRB Pass/Fail
Maritime TTFFT success rate ≥ 70 %	
Maritime location accuracy pass rate ≥ 70 %	
GNSS indicator functions correctly	
All results shall be a "Pass" for the EPIRB to pass, any one or more "Fails" indicates failure.	

Note that a separate results analysis table for each GNSS constellation that the EPIRB under test can be programmed to operate with shall be provided.

Annex C
(normative)

Standards for an EPIRB without a float-free mechanism

C.1 Requirements

A non-float-free EPIRB shall meet all the requirements of this document with the exception of the following subsclauses and replacement text:

4.2 d) Not applicable.

4.2 e) Not applicable.

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

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

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

4.5 Manual release arrangements

4.5.1 General

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

a) be constructed to prevent release when seas wash over the unit (unless the mounting bracket is intended exclusively for mounting inside the vessel);
b) have its release mechanism fitted with adequate means to prevent the 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) to the maximum extent possible prevent inadvertent activation of the EPIRB in the bracket due to movement. The design shall allow for the effects of a normal marine environment, (e.g. motion, vibrations, bumping) and any potential normal wear and tear and aging of flexible and elastic parts of the bracket (e.g. cushions, spacers, back-stops);
e) to the maximum extent possible, be so designed as to ensure that the EPIRB cannot be placed in its mounting bracket incorrectly such that the automatic activation disabling feature of the bracket is rendered inoperable allowing the EPIRB to be activated when water washes over it and thus give rise to false alerts;
f) including the labelling, not be unduly affected by seawater or oil or prolonged exposure to sunlight.

4.5.2 External power or data connection

For the 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 EPIRB.

4.5.3 Not applicable.

4.5.4 Manual release

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

4.7 a) Not applicable.

4.7 c) Not applicable.

4.12.2 Manual release arrangement labelling

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

a) the operating instructions for manual release;

b) the category (see Clause 1).

c) Not applicable.

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.

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

4.13 b) Not applicable.

C.2 Tests

If the EPIRB has already (or is at the same time being) tested in accordance with this document 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 an EPIRB fitted in it (unless otherwise indicated):

6.3.1 a), 6.5.2 (except for mounting brackets intended exclusively for mounting inside the vessel), 6.5.3 (manual release only, not EPIRB), 6.5.4 if applicable, 6.5.6, 6.12.2, 6.17.7, 6.17.8, 6.17.10 (manual release only, not EPIRB), 6.17.11 (Manual release only, not EPIRB), 6.17.12 (manual release only, not EPIRB), 6.20.

If, however, the EPIRB has not already (or is not at the same time being) tested in accordance with this document with a float free arrangement, then the manual release and the EPIRB shall be subjected to all of the tests in Clause 6 except for 6.2.2 and 6.5.5.

Annex D
(normative)

Technical standards for 121,5 MHz homing device

D.1 General

(See 5.5, and 6.14.2)

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 406 MHz emergency position indicating radio beacon (EPIRB) described in this document.

D.2 Performance requirements

D.2.1 (MSC.471(101), annex, Part A, 2.3.14) *Be provided with a 121,5 MHz homing beacon primarily for homing by aircraft*.

D.2.2 (MSC.471(101), annex, Part B, 4) *The 121,5 MHz homing signal shall*:

a) *have a 121,5 MHz transmitting duty cycle not less than 50 % (1,125 s on, 1,125 s off) and if more than 50%, the on time should be increased beyond 1,125 s and the off time reduced accordingly*. The swept tone signal excludes any interruptions for transmission of the 406 MHz signal, transmission of an AIS pulse (if this would clash with the 121,5 MHz sweep) and if applicable a Morse letter;

b) *with the exception of the sweep direction*, and if applicable the transmission of an AIS pulse or a Morse letter, *meet the technical characteristics of Appendix 15 of the ITU Radio Regulations. The sweep may be either upward or downward*; and

c) if the 121,5 MHz homing signal in the EPIRB is required to include a Morse letter, it shall be transmitted as a series of tones modulated on the 121,5 MHz carrier, transmitted after each 406 MHz signal transmission, prior to the start of the swept tone transmission.

D.3 Technical characteristics

a) Carrier frequency — 121,5 MHz ± 50 ppm (parts per million)

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

c) Transmitter duty cycle — 50 % minimum (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.

[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.

e) Morse letter (if applicable):
   1) Modulating frequency 1 000 Hz ± 50 Hz.
   2) Dot duration 115 ms with a tolerance of ±5 %.
   3) Dash duration three times the dot duration.
   4) Space between the letter and the commencement of the sweep three times the dot duration.

f) Spurious emissions — See Figure D.1.

g) Antenna
   1) pattern — essentially omni-directional in the horizontal plane;
   2) polarization — vertical.

h) Environment — shall meet the requirements of 4.6.

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

D.4 Methods of testing and required test results

D.4.1 General

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

For the purpose of testing outside a screened room, the equipment shall be prepared as required by 6.1.8.

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 EPIRB has been temperature stabilized for at least 1 h and for FGBs only, has been ON for at least 15 min. Unless otherwise specified, the test shall be performed with modulation present.

D.4.2 Carrier frequency

The carrier frequency test may be performed with a frequency counter or a spectrum analyser. The carrier frequency, shall be 121,5 MHz ± 50 ppm.

D.4.3 Peak effective radiated power

D.4.3.1 Test conditions

This test is only required to be performed at ambient temperature and shall use an 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 EPIRB exhibits a maximum antenna gain (note this may not be the elevation at which maximum output is achieved). The median value of PERP shall be between 25 mW (14 dBm) and 100 mW (20 dBm); the ratio of maximum to minimum of the 11 highest values of PERP shall not exceed 4 to 1 (6 dB).

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, for at least 30 m from the EPIRB, and the search antenna. The EPIRB shall be placed in the centre of a ground plane with a radius of no less than 75 cm.

The EPIRB shall be positioned vertically so that the nominal waterline of the EPIRB is level with the ground plane. 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 EPIRB which is below the waterline.

Measurement of the radiated signals shall be made at a point 10 m from the 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 analyser located at the foot of the mast.

D.4.3.2 Method of measurement

The elevation angle between 5° and 20° which produces a maximum gain is determined with the 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 EPIRB in increments of 30° ± 3°. For each measurement, the EPIRB's PERP shall be computed using the following equation:

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

where

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

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

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

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

D.4.4 Off-ground plane radiated power test

D.4.4.1 Test conditions

This test is effectively a repeat of the peak effective radiated power test in D.4.3 except that the EPIRB is raised off the ground plane.

This test is only required to be performed at ambient temperature and shall use an 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 EPIRB exhibits a maximum antenna gain (it should be noted that this may not be the same elevation angle as that determined in D.4.3). The starting point for the four azimuth measurements shall be the centre of the forward face (front) of the EPIRB (0°). The minimum value of PERP measured at each of the four azimuth angle increments shall be 2 mW (3 dBm).

The test site shall be the same as used in C/S T.007, Figure B.5 (note that this same test configuration is also used for the 121,5 MHz homer in SGBs as well as FGBs) except that the distance between the beacon under test and the RF receiver antenna shall be 10 m (instead of that in C/S T.007). The RF absorbing material (RAM) 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 EPIRB exhibits a maximum antenna gain. The EPIRB shall be placed upright on a non-conductive stand (for example a dry wooden or strong dry cardboard box) that raises the height of the base of the EPIRB 450 mm ± 25 mm above ground level.

D.4.4.2 Method of measurement

The method of measurement is the same as in D.4.3.2 except that only four azimuth measurements are made at 90° ± 3° intervals.

D.4.5 Transmitter duty cycle

The transmitted signal shall be observed on a suitable test instrument over a duration of between 5 min and 10 min, commencing 5 min $^{+10}_{0}$ s after beacon activation and it shall be determined that the signal has a swept tone duty cycle of not less than 50 % (1,125 s minimum on time, 1,125 s maximum off time) and if more than 50 %, the on time should be increased beyond 1,125 s and the off time reduced accordingly with the exception of up to 2 s during transmission of each 406 MHz signal, up to 50 ms for the transmission of an AIS pulse (if this coincides with a scheduled 121,5 MHz sweep signal) and if applicable the transmission of a Morse letter.

The following formula shall be used to calculate the minimum 121,5 MHz swept tone duration.

The time over which measurements were made shall be converted into seconds and is given the nomenclature 'T' seconds in the formula below.

Minimum 121,5 swept tone transmission time in time
'T' = (T – (($X1$ × (T_m + 2)) + (0,05 × $X2$))) / 2 s

where

$X1$ is the number of 406 transmissions in time 'T';

$X2$ is the number of AIS messages in time 'T' (an AIS message is a single transmission of duration 26,7 ms, thus there are 8 of these messages in a burst, which occurs once per minute);

T_m is the total Morse character transmission time (including gaps) in seconds (0 if no Morse character transmitted).

The transmitted signal shall be analysed over the measurement period to ensure that the minimum 121,5 MHz swept tone signal duration complies with that calculated from the above formula.

This test may be combined with the test in 6.14.1.

D.4.6 Modulation characteristics

D.4.6.1 General

The transmitter duty cycle, modulation frequency, modulation duty cycle, modulation factor, and sweep repetition rate (including if applicable that of the Morse letter) shall be determined by the method now described, by observing the detected RF signal with a storage oscilloscope or similar instrument.

D.4.6.2 Modulation frequency and sweep repetition rate

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. If applicable the Morse letter shall meet the requirements of D.3.e) and contain the relevant number of dots, dashes and gaps applicable to the Morse letter required to be transmitted by the relevant related regulation or standard.

D.4.6.3 Modulation duty cycle

Modulation duty cycle (D) 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.2 a)):

$$D = \frac{A}{B} \times 100\%$$

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

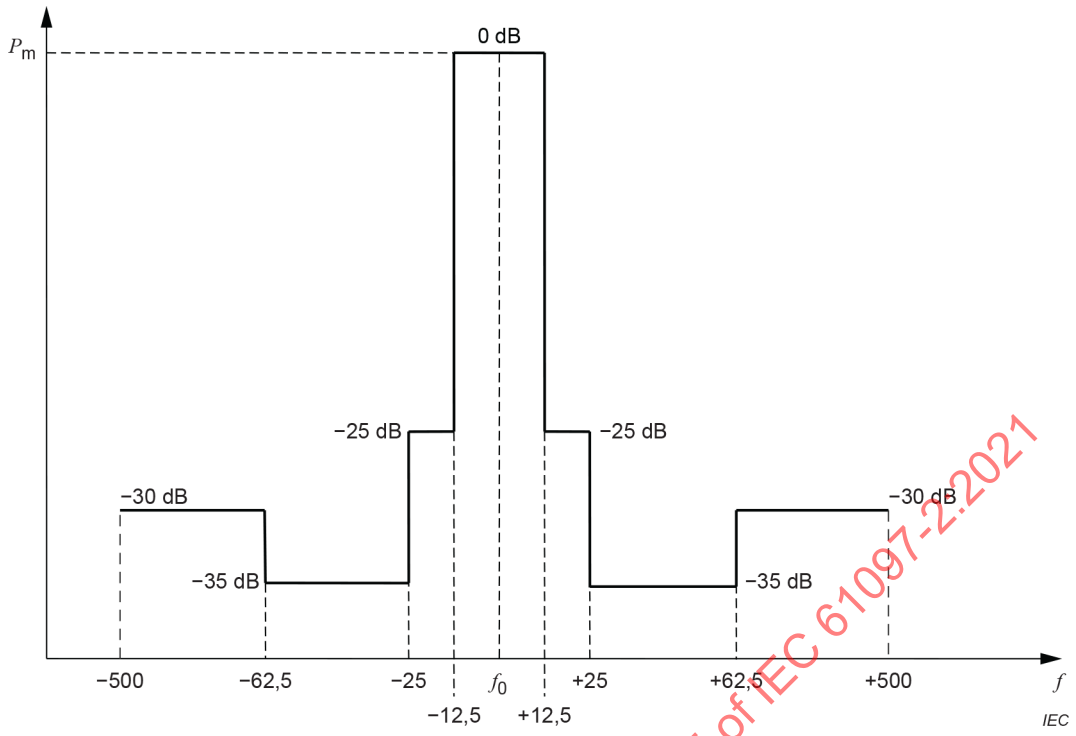
The duty cycle shall meet the requirements of Clause D.3, d) 3).

D.4.6.4 Modulation factor

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

$$m = \frac{A - B}{A + B}$$

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



Key

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