COSPAS-SARSAT
406 MHz DISTRESS BEACON
TYPE APPROVAL STANDARD

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COSPAS-SARSAT 406 MHz DISTRESS BEACON TYPE APPROVAL STANDARD

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1. INTRODUCTION

1.1 Scope

This document defines the Cospas-Sarsat policy on type approval of 406 MHz distress beacons and describes:

a. the procedure to apply for Cospas-Sarsat type approval of a 406 MHz distress beacon; and

b. the type approval test methods.

1.2 Reference Documents

a. Cospas-Sarsat Document C/S T.001, "Specification for Cospas-Sarsat 406 MHz Distress Beacons".

b. Cospas-Sarsat Document C/S T.008, "Cospas-Sarsat Acceptance of 406 MHz Beacon Type Approval Test Facilities".

c. Cospas-Sarsat Document C/S T.012, "Cospas-Sarsat 406 MHz Frequency Management Plan".

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

-END OF SECTION 1-

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2. COSPAS-SARSAT TYPE APPROVAL

2.1 Policy

The issuing of performance requirements, carriage regulations and the testing and type approval of 406 MHz distress beacons are the responsibilities of national authorities.

However, to ensure beacon compatibility with Cospas-Sarsat receiving and processing equipment, it is essential that beacons meet specified Cospas-Sarsat performance requirements. Compliance with these requirements provides assurance that the tested beacon performance is compatible with, and will not degrade, the Cospas-Sarsat system. A 406 MHz beacon with an integrated navigation system will be considered as a single integral unit for type approval testing.

Therefore, it is recommended that national authorities and search and rescue agencies require manufacturers to comply with the provisions of this document.

2.2 Testing

The Cospas-Sarsat tests described in this document are limited to ensure that:

a. beacon signals are compatible with System receiving and processing equipment;

b. beacons to be deployed do not degrade nominal System performance; and

c. beacons encoded position data is correct.

These tests will determine if beacons comply with this document, with the "Specification for Cospas-Sarsat 406 MHz Distress Beacons" (C/S T.001), and with the document "Cospas-Sarsat 406 MHz Frequency Management Plan" (C/S T.012).

Tests conducted in beacon manufacturing facilities during development of new beacon models or production unit testing must not cause harmful interference to the operational Cospas-Sarsat system. The level of 406 MHz emissions from beacon manufacturing facilities should be less than -51 dBW in an area immediately external to the manufacturers' facility. The -51 dBW is equivalent to a power flux density of -37.4 dB (W/m^2) or a field intensity of -11.6 dB (V/m).

2.3 Type Approval Certificate

A Cospas-Sarsat Type Approval Certificate (see sample in Annex M) will be issued by the Cospas-Sarsat Secretariat, on behalf of the Cospas-Sarsat Council (CSC), to the manufacturer of each 406 MHz distress beacon model that is successfully tested at an accepted Cospas-Sarsat test facility. All manufacturers are encouraged to obtain a Cospas-Sarsat Type Approval Certificate for each of their beacon models. The Secretariat will treat manufacturer's proprietary information in confidence.

The Cospas-Sarsat Type Approval Certificate itself does not authorize the operation or sale of 406 MHz beacons. National type acceptance and/or authorization may be required in countries where the manufacturer intends to distribute beacons.

The Certificate is subject to revocation by the Cospas-Sarsat Council should the beacon type for which it was issued cease to meet the Cospas-Sarsat specification.

- END OF SECTION 2 -

3. TESTING LABORATORIES

3.1 Testing

The tests described in this document consist of a series of laboratory technical tests and an outdoor functional test of the beacon transmitting to the satellite. Manufacturers are encouraged to conduct preliminary laboratory tests on their beacons, but are cautioned not to radiate signals to the satellite. If open air radiation of 406 MHz signals should be necessary, the manufacturer must coordinate and receive approval for the test from the appropriate national or regional MCC. Any such radiation must use the test protocol of the appropriate type and format. For example, test user-location protocol shall be used for testing of beacons intended to be encoded with user-location protocol.

All type approval tests shall be conducted by an accepted test facility unless specifically stated otherwise in this document.

3.2 Cospas-Sarsat Accepted Test Facilities

Certain test facilities are accepted by Cospas-Sarsat to perform Cospas-Sarsat type approval tests, as described in document C/S T.008. Accepted test facilities are entitled to perform tests on any 406 MHz distress beacon for the purpose of having a Cospas-Sarsat Type Approval Certificate issued by the Secretariat. A list of Cospas-Sarsat accepted test facilities is maintained by the Cospas-Sarsat Secretariat.

Following successful testing of a beacon, the technical information listed in section 5 of this document should be submitted to the Cospas-Sarsat Secretariat, so that a Cospas-Sarsat Type Approval Certificate can be issued to the beacon manufacturer.

3.3 Testing of ELT Antennas Separated from Beacons

Although the Cospas-Sarsat type approval policy is to consider only the complete beacon with its antenna (i.e. Cospas-Sarsat does not type approve specific beacon components), this policy is not strictly applicable to ELTs which can be approved for use with different aircraft antennas.

In respect of antenna testing requirements provided in Annex B to this documents, testing ELT antenna at a reputable and independent test facility specialised in antenna measurements is acceptable subject to prior agreement by Cospas-Sarsat and provided that the test facility is accredited by recognised standardisation bodies responsible for type approval of electronic and electrical equipment.

In such case, the testing application package shall also include:

a. written confirmation by the Cospas-Sarsat Representative of the country where the facility is located (see Annex J) of the independence of the antenna testing facility from the beacon manufacturer;

b. a letter from the test facility briefly describing their capability in respect of ELT antenna testing to the requirements specified in applicable Cospas-Sarsat documents; and

c. the reference of the test facility accreditation by recognised standardisation bodies responsible for type approval of electronic and electrical equipment in the facility's country.

In all cases, the testing of the aircraft antenna, as described above, shall be completed with:

i. VSWR measurement as described at Annex B,

ii. the calculated EIRP values in the format provided at Tables F-B.1 and F-B.2;

iii. the calculations for EIRP minimum and maximum at beacon end of operational life ($EIRP_{minEOL}$ and $EIRP_{maxEOL}$) in the format provided at Table F-B.1; and

iv. satellite qualitative tests using a type approved ELT or the ELT submitted for type approval as described at Annex A, and reported as per Appendix A to Annex F.

- END OF SECTION 3 -

4. COSPAS-SARSAT TESTING PROCEDURE

4.1 Sequence of Events

Typical steps to obtain a Cospas-Sarsat Type Approval Certificate for a new beacon are:

a. manufacturer develops a beacon;

b. manufacturer conducts preliminary testing in his laboratory;

c. manufacturer schedules testing at a Cospas-Sarsat accepted test facility;

d. test facility conducts[1] type approval tests;

e. manufacturer and/or test facility (as coordinated by the manufacturer) submits to the Cospas-Sarsat Secretariat the information listed in section 5 of this document;

f. Secretariat and Cospas-Sarsat Parties review the test results and technical data; and

g. Cospas-Sarsat Secretariat provides results of review to the manufacturer within approximately 30 days, and if approved, a Cospas-Sarsat Type Approval Certificate is subsequently issued.

4.2 Initial Request

An initial request to a test facility might need to be made several weeks prior to the desired testing date. Since the manufacturer may wish to send a representative to witness the tests and provide assistance in operating the beacon, proper clearances should be made with the test facility well in advance. The manufacturer should be prepared to provide the test facility with:

a. two beacons for testing purposes;

b. replacement batteries.

4.3 Test Units

If the beacon has a 121.5 MHz homer, the homer transmitter of the test beacon shall be tuned to the frequency nearest to 121.5 MHz allowed by the national administration for type approval testing, but under no circumstances should this frequency be greater than 121.65 MHz.

[1] The cost of the testing is to be borne by the manufacturer.

One test unit shall be a fully packaged beacon, similar to the proposed production beacons, operating on its normal power source and equipped with its proper antenna.

The second beacon shall be configured such that the antenna port can be connected to the test equipment by a coaxial cable terminated by a 50-Ohm load. All necessary signal or control devices shall be provided by the beacon manufacturer to simulate nominal operation of all ancillary devices of the beacon, such as external navigation input signals and manual control, in accordance with A.3.7, while in an environmental test chamber. The means to operate these devices in an automated and programmable way shall be also provided by the manufacturer.

The test units shall be coded with the test protocol of appropriate type and format and shall meet the requirements of C/S T.001. It should be noted that:

a. The test unit subjected to the Cospas-Sarsat tests remains the property of the manufacturer. All information marked as proprietary shall be treated as such.

b. The organization performing the Cospas-Sarsat tests bears no responsibility for either the manufacturer's personnel or equipment.

c. The manufacturer shall certify that the units submitted for test contain no hazardous components. The testing organization may choose not to test units that it regards as hazardous.

If a beacon is to receive certification for additional location protocol types, means of changing the protocol type shall be provided. Alternatively, this can be satisfied with additional test units.

If a beacon is to receive certification for standard location protocol and/or the national location protocol, the unit used for the tests listed in A.2 shall be coded with one of these protocols.

4.4 Test Conditions

Tests shall be conducted by facilities accepted by Cospas-Sarsat. It is advisable that the manufacturer, or his representative, witness the tests.

The tests shall be carried out on the test beacon with its own power source. Test results shall be presented on the forms shown in Annex F of this document, along with additional graphs as necessary. Tests shall demonstrate compliance with C/S T.001 and comprise the following elements:

a. operating life and performance measurements at the beacon's minimum specified operating temperature;

b. performance measurements at room ambient temperature;

c. performance measurements at the beacon's maximum specified operating temperature;

d. performance measurements during the thermal gradient;

e. performance measurements beginning 15 minutes after thermal shock and activation;

f. antenna measurements; and

g. a qualitative performance test through the satellites.

At the discretion of the test authority, the manufacturer may be required to replace the batteries between these phases. However, no other modifications to the beacon will be allowed during the test period without a full re-test.

Beacons with multiple operator selectable and / or automatic modes of operation (e.g. voice transceivers, internal GNSS receivers, homers, etc.) shall undergo testing by the manufacturer to determine:

i. the mode that draws maximum battery energy;

ii. the modes that exhibit pulse loads greater than in (i) above.

The results of the manufacturer testing shall be included in the technical data submitted to the Cospas-Sarsat Secretariat.

The mode that draws the maximum battery energy shall be tested to the full range of the test requirements by the test laboratory. Operating modes that exhibit a pulse load greater than the mode that draws maximum battery energy shall undergo the operating lifetime at minimum temperature test.

Approved measurement methods are described in Annexes A, B, C, D and E of this document, although other appropriate methods may be used by the testing authority to perform the measurements. These shall be fully documented in a technical report along with the test results.

4.5 Test Configuration

The type approval tests required by Cospas-Sarsat are identical for all types of 406 MHz beacons, with the exception of the tests identified below:

a. satellite qualitative test (Annex A section A.2.5);

b. antenna characteristics (Annex A section A.2.6); and

c. position acquisition time and position accuracy (Annex A section A.3.8.2).

The test configurations for evaluating the beacon antenna characteristics are a function of the beacon type and the operational environments supported by the beacon, as declared by the manufacturer. The applicable test configurations for the beacon antenna testing are summarised below in Figure 4.1.

	Operational Environment: Beacon used while:	**Configuration 1 (Fig: B.4)** **"Water" ground plane**	**Configuration 2 (Fig: B.3)** **Antenna fixed to ground plane**	**Configuration 3 (Fig: B.2)** **Beacon sitting on ground plane**	**Configuration 4 (Fig: B.5)** **Beacon above ground plane**
EPIRB (*)	Floating in water, in safety raft or on deck of vessel	**X**			**X**
PLB	On ground and above ground			**X**	**X**
PLB	As above plus floating in water	**X**			**X**
ELT Survival	On ground and above ground			**X**	**X**
ELT Survival	As above plus floating in water	**X**			**X**
ELT Auto. Fixed	Fixed ELT with external antenna		**X**		
ELT Auto. Portable	On aircraft with external antenna		**X**		
	Outside of aircraft with own antenna attached			**X**	**X**
ELT Auto. Deployable	Released with attached antenna, assumed to be self righting in water	**X**		**X (**)**	**X**

* As configurations 1 and 4 cover the two extremes, configuration 3 is not required.
** For possible landing configuration not covered in Test Configuration 1, i.e. upside down.

Figure 4.1: Antenna Test Configuration Requirements

4.6 Test Procedure for Beacon with Operator Controlled Ancillary Devices

A unique test procedure may need to be defined for beacons with operator controlled ancillary devices to characterise the possible impact of these devices on the beacon performance. Such test procedure shall follow the guidelines provided at section A.3.7.2. A typical procedure for a beacon with a voice transceiver is provided at Annex E as an example of the guidelines implementation.

Unique test procedures for beacons with operator controlled ancillary device shall be:

a. coordinated between the beacon manufacturer and a Cospas-Sarsat type approval facility;

b. submitted to the Cospas-Sarsat Secretariat for review prior to type approval testing at the Cospas-Sarsat type approval facility; and

c. approved by the Cospas-Sarsat Parties as appropriate.

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5. TECHNICAL DATA

The technical data submitted to the Cospas-Sarsat Secretariat shall include the following:

a. an application form (Annex G) for a Cospas-Sarsat Type Approval Certificate, signed by the Cospas-Sarsat accepted test facility confirming that the beacon was tested in accordance with C/S T.007 and complies with C/S T.001, and signed by the manufacturer to confirm the technical details of the beacon, including:

   i. the list of operational configurations supported,

   ii. details of the beacon battery and battery pack,

   iii. details on the special features of the beacon (e.g. homer, strobe light, etc),

   iv. information on the beacon navigation system where appropriate (i.e. navigation device manufacturer, navigation interface specifications, etc.),

   v. a description of the beacon self-test characteristics;

b. a summary of the beacon and antenna test results , with supporting test data, graphs and tables, as designated in Annexes A, B and F, including:

   i. satellite qualitative test results as per Appendix A to Annex F,

   ii. beacon antenna test results as per Appendix B to Annex F,

   iii. navigation system test results as per Appendix C to Annex F,

   iv. sample messages generated by the beacon coding software for each coding option applicable to the beacon model as per Appendix D to Annex F[1];

c. analysis and calculations from the manufacturer that support the pre-test battery discharge figures required for the operating lifetime at minimum temperature test;

d. for beacons with multiple operator selectable and / or automatic modes of operation (e.g. voice transceivers, internal GNSS receivers, homers, etc.), analysis supported by test results that identifies:

   i. the operating mode that draws the maximum battery energy,

   ii. operating modes that have pulse loads greater than in i. above;

e. beacon operating instructions and a technical data sheet;

[1] Type approval will not be granted to beacons that use the short format variants of location protocols.

f. brochure and photographs of the beacon, with its antenna deployed whilst in all manufacturer declared configurations (e.g. floating in water, resting on ground, held by operator, etc.);

g. the technical data sheet for the battery cells used in the beacon and the electric diagram of the beacon's battery pack;

h. a copy of the beacon label;

i. the technical data sheet of the reference oscillator, including oscillator type and specifications;

j. descriptions, complete with diagrams as necessary, to demonstrate that the design:

i. provides protection against continuous transmission (see section A.3.4),

ii. meets the frequency stability requirements over 5 years (see section A.3.5),

iii. provides protection from repetitive self-test mode transmissions (see section A.3.6);

k. a technical description and analysis of the matching network supplied for testing purposes per section A.1, or for cases where a matching network is not required, information shall be provided that confirms that the nominal output impedance of the beacon power amplifier is 50 Ohms and the beacon antenna VSWR measured relative to 50 Ohms is within a ratio of 1.5:1;

l. for ELT separated antennas, a statement of the beacon manufacturer if they do not want to have their own antenna included on the Secretariat-maintained list of accepted ELT antennas (for antennas of their own design and having their own part number, see Annex K);

m. the beacon quality assurance plan (see Annex L).

For separated ELT antennas, the antenna test results requested under (b) above may be replaced by a reference to the proper entry in the Secretariat-maintained list of accepted antennas[1], along with:

- test laboratory VSWR measurements conducted in the appropriate configuration(s), as per Annex B; and

[1] The measurement of parameters for antennas included in the Secretariat list are kept on file at the Cospas-Sarsat Secretariat and are available upon request.

- a completed Table F-B.1 that includes the calculated EIRP levels for each azimuth and elevation, and the calculated maximum and minimum EIRP levels at the end of life taking into account the beacon power and $EIRP_{LOSS}$ figure measured by the test laboratory.

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6. COSPAS-SARSAT CERTIFICATION

6.1 Approval of Results

To receive a Cospas-Sarsat Type Approval Certificate, a beacon shall have been demonstrated to meet the requirements of C/S T.001. The technical data and test results will be reviewed by the Cospas-Sarsat Secretariat and then, if found satisfactory, submitted to the Cospas-Sarsat Parties for approval. The results of this process will be conveyed to the manufacturer within approximately 30 days.

If the unit is deemed to have passed the tests, the Secretariat will subsequently issue a Cospas-Sarsat Type Approval Certificate on behalf of the Cospas-Sarsat Council. The technical data and test results will be retained on file at the Secretariat.

6.2 Changes to Type Approved Beacons

The manufacturer must advise the Cospas-Sarsat Secretariat (see Annex H) of any changes to the design or production of the beacon or power source, which might affect beacon electrical performance. All tests for demonstrating the performance of modified beacons shall be conducted at a Cospas-Sarsat accepted test facility unless specifically stated otherwise in this document.

The manufacturer shall provide a statement clarifying whether the modification changed the beacon physical characteristics (e.g. weight, dimensions, centre of gravity, floatation characteristics, etc.). If the physical characteristics of the beacon have changed, the manufacturer shall provide photographs of the beacon in its operational configurations and submit an analysis regarding the possible impact on beacon electrical performance.

For minor modifications to the beacon, factory test results provided to the Secretariat by the manufacturer can be considered on a case-by-case basis. These test results will be reviewed by the Secretariat, in consultation with the test facility which conducted the original type approval tests on the beacon, and the manufacturer will be advised if there is a need for further testing.

Once a beacon incorporating a particular type of battery has been successfully tested at a Cospas-Sarsat test facility and type approved by Cospas-Sarsat, subsequent upgrades to that battery are permitted without further type approval testing at a Cospas-Sarsat test facility, provided the beacon manufacturer demonstrates that the changes do not degrade the performance of the 406 MHz beacon, as described below.

If a beacon manufacturer wishes to make changes to the type of battery after the beacon has been Cospas-Sarsat type approved, the change notice form in Annex H shall be completed and submitted to the Secretariat, together with factory test data confirming that the substitute battery is at least technically equivalent to that used when the beacon was type approved, and a summary of the required test results provided as per Table F.1.

The Cospas-Sarsat type approval certificate will not be amended to include the alternative battery in such cases, unless the beacon was partially retested at a Cospas-Sarsat type approval test facility.

6.3 Alternative Batteries

6.3.1 Batteries Not Used in Beacons Tested at an Approved Facility

The factory tests to be performed on the 406 MHz beacon with a type of battery that has not been used in previous models tested at a Cospas-Sarsat type approval facility shall include:

a. electrical tests at the three constant temperatures (maximum, minimum and ambient), excluding spurious output, VSWR and self-test (section A.2.1);

b. thermal shock test (section A.2.2);

c. operating lifetime at minimum temperature (section A.2.3); and

d. satellite qualitative test (section A.2.5), in a single configuration only.

The beacon manufacturer shall also submit technical data sheets describing the new battery.

6.3.2 Batteries Used in Two Beacons Tested at an Approved Facility

If the alternative battery has been previously used in at least two beacon models for testing at a Cospas-Sarsat type approval test facility, the factory tests to be performed on the 406 MHz beacon with the alternative batteries shall include:

a. electrical tests at ambient temperature excluding digital message, digital message generator, modulation, spurious output, VSWR check, self-test mode (section A.2.1);

b. operating lifetime at minimum temperature, excluding digital message (section A.2.3); and

c. satellite qualitative test (section A2.5), in a single configuration only.

6.4 Internal Navigation Device

6.4.1 Inclusion or Removal of an Internal Navigation Device

A type approved beacon modified to include an internal navigation device shall be completely retested at a facility accepted by Cospas-Sarsat.

A type approved beacon modified to remove an internal navigation device shall undergo the satellite qualitative test (C/S T.007, A.2.5) and spurious output test (C/S T.007, A.3.2.2.4) at a Cospas-Sarsat accepted facility. This shall be supported by the beacon coding software test (C/S T.007, A.2.8), which may be performed either by the manufacturer or the accepted test facility.

In cases of new beacon models that have variants both with and without an internal navigation device, the variant with the internal navigation device shall be completely tested at a facility accepted by Cospas-Sarsat. The variant without an internal navigation device shall undergo the satellite qualitative test, spurious output test, and beacon coding software test at a Cospas-Sarsat accepted facility.

6.4.2 Change to Internal Navigation Device

For changes to the internal navigation device of a type approved beacon which might affect the beacon electrical performance, the tests identified below shall be conducted at a Cospas-Sarsat accepted facility:

a. position acquisition time and position accuracy (section A.3.8.2); and

b. satellite qualitative test (section A.2.5).

In addition, the manufacturer shall provide the results and analysis of tests conducted at the manufacturer's facilities that demonstrate that the load on the beacon battery is not greater than the load measured for the approved beacon model prior to the change of the internal navigation device.

If the change of internal navigation device results in higher battery loads, or might affect aspects of the beacon performance other than the position acquisition time and position accuracy, the scope of testing shall be determined by Cospas-Sarsat after reviewing a description of the proposed change provided by the manufacturer.

6.5 Interface to External Navigation Device

6.5.1 Modifications to Include Encoded Position Data from an External Navigation Device

A type approved beacon modified to accept position data from an external navigation device shall be tested with the test protocol of appropriate type and format at a Cospas-Sarsat type approval facility. The tests to be performed shall consist of:

a. electrical tests at ambient and maximum temperatures but excluding modulation, spurious output, and VSWR check (section A.2.1);

b. operating lifetime at minimum temperature (section A.2.3);

c. navigation system test (section A.2.7);

d. beacon coding software (section A.2.8); and

e. satellite qualitative test (section A.2.5).

In addition, the beacon manufacturer shall also provide technical data sheets describing the navigation interface unit.

6.5.2 Modifications to Interface to External Navigation Device

For a subsequent change to the beacon navigation interface unit that might affect the beacon electrical performance, the tests identified below shall be conducted at a Cospas-Sarsat accepted facility:

a. navigation system tests (section A.2.7); and

b. satellite qualitative tests (section A.2.5).

In addition, the manufacturer shall provide the results and analysis of tests conducted at the manufacturer's facilities that demonstrate that the load on the beacon battery is not greater than the load measured for the approved beacon model prior to the change of the external navigation device.

For a change to the navigation interface that might affect aspects of beacon performance beyond the processing of encoded location information from the external navigation device, the scope of testing will be determined by Cospas-Sarsat after reviewing a description of the proposed changes provided by the manufacturer.

6.6 Changes to Frequency Generation

6.6.1 Minor Changes to Frequency Generation

In the case of oscillator replacement by an identical oscillator (on the basis of oscillator manufacturer data and written assurance) and when no other changes are required to beacon electronics or firmware, or in the case of a change of frequency of the beacon when this is achieved by modification of the oscillator (tuning or replacement of the oscillator crystal by a crystal of the same type) which does not involve significant changes to the oscillator performance, or in the case of a type approved beacon using a frequency synthesiser, the modification of the beacon can be considered as minor.

Factory tests verifying the beacon performance can be accepted after consideration by the Secretariat on a case-by-case basis.

6.6.1.1 In the case of a change of frequency, if the modification of the oscillator is limited to the replacement of the crystal by a crystal of the same type, or tuning the oscillator by the oscillator manufacturer, or reprogramming of the frequency synthesiser, the factory testing shall include:

a. measurement of absolute value of the beacon 406 MHz transmitted carrier frequency at ambient temperature; and

b. satellite qualitative test (section A.2.5).

6.6.1.2 In the case of oscillator replacement with an identical oscillator[1] and no other changes are required to the beacon electronics, or in the case of a change of frequency if the modification includes changes to circuits external to the frequency oscillator/synthesiser (e.g., an external trimmer), the factory tests shall include:

a. transmitted frequency (section A.3.2.1) at minimum, ambient and maximum temperature;

b. thermal shock (section A.2.2) excluding transmitted power and digital message;

c. frequency stability with temperature gradient (section A.2.4) excluding transmitted power and digital message; and

d. satellite qualitative test (section A.2.5).

6.6.1.3 In both cases (6.6.1.1 and 6.6.1.2 above) the technical file shall be submitted to the Secretariat including at least the following:

a. a change notice form (Annex H) specifying the details of frequency generation change;

b. the measurement results of required tests; and

c. a technical data sheet describing the oscillator, including:

i. oscillator type,

ii. oscillator specifications,

[1] For the purpose of the Cospas-Sarsat type approval a replacement oscillator can be considered to be identical to the original oscillator if they have the same circuitry, packaging, physical dimensions and firmware (as applicable) and the replacement reference oscillator has electrical and mechanical parameters that are equal to, or better than, those of the original oscillator.

iii. assurance of oscillator manufacturer that the specification of the old and new oscillators are identical, except for the frequency, as appropriate, in the form of a detailed statement.

6.6.2 Changes to Frequency Generation which Might Affect Beacon Performance

If the alternative oscillator has different parameters, or alternative technology is used to generate the RF frequency (e.g. frequency synthesiser), or additional changes are required to the beacon electronics or firmware, the modified beacon shall be re-tested at a Cospas-Sarsat accepted facility.

The testing shall include:

a. transmitted frequency (section A.3.2.1) at minimum, ambient and maximum temperature;

b. thermal shock (section A.2.2);

c. operating lifetime at minimum temperature (section A.2.3);

d. frequency stability with temperature gradient (section A.2.4) excluding transmitted power and digital message;

e. oscillator aging (section A.3.5); and

f. satellite qualitative test (section A.2.5).

The technical data submitted to the Cospas-Sarsat Secretariat shall include at least the following:

i. a change notice form (Annex H) specifying the details of frequency generation change;

ii. beacon technical data sheet;

iii. statement of the specified operating temperature range of the beacon (maximum and minimum temperatures);

iv. descriptions, complete with diagrams as necessary, to demonstrate that the design meets the long term frequency stability requirement;

v. the measurement results as specified above; and

vi. technical data sheet describing the oscillator, including

- oscillator type,
- oscillator specifications.

6.7 Alternative Names for a Type Approved Beacon

If a beacon manufacturer wishes to have the type approved beacon designated under alternative names (e.g., agent/distributor's name and model number), Annex I of this document shall be completed and sent to the Secretariat.

6.8 Beacon Hardware or Software Modifications

Any change to the beacon hardware or software which might affect the beacon electrical performance not specifically addressed above shall also be supported by a change notice form (Annex H) and testing as appropriate. The scope of the testing and reporting requirements will be determined by Cospas-Sarsat after a review of the modifications. As a minimum all changes must be supported by satellite qualitative tests (A.2.5).

- END OF SECTION 6 -

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ANNEXES
TO THE COSPAS-SARSAT
406 MHz DISTRESS BEACON
TYPE APPROVAL STANDARD

ANNEX A

BEACON MEASUREMENT SPECIFICATIONS

A.1 GENERAL

The tests required by Cospas-Sarsat for 406 MHz beacon type approval are described in this Annex and Annexes B, C, D and E, giving details on the parameters, defined in C/S T.001, which must be measured during the tests.

All measurements shall be performed with equipment and instrumentation which is in a known state of calibration, and with measurement traceability to National Standards. The measurement accuracy requirements for Cospas-Sarsat accepted test facilities are given in Annex A of C/S T.008. These measurement accuracies may be added to the beacon specification limits of C/S T.001 (thereby allowing a slight extra margin) when considering test results which are near the specification limit.

All measurement methods used by Cospas-Sarsat accepted test facilities (as defined in C/S T.007) must be approved by Cospas-Sarsat to ensure the validity and repeatability of test data.

In general, the test equipment used shall be capable of:

a. measuring the power that would be accepted by the antenna while the power is directed to a 50 Ohm load. An impedance matching network is to be provided for the test period by the beacon manufacturer. The matching network shall present a 50 Ohm impedance to the dummy load and shall present to the beacon power amplifier output the same impedance as would be present if the antenna were in place (the matching network is not required if the beacon power amplifier nominal output impedance is 50 Ohm and the beacon antenna VSWR measured relative to 50 Ohm is within the 1.5:1 ratio);

b. determining the instantaneous phase of the output signal and making amplitude and timing measurements of the phase waveform;

c. interpreting the phase modulation to determine the value of the encoded data bits;

d. measuring the frequency of the output signal;

e. producing gating signals synchronized with various features of the signal modulation;

f. maintaining the beacon under test at specified temperatures and temperature gradients while performing all other functions stated;

g. providing appropriate navigation input signals, if applicable; and

h. measuring the radiated power level, as described in Annex B.

A suggested sequence for performing the tests described herein is shown in Table F.1 of Annex F, but the tests may be performed in any other convenient sequence. The test results are to be summarized and reported as shown in Annex F, with appropriate graphs attached as indicated.

A.2 TESTS REQUIRED

A.2.1 Electrical and Functional Tests at Constant Temperature (test no. 1 to 8 in Table F.1)

The tests specified in para. A.3.1 through para. A.3.3 (except A.3.2.2.3, antenna tests) are performed after the beacon under test, while turned off, has stabilized for a minimum of 2 hours at laboratory ambient temperature, at the specified minimum operating temperature, and at the maximum operating temperature. The beacon is then allowed to operate for 15 minutes before measurements are started to measure the following parameters at each of the three constant temperatures:

a. transmitter power output, per para. A.3.2.2 (except A.3.2.2.3 antenna tests);

b. digital message, per para. A.3.1.4;

c. digital message generator, per para. A.3.1, A.3.1.1, A.3.1.2 and A.3.1.3;

d. modulation, per para. A.3.2.3;

e. transmitted frequency, per para. A.3.2.1;

f. spurious output, per para. A.3.2.2.4;

g. VSWR check, per para. A.3.3; and

h. self-test mode, per para. A.3.6.

A.2.2 Thermal Shock Test (test no. 9 in Table F.1)

The beacon under test, while turned off, is to stabilize at a selected temperature in its operating range. The beacon is then simultaneously placed into an environment held at 30 degrees C offset from the initial temperature and turned on. The beacon is then allowed to operate for 15 minutes before measurements are started to measure the following parameters:

a. transmitted frequency, per para. A.3.2.1;

b. transmitter power output, per para. A.3.2.2.1; and

c. digital message, per para. A.3.1.4.

Frequency measurements are made continually for two hours. Stability analysis is performed for these frequency samples as in para. A.3.2.1. The 18-sample analysis window of the stability calculations is advanced in time through the period such that each succeeding data set includes the latest frequency sample and drops the earliest one. Power output per para. A.3.2.2.1 and digital message checks per para. A.3.1.4 shall also be made continually throughout the two-hour period.

A.2.3 Operating Lifetime at Minimum Temperature (test no. 10 in Table F.1)

The beacon under test is operated at its minimum operating temperature for its rated life. During this period, the following parameters are measured on each transmission:

a. transmitted frequency, per para. A.3.2.1;

b. transmitter power output, per para. A.3.2.2.1; and

c. digital message, per para. A.3.1.4.

The 18-sample analysis window of the stability calculations is advanced in time through the period such that each succeeding data set includes the latest frequency sample and drops the earliest one.

If beacon is intended to be encoded with short or long format messages, this test shall be performed with a long format message. If the beacon includes an internal GNSS receiver, this test shall be performed in an environment that ensures that the GNSS receiver draws the maximum energy from the battery (e.g. ensuring that any GNSS receiver sleep time is minimised over the test duration).

The operational lifetime test is intended to establish, with reasonable confidence, that the beacon will function at its minimum operating temperature for its rated life using a battery that has reached its expiration date[1]. To accomplish this, the lifetime test of a beacon with its circuits powered from the beacon battery prior to beacon activation shall be performed with a fresh battery pack which has been discharged to take into account:

i. the depletion in battery power resulting from normal battery loss of energy due to battery ageing over the rated life of the battery pack;

ii. the average current drain resulting from constant operation of the circuits powered from the beacon battery prior to beacon activation over the rated life of the battery pack;

[1] The beacon manufacturer shall provide data necessary to discharge a fresh battery pack at room temperature to account for current drain over the battery pack rated life time. The battery discharge figures provided by the beacon manufacturer shall be measured by the testing laboratory.

iii. the number of self-tests, as recommended by the beacon manufacturer over the rated life of the battery pack (the beacon manufacturer shall substantiate the method used to determine the corresponding current drain); and

iv. correction coefficient of 1.65 (applied to item (ii) and item (iii)) to account for differences between battery to battery, beacon to beacon and the possibility of exceeding the battery replacement time.

After the battery pack has been appropriately discharged, the beacon is tested at its minimum operating temperature for its rated life as indicated above. Discharge of the battery may be replaced by the equivalent extension of the operating lifetime test.

A.2.4 Frequency Stability Test with Temperature Gradient (test no. 11 in Table F.1)

The beacon under test, while turned off, is to stabilize for 2 hours at the minimum specified operating temperature. It is then turned on and subjected to temperature gradient specified in Figure A.1, during which time the following tests are performed continually on each burst:

a. transmitted frequency, per para. A.3.2.1;

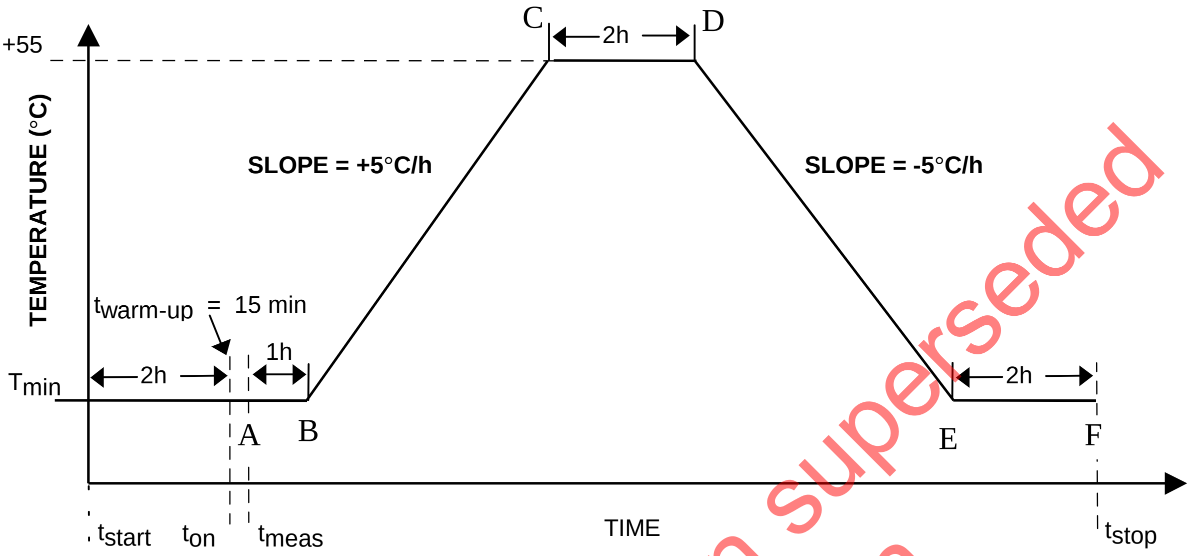
b. transmitter power output, per para. A.3.2.2.1; and

c. digital message, per para. A.3.1.4.

The 18-sample analysis window of the stability calculations is advanced in time through the period such that each succeeding data set includes the latest frequency sample and drops the earliest one.

When a battery replacement is required, two separate tests shall be performed. The up-ramp test is from t_{start} to point D (see Figure A.1) and the down-ramp test is from point C to t_{stop}. Before point C of the down-ramp, the beacon under test, while turned off, is to stabilize for 2 hours at +55°C and is then turned on and allowed a 15 minute warm-up period.

Figure A.1: Temperature Gradient Test Profile



NOTES:	T_{min} =	- 40°C (Class 1 beacon)
	T_{min} =	- 20°C (Class 2 beacon)
	t_{on} =	beacon turn-on time after 2 hour "cold soak"
	t_{meas} =	start time of frequency stability measurement (t_{on} + 15 min)

Table A.1: Medium-Term Frequency Stability Criteria
During Temperature Gradient Test

Points in Figure A.1	Requirements
During warm-up	No Requirement
A to B	$1x10^{-9}$
B to C+15 minutes	$2.0x10^{-9}$
C+15 minutes to D	$1x10^{-9}$
D to E+15 minutes	$2.0x10^{-9}$
E+15 minutes to F	$1x10^{-9}$

A.2.5 **Satellite Qualitative Test** (test no. 14 in Table F.1)

This test is to be performed only in coordination with the cognizant Cospas-Sarsat Mission Control Centre (MCC) and local authorities. The beacon should operate in its nominal configuration, if possible. However, if the beacon includes a homing transmitter operating on a distress frequency (e.g. 121.5 MHz or 243 MHz), this transmitter may need to be disabled or offset from the distress frequency for this test, as per the national requirements of the test facility.

This test shall be performed in environment(s) which approximate, as closely as practicable, the intended use of the beacon. If the beacon is designed to operate in multiple configurations (e.g. floating in water, resting on dry ground, above ground, etc.) the satellite qualitative test shall be performed for each configuration.

The test beacon shall have its own antenna connected and shall be coded with a test protocol of appropriate type and format (see sections 4.3 and A.3.1.4). The beacon shall be turned on for 15 minutes prior to the start of this test and then operated in the open for at least 5 LEOSAR satellite passes characterised by cross track angles between 1 and 21 degrees, and with bursts that bracket the satellite time of closest approach (TCA) to the beacon.

The pass/fail criteria are as follows:

a. LEOLUT solutions producing the correct beacon 15 hexadecimal identification must be provided for all satellite passes with cross track angles between 1 and 21 degrees; and

b. at least 80% of the LEOLUT Doppler locations, associated with satellite passes with cross track angles between 1 and 21 degrees and with bursts that bracket TCA, must be accurate to within 5 km.

Successful completion of this test shall be indicated by a "√" in Table F.1, and a "Satellite Qualitative Test Summary Report (Appendix A to Annex F) shall be provided for each operational configuration tested. The "Satellite Qualitative Test Summary Reports" shall indicate all LEOSAR satellite passes with cross track angles between 1 and 21 degrees for the period of the testing, even if a solution was not produced by the LEOLUT.

A.2.6 Beacon Antenna Test (test no. 15 in Table F.1)

The beacon antenna test, described in section A.3.2.2.3 and Annex B, shall be performed at the ambient temperature of the test facility and a correction factor shall be applied to the data to calculate the radiated power at minimum temperature at the end of the operating lifetime. This test shall be performed using the non-modified test beacon, including the navigation antenna, if applicable.

A.2.7 Navigation System Test, if Applicable (test no. 17 in Table F.1)

For beacons incorporating the optional capability to transmit encoded position data, some additional tests, described in section A.3.8, are required to verify the beacon output message, including the correct position data, BCH error-correcting code(s), default values, and update rates, if applicable. With the exception of the Position Data Encoding test (A.3.8.7) the navigation input system shall be operating for the duration of all tests to ensure that it does not affect the 406 MHz signal and that the beacon can operate for the required operating lifetime. The beacon output digital message shall be monitored during all tests, as described in section A.3.1.4.

If the beacon has a homer transmitter or ancillary devices, the transmitter shall be operated and all ancillary devices shall be active for all navigation system tests.

Unless stated otherwise:

a. navigation tests do not have to be repeated for each message protocol supported by the beacon;

b. simulators shall not be used to replicate signals from GNSS satellites; and

c. in the case of beacons that interface with external navigation devices, a simulated data stream provided in the format/protocol of the navigation interface may be used in lieu of an actual GNSS receiver.

A.2.8 Beacon Coding Software (test no. 16 in Table F.1)

The digital message for each beacon message protocol supported by the beacon shall be verified at ambient temperature according to A.3.1.4. This test shall evaluate both the real and self-test modes for each beacon message protocol. For the purpose of validating specific beacon message protocols, the beacon shall be programmed in accordance with the guidance provided at Annex C.

For location protocols, verification of 2 messages with encoded position data is required, the second message shall be provided with encoded position at least 500 metres from the first position for the National and Standard location protocols or 10 km for the User-Location protocol. The verification of the digital message does not require a change of location of the beacon.

The content of the complete digital message for both real and self-test transmissions (including bits 1-24) shall be included in the test report as per Appendix D to Annex F.

This test can be conducted either by the test laboratory or by the beacon manufacturer. If performed by the beacon manufacturer, the manufacturer shall provide the test laboratory with the required information for inclusion in the test report.

Type approval will not be granted for beacons to use the short format variants of location protocols.

A.3 MEASUREMENT METHODS

A.3.1 Message Format and Structure

The repetition period T_R and the duration of the unmodulated carrier T_1 are illustrated in Figure A.2. (Note: many of the following measurements can be performed on the same set of 18 bursts).

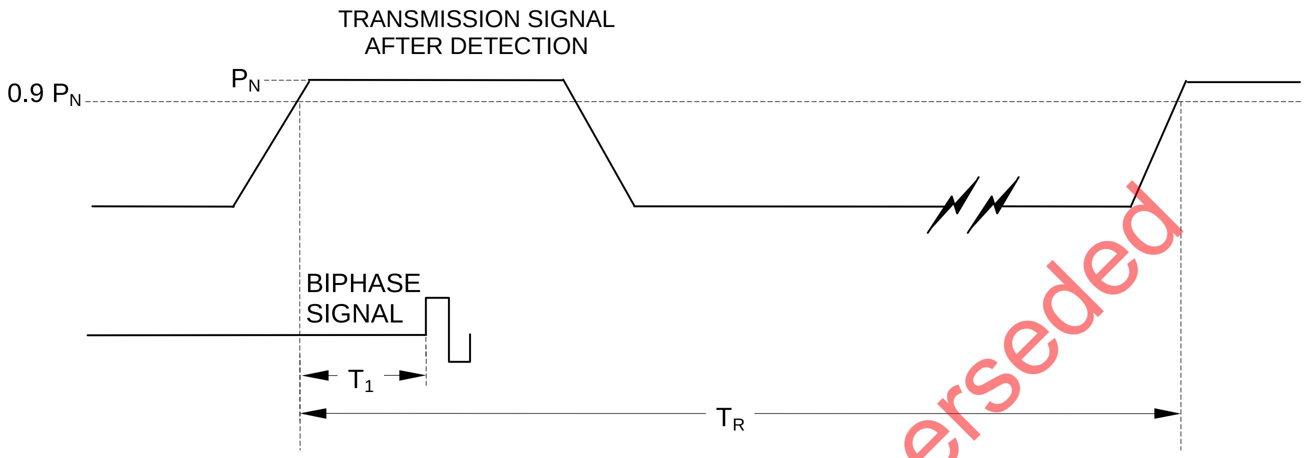


Figure A.2: Transmission Timing

A.3.1.1 Repetition Period

The repetition period, T_R , between the beginnings of two successive transmissions (see Figure A.2) shall be randomised over the range of 47.5 to 52.5 seconds. 18 successive measurements shall be made and the difference between the maximum and minimum repetition periods shall be more than 4 seconds. The average repetition period shall be 50s ± 1.5s. The standard deviation of the 18 values of T_R shall be between 0.5 and 2.0 seconds. The minimum value of T_R observed shall be between 47.5 and 48.0 seconds, the maximum value of T_R observed shall be between 52.0 and 52.5 seconds. The standard deviation, average, maximum and minimum values of T_R shall be recorded in Table F.1.

In the event that the testing does not demonstrate conformance to the minimum or maximum T_R, requirements, the test may be repeated a maximum of three times. If the test is repeated, the results for each shall be recorded in Table F.1.

A.3.1.2 Duration of the Unmodulated Carrier

The unmodulated carrier duration, T_1, between the beginning of a transmission and the beginning of the data modulation (see Figure A.2) shall satisfy the following requirement, where the values are derived from 18 successive measurements:

$$158.4 \text{ ms} \leq T_1 \leq 161.6 \text{ ms}$$

The maximum and minimum values of T_1 are to be recorded in Table F.1.

A.3.1.3 Bit Rate and Stability

The bit rate, f_b , in bits per second (bps) which is measured over at least the first 15 bits of one transmission, shall satisfy the following requirement, where the values of f_b are provided from 18 successive measurements:

$$396 \text{ bps} \leq fb \leq 404 \text{ bps}$$

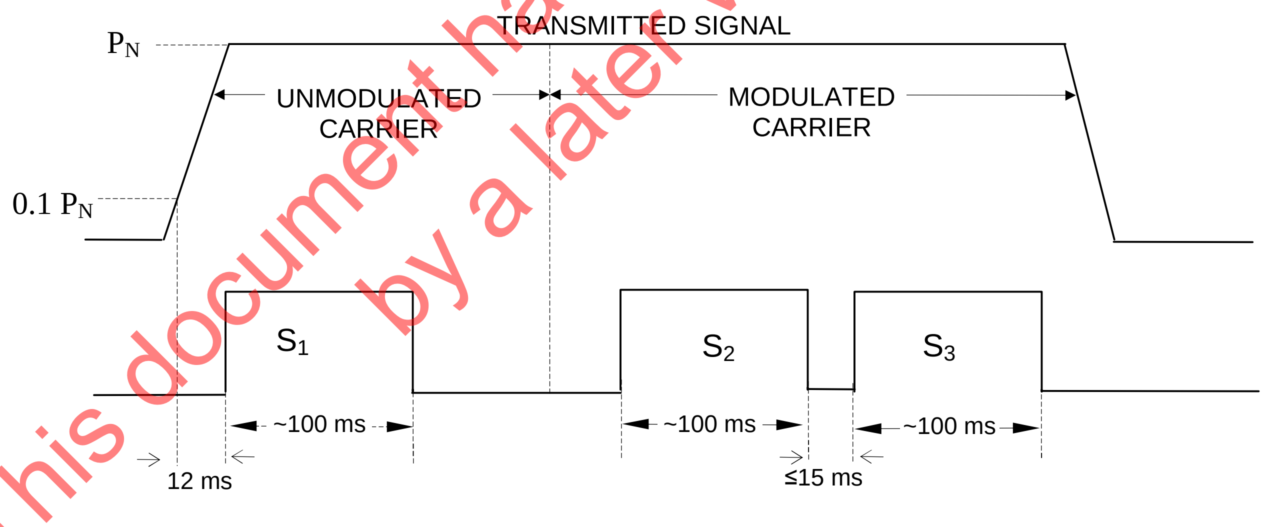
The maximum and minimum values of f_b are to be recorded in Table F.1.

A.3.1.4 Message Coding

The content of the demodulated digital message shall be checked for validity and compliance with the format for each data field, bit by bit, and the BCH error correcting code(s) shall be checked for correctness.

The content of the digital message shall be monitored during all tests. Note that protocols that support encoded location information (e.g. User-Location, Standard Location and National Location) shall only be used in beacons that are designed to accept location information from a navigation system.

A.3.2 Modulator and 406 MHz Transmitter



The S_1 pulse starts 12 ms after the beginning of the unmodulated carrier.
The S_2 pulse starts at the beginning of bit 23.
The S_3 pulse starts not later than 15 ms after the end of S_2.

Figure A.3 : Definition of Measurement Intervals

A.3.2.1 Transmitted Frequency

Frequency measurements shall be made during each transmission, either directly at 406 MHz or at a stable downconverted frequency, during various intervals of approximately 100 milliseconds, as shown in Figure A.3.

The various frequency and frequency stability computations defined hereunder can all be made using data collected from the same set of 18 transmissions.

A.3.2.1.1 Nominal Value

The mean transmission frequency, f_0, shall be determined from 18 measurements of $f_i^{(1)}$ made during the interval S_1 during 18 successive transmissions, as follows:

$$f_0 = f^{(1)} = \frac{1}{n}\sum_{i=1}^{n} f_i^{(1)}$$

where n=18

A.3.2.1.2 Short-Term Stability

The short-term frequency stability shall be derived from measurements[1] of $f_i^{(2)}$ and $f_i^{(3)}$ made during the intervals S_2 and S_3 during 18 successive transmissions, as follows:

$$S_{100ms} = \left\{ \frac{1}{2n}\sum_{i=1}^{n}\left(\frac{f_i^{(2)} - f_i^{(3)}}{f_i^{(2)}}\right)^2 \right\}^{1/2}$$

where n=18

The above relationship corresponds to the Allan variance. The measurement conditions used here are different (i.e. dead time between two measurements). Experience, however, has shown that the results obtained are very close to those achieved under the normal measurement conditions for the Allan variance.

A.3.2.1.3 Medium-Term Stability

The medium-term frequency stability shall be derived from measurements of $f_i^{(2)}$ made over 18 successive transmissions at instants t_i (see Figure A.4).

1 To correctly measure the short-term frequency stability, it is essential that an equal number of positive and negative phase transitions are included in the gating intervals defined as S_2 and S_3 in Figure A.3, hence these intervals are only approximately 100 ms duration.

For a set of n measurements[1], the medium-term frequency stability is defined by the mean slope of the least-squares straight line and the residual frequency variation about that line.

The mean slope is given by:

$$A = \frac{n\sum_{i=1}^{n} t_i f_i - \sum_{i=1}^{n} t_i \sum_{i=1}^{n} f_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2}$$

where n=18

The ordinate at the origin of the least-squares straight line is given by:

$$B = \frac{\sum_{i=1}^{n} f_i \sum_{i=1}^{n} t_i^2 - \sum_{i=1}^{n} t_i \sum_{i=1}^{n} t_i f_i}{n\sum_{i=1}^{n} t_i^2 - \left(\sum_{i=1}^{n} t_i\right)^2}$$

where n=18

The residual frequency variation is given by:

$$s = \left\{ \frac{1}{n} \sum_{i=1}^{n} \left(f_i - At_i - B \right)^2 \right\}^{1/2}$$

where n=18

[1] With a transmission repetition period of approximately 50 seconds, there will be 18 measurements during an approximate 15 minute period (i.e. n=18).

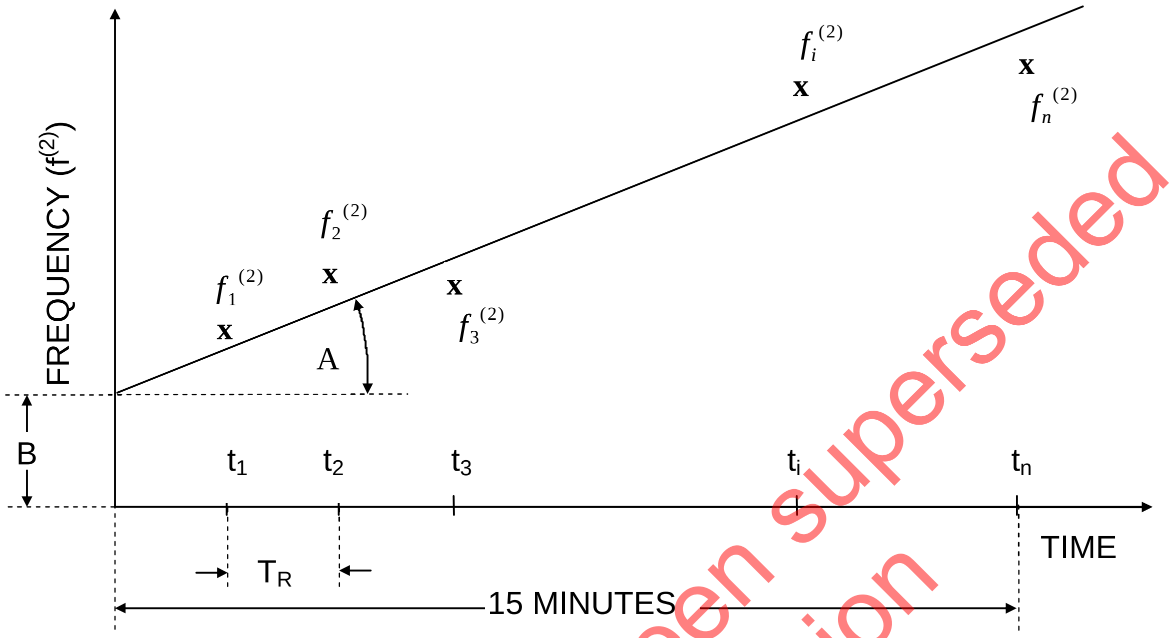


Figure A.4: Medium-Term Frequency Stability Measurement (not to scale)

A.3.2.2 Transmitter Power Output

A.3.2.2.1 Transmitter Power Output Level

The transmitter power output level shall be measured at the transmitter output. During output power measurement, the antenna shall be replaced by a dummy load that presents to the transmitter an impedance equal to that of the antenna under normal operation conditions. The RF losses of any impedance matching network which is connected to the beacon only for test purposes shall be accounted for in the power output measurement.

A.3.2.2.2 Transmitter Power Output Rise Time

The transmitter power output rise time may be determined on an oscilloscope by measuring the rise time of the burst envelope from the 10% power point to the 90% power point.

The power output level, measured 1 millisecond before the 10% power point, shall be less than -10 dBm. (Note: this can be measured using a spectrum analyzer in its "zero span" mode, with a wide resolution bandwidth (e.g ≥3 kHz), with the beacon output signal activating the video trigger to start a sweep.)

A.3.2.2.3 Antenna Characteristics

The antenna characteristics test procedure is given in Annex B of this document. Successful completion of these tests is sufficient to show that the beacon meets the antenna and radiated output requirements for Cospas-Sarsat Type Approval. Alternative procedures may also be used to provide equivalent information, but these procedures must be agreed by the Cospas-Sarsat Secretariat in advance.

For antennas tested separately from beacons, either the procedures of Annex B (with “Beacon Under Test” replaced by “Antenna Under Test” where appropriate), or equivalent conventional antenna range test procedures may be used to demonstrate the antenna radiation pattern. In any case, the test results shall demonstrate that the antenna, when receiving an input power level of 37 dBm, would produce EIRP within the limits 34 dBm to 41 dBm for at least 90 % of the measurement coordinates of Annex B.

A.3.2.2.4 Spurious Output

This measurement shall be performed with the beacon operating into 50 Ohms. The resolution bandwidth for the measurement of the spurious emission levels shall be 100 Hz or less. If this measurement is made on a spectrum analyzer, the spectrum analyzer display shall be used on a maximum hold for a period which is long enough to integrate the entire frequency spectral response. The 406 MHz beacon type approval test report shall include spectral plots depicting the complete 406.0 MHz to 406.1 MHz band.

A.3.2.3 Data Encoding and Modulation

The data encoding, the modulation sense, the modulation index, the modulation rise and fall times, and the modulation symmetry of the bi-phase demodulated signal may be checked with an oscilloscope.

The modulation rise and fall times, t_R and t_F, and the modulation symmetry are defined in C/S T.001.

The modulation index measurement[1] shall be performed during the first 15 bits of the modulated portion of the transmission and average values determined for the positive

[1] Any overshoot observed in the modulation index (as illustrated in Figure 2.5 of C/S T.001) can be disregarded if its amplitude does not exceed 10% of the specification limit and its duration does not exceed 10% of a half-bit period.

This means that the overshoot can be ignored if the absolute value of the modulation index remains within these limits. That is, the modulation index may go out of the specification limits (1.0 to 1.2 radians) momentarily following the phase transition, provided the absolute value of the modulation index remains between 0.90 radians and 1.32 radians (1.0 - 10% and 1.2 + 10%), and returns to the normal specification in less than 0.125 ms (10% of the half-bit period of 1.25 ms) after it departed from those limits.

Any overshoots shall be analysed by the test laboratory and a statement regarding whether they can be disregarded shall be provided as comments to items 4 or 7 of Table F.1.

and negative phase deviations. It is recommended to display or monitor the complete demodulated transmission.

A.3.3 Voltage Standing-Wave Ratio

The transmitter shall be operated into an open circuit for a minimum period of 5 minutes, and then into a short circuit for a minimum period of 5 minutes. Afterwards, the transmitter shall be operated into a load having a VSWR of 3:1 (pure resistive load R < 50 Ohm i.e. R=17 Ohm), during which time the following parameters shall be measured:

a. transmitter nominal frequency, as per para. A.3.2.1.1;

b. digital message content, as per para. A.3.1.4; and

c. the modulation parameters, as per para. A.3.2.3.

This sequence of transmitter loads and measurements shall be performed at maximum, minimum and ambient temperatures.

A.3.4 Protection Against Continuous Transmission

If possible, the protection against continuous transmission shall be checked by inducing a continuous transmission from the beacon under test. However, if the beacon manufacturer has determined that this test is not feasible for his beacon, he must provide a technical explanation which demonstrates that his design complies with the specification.

A.3.5 Oscillator Aging

Long-term frequency stability shall be demonstrated by data (e.g. oscillator manufacturer's test data) provided by the beacon manufacturer to the test facility.

For oscillators which require compensation over the operating temperature range, measurement results and a technical analysis shall also be provided to substantiate that short and medium-term stability would remain within specification after five years.

A.3.6 Self-test Mode

The manufacturer shall provide a list of the parameters that are monitored in the self-test mode (see Annex G).

Self-test operation shall not cause any operational mode transmissions.

The duration of the 406 MHz burst shall be measured, the frame synchronization pattern shall be checked and, if applicable, the encoded location checked for correct default code. The format flag bit shall be reported. The self-test mode shall be tested to verify that any transmission is limited to one self-test burst only.

Design data shall be provided on protection against repetitive self-test mode transmissions.

A.3.7 Ancillary Electrical Devices in the Beacon

It is recommended that all graphs and tables which make reference to beacon burst characteristics be annotated in a manner that identifies the times at which ancillary devices are in operation, or when operating modes are changed.

A.3.7.1 Automatically Controlled Ancillary Devices

Automatically controlled ancillary devices in the beacon (e.g. homing transmitter, Search and Rescue Radar Transponder (SART), strobe light, etc.) must be operating for the duration of the tests in the laboratory to ensure that they do not affect the 406 MHz signal and that the battery can operate the full load for the required operating lifetime. (Note that for beacon tests through the satellite, any homing transmitter may need to be turned off or offset from the distress frequency, as per the national requirements of the test facility.)

A.3.7.2 Operator Controlled Ancillary Devices

Type approval testing of beacons with ancillary devices under operator control shall be designed to confirm that the ancillary devices do not degrade beacon transmission characteristics, including frequency stability, timing, and modulation. This may be accomplished by causing the ancillary devices that are under operator control to be activated periodically during the measurement of these characteristics.

The timing of the periodic activation of ancillary devices shall be such that the instants of activation and deactivation occur over the full range of times relative to the beacon transmission burst, with the intent of detecting any effects of the activations or deactivations on the signal characteristics. The activation-deactivation regime shall be carried out for selected intervals spaced out over the duration of the long term tests (i.e. thermal shock, temperature gradient) to characterise the performance of the beacon over the entire range of operating conditions.

The test procedure shall include the operating life tests with the ancillary devices set in the operating mode that draws maximum battery energy. During this test the activation deactivation regime shall be carried out at suitable intervals. An example of test procedure for a beacon with an operator controlled voice transceiver function is provided at Annex G.

A.3.8 Navigation System (if applicable)

Except for the position data encoding test (section A.3.8.7), the navigation input system must be operating for the duration of all tests to ensure that it does not affect the 406 MHz signal and that the beacon can operate for the required operating lifetime. For a beacon operating with an external navigation device, navigation data input shall be provided in the same way as it would be by an operational navigation device.

All the tests specified below shall be performed at ambient temperature. A check for valid BCH code shall be performed throughout these tests, and any examples where the encoded BCH was not correct shall be specifically identified in the test report and an annotation provided at item 17 of Table F.1.

A.3.8.1 Position Data Default Values

If valid navigation data is not available in the beacon memory at the time the beacon transmits a 406 MHz message, the message shall contain default values for position data bits as specified in C/S T.001. To test this, ensure that no navigation input is present for at least 4 hours and 5 minutes (i.e. remove the appropriate navigation signal or navigation data input to the beacon), then activate and operate the test beacon for 30 minutes. Verify that the default values for position data are present in the digital message throughout this period. Deactivate the beacon. Record the results with a pass/fail indication at item 17 of Table F.1.

A.3.8.2 Position Acquisition Time and Position Accuracy

A.3.8.2.1 At a known location, apply the appropriate navigation signal or navigation data input to the beacon. Activate the beacon and verify that the position is acquired and entered in the digital message within the specified time interval (1 min for external navigation device, 10 min for internal navigation device). Check that the encoded data is correct within 500 metres for beacons with Standard or National Location protocols or 5.25 km for beacons with User-Location protocols. Deactivate the beacon.

A.3.8.2.2 Change navigation data input or the navigation signal (by using GNSS RF simulator or by moving the beacon) by more than 5 km with respect to the position of A.3.8.2.1. Activate the beacon and verify that the new position is acquired and encoded into the digital message within the specified time interval (1 min for external navigation device, 10 min for internal navigation device). Check that the encoded data is correct within 500 metres for beacons with Standard or National Location protocols or 5.25 km for beacons with User-Location protocols. Deactivate the beacon.

Record the results to A.3.8.2.1 and A.3.8.2.2 with a pass/fail indication at item 17 of Table F.1, and the measured values in Table F-C.4 or Table F-C.5 as appropriate. If the test had to be repeated because initial test results failed to meet requirements, the failed tests shall also be reported and an explanation for the failure included in the report. In such circumstances the tests shall be repeated and reported at least 5 times in the configuration that failed.

In the case of beacons with internal navigation devices:

a. test A.3.8.2.1 shall be conducted at a location where the beacon has clear visibility to the available GNSS satellites; and

b. tests A.3.8.2.1 and A.3.8.2.2 shall be conducted with the beacon in all the configurations declared by the manufacturer in the application form (Annex G) consistent with the manufacturers operational instructions and in accordance with the guidance provided below.

   Floating. The beacon shall be completely submerged in salt water [composition 5% salt solution by weight], activated while submerged, and allowed to float to the surface under its own buoyancy.

Resting on Ground. The beacon shall be placed on dry ground in the orientation described in the manufacturer's instructions.

A.3.8.3 Encoded Position Data Update Interval

If the beacon is capable of updating the encoded position data, apply the appropriate navigation signal or navigation data input to the beacon which should cause the encoded position data to update and verify that the beacon does not update the digital message within 20 minutes after the time of the last update. For beacons with internal navigation devices, the test can be performed either by changing the beacon position or with a GNSS RF simulator to emulate the GNSS satellite downlinks. Verify that the beacon updates the digital message in accordance with the manufacturer's design. If the beacon design does not allow encoded position data updates, verify that the encoded position data in the digital message does not change when the appropriate navigation signal, or navigation data input to the beacon, are applied. Record the first measured position data update interval at item 17 of Table F.1.

This test can be conducted in a configuration determined between the beacon manufacturer and the test laboratory. Unlike A.3.8.2.1 and A.3.8.2.2 this test does not have to be repeated for each operational configuration.

A.3.8.4 Position Clearance after Deactivation

After the test A.3.8.3 deactivate and reactivate the beacon, with no navigation signal or navigation data input to the beacon, to verify that the previous position data has been cleared and that the correct default values are encoded in the message. Record the results with a pass/fail indication at item 17 of Table F.1.

A.3.8.5 Position Data Input Update Interval

If a beacon is designed to accept position data from an external navigation device prior to beacon activation, navigation data input should be provided and stored in the beacon memory at intervals not longer than 20 minutes for EPIRBs and PLBs, or 1 minute for ELTs. To test this, deactivate the beacon, change the initial position data, allow for the appropriate time interval (20 min (–0/+10 min) or 1 min (–0/+0.5 min)) for the changed position to be accepted. Remove the navigation data input to the beacon. Activate the beacon. Verify that the encoded position data is correct. A GNSS RF simulator may be used to simulate the GNSS satellite downlinks. Identify in Table F.1 the applicable time interval for this test, and record the results with a pass/fail indication at item 17 of Table F.1.

A.3.8.6 Last Valid Position

Remove the appropriate navigation signals or the navigation input and verify that the last valid position data before the loss of navigation signal is retained in the 406 MHz beacon digital message for 4 hours (± 5 min) from the last valid position data input. Check that position data has been cleared and that the correct default values are encoded in the message after 4 hours (± 5 min). Identify in Table F.1 the duration for which the last valid position data continued to be transmitted by the beacon, and also that the correct default values were transmitted afterwards.

A.3.8.7 Position Data Encoding

This test is conducted by substituting the output of the navigation device with test scripts which replicate the location information provided in Table D.1 for the User-Location protocol, Table D.2 for the Standard Location Protocol, and Table D.3 for the National Location protocol.

This test may be conducted either by the test laboratory or the manufacturer. The results shall be provided in the formal report as per Appendix C to Annex F. The test laboratory shall annotate Table F.1 with "√" if the beacon performed as required for all the scripts tested.

- END OF ANNEX A -

ANNEX B

ANTENNA CHARACTERISTICS

B.1 SCOPE

This Annex describes the measurement procedure to verify the antenna characteristics of 406 MHz distress beacons defined in document C/S T.001. Alternative procedures, including the use of a shielded anechoic room, are acceptable if they provide equivalent information and have minimal impact on Cospas-Sarsat operations.

B.2 GENERAL TEST CONFIGURATION

B.2.1 The antenna characteristics of the Beacon Under Test (BUT) shall be measured in an open field test site or a shielded anechoic room. In accordance with the guidance provided at Section 4.5, the beacon shall be tested in configuration(s) that simulate the ground conditions in which the beacon might be expected to operate.

A measuring antenna located at a horizontal distance of 3 metres from the BUT shall be used to measure the emitted field strength. In order to make measurements at all the required azimuths the BUT will have to be rotated through 360°, and to make measurements at the required elevation angles the measuring antenna will have to be moved vertically. The BUT shall be equipped with a fresh battery and the test shall be performed at ambient temperature.

B.2.2 Prior to each open field test site transmission, the appropriate national authorities responsible for Cospas-Sarsat and radio emissions shall be notified.

In order to keep the potential disturbance to the Cospas-Sarsat System to a minimum, these antenna tests shall be conducted using a beacon operating at its nominal repetition rate and coded with the test protocol of the appropriate type and format. Transmission of any continuous wave (CW) signal from a signal generator in the 406.0 - 406.1 MHz band is strictly forbidden.

B.3 TEST SITE

B.3.1 The test site shall be an area clear of any obstruction such as trees, bushes or metal fences within an elliptical boundary of dimensions shown in Figure B.1. Objects outside this boundary may still affect the measurements and care shall be taken to choose a site as far as possible from large objects or metallic objects of any kind.

B.3.2 The terrain at an outdoor test site shall be flat. Any conducting object inside the area of the ellipse shall be limited to dimensions less than 7 cm. A metal ground plane or wire mesh enclosing at least the area of the ellipse and keeping the same major and minor axis as indicated in Figure B.1 is preferred (indicated as ground plane "A" in figures B.2 through B.5). If this is not practical then a surface of homogeneous good soil (not sand or rock) is satisfactory. All electrical wires and cables shall be run underground or under the ground plane. The antenna cable shall be extended behind the measuring antenna along the major axis of the test site for a distance of at least 1.5 metres from the dipole elements before being routed down to ground level.

B.3.3 All precautions shall be taken to ensure that reflections from surrounding structures are minimized. No personnel shall be within 6 metres of the BUT during actual measurements. Test reports shall include a detailed description of the test environment. Reports shall specifically indicate what precautions were taken to minimize reflections.

B.3.4 Weather protection enclosures may be constructed either partially or entirely over the site. Fibreglass, plastics, treated wood or fabric are suitable materials for construction of an enclosure. Alternatively, the use of an anechoic enclosure is acceptable.

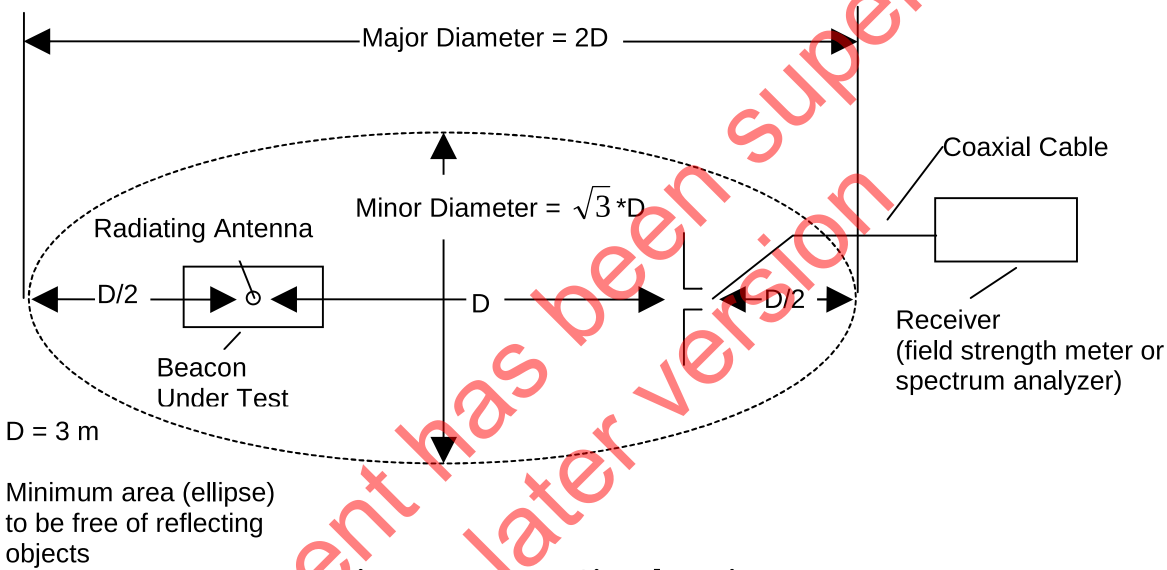


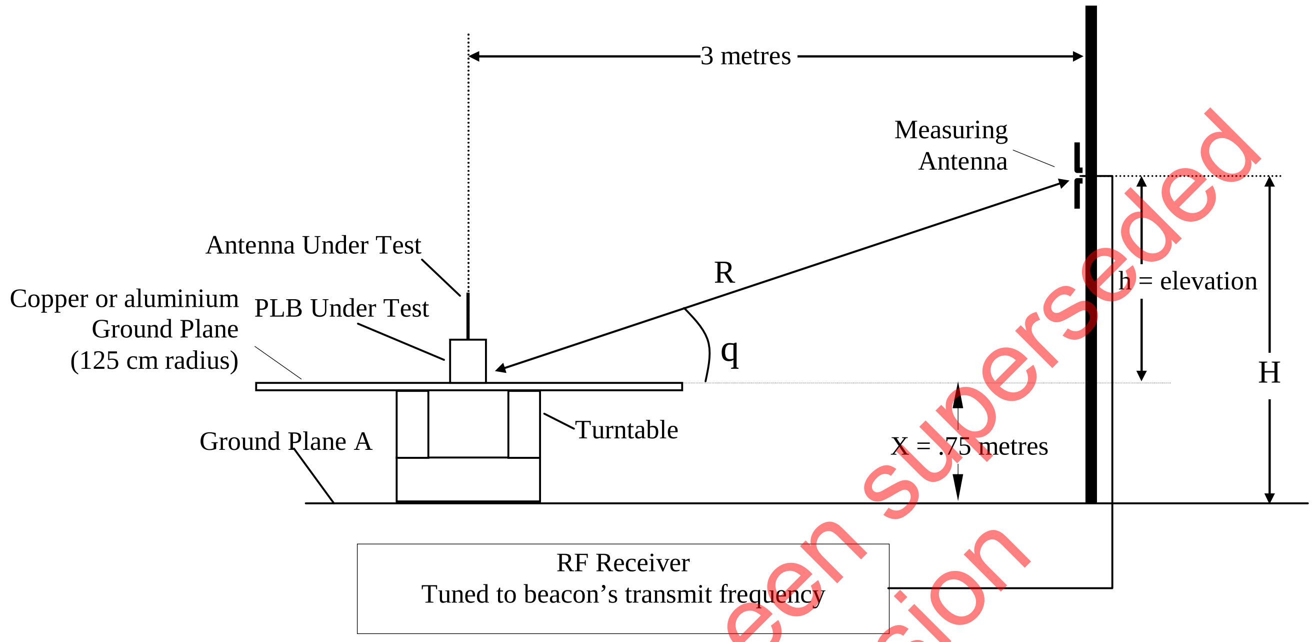
Figure B.1: Test Site Plan View

B.4 GROUND PLANE AND BEACON INSTALLATION

B.4.1 In accordance with the guidance provided at Section 4.5 the beacon shall be tested in the configurations that simulate the ground conditions in which the beacon might be expected to operate (see Figure 4.1). Descriptions of the test configurations are provided at Figures B.2 through B.5.

B.4.2 The applicable ground plane configurations, as described in Figures B.2 through B.5, will be decided by Cospas-Sarsat on the basis of technical considerations relevant to the beacon operation and information provided by the manufacturer. If there is any doubt in respect of the test configurations that must be tested, the beacon manufacturer and the type approval facility shall contact the Cospas-Sarsat Secretariat prior to the start of testing.

Figure B.2: Test Configuration for "PLB-like" Devices (e.g. PLB, survival ELT, automatic portable ELT)



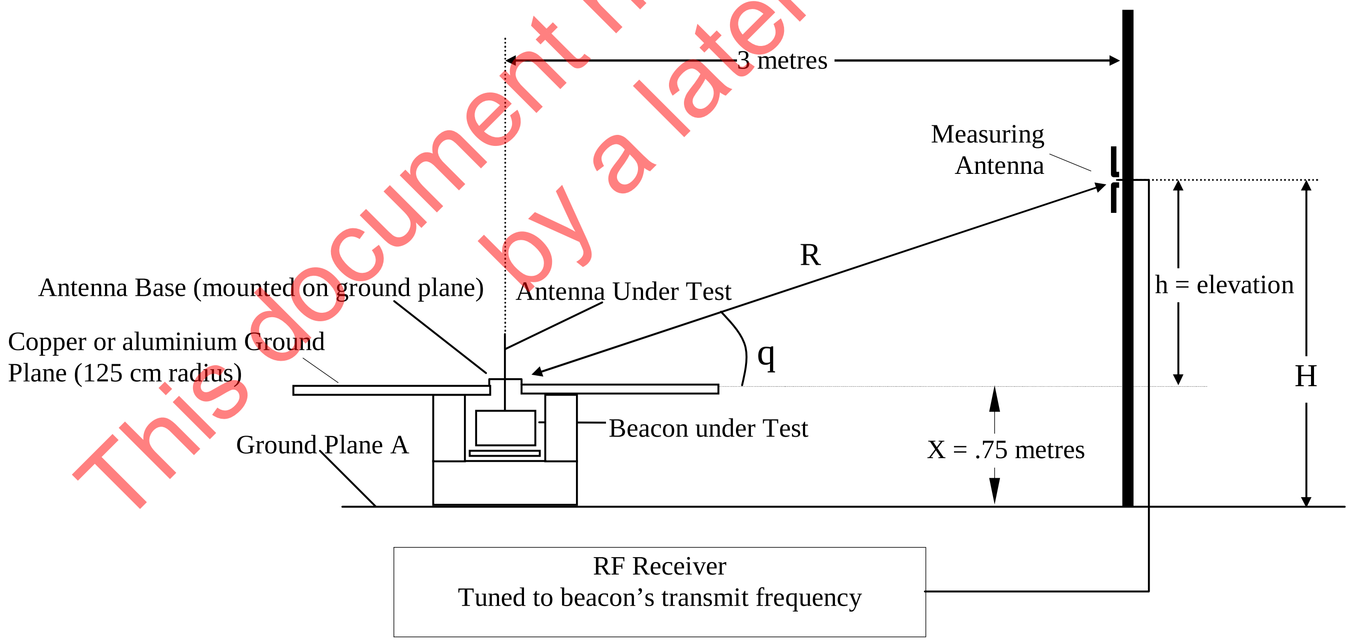
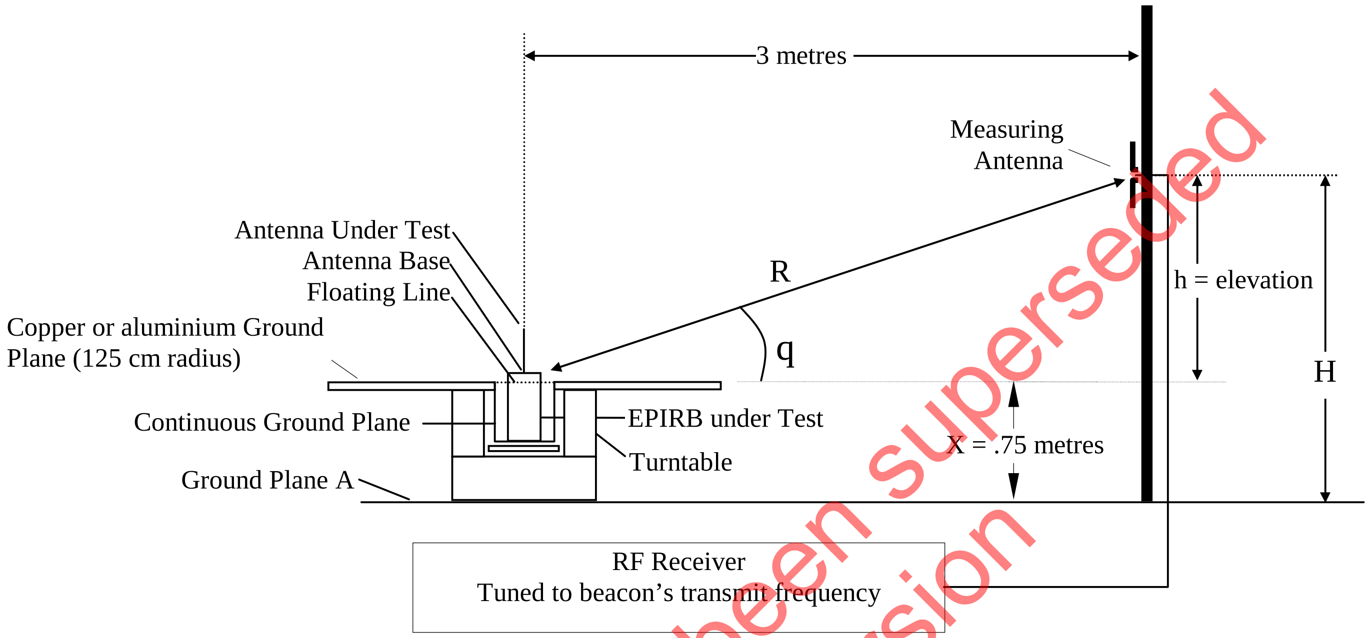


Figure B.3: Test Configuration for "Fixed ELT-like" Devices (i.e. beacon with an antenna designed to be mounted on a metal surface)

**Figure B.4: Test Configuration for "EPIRB-like" Devices
(i.e. beacons designed to operate while floating in water)**



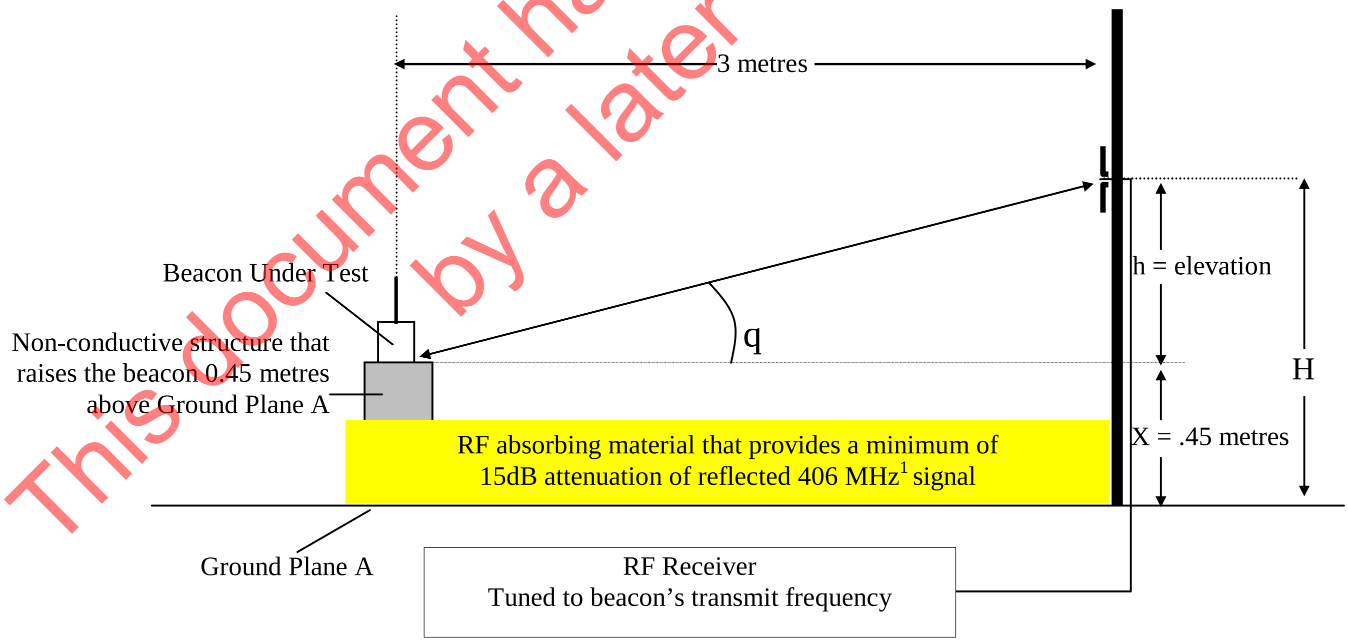
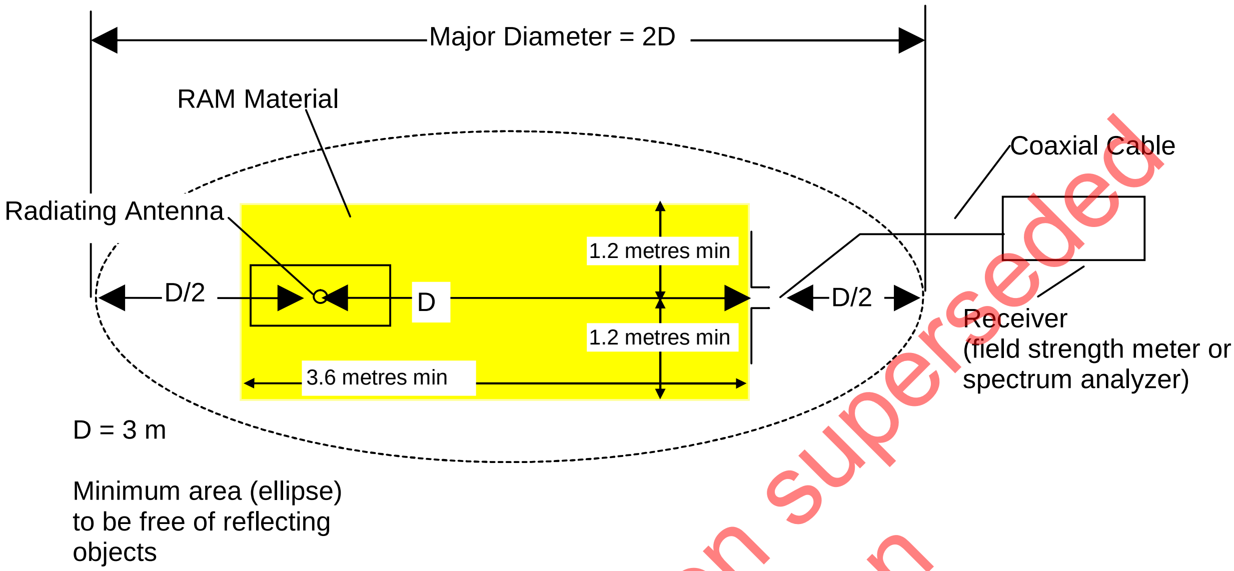


Figure B.5: Additional Test Configuration for all Devices that Might be Required to Operate Without a Ground Plane

[1] The dimensions of the RF absorbing material: minimum length of 3.6 metres, minimum width of 2.4 metres and equally spaced either side of the major axis "D" (see Figures B.1 and B.6), maximum height of 0.4 metres.

Figure B.6: Test Site Plan View with RAM Material



B.5 MEASURING ANTENNA

B.5.1 The radiated field of the BUT antenna shall be detected and measured using a tuned dipole. This dipole antenna shall be positioned at a horizontal distance of 3 metres from the BUT antenna and mounted on a non-conducting vertical mast that permits the height of the measuring antenna to be varied sufficiently to measure the beacon EIRP at elevation angles ranging from 10 to 50 degrees.

Referring to Figures B.2 through B.5, the height at which the measuring antenna must be elevated on the supporting mast for a specific elevation angle θ is calculated as follows:

$$h = 3 (\tan \theta) \text{ metres}$$

and

$$H = h + X$$

where,

X is the reference height (0.45 metres or 0.75 metres depending upon the test configuration)

h[1] is the height of the measuring antenna relative to the reference height X,

θ is the desired angle of elevation as indicated on Figures B.2 through B.5 (at reference height X),

H is the height of the measuring antenna above the ground plane A.

[1] The centre of the measuring dipole antenna is used as the reference to determine its height.

B.5.2 As the measuring antenna is vertically elevated, the distance (R) between the BUT antenna and the measuring antenna increases. The distance (R) is a function of the elevation angle (θ) and it is calculated as follows:

$$R = \frac{3}{\cos\theta} \text{ metres}$$

B.5.3 The antenna factor (AF) of the measuring antenna at 406 MHz must be known. This factor is normally provided by the manufacturer of the dipole antenna or from the latest antenna calibration data. It is used to convert the induced voltage measurement into electric field strength.

B.5.4 Since the value of AF depends on the direction of propagation of the received wave relative to the orientation of the receiving antenna, the measuring dipole should be maintained perpendicular to the direction of propagation. In order to minimize errors during measurement, it is recommended to adopt this practice (Figure B.7). If the measuring antenna cannot be maintained perpendicular to the direction of propagation (Figure B.8), a correction factor must be considered due to the gain variation pattern of the measuring antenna. For a dipole, the corrected antenna factor (AF_c) is calculated as follows:

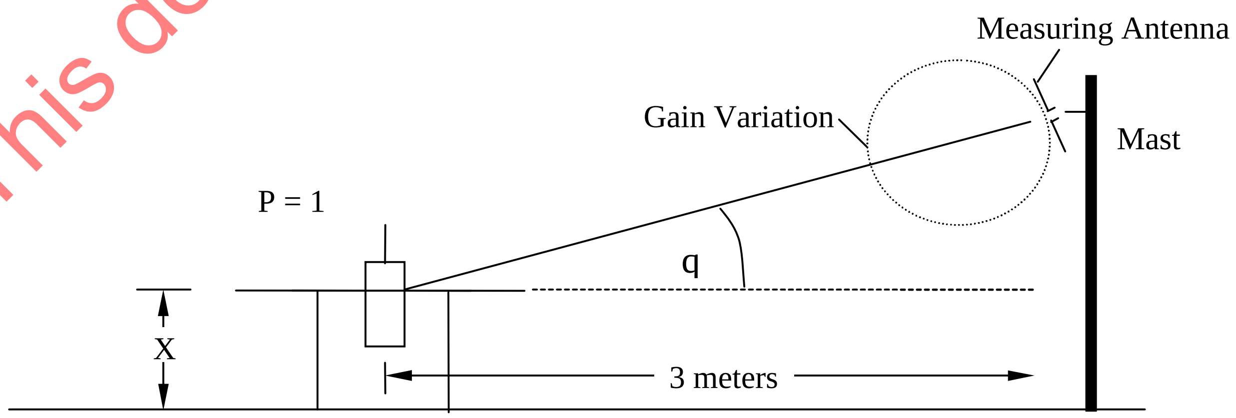
$$AF_c = \frac{AF}{P}$$

and

$$P = \frac{\cos(90 \text{ x } \sin\theta)}{\cos\theta}$$

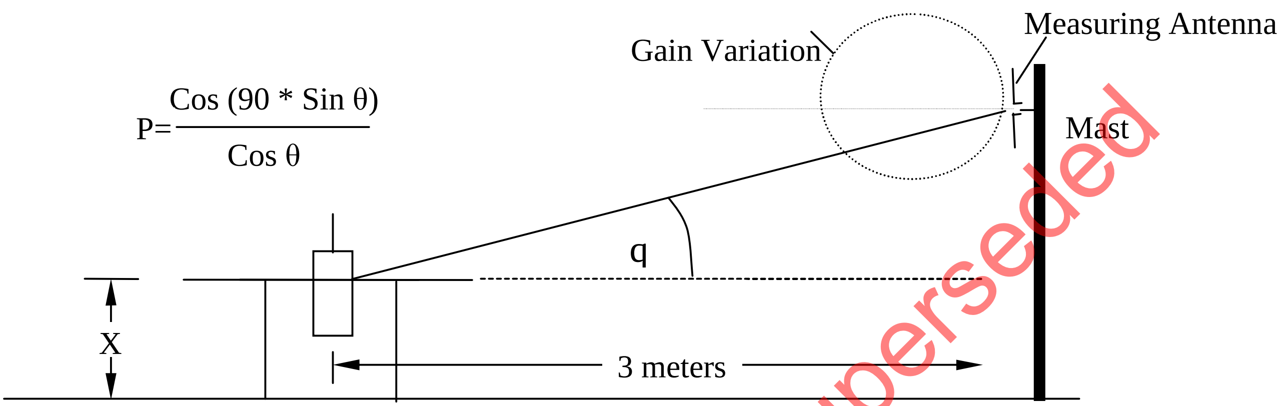
where: AF is the antenna factor from paragraph B.5.3,
θ is the elevation angle,
P[1] is the correction factor for the dipole antenna pattern.

Figure B.7: Measuring Antenna Perpendicular to the Direction of Propagation



[1] The correction factor (P) is equal to 1 when the measuring antenna elements are maintained perpendicular to the direction of propagation. P is therefore equal to 1 when the measuring antenna is horizontally polarized at any elevation angle. The correction factor applies only to vertically polarized measurements.

Figure B.8: Measuring Antenna NOT Perpendicular to the Direction of Propagation



B.6 BEACON TRANSMITTING ANTENNA

The BUT antenna may have been designed to transmit signals in the 406.0 – 406.1 MHz frequency band, and also at 243 MHz and 121.5 MHz, and also to conduct power to a strobe light mounted above the antenna. It is possible that the radiated signal will be composed of an unknown ratio of vertically and horizontally polarized waves. For this reason, consideration shall be given to the type of antenna and its radiated field. The results shall encompass all wave polarizations. The antenna pattern and field strength measurements should provide sufficient data to evaluate the antenna characteristics.

B.7 RADIATED POWER MEASUREMENTS

B.7.1 Prior to each open field test site transmission, the appropriate national authorities responsible for Cospas-Sarsat and radio emissions shall be notified.

B.7.2 The test provides data which characterises the antenna by measuring the vertically and horizontally polarised waves.

B.7.2.1 Measurement Requirements

The BUT shall be transmitting normally with a fresh battery. The signal received by the measuring antenna shall be coupled to a spectrum analyzer or a field strength meter and the radiated power output shall be measured during the beacon transmission. An example of a power measurement made with a spectrum analyzer during the unmodulated portion of a beacon transmission is illustrated in Figure B.9. The receiver shall be calibrated according to the range of levels expected, as described in Section B.8.

Measurements[1] shall be made at the azimuth and elevation angles indicated in the table below.

Test Configurations	Azimuth Angle in Degrees Rotated about the Antenna Axis ($\pm$ 3°)	Elevation Angle in Degrees ($\pm$ 3°)
Figures B.2, B.3 and B.4	0, 30, 60, 90, 120, 150, 180, 210, 240, 270, 300 and 330	10, 20, 30, 40, 50
Figure B.5	0, 90, 180, 270	10, 20, 30, 40, 50

B.7.2.2 EIRP and Antenna Gain Calculations

The following steps shall be performed for each set of measured voltages and the results recorded:

Step 1: Calculate the total induced voltage V_{rec} in dBV using

$$V_{rec}(\text{dBV}) = 20 \log \sqrt{V_v^2 + V_h^2}$$

where:

V_v and V_h are the induced voltage measurements (in volts) when the measuring antenna is oriented in the vertical and the horizontal plane respectively.

Step 2: Calculate the field strength E in dBV/m at the measuring antenna using

$$E\ (\text{dBV/m}) = V_{rec} + 20 \log AF_c + Lc$$

where:

V_{rec} is the calculated signal level from Step 1 (dBV)
AF_c is the corrected antenna factor as defined in paragraph B.5.4
Lc is the receiver system[2] attenuation and cable loss (dB)

Step 3: Calculate the EIRP and the G_i

Using the standard radio wave propagation equation:

$$E(\text{volts / metre}) = \frac{\sqrt{(30 \text{ x } Pt(\text{Watts}) \text{ x } Gi)}}{R\ (\text{metres})}$$

[1] The measuring antenna should be linearly polarized and positioned twice to align with both the vertical and horizontal components of the radiated signal in order to measure the total EIRP as described in section B.7.2.2.

[2] The receiver system attenuation is compensated for when performing the calibration procedure (section B.8). Otherwise, it shall be calculated separately.

and

$$Pt(Watts) \times Gi = EIRP$$

the EIRP for each set of angular coordinates is obtained from

$$EIRP\ (Watts) = \frac{E^2 x R^2}{30}$$

and the antenna gain from

$$Gi = \frac{E^2 \ x\ R^2}{30 \ x\ Pt}$$

where:

R is the distance between the BUT and the measuring dipole antenna calculated in section B.5.2

Pt is the power transmitted into the BUT antenna

Gi is the BUT antenna numerical gain relative to an isotropic antenna

E is the field strength converted from Step 2 into volts/metre

B.8 TEST RECEIVER CALIBRATION

In order to minimize measurement errors due to frequency response, receiver linearity and cable loss, the test receiver (which may be a field strength meter or a spectrum analyzer) shall be calibrated as follows:

a. Connect the equipment as shown in Figures B.2 through B.5, as appropriate. Install the BUT as described in Section B.4.

b. Turn on the BUT for normal transmission. Set the receiver bandwidth to measure the power of the transmission. An example using a spectrum analyzer to measure the unmodulated portion of the transmission is illustrated in Figure B.9. The same receiver bandwidth shall be used during the antenna measurement process. Tune the receiver for maximum received signal. Position the measuring antenna in the plane (horizontal or vertical) that gives the greatest received signal. Rotate the BUT antenna and determine an orientation which is representative of the average radiation field strength (not a peak or a null). Record the receiver level.

c. Disconnect the measuring antenna and feed the calibrated RF source to the receiver through the measuring antenna cable. Adjust the signal source to give the same receiver level recorded in (b) above.

d. Disconnect the calibrated RF source from the measuring antenna cable and measure its RF output with a power meter.

e. Reconnect the calibrated RF source to the measuring antenna cable and adjust the gain calibration of the receiver for a reading which is equal to the power.

B.9 ANTENNA POLARIZATION MEASUREMENT

B.9.1 An analysis of the raw data (V_v, V_h) obtained during the antenna test conducted with the beacon in configurations B.2 through B.4 should be sufficient to determine if the polarization of the BUT antenna is linear or circular. There is no requirement to evaluate the sense of polarization for Figure B.5.

B.9.2 If the induced voltage measurements V_v and V_h for at least 80% of all angular coordinates (azimuth, elevation) differ by at least 10 dB, the polarization is deemed to be linear. The polarization shall be declared as vertical or horizontal depending upon whether Vv or V_h is greater.

B.9.3 If more than 20% of the induced voltage measurements (V_v, V_h) are within 10 dB of each other, the BUT antenna is considered to be circularly polarized. Since the sense of the polarization must be right hand circular polarized (RHCP), determine the polarization using the following method and report the results.

Compare the signals received at an elevation angle of 40° for each specified azimuth angle using known right-hand circularly-polarized (RHCP) and left-hand circularly-polarized (LHCP) antennas. The circularly polarized antenna that receives the maximum signal obtained from measurements at the required azimuth angles determines the sense of polarization.

The amount of gain variation, see item B.10.5, is determined by the results obtained with circularly-polarized antennas.

B.9.4 In the case of inclined linear beacon antennas, EIRP measurements may be performed directly using a RHCP measuring antenna with known antenna factor at 406 MHz. In this case the requirements of section B.10 shall be directly applied to the EIRP results. If the results are in accordance with C/S T.007 requirements, then the antenna should be accepted regardless of any circularly polarized component of the signal.

B.9.5 Report the measurement results in Table F-B.2.

B.10 ANALYSIS OF RESULTS

B.10.1 Enter the sense of the antenna polarization, determined per Section B.9, into Table F.1.

B.10.2 Provide the measured EIRP levels in Table F-B.1 (for configurations described in Figures B.2 through B.4) and Table F-B.3 (for Figure B.5). Verify that the BUT produces a field equivalent to an EIRP in the ranges indicated in the table below.

Test Configurations	EIRP Required
Figures B.2, B.3, and B.4	32 dBm to 43 dBm[1] for at least 90% of the measurement points
Figure B.5	30 dBm to 43 dBm for at least 80% of the measurement points

Specifically annotate Table F-B.1 and F-B.3:

a. with highlighted text, to indicate all the EIRP values that are not within the ranges indicated above; and

b. with stricken-out text, to indicate any EIRP levels that were removed from consideration for calculating the EIRP maximum and minimum values at the end of life.

B.10.3 For the set of measurements identified in Section B.10.2, the overall maximum ($EIRP_{max}$) and minimum ($EIRP_{min}$) EIRP values shall be determined.

B.10.4 A power loss factor ($EIRP_{Loss}$) shall be determined[2] to correct for what the power output would be after the beacon had operated at minimum temperature for its operating lifetime. The value of $EIRP_{LOSS}$ shall be entered in Table F.1 and also at Appendix B to Annex F. This value shall be subtracted from the results in Section B.10.3 and entered in Appendix B to Annex F and item 15 of Table F.1 as $EIRP_{max\ EOL}$ and $EIRP_{min\ EOL}$.

B.10.5 The amount of gain variation in azimuth for the 40° measurements shall be extracted from Table F-B.1 and entered in Table F.1.

B.11 ANTENNA VSWR MEASUREMENT

This section is not applicable to beacons with integral antennas, nor for tests conducted in the configuration described at Figure B.5.

B.11.1 The antenna VSWR of the BUT shall be measured at the input of the antenna (or the matching network if applicable) using an acceptable VSWR measurement technique, to be described in the test report.

B.11.2 Numerous precautions are necessary in VSWR measurement to avoid errors due to the effect of nearby conducting objects on the antenna current distribution.

B.11.3 The VSWR measurement shall be performed with the BUT mounted in the configurations that were used for the previously described antenna test (i.e. configurations B.2 through B.4 as appropriate).

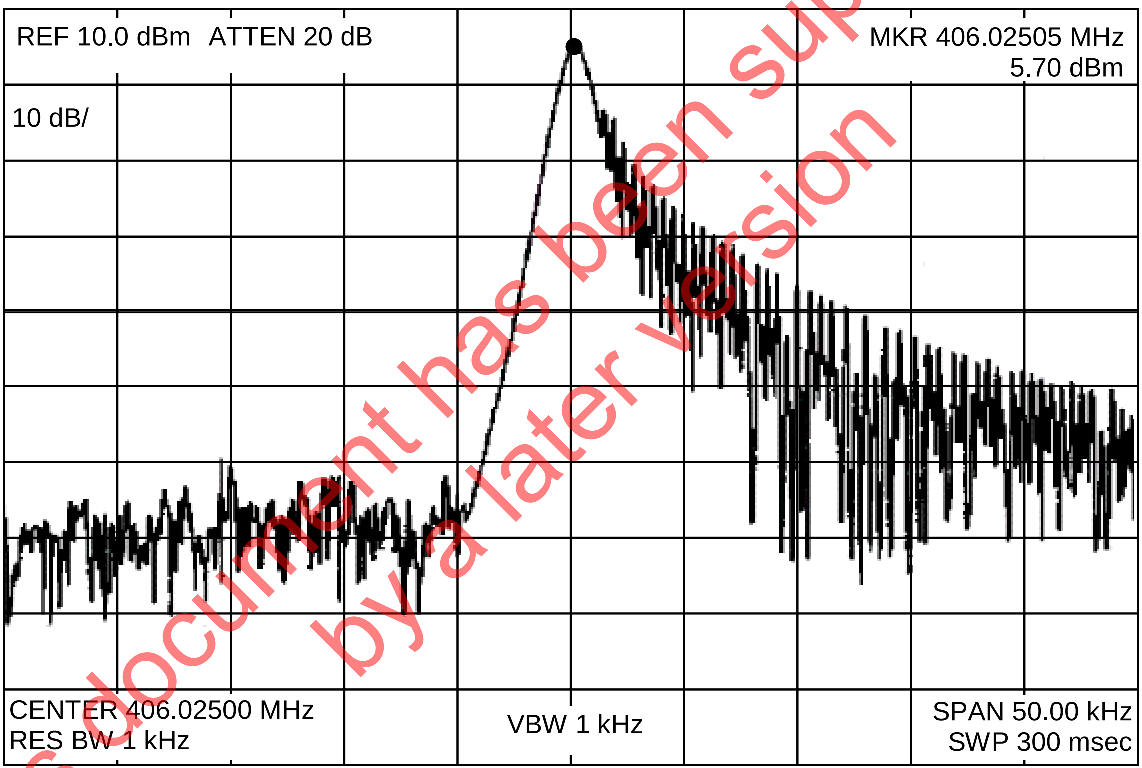
[1] The 32 dBm to 43 dBm limit is calculated from the specifications of Transmitter Power Output (37 dBm ± 2 dB) and Antenna Characteristics (+4 dBi and -3 dBi).

[2] The loss factor ($EIRP_{Loss}$) is defined as the minimum transmitter power measured during the operating lifetime test (at minimum temperature) subtracted from the transmitter power measured at ambient temperature during the transmitted power output test (i.e. $EIRP_{Loss} = Pt_{ambient} - Pt_{EOL}$).

B.11.4 Report the measured results in Table F.1. The antenna VSWR at the nominal value of the transmitted frequency in the 406.0 – 406.1 MHz frequency band shall not exceed a 1.5:1 ratio.

B.11.5 If the antenna VSWR exceeds the 1.5:1 ratio but remains less than 1.8:1[1] at the nominal operational frequency, and if the antenna EIRP is evaluated by direct measurements[2] and is within the limits specified in section B.10, the beacon can still be considered as meeting the Cospas-Sarsat requirements. However, in this case, Cospas-Sarsat type approval will be deemed as valid only for the beacon-cable-antenna configuration tested (with specific cable type and length) and the antenna should not be used with any other beacon/cable[3] without further type approval testing.

Figure B.9: RF Measurement During Preamble



1 Provisions of section A.1 in respect of impedance matching network apply.

2 In the case when the separated antenna was previously tested for type approval with an ELT, the direct EIRP measurement may be replaced with an analysis showing that the EIRP of the beacon-antenna combination would be within the limits specified in Section B.10.2 of Annex B. The analysis must address the actual measured beacon output power and the impedance mismatch between the beacon and the cable loaded with the ELT antenna.

3 A special tag should be provided on the antenna cable with a warning that the length of the cable should not be changed.

- END OF ANNEX B -

ANNEX C

BEACON CODING TO BE USED FOR EVALUATING BEACON MESSAGE CODING

If the beacon is designed to operate with a protocol that requires any of the following data elements, the values programmed into the beacon for evaluating beacon message coding (Table F.1 item 16) shall be in accordance with Table C.1. Examples of each requested beacon message protocol shall be included in the test report as per Tables F-D.1 and F-D.2.

Table C.1: CODING VALUES FOR BEACON MESSAGE CODING TESTING

Data Element	Value
Format Flag	As required by the specific protocol
Protocol Flag	As required by the specific protocol
Country Code	201
Protocol Code	As required by the specific protocol
MMSI	999999
Radio Call Sign	XPA02
Cospas-Sarsat Type Approval Certificate Number	999
Beacon Serialised Number	99
Any National Use Data Elements	Default values as specified in C/S T.001
Aircraft Registration Marking	C7518
Aircraft Operator Designator and a serial number	AAA1000
Aircraft 24-bit Address	11472655 (Base 10 representation)
Specific Beacon	Assume only 1 beacon on vessel or aircraft
Non-Protected Data Field	Default values specified in C/S T.001
Auxiliary Radio Locating Device	As appropriate for the beacon design[1]
Manual / Automatic Activation	As appropriate for the beacon design[1]

[1] In cases where the beacon has several variants (i.e. with and without an automatic activation capability, with and without a 121.5 MHz homer), the report shall provide examples of the coding assuming automatic activation and the 121.5 MHz homer.

-END OF ANNEX C-

ANNEX D

NAVIGATION SYSTEM TEST SCRIPTS

This test shall be conducted by inputting the test scripts provided below into the beacon. The test scenario shall be implemented in the order indicated, and the beacon shall not be turned-off until after all the scenarios have been completed. The procedure shall be completed for each location protocol type (i.e. Standard, National or User) for which type approval is being requested.

The test results shall be reported in the format provided at Tables F-C.1, F-C.2 and F-C.3.

Table D.1: User-Location Protocol Procedure

Script	Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal)	BCH Correct (√)	Required Value of Encoded Location Bits (Hexadecimal)[1]
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	Bits 108-132=		Bits 108-132= FE0FF0
2. Keeping the beacon active, apply the following navigation data to the beacon: 1° 3min 30 sec North, 1° 2min 30 Sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	Bits 108 – 132= Number of seconds after providing navigation data that beacon transmitted the above encoded location information: _______		Bits 108-132= 23011 Response time for beacon to transmit correct encoded location must be less than 52.5 Sec.
3. Keeping the beacon active, change the navigation input to the beacon to: 3° 23min 30 sec North, 5° 6min 15 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 108-132=		Bits 108-132= 6D052

[1] The hexadecimal values reported in this column are calculated by converting the binary value of the data required by column two into a base 16 value. For example the following bits 0000 0011 would be expressed as "3", not "03".

Table D.2: Standard Location Protocol Procedure

Script	Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal)	BCH Correct (√)	Required Value of Encoded Location Bits (Hexadecimal)
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= FFBFF Bits 113-132= 83E0F
2. Keeping the beacon active, apply the following navigation data to the beacon: 1° 3 min 31 sec North, 1° 2 min 29 Sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	Bits 65-85= Bits 113-132= Number of seconds after providing navigation data that beacon transmitted the above encoded location information: _______		Bits 65-85= 2404 Bits 113-132= 8E227 Response time for beacon to transmit correct encoded location must be less than 52.5 Sec.
3. Keeping the beacon active, change the navigation input to the beacon to: 1° 30 min 0 sec North, 1° 2 min 29 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 2404 Bits 113-132= F8227
4. Keeping the beacon active, change the navigation input to the beacon to: 1° 32 min 0 sec North, 1° 2 min 29 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 3404 Bits 113-132= 88227
5. Keeping the beacon active, change the navigation input to the beacon to: 1° 0 min 56 sec North, 1° 2 min 29 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 3404 Bits 113-132= 74627

Script	Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal)	BCH Correct (√)	Required Value of Encoded Location Bits (Hexadecimal)
6. Keeping the beacon active, change the navigation input to the beacon to: 0° 58 min 0 sec North, 1° 2 min 29 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 2404 Bits 113-132= 8227
7. Keeping the beacon active, change the navigation input to the beacon to: 0° 58 min 0 sec North, 1° 29 min 29 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 2404 Bits 113-132= 83D7
8. Keeping the beacon active, change the navigation input to the beacon to: 0° 58 min 0 sec North, 1° 32 min 29 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 2406 Bits 113-132= 8227
9. Keeping the beacon active, change the navigation input to the beacon to: 0° 58 min 0 sec North, 1° 2 min 29 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 2406 Bits 113-132= 81B8
10. Keeping the beacon active, change the navigation input to the beacon to: 0° 58 min 0 sec North, 0° 30 min 24 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 2402 Bits 113-132= 8206

Table D.3: National Location Protocol Procedure

Script	Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal)	BCH Correct (√)	Required Value of Encoded Location Bits (Hexadecimal)
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= 3F81FE0 Bits 113-126= 27CF
2. Keeping the beacon active, apply the following navigation data to the beacon: 21° 4 min 36 sec North, 6° 3 min 24 Sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	Bits 59-85= Bits 113-126= Number of seconds after providing navigation data that beacon transmitted the above encoded location information: _______		Bits 59-85= A8A0C2 Bits 113-126= 2489 Response time for beacon to transmit correct encoded location must be less than 52.5 Sec.
3. Keeping the beacon active, change the navigation input to the beacon to: 21° 7 min 56 sec North, 6° 3 min 24 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= A8A0C2 Bits 113-126= 3F09
4. Keeping the beacon active, change the navigation input to the beacon to: 27° 4 min 12 sec North, 6° 3 min 24 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126= =		Bits 59-85= D8A0C2 Bits 113-126= 2189
5. Keeping the beacon active, change the navigation input to the beacon to: 27° 2 min 36 sec North, 6° 3 min 24 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= D8A0C2 Bits 113-126= B09

Script	Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal)	BCH Correct (√)	Required Value of Encoded Location Bits (Hexadecimal)
6. Keeping the beacon active, change the navigation input to the beacon to: 25° 3 min 4 sec North, 179° 58 min 36 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= C8B67D Bits 113-126= 749
7. Keeping the beacon active, change the navigation input to the beacon to: 25° 3 min 4 sec North, 179° 58 min 4 Sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= C8B67D Bits 113-126= 77E
8. Keeping the beacon active, change the navigation input to the beacon to: 25° 3 min 4 sec North, 179° 55 min 52 Sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= C8967C Bits 113-126= 702
9. Keeping the beacon active, change the navigation input to the beacon to: 25° 3 min 4 sec North, 179° 59 min 56 Sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= C8967C Bits 113-126= 77E
10. Keeping the beacon active, change the navigation input to the beacon to: 25° 3 min 4 sec North, 179° 58 min 36 Sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= C8B67D Bits 113-126= 749

- END OF ANNEX D –

ANNEX E

SAMPLE PROCEDURE FOR TYPE APPROVAL TESTING OF 406 MHz BEACONS WITH VOICE TRANSCEIVER

The following sample procedure illustrates the guidelines provided in section C/S T.007, section A.3.7.2, concerning the testing of beacons with operator controlled ancillary devices. It is applicable to beacons with operator controlled voice transceivers but may need to be adapted for specific beacon designs. All other aspects of the testing, as documented in C/S T.007 are unchanged.

E.1 Beacon Voice Transceiver Configuration

The following requirements pertain to the configuration of the beacon voice transceiver for the duration of all testing:

a. if the beacon has a volume control setting, the beacon loudspeaker shall be set to maximum volume;

b. if the beacon includes a manual squelch mode, this shall be selected, and it shall be set to its most sensitive level;

c. if the beacon includes different transmitter power levels, the highest level shall be selected; and

d. any other manual settings shall be set to the mode which creates the highest load on the beacon battery.

E.2 Thermal Shock Test (C/S T.007, section A.2.2)

The beacon transceiver shall be operated as described below for the duration of the thermal shock test:

a. 5 Seconds (+/- 2.5 Seconds) before the first beacon burst to be measured, the voice transmitter shall transmit for 30 seconds, followed immediately by 30 seconds during which the beacon voice transmitter is not active. The receive mode shall be activated during the 30 seconds following the transmission cycle. This process shall be repeated for 15 minutes; and

b. thereafter, the transceiver shall be configured to repeat the following cycle, 3 times in succession, once each hour;

   i. transmit for 30 seconds,

   ii. followed by 30 seconds receiving.

E.3 Operating Lifetime at Minimum Temperature (C/S T.007, section A.2.3)

The beacon transceiver shall be operated as described below, for the duration of this test:

a. for the first 15 minutes of this test, the transceiver shall be operated as described at paragraph 2.a above;

b. 4 hours before the end of the test period the procedure described at paragraph 2.a above shall be repeated for 15 minutes; and

c. for the full duration of the test except the periods specified in paragraphs (a) and (b) above, the transceiver shall be operated to drain maximum energy from the battery.

E.4 Frequency Stability Test with Temperature Gradient (C/S T.007, section A.2.4)

The beacon transceiver shall be operated as described below, for the duration of this test:

a. the transceiver shall be operated as described at paragraph 2.b above for the duration of the test period; and

b. in addition, the transceiver shall be operated as described at paragraph 2.a above for one 15 minute period during which the temperature is rising, and for one 15 minute period during which the temperature is falling.

E.5 Satellite Qualitative Tests (C/S T.007, section A.2.5)

The beacon transceiver shall be operated as described at paragraph 2.a above for the entire duration that the beacon is in view of the satellite.

E.6 All Other Tests

For all other tests, the beacon transceiver shall be operated as described at paragraph 2.b above.

- END OF ANNEX E -

ANNEX F

BEACON TYPE APPROVAL TEST RESULTS

Table F.1: Overall Summary of 406 MHz Beacon Test Results

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			T_{min} (______C)	T_{amb} (______C)	T_{max} (______C)	
1. Power Output						
-transmitter power output	35-39	dBm				
-power output rise time	<5	ms				
-power output 1 ms before burst	<-10 dBm	√[1]				
2. Digital Message — Bits number						
-bit sync — 1-15	15 bits “1”	√				
-frame sync — 16-24	“000101111”	√				
-format flag — 25	1 bit	bit value				
-protocol flag — 26	1 bit	bit value				
-identification / position data — 27-85	59 bit	√				
-BCH code — 86-106	21 bits	√				
-emerg. code / nat. use / supplem. data — 107-112	6 bits	bit value				
-additional data / BCH (if applicable) — 113-144	32 bits	√				
-position error (if applicable)	<5	km				
3. Digital Message Generator						
-repetition rate T_R:						
• average T_R	48.5-51.5	sec				
• min T_R	$47.5 \leq T_R \leq 48.0$	sec				
• max T_R	$52.0 \leq T_R \leq 52.5$	sec				
• standard deviation	0.5-2.0	sec				
-bit rate:						
• min f_b	≥396	bit/sec				
• max f_b	≤404	bit/sec				
-total transmission time:						
• short message	435.6-444.4	ms				
• long message	514.8-525.2	ms				
-unmodulated carrier:						
• min T_1	≥158.4	ms				
• max T_1	≤161.6	ms				
-first burst delay	≥47.5	sec				

[1] Indicate that testing demonstrated conformance to requirements by placing the √ symbol in Table F.1.

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			T_{min} (______C)	T_{amb} (________C)	T_{max} (________C)	
4. Modulation						
-biphase-L		√				
-rise time	50-250	µsec				
-fall time	50-250	µsec				
-phase deviation: positive	+(1.0 to 1.2)	radians				
-phase deviation: negative	-(1.0 to 1.2)	radians				
-symmetry measurement	≤0.05	√				
5. 406 MHz Transmitted Frequency						
-nominal value	C/S T.001	MHz				
-short-term stability	$\leq 2x10^{-9}$	/100 ms				
-medium-term stability slope	$(-1 \text{ to } +1)x10^{-9}$	/min				
-medium-term stability residual frequency variation	$\leq 3x10^{-9}$					
6. Spurious Emissions into 50 Ohms (406.0 – 406.1 MHz)[1]	C/S T.001 mask	√				
7. 406 MHz VSWR Check						
-nominal transmitted frequency	C/S T.001	MHz				
-modulation rise time	50-250	µsec				
-modulation fall time	50-250	µsec				
-modulation phase deviation +ve	+(1.0 to 1.2)	radians				
-modulation phase deviation -ve	-(1.0 to 1.2)	radians				
-modulation symmetry measurement	≤0.05	√				
-digital message	correct	√				

[1] Include spectral plots of the 406.0-406.1 MHz band, showing the transmit signal and the emission mask as defined in document C/S T.001.

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
8. Self-test Mode				
-frame sync	"011010000"	√		
-format flag	1/0	bit value		
-single radiated burst	≤440/520 (+1%)	ms		
-default position data (if applicable)	must be correct	√		
-description provided		√		
-design data provided on protection against repetitive self-test mode transmissions		√		
-single burst verification	one burst	√		
-provides for 15 Hex ID	correct	√		
-121.5 MHz RF power (if applicable)	self-test checks that RF power emitted	√		
-406 MHz RF power	self-test checks that RF power emitted	√		
9. Thermal Shock[1]				
-soak temperature			T_{soak}=________°C	
-measurement temperature			T_{meas}=________°C	
the following parameters are to be met within 15 minutes of beacon turn on and maintained for 2 hours:				
-transmit frequency nominal value	C/S T.001	MHz		
-transmit frequency short-term stability	$\leq 2 \times 10^{-9}$	/100 ms		
-transmit frequency medium-term stability slope	$(-2 \text{ to } +2) \times 10^{-9}$	/min		
-transmit frequency medium-term stability residual frequency variation	$\leq 3 \times 10^{-9}$			
-transmitter power output	35-39	dBm		
-digital message	correct	√		

[1] Attach graphs depicting the test results.

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
10. Operating Lifetime at Minimum Temperature[1]				
-duration	>24		_____hours at T_{min}=_____	
-transmit frequency nominal value	C/S T.001	MHz		
-transmit frequency short-term stability	$\leq 2x10^{-9}$	/100ms		
-transmit frequency medium-term stability slope	$(-1 \text{ to } +1)x10^{-9}$	/min		
-transmit frequency medium-term stability residual frequency variation	$\leq 3x10^{-9}$			
-Pt_{EOL}=minimum transmitter power output observed during lifetime at minimum temperature	35-39	dBm		
-Digital message	correct	√		
11. Temperature Gradient (5 C/hr)[1]				
-transmit frequency nominal value	C/S T.001	MHz		
-transmit frequency short-term stability	$\leq 2x10^{-9}$	/100ms		
-transmit frequency medium-term stability				
• slope (A to B, C+15 to D and E+15 to F)	$(-1 \text{ to } +1)x10^{-9}$	/min		
• slope (B to C+15 and D to E+15)	$(-2 \text{ to } +2)x10^{-9}$	/min		
• residual frequency variation	$\leq 3x10^{-9}$			
-transmitter power output	35-39	dBm		
-digital message	correct	√		
12. Oscillator Aging (data provided)	C/S T.001	MHz		
13. Protection Against Continuous Transmission description provided	<45	sec		Provide description.
14. Satellite Qualitative Test (results provided)[2]	15 Hex ID provided by LUT and position within 5 km 80% of time	√		

[1] Attach graphs depicting test results.

[2] Attach a satellite qualitative test summary report (Appendix A to Annex F) for each test configuration.

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
15. Antenna Characteristics				
-polarization	linear or RHCP			
-VSWR	≤1.5			Report each Antenna Configuration Tested
-$EIRP_{LOSS}$		dB		
-$EIRP_{maxEOL}$	≤43	dBm		
-$EIRP_{minEOL}$	≥32	dBm		
-azimuth gain variation at 40° elevation angle	≤3	dB		
16. Beacon Coding Software[1]				
-sample message provided for each coding option of the applicable coding types	correct	√		Per Table F-D.1
-sample self-test message provided for each coding option of the applicable coding types	correct	√		Per Table F-D.1
17. Navigation System[2]				
-position data default values	correct	√		
-position acquisition time	<10/1	min		Per Table F-C.4 or Table F-C.5
-position accuracy	C/S T.001			
-encoded position data update interval	>20	min		
-position clearance after deactivation	cleared	√		Test per A.3.8.4
-position data input update interval (as applicable)	20/1	min		
-position data encoding	correct	√		Results per tables F-C.1, F-C.2 and F-C.3 as appropriate
-retained last valid position after navigation input lost	240(±5)	min		
-default position data transmitted after 240(±5) minutes without valid position data	cleared	√		Test per A.3.8.6
-information provided on protection against beacon degradation due to navigation device, interface or signal failure or malfunction		√		

[1] Attach examples of each requested coding option as per Appendix D to Annex F.

[2] Attach navigation system test results as per Appendix C to Annex F.

APPENDIX A TO ANNEX F

SATELLITE QUALITATIVE TEST SUMMARY REPORT

Date of the Test:____

Time of the Test:____

Beacon Model:____

Beacon 15 Hex ID:____

Actual location of the test beacon: Latitude:____ ___ ___; Longitude:____________

Beacon test configuration (e.g. on dry ground, floating in water, etc):____________

Satellite ID	Satellite Pass Number	Time of Closest Approach (TCA)	Cross Track Angle	15 Hex ID Provided by LUT	Doppler Location	Location Error (km)

$$\text{Ratio of successful solutions} = \frac{\text{number of Doppler solutions within 5 km with } 1^\circ < CTA < 21^\circ}{\text{number of satellite passes over test duration with } 1^\circ < CTA < 21^\circ} \times 100 = \_\_\_\_\%$$

Note: A separate table shall be provided for each beacon configuration tested.

APPENDIX B TO ANNEX F

406 MHz BEACON ANTENNA TEST RESULTS

Table F-B.1: Equivalent Isotropically Radiated Power (dBm) / Antenna Gain (dBi)
(To be used for reporting the results of antenna testing in configurations B.2, B.3 and B.4)

Azimuth Angle (degrees)	Elevation Angle (degrees)				
	10	20	30	40	50
0	/	/	/	/	/
30	/	/	/	/	/
60	/	/	/	/	/
90	/	/	/	/	/
120	/	/	/	/	/
150	/	/	/	/	/
180	/	/	/	/	/
210	/	/	/	/	/
240	/	/	/	/	/
270	/	/	/	/	/
300	/	/	/	/	/
330	/	/	/	/	/
Overall Gain Variation					

$EIRP_{LOSS} = Pt_{AMB} - Pt_{EOL}$ =__________dB

$EIRP_{max\ EOL}$ = **MAX [** $EIRP_{max}$ **,** $(EIRP_{max} - EIRP_{LOSS})$ **]** = **MAX (** _____ **,** _____ **)** = __________dBm

$EIRP_{min\ EOL}$ = **MIN [** $EIRP_{min}$ **,** $(EIRP_{min} - EIRP_{LOSS})$ **]** = **MIN (** _____ **,** _____ **)** = __________dBm

Table F-B.2: Induced Voltage Measurements V_v / V_h (dBuV)
(To be used for reporting the results of antenna testing in configurations B.2, B.3 and B.4)

Azimuth Angle (degrees)	Elevation Angle (degrees)				
	10	20	30	40	50
0	/	/	/	/	/
30	/	/	/	/	/
60	/	/	/	/	/
90	/	/	/	/	/
120	/	/	/	/	/
150	/	/	/	/	/
180	/	/	/	/	/
210	/	/	/	/	/
240	/	/	/	/	/
270	/	/	/	/	/
300	/	/	/	/	/
330	/	/	/	/	/
Min(V_v-V_h)					

Table F-B.3: Equivalent Isotropically Radiated Power (dBm) / Antenna Gain (dBi)
(To be used for reporting the results of antenna testing in Figure B.5 configuration)

Azimuth Angle (degrees)	Elevation Angle (degrees)				
	10	20	30	40	50
0	/	/	/	/	/
90	/	/	/	/	/
180	/	/	/	/	/
270	/	/	/	/	/

$EIRP_{LOSS}$ = Pt_{AMB} – Pt_{EOL} =__________dB

$EIRP_{max\ EOL}$ = **MAX [** $EIRP_{max}$ **,** ($EIRP_{max}$ – $EIRP_{LOSS}$) **] = MAX (** _____ **,** _____ **)** = __________dBm

$EIRP_{min\ EOL}$ = **MIN [** $EIRP_{min}$ **,** ($EIRP_{min}$ – $EIRP_{LOSS}$) **] = MIN (** _____ **,** _____ **)** = __________dBm

APPENDIX C TO ANNEX F

NAVIGATION SYSTEM TEST RESULTS

Table F-C.1: Position Data Encoding Results User-Location Protocol

Script Reference (See Table D.1)	Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal)	Confirmation that BCH Correct (√)
1	Bits 108-132=	
2	Bits 108 – 132= Number of seconds after providing navigation data that beacon transmitted the above encoded location information: ______	
3	Bits 108-132=	

Table F-C.2: Position Data Encoding Results Standard Location Protocol

Script Reference (See Table D.2)	Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal)	Confirmation that BCH Correct (√)
1	Bits 65-85= Bits 113-132=	
2	Bits 65-85= Bits 113-132= Number of seconds after providing navigation data that beacon transmitted the above encoded location information: ______	
3	Bits 65-85= Bits 113-132=	
4	Bits 65-85= Bits 113-132=	
5	Bits 65-85= Bits 113-132=	
6	Bits 65-85= Bits 113-132=	
7	Bits 65-85= Bits 113-132=	
8	Bits 65-85= Bits 113-132=	

Script Reference (See Table D.2)	Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal)	Confirmation that BCH Correct (√)
9	Bits 65-85= Bits 113-132=	
10	Bits 65-85= Bits 113-132=	

Table F-C.3: Position Data Encoding Results National Location Protocol

Script Reference (See Table D.3)	Value of Encoded Location Bits Transmitted by Beacon (Hexadecimal)	Confirmation that BCH Correct (√)
1	Bits 59-85= Bits 113-126=	
2	Bits 59-85= Bits 113-126= Number of seconds after providing navigation data that beacon transmitted the above encoded location information: ______	
3	Bits 59-85= Bits 113-126=	
4	Bits 59-85= Bits 113-126= =	
5	Bits 59-85= Bits 113-126=	
6	Bits 59-85= Bits 113-126=	
7	Bits 59-85= Bits 113-126=	
8	Bits 59-85= Bits 113-126=	
9	Bits 59-85= Bits 113-126=	
10	Bits 59-85= Bits 113-126=	

Table F-C.4: Position Acquisition Time and Position Accuracy (Internal Navigation Devices)

Operational Configuration	C/S T.007 Section A3.8.2.1		C/S T.007 Section A3.8.2.2	
	Time to Acquire Position (sec)	Location Error in metres	Time to Acquire Position (sec)	Location Error in metres
Floating in Water				
Resting on Dry Ground				
Other (specify)				

Table F-C.5: Position Acquisition Time and Position Accuracy (External Navigation Devices)

C/S T.007 Section A3.8.2.1		C/S T.007 Section A3.8.2.2	
Time to Acquire Position (sec)	Location Error in metres	Time to Acquire Position (sec)	Location Error in metres

APPENDIX D TO ANNEX F

BEACON CODING SOFTWARE RESULTS

Table F-D.1: Examples of User Protocol Beacon Messages
(Examples required for each protocol requested for inclusion on the type approval certificate)

Protocol	Operational Message (in hexadecimal including bit and frame synchronisation bits)	Self-Test Message (in hexadecimal including bit and frame synchronisation bits)
Maritime User Protocol with MMSI		
Maritime User Protocol with Radio Call Sign		
Radio Call Sign User Protocol		
Serial User: Float-Free EPIRB with Serial Number		
Serial User: Non Float-Free EPIRB with Serial Number		
Aviation User Protocol		
Serial User: ELT with Serial Number		
Serial User: ELT with Aircraft Operator Designator & Serial Number		
Serial User: ELT with Aircraft 24-bit address		
Serial User: PLB with Serial Number		
National User (Short)		
National User (Long)		

Table F-D.2: Examples of Location Protocol Beacon Messages
(Examples required for each protocol requested for inclusion on the type approval certificate)

Protocol	Operational Message (in hexadecimal including bit and frame synchronisation bits)		Self-Test Message (in hexadecimal including bit and frame synchronisation bits)
	Location "A"[1]	Location "B"[1]	
Standard Location: EPIRB with MMSI			
Standard Location: EPIRB with Serial Number			
Standard Location: ELT with 24-bit Address			
Standard Location: ELT with Serial Number			
Standard Location: ELT with Aircraft Operator Designator			
Standard Location: PLB with Serial Number			
National Location: EPIRB			
National Location: ELT			
National Location: PLB			
User-Location[2]			

- END OF ANNEX F -

1 Location "A" and location "B" must be separated by at least 500 metres for the Standard and National location protocols, and by at least 10 km for the User-Location protocol.

2 Conformance of User-Location protocol demonstrated by a single example of "A", "B", and self-test messages provided in Table F-D.2 supplemented by Table F-D.1 completed with the specific User protocol variations requested.

ANNEX G

APPLICATION FOR A COSPAS-SARSAT 406 MHz BEACON TYPE APPROVAL CERTIFICATE

G.1 INFORMATION PROVIDED BY THE BEACON MANUFACTURER

Beacon Manufacturer and Beacon Model

Beacon Manufacturer	
Beacon Model	

Beacon Type and Operational Configurations

Beacon Type	Beacon used while:	Tick where appropriate
EPIRB	Floating in water or on deck or in a safety raft	
PLB	On ground and above ground	
	On ground and above ground and floating in water	
ELT Survival	On ground and above ground	
	On ground and above ground and floating in water	
ELT Auto Fixed	Fixed ELT with aircraft external antenna	
ELT Auto Portable	In aircraft with an external antenna	
	On ground, above ground, or in a safety raft with an integrated antenna	
ELT Auto Deployable	Deployable ELT with attached antenna	
Other (specify)		

Beacon Characteristics

Characteristic	**Specification**
Operating temperature range	Tmin =______ Tmax=______
Operating lifetime	_______hours
Battery chemistry	
Battery cell size and number of cells	
Battery manufacturer	
Battery pack manufacturer and part number	
Oscillator type (e.g. OCXO, MCXO, TCXO)	
Oscillator manufacturer	
Oscillator part name and number	
Oscillator satisfies long-term frequency stability requirements (Yes or No)	
Antenna type (Integrated or External)	
Antenna manufacturer	
Antenna part name and number	
Navigation device type (Internal, External or None)	
Features in beacon that prevent degradation to 406 MHz signal or beacon lifetime resulting from a failure of navigation device or failure to acquire position data (Yes, No, or N/A)	
Features in beacon that ensures erroneous position data is not encoded into the beacon message (Yes, No or N/A)	
Navigation device capable of supporting global coverage (Yes, No or N/A)	

Characteristic	**Specification**
For Internal Navigation Devices	
- Geodetic reference system (WGS 84 or GTRF)	
- GNSS receiver cold start forced at every beacon activation (Yes or No)	
- Navigation device manufacturer	
- Navigation device model name and part Number	
- GNSS system supported (e.g. GPS, GLONASS, Galileo)	
For External Navigation Devices	
- Data protocol for GNSS receiver to beacon interface	
- Physical interface for beacon to navigation device	
- Electrical interface for beacon to navigation device	
- Navigation device model and manufacturer (if beacon designed to use specific devices)	
Self-Test Mode Characteristics	
- Self-test has separate switch position (Yes or No)	
- Self-test switch automatically returns to normal position when released (Yes or No)	
- Self-test activation can cause an operational mode transmission (Yes or No)	
- Self-test causes a single beacon self-test message burst only regardless of how long the self-test activation mechanism applied (Yes or No)	
- Results of self-test indicated by (e.g. Pass / Fail Indicator Light, Strobe Light, etc.)	
- Self-test can be activated from beacon remote activation points (Yes or No)	

Characteristic	**Specification**
- Self-test performs an internal check and indicates that RF power emitted at 406 MHz and 121.5 MHz if beacon includes a 121.5 MHz homer (Yes or No)	
- Self-test transmits a signal(s) other than at 406 MHz (Yes & details or No)	
- Self-test can be activated directly at beacon (Yes or No)	
- List of Items checked by self-test	
- Self-test transmission burst duration (440 or 520 ms)	
- Self-test format bit (“0” or “1”)	
Beacon includes a homer transmitter (if yes identify frequency of transmission)	________MHz
-Homer Transmit Power	________dBm
-Homer Duty Cycle	________%
-Duty Cycle of Homer Swept Tone	________%
Beacon includes a strobe light (Yes or No)	
- Strobe light intensity	
- Strobe light flash rate	
Beacon transmission repetition period satisfies C/S T.001 requirement that two beacon’s repetition periods are not synchronised closer than a few seconds over 5 minute period, and the time intervals between transmissions are randomly distributed on the interval 47.5 to 52.5 seconds (Yes or No)	
Other ancillary devices (e.g. voice transceiver). List details on a separate sheet if insufficient space to describe.	
Beacon includes automatic activation mechanism (Yes or No)	

Dated:...................... Signed:..
(Name, Position and Signature of Beacon Manufacturer Representative)

(Continued on Next Page)

G.2 INFORMATION PROVIDED BY THE COSPAS-SARSAT ACCEPTED TEST FACILITY

Name and Location of Beacon Test Facility: ____

Date of Submission for Testing: ____

Applicable C/S Standards:

Document	Issue	Revision
C/S T.001		
C/S T.007		

I hereby confirm that the 406 MHz beacon described above has been successfully tested in accordance with the Cospas-Sarsat 406 MHz Beacon Type Approval Standard (C/S T.007) and complies with the Specification for Cospas-Sarsat 406 MHz Distress Beacons (C/S T.001) as demonstrated in the attached report.[1]

Dated:........................ Signed:..
(Name, Position and Signature of Cospas-Sarsat Accepted Test Facility Representative)

– END OF ANNEX G –

1 If the test results do not support full compliance to the above standards, the test laboratory shall modify this statement to identify discrepancies. A complete explanation of such discrepancies should be provided in the test report and the report references identified in this statement.

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ANNEX H

CHANGE NOTICE FORM

The Manufacturer of the Cospas-Sarsat Type Approved 406 MHz Distress Beacons:

Manufacturer: ______________________________

(name and address) ______________________________

____

406 MHz Beacon Model numbers: ______________________________

Cospas-Sarsat Type Approval Certificate Numbers:______________________________

Proposed New Model Numbers Beacon:______________________________

hereby informs Cospas-Sarsat of the following changes to production beacons

planned date of change ______________

Oscillator type: _____

Battery: _____ (specify): ________

Antenna type: _____

Homing transmitter: _____

Strobe light: _____

Size or shape of beacon package: _____

Other physical characteristics: _____(specify): ______________________

Significant change to circuit design: _____

Internal navigation device: _____(specify): ______________________

Other _____(specify): ______________________

and substantiates these changes with the attached technical documentation and beacon test results (if applicable).

I hereby confirm that with these changes the above 406 MHz beacon models are technically equivalent to the type approved beacon and continue to meet the Cospas-Sarsat requirements.

Dated:...................... Signed:...

(Name, Position and Signature of Beacon Manufacturer Representative)

-END OF ANNEX H-

ANNEX I

DESIGNATION OF ADDITIONAL NAMES OF A COSPAS-SARSAT TYPE APPROVED 406 MHz BEACON MODEL

The Manufacturer of the following Cospas-Sarsat Type Approved 406 MHz Distress Beacon:

Beacon Manufacturer: ____
(name and address)

____

____

406 MHz Beacon model: ____

having Cospas-Sarsat Type Approval Certificate Number: ____________________

hereby informs Cospas-Sarsat that the above beacon will also be sold as:

Additional name and model number of beacon: __________________________

by Agent/Distributor:
(name and address) ____

telephone: ____

fax: ____

contact person/title: ____

I certify that we have an agreement with this agent/distributor to market the above-referenced 406 MHz beacon, which we will manufacture and which will be identical to the Cospas-Sarsat type approved beacon, except for labelling.

Dated:...................... Signed:...

(Name, Position and Signature of Beacon Manufacturer Representative)

- END OF ANNEX I -

ANNEX J

APPLICATION FOR TESTING SEPARATED ELT ANTENNA(S) AT AN INDEPENDENT ANTENNA TEST FACILITY

The Manufacturer of the Cospas-Sarsat Type Approved 406 MHz Distress Beacons:

Manufacturer: ______________________________

(name and address) ______________________________

____

applies to test ELT antennas: ______________________________

____

at antenna test facility: ______________________________

located at: ______________________________

Dated:...................... Signed:..

(Name, Position and Signature of ELT Manufacturer Representative)

DECLARATION OF COSPAS-SARSAT REPRESENTATIVE FOR THE COUNTRY WHERE THE ANTENNA TEST FACILTY IS LOCATED:

I hereby confirm that the operation of the antenna test facility mentioned above is independent from the 406 MHz beacon manufacturer who is submitting this application.

Dated:...................... Signed:..

(Name and Signature of Cospas-Sarsat Representative)

- END OF ANNEX J -

ANNEX K

REQUEST TO EXCLUDE ELT ANTENNA(S) FROM THE COSPAS-SARSAT SECRETARIAT LIST OF ELT ACCEPTED ANTENNAS

The Manufacturer of the Cospas-Sarsat 406 MHz ELT:

Manufacturer: ______________________________

(name and address) ______________________________

____

requests that the following ELT antenna(s), designed by us:

____

____

(model, part number)

used with the 406 MHz ELT: ______________________________

not be included in the Cospas-Sarsat Secretariat list of accepted ELT antennas

Dated:........................ Signed:...

(Name, Position and Signature of ELT Manufacturer Representative)

- END OF ANNEX K –

ANNEX L

BEACON QUALITY ASSURANCE PLAN

We, manufacturer of Cospas-Sarsat 406 MHz beacons (Manufacturer name and address)

____

____

confirm that ALL PRODUCTION UNITS of the following beacon model(s),

____

(model, part number)

will meet the Cospas-Sarsat specification and technical requirements in a similar manner to the units subjected for type approval testing. To this effect all production units will be subjected to following tests at ambient temperature:

- Digital message
- Bit rate
- Rise and fall times of the modulation waveform
- Modulation Index (positive/negative)
- Output power
- Frequency stability (short, medium)*

Note*: Beacon manufacturer shall provide technical data on the beacon frequency generation to demonstrate that the frequency stability tests at ambient temperature are sufficient for ensuring that each production beacon will exhibit frequency stability performance similar to the beacon submitted for type approval over the complete operating temperature range. If such assurance of adequate performance over the complete operating temperature range cannot be deduced from the technical data provided and the frequency stability test results at ambient temperature, a thermal gradient test shall be performed on all production units.

- Other tests:

____

____

____

____

____

We confirm that the above tests will be performed as appropriate to ensure that the complete beacon satisfies Cospas-Sarsat requirements, as demonstrated by the test unit submitted for type approval.

We agree to keep the test result sheet of every production beacon for inspection by Cospas-Sarsat, if required, for a minimum of 10 years.

We confirm that Cospas-Sarsat representative(s) have the right to visit our premises to witness the production and testing process of the above-mentioned beacons. We understand that the cost related to the visit is to be borne by Cospas-Sarsat.

We also accept that, upon official notification of Cospas-Sarsat, we may be required to re-submit a unit of the above beacon model selected by Cospas-Sarsat for the testing of parameters chosen at Cospas-Sarsat discretion at a Cospas-Sarsat accepted test facility selected by the Cospas-Sarsat. We understand that the cost of the testing shall be borne by Cospas-Sarsat.

We understand that the Cospas-Sarsat Type Approval Certificate is subject to revocation should the beacon type for which it was issued, or its modifications, cease to meet the Cospas-Sarsat specifications, or Cospas-Sarsat has determined that this quality assurance plan is not implemented in a satisfactory manner.

Dated:...................... Signed:..

(Name, Position and Signature of Beacon Manufacturer Representative)

- END OF ANNEX L –

ANNEX M

TYPE APPROVAL CERTIFICATE

For a 406 Megahertz Distress Beacon for use with the Cospas-Sarsat Satellite System

Certificate Number: …xxx

Manufacturer:	The ABC Beacon Company, London, UK
Beacon Type(s):	EPIRB
Beacon Model(s):	ABC-406
Test Laboratory:	Intespace, Toulouse, France
Date of Test:	January 2005

Details of the beacon features and battery type are provided overleaf.

The Cospas-Sarsat Council hereby certifies that the 406 MHz Distress Beacon Model identified above is compatible with the Cospas-Sarsat System as defined in documents:

C/S T.001 Specification for Cospas-Sarsat 406 MHz Distress Beacon
Issue 3 – Rev. 6, October 2004

C/S T.007 Cospas-Sarsat 406 MHz Distress Beacon Type Approval Standard
Issue 4 , November 2005

Date Originally Issued: 10 March 2005

Date(s) Amended:

D. Levesque
Head of Cospas-Sarsat Secretariat

NOTE, HOWEVER:

1. This certificate does not authorize the operation or sale of any 406 MHz distress beacon. Such authorization may require type acceptance by national administrations in countries where the beacon will be distributed, and may also be subject to national licensing requirements.

2. This certificate is intended only as a formal notification to the above identified manufacturer that the Cospas-Sarsat Council has determined, on the basis of test data of a beacon submitted by the manufacturer, that 406 MHz distress beacons of the type identified herein meet the standards for use with the Cospas-Sarsat System.

3. Although the manufacturer has formally stated that all beacons identified with the above model name(s) will meet the Cospas-Sarsat specification referenced above, this certificate is not a warranty and Cospas-Sarsat hereby expressly disclaims any and all liability arising out of or in connection with the issuance, use or misuse of the certificate.

4. This certificate is subject to revocation by the Cospas-Sarsat Council should the beacon type for which it is issued cease to meet the Cospas-Sarsat specification. A new certificate may be issued after satisfactory corrective action has been taken and correct performance demonstrated in accordance with the Cospas-Sarsat Type Approval Standard.

5. Cospas-Sarsat type approval testing requirements only address the electrical performance of the beacon at 406 MHz. Conformance of the beacon to operational and environmental requirements is the responsibility of national administrations.

Certificate Number: …xxx **Dated: …xxx**

Operating temperature range: -20°C to +55°C

Battery Details: xxx Battery Company, type 123 (4 D-cells)
Battery chemistry

Operating Lifetime: 48 hours

Transmit Frequency: 406.028 MHz

Beacon Model Features:

- 121.5 MHz auxiliary radio locating device (50 mW, continuous)
- Automatic activation mechanism
- Strobe light (0.75 cd, 20 flashes/min)
- Internal navigation device (GPS): manufacturer: YY, model ZZZ
- Self-test mode: one burst of 520 ms

Approved Beacon Message Protocols: Beacon is approved for use with the beacon message protocols blackened below:

USER PROTOCOLS

- ■ Maritime with MMSI
- ■ Maritime with Radio Call Sign
- ■ EPIRB Float Free with Serial Number
- ■ EPIRB Non Float Free with Serial Number
- ■ Radio Call Sign
- □ Aviation
- □ ELT with Serial Number
- □ ELT with Aircraft Operator and Serial Number
- □ ELT with Aircraft 24-bit Address
- □ PLB with Serial Number
- □ National (Short Format Message)
- □ National (Long Format Message)

USER-LOCATION PROTOCOLS

- ■ Maritime with MMSI
- ■ Maritime with Radio Call Sign
- ■ EPIRB Float Free with Serial Number
- ■ EPIRB Non Float Free with Serial Number
- ■ Radio Call Sign
- □ Aviation
- □ ELT with Serial Number
- □ ELT with Aircraft Operator and Serial Number
- □ ELT with Aircraft 24-bit Address
- □ PLB with Serial Number

LOCATION PROTOCOLS

- ■ Standard Location: EPIRB with MMSI
- ■ Standard Location: EPIRB with Serial Number
- □ Standard Location: ELT with 24-bit Address
- □ Standard Location: ELT with Aircraft Operator Designator
- □ Standard Location: ELT with Serial Number
- □ Standard Location: PLB with Serial Number
- ■ National Location: EPIRB
- □ National Location: ELT
- □ National Location: PLB

-END OF ANNEX M

-END OF DOCUMENT-

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