COSPAS-SARSAT
406 MHz DISTRESS BEACON
TYPE APPROVAL STANDARD

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COSPAS SARSAT

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

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

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

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

- ITU-R M.633, "Transmission characteristics of a satellite emergency position-indicating radio beacon (satellite EPIRB) system operating through a low polar-orbiting 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:

- beacon signals are compatible with system receiving and processing equipment;
- beacons to be deployed do not degrade nominal system performance; and
- 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).

2.3 Type Approval Certificate

A Cospas-Sarsat Type Approval Certificate (see sample in Annex D) 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 should be used for testing of beacons intended to be encoded with user-location protocol.

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 should also include:

a) written confirmation by the Cospas-Sarsat Representative of the country where the facility is located (see Annex H) 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, should be completed with VSWR measurement as described at Annex B, and satellite qualitative tests using a type approved ELT or the ELT submitted for type approval as described at Annex A.

- 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* type approval tests (see Annex C);

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;

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.

* NOTE: Cost of the testing is to be borne by the manufacturer.

4.3 Test Units

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 should 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 A3.7, while in an environmental test chamber. The means to operate these devices in an automated and programmable way should 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:

- 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.

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

- 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 should be presented on the forms shown in Annex C 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 modes of operation shall have their 406 MHz characteristics measured in each operating mode. The mode that draws maximum battery energy shall be tested to the full range of the test requirements. If any other operating mode exhibits a pulse load which is greater than the mode that draws maximum battery energy, this mode shall also undergo the operating lifetime test. Approved measurement methods are described in Annexes A and B 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 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 A3.7.2. A typical procedure for a beacon with a voice transceiver is provided at Annex G 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.

- END OF SECTION 4 -

5. TECHNICAL DATA

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

a) an application form (page C-1) for a Cospas-Sarsat Type Approval Certificate, listing details of beacon, 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;

b) beacon operating instructions and a technical data sheet;

c) brochure or photograph of the beacon;

d) statement of the specified operating temperature range of the beacon (maximum and minimum temperatures) (see Annex C);

e) descriptions, complete with diagrams as necessary, to demonstrate that the design:

- meets the requirement that the probability of any two beacons having an identical repetition period sequence is less than 0.001 (see section A3.1.1),
- provides protection against continuous transmission (see section A3.4),
- meets the frequency stability requirements over 5 years (see section A3.5),
- provides protection from repetitive self-test mode transmissions (see section A3.6);

f) a technical description and analysis of the matching network supplied for testing purposes per section A.1;

g) a list of the special features in the beacon (homer, strobe light, etc., see Annex C);

h) a description of the "self-test" mode (see Annex C);

i) a complete description of the power source, including, battery manufacturer's name(s), cell manufacturer name, cell chemistry, number and type of cells, and electric diagram of the battery pack;

j) the technical data sheet of the reference oscillator, including oscillator type and specifications;

k) a summary of test results of the beacon and antenna, with supporting test data, graphs and tables, as designated in Annexes A, B and C;

l) a print out of sample messages generated by the beacon coding software providing the beacon 15 Hex ID, for each coding option applicable to that beacon model with encoded identification representative of a real ID (e.g. not all “1” or “0”) for the nominal and the self-test modes (see Annex C, Table C2, section 16);

m) for beacons with internal navigation device a statement that GNSS cold start is forced at every beacon activation (self-test, nominal), i.e. that no time dependent or position dependent data is stored in the memory of the GNSS device;

n) for beacons designed to transmit encoded position data, technical data showing that the design incorporates a protection mechanism to ensure the 406 MHz signal is not degraded by a malfunction of the navigation device or a failure of the navigation device to acquire valid data;

o) for beacons designed to transmit encoded position data, sample messages to demonstrate correct position data encoding, including initial coarse position, the delta offset, and overrange limits in the positive and negative direction (see section A3.8.7);

p) a copy of the beacon label;

q) 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 I); and

r) the beacon quality assurance plan (see Annex J).

For separated ELT antennas, the test results requested under (k) above may be replaced by a reference to the proper entry in the Secretariat-maintained list of accepted antennas*, along with an analysis showing that the ERP of the beacon-antenna combination would be within the limits specified in Section B10 of Annex B. The analysis must address the actual measured beacon output power and power loss factor. This does not modify the requirement for the provision of a full operational configuration defined in section 4.3 and for performing and reporting the satellite tests and VSWR tests.

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* Note: The measurement results of parameters for antennas included in the Secretariat list are kept on file at the Cospas-Sarsat Secretariat and are available upon request.

- END OF SECTION 5 -

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 Future Changes

The manufacturer must advise the Cospas-Sarsat Secretariat (see Annex E) of any future changes to the design or production of the beacon or power source, which might affect beacon 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 and /or an internal navigation device (such as a GPS or GLONASS engine) has been successfully tested at a Cospas-Sarsat test facility, and type approved by Cospas-Sarsat, subsequent upgrades to that battery or navigation device 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 or the internal navigation device after the beacon has been Cospas-Sarsat type approved, the change notice form in Annex E must be completed and submitted to the Secretariat, together with factory test data confirming that the substitute battery or navigation device is at least technically equivalent to that used when the beacon was type approved.

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

6.2.1 Alternative Batteries

6.2.1.1 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 are:

i) electrical tests at the three constant temperatures (maximum, minimum and ambient), excluding spurious output, VSWR and self-test (section A2.1);

ii) thermal shock test (section A2.2); and

iii) operating lifetime at minimum temperature (section A2.3).

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

6.2.1.2 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 are:

i) electrical tests at ambient temperature excluding digital message, digital message generator, modulation, spurious output, VSWR check, self-test mode (section A2.1); and

ii) operating lifetime at minimum temperature, excluding digital message (section A2.3).

In both cases the beacon manufacturer shall also provide a written confirmation that the general performance of the 406 MHz beacon is not degraded using the alternative battery, and that the alternative battery is at least technically equivalent to the battery in the beacon originally type approved.

6.2.2 Alternative Internal Navigation Device

For a change to the internal navigation device, the beacon manufacturer shall provide test and analysis results confirming that:

i) the load on the beacon battery will not be more than when the beacon was initially type approved;

ii) the interface between the navigation device and the beacon is still compatible; and

iii) the performance of the 406 MHz beacon is not degraded.

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

6.3.1 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:

i) electrical tests at ambient and maximum temperatures but excluding modulation, spurious output, and VSWR check (section A2.1);

ii) operating lifetime at minimum temperature (sectionA2.3);

iii) navigation system test (section A2.7); and

iv) beacon coding software (item 16 of Table C2).

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

6.3.2 In the case of a subsequent change of the beacon navigation interface unit, the beacon manufacturer shall provide tests and analysis results confirming that:

i) the load on the beacon battery will not be more than when the beacon was initially type approved;

ii) the interface between the navigation device and the beacon is still compatible; and

iii) the performance of the 406 MHz beacon is not degraded.

6.4 Changes to Frequency Generation

6.4.1 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.

6.4.1.1 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 should include:

- measurement of absolute value of the beacon 406 MHz transmitted carrier frequency at ambient temperature.

6.4.1.2 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 should include (with reference to Table C2):

- item 5: 406 MHz transmitted frequency,
- item 9: thermal shock, except transmitted power and digital message,
- item 11: temperature gradient, except transmitted power and digital message.

6.4.1.3 In both cases (6.4.1.1 and 6.4.1.2 above) the technical file should be submitted to the Secretariat including at least the following:

a) a change notice form (E1) specifying the details of frequency generation change;

b) the measurement results of required tests; and

c) a technical data sheet describing the oscillator, including:
   - oscillator type
   - oscillator specifications
   - 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.

6.4.2 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 should be re-tested at a Cospas-Sarsat accepted facility.

The testing should include (with reference to Table C2):

- item 5: 406 MHz transmitted frequency,
- item 9: thermal shock,
- item 10: operating lifetime at minimum temperature,
- item 11: temperature gradient, except transmitted power and digital message,

[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.

- item 12: long term frequency stability,
- item 14: satellite qualitative tests.

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

a) application form (page C-1) for Cospas-Sarsat Type Approval Certificate, listing details of beacon, the details of frequency generation change 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;

b) beacon technical data sheet;

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

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

e) the measurement results as specified above; and

f) technical data sheet describing the oscillator, including
   - oscillator type,
   - oscillator specifications.

6.5 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 F of this document should be completed and sent to the Secretariat.

- END OF SECTION 6 -

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

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ANNEX A

BEACON MEASUREMENT SPECIFICATIONS

A1 GENERAL

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

All measurements must 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 should 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 must be capable of:

- 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);
- determining the instantaneous phase of the output signal and making amplitude and timing measurements of the phase waveform;
- interpreting the phase modulation to determine the value of the encoded data bits;
- measuring the frequency of the output signal;
- producing gating signals synchronized with various features of the signal modulation;
- maintaining the beacon under test at specified temperatures and temperature gradients while performing all other functions stated;
- providing appropriate navigation input signals, if applicable; and
- measuring the radiated power level, as described in Annex B.

A suggested sequence for performing the tests described herein is shown in Table C2 of Annex C, but the tests may be performed in any other convenient sequence. The test results are to be summarized and reported as shown in Annex C, with appropriate graphs attached as indicated.

A2 TESTS REQUIRED

A2.1 Electrical and Functional Tests at Constant Temperature (test no. 1 to 8 in Annex C)

The tests specified in para. A3.1 through para. A3.3 (except A3.2.2.3, 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:

- transmitter power output, per para. A3.2.2 (except A3.2.2.3 antenna tests)
- digital message, per para. A3.1.4
- digital message generator, per para. A3.1, A3.1.1, A3.1.2 and A3.1.3
- modulation, per para. A3.2.3
- transmitted frequency, per para. A3.2.1
- spurious output, per para. A.3.2.2.4
- VSWR check, per para. A3.3
- self-test mode, per para. A3.6

A2.2 Thermal Shock Test (test no. 9 in Annex C)

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:

- transmitted frequency, per para. A3.2.1
- transmitter power output, per para. A3.2.2.1
- digital message, per para. A3.1.4

Frequency measurements are made continually for two hours. Stability analysis is performed for these frequency samples as in para. A3.2.1. 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. A3.2.2.1 and digital message checks per para. A3.1.4 are also made continually throughout the two-hour period.

A2.3 Operating Lifetime at Minimum Temperature (test no. 10 in Annex C)

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:

- transmitted frequency, per para. A3.2.1
- transmitter power output, per para. A3.2.2.1
- digital message, per para. A3.1.4

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 should be performed with a long format message.

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. To accomplish this, the lifetime test of a beacon with its circuits powered from the beacon battery prior to beacon activation should be performed with a fresh battery pack which has been discharged to take into account:

a) 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 (see note);

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

c) a correction coefficient of 1.65 (applied to item a and item b) 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.

Note: The beacon manufacturer should 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 should be verified by the testing laboratory, using an integrating charge meter which measures the total charge delivered to the inactivated test beacon in conjunction with the active circuits, over a sufficient period of time (supplied by the beacon manufacturer). This total measured charge, divided by the time recorded for the charge measurement, is the average current drain on the battery over the measurement time period which should be prorated to the rated life of the battery pack. The duration of the average current drain measurement should be defined by the testing laboratory.

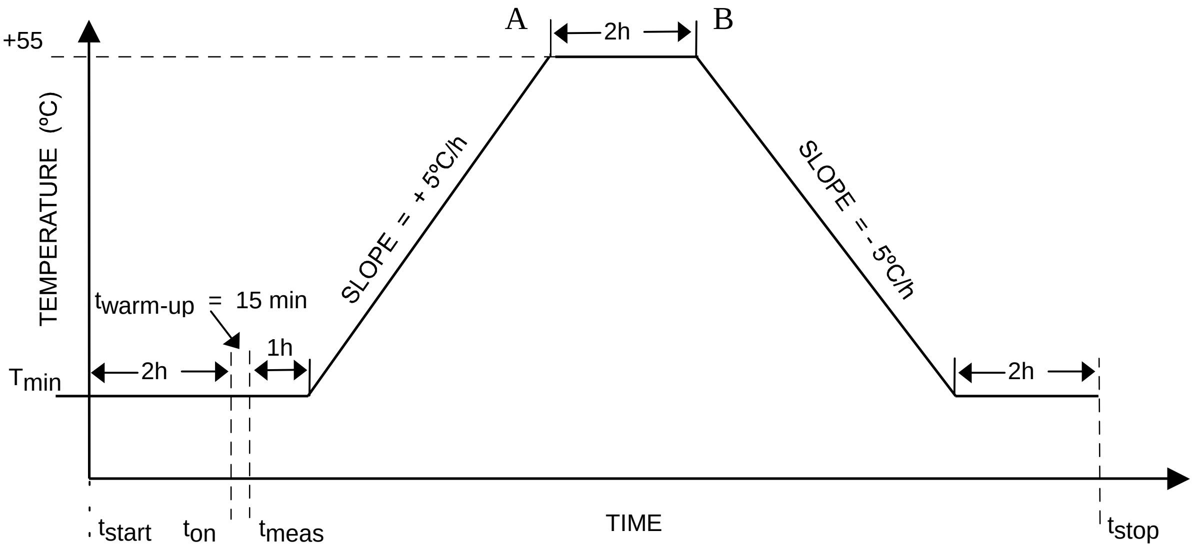
A2.4 Frequency Stability Test with Temperature Gradient (test no. 11 in Annex C)

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 A1 below, during which time the following tests are performed continually on each burst:

- transmitted frequency, per para. A3.2.1
- transmitter power output, per para. A3.2.2.1
- digital message, per para. A3.1.4

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 are performed. The up-ramp test is from t_{start} to point B (see Figure A1) and the down-ramp test is from point A to t_{stop}. Before point A 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.



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)

Figure A1: Temperature gradient showing points A, B, t_{start} and t_{stop}

A2.5 Satellite Qualitative Tests (test no. 14 in Annex C)

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 is to be performed in an environment which approximates, as closely as practicable, the intended use of the beacon.

The test beacon must have its own antenna connected and must be coded with a test protocol of appropriate type and format (see sections 4.3 and A3.1.4). The beacon is operated in the open during at least 3 satellite passes and downlink data is checked for correctness of:

- location data computed by the LUT
- digital message, per para. A3.1.4

The beacon must be successfully located and identified by a Cospas-Sarsat LEOLUT. Successful completion of this test is to be indicated by a "√" in the Table C2 of Annex C, and a summary of the results is to be attached to the Table.

A2.6 Beacon Antenna Test (test no. 15 in Annex C)

The beacon antenna test, described in section A3.2.2.3 and Annex B, is performed at the ambient temperature of the test facility and a correction factor is applied to the data to calculate the radiated power at minimum temperature at the end of the operating lifetime. This test must be performed using the non-modified test beacon, including the navigation antenna, if applicable.

A2.7 Navigation System Test, if Applicable (test no. 17 in Annex C)

For beacons incorporating the optional capability to transmit encoded position data, some additional tests, described in section A3.8, 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. 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. The beacon output digital message is monitored during all tests, as described in section A3.1.4.

A2.8 Additional Protocols (test no. 18 in Annex C)

If the beacon is capable of operating with protocol types not tested under A2.1, A2.2, A2.3, A2.4, and A2.5, the digital message for each protocol type shall be verified at ambient temperature according to A3.1.4. These should also include the self-test mode.

For location protocols verification of 2 messages with encoded position data is required, the second message shall be provided with encoded position at least 5 km from the first position. The verification of the digital message does not require a change of location of the beacon.

A3 MEASUREMENT METHODS

A3.1 Message Format and Structure

The repetition period T_R and the duration of the unmodulated carrier T_1 are illustrated in Figure A2. (Note: many of the following measurements can be performed on the same set of 18 bursts.)

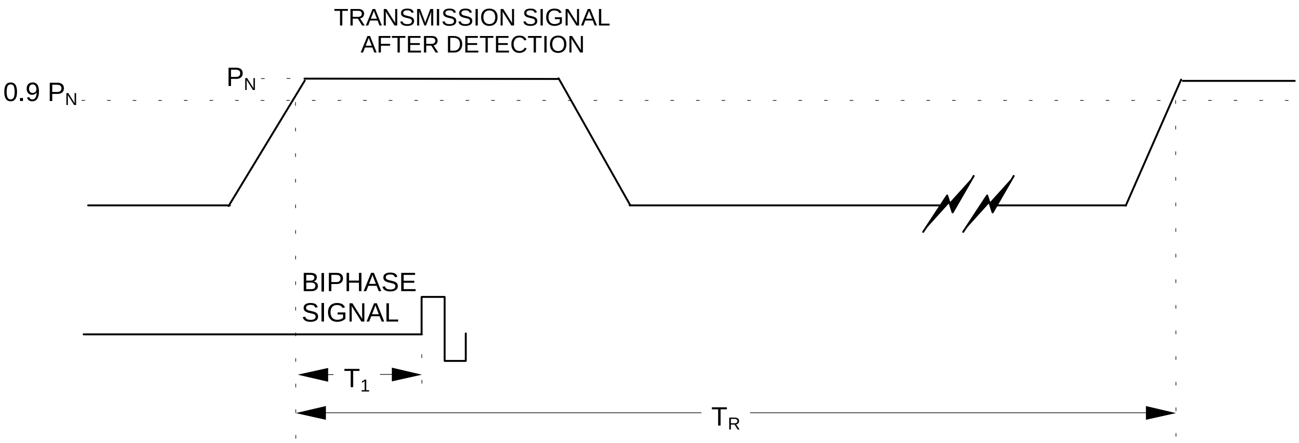


Figure A2 : Transmission Timing

A3.1.1 Repetition Period

The repetition period, T_R , between the beginnings of two successive transmissions (see Figure A2) 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 1 second. 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 standard deviation, average, maximum and minimum values of T_R are to be recorded in the Table C2 of Annex C.

Additionally, the manufacturer shall show by analysis that the probability of any two of the manufacturer's beacons having an identical T_R sequence is less than 0.001.

A3.1.2 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 A2) shall satisfy the following relationship, where the values are derived from 18 successive measurements, and all values must be such that:

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

The maximum and minimum values of T_1 are to be recorded in the Table C2 of Annex C.

A3.1.3 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 relationship, where the values of f_b are derived from 18 successive measurements and all values must be such that:

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

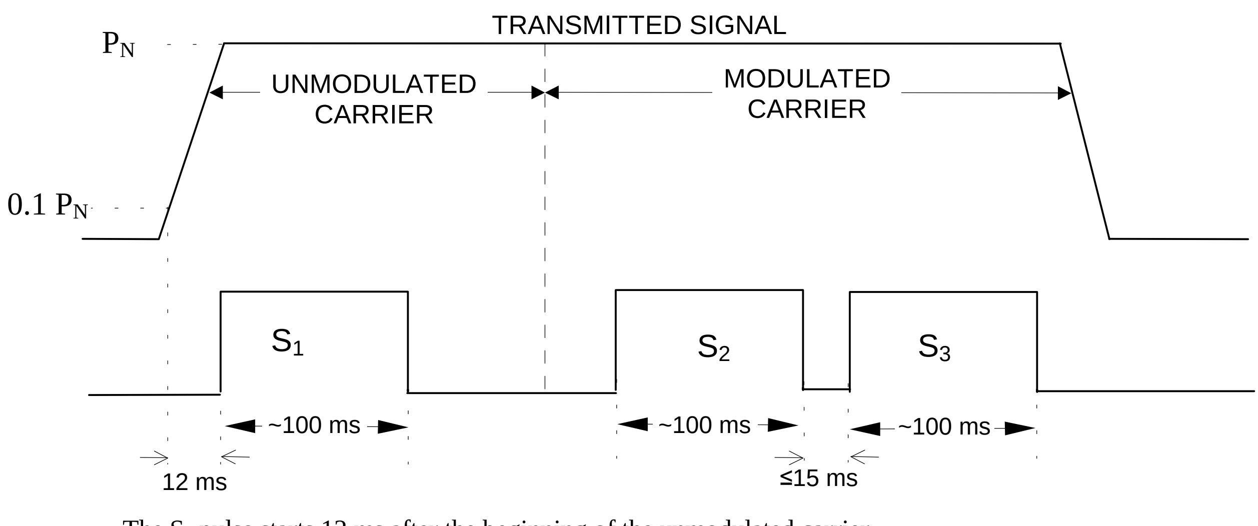
The maximum and minimum values of f_b are to be recorded in the Table C2 of Annex C.

A3.1.4 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 for the protocol selected according to section 4.3.

A3.2 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 A3 : Definition of Measurement Intervals

A3.2.1 Transmitted Frequency

Frequency measurements are 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 A3.

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

A3.2.1.1 Nominal Value

The mean transmission frequency, f_0, is 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

A3.2.1.2 Short-Term Stability

The short-term frequency stability is derived from measurements* 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.

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* Note: 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 A3, hence these intervals are only approximately 100 ms duration.

A3.2.1.3 Medium-Term Stability

The medium-term frequency stability is derived from measurements of $f_i^{(2)}$ made over 18 successive transmissions at instants t_i (see Figure A4).

For a set of n measurements*, 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:

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

where n=18

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

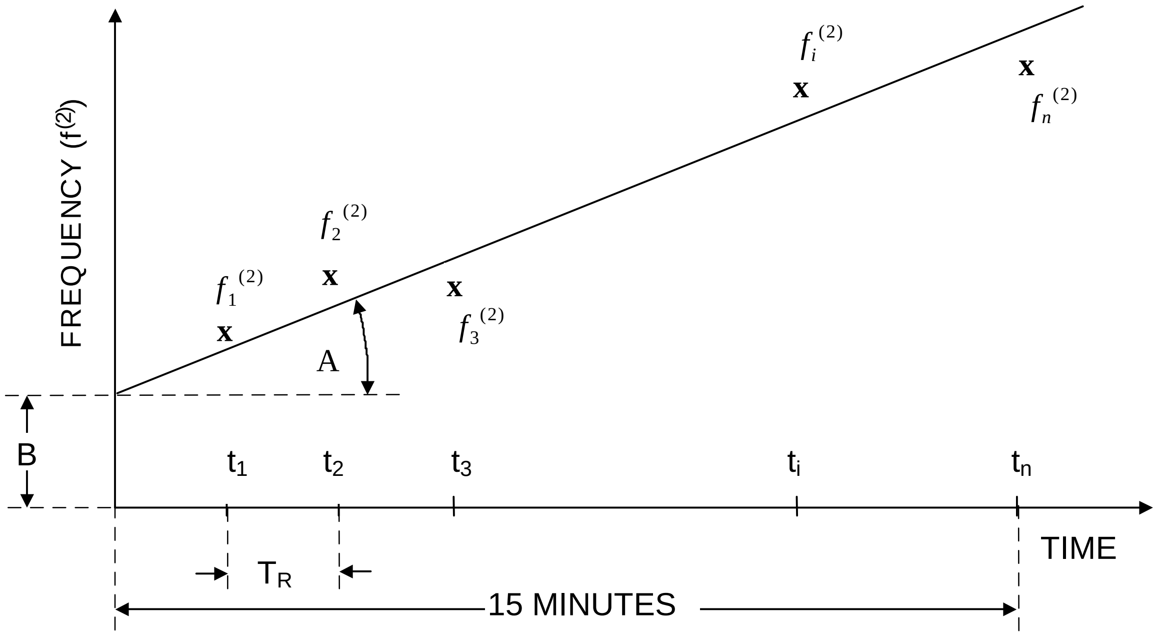

Figure A4* : Medium-Term Frequency Stability Measurement

* Figure not to scale

A3.2.2 Transmitter Power Output

A3.2.2.1 Transmitter Power Output Level

The transmitter power output level is measured at the transmitter output. During output power measurement, the antenna is 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.

A3.2.2.2 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.)

A3.2.2.3 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.

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 ERP within the limits 34 dBm to 41 dBm for at least 90 % of the measurement coordinates of Annex B.

A3.2.2.4 Spurious Output

This measurement is to be performed with the beacon operating into 50 Ohms. The resolution bandwidth for the measurement of the spurious emission levels is 100 Hz. If this measurement is made on a spectrum analyzer, the spectrum analyzer display should be used on a maximum hold for a period which is long enough to integrate the entire frequency spectral response. It will normally take two to three hours to complete the measurement with a frequency span of 50 kHz. Alternative procedures may also be used to provide equivalent information.

A3.2.3 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* should be performed during the first 15 bits of the modulated portion of the transmission and average values determined for the positive and negative phase deviations. It is recommended to display or monitor the complete demodulated transmission.

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* 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.

A3.3 Voltage Standing-Wave Ratio

The transmitter shall be operated into an open circuit for a minimum period of 5 minutes, then into a short circuit for a minimum period of 5 minutes, then 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 are to be measured:

- transmitter nominal frequency, as per para. A3.2.1.1
- digital message content, as per para. A3.1.4
- the modulation parameters, as per para. A3.2.3

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

A3.4 Protection Against Continuous Transmission

If possible, the protection against continuous transmission will 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.

A3.5 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 should also be provided to substantiate that short and medium term stability would remain within specification after five years.

A3.6 Self-test Mode

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

If the self-test includes radiation of RF energy, the duration of the burst shall be measured, the frame synchronization pattern (if present) 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 should be tested to verify that any transmission is limited to one burst.

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

A3.7 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.

A3.7.1 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.)

A3.7.2 Operator Controlled Ancillary Devices

Type approval testing of beacons with ancillary devices under operator control shall be designed to ensure 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 should 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 should 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 should 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.

A3.8 Navigation System (if applicable)

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 should be provided in the same way as it would be by an operational navigation device.

All the tests specified below should be performed at ambient temperature. A check for valid BCH code should be performed throughout these tests.

A3.8.1 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.

A3.8.2 Position Acquisition Time and Position Accuracy

A3.8.2.1 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, 30 min for internal navigation device). Check that the encoded data is correct within 5 km. Deactivate the beacon.

A3.8.2.2 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 A3.8.2.1. 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, 30 min for internal navigation device). Check that the encoded data is correct within 5 km. Deactivate the beacon.

[Insert table to be developed]

A3.8.3 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. 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.

A3.8.4 Position Clearance after Deactivation

After the test A3.8.3 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.

A3.8.5 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.

A3.8.6 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).

A3.8.7 Coarse Position and Delta Offset

Sample messages to demonstrate correct position data encoding, including coarse position, the delta offset, and overrange limits in the positive and negative direction shall be provided by beacon manufacturers and shall be included in the technical data submitted to the Cospas-Sarsat Secretariat together with the type approval test results.

- END OF ANNEX A -

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ANNEX B

ANTENNA CHARACTERISTICS

B1 SCOPE

B1.1 This Annex describes the measurement procedure to verify the antenna characteristics of 406 MHz distress beacons defined in document C/S T.001, by measuring the effective radiated power (ERP). Alternative procedures induding the use of a shielded anechoic room, are acceptable if they provide equivalent information, provided they have minimal impact on Cospas-Sarsat operations.

B1.2 This antenna test requires data to be measured at 60 antenna positions, so if the antenna can be set to its new position during the 50-second interval between beacon transmissions, the entire test could be performed in about 2 hours (1 hour for each polarization), thereby minimizing the impact on the Cospas-Sarsat System if tests are performed outside. The qualitative tests through the satellite could also be done at the same time if convenient.

B2 GENERAL TEST CONFIGURATION

B2.1 The antenna characteristics of the Beacon Under Test (BUT) shall be measured in an open field test site or a shielded anechoic room. The BUT is placed either in or on a reference ground plane to simulate the ground condition in which the beacon normally operates. A measuring antenna located at a horizontal distance of 3 metres from the BUT is used to measure the emitted field strength. The BUT is installed on a turntable, and the measuring antenna is allowed to be moved vertically. With this configuration, the antenna can be characterized in azimuth and in elevation using the radiated power from an unmodified beacon. The BUT shall be equipped with a fresh battery and the test performed at ambient temperature.

B2.2 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.

B3 TEST SITE

B3.1 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 B1. 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 sort.

B3.2 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 B1 is preferred. If this is not practical then a surface of homogeneous good soil (not sand or rock) is satisfactory. All electrical wires and cables should 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.

B3.3 All precautions shall be taken to ensure that reflections from surrounding structures are minimized. No personnel above ground shall be within 6 metres of the BUT during actual measurements. Test reports shall include a detailed description of the test environment. They shall specifically indicate what precautions were taken to minimize reflections.

B3.4 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.

B4 GROUND PLANE AND BEACON INSTALLATION

B4.1 The (BUT) shall be oriented in a manner in which it is designed to operate and placed on a circular ground plane capable of rotation through 360 degrees in azimuth. As shown in Figures B2a, b and c, the rotating ground plane B shall have a minimum radius of 1.7λ (125 cm) and be made of highly conductive material (aluminium or copper). It shall be located at $X = 0.75 \pm 0.10$ metre above ground plane A.

B4.2 When the BUT is designed for normal operation without a ground plane, such as a Personal Locator Beacon (PLB), it shall be placed on the rotating ground plane B as shown in Figure B2a.

B4.3 When the BUT antenna is designed to be mounted on a metal surface during normal operation, such as an Emergency Locator Transmitter (ELT), the antenna shall be mounted on the rotating ground plane B in the same orientation as in normal operation. Refer to Figure B2b.

B4.4 When the BUT is designed for normal operation in water, such as an Emergency Position Indicating Radio Beacon (EPIRB), the rotating ground plane B shall be used to simulate water conductivity (refer to Figure B2c). The EPIRB shall be mounted within the rotating ground plane B to a level such that its float line is aligned with the ground plane B. The ground plane shall be extended to fit closely around the beacon and to surround the below-waterline portion of the unit (e.g. using metal foil). An adapter plate which has a close fit to the sides of the EPIRB is recommended.

B4.5 In all cases, the BUT antenna shall always be positioned at the centre of the rotating ground plane B.

B4.6 The applicable ground plane configuration, as described in sections B4.2 to B4.4, will be decided by Cospas-Sarsat on the basis of technical considerations relevant to the beacon operation and information provided by the manufacturer.

B5 MEASURING ANTENNA

B5.1 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 from 1.3 to 4.3 metres (i.e. from 10 to 50 degrees relative to the ground plane B located at reference height X = 0.75 metre). Refer to Figure B2. The height at which the measuring antenna must be elevated on the supporting mast for a specific angle of elevation is calculated as follows:

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

and

$$H = h + X$$

where,

X is the reference height (0.75 metre)
h is the height of the measuring antenna relative to the reference height X,
Π is the desired angle of elevation with respect to the rotating ground plane B (at reference height X),
H is the height of the measuring antenna above the ground plane A.

Note: The centre of the measuring dipole antenna is used as the reference to determine its height.

B5.2 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 (Π) and it is calculated as follows:

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

B5.3 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.

B5.4 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. Refer to Figure B3a. If the measuring antenna cannot be maintained perpendicular to the direction of propagation (Figure B3b), 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

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

where: AF is the antenna factor from paragraph B5.3,
Π is the elevation angle,
P is the correction factor for the dipole antenna pattern.

Note: 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.

B6 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 be composed of an unknown ratio of vertically and horizontally polarized waves. For this reason, some 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.

B7 RADIATED POWER MEASUREMENTS

B7.1 Prior to each open field test site transmission, the appropriate national authorities responsible for Cospas-Sarsat and radio emissions shall be notified.

B7.2 The radiated power procedure provides data which characterize the antenna by measuring the vertically and horizontally polarised waves.

B7.2.1 Measurement Requirements

The BUT shall be transmitting normally with a fresh battery. The signal received by the measuring antenna should be coupled to a spectrum analyzer or a field strength meter and the radiated power output should be measured during the beacon transmission. An example of a power measurement made on a spectrum analyzer during the unmodulated portion of the transmission is illustrated in Figure B4. The receiver should be calibrated according to the range of level expected, as described in section B8. The BUT should be rotated through 360° of azimuth with a minimum of twelve equal steps (30° ± 3°) and measurements made[1]. Measurements are then taken with the measuring antenna positioned at elevation angle (± 3°) of 10°, 20°, 30°, 40° and 50° for azimuth angles (± 3°) of 0° to 360° in 30° steps and the induced voltages for both polarizations are measured for each one of the 60 positions.

---

[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 ERP as described in section B7.2.2.

B7.2.2 ERP and Antenna Gain Calculations

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

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

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

where:
Vv and Vh 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 B5.4
Lc is the receiver system[2] attenuation and cable loss (dB)

Step 3: Calculate the ERP and the G_i

Using the standard radio wave propagation equation:

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

and

$$Pt(\text{watts}) \text{ x } Gi = ERP$$

we get the ERP for each set of angular coordinates from

$$ERP\ (\text{watts}) = \frac{E^2 \text{ x } R^2}{30}$$

[2] The receiver system attenuation is compensated for when performing the calibration procedure (sectionB8). Otherwise, it shall be calculated separately.

and the antenna gain from

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

where:

R is the distance between the BUT and the measuring dipole antenna calculated in section B5.2
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

B8 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) should be calibrated as follows:

a) Connect the equipment as shown in Figure B2. Install the BUT as described in section B4.

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 B4. 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.

B9 ANTENNA POLARIZATION MEASUREMENT

B9.1 An analysis of the raw data (Vv, Vh) obtained during the antenna test should be sufficient to determine if the polarization of the BUT antenna is linear or circular.

B9.2 If the induced voltage measurements Vv and Vh for each specific angular coordinates (azimuth, elevation) differ by at least 10 dB, the polarization should be linear. The polarization will be vertical or horizontal if Vv or Vh is greater respectively.

B9.3 If the induced voltage measurements (Vv, Vh) 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 sense of 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 when the BUT antenna is radiating. 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 B10.5, is determined by the results obtained with circularly-polarized antennas.

B9.4 In the case of inclined linear BUT antenna ERP measurements may be performed directly using a RHCP measuring antenna with known antenna factor at 406 MHz. In this case the requirements of section B10 should be directly applied to the ERP 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.

B10 ANALYSIS OF RESULTS

B10.1 Enter the type of antenna polarization determined per Section B9 in Table C2 of Annex C.

B10.2 Verify that, for at least 90% of the measurement coordinates, the BUT produces a field equivalent to an ERP in the range[3] of 1.6 to 20 Watts (32 dBm to 43 dBm).

B10.3 For the set of measurements identified in Section B10.2, the overall maximum (ERP_{max}) and minimum (ERP_{min}) ERP values are entered in Table C1 in Annex C.

B10.4 A power loss factor (ERP_{Loss}) is determined[4] to correct for what the power output would be after the beacon operated at minimum temperature for its operating lifetime. The value of ERP_{LOSS} is entered in Table C1 of Annex C. That result is then subtracted from the results in Section B10.3 and entered in Table C1 and item 15 of Table C2 of Annex C as $ERP_{max\ EOL}$ and $ERP_{min\ EOL}$.

B10.5 The amount of gain variation in azimuth for the 40° measurements is extracted from Table C1 and entered in Table C2.

B11 ANTENNA VSWR MEASUREMENT

This section is not applicable to beacons with integral antennas.

B11.1 The antenna VSWR of the BUT should 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.

B11.2 Numerous precautions are necessary in VSWR measurement to avoid errors due to the effect of nearby conducting objects on the antenna current distribution.

B11.3 Consequently, the VSWR measurement should be done with the BUT mounted in the same configuration as used for the open field test site used for antenna test.

B11.4 Report the measurement results in Table C2 of Annex C. 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.

---

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

[4] The loss factor (ERP_{Loss}) is defined as the transmitter power measured at the end of the operating lifetime test (at minimum temperature) subtracted from the transmitter power measured at the same temperature as the ambient temperature during the radiated test (i.e. $ERP_{Loss} = Pt_{ambient} - Pt_{EOL}$).

B11.5 If the antenna VSWR exceeds the 1.5:1 ratio but remains less than 1.8:1[5] at the nominal operational frequency, and if the antenna ERP is evaluated by direct measurements[6] and is within the limits specified in sections B10.3 and B10.4, 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[7] without further type approval testing.

5 Provisions of section A1 in respect of impedance matching network apply.

6 In the case when the separated antenna was previously tested for type approval with an ELT, the direct ERP measurement may be replaced with an analysis showing that the ERP of the beacon-antenna combination would be within the limits specified in Section B10.2 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.

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

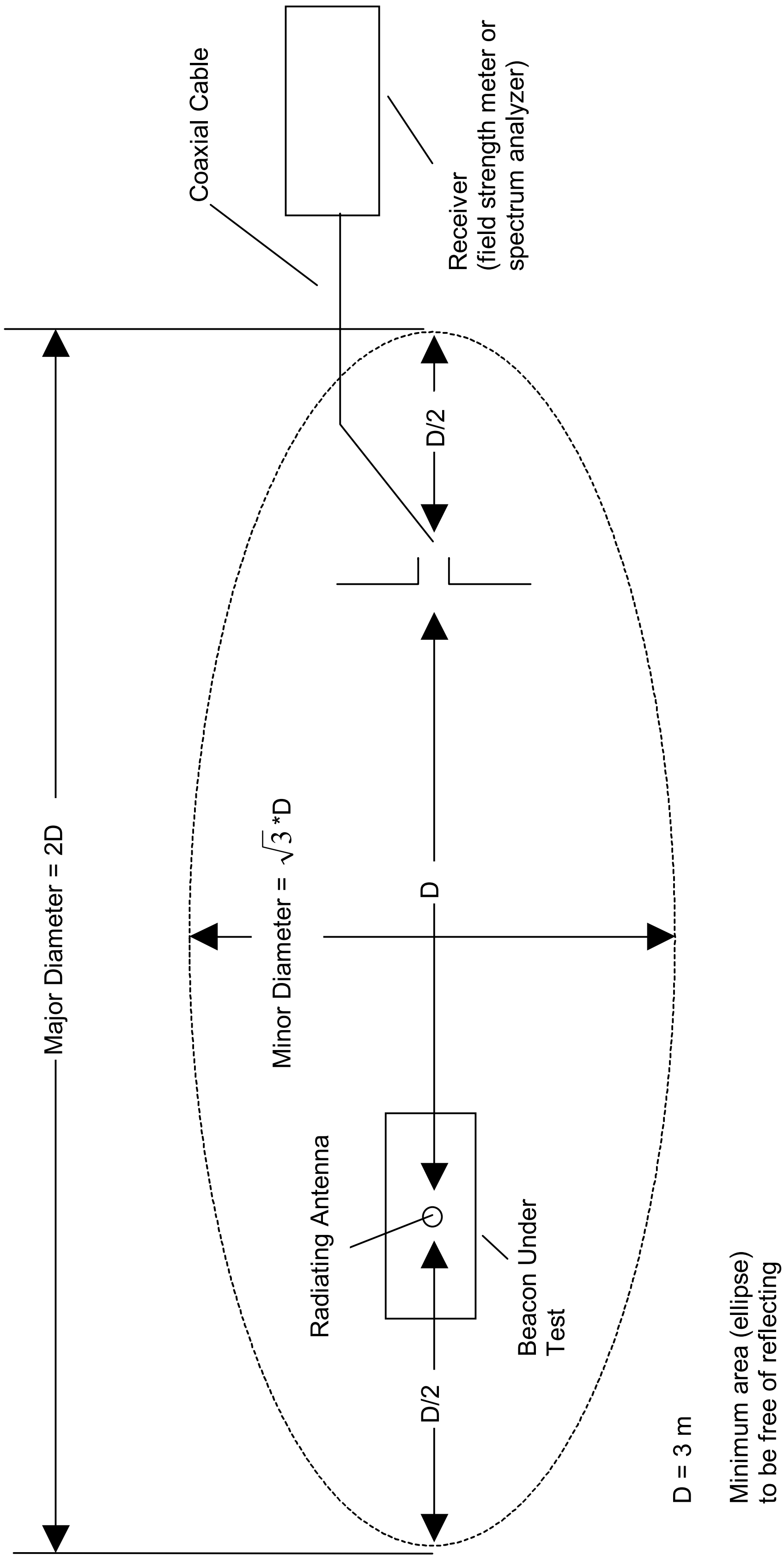

Figure B1: Test Site Plan View

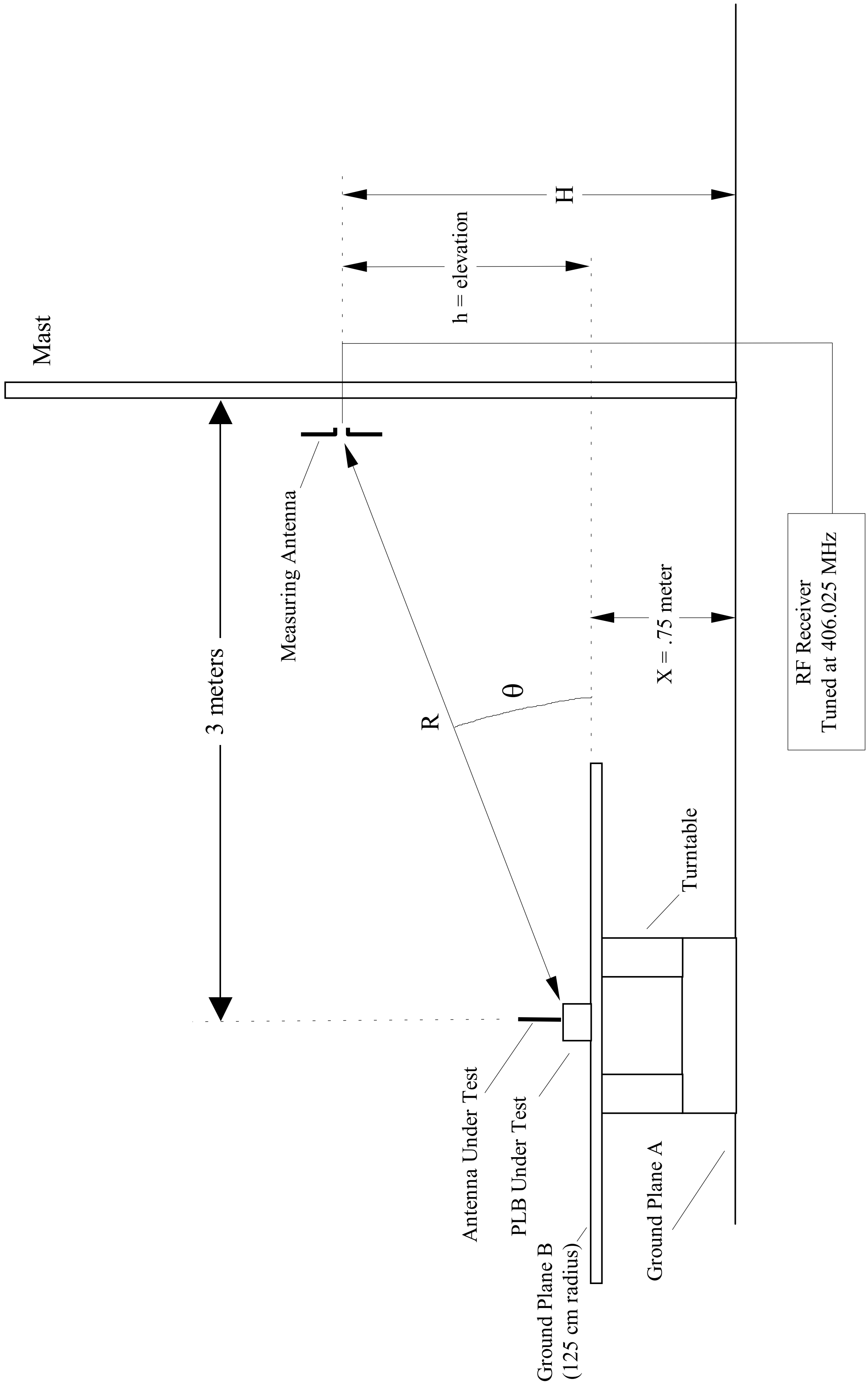

Figure B2a: Equipment Test Set-Up For Beacon Antenna Test.
(For Beacon designed for normal opertion without a ground plane, ex: PLB)

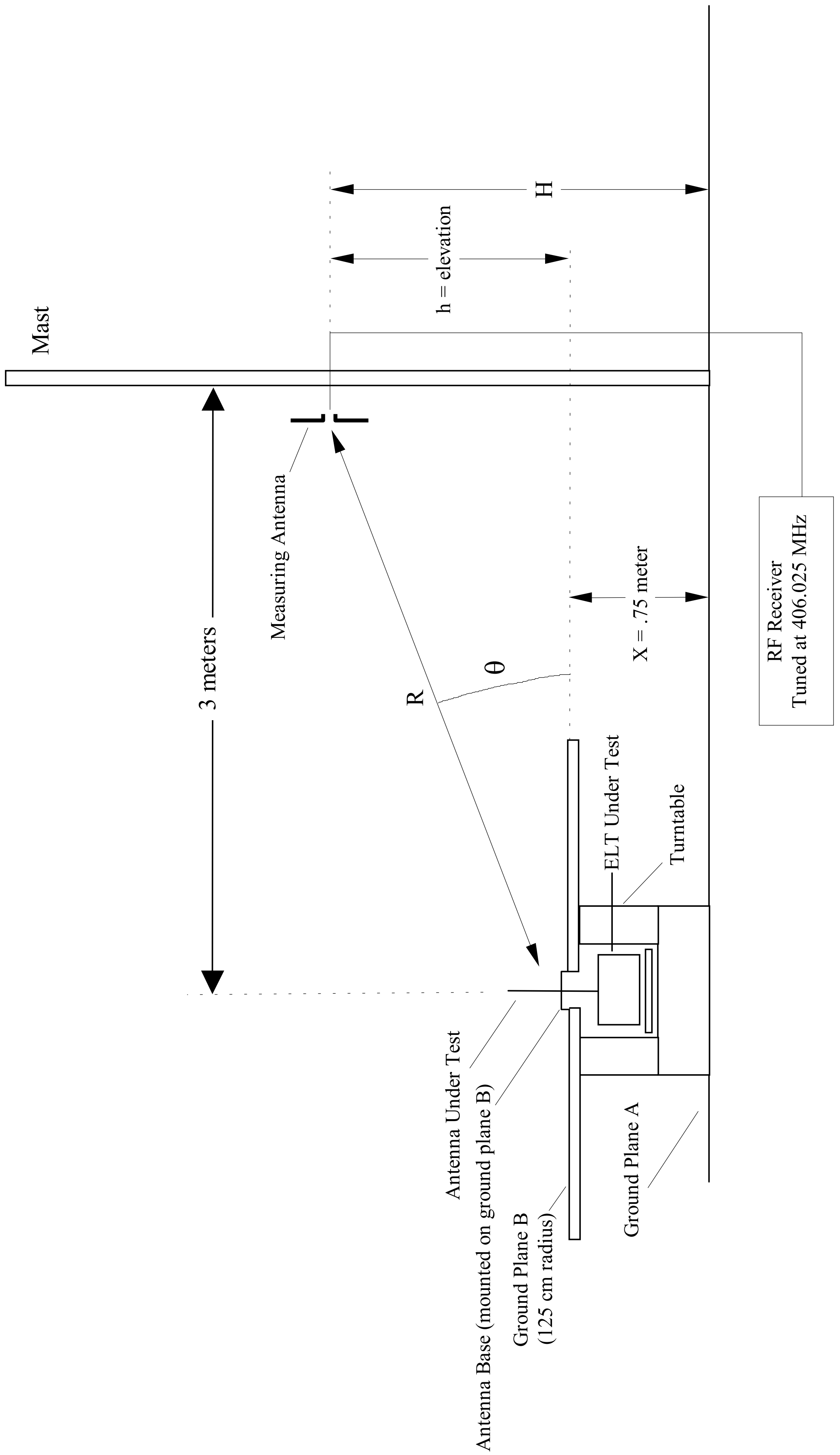

Figure B2b: Equipment Test Set-Up For Beacon Antenna Test.
(For Beacon antenna designed to be mounted on a metal surface, ex:ELT)

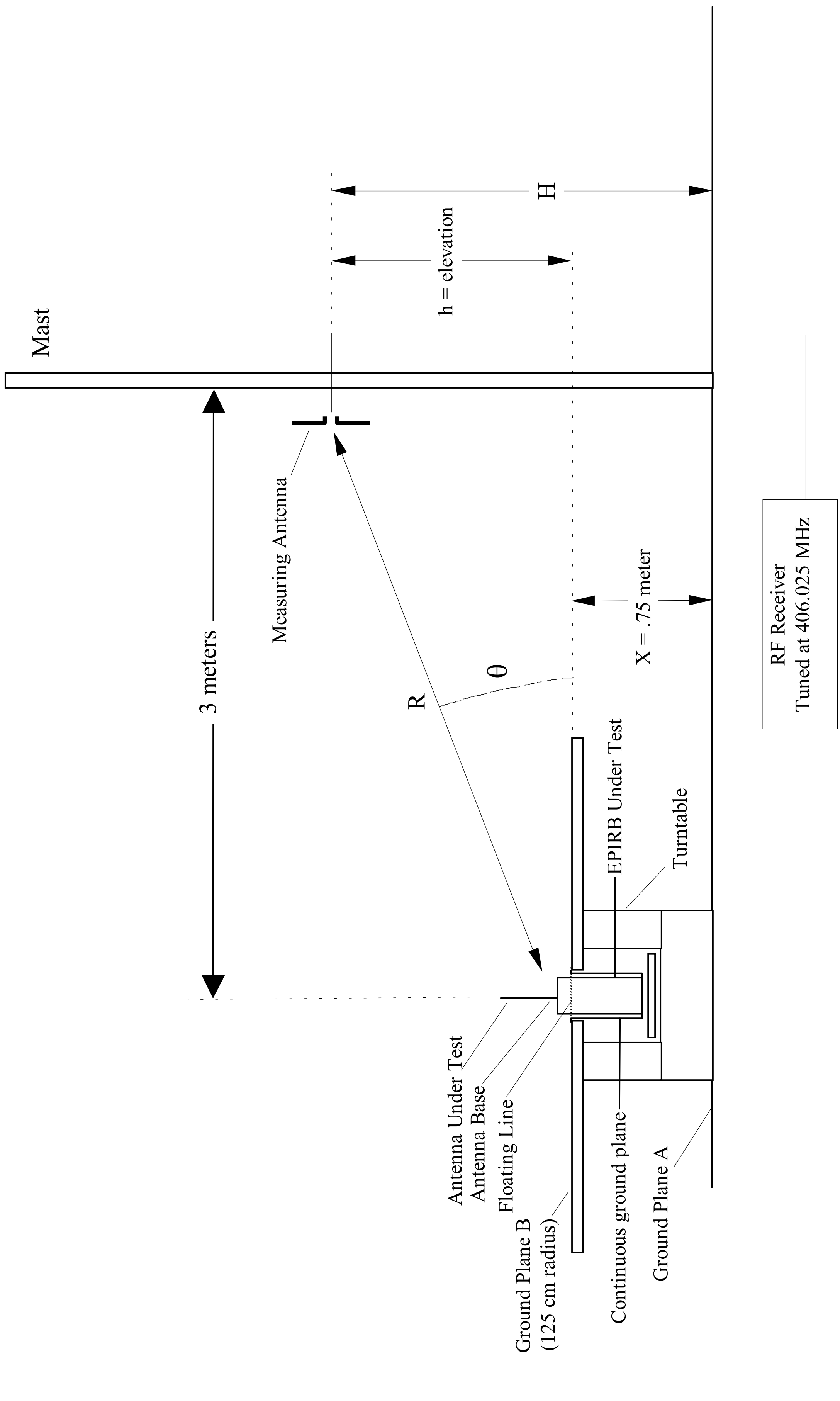

Figure B2c: Equipment Test Set-Up For Beacon Antenna Test.
(For Beacon designed for normal operation in water, ex: EPIRB)

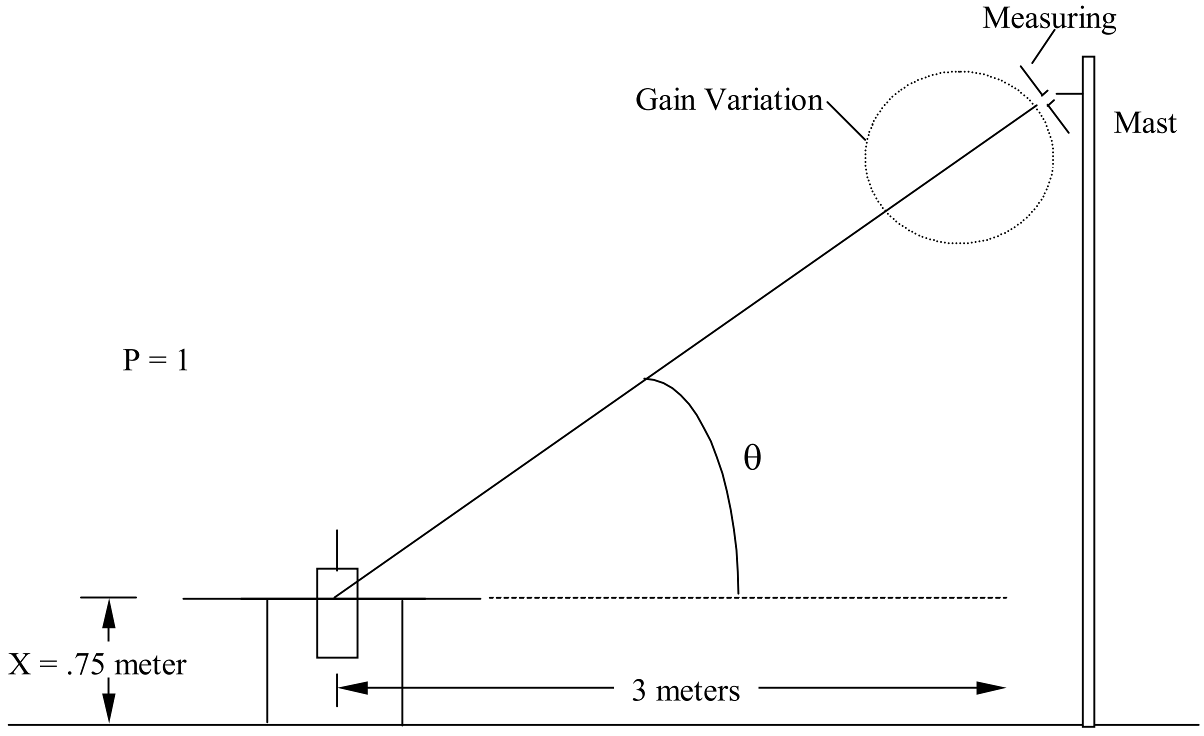

Figure B3a: Measuring Antenna Perpendicular to the Direction of Propagation

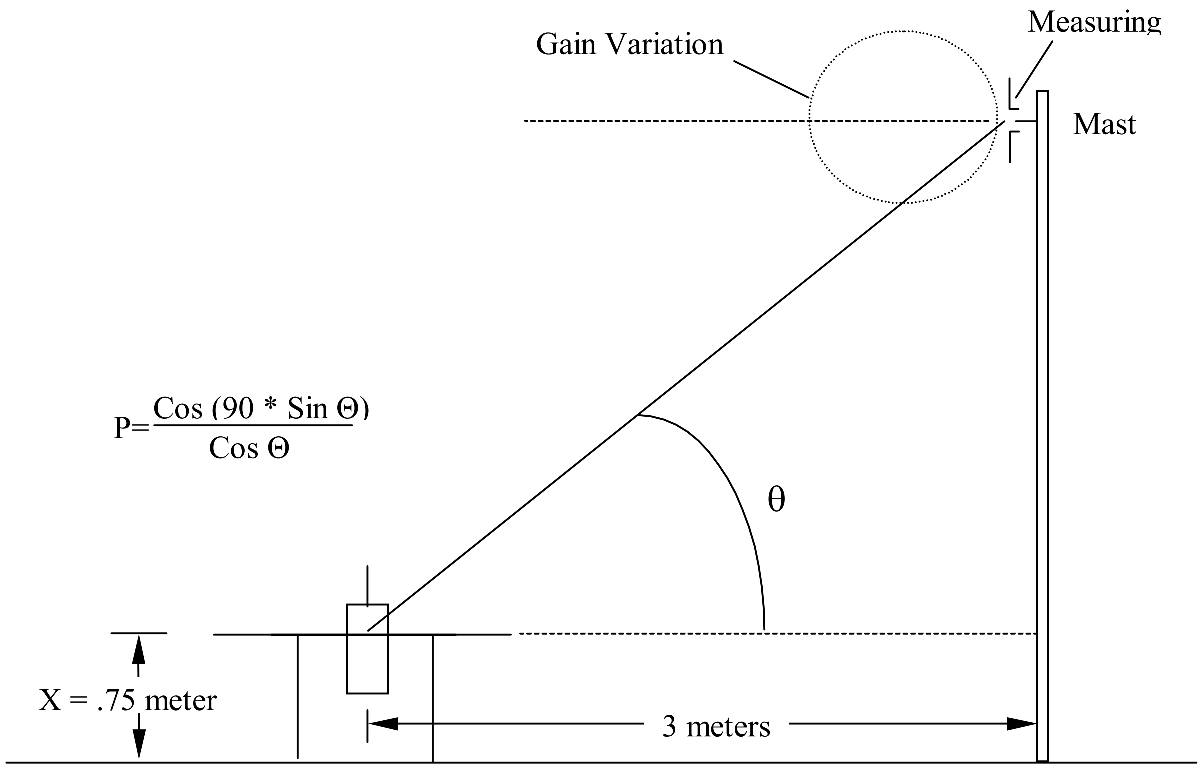

Figure B3b: Measuring Antenna NOT Perpendicular to the Direction of Propagation

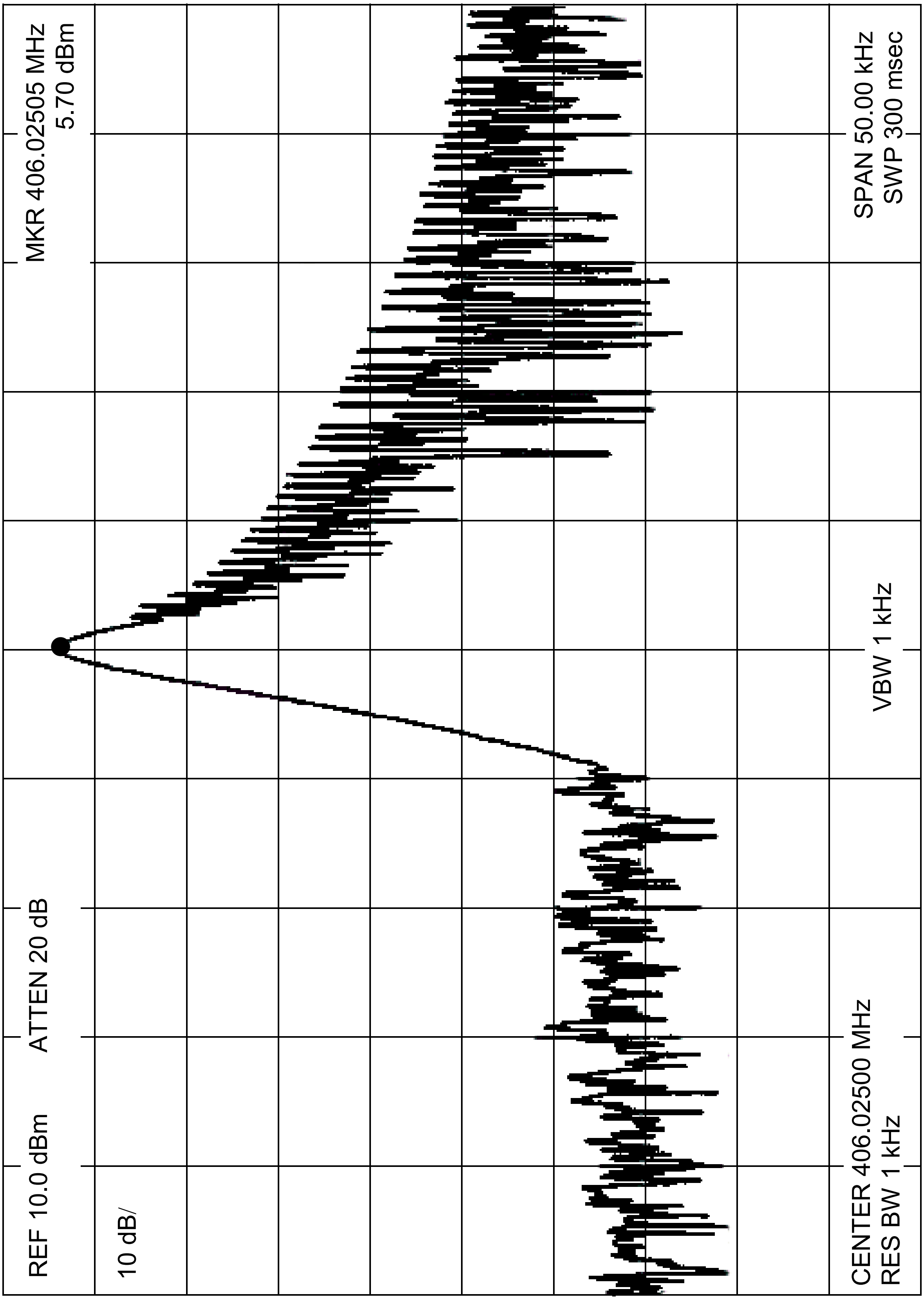

Figure B4: RF Measurement During Preamble

- END OF ANNEX B -

ANNEX C

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

Beacon Manufacturer: ______________________________

Beacon Model: ______________________________

Name and Location of Beacon Test Facility: ______________________________

Beacon Type: Aviation: _____ Land: _____ Maritime: _____

Specified Operating Temperature Range: ___ °C to ___ °C

Specified Operating Lifetime: 24 hr. _____ 48 hr. _____ Other _____ Specify: _____

Beacon Battery Type(s):

Chemistry: ______________________________

Manufacturer & model no.: ______________________________

Size & number of cells: ______________________________

Beacon Oscillator: Type (OCXO, MCXO, TCXO, ...): ______________________________

Model, Manufacturer: ______________________________

Extra Features in Beacon:	**No**	**Yes**	**Details**
a) Auxiliary Radio-Locating Device:	_____	_____	Frequency: __________ Power: __________ Tx. Duty Cycle: __________
b) Transmits Encoded Position Data:	_____	_____	Nav. Device (Internal or External): _____ Type (GPS, GLONASS, etc.): _____ Manufacturer: __________ Model: __________
c) Transmits Long Message (144 bits):	_____	_____	
d) Automatic Activation:	_____	_____	
e) Built-in Strobe Light:	_____	_____	Intensity: __________ Flash rate: __________
f) Self-test mode	_____	_____	
g) Other:	_____	_____	Specify: __________

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

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

(for test facility)

Send to: Cospas-Sarsat Secretariat c/o Inmarsat, 99 City Road, London EC1Y 1AX, United Kingdom

406 MHz BEACON SELF-TEST CHARACTERISTICS

406 MHz Beacon Model(s): ______________________________

	Answer (√) Yes	No
1. Beacon self-test mode		
• self-test has a separate switch position	....	....
• does self-test switch automatically return to normal position when released ?	....	....
• self-test transmits a 406 MHz signal	....	....
- normal data, but with inverted frame synchronization pattern	....	....
- 1 burst only	....	....
• does self-test transmit a 121.5 MHz signal ?	....	....
if yes:		
- for less than 1 second	....	....
- continually while self-test switch is activated	....	....
- other (please specify) : ______________________	....	
• does self-test transmit any other frequency (e.g. 243 MHz) ?	....	....
2. Result of self-test is indicated by:		
• pass/fail display indicator light	....	....
• strobe light flash	....	....
• other (please specify) : ______________________	....	
3. Can the self-test be performed without removing the beacon from its mounting bracket ?	....	....
4. What parameters are internally tested by the self-test ?		
• battery voltage	....	....
• RF power at 406 MHz	....	....
• RF power at 121.5 MHz, if applicable	....	....
• approximate RF frequency	....	....
• phase locked loop	....	....
• other (please specify) : ______________________	....	
5. Do the above characteristics apply to this beacon model:		
• **for all countries where beacon is sold ?**	....	....
if no, please specify : ______________________		
• **for all production serial numbers?**	....	....
if no, please specify : ______________________		

6. Comments: ______________________________

406 MHz BEACON ANTENNA TEST RESULTS

Table C1a: EFFECTIVE RADIATED POWER (dBm) / ANTENNA GAIN (dBi)

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					

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

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

Table C1b: INDUCED VOLTAGE MEASUREMENTS Vv/ Vg (dBuV)

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

Table C2: SUMMARY OF 406 MHz BEACON TEST RESULTS

PARAMETERS TO BE MEASURED DURING TESTS		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		must be < -10 dBm	√ *				
2. DIGITAL MESSAGE	Bits number						
• bit sync	1-15	15 bits "1"	√				
• frame sync	16-24	9 bits (000101111)	√				
• format flag	25	1 bit	data bit				
• protocol flag	26	1 bit	data bit				
• identification/position data	27-85	59 bits	√				
• BCH code	86-106	21 bits	√				
• emerg. code/nat. use/supplem. data	107-112	6 bits	data bits				
• additional data/BCH (if applicable)	113-144	32 bits	√				
• position error (if applicable)		< 5	km				

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			$T_{min.}$ (_____ °C)	$T_{amb.}$ (_____ °C)	$T_{max.}$ (_____°C)	
3. DIGITAL MESSAGE GENERATOR						
• repetition rate T_R						
average $T_{R =}$	48.5 - 51.5	seconds				
minimum T_R	47.5	seconds				
maximum $T_{R =}$	52.5	seconds				
standard deviation	0.5 - 2.0					
• unique TR sequence						
probability of 2 beacons with identical patterns (analysis to be provided)	< 0.001	√				
• bit rate:						
minimum f_b =	396	bits/sec.				
maximum f_b =	404	bits/sec.				
• total transmission time:						
short message =	435.6 - 444.4	ms				
long message =	514.8 - 525.2	ms				
• unmodulated carrier						
minimum T_1 =	158.4	ms				
maximum T_1 =	161.6	ms				
• first burst delay	> 47.5	seconds				

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			$T_{min.}$ (_____ °C)	$T_{amb.}$ (_____ °C)	$T_{max.}$ (_____°C)	
4. MODULATION						
• Biphase-L		√				
• rise time	50 - 250	microsec.				
• fall time	50 - 250	microsec.				
• 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	as specified in C/S T.001 and C/S T.012	MHz				
• short term stability	≤ 2 x 10^{-9}	/100 ms				
• medium term stability:						
- slope	(-1 to +1) x 10^{-9}	/minute				
- residual frequency variation	≤ 3 x 10^{-9}					
6. SPURIOUS EMISSIONS** (into 50 Ohms)						
• in-band (406.0 - 406.1 MHz)	see spurious emission mask in C/S T.001	√				

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS			COMMENTS
			$T_{min.}$ (_____ °C)	$T_{amb.}$ (_____ °C)	$T_{max.}$ (_____°C)	
7. 406 MHz VSWR CHECK after open circuit, short circuit, then while VSWR is 3:1, measure:						
• nominal transmitted frequency	as specified in C/S T.001 and C/S T.012	MHz				
Modulation:						
• rise time	50 - 250	microsec.				
• fall time	50 - 250	microsec.				
• phase deviation: positive	+(1.0 to 1.2)	radians				
• phase deviation: negative	- (1.0 to 1.2)	radians				
• symmetry measurement	≤ 0.05	√				
• digital message	must be correct	√				

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS	COMMENTS
8. SELF-TEST MODE				
• frame sync	9 bits (011010000)	√		
• format flag	1/0	bit		
• 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	protection provided	√		
• single burst verification	one burst	√		
• provides for beacon 15 Hex ID	must be correct	√		
9. THERMAL SHOCK** (30°C change)				
• 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:				
• transmitted frequency:				
• nominal value	as specified in C/S T.001 and C/S T.012	MHz		
• short-term stability	$\leq 2 \times 10^{-9}$	/100 ms		
• medium-term stability: - slope	$(-1 \text{ to } +1) \times 10^{-9}$	/minute		
- residual frequency variation	$\leq 3 \times 10^{-9}$			
• transmitter power output	35 - 39	dBm		
• digital message	must be correct	√		

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS	COMMENTS
10. OPERATING LIFETIME AT MINIMUM TEMPERATURE**				
• duration	> 24	hours	________ hours at T_{min} = ________°C	
• transmitted frequency:				
• nominal value	as specified in C/S T.001 and C/S T.012	MHz		
• short-term stability	≤ 2 x 10^{-9}	/100 ms		
• medium-term stability:				
- slope	(-1 to +1) x 10^{-9}	/minute		
- residual frequency variation	≤ 3 x 10^{-9}			
• transmitter power output	35 - 39	dBm		
• digital message	must be correct	√		
11. TEMPERATURE GRADIENT** (5°C/hr)				
• transmitted frequency:				
• nominal value	as specified in C/S T.001 and C/S T.012	MHz		
• short-term stability	≤ 2 x 10^{-9}	/100 ms		
• medium-term stability:				
- slope	(-1 to +1) x 10^{-9}	/minute		
- residual frequency variation	≤ 3 x 10^{-9}			
• transmitter power output	35 - 39	dBm		
• digital message	must be correct	√		

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS	COMMENTS
12. LONG TERM FREQUENCY STABILITY • data provided	as specified in C/S T.001 and C/S T.012	MHz √		
13. PROTECTION AGAINST CONTINUOUS TRANSMISSION • description provided	≤45	seconds √		
14. SATELLITE QUALITATIVE TESTS** • results provided	successfully located by satellites / LUT and position within 5 km	√ √		
15. ANTENNA CHARACTERISTICS • polarization • VSWR • $ERP_{max\ EOL}$ • $ERP_{min\ EOL}$ • azimuth gain variation at 40° elevation angle	 linear or RHCP ≤1.5 ≤ 20 ≥ 1.6 ≤ 3	 √ √ - Watts Watts dB		
16. BEACON CODING SOFTWARE • sample message provided for each coding option of the applicable coding protocol types • sample self-test message provided for each coding option of the applicable coding protocol types	 must be correct must be correct	 √ √		 (attach to report) (attach to report)

PARAMETERS TO BE MEASURED DURING TESTS	RANGE OF SPECIFICATION	UNITS	TEST RESULTS	COMMENTS
17. NAVIGATION SYSTEM** (as applicable)				
• position data default values	must be correct	√		
• position acquisition time	< 30 / 1	minutes		
• encoded position data update interval	> 20	minutes		
• position data input update interval (as applicable)	20 / 1	minutes		
• coarse position close to actual position	must be correct	√		
• delta offset:				
- positive direction	must be correct	√		
- negative direction	must be correct	√		
- overrange to 2 times coarse res.	must be correct	√		
• last valid position:				
- retained after navigation input lost	240 (± 5)	min		
- cleared when beacon reactivated	must be correct	√		
• design data provided on protection against beacon degradation due to navigation device, interface or signal failure or malfunction	no degradation	√		
18. ADDITIONAL TYPES OF PROTOCOL**				
print out of the messages provided, if applicable, with encoded positions at least 5 km apart for each applicable coding protocol type	must be correct	√		(attach to report)

* the tick mark √ can be used where indicated to record that the requirement is met (no value needs to be shown)

** attach graphs of test results for test numbers 6, 9, 10 and 11, and a summary table of results for test numbers 14, 17, and 18

- END OF ANNEX C -

COSPAS-SARSAT
TYPE APPROVAL CERTIFICATE

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

WHEREAS, The ABC Beacon Company of **London, England,** the manufacturer of a 406 Megahertz Distress Beacon packaged as an **EPIRB**, and identified as Model **ABC-406** has submitted test data and had said beacon tested in **January 2003** at a facility accepted by Cospas-Sarsat at **Intespace, Toulouse, France,** to demonstrate that said beacon meets the applicable technical requirements for use with the Cospas-Sarsat Satellite System, as defined in documents C/S T.001 "Specification for Cospas-Sarsat 406 MHz Distress Beacons", Issue 3 – rev. 4, October 2002 and C/S T.007 "Cospas-Sarsat 406 MHz Distress Beacon Type Approval Standard", Issue 3 – Rev. 9 October 2002,* for the frequency channels **406.0XX** MHz and **406.0XY** MHz;

WHEREAS, the Cospas-Sarsat Council has determined, following a review of the test results, that the said beacon meets the Cospas-Sarsat Class **2** requirements and is rated for operating over the temperature range of **-20°C to +55C**,**
with battery: **XXX Battery Company, type 123 (4 D-cells)**
(battery chemistry) and

WHEREAS, said manufacturer has certified that all other units of the same type will meet said technical requirements in a similar manner to the unit subjected to test, which incorporated the following features:

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

* beacon is approved for use with user location protocol
** specified operating lifetime 48 hours

NOW, THEREFORE, in reliance upon the following, the Cospas-Sarsat Council does hereby certify that the 406 MHz Distress Beacon Model identified herein is compatible with the Cospas-Sarsat System as of the date of this Certificate.

Certificate No…**nnn**……………………

Date: **15 February 2003**

Signed by:

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. 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 this certificate.

3. 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.

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ANNEX E

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 of 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: ____

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: ....
(for manufacturer)

Complete and send to:
Cospas-Sarsat Secretariat, c/o Inmarsat, 99 City Road, London EC1Y 1AX, United Kingdom, Fax: +44 20 7728 1170

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ANNEX F

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: ....

(for manufacturer)

Complete and send to:
Cospas-Sarsat Secretariat, c/o Inmarsat, 99 City Road, London EC1Y 1AX, United Kingdom,
Fax: +44 20 7728 1170

- END OF ANNEX F -

ANNEX G

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.001, section A3.7.2, 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.

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.

2. Thermal Shock Test (C/S T.007, section A2.2)

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.

3. Operating Lifetime at Minimum Temperature (C/S T.007, section A2.2)

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.

4. Frequency Stability Test with Temperature Gradient (C/S T.007, section A2.4)

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.

5. Satellite Qualitative Tests (C/S T.007, section A2.5)

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.

6. All Other Tests

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

- END OF ANNEX G -

ANNEX H

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: ____

____

____

Date *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.

____

Date *Name and Signature of Cospas-Sarsat Representative*

Complete and send to:
Cospas-Sarsat Secretariat, c/o Inmarsat, 99 City Road, London EC1Y 1AX, United Kingdom
Fax +44 20 7728 1170

- END OF ANNEX H -

ANNEX I

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

____

Date *Name, Position and Signature of ELT Manufacturer Representative*

Complete and send to:
Cospas-Sarsat Secretariat, c/o Inmarsat, 99 City Road, London EC1Y 1AX, United Kingdom
Fax +44 20 7728 1170

- END OF ANNEX I -

ANNEX J

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)

designed by us 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.

Date *Name, Position and Signature of beacon Manufacturer Representative*

Complete and send to:
Cospas-Sarsat Secretariat, 99 City Road, London EC1Y 1AX, United Kingdom
Fax +44 20 7728 1170

- END OF ANNEX J -

- END OF DOCUMENT -

Cospas-Sarsat Secretariat
Inmarsat, 99 City Road, London EC1Y 1AX, United Kingdom
Telephone: +44 20-7728 1391 Facsimile +44 20-7728 1170
Internet e-mail: *cospas_sarsat@imso.org*
Web Site address: *http://www.cospas-sarsat.org*