COSPAS-SARSAT
406 MHz DISTRESS BEACONS
TYPE APPROVAL STANDARD

C/S T.007
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This document is provided as a complement to the final clean version of the document. In case of discrepancy between this marked-up version and the clean final version, the information in the clean final version shall prevail.

COSPAS-SARSAT 406 MHz DISTRESS BEACON TYPE APPROVAL STANDARD

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1. INTRODUCTION

1.1 Scope

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

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

b) the type approval test methods.

1.2 Reference Documents

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

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

c) Cospas-Sarsat Document C/S T.012, “Cospas-Sarsat 406 MHz Frequency Management Plan”; and

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

1.3 Beacon Model Definitions

The definition of beacon models, variants, and changes is integral to the assignment and maintenance of the type approval certificates and letters of compatibility that are assigned by the Cospas-Sarsat Secretariat.

Beacon Model:
A beacon model is a specific version of a beacon design that has been defined by the beacon manufacturer and results in specific configuration(s) of the deployed beacon with a known feature set that is covered by the type approval for that beacon. (e.g., Model X1-G is an EPIRB, with a 121.5 MHz homer, including a GNSS capability, Model X1 is an EPIRB, with a 121.5 MHz homer but does not include a GNSS capability).

Beacon Model Family:
A beacon family is a series of beacon models which have similar design origins for which all beacon model features can be evaluated by the testing of a subset of the beacon models. (i.e., testing a beacon model with 121.5 MHz and 243 MHz homer would be sufficient to also accept

(with supporting documentation) a model that only had a 121.5 MHz homer enabled). The relationship between these beacon models will be documented by the Cospas-Sarsat Secretariat.

Approved Configuration:
A single beacon model may have several approved configurations which were included in the original type approval or change application (e.g., an ELT may be approved for use with several different antennas, or various remote-control panels, a military PLB may be approved with different antennas).

Beacon Variant:
A beacon variant is a beacon model that is identical to an approved beacon design in electrical design and Cospas-Sarsat certified performance. This may include labels and product branding and/or variations in product features that are outside the Cospas-Sarsat certification, such as hydrostatic release mechanisms, mounting brackets, case colour or features, etc. Beacon variants will be treated as a single beacon model, but will be listed separately on the TAC for that model.

Beacon Modifications:
A beacon modification is any change to the beacon design, as previously approved by Cospas-Sarsat, which results in a change in the electrical performance of production beacons.

– END OF SECTION 1 –

2. COSPAS-SARSAT TYPE APPROVAL

2.1 Policy

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

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

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

2.2 Testing

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

a) beacon signals are compatible with System receiving and processing equipment;
b) beacons to be deployed do not degrade nominal System performance; and
c) beacons encoded position data is correct.

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

Type approval testing shall be conducted at accepted Cospas-Sarsat test facilities unless stated otherwise in this document.

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

2.3 Review of Type-Approval Application

Further to completion of type approval testing at a Cospas-Sarsat accepted test facility, a type-approval application package comprising a technical report on type-approval testing and supporting technical data listed in section 5 of this document shall be submitted to the Secretariat for review.

The Cospas-Sarsat Secretariat will reviews the type-approval application package to verify and establish that:

d) the technical data and documentation submitted by the beacon manufacturer provide sufficient information about beacon design and its features, details of the intended operational scenarios, and that they comply with the requirements of this document;

e) the scope of type-approval testing and test procedures correspond to the requirements of this document; and

f) the results of type-approval testing provide sufficient evidence that the beacon complies with the requirements of the "Specification for Cospas-Sarsat 406 MHz Distress Beacons" (C/S T.001), and of "Cospas-Sarsat 406 MHz Frequency Management Plan" (C/S T.012).

The Secretariat should normally provide results of the review to the beacon manufacturer within approximately 30 calendar days. Once all requirements have been successfully addressed by the applicant, a summary report will be provided to the Cospas-Sarsat Parties for final approval.

2.4 Type Approval Certificate

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

Cospas-Sarsat will typically issue a unique TAC number(s) for each beacon model(s) (or beacon model family) (See section 1.3). Each individual beacon model design may be assigned to a unique certification TAC number, however beacon models in a beacon model family may be assigned to the one TAC or multiple TACs, as deemed appropriate. The approved beacon models associated with a TAC number are documented by the Secretariat and identified on the Cospas-Sarsat web-site.

For reports published on the web, Cospas-Sarsat will assign a unique TAC number or suffix to each approved beacon model which will include a dash number to identify the beacon model, and a decimal suffix number to identify the Cospas-Sarsat approved modification state of that beacon model design. Thus, the unique representation of the beacon model would be provided in the form:

TAC NNN-M.m

Where:

NNN is a three-digit TAC number (1 to 999),
M is an integer dash number for a unique Beacon Model (1, 2, …, nth), and
m is an integer number indicating a Cospas-Sarsat approved modification (0, 1, 2, …).

A unique TAC number may be assigned to each beacon model in a beacon model family, in which case M will be "1" for each of the approved models, and a beacon model family may have several TAC numbers assigned. This relationship among related beacon models (under one or more TACs) in a beacon model family will be documented by the Secretariat.

In the case of RLS beacons, the Secretariat will also assign an Administration a National RLS Number to allow that Administration, or their competent authority to allocate beacon serial numbers, in accordance with document C/S T.001, section A.3.3.7. The same National RLS Number may be associated with several Administrations, which are uniquely identified by their individual country codes.

Cospas-Sarsat TAC numbers will be issued only in the following cases:

- type approval of new beacon models,
- significant changes to an approved beacon model that has been retested at an accepted test facility*, and
- the need for additional serial numbers to encode a unique identification with the Standard Location Protocol, provided that the capacity of all possible serial numbers associated with previously assigned TAC numbers was fully used.

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.

2.5 Letter of Compatibility

At times, at the request of Cospas-Sarsat Participants, beacons could be designed to meet specific user needs while not meeting some of the Cospas-Sarsat operational requirements, e.g., the minimum duration of continuous operation, as specified in the Cospas-Sarsat beacon specification, document C/S T.001. When such beacon models satisfy all other requirements in document C/S T.001, as verified in accordance with the type approval standard in document C/S T.007, Cospas-Sarsat may consider

* As historically applied. Subject also to further definition based on recommendations of the Joint Committee and decisions of the Council.

issuing a letter of compatibility (LOC) in lieu of a Cospas-Sarsat Type Approval Certificate (See document C/S P.011 for further details).

Cospas-Sarsat will issue a unique TAC number (from the 700 series of TACs) to each beacon model that is approved under a LOC. The approved beacon models associated with a TAC number are documented by the Secretariat and identified on the Cospas-Sarsat web-site.

- END OF SECTION 2 -

3. TESTING LABORATORIES

3.1 Testing

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

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

3.2 Cospas-Sarsat Accepted Test Facilities

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

Following successful testing of a beacon, the technical report on type-approval testing and the technical information listed in section 5 of this document should be submitted to the Cospas-Sarsat Secretariat for review by the Secretariat and the Parties, so that an approval and, if applicable, 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~~ *separate* 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,~~ *it is acceptable to perform* testing *of* ELT *external fixed* antenna*s connected to a type approved ELT, as described in Annex B to this document,* at a reputable and independent test facility specialised in antenna measurements ~~is acceptable,~~ subject to *a* prior agreement by Cospas-Sarsat and provided that the test facility is accredited by recognised standardisation bodies responsible for type approval of electronic and electrical equipment.

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

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

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

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

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

i. VSWR measurement as described at Annex B;

ii. the calculated EIRP values and results of antenna polarisation test in the format provided at Tables F-B.1 and F-B.2;

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

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

- END OF SECTION 3 -

4. COSPAS-SARSAT TESTING PROCEDURE

4.1 Sequence of Events

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

a) manufacturer develops a beacon;

b) manufacturer conducts preliminary testing in his laboratory;

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

d) test facility conducts* type approval tests;

e) manufacturer and/or test facility (as coordinated by the manufacturer) submits to the Cospas-Sarsat Secretariat report on type approval testing, and technical data listed in section 5 of this document;

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

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

4.2 Initial Request

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

a) one or more beacons for testing purposes; and

b) replacement batteries.

The power output of the test beacons when measured relative to 50 Ohm impedance shall have identical factory settings (aligned to 0.3 dB).

4.3 Test Units

If the beacon has a 121.5 MHz homer, the homer transmitters of the test beacons shall be aligned in power, and set for the maximum output power declared by the beacon manufacturer in the application form. For the test beacon subjected to antenna and satellite qualitative tests, the homer

* The cost of the testing is to be borne by the manufacturer.

transmitter may be tuned to the frequency nearest to 121.5 MHz allowed by the national administration for type approval testing, but under no circumstances should this frequency be greater than 121.65 MHz. For position acquisition time and position accuracy test of beacon models equipped with internal navigation device, the homer-transmitter frequency shall be set in the range from 121.35 to 121.5 MHz. If such frequency offset is not possible due to national restrictions or design limitations of the beacon, the homer transmitter shall be tuned to frequency above 121.5 MHz.

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

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

Another beacon may be required to perform the RLS tests described in sections A.3.8.8 and A.3.8.9, or the second test beacon may be modified to permit this testing to take place on that unit.

All external ancillary devices specific to beacon operation, designed principally for use with the beacon model and forming part of nominal system configuration, such as remote control panels and switches, sound and light indicators, external navigation interface units, beacon programmers (dongles), remote activators and etc., shall be connected, powered, operated in nominal mode and placed in the same environmental conditions as beacons during all tests. If necessary, it is permissible to shield external ancillary devices from the effects of humidity and moisture during environmental tests (e.g. by enclosing them in a plastic bag).

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.

If a beacon is to receive certification for location protocols and non-location protocols:

- a full type-approval testing shall be conducted with a location-protocol encoded test beacon,

* For type-approval testing of beacon models with detachable, remote or external antennas, it is allowed to submit a single test beacon to a type approval test facility, provided that either such beacon has a 50-Ohm antenna cable port or a robust electrically equivalent impedance matching network as described in section 5(k) and A.1.a. which can allow connection of the test equipment.

- a test beacon encoded with a short-format message shall be subjected to the Digital Message test (test parameter TP-2), Digital Message Generator test (TP-3), Modulation test (TP-4), Self-test Mode test (TP-8a), Beacon Coding Software test (TP-16).

RLS-capable beacons shall allow message encoding with RLS Location Test protocol and a location test protocol*, with the RLS Location Test Protocol to be used only for the Satellite Qualitative test and the Position Acquisition Time and Position Accuracy test, and another location test protocol to be used for all other on-air tests.

4.4 Test Conditions

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

The applicable beacon specification (document C/S T.001) and beacon type approval standard (document C/S T.007) are the documents' issues and revisions in effect at the date when a new beacon model is first submitted for type approval testing at an accepted test facility.

For change notices of earlier type-approved models, unless stated otherwise :

- *the applicable beacon specification (document C/S T.001) is the document's issues and revisions in effect at the date when a beacon model was first submitted for type approval testing at an accepted test facility, except for the beacon characteristics that are affected by the modifications, only for which the latest version of the standard apply; and*

- *the applicable beacon type approval standard (document C/S T.007) is the document's issue and revision in effect at the date when the beacon model with changes is subjected to type-approval testing.*

If the beacon manufacturer or test facility has any concerns as to what version of the specification or what version of the type approval standard to apply to a change then they should consult the Secretariat prior to starting testing.

The tests shall be carried out on the test beacon with its own power source and without any additional thermal shielding around the beacon that might prevent it from being exposed to the specified test temperature. However shields or deflectors inside the chamber designed to prevent the beacon from being exposed to temperatures lower or higher than the specified test temperature

* The location test protocol may be either standard location test or national location test protocol and must be used in addition to the RLS location test protocol.

are permitted. In cases, when such additional shields and deflectors are used in thermal chambers, this shall be documented with photographs and reflected in the test reports.

If the ELT(DT) has an external power source, as defined in section 4.5.11 of document C/S T.001, that is used to power the main beacon electronics when it is in the ON or ARMED mode of operation, as defined in section 4.5.6.1 of document C/S T.001, the beacon shall be tested as per section A.2.10. For ELT(DT)s where tests refer to the beacon under test being 'off' or 'deactivated' or being 'turned on for 15 minutes prior to the start of a test', these conditions shall be taken to mean that the ELT(DT) is in its ARMED mode of operation.

Test results shall be presented on the forms shown in Annex F of this document, along with additional graphs as necessary. Test results shall demonstrate compliance with C/S T.001.

At the discretion of the test authority, the manufacturer may be required to replace the batteries between tests.

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

i. the mode that draws maximum battery energy; and

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

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

The mode that draws the maximum battery energy shall be tested to the full range of the test requirements by the test laboratory.

During type-approval testing, certain beacon characteristics are measured and test parameters evaluated over a period of 15 minutes by making 18 successive measurements of the 406 MHz signal during this period. The measurement interval and the number of measurements shall if necessary be extended to cover all beacon ancillary devices operating conditions (e.g. homing transmitter(s) turning on and off, GNSS receiver powered on and off, voice-transceivers in receive and transmit etc.).

Test facilities shall perform analysis of the beacon design and modes of operation to define the measurement interval and include this information in the test report.

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

4.5 Test Configuration

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

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

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

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

The test configurations for these tests are a function of the beacon type and the operational environments supported by the beacon, as declared by the manufacturer in Annex G. The applicable test configurations for the beacon antenna testing are summarised below in Figure 4.1, while the applicable test configurations for the satellite qualitative test and the position acquisition time and position accuracy test are summarised in Figure 4.2.

	Operational Environment Beacon used while	Configuration 1 (Fig: B.4) "Water" ground plane	Configuration 2 (Fig: B.3) Antenna fixed to ground plane	Configuration 3 (Fig: B.2) Beacon sitting on ground plane	Configuration 4 (Fig: B.5) Beacon above ground plane
EPIRB (*)	Floating in water, in safety raft or on deck of vessel	**X**			**X**
PLB	On ground and above ground			**X**	**X**
PLB	As above plus floating in water	**X**			**X**
PLB	On ground, above ground and operated on a personal floatation device (e.g. lifejacket)†			**X** (PLB on PFD tests)	**X**
ELT Survival	On ground and above ground			**X**	**X**
ELT Survival	As above plus floating in water	**X**			**X**
ELT Auto-Fixed	Fixed ELT with external antenna		**X**		
ELT(DT)	Distress Tracking ELT with aircraft external antenna		**X**		
ELT	On aircraft with external antenna		**X**		
Auto-Portable	Outside of aircraft with own antenna attached			**X**	**X**
ELT Auto-Deployable	In deployed state on ground, above ground and floating in water	**X**		**X (‡)**	**X**
Other	For operational environments not defined above	To be determined by the Cospas-Sarsat Secretariat, following consultations with the beacon manufacturer, and the test facility (as appropriate)			

Figure 4.1: Antenna Test Configuration Requirements

* As configurations 1 and 4 cover the two extremes, configuration 3 is not required.

† Applicable to:

a) PLBs with integral antennas operated while attached to personal flotation devices (e.g. lifejackets) where the PLB and its antenna are mounted on PFD in such a position, that, in the nominal mode of operation, they are kept above water, and

b) PLBs with non-integral antennas operated where the antenna is mounted on the PFD in such a position, that, in the normal mode of operation, it is kept above water (the PLB itself is attached elsewhere and can be underwater).

‡ For possible landing configuration not covered in Test Configuration 1, i.e. upside down.

	Operational Environment Bacon Used While	**Configuration 5 (see below)** ***Beacon in*** ~~**Water**~~ ***water*** ~~**ground plane**~~	**Configuration 6 (see below)** ***External*** **Antenna fixed to ground plane**	**Configuration 7 (see below) Beacon on ground***	**Configuration 8 (see below) Beacon~~–~~ above ground†**
EPIRB	Floating in water or on deck or in a safety raft	**X**		**X**	**X**
PLB	On ground and above ground			**X**	**X**
PLB	On ground and above ground and floating in water	**X**		**X**	**X**
PLB	On ground, above ground and operated on a personal floatation device (e.g. lifejacket)‡			**X** (SQT ‘ dry’) (PAT-PAT ‘wet’)	**X**
ELT Survival	On ground and above ground			**X**	**X**
ELT Survival	On ground and above ground and floating in water	**X**		**X**	**X**
ELT Auto-Fixed	Fixed ELT with aircraft external antenna		**X**		
ELT(DT)	Distress Tracking ELT with aircraft external antenna		**X**		
ELT Auto-Portable	In aircraft with an external antenna		**X**		
	On ground, above ground, or in a safety raft with an integral antenna			**X**	**X**
ELT Auto-Deployable	In deployed state on ground, above ground and floating in water	**X**		**X**	**X**
Other	For operational environments not defined above	To be determined by the Cospas-Sarsat Secretariat, following consultations with the beacon manufacturer, and the test facility (as appropriate)			

Figure 4.2: Satellite Qualitative Test ~~&~~, Position Acquisition Time and Position Accuracy *and RLS* Test Configuration Requirements

* Configuration 7 is used to represent a beacon on ground, on the deck of a metal vessel and on the floor of a safety raft.

† Configuration 8 is used to represent a beacon above ground (e.g. held in the hand), on the deck of a fibreglass or wooden vessel and being held in a safety raft.

‡ Applicable to:

a) PLBs with integral antennas operated while attached to personal flotation devices (e.g. lifejackets) where the PLB and its antenna are mounted on PFD in such a position, that, in the nominal mode of operation, they are kept above water; and

b) PLBs with non-integral antennas operated where the antenna is mounted on the PFD in such a position, that, in the normal mode of operation, it is kept above water (the PLB itself is attached elsewhere and can be underwater).

When performing the Satellite Qualitative Test (Annex A section A.2.5)~~ and ~~*, the* Position Acquisition Time and Position Accuracy test (Annex A section A.3.8.2) *and the RLS tests (Annex A, section A.3.8.8)*, each of the applicable test configurations in Figure 4.2 shall be applied, even if the manufacturer states that this beacon will only be used in one configuration~~.~~*, unless required otherwise as per section A.3.8.8.*

PLB~~'~~s used near water but not designed to be used in the water shall not be subjected to the *Configuration 5 (Beacon in water)*~~Water Ground Plane Test~~*test*. The test *setup* requirements for each configuration are as follows:

Configuration 5 – *Beacon in* ~~Water~~ *water*~~ground plane~~: The beacon shall be completely submerged in salt water (composition 5% salt solution by weight), activated while submerged, and allowed to float to the surface under its own buoyancy. The beacon shall be maintained at or near the centre of the container for the duration of the test. The container holding the salt water shall be placed on a flat surface in an area with a good all round view of the sky. The container shall be made from a non-conductive material (e.g. plastic) and there shall be at least 10cm of salt water under the base of the beacon when it is floating in the container and at least 10cm of salt water between the beacon and the sides of the container.

Configuration 6 – *External* ~~Antenna~~ *antenna* fixed to ground plane: The base of the *external* antenna shall be placed in the centre of a thin 50cm ±2cm diameter conductive metal disc (made of aluminium or copper) which shall be placed directly on level dry ground (ideally cement, tarmacadam or dirt) in an area with a good all round view of the sky. The beacon itself shall either be placed in a hole under the conductive metal disc or shall be run off at least 3m (from the antenna) to one side of the disc using a coaxial cable.

Configuration 7 – Beacon on ground~~ plane~~: The beacon shall be placed in the centre of a thin 27cm ±1cm diameter conductive metal disc (made of aluminium or copper) which shall be placed directly on level dry ground (ideally cement, tarmacadam or dirt) in an area with a good all round view of the sky, in the orientation described in the manufacturer's instructions.

For testing of PLBs intended to operate on PFDs, the Satellite Qualitative Test shall be performed as above with a PLB remaining in "dry" condition. For testing of PLBs intended to operate on PFDs, the Position Acquisition Time and Position Accuracy Test shall be performed as described above (~~-~~in addition, a plastic container, described for the test configuration of Figure B.2*b*, may be used as needed), with a PLB (or for PLBs with non-integral antennas the antenna) remaining in "wet" condition for the duration of the test.

Configuration 8 – Beacon above ground~~ plane~~: The beacon shall be placed on an electrically insulating support so that its base is 0.45m ±5cm above level dry ground (ideally cement, tarmacadam or dirt) in an area with a good all round view of the sky, in the orientation described in the manufacturer's instructions. The conductive metal disc used in Configuration 7 above shall be removed for this test.

4.6 Bandwidth of Measurement Equipment

Except where it is specifically stated otherwise, the bandwidth of the measurement equipment shall be as close as possible to 100 kHz, but not less than 80 kHz for all frequency and time-related measurements of the 406 MHz signal characteristics, with measurement uncertainties specified in document C/S T.008.

4.7 Test Procedure for Beacon with Operator Controlled Ancillary Devices

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

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

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

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

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

4.8 Test Report

Type approval test reports shall provide a summary of the beacon and antenna test results, with supporting test data, graphs and tables, as designated in Annexes A, B and F. It is recommended that the test reports be prepared in accordance with Appendix G to Annex F and contain as a minimum the following information:

a) Report management information:

   i. report reference number, issue/revision number, date of issue, report modification record with indication of the reasons for re-issue;

   ii. indication of the test facility specialist(s) in charge of the testing and contact details of the beacon manufacturer point of contact (representative) for the type approval application;

   iii. date when the test beacons have been submitted for testing; and

   iv. dates of testing start and finish;

b) Test samples details:

   i. application data and beacon design details, as per Part G.1 of Annex G,

   ii. indication of the test samples model name, part numbers (P/Ns) and serial numbers (S/Ns), details of the test beacon hardware, firmware and software P/Ns, battery pack details and composition, external components, manufacturer's test equipment,

iii. photos of the test samples with antenna deployed and external ancillary devices as subjected to TA testing (if applicable),

iv. description of physical test configuration supported with photos and/or diagram~~me~~s, providing details of a beacon and external components subjected to type approval testing;

c) Indication and description of any modifications made to the test beacons during type approval testing;

d) Statement*, as per section G-2 of Annex G, indicating that type-approval testing was conducted in accordance with document C/S T.007 (indicating the issue and revision numbers of the document),* ~~of~~ *stating the* beacon model compliance with document C/S T.001 *(indicating the issue and revision numbers of the document)*, and ~~indication~~ *indicating* ~~of~~ non-compliances observed *and/*or deviations from standard test procedures, which were allowed during type-approval testing~~, as per section G-2 of Annex G~~;

e) A summary of the beacon and antenna test results, with supporting test data, graphs and tables, as designated in Annexes A, B and F (if applicable).

f) Other technical information, technical data and, test procedure and results as included in the test report provided by the beacon manufacturer, which shall be referenced in the overall type approval test report from the test facility;

g) Photographs of beacon during radiation tests in all tested configurations (if applicable);

h) List of measurement equipment with indication of test and calibration due date and information about the actual test facility measurement accuracies for all test parameters; and

i) Details of non-standard test configurations, including technical drawings, photos and description.

Results of tests performed by a beacon manufacturer (e.g., current measurements, position data encoding, beacon coding software, or other additional tests) shall include the data required by items a) to h) of this section, as applicable, be submitted in a test report, and must contain the equivalent content as required in Appendix G to Annex F (Part F.7), as applicable, but is not restricted to the precise format of the Part F.7~~.~~*, and include description of applicable test procedures.* Test facilities shall check the manufacturers' test reports to ensure that all necessary information is provided in consistency with Annex G (Part G.1) and other technical documentation.

4.9 Additional Type Approval Testing Clarifications and Requirements

If the beacon fails during type approval testing or an issue of results or test method interpretation occurs at some point during the test period then the test laboratory shall inform the manufacturer and where applicable the Secretariat of the failure/problem.

For beacon failures during type approval testing the manufacturer shall investigate the issue and develop / propose corrective measures.

The manufacturer and / or test facility shall in a timely manner advise the Cospas-Sarsat Secretariat of the problem or issue, the reason for it and their proposed solution, including any necessary modifications to the beacon hardware, firmware or software. The Secretariat will in a timely manner review the information provided by the manufacturer and/or test facility and in consultation with them will provide clarifications and where necessary recommendations for additional testing.
Circumstances which will result in a need for additional or further testing include, but are not limited to:

- beacons with novel or non-standard design features or operational configurations, which are not described in the current standards and for which test procedures have not been agreed with the Secretariat prior to testing,
- any modification of the test beacon during type approval testing,
- non-compliances with C/S T.001 performance requirements,
- deviations from standard and/or agreed test procedures,
- lack and / or omission of test results or technical data,
- inadequacy of testing to cover features, modes, related functions or intended operational scenarios, as declared by the manufacturer,
- as a means to verify the effectiveness of undertaken corrective measures.

The scope of additional testing shall be defined and/or confirmed by the Cospas-Sarsat Secretariat following consultations with the beacon manufacturer and the test facility, as appropriate, and may range from only those tests relevant to the circumstances to a full beacon retest. In some cases, development of new test procedures may be required for beacons with non-standard or novel design and operational features.

4.10 Approval of Beacons with Multiple Models or Configurations

If a beacon manufacturer chooses to develop a beacon model family or elects to provide multiple beacon configurations for approval, they may elect to reduce the testing required by submitting all beacon models and configurations under one type-approval submission. Section 5.2 provides guidance to test facilities and beacon manufacturers regarding the process to follow should they elect to pursue this approach. Alternatively, each beacon model and/or configuration can be approved separately by submitting a complete application package including all necessary testing and data items for each configuration/model of interest, per section 5.1 of this document.

– END OF SECTION 4 –

5. TECHNICAL DATA

5.1 Technical Data Item Descriptions

Beacon manufacturers are required to provide* technical data indicated below as part of their type approval application. This technical data is used to determine the appropriate test configurations and procedures. It is therefore expected that the technical data will be provided to the accepted test facility prior to type approval testing to ensure that appropriate test procedures are used.

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

a) an application form (Annex G) for a Cospas-Sarsat Type Approval Certificate, *comprising:*

- *Part G-1* signed by the *beacon* manufacturer ~~attesting to the~~*declaring* technical details of the beacon *model* ~~as specified~~*submitted for type approval testing*, and
- *Part G-2* signed by the Cospas-Sarsat accepted test facility attesting that the beacon was tested in accordance with *document* C/S T.007 *and other type-approval standards (stating the issue and revision of the documents)* and found in compliance with *document* C/S T.001 *(stating the issue and revision of the document)* and~~/or~~ indicating the observed non-compliances and/or *allowed* deviations from standard test procedures;

b) photographs of the beacon *in all the declared beacon system configurations*, *showing external devices connected (if any),* with its antenna deployed whilst in all manufacturer declared *operational* configurations (e.g., floating in water, resting on ground, placed above ground, held by operator, etc.)~~-~~, and appropriate descriptions;

c) analysis and calculations from the beacon manufacturer that support the pre-test battery discharge figures required for the operating lifetime at minimum temperature test, as per Table F-E.2;

*The type-approval application form and other forms (e.g., Change-Notice form, Quality Assurance Plan, etc.), included in the Annexes of this document, shall be completed, signed and submitted, or, alternatively, this information may be provided using the electronic format and procedures as available on the Cospas-Sarsat website.

d) ~~a list and descriptions of all~~ *for beacon* ~~automatic and manually selectable~~ operati~~on~~*ng* modes~~,~~*:*

- *a list and descriptions of all automatic and manually selectable operating modes,*
- description of beacon working cycle phases and durations,
- justification of the measurement interval, and
- analysis supported by results of battery current measurements, provided in the manufacturer's test report as per Table F-E.1 with content as required or equivalent to Appendix G to Annex F (Part F.7), that identifies:
  - i. the operating mode that draws the maximum battery energy, and
  - *ii.* operating modes that have pulse loads greater than in i. above~~,~~*;*
  - *iii. for ELT(DT)s designed to withstand a crash, an assessment of the test condition (with supporting evidence) that maximizes battery energy consumption during the operating lifetime at minimum temperature test, taking into account the variations in the battery energy required to provide 406 MHz transmissions, GNSS receiver operations, homing and locating signals and any other sources of energy consumption that vary between the time prior to and after crash sensor activation.*

    (e.g., measure the charge (C) taken from the battery in the first 30 minutes after worst case mode of ELT(DT) activation and again between 30 and 60 minutes after activation. Then activate the crash sensor and measure the charge (C) taken from the battery in the first 30 minutes after crash sensor activation and again between 30 and 60 minutes (assuming that no beacon functions that would change the current consumption vary after 60 minutes) after crash sensor activation. Given that the pre-crash ELT(DT) mode of operation is between 10 and 370 minutes, use this data to calculate the pre-crash time that results in the worst case conditions for the operating lifetime test (the point at which switching between pre-crash and post-crash modes results in maximum drain on the battery));

~~j)~~*e)* the beacon operating instructions and /or other owner manuals describing the:

- i. beacon type and designation,
- ii. beacon specification~~;~~*,*
- iii. typical operational scenarios and limitations with photos/drawings illustrating beacon configurations for operation with antenna(s) deployed,
- iv. system configuration, including external ancillary devices and antennas, if applicable,

v. methods of beacon activation and beacon/antenna deployment,

vi. self-test mode and GNSS self-test mode activation and indication,

vii. battery replacement instructions and battery replacement period,

viii. for beacons with voice-transceivers, providing for a design limitation of the voice-transceiver operation, indication of the maximum cumulative transmit-mode 'on' time, and appropriate warnings for the users for beacons with voice-transceivers, providing for design limitation of the voice-transceiver operation, indication of the maximum cumulative transmit-mode 'on' time, and appropriate warnings to the users, that that voice-transceiver transmit operation exceeding the declared maximum cumulative transmit-mode 'on' time will reduce duration of operation of the activated 406-MHz beacon,

ix. for beacons with RLS capability, the operation of the RLS function shall be clearly explained, such that it can be easily understood, including any limitations of the overall RLS system.

~~k)~~*f)* beacon marketing brochure, if available;

~~l)~~*g)* the technical data sheet for the battery cells used in the beacon indicating nominal cell capacity and self-discharge rate over the declared battery replacement period and the declared battery shelf-life, and the electric diagram of the beacon's battery pack;

~~m)~~*h)* copy of the beacon markings and labels (for all beacon models and additional names) indicating, as per C/S T.001 section 4.5.8:

i. beacon model name, beacon manufacturer, and C/S TAC number,

ii. beacon 15-HEX ID,

iii. Aircraft Operator 3LD - for ELT(DT)s coded with a 3LD in PDF2,

iv. operating temperature range (e.g., -20°C to +55°C).

v. minimum operating lifetime (e.g., 24 hours),

vi. for RLS-capable beacons:

- that the beacon is equipped with RLS functionality (i.e. RLS-capable),
- wording on the beacon identity label (i.e., label with C/S TAC Number and 15-Hex ID) indicating that the RLS function is either enabled *(*for beacons coded with the RLS Location protocol), or disabled (for beacons coded with protocols other than the RLS Location protocol),
- marking(s) indicating which are the RLS and RLM indicator(s);

~~n)~~*i)* the technical information on the reference oscillator, including:

i. oscillator type and specifications,

ii. technical data on long-term frequency stability and description of the beacon frequency-generation circuitry (section A.3.5),

iii. technical data sheet for any temperature-compensated oscillator (e.g., TCXO, MCXO) that may be employed, indicating maximum MTS characteristics specified for the oscillator model,

iv. report on the oscillator ageing characteristics (section A.3.5),

v. the serial number of the temperature-compensated oscillator device installed in the test beacon that was subjected to conductive testing at a test facility, and MTS characteristics from the reference oscillator manufacturer, if applicable,

~~o~~*j)* statements and descriptions, complete with diagrams as necessary, to demonstrate that the design:

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

ii. provides protection from repetitive self-test mode transmissions (see section A.3.6.1),

iii. ensures that the self-test messages (except for GNSS self-test) have default values encoded in position fields, at all times and irrespective of the navigation data input,

iv. for location protocol beacons, provides protection against degradation in beacon 406 MHz performance due to faulty operation or failure in operation of internal or external navigation device and against invalid position encoding into the beacon message (see section 4.5.5 of C/S T.001),

v. for beacon models that are intended to be encoded with the National-User protocol (long format), provides for bits 1 to 106 to remain fixed after beacon activation, and bits 107 onwards to be updated not more frequently than once every 20 minutes, (a description of conditions which may cause changes to the message content shall be provided);

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

~~q~~*l)* for beacon models with separated and/or remote antennas, technical data about the type of antenna cable and allowed minimum and maximum losses at 406 MHz of antenna cable assembly;

~~r)~~*m)* the beacon quality assurance plan (see Annex L);

~~s)~~*n)* for beacons with an internal GNSS receiver:

i. description of the GNSS receiver operation cycle and its phases, including duration of GNSS receiver ON and OFF phases when navigation signal is present or absent,

ii. average battery current measured for each of the following conditions:

- GNSS receiver - ON but not yet acquired a position (navigation data),
- GNSS receiver - ON with a position acquired,
- GNSS receiver - OFF or in sleep mode,

iii. technical data sheet of the internal GNSS receiver and the antenna for the internal GNSS receiver from the navigation-receiver and antenna manufacturers,

iv. designed to be coded with multiple location protocol types (e.g., User, Standard, National, RLS), if applicable, a statement that the encoded position data update timings are identical for all of the declared location protocols (except for the RLS GNSS Receiver timing, which shall also comply, with C/S T.001 section 4.5.7.2.1, but may be more frequent, in which case this must be described),

v. description to demonstrate that the beacon design provides for the cold start of the internal GNSS receiver by clearing on a beacon restart the GNSS receiver internal memory, including time, data on the current (last) location determined by the GNSS receiver, the GNSS satellites almanac data, and the GNSS satellite ephemeris data;

~~t)~~*o)* for beacons capable of accepting position data from an external navigation device:

i. specification and description of the interface to the external navigation device, and

ii. diagrams showing electrical connections to the beacon and providing details of the external power supply, if it is required for operation of the interface to the external navigation device;

~~u)~~*p)* for beacons with external ancillary devices (e.g. external G-switch and other activation devices, remote control panel, audio- and light-indicator, S-VDR memory module etc.), and/or when an external power supply is required for beacon operation:

i. technical data sheets, photographs and description for all the external ancillary devices, and

ii. schematic diagrams, indicating electrical connections to the beacon and providing details of external power supply;

~~v)~~*q)* for beacon model families with several beacon models, a comprehensive description of differences between these models;

~~w)~~*r)* a complete check-list of technical information provided in support of the type-approval or change-notice application, as per Appendix F to Annex F;

~~x)~~*s)* a detailed description of the associated beacon design feature shall be provided if the temperature within the declared operating temperature range, at which the shortest duration of continuous beacon operation is expected, as declared in Annex G, is not the minimum operating temperature;

~~y)~~*t)* a statement and description of any known non-compliances, if any are declared in Annex G;

~~z)~~*u)* a statement from the beacon manufacturer that the test samples are aligned in 406 MHz conducted output power levels to within 0.3 dB of each other if multiple beacon samples are provided for type approval testing;

~~aa)~~*v)* technical information for characterisation of the self-test indication of insufficient battery energy to be provided as per Table F-E.5:

- Manufacturer-declared Minimum Operating Lifetime **(C_{CO})**, which is declared by the manufacturer in the type-approval application form, Annex G of document C/S T.007, as the Operating Lifetime;

- Full Battery Pack Capacity **(C_{BP})**, which is defined as the duration in hours that a beacon with a fresh battery pack will continuously operate for in the worst-case operating mode (i.e. operating mode that draws the highest current from the battery) until it the beacon fails to meet C/S T.001 requirements;

- Capacity corresponding to the Pre-Operational Losses **(C_{PO})**, which is defined as the duration in hours required to deplete the fresh battery by the value corresponding to the Calculated Battery Pack Pre-Discharge (L_{CDC}) of the Table F-E.2 * by operating the beacon in the worst-case operating mode;

- Spare battery pack capacity at ambient temperature **($C_{SP\text{-}AMB}$)**, which corresponds to the battery energy that could remain after the beacon with a pre-discharged battery has been operated in the worst-case mode at minimum temperature for the duration of the declared minimum continuous

* **L_{CDC}** - as defined in Appendix E to Annex F of document C/S T.007, and include among others battery capacity losses due to self-discharge, self-tests, GNSS self-tests and operation of the beacon circuitry while in the stand-by mode.

operation. **$C_{SP\text{-}AMB}$** may be calculated as the Full Battery Pack Capacity **(C_{BP})** deducted by the sum of the Capacity of Pre-Operational Losses **(C_{PO})** and the Manufacturer-Declared Minimum Operating Lifetime **(C_{CO}).** The value of **$C_{SP\text{-}AMB}$** shall be declared by the beacon manufacturer or measured by the test facility; and

- Description of conditions and specification of criteria that shall be met to trigger the indication of Potentially Insufficient Battery Energy (**PIE**) during self-test.

~~bb)~~*w)* for beacon models with multiple programmable options, except for message protocols:

i. a list of and description of all programmable options and programmable parameters that can change performance of an operational beacon,

ii. a statement indicating which of the available programmable options are associated with the type-approval application,

iii. description of technical means to set the desired programmable options and set programmable parameters; and

~~cc)~~*x)* for beacon models with external power supply:

i. description of the nominal voltage conditions and performances,

ii. description of the worst-case (nominal minimum and nominal maximum)* external power supply voltage conditions.

~~dd)~~*y)* for beacon models supporting repetitive automated interrogation of beacon status:

i. description of the feature including triggering mechanism, timing of interrogation and items/functions verified,

ii. details of how this feature is powered, including assessment of its impact on the beacon battery.

* For example, the nominal minimum and maximum voltages for the 14 V and 28 V DC power supplies on the aircraft, as described in documents EUROCAE ED-14G and RTCA DO-160G, are as follows:

Nominal Aircraft Power Supply Voltage	Nominal Minimum Aircraft Power Supply Voltage	Nominal Maximum Aircraft Power Supply Voltage
14.0V	11.0V	15.15V
28.0V	20.5V	32.2V

5.2 Guidance for Applications with Multiple Beacon Models

In cases where several beacon models are developed as part of a beacon model family, some customization of the application process will be required. This section outlines some typical examples of the type of customization of the data package and test facility testing that could be required to accommodate these applications. A pre-application consultation of a beacon manufacturer with the Cospas-Sarsat Secretariat may also be prudent prior to conducting a type-approval test campaign to ensure that the required documentation is complete, that the scope of type approval testing is adequate, and to reduce the likelihood of any unnecessary delays in the type-approval application review and approval process.

5.2.1 General Guidance

In all cases where multiple beacon models are being submitted under a single type approval application, the following guidance applies:

a) a separate application form (Annex G) should be submitted for each beacon model under consideration, however beacon variants may be included in the same Annex G form;

b) each beacon model under consideration should be identifiable by a unique beacon model name (e.g., model names: EPIRB-abc, EPIRB-abc-AIS, EPIRB-abc-GPS, ELT-xyz, Brand X, etc.);

c) the inclusion of item 5.1(q) which provides a comprehensive description of the differences between the various beacon models is a critical component of the application as this should be used to determine the required test program to ensure each different aspect of the beacon models in the family are appropriately tested by the test facility;

d) the data items in section 5.1 must be applicable to each beacon model in the family, or a specific version of each data item should be supplied as appropriate for each beacon model under consideration (e.g., one all-encompassing manual that distinguishes features for each model or several individual manuals should be submitted under item 5.1(e)).

– 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 Changes to Type Approved Beacons

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

The manufacturer shall provide sufficient information for the scope of the changes, including a brief description of the modifications and indication of the beacon sub-systems, modules, functions and characteristics affected by the change.

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

For minor modifications to the beacon, factory test results provided to the Secretariat by the manufacturer can be considered on a case-by-case basis. The results of factory tests 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. Test results shall be submitted as described in section 4.8.

6.3 Alternative Batteries

Once a beacon incorporating a particular type of battery has been successfully tested at a Cospas-Sarsat test facility and type approved by Cospas-Sarsat, subsequent upgrades to that battery are permitted without further type approval testing at a Cospas-Sarsat test facility, provided the beacon

manufacturer demonstrates that the changes do not degrade the performance of the 406 MHz beacon, as described below.

If a beacon manufacturer wishes to make changes to the type of battery after the beacon has been Cospas-Sarsat type approved, the change notice form in Annex H shall be completed and submitted to the Secretariat, together with test data, as per section 4.7, confirming that the substitute battery is at least technically equivalent to that used when the beacon was type approved. The beacon manufacturer shall submit technical information per Section 5, items "a" (part G.1 only), "c", "d", "e " (item' vii' only), "g", "k", "m" and "r".

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

6.3.1 Batteries Not Used in Beacons Tested at an Approved Facility

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

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

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

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

d) re-calculations and analysis of $EIRP_{EOL\ min/max}$ for all approved 406 MHz antenna models, based on results of the original type approval testing (sections B.10.3 and B.10.4), performed in accordance with guidance in section B.10.5; and

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

6.3.2 Batteries Used in Two Beacons Tested at an Approved Facility

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

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

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

c) re-calculations and analysis of $EIRP_{EOLmin/max}$ for all approved 406 MHz antenna models, based on results of the original type approval testing (sections B.10.3 and B.10.4), performed in accordance with guidance in section B.10.5; and

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

6.4 Internal Navigation Device

6.4.1 Inclusion or Removal of an Internal Navigation Device

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

In cases of a type approved beacon modified to remove an internal navigation device or new beacon models that have variants both with and without an internal navigation device, the variant with the internal navigation device shall be completely tested at a facility accepted by Cospas-Sarsat.

The variant without an internal navigation device shall undergo at a Cospas-Sarsat accepted facility the following testing:

a) electrical and functional tests at ambient temperature (section A.2.1), excluding Transmitted Frequency tests;

b) operating current measurements and analysis demonstrating that the load on the battery of beacon without the internal navigation device is not greater than the load measured for the beacon model variant with the internal navigation device;

c) beacon coding software test, which may also be performed by the beacon manufacturer; and

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

The beacon manufacturer shall provide detailed description of differences between variants with and without an internal navigation device.

For the variant without the internal navigation device, the beacon manufacturer shall submit to the Cospas-Sarsat Secretariat, technical information per Section 5, excluding items ”n” and “o”.

6.4.2 Change to Internal Navigation Device

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

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

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

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

If the change of internal navigation device results in higher battery loads, *or results in modifications to the beacon software (SW), firmware (FW) or printed-circuit board (PCB) layout and electronic components (other than GNSS chipset),* or might affect aspects of the beacon performance other than the position acquisition time and position accuracy, the scope of testing shall be determined by Cospas-Sarsat after reviewing a description of the proposed change*s* provided by the manufacturer.

Beacon manufacturer shall submit, to the Cospas-Sarsat Secretariat, technical information per Section 5, excluding items "i", "j (i-iii)", and "o".

6.5 Interface to External Navigation Device

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

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

a) electrical and functional tests (section A.2.1);

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

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

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

e) re-calculations and analysis of $EIRP_{EOLmin/max}$ for all approved 406 MHz antenna models, based on results of the original type approval testing (sections B.10.3 and B.10.4), performed in accordance with guidance in section B.10.5; and

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

In addition, the beacon manufacturer shall also provide technical data sheets describing the navigation interface unit and technical information as per Section 5, excluding items "a" (part G.2), "h", "i", "k", "l" and "n".

6.5.2 Modifications to Interface to External Navigation Device

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

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

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

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

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

For the modified beacon, the beacon manufacturer shall submit technical information per Section 5, excluding items "a" (part G.2), "h", "i", "j (i-iii)", "k", "l", "n".

6.6 Changes to Frequency Generation

6.6.1 Minor Changes to Frequency Generation

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

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

6.6.1.1 Change of Frequency

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

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

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

6.6.1.2 Change of Existing Oscillator

In the case of oscillator replacement with an identical oscillator* and no other changes are required to the beacon electronics, or in the case of a change of frequency if the

* 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.

modification includes changes to circuits external to the frequency oscillator/synthesiser (e.g., an external trimmer), the factory tests shall include:

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

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

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

d) oscillator ageing and MTS analysis (section A.3.5); and

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

6.6.1.3 Data Submission Requirements

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

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

b) the measurement results of required tests, in accordance with section 4.7; and

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

   i. oscillator type,

   ii. oscillator specifications, and

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

6.6.2 Changes to Frequency Generation which Might Affect Beacon Performance

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

The testing shall include:

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

b) thermal shock (section A.2.2);

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

d) frequency stability with temperature gradient test (section A.2.4);

e) oscillator ageing and MTS analysis (section A.3.5);

f) re-calculations and analysis of $EIRP_{EOLmin/max}$ for all approved 406 MHz antenna models, based on results of the original type approval testing (sections B.10.3 and B.10.4), performed in accordance with guidance in section B.10.5; and

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

The beacon manufacturer shall submit technical data per Section 5, indicated in items "a" (part G.1 only), "c", "d", "i", j(ii)," k"," m", "q" and "r".

6.7 Alternative Model Names for a Type Approved Beacon

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

The beacon manufacturer shall also submit technical data per Section 5, items "a" (part G.1 only), "e", "f", "h", "m" , "q" and "r".

6.8 Beacon Hardware or Software Modifications

Any change to the beacon hardware or software which might affect the beacon electrical performance not specifically addressed above shall also be supported by a change notice form (Annex H) and test results as appropriate. The scope of the testing and the required technical data will be determined by Cospas-Sarsat Secretariat, following consultation with the manufacturer and the test facility after a review of the proposed modifications.

In the case of beacon changes that affect the software used to encode the position received from the navigation device into transmitted message, these beacons shall be updated to use the latest location protocol rules and be retested in accordance with A.3.8.

As a minimum all changes must be supported by satellite qualitative tests (A.2.5).

6.9 Change of Beacon Manufacturer

In case of a transfer of ownership / manufacturing rights for the type-approved beacon model to another organisation, or a change of beacon manufacturer's name, an official letter shall be submitted to the Secretariat indicating:

a) nature of and date for the expected change;

b) the list of type-approved production and discontinued beacon models to be transferred (or rebranded);

c) indication of what organisation will be responsible for beacon production, maintenance of production standards, quality assurance, technical maintenance, repairs, battery replacement, customer support, and market distribution of the beacon model (not applicable for name change only);

d) whether a re-issue of type approval certificates in the name of new owner (or new company name) and changes to information published on Cospas-Sarsat website are required;

e) whether a revision of beacon manuals, marketing brochures and beacon labels is planned; and

f) any new points of contact for beacon engineering, type approval and customer care.

For each beacon model concerned, the new beacon manufacturer shall also complete and submit Annex L and the technical data per Section 5, items "a" (part G.1 only), "e", "f", "h", "m", "q" and "r".

6.10 Additional Variants and Types of Message Protocols

In cases when an additional variant of an earlier type approved type of message protocol is added, beacon manufacturer or an accepted test facility shall perform and submit results of the beacon coding software test.

In cases when an additional, not earlier approved type of message protocol is added, the modified beacon encoded with a variant of a new protocol type shall undergo at a Cospas-Sarsat accepted facility the following testing:

g) navigation system tests (section A.3.8), if applicable;

h) operating current measurements and analysis demonstrating that none of the currents recorded in Table F-E.1 are more than 1% greater than those measured prior to making the modification (which may be performed by the beacon manufacturer);

i) the operating lifetime at minimum temperature test (or a calculation demonstrating that with the increased current the beacon will still meet the minimum duration of continuous operation requirement), if the results of the measurements and analysis in b) show an increase in current;

j) beacon coding software test, which may be performed by the beacon manufacturer; and

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

Beacon manufacturer shall complete and submit Annex H and technical data per section 5, items "a" (part G.1 only), "d", "j(iv)", "j(v)" (if applicable), "m", "n", "o" (if applicable), and "r" and only if there are changes to the items "e" and "n".

6.11 Alternative Antennas

In cases of beacon modification to include an alternative antenna, such beacon shall undergo at a Cospas-Sarsat accepted facility the following testing*:

a) antenna tests (Annex B) in all declared configurations;

b) transmitter power output level at ambient temperature (section A.3.2.2.1); and

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

Beacon manufacturer shall complete and submit Annex H and technical data per Section 5, items "a" (part G.1 only), "b", "e", "f", "k", "l", "m", "q"(if applicable), and "r".

6.12 Request for an Additional TAC Number

In the case that additional serial numbers are required to encode a unique identification with the Serial User Protocol or Standard Serial Location Protocol†, the manufacturer shall submit a letter to the Cospas-Sarsat Secretariat that includes:

a) manufacturer information;

b) a request for an additional TAC number;

c) TAC number of the original type approval;

d) the TAC number(s) and associated model name(s) of beacons which are currently in production;

e) the date at which the depletion of the available serial numbers is anticipated; and

f) declaration that the design is unchanged from the approved model(s) and that the Quality Assurance Plan remains valid for the beacon models to be manufactured under newly requested TAC, or, if modifications to the approved beacon model(s) have occurred, provide Annex H and the updated Annex L.

* *For testing of ELT external fixed antennas at alternative reputable test facilities, please be referred to section 3.3.*

† Additional TAC request may also apply to RLS and ELT(DT) beacon IDs after production of RLS and ELT(DT) beacons commence.

6.13 Addition of the RLS capability

For changes to an earlier type approved beacon related to addition of RLS functionality, without modifications to the HW, beacon battery pack, antenna, electronic components, printed-circuit board (PCB) of the originally type-approved beacon model, unless otherwise specified, the tests identified below shall be conducted at a Cospas-Sarsat accepted facility:

a) electrical and functional tests at ambient temperature (section A.2.1).

b) battery current measurements and analysis of results comparing currents recorded in Table F-E.1 and battery energy consumption (specifically due to any increase of the GNSS receiver duty cycle as required for RLS) for the modified beacon against the one prior to the modification;

c) the operating lifetime at minimum temperature test (or a calculation demonstrating that, with the changes, the beacon will still meet the minimum duration of continuous operation requirement), if the results of the battery current measurements and analysis in b) show an increase in the energy consumption;

d) re-calculations and analysis of $EIRP_{EOLmin/max}$ for all approved 406 MHz antenna models, based on results of the original type approval testing (sections B.10.3 and B.10.4), performed in accordance with guidance in section B.10.5;

e) beacon coding software test (section A.2.8) - for the declared message protocols, which may be performed by the beacon manufacturer;

f) navigation system (section A.3.8.1 – A.3.8.7) - for the declared types of location protocols;

g) RLS tests (section A.3.8.8); and

h) satellite qualitative test (section A.2.5) in one test configuration.

If the addition of RLS functionality results in higher battery loads, and/or includes modifications to the beacon HW, electronic components, printed-circuit board (PCB), and/or might affect other aspects of the beacon performance which are not covered by the above tests, the scope of testing shall be determined by Cospas-Sarsat after reviewing a description of the proposed change provided by the manufacturer.

Beacon manufacturer shall submit, to the Cospas-Sarsat Secretariat, technical information per Section 5.1, excluding items "i", "j", and, subject to the beacon design and scope of modifications: items "p", "x", "v", "y".

– END OF SECTION 6 –

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

ANNEX A: BEACON MEASUREMENT SPECIFICATIONS

A.1 GENERAL

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

All measurements shall be performed with equipment and instrumentation which is in a known state of calibration, and with measurement traceability to National Standards. The measurement accuracy requirements for Cospas-Sarsat accepted test facilities are given in Annex A of C/S T.008. These measurement accuracies may be added to the beacon specification limits of C/S T.001 (thereby allowing a slight extra margin) when considering test results which are near the specification limit. For the Beacon Antenna Test Results (Table F-B.1 and Table F-B.3), the allowance cannot exceed a maximum 1 dB applied to no more than 4 measurement points (Table F-B.1), or 2 measurement points (Table F-B.3).

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

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

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

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

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

d) measuring the frequency of the output signal;

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

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

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

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

A suggested sequence for performing the tests described herein is shown in Table F.1 of Annex F, but the tests may be performed in any other convenient sequence. However, it is recommended that at the start of the type-approval testing, the test facilities:

- confirm that the beacon manufacturer has provided a statement (section 5, item "u") that the test beacons' 406-MHz transmitters are aligned in power or, alternatively, if the statement is not provided or the manufacturer requests verification, verify (only if all test beacons are provided with a suitable conducted test interface) the alignment by testing, in which case the results of this verification shall be included in the test report;
- verify that homer-transmitter output power and duty cycle settings correspond to the maximum values declared in Annex G;
- conduct measurements of battery current;
- perform an analysis of operating modes and system configurations, and define the beacon mode to be used for type-approval testing; and
- define the measurement interval for electrical tests listed in section A.2.1.

It is highly recommended that, when applicable, the tests requiring open air radiation be performed only after successful completion of conductive, non-radiation tests. For ELT(DT)s with external power source, it is recommended that additional testing described in section A.2.10 be performed prior to other conductive tests.

The test results are to be summarized and reported as shown in Annex F, with appropriate graphs attached as indicated.

A.2 TESTS REQUIRED

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

The tests specified in para. A.3.1 through para. A.3.3 (except A.3.2.2.3, antenna tests) are performed after the beacon under test, while turned off (except for ELT(DT)s which shall be in the ARMED mode), has stabilized for a minimum of 2 hours* at laboratory ambient temperature, at the specified minimum operating temperature, and at the maximum operating temperature. Except for testing in the self-test mode (per paragraph A.3.6), the beacon is then allowed to operate for 15 minutes before measurements are started, except for ELT(DT)s, for which measurements shall commence immediately after the ELT(DT) has been activated. The following parameters shall be measured at each of the three constant temperatures:

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

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

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

d) modulation, per para. A.3.2.~~3~~*5*;

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

f) spurious output, per para. ~~A.3.2.2.4~~*A.3.2.4*;

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

h) self-test mode and GNSS self-test mode (if applicable), per para. A.3.6.

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

The beacon under test, while turned off, is to stabilize at a selected temperature in its operating range. The beacon is then simultaneously placed into an environment held at 30 degrees C offset (50 degrees C for ELT(DT)s) from the initial temperature and turned on. The beacon is then allowed to operate for 15 minutes before measurements are started (except for ELT(DT)s for which measurements shall commence immediately) after the beacon activation to measure the following parameters:

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

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

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

* For beacons with weight of 2 kg and more, the manufacturer shall perform factory tests to define the time of the temperature stabilisation inside the beacon. If needed, a typical soaking time of two hours for all conductive tests shall be increased accordingly.

Frequency measurements are made continually for two hours. Stability analysis is performed for these frequency samples as in para. A.3.2.1 (except ELT(DT)s for which verification of the Medium-Term Frequency Stability characteristics is not required). The 18-sample analysis window of the stability calculations is advanced in time through the period such that each succeeding data set includes the latest frequency sample and drops the earliest one. Power output per para. A.3.2.2.1 and digital message checks per paragraph A.3.1.4 shall also be made continually throughout the two-hour period.

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

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

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

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

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

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

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

The operating lifetime at minimum temperature test is intended to establish with reasonable confidence that the beacon will function at its minimum operating temperature for the manufacturer-declared minimum operating lifetime, using a battery that has reached its expiration date[*]. To accomplish this, prior to the operating lifetime at minimum temperature test the beacon battery pack powering beacon circuits shall be discharged to take into account:

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

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

iii. the number of self-tests, as recommended by the beacon manufacturer and, when the function is included, the maximum number and maximum duration of GNSS self-test transmissions, over the rated life of the battery

[*] The beacon manufacturer shall provide data necessary to discharge a fresh battery pack at room temperature to account for current drain over the battery pack rated life time. The battery discharge figures provided by the beacon manufacturer shall be verified by the testing laboratory with current measurement results reported in the format of Table F-E.1 and pre-test battery discharge calculations reported in the format of Table F-E.2.

pack (the beacon manufacturer shall substantiate the method(s) used to determine the corresponding current drain(s)),

iv. the worst case depletion in battery power due to current draw that cannot be replicated during the operating lifetime at minimum temperature test, for example, to account for any difference between the actual output power setting of the test unit homer transmitter and the output power of the homer transmitter, as declared by the beacon manufacturer in Annex G, and

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

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

Measurements shall start after soaking of beacon at minimum temperature for 2 hours, upon beacon activation, without allowing a beacon warm-up. However, compliance to the medium-term frequency stability requirements (not applicable to ELT(DT)s) is applicable only for measurements taken 15 minutes after the test beacon activation, in accordance with C/S T.001 section 2.3.1.

If applicable, homer transmitter characteristics, including homer frequency, peak power level and transmitter duty cycle shall be measured during the operating lifetime at minimum temperature test at least in the beginning and at the end of the test and the results recorded in Table F.1.

For an ELT(DT) specifically designed to withstand a crash, the test facility shall review the justification provided by the beacon manufacturer related to which period of time prior and after crash sensor activation shall be applied in order to maximize the battery energy consumption during the test. In any case, duration of the worst case beacon operation prior to the crash sensor activation shall be at least 10 minutes. The justification for the selected testing configuration shall be included in the test report.

For an ELT(DT) combined with an Automatic ELT, the test facility shall operate the beacon in the worst case ELT(DT) mode for 370 minutes and in the worst case Automatic ELT mode for the remainder of the test (at least an additional 24 hours).

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

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

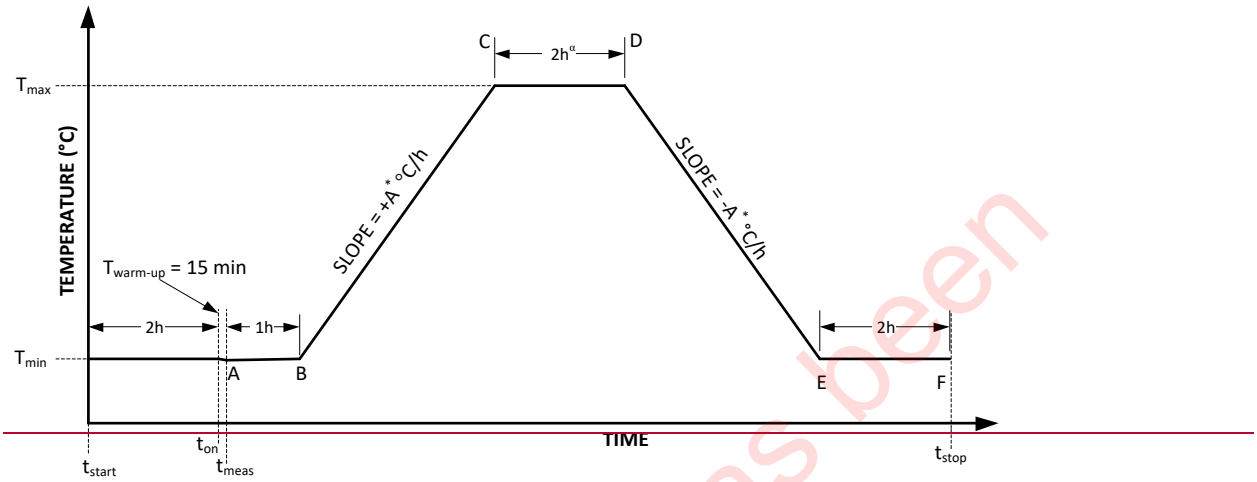
a) transmitted frequency, per para. A.3.2.1;

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

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

The 18-sample analysis window of the stability calculations is advanced in time through the period such that each succeeding data set includes the latest frequency sample and drops the earliest one. A 15-minute warm-up is allowed at the beginning of the test, after which measurements shall start, except ELT(DT)s, for which measurements shall start immediately after beacon activation.

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



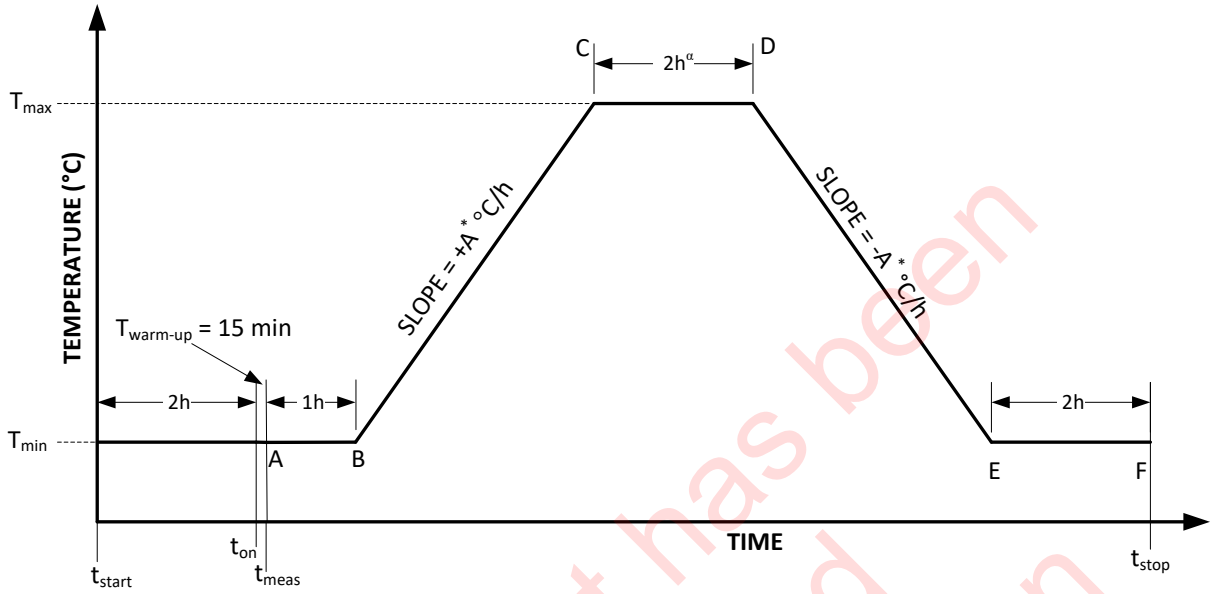
NOTES:

T_{max} = + 70°C (Class 0 beacon)
T_{max} = + 55°C (Class 1 & 2 beacons)

T_{min} = - 55°C (Class 0 beacon)
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, except for ELT(DT)s where $t_{meas} = t_{on}$)

A^* = 7°C/hour for Class 0 (45°C/hour for ELT(DT))
A^* = 5°C/hour for Class 1 and Class 2 (33°C/hour for ELT(DT))
α = For ELT(DT)s the time between points C and D is reduced on the down-ramp test to one (1) hour.



NOTES:

T_{max} = + 70°C (Class 0 beacon)
T_{max} = + 55°C (Class 1 & 2 beacons)

T_{min} = - 55°C (Class 0 beacon)
T_{min} = - 40°C (Class 1 beacon)
T_{min} = - 20°C (Class 2 beacon)

t_{start} = test start time (overall and up-ramp tests)
t_{stop} = test stop time (down-ramp and overall tests)

t_{on} = beacon turn-on time after 2 hour "cold soak"
t_{meas} = start time of frequency stability measurement (t_{on} + 15 min, except for ELT(DT)s where $t_{meas} = t_{on}$)

A^* = 7°C/hour for Class 0 (45°C/hour for ELT(DT))
A^* = 5°C/hour for Class 1 and Class 2 (33°C/hour for ELT(DT))
α = For ELT(DT)s the time between points C and D is reduced on the down-ramp test to one (1) hour.

Figure A.1: Temperature Gradient Test Profile

Table A.1: Medium-Term Frequency Stability Requirements During Temperature Gradient Test (Except for ELT(DT)s)

Points in Figure A.1	Requirements	
	Mean Slope, x10^{-9}/min	**Residual frequency variation, x10^{-9}**
During warm-up	No Requirement	No Requirement
A to B	-1.0 to +1.0	≤ 3.0
B to C+15 minutes	-2.0 to +2.0	
C+15 minutes to D	-1.0 to +1.0	
D to E+15 minutes	-2.0 to +2.0	
E+15 minutes to F	-1.0 to +1.0	

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

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

This test shall be performed in environment(s) which approximate, as closely as practicable, the intended use of the beacon. Required test configurations are shown in Figure 4.2 and are dependent on the manufacturer's declaration of Operational Configurations in Annex G.

The test beacon shall have its own antenna connected and shall be coded with a test protocol of appropriate type and format (see sections 4.3 and A.3.1.4). Other parameters of the test beacon message coding including "Country Code" shall be set in coordination with the MCC.

For testing of beacons with external/remote antennas, the antenna cable assembly used in the test shall have at least the maximum declared insertion loss (see section 5 "l"). For such beacons, the antenna cable assembly may be provided by a beacon manufacturer, in which case its loss at 406 MHz shall be verified by the test facility.

The beacon shall be turned on for 15 minutes prior to the start of this test and then operated in the open for at least 5 LEOSAR satellite passes characterised by cross track angles between 1 and 21 degrees, and with bursts that bracket the satellite time of closest approach (TCA) to the beacon.

The pass/fail criteria are as follows:

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

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

For beacons with the RLS function, the test shall commence without a 15 minute warm up period, then within 15 minutes after activation of the beacon, the beacon shall indicate reception of the Type 1 acknowledgement as indicated in document C/S T.001, section 4.5.7.3.

For ELT(DT)s, the test shall commence without a 15-minute warm-up period after activation. Also for ELT(DT)s, the test data shall be obtained from MEOSAR satellites rather than LEOSAR. The test shall be performed at a known location 3 times for a period of between 15 to 20 minutes each time separated by a period of 5 to 7 hours between *the end of* ~~each~~ *the previous and beginning of the subsequent* test, when there are at least 4 MEOSAR satellites in co-visibility with the ELT(DT) and MEOLUT capable of tracking the satellites in question (either L-or S-Band or a combination of these).

The pass/fail criteria for ELT(DT)s is as follows:

a) the MEOLUT shall produce an alert with a complete beacon message, including the correct beacon 15 hexadecimal identification, at least once every minute for greater than 90% of the total test time;

b) the encoded location provided by the MEOLUT for each alert in a) above shall be accurate in the horizontal plane to within 200 metres for greater than 90% of the alerts. For ELT(DT)s that transmit the 3LD in PDF-2, all bursts that provide the 3LD in PDF-2 instead of the fine encoded location shall be omitted from this calculation; and

c) the encoded location provided by the MEOLUT for each of the alerts in a) above shall be accurate in the vertical plane such that the altitude above sea level* is correctly reported as follows:

i. if the actual test location altitude above sea level is within 200 metres† of one of the encoded altitude band edges, then the ELT(DT) either reports the altitude band or reports the adjacent band on the side that is within 200 metres, or

ii. alternatively if the actual test location altitude above sea level is not within 200 metres of one of the encoded altitude band edges, then the ELT(DT) reports that altitude band, and

iii. in both cases the correct altitude band (see C/S T.001 Section A3.3.2.4) shall be reported as defined above for greater than 90% of the correctly decoded bursts.

Successful completion of this test shall be indicated by a "√" in Table F.1, *test parameters 14-a and 14-b,* and ~~a "~~*the "*Satellite Qualitative ~~Test~~ *Test* ~~Summary~~ *Summary* ~~Report~~ *Report" forms* (~~Appendix~~ *Appendix* A*1 and Appendix A2* to Annex F)~~2~~ shall be *completed and* provided for each operational configuration tested.

For beacon types, other than ELT(DT), ~~The~~ *the* "Satellite Qualitative Test ~~Summary~~ *Summary* Report~~s~~" *(Appendix A1 to Annex F)* shall ~~indicate~~ *be provided for* all LEOSAR satellite passes with cross track angles between 1 and 21 degrees for the *full* period of the testing, even if a solution was not produced by the LEOLUT.

For ELT(DT)s, LEOSAR passes do not apply, and instead, *the* ELT(DT) *the "Satellite Qualitative Test Summary Report (for ELT(DT)" form (Appendix A2 to Annex F)* ~~test report~~ shall *be provided for alerts received via MEOSAR and* indicate the time of the tests and tracking schedule of the MEOLUT supporting the tests (including starting and ending azimuth and elevation of each MEOSAR satellite tracked during the test).

* The test shall be performed at an altitude of less than 4000 metres above sea level.

† The requirement for the accuracy of the altitude-band encoded in the transmitted message relative to the actual altitude of the ELT(DT) at the time of position update is not derived from a requirement in document C/S T.001, but should be used for the purposes of evaluating the beacon performance in this and related tests (i.e., A.2.5, A.3.8.2).

Photos of the beacon with the antenna deployed shall be included in the report for all tested configurations.

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

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

For testing of EPIRBs and other beacon types intended for operation while floating in water, position of floatation line shall be verified by placing a fully-packaged test beacon in fresh water (i.e., domestic tap water).

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

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

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

Please note:

a) navigation tests shall be performed for one variant of each of the declared User-Location, Standard Location, National Location, ELT(DT) Location and RLS Location protocols;

b) simulators shall not be used to replicate signals from GNSS satellites, unless stated otherwise;

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

d) when GNSS simulators are used, the peak level of a simulated navigation signal (per simulated satellite) shall be no higher than -123 dBm for all tests, except the Position Acquisition Time and Position Accuracy test, for which the peak level of a signal (per simulated satellite) shall be set to no higher than -130 dBm. For ELT(DT)s, the GNSS simulator shall also be able to simulate movement of the ELT(DT) at speeds of at least 1,000 km/h and with an altitude range from -100 m to 11,000 m;

e) for RLS-enabled beacons, the correct activation of the RLS indicator shall be verified; and

f) unless specifically stated otherwise, for ELT(DT)s that transmit the 3LD in PDF-2, for all the tests in section A.3.8, transmitted bursts with the 3LD in PDF-2 shall be ignored.

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

The digital message for each beacon message protocol supported by the beacon shall be verified at ambient temperature according to A.3.1.4. This test shall evaluate messages transmitted in operational, self-test, and, if applicable, GNSS self-test modes, for each of the declared beacon message protocols, and, for the purposes of type-approval testing, *for* test *protocols* of the declared types of message protocols.

For ELT(DT)s that transmit the 3LD in PDF-2 both variants of PDF-2 shall be validated (the fine encoded location and the aircraft operators 3LD). In addition, when validating the correct application of the rotating field in PDF-2, PDF-1 shall also be checked to ensure that the beacon message in PDF-1 is the same for both variants of PDF-2.

For the purpose of validating specific beacon message protocols, the beacon shall be programmed in accordance with the guidance provided at Annex C.

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

For RLS-enabled beacons check the correct operation of the RLS indicator for the RLS message protocol.

For beacons encoded with National-User (long format) protocol, verify that bits 1 to 106 remain fixed at all times after beacon activation, and bits 107 onwards are updated not more frequently than once every 20 minutes, by changing conditions declared by the beacon manufacturer (see section 5, technical data item “j-(v)”).

The content of the complete digital messages for operational, self-test and, if applicable, GNSS self-test transmissions (including frame synchronisation bits 1-24) shall be included in the test report as per Appendix D to Annex F, and full transcripts of the decoded digital messages shall be provided.

This test can be conducted either by the test laboratory or by the beacon manufacturer. If performed by the beacon manufacturer, the manufacturer shall provide the test laboratory a formal report with content as required or equivalent to Appendix G to Annex F (Part F.7) with the required test results for verification and inclusion in the test report. The test laboratory shall check the results provided by the manufacturer for correct format and content, or, if not provided, or the manufacturer requests verification, perform the test and annotate Table F.1 with a “tick”, if all beacon messages for all protocols are compliant with Cospas-Sarsat requirements.

A.2.9 Testing Beacons Designed to Transmit Short- or Long-Format Messages

If a beacon is designed to allow encoding with either long format or short format messages, all tests shall be performed using long format message. In addition, beacon encoded with a short format message shall be subjected to:

a) Electrical and Functional tests (as per A.2.1) at ambient temperature, excluding Transmitter Power Output, Spurious Output, VSWR check and Transmitted Frequency tests; and

b) Beacon Coding Software test.

A.2.10 Testing ELT(DT)s Capable of Operating with External Power Source*

A.2.10.1 Additional Testing Required for ELT(DT) with External Power Source

ELT(DT)s capable of operating (transmitting satellite distress alerts on 406 MHz) when powered from an external power source shall be subjected to a combined test which is a variation of the Electrical and Functional Tests at Constant Temperature and the Frequency Stability ~~Test~~ with Temperature Gradient *Test*, followed by a Position Acquisition Time and Position Accuracy Test, in order to demonstrate compliance with the requirement in document C/S T.001 section 4.5.11.

It is recommended, that the testing described in this section be conducted prior to other conductive tests.

A.2.10.2 Combined Constant Temperature and Frequency Stability Test

The ELT(DT), while turned off, is to stabilize (soak) for 2 hours at the specified maximum operating temperature for the ELT(DT) (either Class 0, 1 or 2), as declared by the beacon manufacturer in the technical details as per section 5, and Annex G. The ELT(DT) is to be denied a GNSS radiated signal, such that it cannot obtain a GNSS location for the duration of this test.

The ELT(DT) is then activated while being powered from the external power supply set to the maximum normal input voltage, as declared by the beacon manufacturer in the technical details as per section 5, and Annex G and is maintained at its specified maximum operating temperature for a period of 20 minutes plus or minus 2 minutes.

During this period the following tests are performed:

a) transmitter power output tests, as per sections A.3.2.2.1 and A.3.2.2.2;
b) digital message test, as per section A.3.1.4;
c) digital message generator tests, as per sections A.3.1.1, A.3.1.2, and A.3.1.3;
d) modulation test, as per section A.3.2.3;
e) 406 MHz transmitted frequency tests, as per sections A.3.2.1.1 and A.3.2.1.2; and

* The external power supply voltages and currents shall be logged for the duration of all tests involving the external power supply.

f) spurious output test, as per section A.3.2.2.4.

The ELT(DT) is then reset (i.e., deactivated) and left in that state for a period of between 3 and 5 minutes before starting the next part of this test.

The ELT(DT) is then activated again and subjected to the testing below, over the temperature gradient specified in Figure A.2,

During this period the following tests are performed:

a) transmitter power output tests, as per sections A.3.2.2.1 and A.3.2.2.2;
b) digital message test, as per section A.3.1.4;
c) digital message generator tests, as per sections A.3.1.1, A.3.1.2, and A.3.1.3;
d) modulation test, as per section A.3.2.3;
e) 406 MHz transmitted frequency tests, as per sections A.3.2.1.1 and A.3.2.1.2; and
f) spurious output test, as per section A.3.2.2.4.

After the test has commenced, the external power supply shall be turned off and on in the following sequence, and then shall be left on until 15 minutes before the end of the gradient portion of the test.

Time from the Start of Test (T)	External Power Supply	Comments
T = 0	Turn on	ELT(DT) runs on external power supply
T = 2 min 30 sec +/- 5 sec	Turn off	ELT(DT) runs on internal battery
T = 3 min 30 sec +/- 5 sec	Turn on	ELT(DT) runs on external power supply
T = 4 min 30 sec +/- 5 sec	Turn off	ELT(DT) runs on internal battery
T = 5 min 30 sec +/- 5 sec	Turn on	ELT(DT) runs on external power supply

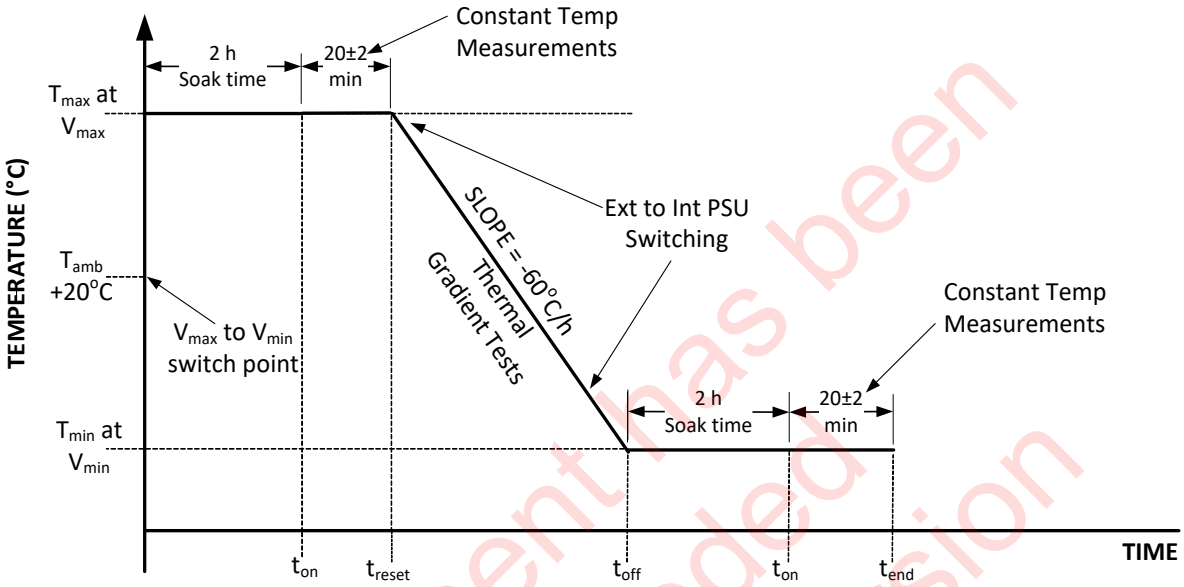
Note that when the ELT(DT) power supply is switched from the external power supply to the internal battery and back again, the transmission repetition interval shall continue uninterrupted, i.e., it shall not reset and restart transmitting once every 5 seconds.

At the point at which the temperature reaches +20°C +/- 5°C, the external power supply is then set to the minimum normal external power supply voltage, as declared by the beacon manufacturer in the technical details as per section 5, and Annex G, for the remaining portion of the test.

Fifteen minutes before the end of the test, the external power supply shall be turned off and on in the following sequence and then shall be left on until the end of the test.

Time before the End of Test (EOT)	External Power Supply	Comments
EOT – 15 min +/- 10 sec	Turn off	ELT(DT) runs on internal battery
EOT – 12 min +/- 10 sec	Turn on	ELT(DT) runs on external power supply
EOT – 9 min +/- 10 sec	Turn off	ELT(DT) runs on internal battery
EOT – 6 min +/- 10 sec	Turn on	ELT(DT) runs on external power supply

Note that when the ELT(DT) power supply is switched from the external power supply to the internal battery and back again, the transmission repetition interval shall continue uninterrupted, i.e., it shall not reset and restart transmitting once every 5 seconds.



NOTES:

T_{max} = + 70°C (Class 0 beacon)
T_{max} = + 55°C (Class 1 & 2 beacons)

T_{min} = - 55°C (Class 0 beacon)
T_{min} = - 40°C (Class 1 beacon)
T_{min} = - 20°C (Class 2 beacon)

t_{on} = beacon turn-on time after 2 hour "soak"
t_{reset} = beacon reset by turning off and then back on a few minutes later

Figure A.2: External Power Source Temperature Profile

The ELT(DT) is then powered off and left off to soak at minimum temperature for a period of two hours before starting the next part of this test.

The ELT(DT) is then powered on from the external power supply set to the minimum normal input voltage as declared by the beacon manufacturer in the technical details as per section 5, and Annex G and is maintained at its minimum specified operating temperature for a period of 20 minutes plus or minus 2 minutes.

During this period the following tests are performed:

a) transmitter power output tests, as per sections A.3.2.2.1 and A.3.2.2.2;
b) digital message test, as per section A.3.1.4;
c) digital message generator tests, as per sections A.3.1.1, A.3.1.2, and A.3.1.3;
d) modulation test, as per section A.3.2.3;

e) 406 MHz transmitted frequency tests, as per sections A.3.2.1.1 and A.3.2.1.2; and
f) spurious output test, as per section A.3.2.2.4.

On completion of the above tests the ELT(DT) is powered off and returned to room temperature and is allowed to stabilise at room temperature for a minimum period of 2 hours before performing any further tests.

Transmitted bursts and their message content that occurred either during a switching interval or within 2 seconds following a switching interval shall be excluded from the 18-burst analysis.

The results of the above tests shall be recorded in Table F.1.

A.2.10.3 Position Acquisition Time and Position Accuracy Test

The ELT(DT) shall then be subjected to the Position Acquisition Time and Position Accuracy Test per para A.3.8.2.

The ELT(DT) shall be activated while being powered from the external power supply set to the maximum external power supply voltage, as declared by the beacon manufacturer in the technical details as per section 5, and Annex G, and shall be maintained at ambient operating temperature for the duration of the test.

Then perform tests A.3.8.2.1 and A.3.8.2.2. If the ELT(DT) is capable of accepting data from an external navigation device, then this input shall be disabled for both of these tests.

At the completion of the test turn the ELT(DT) off and wait for a period of 2 hours (if applicable the GNSS Simulator is left running during this time).

The ELT(DT) shall then be powered on from the external power supply set to the minimum normal input voltage as declared by the beacon manufacturer in the technical details as per section 5, and Annex G and shall be maintained at ambient operating temperature for the duration of the test.

The tests in sections A.3.8.2.1 and A.3.8.2.2 are then repeated, in both cases if the ELT(DT) is capable of accepting data from an external navigation device then this input shall be disabled for these tests.

The results of the above tests shall be recorded in Table F.1.

A.3 MEASUREMENT METHODS

A.3.1 Message Format and Structure

The repetition period T_R and the duration of the unmodulated carrier T_1 are illustrated in Figure A.3. (Note: many of the following measurements can be performed on the same set of at least 18 bursts).

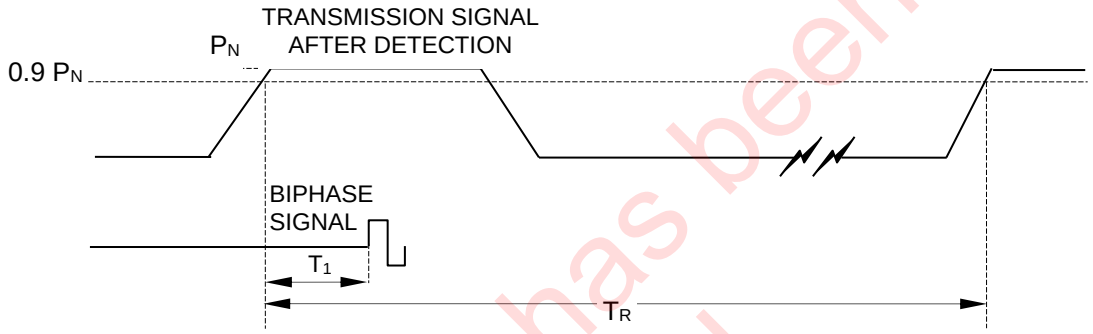


Figure A.3: Transmission Timing

A.3.1.1 First Burst Delay and Repetition Period

The first burst delay (FBD) is the time interval between the time of an action to activate beacon and the time of the beginning of the first operational burst, defined as the time when the beacon transmitter reaches 90% of the nominal transmit power P_N (see Figure A.3).

As specified in section 4.5.6 of C/S T.001, the FBD value shall not be less than 47.5 seconds for all beacon types, except for ELTs when activated automatically by G-switch / deformation, and for ELT(DT)s, for which the value of FBD shall not exceed:

i. 15 seconds - for ELTs activated by G-switch/deformation, and*
ii. 5 seconds - for ELT(DT)s .

The value of measured FBD shall be recorded in Table F.1.

If there are 406 MHz self-test bursts observed prior to the first operational 406 MHz burst, these observations shall be recorded in the test report and reflected in Table F.1.

A.3.1.1.1 Repetition Period – All Beacons Except ELT(DT)s

The repetition period, T_R, between the beginnings of two successive transmissions (see Figure A.3) shall be randomised over the range of 47.5 to 52.5 seconds.

* This requirement is mandatory to new beacon models submitted for type-approval testing at accepted test facilities after 1 January 2018-.

At least 18 successive measurements shall be made and the difference between the maximum and minimum repetition periods shall be more than 4 seconds. The average repetition period shall be 50s ± 1.5s. The standard deviation of the 18 values of T_R shall be between 0.5 and 2.0 seconds. The minimum value of T_R observed shall be between 47.5 and 48.0 seconds, the maximum value of T_R observed shall be between 52.0 and 52.5 seconds. The standard deviation, average, maximum and minimum values of T_R shall be recorded in Table F.1.

A.3.1.1.2 Repetition Period - ELT(DT)s Not Transmitting the 3LD in PDF-2

For ELT(DT)s not transmitting the 3LD aircraft operator designator in PDF-2 the repetition period, T_R, between the beginnings of two successive transmissions (see Figure A.3) shall be randomised over the range of 27.0 to 30.0 seconds after the transmission of the 42th burst (which occurs approximately 300 seconds after activation). From burst number 1 to burst number 24 (corresponding approximately to the first 120 seconds after activation), the repetition period shall be 5.0 seconds (+0/ -0.2s) without randomisation. From burst number 24 to burst number 42 (corresponding approximately to the period of between 120 seconds and 300 seconds after activation), the repetition period shall be 10 seconds (+0/ -0.2s) without randomization. The results of the repetition period measurements during the first 42 bursts shall be recorded in Table F.1. At least 18 successive measurements shall be made after the 42nd burst. The standard deviation of at least 18 measured values of T_R shall be greater than 0.8 seconds. The minimum value of T_R observed shall be between 27.0 and 27.2 seconds, the maximum value of T_R observed shall be between 29.8 and 30.0 seconds. The standard deviation, average, maximum and minimum values of T_R shall be recorded in Table F.1.

A.3.1.1.3 Repetition Period - ELT(DT)s Transmitting the 3LD in PDF-2

For ELT(DT)s transmitting the 3LD aircraft operator designator in PDF-2, all transmissions containing the 3LD in PDF-2 after burst number 24 shall be ignored when calculating the repetition period, T_R, as defined in section A.3.1.1.2. In addition, for ELT(DT)s transmitting the 3LD in PDF-2, transmissions shall be monitored for a period of at least 60 minutes from activation. During this time, transmissions shall be monitored to ensure that bursts containing the 3LD in PDF-2 comply with the burst transmission scheme in C/S T.001 Figure 2.1 and Section 2.2.1.

A.3.1.1.4 Repetition Period - ELT(DT)s Specifically Designed to Withstand a Crash and Not Transmitting the 3LD in PDF-2

For ELT(DT)s specifically designed to withstand a crash, the repetition period after activation of the crash sensor shall be:

- 5.0 seconds (+0.0/ -0.2s) without randomization for burst number 1 to burst number 24,
- 10.0 seconds (+0.0/ -0.2s) without randomization for burst number 24 to burst number 42,
- randomized over the range of 27.0 to 30.0 seconds for burst number 42 to burst number 95 , with:
  - the standard deviation of at least 18 measured values of T_R shall be greater than 0.8 seconds,

  - the minimum value of observed T_R shall be between 27.0 and 27.2 seconds,
  - the maximum value of observed T_R shall be between 29.8 and 30.0 seconds.
- randomized over the range of 115.0 to 125.0 seconds after burst number 95, for at least 18 measured values of T_R, with:
  - the standard deviation shall be greater than 2.5 seconds,
  - the minimum value of observed T_R shall be between 115.0 and 115.2 seconds,
  - the maximum value of observed T_R shall be between 124.8 and 125.0 seconds.

A.3.1.1.5 Repetition Period - ELT(DT)s Specifically Designed to Withstand a Crash and Transmitting the 3LD in PDF-2

For ELT(DT)s specifically designed to withstand a crash and transmitting the 3LD aircraft operator designator in PDF-2, all transmissions containing the 3LD in PDF-2 after burst number 24 shall be ignored when calculating the repetition period, T_R, as defined in section A.3.1.1.4. In addition, for ELT(DT)s specifically designed to withstand a crash and transmitting the 3LD in PDF-2, transmissions shall be monitored for a period of at least 60 minutes from activation. During this time, transmissions shall be monitored to ensure that bursts containing the 3LD in PDF-2 comply with the burst transmission scheme in C/S T.001 Figure 2.1, Section 2.2.1 and Section 4.5.10.3 (that is bursts containing the 3LD in PDF-2 are not required to be transmitted beyond burst number 100 after crash detection).

A.3.1.1.6 Repetition Period – ELT(DT)s Combined with an Automatic ELT and Not Transmitting the 3LD in PDF-2

For ELT(DT)s combined with an automatic ELT and not transmitting the 3LD aircraft operator designator in PDF-2, when activated as an ELT(DT) transmissions, shall comply with section A.3.1.1.2.

When activated as an Automatic ELT or if transitioning from an ELT(DT) to an Automatic ELT, then the combined device shall commence the burst repetition requirements for a non-ELT(DT) 406 MHz beacon in compliance with section A.3.1.1.1.

A.3.1.1.7 Repetition Period – ELT(DT)s Combined with an Automatic ELT and Transmitting the 3LD in PDF-2

For ELT(DT)s combined with an automatic ELT and transmitting the 3LD aircraft operator designator in PDF-2, when activated as an ELT(DT), all transmissions containing the 3LD in PDF-2 after burst number 24 shall be ignored when calculating the repetition period, T , in accordance with section A.3.1.1.2. In addition, for ELT(DT)s combined with an automatic ELT and transmitting the 3LD aircraft operator designator in PDF-2, when activated as an ELT(DT), transmissions shall be monitored for a period of at least 60 minutes from activation. During this time, transmissions shall be monitored to ensure that bursts containing the 3LD in PDF-2 comply with the burst transmission scheme in C/S T.001 Figure 2.1 and Section 2.2.1

When activated as an Automatic ELT or if transitioning from an ELT(DT) to an Automatic ELT, then the combined device shall commence the burst repetition requirements for a non-ELT(DT) 406 MHz beacon in compliance with section A.3.1.1.1, except that for the first 5 minutes after

activation as an automatic ELT, transmissions shall alternate between the encoded location and the 3LD in PDF-2, starting with the encoded location.

A.3.1.1.8 Repetition Period – Repetitive Testing

In the event that the testing in sections A.3.1.1.1 to A.3.1.1.7 does not demonstrate conformance to the minimum or maximum T_R, requirements, the test may be repeated a maximum of three times. If the test is repeated, the results for each shall be recorded in Table F.1.

A.3.1.2 Duration of the Unmodulated Carrier

The unmodulated carrier duration, T_1, between the beginning of a transmission and the beginning of the data modulation (see Figure A.3) shall satisfy the following requirement, where the values are derived from at least 18 successive measurements:

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

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

A.3.1.3 Bit Rate and Stability

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

i. for all beacons except those below 396 bps $\leq f_b \leq$ 404 bps, and

ii. for ELT(DT)s and those with RLS Location Protocol 399.6 bps $\leq$ fb $\leq$ 400.4 bps.

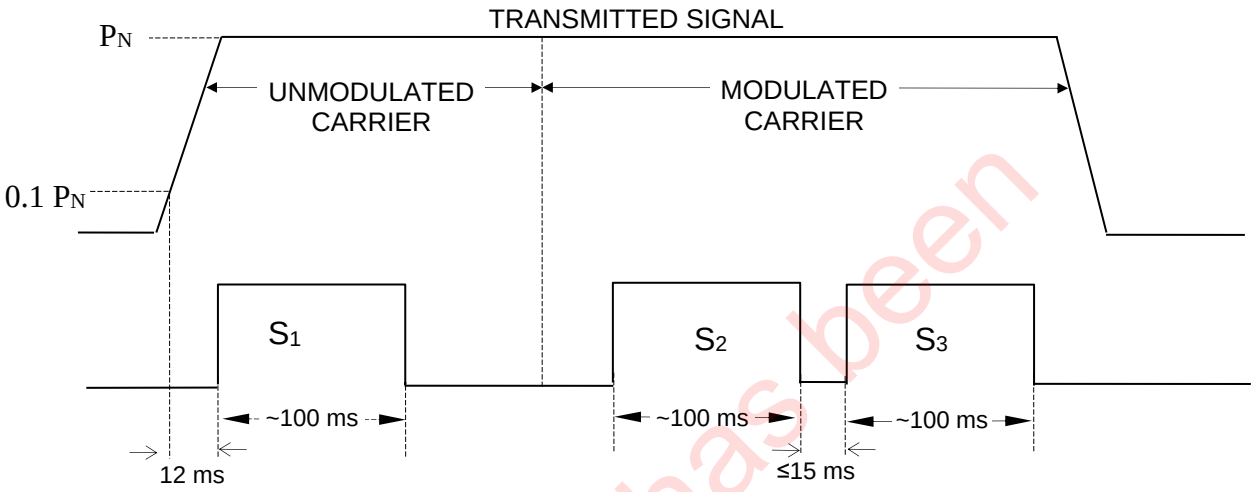
The maximum and minimum values of f_b are to be recorded in Table F.1.

A.3.1.4 Message Coding

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

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

A.3.2 Modulator and 406 MHz Transmitter



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

Figure A.4: Definition of Measurement Intervals

A.3.2.1 Transmitted Frequency

Frequency measurements shall be made during each transmission, either directly at 406 MHz or at a stable down-converted frequency, during various intervals of approximately 100 milliseconds, as shown in Figure A.4.

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

A.3.2.2 Nominal Value

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

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

where n=18

A.3.2.2.1 Short-Term Stability

The short-term frequency stability shall be 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:

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

where n=18

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

A.3.2.2.2 Medium-Term Stability (not applicable to ELT(DT)s)

The medium-term frequency stability shall be derived from measurements of $f_i^{(2)}$ made over 18 successive transmissions at instants t_i (see Figure A.5).

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:

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

where n=18

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

† With a transmission repetition period of approximately 50 seconds, there will be 18 measurements during an approximate 15 minute period (i.e. n=18). The time reference for this group of 18 measurements is to be taken as the time of the last measurement in the group, (i.e. t_n). When reporting results of the medium-term frequency stability, the values of calculated mean slope (A) and residual frequency variation (σ) shall be divided by the value of the mean transmission frequency (f_0), defined in section A.3.2.1.1.

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:

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

where n=18

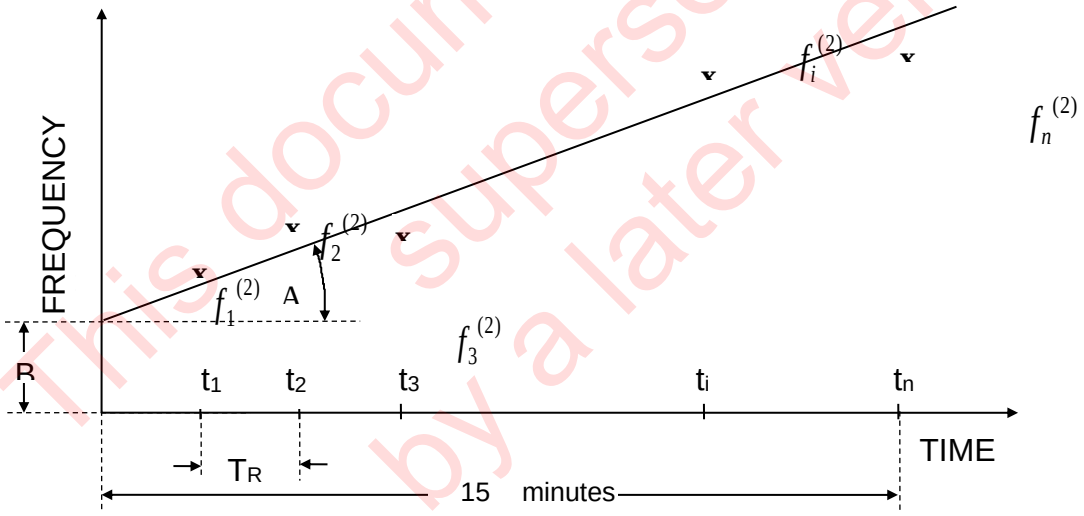

Figure A.5: Medium-Term Frequency Stability Measurement (not to scale)

A.3.2.3 Transmitter Power Output

A.3.2.3.1 Transmitter Power Output Level

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

The minimum and maximum values of transmitter output power measured over the full test interval shall be reported in Table F.1.

A.3.2.3.2 Transmitter Power Output Rise Time and Power Level 1 ms Before Burst

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). To reduce possible variation of measurement results due to noise, it is recommended to repeat the test 10 times and average the results of the output power level 1 ms before the burst.

The minimum and maximum values of transmitter output power measured over the full measurements interval, the power output rise time and the power output 1 ms before burst shall be reported in Table F.1.

A.3.2.3.3 Antenna Characteristics

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

For antennas tested separately from beacons, either the procedures of Annex B (with “Beacon Under Test” replaced by “Antenna Under Test” where appropriate), or equivalent conventional antenna range test procedures may be used to demonstrate the antenna radiation pattern. In any case, the test results for all beacons except ELT(DT)s shall demonstrate that the antenna, when receiving an input power level of 37 dBm produces an EIRP within the limits 34 dBm to 41 dBm for at least 90% of the measurement coordinates of Annex B, except for Figure B.5 configuration, in which it shall produce EIRP within the limits 32 dBm to 41 dBm for at least 80% of the measurement coordinates.

ELT(DT)s shall demonstrate that the antenna, when receiving an input power level of 37 dBm produces an EIRP within the limits 35 dBm to 43 dBm for at least 90% of the measurement coordinates for the test configuration described in Figure B.3 of Annex B.

A.3.2.4 Spurious Output

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

instrumental settings of spectrum analyzer (e.g., resolution bandwidth, video bandwidth, sweep time, frequency span, etc.) and depicting the complete 406.0 MHz to 406.1 MHz band.

A.3.2.5 Modulation

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 and are different for ELT(DT)s.

The modulation characteristics measurement* shall 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.

The minimum and maximum values of the modulation index and modulation rise and fall times, and the maximum value of modulation symmetry shall be reported in Table F.1.

A.3.3 Voltage Standing-Wave Ratio

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

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

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

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

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

A.3.4 Protection Against Continuous Transmission

If possible, the protection against continuous transmission shall be checked by inducing a continuous transmission from the beacon under test. However, if the beacon manufacturer has

* Any overshoot observed in the modulation index (as illustrated in Figure 2.5 of C/S T.001) can be disregarded if its amplitude does not exceed 10% of the specification limit and its duration does not exceed 10% of a half-bit period. This means that the overshoot can be ignored if the absolute value of the modulation index remains within these limits. That is, the modulation index may go out of the specification limits (1.0 to 1.2 radians) momentarily following the phase transition, provided the absolute value of the modulation index remains between 0.90 radians and 1.32 radians (1.0 - 10% and 1.2 + 10%), and returns to the normal specification in less than 0.125 ms (10% of the half-bit period of 1.25 ms) after it departed from those limits. Any overshoots shall be analysed by the test laboratory and a statement regarding whether they can be disregarded shall be provided as comments to items 4 or 7 of Table F.1.

determined that this test is not feasible for his beacon, he must provide a technical explanation which demonstrates that his design complies with the specification.

A.3.5 Oscillator Aging

Long-term frequency stability shall be demonstrated by data (e.g. oscillator manufacturer's test data) provided by the beacon manufacturer to the test facility.
For oscillators which require compensation over the operating temperature range, measurement results and a technical analysis shall be provided to substantiate that the medium-term stability would remain within specification after five years [*] [†].

A.3.6 Self-test Mode

The manufacturer shall provide a list of the parameters that are monitored in the self-test mode (see Annex G). If a GNSS self-test is also provided for, this shall be noted and any additional parameters included.

The presence of a GNSS self-test mode shall be verified for an ELT(DT). The testing of GNSS self-test mode shall be done according to section A.3.6.3.

A.3.6.1 Testing the Self-Test Mode

The test shall verify that the self-test mode:

a) results in a single self-test burst transmission,

b) does not cause any operational mode transmissions,

c) terminates automatically, irrespective of the switch position, immediately after completion of the self-test cycle and indication of the self-test results, and

d) has a duration that does not exceed the maximum value declared in Annex G.

The duration of the 406 MHz burst shall be measured, the frame synchronization pattern shall be checked and, if applicable, the encoded location checked for correct default code.

[*] The requirement can be addressed for example by measuring the medium-term stability on a batch of oscillators over a period of at least 6 months and extrapolating the results over 5 years. This can be achieved by testing a batch of at least 20 oscillators which should be measured every 4 to 6 weeks over a period of at least 6 months. The change in the medium-term slope and residual components should be calculated for each oscillator in a batch. The extrapolated results for at least 90% of the oscillators tested shall meet the performance requirements of the document C/S T.007. It is expected that any oscillator variants will be separately tested unless the manufacturer can demonstrate that they are technically equivalent to the tested oscillator.

[†] The test facility shall perform and report the results of the technical analysis to determine compliance of 406 MHz beacons equipped with a TCXO with Cospas-Sarsat type approval requirements, per C/S IP(TCXO).

ELT(DT)s coded with a 3LD in PDF-2 shall be checked to ensure that they transmit a long message with default location data in PDF-1 and the rotating field and the encoded 3LD in PDF-2 (if the ELT(DT) is capable of transmitting a 3LD in PDF-2 but has not been coded with a 3LD then the default 3LD shall be used).

The test shall verify that activation of the Self-test Mode results in distinct indications that:

a) the self-test mode has been initiated;

b) RF-power is being emitted at 406 MHz and at 121.5 MHz, if applicable;

c) the Self-test has passed successfully, or has failed;

d) the beacon battery may not have sufficient energy to support beacon operation for the manufacturer-declared minimum operating lifetime (note distinct indication of sufficient energy is not mandatory; and

e) only when an RLS-capable beacon is coded with the RLS Location Protocol (i.e., the RLS functionality is enabled), the RLS and RLM indicator(s) operate as described in section 4.5.4 e) of document C/S T.001.

The Self-test Mode shall be tested to verify that any transmission is limited to one self-test burst only.

For beacons with interface to external navigation device or for beacons that have an internal GNSS receiver that is capable for independent operation, the self-test mode test at ambient temperature shall be performed as follows. During the test, a navigation signal shall be provided and sufficient time shall be allowed for position acquisition to be obtained by an internal GNSS receiver or for position data to be acquired from the external navigation device, prior to initiating a self-test.

All beacons capable of transmitting encoded location data shall be subjected to the self-test navigation test scripts contained in Annex D.

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

Observations and results of the Self-test Mode test shall be recorded in the Table F-E.3, and reflected in the Summary of test results table, Table F-1.

A.3.6.2 Testing Self-test Insufficient Battery Energy

The test is aimed to verify that the beacon, when activated in self-test mode, provides a distinct indication of Potentially Insufficient Battery Energy (PIE), i.e. that the remaining battery energy could be not sufficient to support the manufacturer-declared minimum operating lifetime.

A.3.6.2.1 Preparing for the Test

Prior to the test, the beacon manufacturer shall declare technical parameters (see section 5, item "v").

A.3.6.2.2 PIE Indication Test Procedure

The test may be performed on a separate additional test unit and shall be conducted in two steps:

- on the first step, check the self-test indication when the beacon battery has sufficient energy to support beacon operation for the manufacturer-declared minimum operating lifetime, and/or the PIE criteria is not met; and

- on the second step, check the self-test indication, when the test beacon battery capacity is not sufficient to support beacon operation for the manufacturer-declared minimum operating lifetime, and/or the PIE criteria is met.

Step-1: Verification of the Self-Test Indication of Sufficient Battery Energy

As applicable to the beacon design, discharge a fresh battery by operating a beacon in the worst-case operating mode at ambient temperature for the duration corresponding to $\mathbf{C_{PO}}$, or by the amount indicated by the beacon manufacturer, as their criteria for triggering PIE less 30 minutes, if this is different to $\mathbf{C_{PO}}$, and/or make sure that the criteria to generate the PIE indication is not yet met.

At ambient temperature, activate the test beacon in a self-test mode. Observe the beacon indication. The test is passed successfully, if during the self-test, the test beacon does not provide a distinct indication of insufficient battery energy (PIE indication), or (if this feature is supported by the beacon design) the test beacon provides a distinct indication of sufficient energy.

> Note: If applicable to the beacon design and implementation of PIE indication, the sub-criteria for the absence of PIE indication can be achieved, e.g., by performing less than the maximum recommended number of self-tests, and/or less than the maximum number of GNSS self-tests, or by creating other PIE indication conditions declared by a beacon manufacturer (see section 5, item ”u”).

Step-2: Verification of the Self-Test Indication of Insufficient Battery Energy

After completion of Step-1, further discharge the beacon battery, and/or make sure that, as applicable to the test beacon design, the criteria for the PIE indication is now fully met.

> Note 1: The required battery discharge can be achieved by operating the test beacon in the worst-case operating mode at ambient temperature until the residual battery energy corresponds to $\mathbf{C_{CO}}$**+30 minutes** (i.e., the total discharge of a fresh battery will correspond

to the value of **C_{PO}+ $C_{SP\text{-}AMB}$ + 30 minutes**)*, or until the amount of the residual battery energy indicated by the beacon manufacturer as their criteria for triggering PIE indication plus 30 minutes, if this amount is different from **C_{CO}**. Alternatively, if a different method of assessing PIE has been implemented by the manufacturer, the necessary conditions for PIE indication can be achieved in that way, for example, by performing the remaining number of self-tests and GNSS self-tests to reach the declared maximum numbers.

At ambient temperature, activate the beacon in the self-test mode. Observe test beacon indication. The test is passed successfully, if during the self-test the beacon provides a distinct indication of insufficient battery energy.

Note 2: The means to discharge the battery may be as defined by the manufacturer, this may, for example, be achieved by activating the beacon for the required period of time, or by running multiple self-tests, or by running GNSS self-tests, etc.

A.3.6.2.3 Reporting Results of PIE Indication Test

Record the test results/observations of PIE indication in the Table F-E.5 and reflect the test results in the Table F-1, Test Parameter 8(a): Self-Test Mode.

A.3.6.3 Testing the GNSS Self-Test Mode

If a GNSS self-test mode *utilising an internal navigation receiver* is provided, the encoded location shall be checked against the known location to the accuracy defined in C/S T.001 paragraph 4.5.5.3 for the applicable protocols or paragraph 4.5.5.6 for ELT(DT)s. *If a GNSS self-test mode utilising an external navigation device is provided, the encoded location shall be checked to ensure that it is within 200 metres (and it is within 5.25 km for User-Location protocol only) of the position provided by the external navigation device.* The format flag bit shall be reported. The GNSS self-test mode shall be tested to verify that any transmission is limited to one self-test burst only. It shall be verified that inadvertent activation of the GNSS self-test mode is precluded.

For beacon models provided with both an internal navigation receiver and an interface to an external navigation device, for which the beacon manufacturer has declared that the GNSS self-test functionality has been implemented on both navigation data sources, then both of these navigation device options shall be subjected to the GNSS Self-test Mode testing. In addition, a

* If $C_{SP\text{-}AMB}$ is not known and/or not declared, this value, for example, may be measured as follows:

1) Discharge the beacon battery by the value of **C_{PO}** at ambient temperature, and carry out the Operating Lifetime at Minimum Temperature test as defined in C/S T.007 A.2.3, by operating the beacon in the worst-case mode for the manufacturer-declared minimum operating lifetime, after which time, terminate the beacon operation.

2) Place the non-operating beacon in the ambient temperature conditions, allow at least 2 hours of soaking, activate the beacon and operate it in the worst-case mode until the beacon can no longer meet the performance requirements defined in document C/S T.001. The duration of the beacon fault-free operation is equivalent to **$C_{SP\text{-}AMB}$**.

GNSS Self-test Mode test shall be performed with both the internal navigation device and the external interface active (with an offset position of between 3 and 5 km from the actual beacon position) and it shall be confirmed that the GNSS self-test conforms to the requirements of C/S T.001 paragraph 4.5.4 g).

The test results shall be reported separately in the Table F-E.4, and reflected in the Summary of test results table, Table F-1, test parameter 8-b).

The GNSS self-test mode shall be tested at ambient temperature to verify that:

a) inadvertent activation of GNSS self-test mode is precluded;

b) it is limited in duration (all location protocol beacons) and number of GNSS self-test transmissions (beacons with internal navigation devices powered by primary battery only);

c) a distinct indication of successful completion or failure of the GNSS self-test is provided and for ELT(DT)s the beacon transmits a single self-test message with the correct encoded location;

d) a separate distinct indication that the limited number of GNSS self-test attempts has been attained is provided immediately after GNSS self-test mode activation and without transmission of a test message or further GNSS receiver current drain; and

e) the GNSS self-test mode terminates automatically, irrespective of the switch position, immediately after completion of the GNSS self-test cycle and indication of the test results.

Observations and results of the GNSS Self-test Mode test shall be recorded in the Table F-E.4, and reflected in the Summary of test results table, Table F-1.

A.3.6.4 Testing for Repetitive Automated Interrogation of a Beacons Status

If the beacon includes a means of initiating some form of repetitive automated interrogation of its status from either a control on the beacon, or from a remote means of activation of such a function (e.g. an electrical control line interface to the beacon, a wireless interface etc.) then the following test procedure shall be applied at ambient temperature only.

a) The transmitter output of the beacon shall be monitored for any transmissions at either 406 MHz or any of the radio locating signal operating frequencies (if applicable). The beacon shall be kept in its off or non-operational status. The means of activation of the repetitive automated interrogation of beacon status shall then be initiated and left functioning and the output of the beacon shall be monitored for a period of time equivalent to at least three times the repetition period of the automated interrogation system as declared by the beacon manufacturer in Annex G. That is, if the repetition period of the automated interrogation system is 15 minutes, then the beacon output shall be monitored for at least 45 minutes. The means of activation of the repetitive automated interrogation of beacon status shall then be terminated. During this monitoring period no 406 MHz or any of the radio locating signal operating frequencies (if applicable) shall be detected at the transmitter output that exceed a signal level of -10 dBm.

b) If the repetitive automated means of interrogation is meant to function while the beacon is active, then this function will be tested as part of the normal type-approval testing to ensure that it does not interfere with the normal operation of the beacon. However, if the repetitive automated means of interrogation is not meant to function while the beacon is active, then perform the following test.

The transmitter output of the beacon shall be monitored for transmissions at 406 MHz and at any of the radio locating signal operating frequencies (if applicable). The beacon shall then be turned on, so that it is functioning in its normal operational status. The means of activation of the repetitive automated interrogation of beacon status shall then be initiated and left functioning and the output of the beacon shall be monitored for a period of time equivalent to at least three times the repetition period of the automated interrogation system as declared by the beacon manufacturer in Annex G. That is if the repetition period of the automated interrogation system is 15 minutes, then the beacon output shall be monitored for at least 45 minutes. The means of activation of the repetitive automated interrogation of beacon status shall then be terminated and then the beacon shall be turned off / deactivated. While the beacon is turned on its output shall be monitored to ensure that activation of the repetitive automated interrogation of beacon status does not interrupt or affect transmissions from the beacon as would be expected under normal operation (e.g. 406 MHz bursts occur at the correct times and contain valid messages and do not have the self-test frame synchronization pattern, etc.).

A.3.7 Ancillary Electrical Devices in the Beacon

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

A.3.7.1 Automatically Controlled Ancillary Devices

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

A.3.7.2 Operator Controlled Ancillary Devices

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

The timing of the periodic activation of ancillary devices shall be such that the instants of activation and deactivation occur over the full range of times relative to the beacon transmission burst, with the intent of detecting any effects of the activations or deactivations on the signal characteristics.

The activation-deactivation regime shall be carried out for selected intervals spaced out over the duration of the long term tests (i.e., thermal shock test , temperature gradient test) to characterise the performance of the beacon over the entire range of operating conditions.

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

A.3.8 Navigation System (if applicable)

Except for the position data encoding test (section A.3.8.7), the navigation input system must be operating for the duration of all tests to ensure that it does not affect the 406 MHz signal and that the beacon can operate for the manufacturer-declared minimum operating lifetime. For a beacon operating with an external navigation device, navigation data input shall be provided in the same way as it would be by an operational navigation device.
All the tests specified below shall be performed at ambient temperature. A check for valid BCH code shall be performed throughout these tests, and any examples where the encoded BCH was not correct shall be specifically identified in the test report and an annotation provided at item 17 of Table F.1.

A.3.8.1 Position Data Default Values

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

In addition, for ELT(DT)s, carry out the following test to check ~~the location freshness~~ *the beacon behaviour and correctness of the encoded position freshness in the case where a valid position is*~~the location freshness~~ *available in the beacon memory at the time the beacon is activated*:

a) Put the ELT(DT) in the ARMED mode and a~~A~~pply a navigation signal (and if applicable a navigation data input) to the ELT(DT) for a period of at least 3 minutes~~, and then activate the ELT(DT). Ensure that the ELT(DT) is transmitting bursts containing a valid encoded location.~~ *Prior to the beacon activation, to ensure that the ELT(DT) gets a position before its activation.*

~~a) Within 20 seconds of activating the beacon, remove the navigation signal (and if applicable the navigation data input). Accurately time the period from when the navigation signal(s) is removed for at least 100 seconds and during this time note when the ELT(DT) transmits.~~

b) Remove the navigation signal/input and within 20 seconds activate the ELT(DT)((i.e., place the beacon in the ON mode). Accurately time the period from when the navigation signal(s) is removed and note when the ELT(DT) transmits for at least 120 seconds. Check that the

position is retained and that the position freshness in the 406 MHz message evolves from "greater than 2 seconds and equal to or less than 60 seconds" to "more than 60 seconds".

c) Reapply the navigation signal/input for 120 seconds. During this time monitor that the beacon transmits messages with valid encoded position and the encoded position freshness.

d) 90 seconds after the end of the previous step, and not less than 3 seconds before the next scheduled burst transmission, remove the navigation signal/input, and operate the test beacon for a further 120 seconds.

e) Accurately note the time, when the navigation signal/input is removed, and when the transmission period of 120 seconds of step "d" expires, check that the valid encoded position is retained in the transmitted messages and that the encoded position freshness, as encoded in bits 113-114 of the 406-MHz messages, evolves from "less than or equal to 2 seconds" to "greater than 2 seconds and equal to or less than 60 seconds", and then to "more than 60 seconds".

f) After the 120-second period of step "d" expires, reapply the navigation signal (and, if applicable, the navigation data input) and collect the transmitted bursts for a further 120 seconds.

g) Deactivate the ELT(DT)*(place the beacon in the OFF mode)*. Decode the messages transmitted during ~~this time~~ *the test* and check that *the position freshness, encoded in* bits 113 and 114 correctly change over time as the freshness of the encoded location ages. Note that as ELT(DT)s transmit only once every 5 seconds +0 / -0.2 seconds during ~~this time~~*the first 120 seconds after beacon activation,*, but the *encoded* freshness ~~requirements~~ in bits 113 and 114 change ~~after~~ *approximately* 2 seconds *before the burst transmission*, and therefore it may be necessary to repeat this test a few times in order to accurately determine compliance.

~~b)~~*h) Include in the report all the decoded messages, indicate bursts with the encoded position freshness and 3LD, timestamps of the events and actions.*

A.3.8.2 Position Acquisition Time and Position Accuracy

A.3.8.2.1 Position-1 Test

Conduct the test as follows:

a) at a test location with known position* (Position-1), apply the appropriate navigation signal or navigation data input to the beacon;

b) activate the beacon;

c) verify that the position is acquired and entered in the digital message within the specified time interval (1 min for external navigation device, 10 min for internal navigation device, 5 seconds for input from all navigation devices for ELT(DT)s);

d) calculate the distance between the transmitted-position and the beacon known position, and verify that this distance does not exceed:

- 500 metres for beacons with Standard, National or RLS Location protocols,
- 200 metres in the horizontal plane (2D) and within the limits of A.2.5 c) i) and ii) in Altitude for ELT(DT) †,
- 5.25 km for beacons with User-Location protocols; and

e) deactivate the beacon.

A.3.8.2.2 Position-2 Test

Conduct the test as follows:

a) 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-1 of A.3.8.2.1;

b) activate the beacon;

c) verify that the new position is acquired and encoded into the digital message within the specified time interval (1 min for external navigation device, 10 min for internal navigation device, 5 seconds for input from all navigation devices for ELT(DT)s);

d) calculate the distance between the transmitted-position and the beacon known position, and verify that this distance does not exceed:

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* The known beacon position shall have a 2-D location accuracy of ± 10 meters or better, which may be achieved by placing the beacon on the earth surface in a surveyed position with known geographical coordinates, or by determining the beacon position with a high-resolution GNSS receiver.

† For ELT(DT)s this test shall be performed at a height of less than 4000 metres above sea level.

- 500 metres for beacons with Standard, National or RLS Location protocols,
- 200 metres in the horizontal plane (2D) and within the limits of A.2.5 c) i) and ii) in Altitude for ELT(DT)s*,
- 5.25 km for beacons with User-Location protocols;

e) deactivate the beacon.

For ELT(DT)s that can accept navigation data from an external navigation device input as well as its own internal navigation device the above two tests shall be repeated with the external input method disabled.

Record the results to A.3.8.2.1 and A.3.8.2.2 with a pass/fail indication at item 17 of Table F.1, and the measured values in Table F-C.5 or Table F-C.6 as appropriate. If the test had to be repeated because initial test results failed to meet requirements, the failed tests shall also be reported and an explanation for the failure included in the report. In such circumstances the tests shall be repeated and reported at least 5 times in the configuration that failed.

In the case of beacons with internal navigation devices:

a) tests A.3.8.2.1 and A.3.8.2.2. (when moving the beacon) shall be conducted at a location where the beacon has clear visibility to the available GNSS satellites; and

b) tests A.3.8.2.1 and A.3.8.2.2 shall be conducted with the beacon in all the configurations required by Figure 4.2 as applicable per the manufacturer's declaration of Operational Configurations in Annex G.

A.3.8.3 Encoded Position Data Update Interval†

Apply the appropriate navigation signal or navigation data input to the beacon (not applicable to ELT(DT)s), which should cause the encoded position data to update, and verify that the beacon updates the digital message in accordance with the manufacturers declared timing regime, which shall be between 4 minutes and 25 seconds and 15 minutes, after the time of the last update, to which the 90 seconds may be added for the GNSS receiver acquisition. Note that due to the lack of synchronization between the internal navigation device timing and the timing of transmissions, if transmissions are being used to monitor position updates then there may be up to an extra 53 seconds between updates.

* The test shall be performed at an altitude of less than 4000 metres above sea level.

† By decision of the Cospas-Sarsat Council at its Fifty-fourth Session, beacons submitted for type approval prior to 1 January 2017 may be tested to T.007 Issue 4 Revision 8.

Verify that the beacon updates the digital message in accordance with the manufacturer's design, for ELT(DT)s this shall be within 2 seconds immediately prior to every 406 MHz transmission. 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.

For all beacons with an internal navigation device (except ELT(DT)s), continue changing the appropriate navigation signal once every 2 minutes by a distance of at least 1 km and no more than 30 km for beacons coded with Standard, National or RLS Location protocols, and at least 10.5 km and no more than 30 km[*] for beacons coded with User-Location protocols until the end of the manufacturer-declared minimum operating lifetime (depending beacon type). For beacons designed to be coded with multiple location protocol types (e.g., User, Standard, National, RLS), this test shall be repeated once for each type of the declared protocols, however tests of the second and subsequent protocol types shall be limited to a test period of at least 2 hours greater than the time at which the final GNSS timing update transition occurs, as long as the manufacturer provides a statement (section 5.1, part (n)iv), that the encoded position data update timings are identical for all the declared protocols (except for the RLS GNSS Receiver timing, which shall also comply with C/S T.001 section 4.5.7). Ensure that the encoded position data in the digital message changes in accordance with the requirements of C/S T.001 section 4.5.5.4 and as declared by the manufacturer in their location data update scheme[†].

For ELT(DT)s change the navigation signal provided to the internal navigation device (by using a GNSS RF simulator) in accordance with Annex K. Activate the ELT(DT), as defined in Annex K, and monitor the encoded 3D positions provided by the ELT(DT) while running the simulator scenario in Annex K, then deactivate the beacon. Accurately (to a resolution of better than 0.1 second) log the position provided to the beacon and the commencement of beacon transmissions vs time. For each burst from the ELT(DT) compute the 3D position provided by the signal to the beacon at the commencement of the burst ($P(t_0)$) and at the point 2 seconds before the commencement of the burst ($P(t_0\text{-}2)$). Check that in each instance the 3D encoded location transmitted by the ELT(DT) is within 200 metres in the horizontal plane and within 700 metres in altitude of at least one simulated location between the two above computed positions (i.e. ($P(t_0)$) and ($P(t_0\text{-}2)$)), except during the final transition in the Annex K scenario (which in effect simulates a rapid deceleration resulting from an impact). Check that the last available location transmitted by the ELT(DT) before impact is less than 11.1 km (6 NM) from the impact location (latitude = 13.69361° and longitude = 40.71091°) and that a location within 200 m of the impact location (latitude = 13.69361° and longitude = 40.71091°) is transmitted not later than 15 seconds after the

[*] The maximum distance above (30 km) is suggested to prevent the GNSS Receiver cold starting when the position of the beacon is moved.

[†] Beacon models with a fixed value of the encoded position data update interval declared by the beacon manufacturer in Annex G may be tested to document C/S T.007, Issue 4, Revision 8.

impact. Also check that bits 113 and 114 in the digital message are correctly set for location freshness.

If the ELT(DT) can accept navigation data from an external navigation device input as well as its own internal navigation device, then the above test shall be repeated while sending location data through the external navigation interface and over the air to the internal navigation device at the same time. The location data that shall be sent is described in Annex K. All results, shall meet the above requirements (i.e., horizontal accuracy, vertical accuracy and location freshness as well as the source position requirements as defined in section 4.5.5.6 of C/S T.001).

For beacons with internal navigation devices, the tests can be performed either by changing the beacon position or with a GNSS RF simulator to emulate the GNSS satellite downlinks.

Record the first measured position data update interval at item 17 of Table F.1. For beacons with internal navigation devices record the encoded position update intervals throughout the test at item 17 of Table F.1.

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

A.3.8.4 Position Clearance after Deactivation

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

A.3.8.5 Position Data Input Update Interval

If a beacon is designed to accept position data from an external navigation device prior to beacon activation, navigation data input should be provided and stored in the beacon memory at intervals not longer than 20 minutes for EPIRBs and PLBs, or 1 minute for ELTs, except ELT(DT)s for which the interval is no longer than 2 seconds. To test this:

a) deactivate the beacon, change the initial position data, allow for the appropriate time interval (between 20 min and 30 min for EPIRBs and PLBs or between 1 min and 1.5 min for ELTs or between 2 seconds and 3 seconds for ELT(DT)s) for the changed position to be accepted. Remove the navigation data input to the beacon and allow the stored position to be kept in the beacon memory for between 19 min 50 sec and 20 minutes (for EPIRBs or PLBs), or for between 50 sec and 1 minute (for ELTs except ELT(DT)s) or for between 4 minutes and 50 seconds and 5 minutes (for ELT(DT)s). Activate the beacon. Verify that the encoded position data is correct and corresponds to the changed position; and

b) deactivate the beacon, change the initial position data and remove the navigation data input to the beacon. Allow for the appropriate time interval (between 20 and 30 min for EPIRBs and PLBs or between 1 and 1.5 min for ELTs (except ELT(DT)s) or between 5 minutes and 5 minutes and 15 seconds for ELT(DT)s) for the stored position to be cleared.

Activate the beacon. Verify that the location fields of the message are encoded with default values.

For beacons with internal navigation devices, a GNSS RF simulator may be used to simulate the GNSS satellite downlinks. Identify in Table F.1 the applicable time intervals for this test, and record the results with a pass/fail indication at item 17 of Table F.1.

A.3.8.6 Last Valid Position

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

A.3.8.7 Position Data Encoding

This test may be conducted by using a GNSS simulator[*], or by substituting the output of the navigation device with data input, which replicate the location information provided in Table D.1 for the User-Location protocol, Table D.2 for the Standard Location Protocol, Table D.3 for the National Location, Tables D.4 for the ELT(DT) and the RLS Location protocols and Table D.5 for the RLS Location protocol.

For beacons supporting multiple types of data interfaces with an external navigation device, this test shall be performed for each external interface variant. Only the highest data stream baud rate shall be tested.

For beacons not capable of updating the encoded position data after beacon activation, modification shall be made to the test scripts to allow position data changes to be accepted prior to beacon activation. See Footnote 1 associated with the scripts in Tables D.1, D.2 and D.3.

This test may be conducted either by the test laboratory or the manufacturer. The results shall be provided in the formal report as per Appendix C to Annex F. If performed by the beacon manufacturer, the manufacturer shall provide the test laboratory with the required test results for verification and inclusion in the test report with content as required or equivalent to Appendix G to Annex F (Part F.7). The test laboratory shall check the results provided by the manufacturer for correct format and content, or, if not provided, or the manufacturer requests verification, perform the test, and annotate Table F.1 with "√" if the beacon performed as required for all the scripts tested.

[*] If a GNSS simulator is used the internal data line from the GNSS device to the beacon must be monitored to ensure the correct position information is being provided to the beacon

A.3.8.8 ~~RLM Reception Verification~~ *Return-Link Service (RLS) Tests*

A.3.8.8.1 RLM Reception Verification Test

In the Test Configuration 8 (see Figure 4.2) for all beacon types, except ELT(AF) for which Test Configuration 6 shall be used, activate the beacon encoded with the RLS Location Test Protocol.

Check if the beacon indicates reception of the Test RLM message as indicated in document C/S T.001 Section 4.5.7.3. *Record the results of the test and observations in Table F.1 under the test parameter 18.*

~~*A.3.8.8.1*~~*A.3.8.8.2* **M_{offset} Test**

For this test, the test configuration shall be as described in section A.3.8.8.1 above.

Set up the beacon under test such that it is possible to monitor when the GNSS Receiver in the beacon is active (i.e., powered up and providing position and related data) and inactive, and it is possible to monitor the data output from the GNSS Receiver that is providing position and related data to the rest of the beacon electronics. A specially modified beacon (test unit) may be required for this test, thus this test may be performed using either the second beacon or another beacon as defined in Section 4.3.

This test shall be performed by the type approval test facility. This test may be carried out at any time during the testing sequence*.

Set up the beacon under test in an area where it can send 406-MHz signals and clearly receive navigation data to fully test the RLS closed-loop functionality, e.g., in an open area with a clear view of the sky.

Set up the necessary test equipment to enable the functioning of the GNSS Receiver and its data output to be monitored. It shall be possible to either store the information received at the GNSS Receiver data output for later analysis or to decode this data in real time such that the message stream provided can be correctly decoded and interpreted.

Ensure that the beacon is correctly coded with the RLS Location Test Protocol as per C/S T.007 Annex C. Carry out a self-test and ensure that the encoded 15 Hex ID –equates to one of those indicated in Table A.2. Note that each of the 15 Hex IDs indicated in the table corresponds to the appropriate M_{offset} value, which is used to re-activate the GNSS receiver.

* Note it may be necessary to coordinate this test with both the relevant MCC and the Return Link Service Provider (RLSP) in order to ensure that test signals are correctly routed through the ground segment and the appropriate RLM is sent.

Table A.2. 15 Hex ID values used in M_{offset} and UTC Tests

RLS Protocol	15-HEX ID value	Corresponding M_{offset} value
RLS Location Test Protocol with MMSI	193BFFA11FBFDFF	1
RLS Location Test Protocol	193BF7E031BFDFF	55

Note: Only one of the above protocols needs to be tested. If the beacon is capable of being programmed with both protocols, the protocol used for TA testing shall be defined by the beacon manufacturer.

Turn the beacon on at any t_{on} time between 5 minutes and 20 minutes past any natural hour (e.g., between 09:05 and 09:20, between 15:05 and 15:20 etc.) and check the following:

a) that within 5 seconds of the beacon transmitting an initial RLS request through the RLS Location Test Protocol there is a visual indication of an RLS request;

b) that bits 109 to 114 in the 406 MHz transmitted message are '100001';

c) that the GNSS Receiver turns on (becomes active) ~~within 5 seconds of~~ *immediately (within 5 seconds) after* the beacon activation;

d) monitor the GNSS Receiver data output and determine how long it takes after becoming active before the Receiver starts to output UTC in whichever recognised IEC 61162-1 approved sentence (e.g., GNS, ZDA etc.) the manufacturer has defined for this purpose;

e) monitor the GNSS Receiver and ensure that it remains in active mode for a period of at least 30 minutes after beacon activation, or, for beacons only capable of processing Type-1 RLMs, until such time as the conditions in g) below are met, after which time it may turn off, or remain on, or turn on and off one or more times;

f) during the above 30 minute period monitor the RLS indicator and note at what time it changes state to indicate receipt of an RLS request acknowledgement (i.e., receipt of an RLM);

g) monitor bits 109 to 114 in the next 406 MHz transmitted message after the RLS indicator changes state and ensure that bits 109 to 114 change to '101001', after which time, for beacons only capable of processing Type-1 RLMs, the test may be stopped and the beacon turned off for a minimum period of 15 minutes before commencing the next test;

Note, that for beacons only capable of processing Type-1 RLMs tests h) to k) inclusive below do not apply.

h) monitor the GNSS Receiver and ensure that it either is on or turns on at M_{offset} minutes +/- 5 seconds in the same natural hour, , if (t_{on} +30) <= M_{offset}, or at M_{offset} minutes ± 5 seconds in the next natural hour, if (t_{on} +30) > M_{offset} (e.g., if the beacon was first activated at 10:11 check to ensure that it either is on or turns on again at 11hours M_{offset} minutes ± 5 seconds, if M_{offset} < 41);

i) monitor the GNSS Receiver and ensure that it remains in active mode for a minimum period of 15 minutes after which time it may turn off (or remain on, or turn off and on one or more times as the manufacturer may choose to specify, consistent with other requirements of this document);

j) monitor the GNSS Receiver for a further hour and ensure that it either is on or turns on at M_{offset} minutes ± 5 seconds after the next natural hour (e.g., if the beacon was first activated at 10:11 check to ensure that it either is on or turns on again this time at 11 hours M_{offset} minutes ± 5 seconds, if $M_{offset} \geq 41$, or at 12 hours M_{offset} minutes ± 5 seconds, if $M_{offset} < 41$);

Note, that if M_{offset} is >=41 then the beacon should have already activated at 11 hours M_{offset} minutes.

k) monitor the GNSS Receiver and ensure that it remains in active mode for a minimum period of 15 minutes, after which time the test may be stopped and the beacon turned off;

l) record the results of the test and observations in the Table F.1, test parameter 18; and

m) leave the beacon turned off for a minimum period of 15 minutes before commencing the next test.

~~*A.3.8.8.2*~~*A.3.8.8.3* UTC Test

With the equipment and beacon test set-up as in *section* A.3.8.8.1 above, turn the beacon on at any time between 5 minutes and 20 minutes past any natural hour (e.g., between 09:05 and 09:20, between 15:05 and 15:20 etc.) and check the following:

a) that within 5 seconds of the beacon transmitting an initial RLS request through the RLS Location Test Protocol there is a visual indication of an RLS request;

b) that bits 109 to 114 in the 406 MHz transmitted message are ‘100001’;

c) that the GNSS Receiver turns on (becomes active) within 5 seconds of the beacon activation;

d) monitor the GNSS Receiver data output and determine how long it takes after becoming active before the Receiver starts to output UTC in whichever recognised IEC 61162-1 approved sentence (e.g., GNS, ZDA etc.) the manufacturer has defined for this purpose;

e) monitor the GNSS Receiver data output to check for the presence of a valid position in whichever recognised IEC 61162-1 approved sentence (e.g., GNS, RMC etc.) the manufacturer has defined for this purpose. Between 15 seconds and 45 seconds after first obtaining a position deny the beacon access to any satellite signals for the next portion of this test. Monitor the GNSS Receiver data output and ensure that no further time and / or position updates are received;

f) monitor the beacon transmitted signal and ensure that it contains the location of the beacon to within 500m accuracy and that bits 109 to 114 in the 406 MHz transmitted message are still ‘100001’;

g) monitor the GNSS Receiver and ensure that it remains in active mode for a minimum period of 30 minutes after which time it may turn off (or remain on, or turn off and on one or more times as the manufacturer may choose to specify, consistent with other requirements of this document);

h) monitor the GNSS Receiver and ensure that it either is on or turns on at M_{offset} minutes ± 5 seconds in the same natural hour, if (t_{on} +30) ≤ M_{offset}, or at M_{offset} minutes ± 5 seconds in the next natural hour, if (t_{on} +30) > M_{offset} (e.g., if the beacon was first activated at 10:11 check to ensure that it either is on or turns on again at 10 hours M_{offset} minutes ± 5 seconds, if M_{offset} ≥ 41, or at 11 hours M_{offset} minutes ± 5 seconds, if M_{offset} < 41). Note that this test ensures that the internal clock within the beacon is functioning correctly in the absence of UTC;

i) monitor the GNSS Receiver and ensure that it remains in active mode for a minimum period of 15 minutes after which time it may turn off (or remain on, or turn off and on one or more times as the manufacturer may choose to specify, consistent with other requirements of this document);

j) monitor the beacon's transmitted signal and ensure that it still contains the location of the beacon to within 500 m accuracy, and that bits 109 to 114 in the 406 MHz transmitted message are still '100001';

k) monitor the GNSS Receiver for a further hour and ensure that it either is on or turns on at M_{offset} minutes +/- 5 seconds after the next natural hour (e.g., if the beacon was first activated at 10:11 check to ensure that it either is on or turns on again this time at 11hours M_{offset} minutes +/- 5 seconds, if M_{offset} ≥ 41, or at 12 hours M_{offset} minutes+/- 5 seconds, if M_{offset} <41);

Note that if M_{offset} is >=41 then the beacon should have already activated at 11 hours M_{offset} minutes.

l) within 10 seconds to 20 seconds of the GNSS Receiver required M_{offset} turn-on time, allow the beacon access to the satellite signals for the remaining portion of this test;

m) monitor the GNSS Receiver and ensure that it remains in active mode for a minimum period of 15 minutes or, for beacons only capable of processing Type-1 RLMs , until such time as the conditions in test o) below are met, at which point the GNSS receiver may turn off;

n) during the above 15 minute period monitor the RLS indicator and note at what time it changes state to indicate receipt of an RLS request acknowledgement (an RLM); ~~and~~

o) monitor bits 109 to 114 in the next 406 MHz transmitted message after the RLS indicator changes state and ensure that bits 109 to 114 change to '101001', after which time the test may be stopped and the beacon turned off~~.~~*; and*

p) record the results of the test and observations in Table F.1 under the test parameter 18.

~~A.3.8.8.3~~*A.3.8.8.4* RLS Indication Test

Correctness of the RLS indication shall be verified during RLS test, and, where appropriate, during ~~testing of other test parameters~~ *other Return Link Service (RLS) tests* by taking necessary observations of the test beacon indication. The results of the test shall be recorded in ~~the~~ Table F.1~~,~~ *under the* Test Parameter 18, for observations of the following beacon indication:

a) the unique distinct indication RLS request, which shall be provided within 5 seconds after the beacon transmits an initial RLS request, and until a valid Test RLM message is received, or the beacon is switched off, or the beacon battery is expired (this indication shall be verified as part of the test, described in section A.3.8.8.1, item a));

b) the RLS indication is readily and clearly visible to the user in direct sunlight, at a distance of 1 meter from the beacon, when the beacon is operated in all declared operational configurations (this shall be verified during satellite qualitative test);

c) RLS indication remain inactive at all times when the beacon is encoded with any protocol other than the RLS Location Protocol or RLS Location Test Protocol (absence of the RLS indication shall be verified during all tests, when a test beacon is encoded with protocols other than the RLS Location Protocol or RLS Location Test Protocol, including the Beacon Coding Software test);

d) distinct indication that the RLM Type-1 or Test RLM has been received, which shall be provided within 5 seconds after the RLM has been received until either the beacon is deactivated or the beacon battery is expired (this indication shall be verified during the test, described in section A.3.8.8.1, item f)); and

e) the beacon only provides the indication of receipt of the RLM Type 1 or Test RLM, which contain the beacon 15 Hex ID (this indication shall be verified, as part of the Position Data Encoding Test, test script 7 of Table D-5).

~~A.3.8.8.4~~*A.3.8.8.5* RLS GNSS Receiver Satellite Tracking

For RLS capable beacons equipped with a single-constellation GNSS receiver, the beacon manufacturer shall provide a written declaration with supporting details demonstrating that the GNSS receiver used in their RLS capable beacon is configured to maximise reception of GNSS satellites in view above 5 degrees of elevation of the associated RLS provider's GNSS constellation.

For RLS capable beacons which are equipped with a multi-constellation GNSS receiver the following test shall be performed~~.~~ *, and the test results and observations recorded in Table F.1 under the test parameter 18.*

~~A.3.8.8.5~~*A.3.8.8.6* Introduction

This test is designed to ensure that the GNSS receiver in the beacon is capable of receiving signals from the satellites in view above 5 degrees elevation within the relevant RLS constellation. This test may be performed by either the beacon manufacturer or the Cospas-Sarsat test facility. If

performed by the beacon manufacturer then an annotated results file shall be provided to the test facility, so that they can verify the results obtained.

~~*A.3.8.8.6*~~*A.3.8.8.7* *Test* Setup

For this test, the test configuration shall be as described in section A.3.8.8.1 above.

This test requires a specially configured type approval beacon fitted with a new battery pack, for the avoidance of doubt, it is not acceptable to just test a GNSS receiver in isolation. The GNSS receiver shall be configured such that it is permanently on and the output of the GNSS receiver shall be connected to a data logger and configured to output NMEA or equivalent proprietary sentences that provide details of the satellites being tracked (e.g., NMEA 0183 GSV (GNSS Satellites in View) sentence). There shall be a method of time stamping the data provided, such as by linking it to another output sentence (e.g., NMEA 0183 ZDA (Time and Date)) or by having the data logger time stamp the incoming data.

The data logger shall be capable of recording the NMEA or equivalent proprietary sentences being output by the GNSS receiver, at least once every minute for a minimum of 24 hours. Only those sentences applicable to the RLS provider's GNSS constellation need to be recorded. The sentences shall be time stamped in some way.

The test may be performed either outside, with a clear view of the sky in all directions above 5 degrees in elevation, or with the use of a GNSS simulator. If a GNSS simulator is used, then it shall be able to produce, as a minimum, a full GPS satellite constellation and a full satellite constellation of the relevant RLS service provider. The simulator shall be adjusted to produce a signal level at the input to the beacon under test of around -130 dBm. The simulator shall initially run in real time, using its current location, time and date and shall provide all of the appropriate satellites in view at that time and place from, as a minimum, both the GPS and RLS constellations.

> Note, if using a simulator, then if required, rather than just leaving the simulator running in real time, it is permissible to jump ahead in time between each data logging event to the start of the next event.

~~*A.3.8.8.7*~~*A.3.8.8.8* Test Procedure

The test is intended to gather data on the satellites in view of the RLS service provider's constellation, as detected by the GNSS receiver in the beacon, over a period of 15 minutes every hour for 12 hours and compare this with the actual satellites in view, in order to assess how well the receiver tracks all the satellites in view.

The beacon under test shall either be placed outside ~~on level ground~~ with a clear view of the sky *in its normal operational configuration*, or in the test chamber with the *GNSS* simulator as appropriate. Note if using a *GNSS* simulator, then great care shall be taken to ensure that the beacon under test cannot also receive signals from overhead GNSS satellite constellations.

The beacon under test shall be connected to the data logger, and the *GNSS* simulator shall be turned on (if applicable). The beacon shall then be turned on and shall be left on for a *test* period of

between 12 hours and 12 hours plus 15 minutes (this period may be less if using a *GNSS* simulator and jumping time ahead). During this entire ~~time~~ *test period*, the output of the GNSS ~~receiver~~ *Receiver* shall be monitored by the data logger and the received *data* sentences shall be time stamped and stored for subsequent analysis. During the test the data shall be monitored on a regular basis to ensure that the correct NMEA or equivalent proprietary *data* sentences are being time stamped and recorded. At the end of the ~~time~~ *test* period, the beacon and all the test equipment shall be turned off.

~~A.3.8.8.8~~*A.3.8.8.9* Data Analysis

The beacon manufacturer or the test facility (as applicable) shall establish which satellites in the RLS service provider's constellation were operational at the time of the test, by reviewing the published satellite health data for the satellite constellation in question. That is the list of the RLS service provider's satellites providing navigation signals at the time of the test. Care shall be taken to ensure that any satellites that only provided navigation data for a part of the test period were actually above the horizon at the test site at this time, otherwise they shall be discarded.

The beacon manufacturer or the test facility (as applicable) shall then review the constellation data for the time and date of the test and determine for the first 15 minutes of each hour of the test which satellites were more than 5 degrees above the horizon for the entire 15 minute time period. This list of satellites shall then be compared to those satellites that were received during that same time period.

~~A.3.8.8.9~~*A.3.8.8.10* Pass / Fail Criteria

For each of the 15-minute test periods, the beacon under test shall have detected at least 90%, *rounded down to the nearest integer number,* of the RLS provider's GNSS satellites *in view* above 5 degrees over the horizon. ~~at least once in each 15- minute test period.~~

A.3.9 Method of Activation and Cancellation Message Test (ELT(DT) only)

The following tests are specific to ELT(DT)s only and are designed to check for correct activation and deactivation of the ELT(DT) coupled with the transmission of the Cancellation Message at the appropriate time, as defined in C/S T.001.

All the tests specified below shall be performed at ambient temperature, and test results reported in the Test Parameter 20 of the Table F.1. A check for valid BCH codes shall be performed throughout these tests, and any examples where the encoded BCH was not correct shall be specifically identified in the test report and an annotation provided at the Test Parameter 20 of Table F.1.

A.3.9.1 Activation and Deactivation Tests

The control lines into the ELT(DT) shall be activated in the sequences identified in Table A.2 and the correct indications in the beacon transmitted digital message shall be checked.

A.3.9.2 Cancellation Message Tests

When performing the tests identified in Table A.2 the transmissions from the ELT(DT) shall be monitored. The ELT(DT) shall transmit a Cancellation Message each time that it is deactivated (i.e., at the initiation of Tests 5, 7, 11, 13, 18a, 19, 24a and 25, as specified in Table A.2). The Cancellation Message shall be checked to ensure that it meets the following:

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

b) transmitter power output, as per para. A.3.2.2.1;

c) digital message content, as per para. A.3.1.4 and C/S T.001 Section A3.3.8.5 and Figure A.11;

d) the modulation parameters, as per para. A.3.2.3;

e) first cancellation transmitted message occurs within 5 seconds of deactivation;

f) there are 10 cancellation messages transmitted at intervals of 10 seconds +/- 0.5 seconds; and

g) after transmitting 10 cancellation messages the ELT(DT) ceases transmitting.

Table A.3: ELT(DT) Activation and Deactivation Tests

Test No	Control Lines*			Message Bits Status		ELT(DT) Status†
	Auto Activation by beacon	Auto Activation by external means	Manual Activation	Bit 107	Bit 108	
1	Disabled	Disabled	Disabled	N/A	N/A	ARMED
2	Disabled	Enabled	Disabled	1	0	ON
3	Disabled	Enabled	Enabled	0	0	ON
4	Disabled	Disabled	Enabled	0	0	ON
5	Disabled	Disabled	Disabled	N/A	N/A	ARMED
6	Disabled	Enabled	Disabled	1	0	ON
7	Disabled	Disabled	Disabled	N/A	N/A	ARMED
8	Disabled	Disabled	Enabled	0	0	ON
9	Disabled	Enabled	Enabled	1	0	ON
10	Disabled	Enabled	Disabled	1	0	ON
11	Disabled	Disabled	Disabled	N/A	N/A	ARMED
12	Disabled	Disabled	Enabled	0	0	ON
13	Disabled	Disabled	Disabled	N/A	N/A	ARMED
14	Enabled	Disabled	Disabled	0	1	ON
15	Enabled	Disabled	Enabled	0	0	ON
16	Enabled	Enabled	Enabled	1	0	ON
17	Enabled	Disabled	Enabled	0	0	ON
18a	Disabled ‡	Disabled	Disabled	N/A	N/A	ARMED
18b	Enabled §	Disabled	Disabled	0	1	ON
19	Disabled	Disabled	Disabled	N/A	N/A	ARMED
20	Enabled	Disabled	Disabled	0	1	ON
21	Enabled	Enabled	Disabled	1	0	ON
22	Enabled	Enabled	Enabled	0	0	ON
23	Enabled	Enabled	Disabled	1	0	ON
24a	Disabled‡	Disabled	Disabled	N/A	N/A	ARMED
24b	Enabled§	Disabled	Disabled	0	1	ON
25	Disabled	Disabled	Disabled	N/A	N/A	ARMED

* The terms “Enabled” and “Disabled” as used for the ELT(DT) Control Lines are intended to be generic and apply to whatever means of ELT(DT) activation the beacon manufacturer has implemented e.g. hardwired control lines, logic levels, switches, data bits, ARINC labels etc.

† ARMED indicates that the ELT(DT) is not transmitting any 406 MHz signals. ON indicates that the ELT(DT) is transmitting 406 MHz distress signals.

‡ Manually deactivating the ELT(DT) is assumed to reset the “automatic activation by the beacon” (e.g. resetting the G-switch or means of deformation).

§ If the ELT(DT) has a separate means of resetting the “automatic activation by the beacon” then this condition applies

A.3.9.3 Reactivation Tests

The transmissions from the ELT(DT) shall again be monitored during this test. The ELT(DT) shall be activated by one of the means defined in Table A.2 above and shall then be deactivated. Approximately half way through the Cancellation Message sequence (i.e. approximately 50 seconds after deactivating the ELT(DT)) the ELT(DT) shall be reactivated by one of the means defined in Table A.2 above.

The transmissions from the ELT(DT) shall be monitored to ensure that the ELT(DT) immediately ceases transmitting the Cancellation Message as soon as it is reactivated and it then immediately reinitiates the alert sequence and transmits a valid alert message within 5 seconds after reactivation.

A.3.10 Testing Beacon Controls

A.3.10.1 Testing Self-Test and GNSS Self-Test Controls

To determine, if a beacon malfunctions, and begins to transmit more than one self-test transmission as required by document C/S T.001, section 4.5.4, it shall be tested, at ambient temperature only, in the following way.

a) For beacons that have a common self-test and GNSS self-test control, or other functions, where the only differentiation between these modes of operation is the amount of time that the control is operated, establish the minimum time interval from initial activation of the control until the initiation of the GNSS self-test or other functions, 'X seconds'. Apply test i) below but only maintain the control in the self-test activation mode for X-1 seconds and then release it. Then apply test ii), as detailed below.

b) ~~a)~~For beacons where either self-test function is initiated by the release of the control, rather than by its activation, the following tests shall be conducted as stated, except that there shall be no self-test transmissions from the beacon while the control is activated and no more than a single self-test transmission when the control is released.

c) ~~b)~~ For all other beacons:

i. ~~the~~ *The* self-test controls shall be operated and where possible maintained in the self-test activation mode (e.g., if the self-test is activated by a push button, then this shall be held down) for a period of at least 2 minutes longer than the specified maximum duration of the self-test. During this time it shall be ascertained that there is a single self-test transmission and that the beacon returns to its rest state on completion of the self-test cycle, even if the self-test control is still engaged.

ii. If the beacon is equipped with a GNSS self-test mode then the GNSS self-test control(s) shall be activated and, where possible, the(se) control(s) shall be then maintained in this condition for a period of at least 5 minutes longer than the maximum time duration of the GNSS self-test as defined by the manufacturer. During this time it shall be ascertained that there is no more than a single self-test transmission and

that the beacon returns to its rest state on completion of the GNSS self-test cycle, even if the GNSS self-test control is still engaged.

Reflect observations of the beacon behaviour in the report, and annotate Table F.1 with "√" if the beacon performed as required for all the tests.

A.3.10.2 Testing Operational Controls

To determine if a beacon malfunctions and begins to transmit more frequently than is required by C/S T.001 Sections 2.2.1 and 4.5.6, it shall be tested, at ambient temperature only, in the following way:

a) All manual operational controls designed to activate the beacon (e.g., On, Remote On, etc.) shall be activated and where possible maintained in an operational mode (e.g., if the On function is activated by a push button, then this shall be held down) for a period of at least 3 minutes longer than the manufacturer declared time to transmit the first 406 MHz distress message.
b) Where possible, both the self-test control(s) and the operational controls shall be activated together and be maintained in this condition for a period of at least 3 minutes longer than the manufacturer declared time to transmit the first 406 MHz distress message:
    i. by activating the self-test / GNSS self-test and after approximately 2 seconds also activating the operational control(s),
    ii. by activating the operational control(s) and after approximately 5 seconds also activating the self-test / GNSS self-test;

For beacons with an automatic means of beacon activation (e.g., water activation, G-switch, etc.), tests a) and b) above shall be repeated once the beacon has first been activated by the automatic means. *In the case of test b)i) when the automatic activation of the beacon precedes this test step, the beacon is expected to remain in the 'on' condition and continue transmissions in an uninterrupted manner.*

The beacon shall be turned off between each test. In all conditions it shall be ascertained that the beacon does not transmit more than one self-test burst and does not transmit distress bursts more frequently than the repetition period defined in C/S T.001 Section 2.2.1. In addition during test b) ii) above, it shall be ascertained that the beacon continues to remain in the 'on' condition and instead does not activate the self-test function and transmit a self-test burst.

Reflect observations of the beacon behaviour in the report, and annotate Table F.1, *test parameter 22,* with "√" if the beacon performed as required for all the tests.

ANNEX B: ANTENNA CHARACTERISTICS

B.1 SCOPE

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

B.2 GENERAL TEST CONFIGURATION

B.2.1

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

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

B.2.2

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

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

B.3 TEST SITE

B.3.1

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

B.3.2

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

B.3.3

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

B.3.4

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

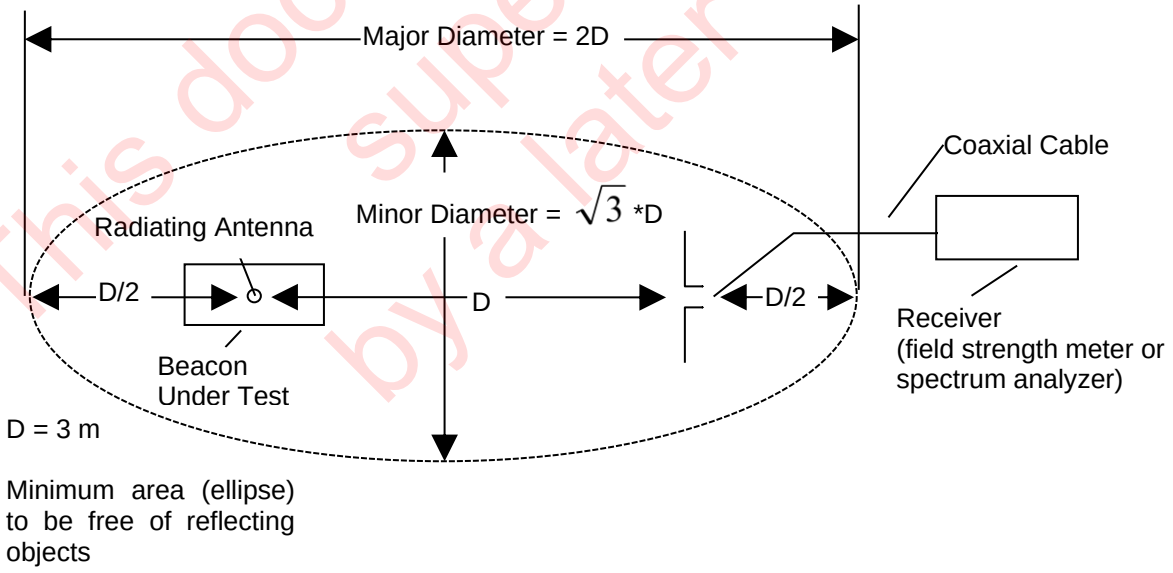

Figure B.1: Test Site Plan View

B.4 GROUND PLANE AND BEACON INSTALLATION

B.4.1

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

B.4.2

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

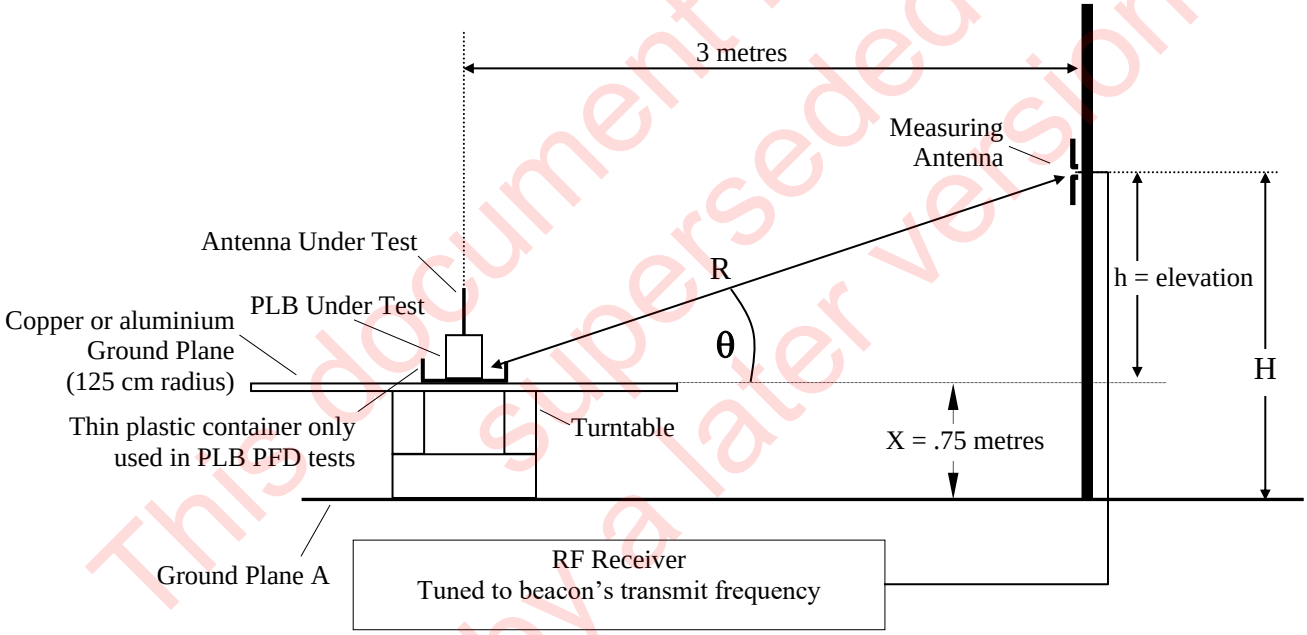

Figure B.2: Test Configuration for "PLB-like" Devices (e.g. PLB, survival ELT, automatic portable ELT)

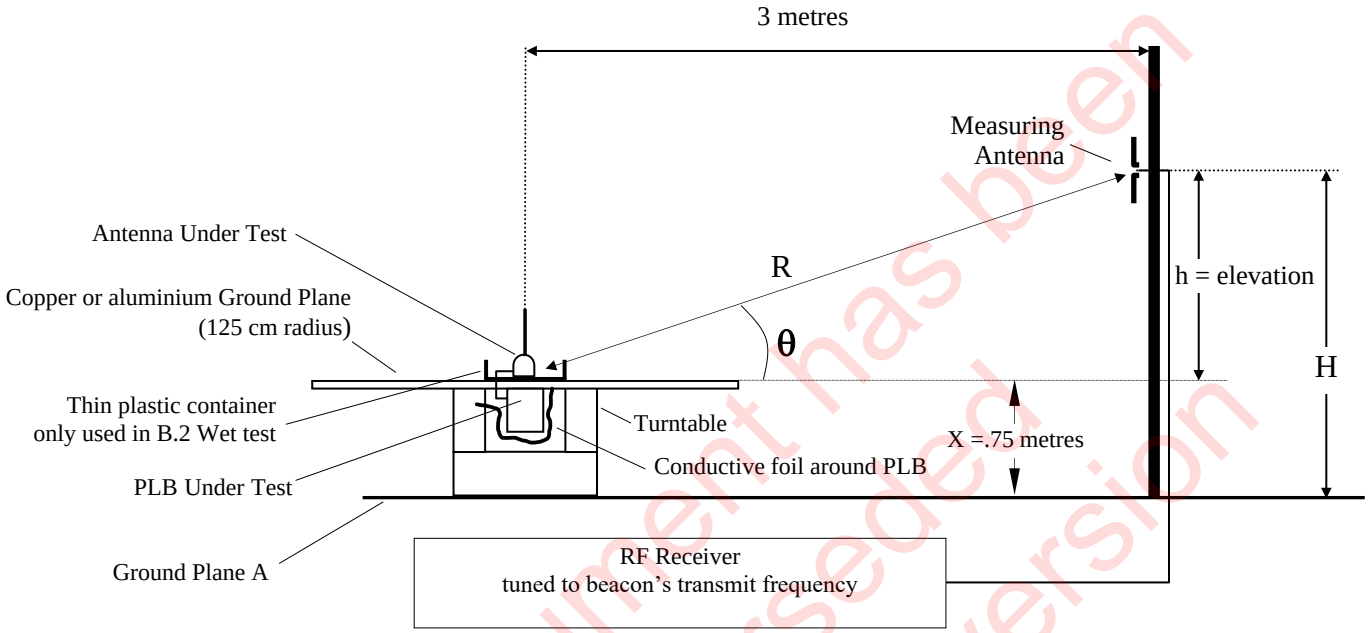

Figure B.2a: Test Configuration for PLBs on PFDs with Non-Integral Antennas

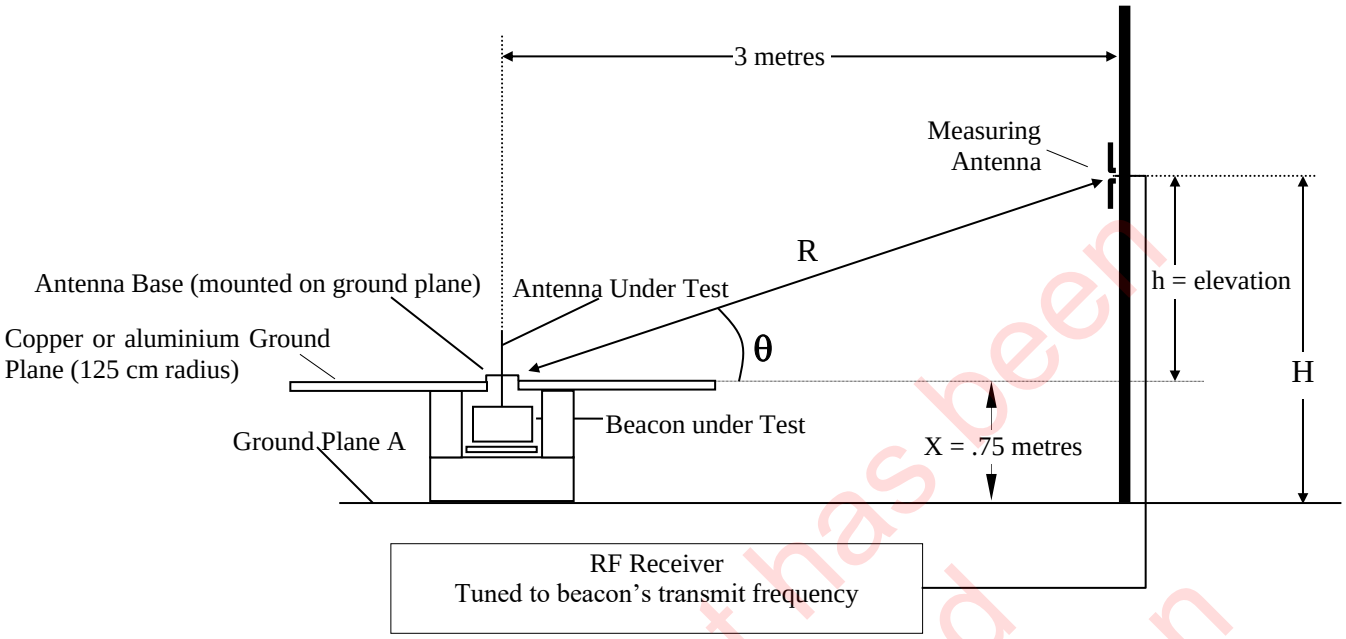

Figure B.3: Test Configuration for "Fixed ELT-like" Devices (including ELT(DT)s) (i.e., beacon with an antenna designed to be mounted on a metal surface)

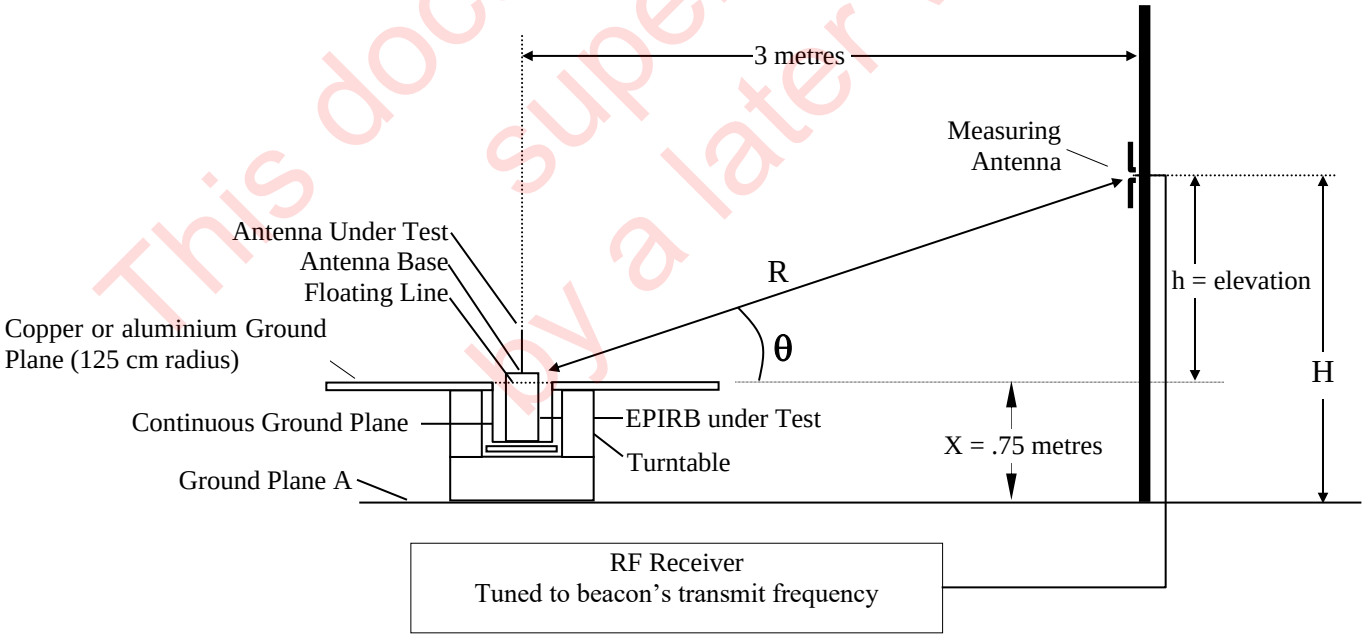

Figure B.4: Test Configuration for "EPIRB-like" Devices (i.e., beacons designed to operate while floating in water)

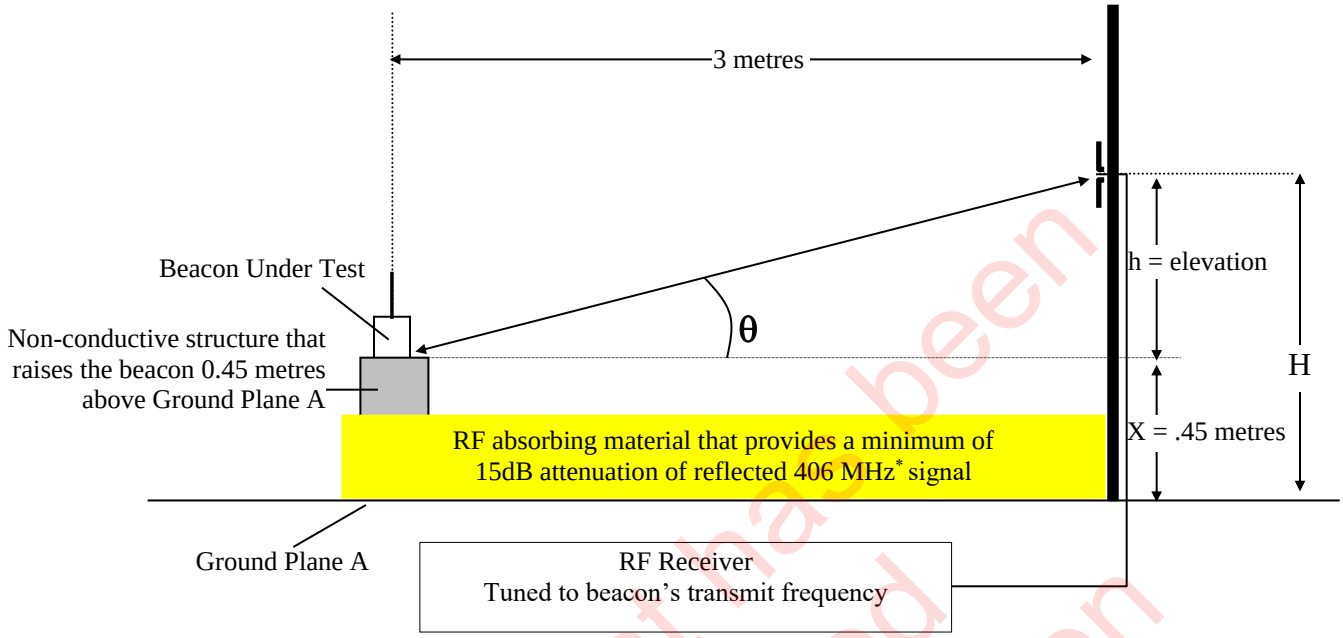

Figure B.5: Additional Test Configuration for all Devices that Might be Required to Operate Without a Ground Plane*

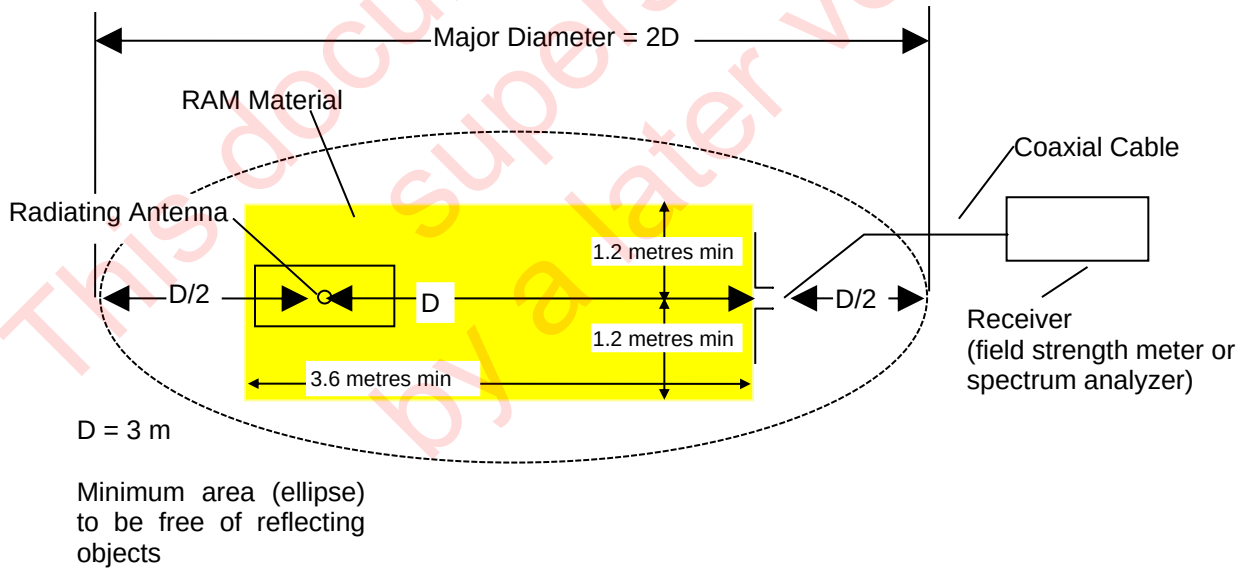

Figure B.6: Test Site Plan View with RAM Material

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

B.5 MEASURING ANTENNA

B.5.1

The radiated field of the BUT antenna shall be detected and measured using a tuned dipole. This dipole antenna shall be positioned at a horizontal distance of 3 metres from the test / pivot position in the centre of the ground plane, or its equivalent, to the phase / calibration centre of the dipole measuring antenna and mounted on a non-conducting vertical mast that permits the height of the measuring antenna to be varied sufficiently to measure the beacon EIRP at elevation angles ranging from 10 to 50 degrees.

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

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

and

$$H = h + X$$

where,

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

h* is the height of the measuring antenna relative to the reference height X,

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

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

B.5.2

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

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

B.5.3

The antenna factor (AF) of the measuring antenna at 406 MHz must be known. This factor is normally provided by the manufacturer of the dipole antenna or from the latest antenna

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

calibration data. It is used to convert the induced voltage measurement into electric field strength.

B.5.4

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

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

and

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

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

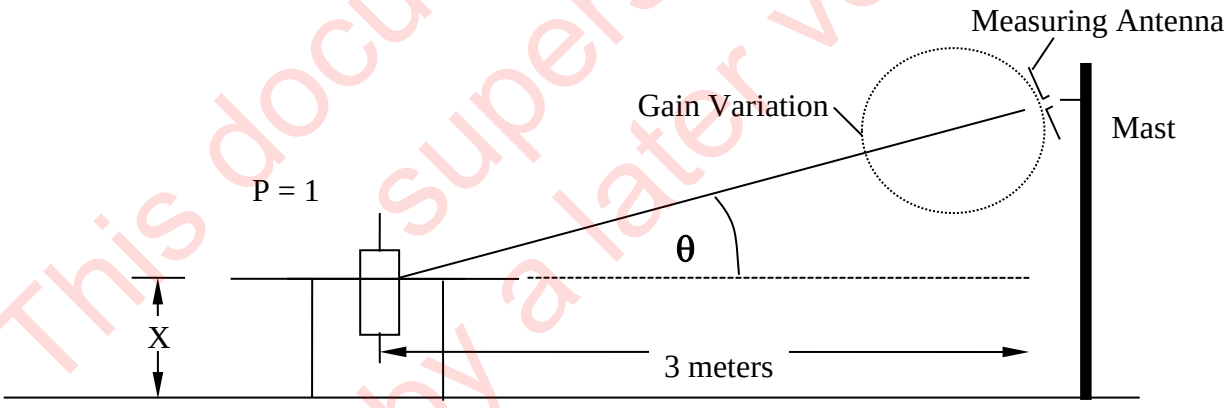


Figure B.7: Measuring Antenna Perpendicular to the Direction of Propagation

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

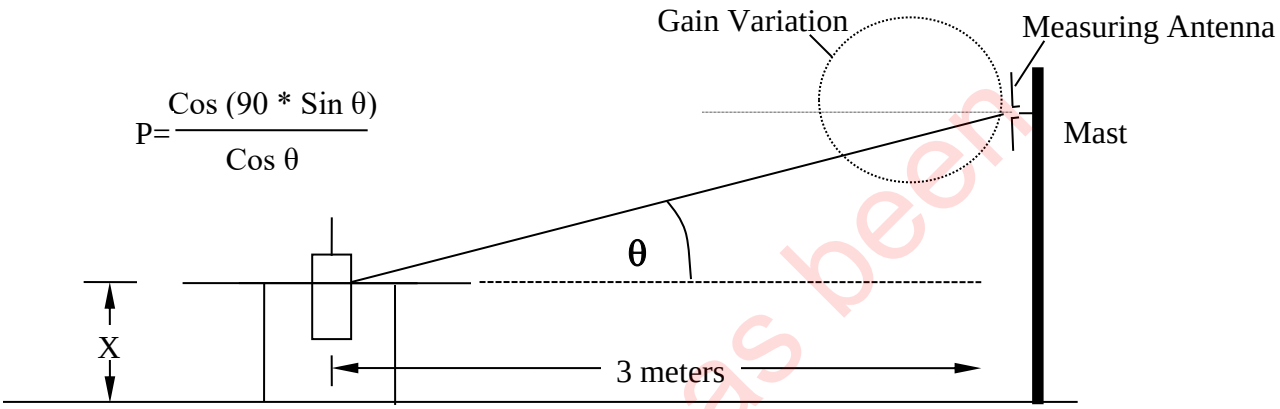


Figure B.8: Measuring Antenna NOT Perpendicular to the Direction of Propagation

B.6 BEACON TRANSMITTING ANTENNA

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

B.7 RADIATED POWER MEASUREMENTS

B.7.1

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

B.7.2

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

B.7.3 Measurement Requirements

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

Measurements* shall be made at the azimuth and elevation angles indicated in the table below.

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

B.7.3.1 Test Configurations for PLBs declared for use on Personal Flotation Devices (PFDs) as well as On Ground and Above Ground

PLBs declared for use on PFDs, as well as on ground and above ground, in accordance with Figure 4.1 and the manufacturer's declaration in Annex G, shall be tested as follows:

a) the PLB shall be subjected to a standard above ground test in the Test Configuration Figure B.5;
b) the PLB shall be subjected to a on ground test in the Test Configuration Figure B.2 or B.2a - PLB on PFD, with the PLB (or the non-integral antenna) placed in a thin plastic container on the raised ground plane as shown in Figure B.2, and the PLB shall be dry for this test; and

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

† The intent of the Figure B.2 and B.2a - PLB on PFD test is to ensure that salt water does not have a detrimental effect on the performance of the PLB under test or the antenna on PLBs with non-integral antennas. This test is to be performed by placing the PLB (or the non-integral antenna) in a thin plastic container with a flat bottom on the B.2 ground plane, such that there is no more than a 1 mm gap between the base of the PLB (or the non-integral antenna) and the ground plane. For PLBs with non-integral antennas, any antenna counterpoise supplied as a part of the antenna for installation on the PFD shall be laid flat in the bottom of the plastic container. For PLBs with non-integral antennas, the PLB shall be mounted under the raised ground plane and covered in conductive foil, any spare cable between the PLB and the antenna shall be secured next to the PLB under the foil. The EIRP of the PLB is then measured with the PLB (or the non-integral antenna) remaining dry. After which without moving the PLB (or the non-integral antenna) it shall be gently sprayed with a 5% by weight solution of salt water such that water can be seen running from the surface of the PLB (or the surface of the non-integral antenna) and any pockets or crevices on the PLB are filled up with salt water (not applicable to PLBs with non-integral antennas) and there is between 1mm and 5mm of water in the base of the container, then the EIRP measurements shall be repeated. If during testing there is any sign of the PLB (or the non-integral antenna) drying out, then it shall be sprayed again to keep it 'wet' throughout all the second set of tests.

c) the test in b) above shall be repeated but with the PLB (or the non-integral antenna) kept 'wet' for the duration of the test.

B.7.4 EIRP and Antenna Gain Calculations

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

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

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

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

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

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

where:
V_{rec} is the calculated signal level from Step 1 (dBV)
AF_c is the corrected antenna factor as defined in paragraph B.5.4
L_c is the *Loss Calibration Factor as calculated in B.8*~~receiver system attenuation and cable loss~~ (dB)

Step 3: Calculate the EIRP and the G_i

Using the standard radio wave propagation equation:

$$E(Volts/metre) = \frac{\sqrt{(30 \times Pt(Watts) \times Gi)}}{R\ (metres)}$$

and

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

the EIRP for each set of angular coordinates is obtained from

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

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

and the antenna gain from

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

where:

R is the distance between the BUT and the measuring dipole antenna calculated in section B.5.2
Pt is the power transmitted into the BUT antenna
Gi is the BUT antenna numerical gain relative to an isotropic antenna
E is the field strength converted from Step 2 into volts/metre

B.8 TEST RECEIVER CALIBRATION *PROCEDURE*

Prior to the commencement of taking EIRP measurements on each Beacon Under Test (BUT) the test setup shall be calibrated in accordance with the following procedure. During EIRP measurements if the test equipment, antennas or cables used are changed in any way (e.g., replaced with alternative items) then this calibration procedure shall be repeated before carrying on taking EIRP measurements.

a) Connect the equipment as shown in Figures B.2 through B.5, as appropriate.

b) Disconnect the measuring antenna and replace it with a UHF Signal Generator producing a CW output signal at the operating frequency of the BUT +/- 1 kHz at a power level of 6 dBm (this level is typical of the level at the output of the measuring antenna) to an accuracy of equal to or better than +/- 0.5 dB. If necessary, the output of the signal generator can be connected directly to an RF Power Meter or similar item of test equipment to set it up accurately.

c) Connect the output of the UHF Signal Generator to the coaxial cable that would normally be connected to the measuring antenna and record the resultant signal level on the Test Receiver (e.g., Field Strength Meter, Spectrum Analyzer, etc.).

d) Calculate the difference (Loss Calibration Factor (Lc)) between the power level in b) and c) above.

e) Disconnect the calibrated RF source from the measuring antenna cable and reconnect the cable to the measuring antenna.

f) Insert the Loss Calibration Factor (Lc) calculated in d) above into the EIRP and Antenna Gain Calculations in Section B.7.4.

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

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

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

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

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

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

B.9 ANTENNA POLARIZATION MEASUREMENT

B.9.1

Provide the measured induced voltage in Table F-B.2 (for configurations described in Figures B.2 through B.4) and annotate the results as described in section B.10.2 below. An analysis of the raw data (V_v, V_h) obtained during the antenna test conducted with the beacon in configurations B.2 through B.4 should be sufficient to determine if the polarization of the BUT antenna is linear or circular. There is no requirement to evaluate the sense of polarization for Figure B.5.

B.9.2

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

B.9.3

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

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

B.9.4

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

B.9.5

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

B.10 ANALYSIS OF RESULTS

B.10.1

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

B.10.2

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

Test Configurations	EIRP Required
Figures B.2, B.3, and B.4	32 dBm to 43 dBm† for at least 90% of the measurement points
Figure B.3 ELT(DT) only	34 dBm to 45 dBm‡ for at least 90% of the measurement points
Figure B.5	30 dBm to 43 dBm for at least 80% of the measurement points
Figure B.2 and B.2a – PLB on PFD§	32 dBm to 45 dBm[3] for at least 90% of the measurement points

Specifically annotate Table F-B.1, F-B.2 and F-B.3:

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

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

c) with highlighted text, to indicate all induced voltage measurements that are within 10 dB of each other, and with stricken-out text to indicate the measurements that were taken out of consideration.

* For beacons with external/remote antennas, the calculations of EIRP/Antenna Gain (Table F.E-1) and analysis of $EIRP_{min/max\ EOL}$ shall be presented separately for the minimum and maximum values of the declared antenna assembly cable loss at 406 MHz.

† The 32 dBm to 43 dBm limit is calculated from the specifications of Transmitter Power Output (37 dBm + 2 dB) and Antenna Gain characteristics (-3dBi to +4dBi).

‡ The 34 dBm to 45 dBm limit is calculated from the specifications of Transmitter Power Output (36 - 39 dBm) and Antenna Gain characteristics (-2dBi to +6dBi).

§ The 32 dBm to 45 dBm limit is calculated from the specifications of Transmitter Power Output (37 dBm + 2 dB) and Antenna Gain characteristics (-3dBi to +6dBi).

B.10.3

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

B.10.4

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

B.10.5 Recalculation of EIRP Results

For recalculation of the original EIRP values and re-evaluation of $EIRP_{min/max\ EOL}$ the following guidance shall be used:

a) recalculate EIRP values of the original test campaign for all beacon-antenna combinations and all applicable test configurations by correcting the EIRP values for all measurement points in the Tables F-B.1 and F-B.3, taking into account:
   - differences in $P_{t\ amb}$ (measured during the Transmitter Power Output test) between the original and current test campaigns,
   - minimum and maximum antenna cable losses, as declared by the beacon manufacturers in the Annex G;

b) annotate the recalculated EIRP test results as described in section B.10.2;

c) identify $EIRP_{MIN}$ and $EIRP_{MAX}$ values for further calculation of $EIRP_{min/max\ EOL}$;

d) recalculate $EIRP_{LOSS}$ by taking into account the values of $P_{t\ AMB}$ and $P_{t\ EOL}$ (determined form results of the Operating Lifetime at Minimum Temperature test) related to the current test campaign, as applicable;

e) recalculate the values of $EIRP_{min/max\ EOL}$;

f) include in the test report the following information and test results:

* The loss factor ($EIRP_{LOSS}$) is defined as the minimum transmitter power measured during the operating lifetime at minimum temperature test subtracted from the maximum transmitter power measured at ambient temperature during the transmitted power output test (i.e. $EIRP_{LOSS} = P_{t\ AMB} - P_{t\ EOL}$).

- annotated Tables F-B.1 and F-B.3 for all test configurations and beacon-antenna system configurations from the original type-approval test campaign;

- detailed explanations of EIRP adjustments due to changes in the antenna cable loss, and values of $P_{t\ amb}$, $P_{t\ min}$, and $EIRP_{LOSS}$;

- annotated recalculated Tables F-B.1 and F-B.3 for all beacon-antenna system configurations and applicable test configurations, provided separately for minimum and maximum antenna cable loss (if applicable) and re-evaluated $EIRP_{min/max\ EOL}$, related to the current test campaign; and

g) if necessary, apply the measurement uncertainty of 0.5 dB to the specification limits, and highlight in the Tables F-B.1 and F-B.3 the measurement points to which the measurement uncertainty of 0.5 dB was applied.

B.11 ANTENNA VSWR MEASUREMENT

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

B.11.1

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

B.11.2

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

B.11.3

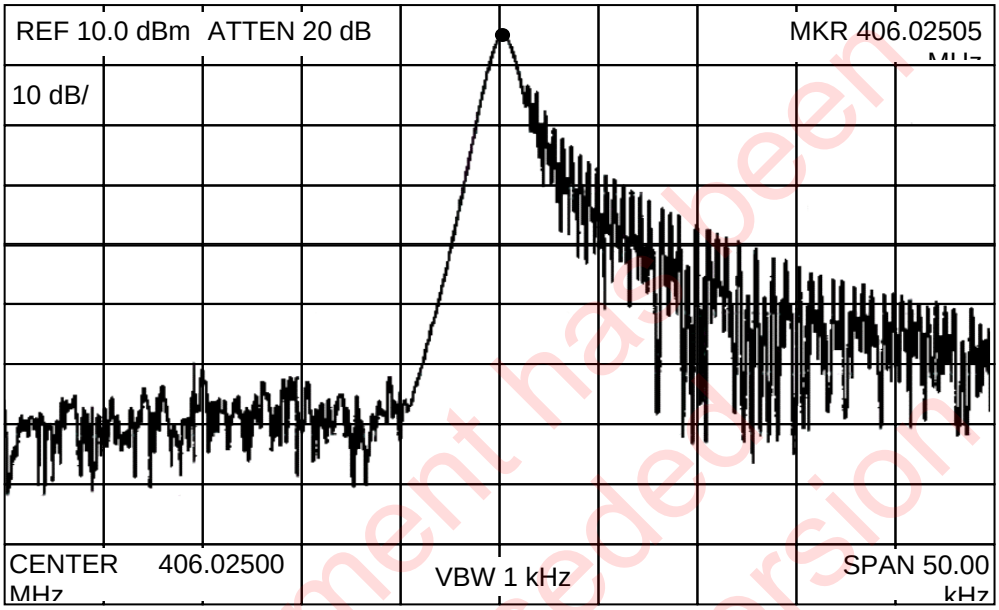
The VSWR measurement shall be performed with the BUT mounted in the configurations that were used for the previously described antenna test (i.e. configurations B.2 through B.4 as appropriate).

B.11.4

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

B.11.5

If the antenna VSWR exceeds the 1.5:1 ratio but remains less than 1.8:1* at the nominal operational frequency, and if the antenna EIRP is evaluated by direct measurements† and



is within the limits specified in section B.10, the beacon can still be considered as meeting the Cospas-Sarsat requirements. However, in this case, Cospas-Sarsat type approval will be deemed as valid only for the beacon-cable-antenna configuration tested (with specific cable type and length) and the antenna should not be used with any other beacon/cable‡ without further type approval testing.

Figure B.9: RF Measurement During Preamble

- END OF ANNEX B -

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

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

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

ANNEX C: BEACON CODING TO BE USED FOR EVALUATING BEACON MESSAGE CODING

If the beacon is designed to operate with a protocol that requires any of the following data elements, the values programmed into the beacon for evaluating beacon message coding (Table F.1 item 16) shall be in accordance with Table C.1. Examples of each requested beacon message protocol shall be included in the test report as per Tables F-D.1, F-D.2, and F-D.3.

Table C.1: Coding Values for Beacon Message Coding Testing

Data Element	Value
Format Flag	As required by the specific protocol
Protocol Flag	As required by the specific protocol
Country Code	201
Protocol Code	As required by the specific protocol
MMSI	999999
Radio Call Sign	XPA02
Cospas-Sarsat Type Approval Certificate Number	999
Cospas-Sarsat RLS Type Approval Certificate Number or National RLS Number	959
Beacon Serialised Number	99
National 18 bits ID Number (binary)	011100000100011001
RLS 2 bits Beacon Type Number (binary)	11
ELT(DT) Location Test protocol: bits 41-42 bits 43-66	00 all "1"s
Any National Use Data Elements	Default values as specified in C/S T.001
Aircraft Registration Marking	C7518
Aircraft Operator Designator and a serial number	AAA500
Aircraft 24-bit Address	11472655 (Base 10 representation)
Aircraft 24-bit Address and 3LD in PDF-2 (ELT(DT)s with rotating PDF-2 field)	PDF-1 - 11472655 (Base 10 representation) PDF-2 – 3LD = YYY
TAC with Serial Number and 3LD in PDF-2 (ELT(DT)s with rotating PDF-2 field)	PDF-1 – TAC = 999, Serial Number = 99 PDF-2 – 3LD = YYY
Specific Beacon	Assume only 1 beacon on vessel or aircraft
Non-Protected Data Field	Default values specified in C/S T.001
Auxiliary Radio Locating Device	As appropriate for the beacon design*
Manual / Automatic Activation	As appropriate for the beacon design†

- END OF ANNEX C -

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

ANNEX D: NAVIGATION SYSTEM TEST SCRIPTS

This test shall be conducted by inputting (e.g. in the form of NMEA sentences from a PC) the test scripts provided below* into the beacon and monitoring the beacon output digital message (ensure that the beacon position data update interval is not modified/reduced during this test in order to reduce test time). The test scenario shall be implemented in the order indicated, and the beacon shall not be turned-off until after all the scenarios have been completed. The procedure shall be completed for each location protocol type (i.e. Standard, National, RLS or User) for which type approval is being requested.

The test results shall be reported in the format provided at Tables F-C.1, F-C.2, F-C.3, F-C.4 and F-C.5.

Table D.1: User-Location Protocol Procedure

Script*	Value of Encoded Location Bits Transmitted by Beacon	BCH Correct (√)	Required Value of Encoded Location Bits†
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	Bits 108-132=		Bits 108-132= 0FE0FF0
2. Keeping the beacon active, apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	Bits 108 – 132= Number of seconds after providing navigation data that beacon transmitted the above encoded location information: _____		Bits 108-132= 1001000 Response time for beacon to transmit correct encoded location must be less than 62.5 sec.

* For beacon models not capable of updating the encoded position data after beacon activation, use the modified procedure for test scripts 2-10, as follows. Instead of keeping the beacon active and applying navigation data to the beacon, the test beacon shall be turned off and then, after the required navigation input is provided, the test beacon shall be turned on.

† The hexadecimal values reported in this column are calculated by converting the binary value of the data required by column two into a hexadecimal value, apart from Bit 108 which remains a binary (0 or 1) character, leading zeros must not be suppressed. For example the following bits 0 1100 0011 0000 1111 0110 1001 would be expressed as 0C30F69.

Script*	Value of Encoded Location Bits Transmitted by Beacon	BCH Correct (√)	Required Value of Encoded Location Bits†
3. Keeping the beacon active, change the navigation input to the beacon to: 0° 0 min 53 sec North, 0° 0 min 51 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 108-132=		Bits 108-132= 0000000
4. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 10 sec North, 179° 47 min 7 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 108-132=		Bits 108-132= 0006B3C
5. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 3 sec South, 179° 46 min 0 sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 108-132=		Bits 108-132= 1007B3C
6. Keeping the beacon active, change the navigation input to the beacon to: 89° 15 min 8 sec South, 89° 0 min 1 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 108-132=		Bits 108-132= 1B28590
7. Keeping the beacon active, change the navigation input to the beacon to: 89° 16 min 10 sec South, 89° 0 min 1 sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 108-132=		Bits 108-132= 1B29590
8. Keeping the beacon active, change the navigation input to the beacon to: 89° 59 min 4 sec North, 179° 59 min 54 sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 108-132=		Bits 108-132= 0B41B40

Script*	Value of Encoded Location Bits Transmitted by Beacon	BCH Correct (√)	Required Value of Encoded Location Bits†
9. Keeping the beacon active, change the navigation input to the beacon to: 89° 57 min 59 sec North, 179° 59 min 24 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 108-132=		Bits 108-132= 0B3CB40
10. Keeping the beacon active, change the navigation input to the beacon to: 36° 30 min 0 sec South, 138° 29 min 59 sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 108-132=		Bits 108-132= 14918A7
Self-Test Navigation Test Scripts			
11.Turn the beacon off. Ensure that navigation data is not provided to the beacon then activate the Self-Test. Record the value of encoded location bits in the self-test message.	Bits 108-132=		Bits 108-132= 0FE0FF0
12. Continuously apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. Activate the Self-Test. Record the value of encoded location bits in the self-test message.	Bits 108 – 132=		Bits 108-132= 0FE0FF0

Table D.2: Standard Location Protocol Procedure

Script*	Value of Encoded Location Bits Transmitted by Beacon	BCH Correct (√)	Required Value of Encoded Location Bits†
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 0FFBFF Bits 113-132= 83E0F
2. Keeping the beacon active, apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	Bits 65-85= Bits 113-132= Number of seconds after providing navigation data that beacon transmitted the above encoded location information: _____		Bits 65-85= 100400 Bits 113-132= 8420E Response time for beacon to transmit correct encoded location must be less than 62.5 sec.
3. Keeping the beacon active, change the navigation input to the beacon to: 0° 0 min 53 sec North, 0° 0 min 51 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 000000 Bits 113-132= 8360D
4. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 10 sec North, 179° 47 min 7 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 000ACF Bits 113-132= 0F222

* For beacon models not capable of updating the encoded position data after beacon activation, use the modified procedure for test scripts 2-11, as follows Instead of keeping the beacon active and applying navigation data to the beacon, the test beacon shall be turned off and then, after the required navigation input is provided, the test beacon shall be turned on.

† The hexadecimal values reported in this column are calculated by converting the binary values of the data required by column two into hexadecimal values, as follows: Bits 65-85 hexadecimal apart from Bit 65 which remains a binary (0 or 1) character, leading zeros must not be suppressed. For example the following bits 1 0000 0111 1110 1111 0001 would be expressed as 107EF1. Bits 113-132 all hexadecimal, leading zeros must not be suppressed. For example the following bits 0000 1000 1011 1111 0010 would be expressed as 08BF2.

Script*	Value of Encoded Location Bits Transmitted by Beacon	BCH Correct (√)	Required Value of Encoded Location Bits†
5. Keeping the beacon active, change the navigation input to the beacon to: 0° 34 min 55 sec North, 179° 35 min 59 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 0012CE Bits 113-132= 93A60
6. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 3 sec South, 179° 46 min 0 sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 100ECF Bits 113-132= 0FA10
7. Keeping the beacon active, change the navigation input to the beacon to: 89° 15 min 8 sec South, 89° 0 min 1 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 1B2964 Bits 113-132= 80A00
8. Keeping the beacon active, change the navigation input to the beacon to: 89° 16 min 10 sec South, 89° 0 min 1 sec West. When the beacon transmitted message changes, record the encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 1B2D64 Bits 113-132= 84E00
9. Keeping the beacon active, change the navigation input to the beacon to: 89° 59 min 4 sec North, 179° 59 min 54 sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 0B46D0 Bits 113-132= 03801
10. Keeping the beacon active, change the navigation input to the beacon to: 89° 57 min 59 sec North, 179° 59 min 24 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 0B42D0 Bits 113-132= 08009

Script*	Value of Encoded Location Bits Transmitted by Beacon	BCH Correct (√)	Required Value of Encoded Location Bits†
11. Keeping the beacon active, change the navigation input to the beacon to: 36° 30 min 0 sec South, 138° 29 min 59 sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 65-85= Bits 113-132=		Bits 65-85= 14962A Bits 113-132= 80200
Self-Test Navigation Test Scripts			
12. Turn the beacon off. Ensure that navigation data is not provided to the beacon then activate the Self-Test. Record the value of encoded location bits in the self-test message.	Bits 65-85= Bits 113-132=		Bits 65-85= 0FFBFF Bits 113-132= 83E0F
13. Continuously apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. Activate the Self-Test. Record the value of encoded location bits in the self-test message.	Bits 65-85= Bits 113-132=		Bits 65-85= 0FFBFF Bits 113-132= 83E0F

Table D.3: National Location Protocol Procedure

Script*	Value of Encoded Location Bits Transmitted by Beacon	BCH Correct (√)	Required Value of Encoded Location Bits†
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= 3F81FE0 Bits 113-126= 27CF
2. Keeping the beacon active, apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	Bits 59-85= Bits 113-126= Number of seconds after providing navigation data that beacon transmitted the above encoded location information: _____		Bits 59-85= 4002000 Bits 113-126= 284E Response time for beacon to transmit correct encoded location must be less than 62.5 sec.
3. Keeping the beacon active, change the navigation input to the beacon to: 0° 0 min 53 sec North, 0° 0 min 51 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= 0000000 Bits 113-126= 26CD
4. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 10 sec North, 179° 47 min 7 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= 0019678 Bits 113-126= 060D

* For beacon models not capable of updating the encoded position data after beacon activation, use the modified procedure for test scripts 2-11, as follows. Instead of keeping the beacon active and applying navigation data to the beacon, the test beacon shall be turned off and then, after the required navigation input is provided, the test beacon shall be turned on.

† The hexadecimal values reported in this column are calculated by converting the binary values of the data required by column two into hexadecimal values, as follows: Bits 59-85 hexadecimal apart from Bits 59, 60 and 61 which form a decimal character (0 to 7), leading zeros must not be suppressed. For example the following bits 101 1000 0000 1100 1111 0101 0000 would be expressed as 580CF50. Bits 113-126 hexadecimal apart from Bits 113 and 114 which form a decimal character (0 to 3), leading zeros must not be suppressed. For example the following bits 10 1111 0000 1100 would be expressed as 2F0C.

Script*	Value of Encoded Location Bits Transmitted by Beacon	BCH Correct (√)	Required Value of Encoded Location Bits†
5. Keeping the beacon active, change the navigation input to the beacon to: 0° 10 min 55 sec North, 179° 51 min 1 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= 001567A Bits 113-126= 2710
6. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 3 sec South, 179° 46 min 0 sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= 401B677 Bits 113-126= 0740
7. Keeping the beacon active, change the navigation input to the beacon to: 89° 15 min 8 sec South, 89° 0 min 1 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= 6CA0B20 Bits 113-126= 06C0
8. Keeping the beacon active, change the navigation input to the beacon to: 89° 16 min 10 sec South, 89° 0 min 1 sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= 6CA2B20 Bits 113-126= 21C0
9. Keeping the beacon active, change the navigation input to the beacon to: 89° 59 min 4 sec North, 179° 59 min 54 sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= 2D03680 Bits 113-126= 0701
10. Keeping the beacon active, change the navigation input to the beacon to: 89° 57 min 59 sec North, 179° 59 min 24 sec East. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= 2CF5680 Bits 113-126= 2009

Script*	Value of Encoded Location Bits Transmitted by Beacon	BCH Correct (√)	Required Value of Encoded Location Bits†
11. Keeping the beacon active, change the navigation input to the beacon to: 36° 30 min 0 sec South, 138° 29 min 59 sec West. When the beacon transmitted message changes, record the new encoded location bits.	Bits 59-85= Bits 113-126=		Bits 59-85= 523F14F Bits 113-126= 2040
Self-Test Navigation Test Scripts			
12. Turn the beacon off. Ensure that navigation data is not provided to the beacon then activate the Self-Test. Record the value of encoded location bits in the self-test message.	Bits 59-85= Bits 113-126=		Bits 59-85= 3F81FE0 Bits 113-126= 27CF
13. Continuously apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. Activate the Self-Test. Record the value of encoded location bits in the self-test message.	Bits 59-85= Bits 113-126=		Bits 59-85= 3F81FE0 Bits 113-126= 27CF

Table D.4: ELT(DT) and RLS* Location Protocol Procedure

Script	Value of Encoded Location Bits Transmitted by Beacon	BCH Correct (√)	Required Value of Encoded Location Bits†
1. Turn on beacon ensuring that navigation is not provided to the beacon. Record the value of encoded location bits.	Bits 67-85= Bits 115-132= Bits 109-112=		Bits 67-85 = 3FDFF Bits 115-132 = 21F0F Bits 109-112 = F
2. Keeping the beacon active, apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. Altitude = 2000m When the beacon transmitted message changes, record the new encoded location bits and the duration of time the beacon took to update.	Bits 67-85= Bits 115-132= Bits 109-112= Number of seconds after providing navigation data that beacon transmitted the above encoded location information: _____		Bits 67-85 = 40200 Bits 115-132 = 2210E Bits 109-112 = 4 Response time for beacon to transmit correct encoded location must be less than 62.5 sec.
3. Keeping the beacon active, change the navigation input to the beacon to: 0° 0 min 53 sec North, 0° 0 min 51 sec East. Altitude = 5600.4m When the beacon transmitted message changes, record the new encoded location bits.	Bits 67-85= Bits 115-132= Bits 109-112=		Bits 67-85 = 00000 Bits 115-132 = 21B0D Bits 109-112 = A

* Note that Altitude and the results for Bits 109-112 in Table D.4 above only apply to ELT(DT)s.

† The hexadecimal values reported in this column are calculated by converting the binary values of the data required by column two into hexadecimal values, as follows: Bits 67-85 hexadecimal apart from Bits 67, 68 and 69 which form a decimal character (0 to 7), leading zeros must not be suppressed. For example the following bits 010 1000 0000 1100 1111 would be expressed as 280CF. Bits 115-132 hexadecimal apart from Bits 115 and 116 which form a decimal character (0 to 3), leading zeros must not be suppressed. For example the following bits 10 1111 0000 1100 0110 1010 would be expressed as 2F0C6A.

Script	Value of Encoded Location Bits Transmitted by Beacon	BCH Correct (√)	Required Value of Encoded Location Bits†
4. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 10 sec North, 179° 47 min 7 sec East. Altitude = 5599.6m When the beacon transmitted message changes, record the new encoded location bits.	Bits 67-85= Bits 115-132= Bits 109-112=		Bits 67-85 = 00168 Bits 115-132 = 366CD Bits 109-112 = 9
5. Keeping the beacon active, change the navigation input to the beacon to: 1° 10 min 55 sec North, 178° 51 min 1 sec East. Altitude = -100m When the beacon transmitted message changes, record the new encoded location bits.	Bits 67-85= Bits 115-132= Bits 109-112=		Bits 67-85 = 00966 Bits 115-132 = 35C90 Bits 109-112 = 0
6. Keeping the beacon active, change the navigation input to the beacon to: 0° 11 min 3 sec South, 179° 46 min 0 sec West. Altitude = 1m When the beacon transmitted message changes, record the new encoded location bits.	Bits 67-85= Bits 115-132= Bits 109-112=		Bits 67-85 = 40368 Bits 115-132 = 362E0 Bits 109-112 = 0
7. Keeping the beacon active, change the navigation input to the beacon to: 89° 15 min 8 sec South, 89° 0 min 1 sec East. Altitude = 401m When the beacon transmitted message changes, record the new encoded location bits.	Bits 67-85= Bits 115-132= Bits 109-112=		Bits 67-85 = 6CCB2 Bits 115-132 = 1DB00 Bits 109-112 = 1

Script	Value of Encoded Location Bits Transmitted by Beacon	BCH Correct (√)	Required Value of Encoded Location Bits†
8. Keeping the beacon active, change the navigation input to the beacon to: 89° 16 min 10 sec South, 89° 0 min 1 sec West. Altitude = 7000m When the beacon transmitted message changes, record the new encoded location bits.	Bits 67-85= Bits 115-132= Bits 109-112=		Bits 67-85 = 6CEB2 Bits 115-132 = 1B900 Bits 109-112 = B
9. Keeping the beacon active, change the navigation input to the beacon to: 89° 59 min 4 sec North, 179° 59 min 54 sec West. Altitude = 9999m When the beacon transmitted message changes, record the new encoded location bits.	Bits 67-85= Bits 115-132= Bits 109-112=		Bits 67-85 = 2D368 Bits 115-132 = 01C01 Bits 109-112 = D
10. Keeping the beacon active, change the navigation input to the beacon to: 89° 57 min 59 sec North, 179° 59 min 24 sec East. Altitude = 10001m When the beacon transmitted message changes, record the new encoded location bits.	Bits 67-85= Bits 115-132= Bits 109-112=		Bits 67-85 = 2D168 Bits 115-132 = 04009 Bits 109-112 = E
11. Keeping the beacon active, change the navigation input to the beacon to: 36° 30 min 0 sec South, 138° 29 min 59 sec West. Altitude = 15240m When the beacon transmitted message changes, record the new encoded location bits.	Bits 67-85= Bits 115-132= Bits 109-112=		Bits 67-85 = 52715 Bits 115-132 = 20100 Bits 109-112 = E

Script	Value of Encoded Location Bits Transmitted by Beacon	BCH Correct (√)	Required Value of Encoded Location Bits†
Self-Test Navigation Test Scripts (except ELT(DT)s with a Rotating PDF-2 Field)			
12. Turn the beacon off. Ensure that navigation data is not provided to the beacon then activate the Self-Test. Record the value of encoded location bits in the self-test message.	Bits 67-85= Bits 115-132= Bits 109-112=		Bits 67-85 = 3FDFF Bits 115-132 = 21F0F Bits 109-112 = F
13. Continuously apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. Altitude = 1000m Activate the Self-Test. Record the value of encoded location bits in the self-test message.	Bits 67-85= Bits 115-132= Bits 109-112=		Bits 67-85 = 3FDFF Bits 115-132 = 21F0F Bits 109-112 = F
Self-Test Navigation Test Scripts (ELT(DT)s with a Rotating PDF-2 Field)			
12. Turn the beacon off. Ensure that navigation data is not provided to the beacon then activate the Self-Test. Record the value of encoded location bits in the self-test message.	Bits 67-85= Bits 113-114= Bits 115-132= Bits 109-112=		Bits 67-85 = 3FDFF Bits 113-114 = 00 Bits 115-132 = 056B5 Bits 109-112 = F
13. Continuously apply the following navigation data to the beacon: 0° 0 min 59 sec South, 0° 0 min 57 sec West. Altitude = 1000 m Activate the Self-Test. Record the value of encoded location bits in the self-test message.	Bits 67-85= Bits 113-114= Bits 115-132= Bits 109-112=		Bits 67-85 = 3FDFF Bits 113-114 = 00 Bits 115-132 = 056B5 Bits 109-112 = F

Table D.5: RLS Location Protocol Procedure Additional Scripts

Script	Expected Result	Actual Result	Pass/Fail (√ or x)
1. Ensure that the beacon is correctly coded as per C/S T.007 Annex C. Carry out a self-test.	Ensure that the encoded 15 Hex ID is '193BFCE031BFDFF'	Hex ID =	
2. Turn the beacon on and check that it is transmitting, and what the Hex ID is, and that there is an indication of an RLS request. Decode the transmitted message and ensure that bits 109 to 114 are correctly encoded.	Transmitted 15 Hex ID is '193BFCE031BFDFF' Visual Indication of RLS request Bits 109 to 114 are '100001'.	Hex ID = Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	
3. Provide an IEC 61162-1 RLM sentence or an equivalent proprietary RLM sentence defined by the GNSS-receiver manufacturer as the navigation input to the beacon with the following data: 15 Hex ID = 193BFCE031BFDFF Message Type = 1 UTC Time = any valid random data Decode the next transmitted message and ensure that bits 109 to 114 are correctly encoded.	Ensure that a different indication of receipt of an RLS request acknowledgement is provided within 5 seconds of the application of the RLM sentence. Bits 109 to 114 are '101001'	Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	
4. Turn the beacon off and remove the RLM sentence from the navigation input. Turn the beacon on and check that it is transmitting, and what the Hex ID is, and that there is an indication of an RLS request. Decode the transmitted message and ensure that bits 109 to 114 are correctly encoded.	Transmitted 15 Hex ID is '193BFCE031BFDFF' Visual Indication of RLS request. Bits 109 to 114 are '100001'.	Hex ID = Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	

Script	Expected Result	Actual Result	Pass/Fail (√ or x)
5. Provide an IEC 61162-1 RLM sentence or an equivalent proprietary RLM sentence defined by the GNSS-receiver manufacturer as the navigation input to the beacon with the following data: 15 Hex ID = 193BFCE031BFDFF Message Type = 2 UTC Time = any valid random data Decode the transmitted message and ensure that bits 109 to 114 are correctly encoded.	Monitor the RLS Indicator for a minimum of 5 minutes and ensure that it continues to provide an indication of an RLS request. Bits 109 to 114 are '100001'.	Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	
6. Turn the beacon off and remove the RLM sentence from the navigation input. Turn the beacon on and check that it is transmitting, and what the Hex ID is, and that there is an indication of an RLS request. Decode the transmitted message and ensure that bits 109 to 114 are correctly encoded.	Transmitted 15 Hex ID is '193BFCE031BFDFF' Visual Indication of RLS request Bits 109 to 114 are '100001'.	Hex ID = Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	

Script	Expected Result	Actual Result	Pass/Fail (√ or x)
7.* Provide an IEC 61162-1 RLM sentence or an equivalent proprietary RLM sentence defined by the GNSS-receiver manufacturer as the navigation input to the beacon with the following data: 15 Hex ID = 193BFCE032BFDFF Message Type = 1 UTC Time = any valid random data Decode the transmitted message and ensure that bits 109 to 114 are correctly encoded.	Monitor the RLS Indicator for a minimum of 5 minutes and ensure that it continues to provide an indication of an RLS request. Bits 109 to 114 are '100001'.	Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	
8. Turn the beacon off and remove the RLM sentence from the navigation input. Turn the beacon on and check that it is transmitting, and what the Hex ID is, and that there is an indication of an RLS request. Decode the transmitted message and ensure that bits 109 to 114 are correctly encoded.	Transmitted 15 Hex ID is '193BFCE031BFDFF' Visual Indication of RLS request Bits 109 to 114 are '100001'	Hex ID = Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	

* Test 7 is aimed at providing a valid change to the beacon serial number from 99 to 101 in the return link message and at confirming that the beacon ignores this message which is not addressed to the beacon under test.

Script	Expected Result	Actual Result	Pass/Fail (√ or x)
9.* Provide an IEC 61162-1 RLM sentence or an equivalent proprietary RLM sentence defined by the GNSS-receiver manufacturer as the navigation input to the beacon with the following data: 15 Hex ID = 193BFCE031BFDFE Message Type = 1 UTC Time = any valid random data Decode the transmitted message and ensure that bits 109 to 114 are correctly encoded.	Monitor the RLS Indicator for a minimum of 5 minutes and ensure that it continues to provide an indication of an RLS request. Bits 109 to 114 are '100001'.	Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	
10. Turn the beacon off and remove the RLM sentence from the navigation input. Turn the beacon on and check that it is transmitting, and what the Hex ID is, and that there is an indication of an RLS request. Decode the transmitted message and ensure that bits 109 to 114 are correctly encoded.	Transmitted 15 Hex ID is '193BFCE031BFDFF' Visual Indication of RLS request Bits 109 to 114 are '100001'.	Hex ID = Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	

* Test 9 is aimed at making an invalid change to the return link message in that it alters the default location data which should not change in a valid Hex ID. This test ensures that beacons are simply not ignoring these bits in their return link message validation of the 15 Hex ID.

Script	Expected Result	Actual Result	Pass/Fail (√ or x)
11. Provide an IEC 61162-1 RLM sentence or an equivalent proprietary RLM sentence defined by the GNSS-receiver manufacturer as the navigation input to the beacon with the following data: 15 Hex ID = 183BFCE031BFDFF Message Type = 1 UTC Time = any valid random data Decode the transmitted message and ensure that bits 109 to 114 are correctly encoded.	Monitor the RLS Indicator for a minimum of 5 minutes and ensure that it continues to provide an indication of an RLS request. Bits 109 to 114 are '100001'.	Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	

- END OF ANNEX D -

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

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

E.1 BEACON VOICE TRANSCEIVER CONFIGURATION

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

a) if the beacon has a volume control setting, the beacon loudspeaker shall be set to maximum volume and a fully modulated voice carrier from an external RF-generator shall be transmitted in the operational frequency channel;

b) if the beacon includes a manual squelch mode, this shall be selected, and it shall be set to its most sensitive level for un-squelched operating periods;

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

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

E.2 THERMAL SHOCK TEST (C/S T.007, SECTION A.2.2)

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

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

b) thereafter, the transceiver shall be configured to repeat the following cycle, 3 times in succession, once per hour of testing:

   i. transmit for 30 seconds, and

   ii. followed by 30 seconds receiving.

E.3 OPERATING LIFETIME AT MINIMUM TEMPERATURE TEST (C/S T.007, SECTION A.2.3)

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

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

b) 4 hours before the end of the test period the procedure described at paragraph E.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 as follows:

i. for beacons with a means to prevent continuous transmission beyond a predetermined limit where the manufacturer has declared a transmit mode test 'on' time, the transceiver shall be operated as described below until the total time of the voice transceiver transmission reaches the declared 'on' time limit* commencing 6 hours after the start of the test. Note that due to the inclusion of the means to prevent continuous transmission it may be necessary to release and reactivate the PTT switch a number of times in order to achieve the declared 'on' time.

a. transmit for 30 seconds,

b. followed by 30 seconds receiving, and

ii. for beacons without a means to prevent continuous transmission beyond a predetermined limit then the transceiver shall transmit for the remaining operation for that beacon.

E.4 FREQUENCY STABILITY ~~TEST~~ WITH TEMPERATURE GRADIENT *TEST* (C/S T.007, SECTION A.2.4)

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

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

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

E.5 SATELLITE QUALITATIVE TESTS (C/S T.007, SECTION A.2.5)

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

* Note that this test requires the beacon to transmit for a period of 15 minutes in excess of the manufacturer declared transmit mode test 'on' time as required by E.3 a. and E.3 b. This additional transmit time is to compensate for the additional current drain during the time that the receiver may be on during the manufacturer-declared minimum operating lifetime.

E.6 PREVENTION OF CONTINUOUS TRANSMISSION TESTS

This test only applies to operator-controlled voice transceivers that include a means to prevent continuous transmission beyond a predetermined limit set by the manufacturer.

Activate the PTT switch on the beacon and keep it this way. Monitor the transmissions from the operator-controlled voice transceiver and ensure that these cease after the predetermined limit set by the manufacturer, which must not exceed 30 minutes. Continue to keep the PTT switch activated for a further period of 15 minutes after the transmissions from the operator-controlled voice transceiver cease and ensure that they do not automatically restart during this period. Release and reactivate the PTT switch and ensure that transmissions from the operator-controlled voice transceiver restart.

Report the results of the test in the Table F.1, test parameter 19.

E.7 ALL OTHER TESTS

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

- END OF ANNEX E -

ANNEX F: BEACON TYPE APPROVAL TEST RESULTS

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

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			T_{min} (___°C)	T_{amb} (___°C)	T_{max} (___°C)	
1. Transmitter Power Output						
- transmitter power output (min and max)						
○ Except ELT(DT)	35-39	dBm				
○ For ELT(DT)	36-39	dBm				
- power output rise time						
○ Except ELT(DT)	< 5	ms				
○ For ELT(DT)	<2	ms				
- power output 1 ms before burst	< -10 dBm	dBm				
2. Digital Message						
Bits number						
- bit sync 1-15	15 bits "1"	√*				
- frame sync 16-24	"000101111"	√				
- format flag 25	1 bit	bit value				
- protocol flag 26	1 bit	bit value				
- identification / position data 27-85	59 bit	√				
- BCH code 86-106	21 bits	√				
- emergency code / nation. use/suppl. data 107-112	6 bits	bit value				
- For RLS/ELT(DT) / suppl. data 107-114	8 bits	bit value				
- additional data /BCH (if applicable) (except for RLS/ELT(DT))	32 bits	√				
- additional data /BCH (if applicable) (for RLS/ELT(DT))	30 bits	√				
3a. Digital Message Generator (except for ELT(DT))						
- repetition rate T_R:						
- average T_R	48.5-51.5	sec				
- min T_R	$47.5 \leq T_R \leq 48.0$	sec				
- max T_R	$52.0 \leq T_R \leq 52.5$	sec				
- standard deviation	0.5-2.0	sec				

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

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			T_{min} (___°C)	T_{amb} (___°C)	T_{max} (___°C)	
- bit rate (except for RLS-capable beacons)						
○ min fb	≥ 396	bit/sec				
○ max fb	≤ 404	bit/sec				
- bit rate (for RLS-capable beacons)						
○ min fb	≥ 399.6	bit/sec				
○ max fb	≤ 400.4	bit/sec				
- total transmission time:						
○ short message	435.6-444.4	ms				
○ long message	514.8-525.2	ms				
- unmodulated carrier:						
○ min T1	≥ 158.4	ms				
○ max T1	≤ 161.6	ms				
- first burst delay:						
○ all beacon types, including ELTs when manually activated	≥ 47.5	sec				
○ ELTs when automatically activated by G-switch/deformation	≤ 15	sec				
3b. Digital Message Generator (for ELT(DT))						
- repetition period T_R (burst 1 to burst 24 after beacon activation)	$4.8 \leq T_R \leq 5.0$	sec				
- repetition period T_R (burst 24 to 42 after beacon activation)	$9.8 \leq T_R \leq 10.0$	sec				
- repetition rate T_R (after burst 42 after beacon activation):						
○ average T_R		sec				Record actual value of the observed average T_R
○ min T_R	$27.0 \leq T_R \leq 27.2$	sec				
○ max T_R	$29.8 \leq T_R \leq 30.0$	sec				
○ standard deviation	>0.8	sec				
- bit rate:						
○ min fb	≥ 399.6	bit/sec				
○ max fb	≤ 400.4	bit/sec				
- total transmission time:						
○ long message	514.8-525.2	ms				
- unmodulated carrier:						
○ min T_1	≥ 158.4	ms				
○ max T_1	≤ 161.6	ms				

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			T_{min} (___°C)	T_{amb} (___°C)	T_{max} (___°C)	
- first burst delay: o ELT(DT)	≤ 5	sec				
(additionally for ELT(DT)s with a rotating PDF-2 field) - repetition rate of 3LD bursts (between bursts 1 and 24) - repetition rate of 3LD bursts (between bursts 25 and 45) - repetition rate of 3LD bursts (from burst 46 onwards)	 19.2≤T_R≤20.0 58.3≤T_R≤60.5 809.5≤T_R≤900.5	 sec sec sec				
3c. Digital Message Generator (for ELT(DT)specifically designed to withstand crash): - repetition period T_R (burst 1 to burst 24 after beacon activation by crash sensor) - repetition period T_R (after-burst 24 to burst 42 after beacon activation by crash sensor) - repetition rate T_R (after burst 42 to burst 95 after beacon activation by crash sensor): o min T_R o max T_R o standard deviation - repetition rate T_R (greater than 30 minutes after beacon activation by a crash sensor): o min T_R o max T_R o standard deviation - bit rate: o min f_b o max f_b - total transmission time (long message) - unmodulated carrier: o min T_1 o max T_1 - first burst delay	 4.8≤ T_R ≤5.0 9.8≤ T_R ≤10.0 27.0≤ T_R ≤27.2 29.8≤ T_R ≤30.0 >0.8 115.0≤ T_R ≤115.2 124.8≤ T_R ≤125.0 >2.5 ≥ 399.6 ≤ 400.4 514.8-525.2 ≥ 158.4 ≤ 161.6 ≤ 5	 sec sec sec sec sec sec sec sec bit/sec bit/sec ms ms ms sec				

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			T_{min} (___°C)	T_{amb} (___°C)	T_{max} (___°C)	
4. Modulation						
- biphase-L		√				
- rise time except ELT(DT) (min and max)	50-250	µsec				
- fall time except ELT(DT) (min and max)	50-250	µsec				
- rise time for ELT(DT) (min and max)	50-150	µsec				
- fall time for ELT(DT) (min and max)	50-150	µsec				
- phase deviation: positive (min and max)	+(1.0 to 1.2)	radians				
- phase deviation: negative (min and max)	-(1.0 to 1.2)	radians				
- symmetry measurement	≤ 0.05					
5. 406 MHz Transmitted Frequency						
- nominal value	C/S T.001	MHz				
- short-term stability	≤ $2x10^{-9}$	/100 ms				
- medium-term stability slope (N/A for ELT(DT))	(-1 to +1)$x10^{-9}$	/min				
- medium-term stability residual frequency variation (N/A for ELT(DT))	≤ $3x10^{-9}$					
6. Spurious Emissions into 50 Ohms (406.0 – 406.1 MHz)*	C/S T.001 mask	√				
7. 406 MHz VSWR Check						
- nominal transmitted frequency	C/S T.001	MHz				
- modulation rise time except ELT(DT) (min and max)	50-250	µsec				
- modulation fall time except ELT(DT) (min and max)	50-250	µsec				
- modulation rise time for ELT(DT) (min and max)	50-150	µsec				
- modulation fall time for ELT(DT) (min and max)	50-150	µsec				
- phase deviation: positive (min and max)	+(1.0 to 1.2)	radians				
- phase deviation: negative (min and max)	-(1.0 to 1.2)	radians				
- modulation symmetry measurement	≤ 0.05					
- digital message	Correct	√				

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

Parameters to be Measured	Range of Specification	Units	Test Results			Comments
			T_{min} (___ºC)	T_{amb} (___ºC)	T_{max} (___ºC)	
8 (a). Self-test Mode						
- frame sync	"011010000"	√				
- format flag	1/0	bit value				
- radiated burst	≤ 440/520 (±1%)	ms				
- default position data (if applicable)	must be correct	√				
- description provided		√				
- design data provided on protection against repetitive self-test mode transmissions		√				
- single burst verification	must be one burst	√				
- provides for 15 Hex ID	must be correct	√				
- 121.5 MHz RF power (if applicable)	verify that RF power is emitted	√				
- 406 MHz RF power	verify that RF power is emitted	√				
- distinct indication of self-test start	must be provided	√				
- distinct indication of RF-power being emitted	must be provided	√				
- indication of the self-test result	must be provided	√				
- distinct indication of insufficient battery capacity	must be provided	√				
- distinct indication if the beacon is coded with the RLS Location Protocol (i.e., the RLS functionality is enabled), and the RLS and RLM indicator(s)are operating as described in section 4.5.4 e) of document C/S T.001.	must be provided					for RLS-capable beacons
- maximum duration of self-test mode	shall not exceed maximum duration of self-test	sec				
- automatic termination of the self-test mode upon completion of the self-test and indication of the self-test results	verify automatic termination, irrespectively of the switch position	√				

8 (b). GNSS Self-Test Mode (if applicable)						
- frame sync	"011010000"	√				
- format flag	1	bit value				
- radiated burst duration	≤ 520 (±1%)	ms				
- position data except for ELT (DT) (if applicable)	must be within 500m (or 5.25km for User-Location Protocol) of the beacon known position	√				
- position data for ELT(DT)	must be within 200m of the beacon known horizontal position and 700m of the altitude	√				
- *position data from External Navigation Input*	*must be within 5250 m from the location data obtained from the external navigation interface (for User-Location protocol)*	*√*				
	must be within 200m from the location data obtained from the external navigation interface (for all other location protocols, than the User-Location protocol)	*√*				
- design data showing how GNSS Self-Test is limited in number of transmissions and duration	must be provided	√				
- single burst verification(if applicable)	must be one burst	√				
- 121.5 MHz RF power (if applicable)	verify that RF power is emitted	√				
- 406 MHz RF power (if applicable)	verify that RF power is emitted	√				
- Maximum duration of GNSS Self-Tests	Manufacturer to specify value	sec				
- Actual duration of GNSS Self-Test with encoded location	Less than maximum duration	sec				
- Maximum number of GNSS Self-Tests (only beacons with internal navigation devices)	Manufacturer to specify number	number				
- Distinct indication to register successful completion or failure of the GNSS self-test	must be provided	√				
- Distinct indication that a maximum number of GNSS self-tests has been attained after GNSS self-test mode activation and without transmission of a test message or further GNSS receiver current drain	must be provided	√				
- Automatic termination of the GNSS self-test mode upon completion of the GNSS self-test cycle and indication of the results	verify automatic termination of GNSS Self-test mode, irrespective of the switch position					

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
9. Thermal Shock*				
- soak temperature			T_{soak}=_____°C	
- measurement temperature			T_{meas}=_____°C	
- the following parameters are to be met within 15 minutes of beacon turn on (except for ELT(DT) for which measurements shall commence immediately after beacon activation) and maintained for 2 hours:				
- transmit frequency nominal value	C/S T.001	MHz		
- transmit frequency short-term stability	≤ $2x10^{-9}$	/100 ms		
- transmit frequency medium-term stability slope (N/A for ELT(DT))	(-2 to +2)$x10^{-9}$	/min		
- transmit frequency medium-term stability residual frequency variation (N/A for ELT(DT))	≤ $3x10^{-9}$			
- transmitter power output except for ELT(DT) (min and max)	35-39	dBm		
- transmitter power output for ELT(DT) (min and max)	36-39	dBm		
- digital message	Correct	√		
10. Operating Lifetime at Minimum Temperature Test†				
Duration of continuous operation, except for ELT(DT))	> 24	hrs	_____hours at T_{min} =_____°C	
Duration of continuous operation for ELT(DT)	> 370	mins	_____minutes at T_{min} =_____°C	
- transmit frequency nominal value	C/S T.001	MHz		

* Attach graphs depicting the test results.
† Attach graphs depicting test results.

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
- transmit frequency short-term stability	≤ $2x10^{-9}$	/100ms		
- transmit frequency medium-term stability slope (N/A for ELT(DT))	(-1 to +1)$x10^{-9}$	/min		
- transmit frequency medium-term stability residual frequency variation (N/A for ELT(DT))	≤ $3x10^{-9}$			
- transmitter power output (except for ELT(DT)) (min and max)	35-39	dBm		
- $P_{t\ EOL}$ is the minimum transmitter power output observed during the operating lifetime at minimum temperature test except for ELT(DT)	35-39	dBm		
- transmitter power output for ELT(DT) (min and max)	36-39	dBm		
- $P_{t\ EOL}$is the minimum transmitter power output observed during the operating lifetime at minimum temperature test for ELT(DT)	36-39	dBm		
- digital message	Correct	√		
- homer transmitter continuous operation during the operating lifetime at minimum temperature test		hours		
- homer frequency		MHz		
- homer peak power level		dBm		
- homer transmitter duty cycle		%		
11. Temperature Gradient *Test* *				
- temperature gradient rate (5/7/33) °**C**/hr	C/S T.001	deg./hr		Indicate rate tested

* Attach graphs depicting the test results.

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
- transmit frequency nominal value	C/S T.001	MHz		
- transmit frequency short-term stability	≤ $2x10^{-9}$	/100ms		
- transmit frequency medium-term stability (N/A for ELT(DT))				
○ slope (A to B, C+15 to D and E+15 to F)	(-1 to +1)$x10^{-9}$	/min		
○ slope (B to C+15 and D to E+15)	(-2 to +2)$x10^{-9}$	/min		
○ residual frequency variation	≤ $3x10^{-9}$			
- transmitter power output except for ELT(DT) (min and max)	35-39	dBm		
- transmitter power output for ELT(DT) (min and max)	36-39	dBm		
- digital message	Correct	√		
12. Oscillator Aging				
- 5-year carrier nominal frequency variation	C/S T.001, section 2.3.1	kHz		
- MTS analysis (if applicable)	Must demonstrate compliance	√		
13. Protection against Continuous Transmission Description Provided	< 45	sec		Provide description.
14a. Satellite Qualitative Test except for ELT(DT) (results provided) *	15 Hex ID provided by LUT and position within 5 km 80% of time	√		
	RLM received within 15 minutes	√		For beacons with an RLS function only

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

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
14b. Satellite Qualitative Test for ELT(DT)(results provided) *	produce an alert with a complete valid beacon message at least once per minute for >90% of the time	√		
	encoded location provided accurate within 200m 2D for >90% of the alerts	√		
	encoded location provided by the MEOLUT as per the pass/fail criteria A.2.5 c) (i, ii, and iii) for altitude	√		
15. Antenna Characteristics				Report results for each beacon-antenna and test configuration tested
- Polarization	linear or RHCP			
- VSWR	≤ 1.5			
- $EIRP_{LOSS}$		dB		
- $EIRP_{max\ EOL}$ except for ELT(DT) and PLB on PFD	≤ 43	dBm		
- $EIRP_{min\ EOL}$ except for ELT(DT)	≥ 32 or ≥ 30	dBm		≥30 dBm for antenna tested in Figure B.5 configuration
- $EIRP_{max\ EOL}$ for ELT(DT) and PLB on PFD	≤ 45	dBm		
- $EIRP_{min\ EOL}$ for ELT(DT)	≥ 34	dBm		

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

16. Beacon Coding Software*				
- sample message provided for each coding option of the applicable coding types	correct	√		Per applicable F-D.1/F-D.2/ F-D.3 Table.
- sample self-test message provided for each coding option of the applicable coding types	correct	√		Per applicable F-D.1/F-D.2/ F-D.3 Table.
17. Navigation System†				Report the results for ULP, SLP, NLP, RLSLP and ELT(DT)LP as appropriate
- position data default value	correct	√		
- freshness of the encoded position (for ELT (DT))	bits 113 and 114 correctly change over time as the freshness of the encoded location ages	√		
- position acquisition time‡	< 10 (int.nav) < 1 (ext.nav) < 3 (all ELT(DT) nav)	min min second		Results per Tables F-C.6 or F-C.7
- position accuracy§	C/S T.001			Results per Tables F-C.6 or F-C.7
- SLP, NLP, RLS	< 500	m		
- ELT(DT)	<200	m		
- ULP	<5.25	km		
- encoded position data update interval	between 4minutes 25 seconds and 16 minutes 30 seconds (except for ELT(DT))	min-sec		
-	> every burst (for ELT(DT))	√		

* Attach examples of each requested coding option as per Appendix D to Annex F.
† Attach navigation system test results as per Appendix C to Annex F.
‡ Report the results of this test for all the declared beacon configurations.
§ Report the results of this test for all the declared beacon configurations.

- internal navigation device update intervals (except for ELT(DT))	as per C/S T.001, section 4.5.5.4	√		Include results from 0 to 2, 2 to 6 and more than 6 hours, in a separate table
- information provided on manufacturers location data update scheme		√		
- internal navigation device update intervals (For ELT(DT))	as per C/S T.001, section 4.5.5.6	√		Results per Table F-C.8
- position clearance after deactivation	Correct	√		Test per A.3.8.4
- position data input update interval	<1.0 min (ELT) <20 min (EPIRB/PLB) <2 seconds (ELT(DT))	√ √ √		Test per A.3.8.5
- stored position cleared within interval	1.0-1.5 min (ELT) 20-30 min (EPIRB/PLB) 10-10.25 min (ELT(DT))	√ √ √		
- position data encoding	Correct	√		Results per Tables F-C.1 to F-C.5 as appropriate
- retained last valid position after navigation input lost	240(±5)	min		Test per A.3.8.6
- default position data transmitted after 240 (±5) minutes without valid position data	Correct	√		Test per A.3.8.6
- information provided on protection against erroneous position encoding into the beacon message		√		
18. Return Link Service (RLS) *Tests*				
- ***A.3.8.8.1*** **RLM Reception verification *Test***	*Test RLM message received*		*Pass / Fail*	
- **A.3.8.8.~~1~~ *2* M_{offset} Test** –Self-Test for correct 15 Hex ID		N/A	Pass / Fail	See Table A.2

a) RLS Indication - RLS request unique distinct indication	≤ 5 seconds after first transmission of RLS request until a valid RLM Type 1 or Test RLM message is received,	sec		to be verified during A.3.8.8.1 M_{offset} Test, item a)
- RLS indication is readily visible to the user when the beacon is operated in all declared operational configurations;	Must be correct	√		to be verified during Satellite Qualitative test - Report results for all test configurations
- RLS indication is clearly visible to the user in direct sunlight, at a distance of 1 meter from the beacon;	Must be correct	√		to be verified for all test configurations
- RLS indication remain inactive at all times when the beacon is encoded with any protocol other than the RLS Location Protocol or RLS Location Test Protocol;	Must be correct	√		
- distinct indication that the RLM Type 1 or Test RLM has been received	< 5 sec, after the RLM has been received until either the beacon is deactivated or the beacon battery is expired	sec		to be verified during A.3.8.8.1 M_{offset} Test, item f)
- the beacon only provides the indication of receipt of the RLM Type 1 or Test RLM, which contain the beacon 15 Hex ID	Must be correct			to be verified during A.3.8.7 Position Data Encoding Test
b) Transmitted Message Bits 109 – 114	100001	N/A	Pass / Fail	
c) GNSS Receiver turns on	≤ 5 seconds after beacon activation	sec		
d) Time to output UTC	Record time since receiver activation	sec		
e) GNSS Receiver on time	≥ 30 minutes after beacon activation	min		
f) Time to indicate RLM receipt	≤ 30 minutes after beacon activation	min		

g) Transmitted Message Bits 109 to 114	101001	N/A	Pass / Fail	First transmitted burst after RLM receipt
h) GNSS Receiver reactivation time (or must be already on)	M_{offset} minutes +/- 5 seconds past next natural hour	min		
i) GNSS Receiver on time	≥ 15 minutes after reactivation	min		
j) GNSS Receiver reactivation time (or must be already on)	M_{offset} minutes +/- 5 seconds past next natural hour	min		
k) GNSS Receiver on time	≥ 15 minutes after reactivation	min		
- A.3.8.8.~~2~~ *3* UTC Test a) Visual Indication	≤ 5 seconds after first transmission	sec		
b) Transmitted Message Bits 109 to 114	100001	N/A	Pass / Fail	
c) GNSS Receiver turns on	≤ 5 seconds after beacon activation	sec		
d) Time to output UTC	Record time since receiver activation	sec		
e) GNSS Receiver position output Deny Beacon further GNSS signals	Valid Lat/Long No further Receiver outputs	N/A N/A	Pass / Fail Pass / Fail	
f) Transmitted message valid location Message Bits 109 to 114	≤ 500m of the beacon known location 100001	m N/A	Pass / Fail	
g) GNSS Receiver on time	≥ 30 minutes after beacon activation	min		
h) GNSS Receiver reactivation time (or must be already on)	M_{offset} minutes +/- 5 seconds past next natural hour	min		
i) GNSS Receiver on time	≥ 15 minutes after reactivation	min		
j) Transmitted message valid location Message Bits 109 to 114	≤ 500m of the beacon known location 100001	m N/A	Pass / Fail	
k) GNSS Receiver reactivation time (or must be already on)	M_{offset} minutes +/- 5 seconds past next natural hour	min		
m) GNSS Receiver on time	≥ 15 minutes after reactivation	min		
n) Time to indicate RLM receipt	≤ 15 minutes after receiver reactivation	min		

o) Transmitted Message Bits 109 to 114	101001	N/A	Pass / Fail	First transmitted burst after RLM receipt
A.3.8.8.4 RLS Indication	*Must be correct*	*N/A*	*Pass / Fail*	*From results of* ***A.3.8.8.2 M_{offset} - a)***
A.3.8.8.5 RLS GNSS Receiver Tracking Test	*≥ detection of 90% of RLS-GNSS satellites (rounded down to the nearest integer number) visible at elevation of ≥ 5 degrees at least once for each 15-minute test period*	*N/A*	*Pass / Fail*	
19. Prevention of Continuous Transmission (for beacons with voice transceiver and means to prevent continuous operation of voice transmitter) - Duration of continuous voice-transceiver operation in transmit mode ("time-out" timer) - Maximum cumulative transmit-mode "on" time	≤ 30 (if implemented)	Minutes Hours and Minutes	___hrs ___mins	Test per section E.6
20. Activation and Cancellation Message Tests (ELT(DT) only)				Test per section A.3.9
Activation and De-activation Tests	Message bits 107-108 comply with Table A.2	√	Pass / Fail	
Cancellation Message Tests	Comply with A.3.9.2			
- nominal transmitted frequency	C/S T.001	MHz		
- Transmitter Power Output	36-39	dBm		
- modulation rise time (min and max)	50-150	µsec		
- modulation fall time (min and max)	50-150	µsec		
- phase deviation: positive (min and max)	+(1.0 to 1.2)	radians		
- phase deviation: negative (min and max)	-(1.0 to 1.2)	radians		
- modulation symmetry measurement	≤ 0.05			
- digital message	Correct	√		

- Transmission of First Cancellation Message	Within 5 seconds of de-activation	√		
- Number of Cancellation Messages	10	√		
- Interval between Cancellation Messages	10 seconds ± 0.5 second	√		
Reactivation Test	Comply with section A.3.9.3	√		

Parameters to be Measured	Range of Specification	Units	Test Results				Comments
			STEP-1 at T_{MAX}	STEP-2 At Changing Temperature		STEP-3 at T_{MIN}	
				At Max Voltage	At Min Voltage		
21. Testing ELT(DT)s with External Power Source (if applicable)							
21-1. Transmitter Power Output							
○ Transmitter power output (min and max)	36-39	dBm					
○ Power output rise time	< 2	ms					
○ Power output 1 ms before burst	< -10	dBm					
21-2. Digital Message							
Bits number							
○ bit sync 1-15	15 bits "1"	√*					
○ frame sync 16-24	"000101111"	√					
○ format flag 25	1 bit	bit value					
○ protocol flag 26	1 bit	bit value					
○ identification / position data 27-85	59 bits	√					
○ BCH code 86-106	21 bits	√					
○ for ELT(DT) suppl. data 107-114	8 bits	bit value					
○ additional data / BCH (if applicable) (for RLS/ELT(DT))	30 bits	√					
21-3b. Digital Message Generator (for ELT(DT))							
- repetition period T_R (burst 1 to burst 24 after beacon activation):							
○ min T_R	4.8	sec					
○ max T_R	5.0	sec					
- repetition period T_R (after burst 24 to burst 42 after beacon activation):							
○ min T_R	9.8	sec					
○ max T_R	10.0	sec					
- repetition rate T_R (after burst 42 after beacon activation):							
○ min T_R	$27.0 \leq T_R \leq 27.2$	sec					
○ max T_R	$29.8 \leq T_R \leq 30.0$	sec					
○ standard deviation	>0.8	sec					
○ bit rate:							
○ min f_b	≥ 399.6	bit/sec					

* Indicate that testing demonstrated conformance to requirements by placing a √ symbol in Table F.1.

Parameters to be Measured	Range of Specification	Units	Test Results				Comments
			STEP-1 at T_{MAX}	STEP-2 At Changing Temperature		STEP-3 at T_{MIN}	
				At Max Voltage	At Min Voltage		
○ max f_b - total transmission time (long message) - unmodulated carrier: ○ min T_1 ○ max T_1 - first burst delay	≤ 400.4 514.8-525.2 ≥ 158.4 ≤ 161.6 ≤ 5	bit/sec ms ms ms sec					
21-4. Modulation - Biphase-L - rise time for ELT(DT) (min and max) - fall time for ELT(DT) (min and max) - phase deviation: positive (min and max) - phase deviation: negative (min and max) - symmetry measurement	 50-150 50-150 +(1.0 to 1.2) -(1.0 to 1.2) ≤ 0.05	 √ µsec µsec radians radians					
21-5. 406-MHz Transmitted Frequency - nominal value - short-term stability	 C/S T.001 ≤ $2x10^{-9}$	 MHz /100 ms					
21-6. Spurious Emissions into 50 Ohms (406.0 – 406.1 MHz)*	C/S T.001 mask	√					

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

Parameters to be Measured	Range of Specification	Units	Test Results		Comments
			At Ambient Temperature		
			At Max Voltage	At Min Voltage	
21-7. Position Acquisition Time and Position Accuracy Test (with nominal minimum and nominal maximum voltage of external power supply)					Record results in F-C.6
position acquisition time, with: ○ nominal minimum voltage of external power supply ○ nominal maximum voltage of external power supply	 < 5 < 5	 seconds seconds			
position accuracy, with: - nominal minimum voltage of external power supply ○ 2D accuracy ○ altitude accuracy	 C/S T.001 C/S T.001	 meters meters			
- nominal maximum voltage of external power supply ○ 2D accuracy ○ altitude accuracy	 C/S T.001 C/S T.001	 meters meters			

Parameters to be Measured	Range of Specification	Units	Test Results	Comments
22. Testing Beacon Controls				
- Self-test controls	Comply with A.3.10.1(i)	√		
- GNSS self-test controls	Comply with A.3.10.1(ii)	√		
- Operational controls	Comply with A.3.10.2	√		

F.1 APPENDIX A TO ANNEX F

F.1.1 APPENDIX A1 TO ANNEX F: SATELLITE QUALITATIVE TEST SUMMARY REPORT (except for ELT(DT))

Date of the ~~Test~~*test*:_____

Time of the ~~Test~~*test*:_____

Test ~~Beacon~~ *beacon* ~~Model~~*details(Model, P/N, Modification State, S/N)*:_____

*Beacon System configuration and external devices (e.g., standalone beacon, remote/external antenna, programming adaptor, remote control panel, etc.):*_____

*External/remote antenna cable loss (dB):*_____

Beacon 15-Hex ID:_____

Actual location of the test beacon: Latitude:_____; Longitude: _____

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

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

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

RLS enabled beacon provided an indication of reception of an RLM message within 15 minutes from beacon activation. Yes / No (indicate as appropriate)

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

Note: For beacons with an RLS function ensure that the complete Return Link Service is operational prior to commencing this test.

F.1.2 APPENDIX A2 TO ANNEX F: SATELLITE QUALITATIVE TEST SUMMARY REPORT (for ELT(DT))

Date of the Test:_____

Time of the Test:_____

*Test beacon details (Model, P/N, Modification State, S/N):*_____

*Beacon System configuration and external devices (e.g., standalone beacon, remote/external antenna, programming adaptor, remote control panel, etc.):*_____

*External/remote antenna cable loss (dB):*_____

Beacon 15-Hex ID:_____

Actual location of the test beacon: Latitude: _____
Longitude: _____
Altitude: _____

*Beacon test configuration (e.g., beacon with external antenna fixed to ground plane):*____

MEOSAR Satellites Tracking schedule

Date of tracking	*Tracking Start time, (HH : min)*	*Tracking End Time, (HH : min)*	*Satellite ID*	*MEOLUT ID - antenna ID*	*Start of tracking session*		*End of tracking session*	
					AZ(degrees)	*EL(degrees)*	*AZ(degrees)*	*EL(degrees)*

Received Alerts and Encoded Location Error

*Test Period Number(*):*_____
Time of the Test Period: from: [HH : min] to: [HH : min]

~~Burst~~ *Alert* number	~~Beacon Tx~~*Alert* time	Complete *30- Hex* beacon message	Encoded location reported in the MEOLUT alert			*Encoded* 2D location error (meters)	Valid altitude band
			Latitude	Longitude	Altitude band		

Ratio of complete messages with correct Hex ID = $\frac{\text{number of complete messages with correct HEX ID}}{\text{number of transmitted messages}}$ X 100 = ____%

Ratio of alerts per minute over the test period = $\frac{\text{number of complete messages with correct HEX ID}}{\text{number of minutes in the test period}}$ *X 100 = ____%*

Ratio of 2D encoded ~~positions~~ *locations with error* within 200 meters = $\frac{\text{number of alerts with 2D encoded positions within 200 meters}}{\text{number of complete message received with correct HEX ID}}$ *X 100 = ____%* ~~X 100 = ____%~~

Ratio of valid altitude = $\frac{\text{number of alerts with valid altitude (as per A.2.5)}}{\text{number of complete message received with correct HEX ID}}$ X 100 = ____%

Note *(*)*: A separate table shall be provided for each *of the required three* test period*s*.

- END OF APPENDIX A TO ANNEX F -

F.2 APPENDIX B TO ANNEX F: 406 MHZ BEACON ANTENNA TEST RESULTS

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

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

$EIRP_{LOSS} = P_{t\,AMB} - P_{t\,EOL} =$_____dB

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

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

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

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

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

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

$EIRP_{LOSS} = P_{t\,AMB} - P_{t\,EOL}$ =_____dB

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

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

- END OF APPENDIX B TO ANNEX F -

F.3 APPENDIX C TO ANNEX F: NAVIGATION SYSTEM TEST RESULTS

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

Script Reference (See Table D.1)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH Correct (√)
1	Bits 108-132=	
2	Bits 108 – 132= Number of seconds after providing navigation data that beacon transmitted the above encoded location information: _____	
3	Bits 108-132=	
4	Bits 108-132=	
5	Bits 108-132=	
6	Bits 108-132=	
7	Bits 108-132=	
8	Bits 108-132=	
9	Bits 108-132=	
10	Bits 108-132=	
11	Bits 108-132=	
12	Bits 108-132=	

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

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

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

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

Table F-C.4: Position Data Encoding Results RLS Location Protocol

Script Reference (See Table D.4)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH Correct (√)
1	Bits 67-85= Bits 115-132= Bits 109-112=	
2	Bits 67-85= Bits 115-132= Bits 109-112= Number of seconds after providing navigation data that beacon transmitted the above encoded location information: ____	
3	Bits 67-85= Bits 115-132= Bits 109-112=	
4	Bits 67-85= Bits 115-132= Bits 109-112=	
5	Bits 67-85= Bits 115-132= Bits 109-112=	
6	Bits 67-85= Bits 115-132= Bits 109-112=	
7	Bits 67-85= Bits 115-132= Bits 109-112=	
8	Bits 67-85= Bits 115-132= Bits 109-112=	
9	Bits 67-85= Bits 115-132= Bits 109-112=	
10	Bits 67-85= Bits 115-132= Bits 109-112=	
11	Bits 67-85= Bits 115-132= Bits 109-112=	
12	Bits 67-85= Bits 115-132= Bits 109-112=	

Script Reference (See Table D.4)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that BCH Correct (√)
13	Bits 67-85= Bits 115-132= Bits 109-112=	

Table F-C.5: Position Data Encoding Results RLS Location Protocol (Additional Scripts)

Script Reference (See Table D.5)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that Result Correct (√)
1	Hex ID =	
2	Hex ID = Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	
3	Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	
4	Hex ID = Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	
5	Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	
6	Hex ID = Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	
7	Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	
8	Hex ID = Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	
9	Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	
10	Hex ID = Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	

Script Reference (See Table D.5)	Value of Encoded Location Bits Transmitted by Beacon	Confirmation that Result Correct (√)
11	Confirm Indication is as per manufacturer's instructions Bits 109 to 114 =	

Table F-C.6: Position Acquisition Time and Position Accuracy (Internal Navigation Devices)

Operational Configuration	C/S T.007 Section A.3.8.2.1		C/S T.007 Section A.3.8.2.2	
	Time to Acquire Position (sec)	Location Error in metres	Time to Acquire Position (sec)	Location Error in metres
Water ground plane				
Antenna fixed to ground plane				
Antenna fixed to ground plane				
Beacon on ground plane				
Beacon above ground plane				
Other (specify)				

Table F-C.7: Position Acquisition Time and Position Accuracy (External Navigation Devices)

C/S T.007 Section A.3.8.2.1		C/S T.007 Section A.3.8.2.2	
Time to Acquire Position (sec)	Location Error in metres	Time to Acquire Position (sec)	Location Error in metres

Table F-C.8: ELT(DT) Encoded Position Update

Burst number	Beacon Tx time	Encoded location reported in the beacon message			Best-Matching simulated location between $P(t_0)$ and $P(t_0\text{-}2)$			2D location error (meters)	Altitude error (meters)
		Latitude	Longitude	Altitude band	Latitude	Longitude	Altitude		

- END OF APPENDIX C TO ANNEX F -

F.4 APPENDIX D TO ANNEX F: BEACON CODING SOFTWARE RESULTS

Table F-D.1: Examples of User Protocol Beacon Messages
(Examples required for each protocol declared in Annex G)

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

Table F-D.2: Examples of Standard, National Location RLS and ELT(DT) Location Protocol Beacon Messages
(Examples required for each protocol declared in Annex G)

Protocol	Operational Message (in hexadecimal including bit and frame synchronisation bits)		Self-Test Message (in hexadecimal including bit and frame synchronisation bits)	GNSS Self Test Message (if applicable, in hexadecimal, including bit and frame synchronisation bits)
	Location "A"*	Location "B"*		Location "A"
Standard Location: EPIRB with MMSI				
Standard Location: EPIRB with Serial Number				
Standard Location: ELT with 24-bit Address				
Standard Location: ELT with Serial Number				
Standard Location: ELT with Aircraft Operator Designator				
Standard Location: PLB with Serial Number				
Standard Location: Test				
National Location: EPIRB				
National Location: ELT				
National Location: PLB				
National Location: Test				
RLS Location – Serial No.: (ELT, EPIRB or PLB)†				
RLS Location – MMSI: (EPIRB or PLB)				
RLS Location: Test				
ELT(DT) Location (24-bit Address, Aircraft Operator Designator, Serial Number~~)~~				

* Location "A" and location "B" must be separated by at least 500 meters for the Standard Location, National Location and RLS Location protocols.

† By decision of the Cospas-Sarsat Council at its Fifty-Seventh Session, RLS protocols will be effective as of 1 January 2018, as a target, subject to further review and consideration. The use of RLS-enabled beacons will be regulated by national administrations.

ELT(DT) Location: Test				
ELT(DT) with Rotating PDF-2 Field PDF-2 = Location PDF-2 = 3LD				

Table F-D.3: Examples of User-Location Protocol Beacon Messages
(Examples required for each protocol declared in Annex G)

Protocol	Operational Message (in hexadecimal including bit and frame synchronisation bits)		Self-Test Message (in hexadecimal including bit and frame synchronisation bits)	GNSS Self Test Message (if applicable, in hexadecimal, including bit and frame synchronisation bits)
	Location "A"*	Location "B"*		Location "A"
Maritime Protocol with MMSI				
Maritime Protocol with Radio Call Sign				
Radio Call Sign				
Serial User-Location: Float-Free EPIRB				
Serial User-Location: Non Float-Free EPIRB				
Aviation				
Serial User-Location: ELT				
Serial User-Location: ELT with Aircraft Operator Designator & Serial Number				
Serial User-Location: ELT with Aircraft 24-bit address				
Serial User-Location: PLB				
User-Location: Test				

- END OF APPENDIX D TO ANNEX F -

* Location "A" and location "B" must be separated by at least 10 km for the User-Location protocol.

APPENDIX E TO ANNEX F~~:~~ – BEACON OPERATING CURRENT*,* ~~AND~~ PRE-TEST DISCHARGE CALCULATIONS*, SELF-TEST AND GNSS SELF TEST MODES ACTIONS AND INDICATIONS*

Table F-E.1: Beacon Operating Current

Beacon ~~Operating~~ Modes *(examples)*	Mode: Manually selectable or Automatic	Measurement interval, sec	Average Current, mA	Peak Current, mA
Off				
Stand-by/ARMED				
*On (Operating, GNSS receiver - On)_*				
On (Operating, GNSS receiver - Off)				
…				
Self-test				
GNSS Self-test				
…				

Notes: Measurement results shall be provided separately for:
1) beacon activation methods (e.g., from remote panel/G-switch/water sensor, by manual activation, etc.)
2) declared system configuration options (e.g., stand-alone beacon, with external buzzer, with internal navigation receiver/external navigation interface, programming adaptor, remote control panel, etc.)
3) conditions of operation (e.g., GNSS Receiver – Turned Off, GNSS Receiver – Turned On)

Table F-E.2: Pre-test Battery Discharge Calculations

Characteristic	Designation	Units	Value	Comments
Beacon manufacturers declared maximum allowed cell shelf-life (from date of cell manufacture to date of battery pack installation in the beacon)	T_{CS} or TCS	Years		
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	T_{BR} or TBR	Years		
Battery pack electrical configuration				
Cell model and cell chemistry				
Nominal cell capacity		A-hrs		
Nominal battery pack capacity	C_{BN}	A-hrs		
Annual battery cell capacity loss (self-discharge) due to aging, as specified by cell manufacturer at ambient temperature	L_{SDC}	%		
Calculated battery pack capacity loss due to self-discharge: $L_{CBN} = C_{BN} - [C_{BN} * (1 - L_{SDC}/100)^{TBR+TCS}]$	L_{CBN}	A-hrs		
Number of self-tests per year	N_{ST}			
Average battery current during a self-test	I_{ST}	mA		
Maximum duration of a self-test	T_{ST}	sec		
Calculated battery pack capacity loss due to self-tests during battery replacement period: $L_{ST} = I_{ST} * T_{ST} * T_{BR} * N_{ST} / 3600$	L_{ST}	mA-hrs		
Maximum Number of GNSS self-tests between battery replacements	N_{GST}			
Average battery current during a GNSS self-test of maximum duration	I_{GST}	mA		
Maximum duration of a GNSS self-test	T_{GST}	sec		
Calculated battery pack capacity loss due to GNSS self-tests during battery replacement period: $L_{GST} = I_{GST} * T_{GST} * N_{GST} / 3600$	L_{GST}	mA-hrs		
Average stand-by battery pack current	I_{SB}	mA		
Other Capacity Losses	L_{OTH}	mA-hrs		See Note 1
Battery pack capacity loss due to constant operation of circuitry prior to beacon activation: $L_{ISB} = I_{SB} * T_{BR} * 8760$	L_{ISB}	mA-hrs		
Calculated value of the battery pack pre-test discharge $L_{CDC} = L_{CBN} + 1.65 * (L_{ST} + L_{GST} + L_{ISB})/1000 + L_{OTH}/1000$	L_{CDC}	A-hrs		

Note 1: The worst case depletion in battery power due to current drawn that cannot be replicated during the operating lifetime at minimum temperature test. This shall also include any losses due to intermittent operation of the beacon (e.g., repetitive interrogating status~~)~~*, or manufacturer-declared planned beacon operation during maintenance)* prior to beacon activation in operational mode.

Table F-E.3: Self-test Mode Actions and Indications (*)

No.	Action/ Indication	Time-stamp (HM:MM:SS)	Description of action/indication	Duration of action/indication (sec)	Notes
1	Self-test mode initiation (distinct action)				
2	Distinct indication of the Self-test initiation				
3	Self-test single burst transmission				
4	Self-test message default values	-			
5	Distinct indication of RF transmission				
6	Distinct indication of the Self-test PASS Result				
7	Distinct indication of the Self-test FAIL Result				
8	Distinct indication of Insufficient Battery Energy				
10	Distinct indication only when a beacon is coded with the RLS Location Protocol (i.e., the RLS functionality is enabled) , and the RLS and RLM indicator(s) are operating as described in section 4.5.4 e) of document C/S T.001.				For RLS-capable beacons
11	Automatic termination of the Self-test mode, irrespectively of the switch position				
12	Duration of Self-test mode	-			

Note * : see example of a complete table in the Appendix G to Annex F

Table F-E.4: GNSS Self-test Mode Actions and Indications (for Beacons With Internal GNSS)

No.	Action/ Indication	Time-stamp (HM:MM:SS)	Description of action/indication	Duration of action/indication (sec)	Notes
1	GNSS Self-test mode initiation (distinct action)				
2	Distinct indication of the GNSS Self-test mode initiation				
3	Single GNSS self-test burst transmission				
4	GNSS Self-test burst with position encoding				Indicate: Yes or No
5	*The encoded indication of the source of navigation data is correct*				*Indicate: Yes or No*
*6*5	Distinct indication of the GNSS Self-test PASS result				
~~*6*~~*7*	Distinct Indication of the GNSS Self-test FAIL Result				
~~*7*~~*8*	Distinct indication that the manufacturer-declared limited number of GNSS self-tests is attained				
~~*8*~~*9*	Automatic termination of GNSS self-test mode, irrespectively of the switch position				
~~*9*~~*10*	Duration of GNSS Self-test mode				
11	*Beacon defaults to the Internal Navigation Position if available*				*Indicate: Yes or No* *See Note 3*

Note 1: For beacons supporting location data input from both the internal navigation device and the external navigation interface, the GNSS Self-test Mode test shall be performed and the results/observations reported separately for each of the options.

Note 2: This indication is required for beacon obtaining position only from the internal navigation device only

Note 3: Shall be verified for beacons capable to obtain location data from the internal navigation device and the external navigation interface

Table F-E.5: Indication of Insufficient Battery Energy

Parameter	Units	Declared by beacon manufacturer	Verified and evaluated by accepted test facility	Notes
Beacon manufacturer-declared Minimum operating lifetime (**C_{CO}**)	Hours		-	**C_{CO}** is declared in Annex G as "Manufacturer-declared Minimum Operating Lifetime". **C_{CO}** is required for the test.
Full Battery Pack Capacity **(C_{BP})**	Hours			If needed to calculate **C_{SP-AMB}**
Battery Pre-Operational Losses **(C_{PO})**	Hours			corresponds to **L_{CDC}**, as defined in the Table F-E.2
Spare Battery Capacity at ambient temperature **(C_{SP-AMB})**	Hours			**C_{SP-AMB}** is required for the test, and shall be defined by testing (see Footnote 4 to section A.3.6.2.2), or by calculation, as follows: **$C_{SP-AMB} = C_{BP} – (C_{PO} + C_{CO})$**
Criteria and conditions to trigger **PIE** indication			-	description of PIE criteria and conditions to be met to trigger PIE indication. Use a separate sheet if needed
Step-1: battery pack discharge	Hours	-		Battery discharge shall correspond to: **C_{PO}** - **30 minutes,** or the value declared by the beacon manufacturer less 30 minutes
Step-1: beacon conditions (if applicable)		-		description of conditions recreated during the Step-1 for which the PIE criteria is <u>not</u> met
Step-1: observations of self-test indication		-		test facility observations of self-test indication: time, duration, type of indication
Step-2: battery pack discharge	Hours	-		Total battery discharge shall correspond to: **$C_{PO} + C_{SP-AMB}$ + 30 minutes** or the value declared by the beacon manufacturer plus 30 minutes
Step-2: beacon conditions (if applicable)	-	-		description of conditions recreated during the Step-2 for which the PIE criteria is met
Step-2: observations of distinct PIE indication		-		test facility observations of PIE indication: time, duration, type of indication

- END OF APPENDIX E TO ANNEX F -

APPENDIX F TO ANNEX F: CHECK-LIST OF TECHNICAL DATA PROVIDED BY BEACON MANUFACTURER

Table F-F.1: Check-List of Technical Data Provided by Beacon Manufacturer

Tick (√) to indicate submission of items	Applicable C/S T.007 requirement	Description of technical information item	File name, title of document, page, section, where the item is located
	5.*1*(a)	Type Approval Application Form (Annex G)	
	6.2	Change Notice Form (Annex H)	
	6.2	Description of Change(s)	
	6.2	Statement on changes to beacon physical characteristics	
	6.2, 4.8	Report on Factory Testing	
	5.*1*(m)	The beacon Quality Assurance Plan (Annex L)	
	5.*1*(b)	Photos of the beacon in all operational configurations	
	5.*1*(c)	Pre-test discharge data and analysis, table F-E.2	
	5.*1*(d)	List, description and analysis of operating modes, Table F-E.1	
	5.*1*(e)	Beacon operating instructions and/or other owner manuals	
	5.*1*(f)	Beacon marketing brochure (if available)	
	5.*1*(g)	Battery cells technical data sheet	
	5.*1*(g)	Electrical diagram of the battery pack	
	5.*1*(h)	Beacon markings and labels	
	5.*1*(i-i)	Reference oscillator type and specification	
	5.*1*(i-ii)	Long-term frequency stability (LTS) and description of the frequency generation circuitry	
	5.*1*(i-iii)	Technical data sheet for TCXO/MCXO	
	5.*1*(i-iv)	Report on oscillator ageing characteristics	
	5.*1*(i-v)	Serial Number and temperature gradient test results (graph, summary and Excel file) for the TCXO unit installed in the test beacon from the TCXO manufacturer	
	5.*1*(j-i)	Design: protection against continuous transmission	
	5.*1*(j-ii)	Design: protection against repetitive self-test	
	5.*1*(j-iii)	Design: self-test default values	
	5.*1*(j-iv)	Design: protection against GNSS receiver faulty operation	
	5.*1*(j-v)	Statement and description on National-User protocol (long format) message encoding	
	5.*1*(k)	Matching network: statement, description and analysis	
	5.*1*(l)	Antenna cable type, minimum and maximum RF-losses	
	5.*1*(n-i)	Description of GNSS receiver operation cycle and its phases	
	5.*1*(n-ii)	Battery current for GNSS receiver operation phases	
	5.*1*(n-iii)	Internal GNSS receiver and its antenna data sheets	
	5.*1*(n-iv)	Statement on the encoded position timings for declared protocol types, if applicable	
	5.*1*(n-v)	Description of the internal GNSS receiver cold start	
	5.*1*(o-i)	Specification and description of the interface with the external navigation device	
	5.*1*(o-ii)	External navigation interface: electrical diagrams	
	5.*1*(p-i)	External ancillary devices: technical data sheets, photos and description	
	5.*1*(p-ii)	External ancillary devices: details of electrical connections	
	5.*1*(q)	Description of differences between beacon model variants	
	5.*1*(r)	Check-list of technical information (Table F-F.1)	
	5.*1*(s)	Statement on the worst-case operating temperature, (if required)	
	5.*1*(t)	Statement on known non-compliances, (if required)	
	5.*1*(u)	Statement on power alignment for units submitted for TA testing	
	5.*1*(v)	Self-test indication of insufficient battery energy (Table F-E.5): technical information	
	5.*1*(w)	Multiple programmable options (list and description)	
	5.*1*(x)	External power supply (parameters for nominal, minimum and maximum voltage)	
	5.*1*(y)	Description of automatic interrogation of beacon status function	
		Other technical material	

_____ _____ _____ _____

(date of) (beacon model) (beacon manufacturer's point of contact for the type approval: name, job title, e-mail address) (signature)

- END OF APPENDIX F TO ANNEX F -

F.5 APPENDIX G TO ANNEX F: TEMPLATE OF TEST REPORT EXAMPLE

[Cospas-Sarsat Accepted Test Facility / Beacon Manufacturer]

Report on

Cospas-Sarsat 406 MHz Emergency Beacon Testing
of the [Beacon Manufacturer][Beacon type] model "[Beacon Model]"
in accordance with C/S T.007

Report Nr. [Reference Nr] – Issue [Issue Nr] [Date of Issue]

Prepared by: [Test facility/ Beacon Manufacturer, contact details, phone, email, www]
Accreditations: [List of National and International accreditations]

Report on: [Beacon type and beacon model number]

Prepared for: [Beacon manufacturer]
[Manufacturer representative (Name, Job title, Contact details)]

Prepared by: [TA specialist in charge of TA-testing: name, job title, contact details]
Approved by: [Test facility/ Manufacturer TA authority name, job title, signature]
Date of Issue: [Date of the Report Issue]

Dates of testing
Submitted for testing:
Start of tests:
End of tests:

History of the report Issue/revisions:

Report Nr – Issue Nr. or Revision Nr.	Date of Issue	Reasons for re-issue

Section	Contents	Page
1.	Scope	
2.	References	
3.	Details of Test Samples	
4.	Type Approval Testing	
5.	Test Details	
5.1	Test Results Summary Table	
5.2	Electrical and Functional Tests at Constant Temperature	
5.2.1	Minimum Operating Temperature tests	
5.2.2	Ambient Operating Temperature tests	
5.2.3	Maximum Operating Temperature tests	
5.3	Thermal Shock Test	
5.4	Operating Lifetime at Minimum Temperature Test	
5.4.1	Operating Current Measurements and Analysis	
5.4.2	Pre-test Battery Discharge	
5.5	Temperature Gradient Test	
5.6	Oscillator Ageing (if applicable)	
5.7	Antenna Characteristics Tests	
5.8	Beacon Coding Software Test	
5.9	Navigation System Test	
5.9.1	Position Data Default Value Test	
5.9.2	Position Acquisition Time and Position Accuracy Test (PAT-PAT)	
5.9.3	Encoded Position Data Update Interval **Test**	
5.9.4	ELT(DT) Encoded Position Data Update Test	
5.9.5	Position Clearance After Deactivation Test	
5.9.6	Position Data Input Update Interval Test	
5.9.7	Last Valid Position Test	
5.9.8	Position Data Encoding Test	
5.10	Satellite Qualitative Test	
5.11	Return Link Service Test	
5.12	Prevention of Continuous Transmission Test (for beacons with voice transceiver)	
5.13	Activation And Cancellation Message Tests (ELT(DT) only)	
5.14	Additional Tests for ELT(DT) with External Power Source	
5.15	Testing Beacon Controls	
6.	Photographs	
7.	List of Test Equipment and Measurement Uncertainties	
8.	Other technical information, which is referred to in the test report	
9.	Technical data submitted by Beacon manufacturer	

1. Scope

2. Reference Documents

3. Details of Test samples

- Model name
- S/Ns of test beacons
- P/Ns (Hardware, Firmware, Software)
- Description of the test beacon and block- diagramme of equipment under test (EUT)
- List of ancillary devices(e.g., antennas, remote switches, remote indicators, external buzzer, external navigation interface units, external activators, etc.)
- List of test equipment, provided by beacon manufacturer for TA testing
- Photos of the EUT with antennas and all external ancillary devices subjected to TA-testing
- Battery pack details (composition, cell type, battery pack P/N)
- Application details: ANNEX G – Part G.1
- Indication that the beacon manufacturer confirmed output power alignment between test beacons (submission of data item per section 5.u), or results of the power alignment verification testing by the test facility (as applicable).

4. Type approval testing

- Applicable standards and compliance statement: ANNEX G – Part G.2
- Statement and details of non-compliances observed during TA testing
- Statement and list and description of deviations from standard test procedures
- EUT Modifications during TA testing:

Example:

Modification State (Mod State)	Date of Implementation	Reasons for modification	Description of modification, HW/FW P/Ns, SW version/release after modification
0	20 June 2013	-	-
1	13 July 2013	Incorrect first burst delay	FW 1.001-02 SW 1.001-x1 HW (no change)

- Modes of EUT operation during TA testing, message encoding, EUT system configuration,
- Modes of operation of external ancillary devices and schedule of operation (for operator-controlled ancillary devices, e.g., voice-transceivers)

- Statement and justification of the beacon mode, beacon system configuration and test conditions (e.g., absence of GNSS signal during conductive tests) applied for the type-approval testing
- Statement and justification of the measurement interval (applicable to section A.2.1 tests)
- List of tests performed by beacon manufacturers

5. Test Results

5.1 Test Results Summary Table

Table F.1 of ANNEX F, additionally indicating for each test parameter:

- date(s) of test,
- EUT S/N
- EUT Modification State
- Test configuration (where applicable)
- Indication of Pass/Fail result
- Indication of deviations from standard test procedures

Example:

Parameters to be Measured	**Range of Specification**	**Units**	**Test Results**			**Comments**
			T_{min} (-20ºC)	T_{amb} (20ºC)	T_{max} (+55ºC)	
10-Aug-12, DEF-406, S/N 001, Mod State 0						FAIL
1. Transmitter Power Output						
- transmitter power output (min and max)	35-39	dBm	37.4 - 37.7	38.1 - 38.2	**38.7 - 39.6**	FAIL at Max Temp
- power output rise time	< 5	Ms	0.4	0.6	0.8	
- power output 1 ms before burst	< -10 dBm	dBm	-33.6	- 32.3	-36.3	

[…]

5.2 Electrical and Functional Tests

Date of test	
Specification	[Reference to C/S T.001 Issue and Revision Number, and section]
Beacon Model	
EUT Mod State	
- EUT S/N	

EUT system configuration, including ancillary devices and modes of their operation	
Measurement Interval	
EUT operating mode during the test	

Environmental conditions	
Deviations from standard test procedures	
Non-compliances noticed	

5.2 Electrical and Functional Tests

…

Test results:

[Provide test results for the following temperature conditions:]

5.2.1 Minimum Operating Temperature
5.2.2 Ambient Operating Temperature
5.2.3 Maximum Operating Temperature

[Provide test results for the following test parameters:]

- Power Output
- Digital Message
- Digital Message Generator
- Modulation
- Spurious Emission
- 406 MHz VSWR Check
- Self-test Mode (Table F-E.3 and Table F-E.5)
- GNSS Self-test Mode (Table F-E.4)

[Provide details of test methods, message decodes, graphs, oscillograms, spectrograms, and tables of test results as appropriate]

Table F-E.3: Self-test Mode Actions and Indications (with example test results)

No.	Action/ Indication	Time-stamp (HM:MM:SS)	Description of action/indication	Duration of action/indication (sec)	Notes
1	Self-test mode initiation (distinct action)	10:00:00	The "Test" button is pressed and hold for 5 seconds then and released	5 sec	3-9 sec as described in the manual
2	Distinct indication of the Self-test initiation	10:00:05	Green LED is ON for 1.0 secs	2.5 sec	
3	Self-test single burst transmission	10:00:15	-	520 ms	Observed on SPAN
4	Self-test message default values	10:00:15	Self-test message structure and bit values are OK	-	As decoded by the beacon tester
5	Distinct indication of RF transmission	10:00:16	Strobe-light single flash	One short burst	
6	Distinct indication of the Self-test PASS Result	10:00:25	Three Green LED short flashes 0.2 sec each and 0.5 sec inter	1.6 sec	
7	Distinct indication of the Self-test FAIL Result	10:00:25	Series of 2-5 Red LED flashes, short flashes 0.2 sec each and 0.5 sec inter	1.4 – 5 sec	As described in the manual
8	Distinct indication of Insufficient Battery Energy	10:00:30	One Red LED flash for 1.5 sec	-	As described in the manual
10	Automatic termination of the Self-test mode, irrespectively of the switch position	10:00:37	Red LED is ON for 1.0 secs		By monitoring battery current
11	Duration of Self-test mode	-	37 secs		Difference between timestamps (10) and (1)

5.3 Thermal Shock Test

Date of test	
Specification	
Beacon Model	
EUT S/N	
EUT Mod State	
EUT system configuration, including ancillary devices and modes of their operation	
EUT operating mode during the test	
Environmental conditions	
Initial/Offset temperature	
Deviations from standard test procedures	
Non-compliances noticed	

Test results:
[Provide details of test methods, message decodes, graphs, oscillograms, spectrograms, and tables of test results as appropriate]

5.4 Operating Lifetime at Minimum Temperature Test

Date of test	
Specification	
Beacon Model	
EUT S/N	
EUT Mod State	
EUT system configuration, including ancillary devices and modes of their operation	
EUT operating mode during the test	
Environmental conditions	
Test temperature	
Pre-test battery discharge amount (A-hrs) and equivalent duration of the battery discharge by operating current	
Beacon Operating Lifetime duration, as demonstrated during the operating Lifetime at Minimum Temperature test, hours	
Deviations from standard test procedures	
Non-compliances noticed	

5.4.1 Operating Current Measurements and Analysis

[Table F-E.1]

[Details of the EUT configuration, incl. ancillary devices and mode of their operation]

[Conclusion about the mode, beacon system configuration and test conditions that exhibit the highest load]

5.4.2 Pre-test Battery Discharge

[Provide results of pre-test discharge calculations in the format of Table F-E.2]

[Describe method of battery discharge (operating current, DC/load, etc.) or equivalent test extension]

Test results:

[Provide details of test methods message decodes, oscillograms, graphs and tables of test results, as appropriate]

5.5 Temperature Gradient Test

Date of test	
Specification	
Beacon Model	
EUT S/N	
EUT Mod State	
EUT system configuration, including ancillary devices and modes of their operation	
EUT operating mode during the test	
Environmental conditions	
Temperature Range	
Deviations from standard test procedures	
Non-compliances noticed	

Test results:
[Provide details of test methods, message decodes, graphs and tables of test results, as appropriate]

5.6 Oscillator Ageing (if applicable)

Date of analysis	
Specification	
Beacon Model	
EUT S/N	
EUT Mod State	
Oscillator Manufacturer and Model (or P/N):	
Oscillator S/N	
Reference documents	
Environmental conditions:	
Deviations from standard test procedures	
Non-compliances noticed	

Record and report:
[Provide details of test methods, summary of MTS analysis and complete Table A-1, Table A-2 of Annex A to C/S IP (TCXO)]

5.7 Antenna Characteristics

Date of tests	
Specification	
Beacon Model	
EUT S/N	
EUT Mod State	
EUT system configuration, including antenna, external ancillary devices and modes of their operation	
Beacon antenna model (P/N)	
Measurement antenna type and model	
Environmental conditions	
Deviations from standard test procedures	
Non-compliances noticed	

Test results:
[Provide details of test methods, test results for each beacon-antenna and for all test configurations, as per APPENDIX B to ANNEX F. Annotate results, as appropriate]

5.8 Beacon Coding Software

Date of test	
Specification	
Beacon Model	
EUT S/N	
EUT Mod State	
Performed by	
Verified by	
Measurement Equipment, provided by beacon manufacturer	
Reference documents	
Environmental conditions:	
Deviations from standard test procedures	
Non-compliances noticed	

Record and report:
[provide details of test methods,]
[provide results in the format of Tables F-D.1, F-D.2, F-D-3 (as applicable) and decodes of all messages]

5.9 Navigation System Test

[Test results shall be presented separately for each of the declared LP protocol types, for each of the declared operational configurations, where appropriate, separately for internal and external navigation device, and for each external navigation interface type]

Date of test	
Specification	
Beacon Model	
EUT S/N	
EUT Mod State	
EUT system configuration during the test, including antenna, external ancillary devices and modes of their operation	
Navigation device details (model, interface)	
Measurement Equipment, provided by beacon manufacturer, if any	
Performed by	
Verified by	
Environmental conditions	
Deviations from standard test procedures	
Non-compliances noticed	

[Provide brief description of actions, messages and decodes, time-stamps, results]

5.9.1 Position Data Default values

5.9.2 Position Acquisition Time and Position Accuracy Test (PAT-PAT)

[Provide results in the format of Table F-C.6 and Table F-C.7]
[Provide information for the known position and results for the encoded positions, messages, decodes, time-stamps, results]
[Indicate if a GNSS simulator was used]

5.9.3 Encoded Position Data Update Interval

[Provide information for the known position and results for the encoded positions, messages, decodes, time-stamps, results]

5.9.4 ELT (DT) Encoded Position Update

[For (ELT(DTs), provide results in the format of Table F-C.8]

5.9.5 Position Clearance After Deactivation

[Provide information for the known position and results for the encoded positions, messages, decodes, time-stamps, results]

5.9.6 Position Data Input Update Interval

[Provide information for the known position and results for the encoded positions, messages, decodes, time-stamps, results]

5.9.7 Last Valid Position
[Provide results for the encoded positions, messages, decodes, time-stamps, results]

5.9.8 Position Data Encoding
[Provide results in the format of Tables F-C.1, F-C.2, F-C.3, F-C.4 (RLS), F-C.5 (RLS-additional scripts)]

5.10 Satellite Qualitative Test

Date of test	
Specification	
Beacon Model	
EUT S/N	
EUT Mod State	
EUT system configuration, including ancillary devices and modes of their operation:	
Beacon Antenna	
Environmental conditions	
Deviations from standard test procedures	
Non-compliances noticed	

Test results:

[For all beacon types, except ELT(DT), provide details of test methods, results for each beacon-antenna and for all test configurations, as per Appendix A1 to Annex F]
[For ELT(DT), provide details of test methods, results for each beacon-antenna configuration, as per Appendix A2 to Annex F (for ELT(DT)s]

5.11 Return Link Service Test*s*

Date of test	
Specification	
Beacon Model	
EUT S/N	
EUT Mod State	
EUT system configuration, including ancillary devices and modes of their operation:	
Beacon Antenna	
Environmental conditions	
Deviations from standard test procedures	
Non-compliances noticed	

Test results:

[Provide details of test methods, results for each beacon-antenna and for all test configurations, as per Appendix A1 to Annex F and/or Appendix A2 to Annex F (for ELT(DT)s)]

5.12 Prevention of Continuous Transmission Test (for beacons with voice transceiver)

Date of test	
Specification	
Beacon Model	
EUT S/N	
EUT Mod State	
EUT system configuration, including ancillary devices and modes of their operation:	
Voice transmitter maximum continuous voice-transmission~~r~~ duration (limit), declared by the beacon manufacturer, sec	
Voice transmitter total duration of the voice-transmitter operation (on-time), declared by beacon manufacturer, hours and minutes	
Environmental conditions	
Test temperature (ambient)	
Deviations from standard test procedures	
Non-compliances noticed	

Results of the tests shall be reflected at Table F.1, Test Parameter 19.

5.13 Activation and Cancellation Message Tests (ELT(DT) only)

Date of test	
Specification	
Beacon Model	
EUT S/N	
EUT Mod State	
EUT system configuration, including ancillary devices and modes of their operation:	
Environmental conditions	
Test temperature (ambient)	
Deviations from standard test procedures	
Non-compliances noticed	

Results of the tests described in sections A.3.9, A.3.9.1, A.3.9.2 and A.3.9.3 shall be reflected at Table F.1, Test Parameter 20.

5.14 ELT(DT) with External Power Source - Additional Testing

Date of test	
Specification	
Beacon Model	
EUT S/N	
EUT Mod State	
EUT system configuration, including ancillary devices and modes of their operation:	
External power source - nominal conditions	
External power source worst-case conditions (maximum and minimum voltage)	
Measurement interval, minutes	
Environmental conditions	
Test temperature	
Deviations from standard test procedures	
Non-compliances noticed	

Summary of the test results:

Table F.1 of ANNEX F, additionally indicating for each of the test parameters:

- date(s) of test,
- EUT Modification State
- Test configuration (where applicable)
- Power supply: from external source
- Indication of Pass/Fail result
- Indication of deviations from standard test procedures

Test results:

[For each test parameter, provide details of test methods, message decodes, graphs, oscillograms, spectrograms, and tables of test results as appropriate]

5.15 Testing Beacon Controls

Date of test	
Specification	As per document C/S T.007, sections A.3.10, A.3.10.1 and A.3.10.2
Beacon Model	
EUT S/N	
EUT Modification State	
EUT system configuration, including ancillary devices and modes of their operation	
Environmental conditions	
Test temperature (ambient)	
Deviations from standard test procedures	
Non-compliances noticed	

Reflect observations of the beacon behaviour

Results of the tests described in sections A.3.10, A.3.10.1 and A.3.10.2 shall be recorded at Table F.1, Test Parameter 22.

6. Photographs

Include photographs of:

- EUT with antenna deployed
- External components
- EUT set for SQT (for all antennas in all test configurations)
- EUT set for PAT-PAT (for all antennas in all test configurations)
- EUT antenna set for Antenna tests (for all antennas in all test configurations)

7. Test Equipment

- List of test equipment and calibration dates
- Block diagrams of test setup
- Measurement accuracies
- Description of measurement methods.

8. Other technical information, which is referred to in the test report

- Technical data sheets for devices and components
- Results of tests from beacon manufacturer
- Other test reports, if applicable

9. Technical data submitted by Beacon manufacturer

- Complete Check-List of Technical Data, as per Appendix F to Annex F.

- END OF APPENDIX G TO ANNEX F -

F.6 APPENDIX H TO ANNEX F: GUIDELINES FOR RECORDING AND ROUNDING OF THE MEASUREMENTS RESULTS

1) The final quantitative value of the parameter (Table F.1 C / S T.007) should be recorded in the same format as the specification.
2) The accuracy of the measurement results and the accuracy of the calculations during processing of the measurement results should be consistent with the required accuracy of the obtained estimate of the measured value.
3) The error of estimation of the measured parameter should be expressed using no more than two significant digits after decimal point.
4) Two significant digits after decimal point in the measurement error of the measured value should be retained:
    a. for accurate measurements;
    b. if the first digit is not more than three.
5) The number of digits in the intermediate results and calculations in the processing of measurements should be at least two more than in the final result.
    a. Note: All measurement results, calculations recorded in the report specified in Appendix F.7 of C / S T.007 should be represented using two more digits than in Table F.1.
6) The error in the intermediate calculations should be expressed using not more than three significant digits after decimal point.
7) The retained significant digit in the error of the measured value evaluation when rounding is increased by one if the discarded digit of the lower-order digit is greater than or equal to five, and does not change if it is less than five.

- END OF APPENDIX H TO ANNEX F -

- END OF ANNEX F -

ANNEX G: APPLICATION FOR A COSPAS-SARSAT 406 MHZ BEACON TYPE APPROVAL CERTIFICATE

G.1 INFORMATION PROVIDED BY THE BEACON MANUFACTURER

Beacon Manufacturer and Beacon Model

Beacon Manufacturer	
Beacon Model Name	
Additional Beacon Model Names	

Beacon Type and Operational Configurations

Beacon Type	**Beacon used while:**	***Tick where appropriate***	
		Beacon without RLS capability	***Beacon with RLS capability***
EPIRB Float Free	Floating in water or on deck or in a safety raft		
EPIRB Non-Float Free (automatic and manual activation)	Floating in water or on deck or in a safety raft		
EPIRB Non-Float Free (manual activation only)	Floating in water or on deck or in a safety raft		
EPIRB Float Free with VDR	Floating in water or on deck or in a safety raft		
PLB	On ground and above ground		
	On ground and above ground and floating in water		
	On ground, above ground, and on a personal floatation device*		
ELT Survival	On ground and above ground		
	On ground and above ground and floating in water		
ELT Auto Fixed	Fixed ELT with aircraft external antenna		

* Applicable only to PLBs with integral antennas operated while attached to personal flotation devices (e.g. lifejackets) where the PLB and its antenna are mounted on PFD in such a position, that, in the nominal mode of operation, they are kept above water.

Beacon Type	**Beacon used while:**	***Tick where appropriate***	
		Beacon without RLS capability	***Beacon with RLS capability***
ELT(DT)	Distress Tracking ELT with aircraft external antenna		
ELT Auto Portable	In aircraft with an external antenna		
	On ground, above ground, or in a safety raft with an integrated antenna		
ELT Auto Deployable	Deployable ELT with attached antenna		
Other (specify)			

Beacon Characteristics

Characteristic	**Specification**
Operating frequency (406 MHz operating channel = 406.xxx)	406._ _ _MHz
Operating temperature range	T_{min} =_____ T_{max} =_____
Temperature, at which minimum duration of continuous operation is expected (Submit C/S T.007 Section 5, part s, if applicable)	T_{min} ☐ or Other (__ºC)
Manufacturer-declared Minimum Operating Lifetime*	24hrs ☐ , or 48hrs ☐ , or 168hrs ☐ , or other____ hrs ☐
Beacon power supply type (internal non-rechargeable, internal re-chargeable, external, combined, other)	
External power supply parameters (AC/DC, nominal voltage, nominal minimum and nominal maximum voltage)	AC or DC (cross, as applicable) Nominal voltage: _____V Nominal minimum voltage: _____V Nominal maximum voltage: _____V

* this value is specified by National Administrations or International Organisations

Characteristic	**Specification**
Is external power supply needed to energise the beacon or its ancillary devices in any of operational modes (N/A or Yes or No)	
Battery cell chemistry	
Battery cell model name, cell size, number of cells in a battery pack, and details of the battery pack electrical configuration	
Battery cell manufacturer	
Battery pack manufacturer and part number	
Beacon manufacturers declared maximum allowed cell shelf-life (from date of cell manufacture to date of battery pack installation in the beacon)	_____years
Declared beacon battery replacement period (from date of installation in the beacon to expiry date marked on the beacon)	_____years
Oscillator type (e.g. OCXO, MCXO, TCXO)	
Oscillator manufacturer	
Oscillator model name/ part number	
Oscillator satisfies long-term frequency stability requirements (Yes or No)	
Antenna type: Integral or Other (e.g. External, Detachable – specify type)	
Antenna manufacturer	
Antenna part name and part number (OEM, if applicable, and beacon manufacturer's)	
Antenna cable assembly min/max RF- losses at 406 MHz, if applicable	
Navigation device type (Internal, External or None)	
Features in beacon that prevent degradation to 406 MHz signal or other beacon performances resulting from a failure of navigation device or failure to acquire position data (Yes, No, or N/A)	
Features in beacon that ensure erroneous position data is not encoded into the beacon message (Yes, No or N/A)	
Navigation device capable of supporting global coverage (Yes, No or N/A)	
Encoded position update capability (Yes, No, N/A) and	

Characteristic	**Specification**
Encoded position update interval value (range)	_____ min
For Internal Navigation Devices	
– Geodetic reference system (WGS 84 or GTRF)	
– GNSS receiver cold start forced at every beacon activation (Yes or No)	
– Navigation device manufacturer	
– Navigation device model name and part Number	
– Internal navigation device antenna type(integrated, internal, external, passive/active) , manufacturer and model	
– GNSS system supported (e.g. GPS, GLONASS, Galileo)	
For External Navigation Devices	
– Data protocol for GNSS receiver to beacon interface	
– Physical interface for beacon to navigation device	
– Electrical interface for beacon to navigation device	
– Part number of the external navigation interface device (if applicable)	
– Navigation device model and manufacturer (if beacon designed to use specific devices)	

Self-Test Mode Characteristics:	Self-Test Mode	Optional GNSS Self-test Mode
– Activated by a separate switch/ separate switch position (Yes or No)		
– Self-test/GNSS self-test mode switch automatically returns to normal position when released (Yes or No)		
– Self-test/ GNSS self-test activation can cause an operational mode transmission (Yes or No)		
– Results in transmission of a single self-test burst only, regardless of how long the self-test activation mechanism is applied (Yes or No)		
– Results of self-test/ GNSS self-test are indicated by (provide details, e.g. Pass / Fail indicator light, strobe light, etc.)		
– The content of the encoded position data fields of the self-test message has default values		N/A
– Performs an internal check and indicates that RF-power is being emitted at 406 MHz and 121.5 MHz, if beacon includes a 121.5 MHz homer (Yes or No)		
– Self-test results in transmission of a signal other than at 406 MHz (Yes & details or No)		
– Self-test can be activated directly at beacon (Yes or No)		
– List of Items checked by self-test		
– Self-test/ GNSS self-test 406 MHz burst duration (440 or 520 ms)		
– Self-test message length format flag in bit 25, (“0” or “1”)		
– Maximum duration of a self-test mode, sec		
– Maximum recommended number of self-tests / GNSS self-tests during battery pack replacement period (as applicable)		
– Distinct indication of self-test start (Yes or No)		
– Indication of self-test results(Yes or No)		
– Distinct indication of insufficient battery capacity (Yes or No)		
– Automatic termination of self-test mode immediately after completion of the self-test cycle (Yes or No)		

Self-Test Mode Characteristics:	Self-Test Mode	Optional GNSS Self-test Mode
– GNSS Self-test results in transmission of a single burst, irrespectively of the test result (Yes or No)	N/A	
– Self-test/ GNSS self-test can be activated from beacon remote activation points (Yes & details or No)		
– List all methods of Self-test mode and GNSS Self-test modes activation~~.~~ *And navigation sources.* Provide details on a separate sheet to describe		
Repetitive Automated Interrogation of a Beacons Status (Yes & details per section 5.1, item (y), or No)	Yes ☐ , or No ☐	
Message Coding Protocols:	(x) Tick the boxes below against the intended protocol options	
User Protocol (tick where appropriate)	☐ Maritime with MMSI	
	☐ Maritime with Radio Call Sign	
	☐ EPIRB Float Free with Serial Number	
	☐ EPIRB Non Float Free with Serial Number	
	☐ Radio Call Sign	
	☐ Aviation	
	☐ ELT with Serial Number	
	☐ ELT with Aircraft Operator and Serial Number	
	☐ ELT with Aircraft 24-bit Address	
	☐ PLB with Serial Number	
	☐ National (Short Message Format)	
	☐ National (Long Message Format)	
Standard Location Protocol (tick where appropriate)	☐ EPIRB with MMSI	
	☐ EPIRB with Serial Number	
	☐ ELT with 24-bit Address	
	☐ ELT with Aircraft Operator Designator	
	☐ ELT with Serial Number	
	☐ PLB with Serial Number	
National Location Protocol (tick where appropriate)	☐ National Location: EPIRB	
	☐ National Location: ELT	
	☐ National Location: PLB	
ELT(DT) Location Protocol (tick where appropriate)	☐ ELT with Serial Number	
	☐ ELT with Aircraft Operator and Serial Number	
	☐ ELT with Aircraft 24-bit Address	
	☐ ELT with Serial Number and 3LD in PDF-2	

		ELT with Aircraft 24-bit Address and 3LD in PDF-2
RLS Location Protocol (tick where appropriate) * (TAC or NRN and Serial Number)		EPIRB
		ELT
		PLB
RLS Location Protocol (MMSI)		EPIRB
		PLB
User Location Protocol (tick where appropriate)		Maritime with MMSI
		Maritime with Radio Call Sign
		EPIRB Float Free with Serial Number
		EPIRB Non Float Free with Serial Number
		Radio Call Sign
		Aviation
		ELT with Serial Number
		ELT with Aircraft Operator and Serial Number
		ELT with Aircraft 24-bit Address
		PLB with Serial Number
Beacon includes a homer transmitter(s) (Yes or No) - homer transmitter(s) frequency and power		Yes ☐ 121.5 MHz _____dBm Yes ☐ 243.0 MHz _____dBm Yes ☐ AIS _____dBm Yes ☐ Other _____ MHz _____dBm Description: _____
– homer transmitter(s) duty cycle		_____%
– duty cycle of homer swept tone		_____%
Beacon includes a high intensity flashing light (e.g. Strobe)		Yes or No
- light intensity		_____ cd
- flash rate		_____ flashes per minute

* By decision of the Cospas-Sarsat Council at its Fifty-Seventh Session, RLS protocols will be effective as of 1 January 2018, as a target, subject to further review and consideration. The use of RLS-enabled beacons will be regulated by national administrations.

Beacon transmission repetition period satisfies C/S T.001 requirement that two beacon's repetition periods are not synchronised closer than a few seconds over 5 minute period, and the time intervals between transmissions are randomly distributed on the interval 47.5 to 52.5 seconds (Yes or No)	
Other ancillary devices (e.g. voice transceiver, remote control, external audio and light indicators, external activation device). List details on a separate sheet if insufficient space to describe.	
Beacon includes automatic activation mechanism (Yes or No). Specify type of automatic beacon activation mechanism	
Beacon includes a voice-transceiver (Yes or No), and if Yes, specify: Voice transmitter nominal output power Voice transmitter operating frequencies - provides prevention against continuous operation of voice transmitter (Yes or No), and if Yes specify - maximum continuous voice-transmission operation ("time-out timer") - maximum cumulative transmit-mode on-time ("on time")	*Yes ☐, or No ☐* ~~Yes/ No~~ _____dBm _____MHz *Yes ☐, or No ☐* ~~Yes/No~~ _____minutes ____hours ____minutes
Beacon includes *other* features and functions~~–~~ *or automatic functions (e.g., automatic termination of 406 MHz transmission, switching between antennas, homer duty cycle, etc.)* not listed above, related or non-related to 406 MHz (Yes or No) List *and describe other* features and *functions.* ~~use~~ *Use* ~~a~~ separate sheet*s* ~~if as i nsufficient space~~*needed*	*Yes ☐, or No ☐*
Beacon model hardware part number (P/N) and version	
Beacon model software/firmware P/N, version, date of issue/releases	
Beacon model printed circuit board P/N and version	

Beacon model multiple programmable options, except message coding protocols (Yes/No)	Yes ☐ , or No ☐ If Yes, list all programmable options associated with this type-approval application: _____ _____ _____
Known non-compliances with C/S T.001 requirements (Yes or No) If Yes, provide details (Submit C/S T.007 Section 5, part t, if applicable)	
Beacon Manufacturer Point of Contact (POC) for this Type Approval application:	Name and Job Title: Phone: E-mail:

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

(Continued on Next Page)

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

Name and Location of Beacon Test Facility: _____

_____

Date of Submission for Testing: _____

Applicable C/S Standards:

Document	Issue	Revision	Date
C/S T.001			
C/S T.007			
IP (TCXO)			
IP (LIRB)			

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

Detail any observed non-compliances and/or deviations from standard test procedures here:

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

- END OF ANNEX G -

* If the test results do not indicate full compliance to the above standards, or deviations from the standard test procedures took place during type approval testing, the test laboratory shall modify this statement to identify discrepancies. A complete explanation of such discrepancies should be provided in the test report and the report references identified in this statement.

ANNEX H: CHANGE NOTICE FORM

Beacon model manufacturer (name and address): _____
406 MHz Beacon Model Name(s): _____
Cospas-Sarsat Type Approval Certificate Number: _____

The Manufacturer of the Cospas-Sarsat Type Approved 406 MHz Distress Beacons hereby informs Cospas-Sarsat of their plans to introduce modifications to the above stated production beacon model(s), as follows:

Planned date of change: _____

Changes of beacon manufacturer: _____

~~Proposed a~~Additional *(or new)* beacon model name(s)	(specify): _____
Operational configuration(s)	(specify): _____
Oscillator type and/or model	(specify): _____
Operating frequency	(specify): _____
Other changes to frequency-generation	(specify): _____
Battery pack and/or battery cell	(specify): _____
Alternative ~~Antenna~~ *antenna* ~~type(s) and antenna~~ model(s)	(specify): _____
Homing transmitter	(specify): _____
Beacon physical characteristics	(specify): _____
Significant change to circuit design	(specify): _____
Internal navigation device	(specify): _____
Interface to external navigation *device*	(specify): _____
Types and variants of message protocols	(specify): _____
Beacon Software	(specify): _____
Request for a TAC number (not related to an additional TAC request described in section 6.12)	*(specify):* _____
Addition of RLS functionality	*(specify):* _____
Other changes	(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 model and continue to meet the Cospas-Sarsat requirements.

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

- END OF ANNEX H -

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

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

Beacon Manufacturer: _____
(name and address)

_____

_____

406 MHz Beacon model: _____

having Cospas-Sarsat Type Approval Certificate Number: _____

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

Additional name and model number of beacon: _____

by Agent/Distributor:
(name and address) _____

telephone: _____

fax: _____

contact person/title: _____

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

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

- END OF ANNEX I -

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

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

Manufacturer: _____

(name and address) _____

_____

applies to test ELT antennas: _____

_____

at antenna test facility: _____

located at: _____

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

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

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

Dated:..... Signed:.....
(Name and Signature of Cospas-Sarsat Representative)

- END OF ANNEX J -

ANNEX K: ELT(DT) ENCODED POSITION DATA UPDATE INTERVAL GNSS SIMULATOR TEST PROCEDURE

K.1 INTRODUCTION

This procedure is intended to provide additional guidance on the testing of an ELT(DT) under typical conditions that may be found on an aircraft in order to ensure the correct operation of the GNSS Receiver within the ELT(DT) using a GNSS Simulator. This procedure is intended to supplement the basic test procedure outlined in C/S T.007 Annex A.3.8.3: it provides guidance to the test facility on setting up the GNSS Simulator and running the appropriate test(s). It is intended to be used in that light and alternative test methods that provide similar results may be used by a test facility in co-ordination with the ELT(DT) manufacturer and the Cospas-Sarsat Secretariat.

K.2 TEST CONDITIONS

K.2.1 GNSS Receiver

If the GNSS Receiver in the ELT(DT) is capable of being configured by the manufacturer or other entities, such that it can function differently either under different circumstances or in different parts of the world, then each of the different modes of operation of the GNSS Receiver shall be tested. For example if the GNSS Receiver can be configured to operate solely as a GPS Receiver for use in North America or solely as a Glonass Receiver for use in Asia then both of these modes must be tested, however if the GNSS Receiver has a single fixed mode of operation pre-set by the manufacturer (regardless of what this might be) then just a single test in this mode is required. Likewise if the GNSS Receiver can handle multiple signals from one constellation (e.g. GPS L1 C/A, L2C or L5) and if these can be configured by the manufacturer or other entities under different circumstances, then each combination of signals shall be tested.

K.2.2 GNSS Constellations

The GNSS simulator shall be configured to operate with the constellations declared by the ELT(DT) manufacturer that the GNSS receiver is configured to accept (this could be a single constellation or multiple constellations). Each constellation shall be configured as an optimized constellation based upon the official published information on that constellation (e.g. GPS – 24 satellites in Orbital Planes A1-4, B1-4, C1-4, D1-4, E1-4 and F1-4, Glonass – 24 satellites in Orbital Planes 1 (Slots 1-8), 2 (Slots 9-16) and 3 (Slots 17-24) and Galileo – 24 satellites in Orbital Planes A (Slots 01-08), B (Slots 01-08) and C (Slots 01-08). Additional or spare satellites in any constellation shall not be included. Each constellation shall be configured to commence testing at 00:00 UTC on January 1, 2018 and the start position for each test shall be at Latitude 13.283 degrees North, Longitude 40.917 degrees East and Altitude -100 m. The simulator output shall be set such that the signal level received by the antenna of the GNSS receiver under test is within +/- 2dB of the nominal signal level at the earth's surface for that constellation. No SBAS

satellite augmentation such as WAAS or EGNOS shall be employed and no interference shall be superimposed on the GNSS signals.

The signal to be injected into the external navigation input (if applicable) shall be in the format of a defined navigation signal that is compliant with a recognized interface standard (such as IEC 61162-1 or an ARINC label). The start position for the external navigation input signal shall be at Latitude 12.283 degrees North, Longitude 41.917 degrees East and Altitude +100 m. The signal shall commence testing at 00:00 UTC on January 1, 2018.

K.2.3 ELT(DT)

The ELT(DT) under test, including its GNSS receiver and related GNSS antenna, shall be configured in a set up representative of a typical installation on board an aircraft. The GNSS antenna shall be mounted in the centre of a superstructure of at least $1m^2$ representative of the aircraft fuselage. The ELT(DT) shall be mounted below the superstructure and the cabling between the GNSS/ELT antenna(s) and the ELT(DT) shall be the maximum length specified by the manufacturer. If the ELT(DT) can accept navigation data from an external navigation device as well as from its own internal navigation device, then the test shall be performed twice. Firstly, with the GNSS simulator signals being fed over the air to the GNSS/ELT antenna(s) and, if applicable, with the external navigation device input disconnected, and secondly with the GNSS simulator signals being fed over the air to the GNSS/ELT antenna(s) and with the ELT(DT) external GNSS input fed with an input signal as defined in K.2.2 above. During this second test, after approximately 1 minute and 30 seconds from turning ON the ELT(DT), remove the GNSS simulator signals fed over the air for a total time period of 1 minute and 30 seconds and then restart the signals. If the GNSS receiver and/or the ELT(DT) is normally powered such that it is in the 'Armed' mode of operation prior to activation of the ELT(DT) then it shall be configured in this mode immediately after the commencement of the following test to ensure that it has initialised and has a valid location.

Note: For ELT(DT) equipped with ARINC429 sentences decoding, the GNSS simulator may be replaced by an ARINC429 simulator to feed the signal to the ELT(DT) external GNSS input.

K.3 GNSS SIMULATOR SCENARIO

The GNSS Simulator shall be programmed to perform a flight pattern that complies with the one provided in the csv file in document C/S T.007 starting at a simulated time of 00:00 UTC on 01/01/2018, which could be summarized as follows:

a) five minutes of stationary (static position) with the beacon in "ARMED" mode and then approximately 15 seconds before the end of this time turn the ELT(DT) to the "ON" mode;

b) accelerate due North at a rate of 5.55 m/s^2 for 60 seconds in a straight line, while climbing to 5,000 m;

c) maintain an horizontal speed to 333 m/s for 60 seconds while climbing to 10,000 m;

d) level out (pitch, roll and heading set to 0) and at a constant horizontal speed of 333 m/s, apply the following during 30 seconds:

- Roll : bank right by +30 °/s until reaching +30°, then bank left by -30 °/s until reaching -30°; continue this sequence until the end of the 30 seconds sequence,
- Heading, pitch, Altitude and speed remain unchanged;

e) still maintaining the same altitude and at a constant horizontal speed of 333 m/s and simultaneously apply the following during 2 seconds:

- Pitch: pitch down by -10 °/s until reaching -20°,
- Roll : bank left by -30 °/s until reaching -60°,
- Heading, Altitude and speed remain unchanged;

f) From this point until the impact at sea level, maintain a constant speed of 333 m/s while implementing a trajectory with the following characteristics until the impact:

- Maintain Pitch: -20°
- and decrease the altitude using a vertical speed of : -80 m/s
- and simultaneously repeat the following sequence:
  i. during 17.5 seconds
     - maintain Roll at : -60°
     - and decrease the heading at a yaw rate: -10°/s
  ii. during 4 seconds
     - increase Roll at 30°/s to reach +60°
     - decrease yaw rate at 5°/s² to reach +10°/s
  iii. during 17.5 seconds
     - maintain Roll at : +60°
     - and increase the heading at a yaw rate: +10°/s
  iv. during 4 seconds
     - decrease Roll at -30°/s to reach -60°
     - decrease yaw rate at -5°/s² to reach -10°/s

g) once impact with the ground occurs maintain 60 seconds of stationary position.

Note - the above trajectory and aircraft attitude shall be implemented such that:

a) The satellites used at the start of the simulation shall be those that are above 5 degrees elevation at the location of the simulation based upon its start time. As the aircraft direction and attitude changes during the simulation (i.e. climbs, banks, descends etc) the horizon shall be considered to change with the aircraft movement, such that the satellites in view change accordingly. For example if the aircraft was heading due north and climbing at an angle of 30 degrees, then any satellites to the North below 35 degrees elevation would be excluded from the simulation, while satellites due South should take

into account the earth's horizon, and satellites at other points around the compass would be included or excluded accordingly on the same basis.

b) Discontinuities between the various phases of the trajectory are limited to a maximum acceleration of 100 m/s^2. Apart from the final transition phase, which in effect simulates the aircraft crashing, where the change in instantaneous acceleration shall be infinite.

The CSV file provided in document C/S T.007 containing the data for the above scenario shall be used to program the GNSS simulator and provide the navigation device input(s) for these tests.

Click the paper clip for the embedded CSV file:

K.4 RESULTS

Ensure that the results obtained comply with C/S T.007 Annex A.3.8.3.

– END OF ANNEX K –

ANNEX L: BEACON QUALITY ASSURANCE PLAN

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

_____

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

_____

(model, hardware part number, firmware part number, software version or part number)

_____

_____

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

- Digital message
- Bit rate
- Rise and fall times of the modulation waveform
- Modulation Index (positive/negative)
- Output power
- Frequency stability (short, medium) [1)]

Note 1): 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.

Note 2): For beacon models equipped with TCXOs, the beacon manufacturer shall provide an additional statement* as required by document C/S IP (TCXO) under the other test section of this form.

_____

* The statement shall contain the following:
"All TCXO devices from [TCXO manufacturer name], Part Number [P/N of TCXO] used for assembly of [beacon model] production beacons will be inspected to ensure that the factory test data sheets associated with those TCXO units demonstrate the following performances, when subjected to the temperature gradient test in accordance with C/S T.001:
- Maximum value of the MTS residual frequency variation does not exceed [value] ppb,
- Maximum and minimum values of MTS mean slope, at steady temperature conditions, do not exceed ± [value] ppb/min,
- Maximum and minimum values of MTS mean slope, at changing temperature conditions, do not exceed ± [value] ppb/min."

- Other tests:

_____
_____
_____
_____
_____

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

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

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

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

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

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

- END OF ANNEX L -

ANNEX M: COSPAS-SARSAT 406 MHz BEACON TYPE APPROVAL CERTIFICATE (SAMPLE)

TYPE APPROVAL CERTIFICATE

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

Certificate Number: …xxx

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

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

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

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

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

Date Originally Issued: 10 March 2005
Date(s) Amended:

_____

Head of Cospas-Sarsat Secretariat

NOTE, HOWEVER:

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

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

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

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

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

6. This certificate authorizes the use of the registered name mark "Cospas-Sarsat" and of registered trademarks for the Programme's logos, for labelling, instruction materials, and marketing of the 406-MHz beacon model identified, but not for other marketing or sales purposes (i.e., not for general uses beyond this specific beacon model).

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

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

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

Minimum Operating Lifetime: 48 hours [1) 2)]

Transmit Frequency: 406.028 MHz

Beacon Model Features:

- 121.5 MHz auxiliary radio locating device (50 mW, continuous)
- Automatic activation mechanism
- Strobe light (0.75 cd, 20 flashes/min)
- Internal navigation device (GPS): manufacturer YYY, model ZZZ
- Encoded position data update interval/range: (e.g., 5 mins/ 4mins 25 sec - 15 min)
- Self-test mode: one burst of 520 ms
- Optional GNSS self-test mode (limited to X times over the life of the battery)

Approved Beacon Message Protocols Beacon is approved for encoding with the message protocols indicated with "Yes" and black text below:

USER PROTOCOLS		USER-LOCATION PROTOCOLS		LOCATION PROTOCOLS	
No	Maritime with MMSI	No	Maritime with MMSI	No	Standard Location: EPIRB with MMSI
No	Maritime with Radio Call Sign	No	Maritime with Radio Call Sign	No	Standard Location: EPIRB with Serial Number
No	EPIRB Float Free with Serial Number	No	EPIRB Float Free with Serial Number	No	Standard Location: ELT with 24-bit Address
No	EPIRB Non Float Free with Serial Number	No	EPIRB Non Float Free with Serial Number	No	Standard Location: ELT with Aircraft Operator Designator
No	Radio Call Sign	No	Radio Call Sign	No	Standard Location: ELT with Serial Number
No	Aviation	No	Aviation	**Yes**	**Standard Location: PLB with Serial Number**
No	ELT with Serial Number	No	ELT with Serial Number	No	National Location: EPIRB
No	ELT with Aircraft Operator and Serial Number	No	ELT with Aircraft Operator and Serial Number	No	National Location: ELT
No	ELT with Aircraft 24-bit Address	No	ELT with Aircraft 24-bit Address	**Yes**	**National Location: PLB**
Yes	**PLB with Serial Number**	**Yes**	**PLB with Serial Number**	No	RLS Location: EPIRB
Yes	**National (Short Format Message)**			No	RLS Location: ELT
No	National (Long Format Message)			No	RLS Location: PLB
				No	*RLS Location: MMSI*
				No	ELT(DT) Location: ELT with Serial Number
				No	ELT(DT) Location: ELT with Aircraft Operator and Serial Number
				No	ELT(DT) Location: ELT with Aircraft 24-bit Address
				No	ELT(DT) Location ELT with Serial Number and 3LD in PDF-2
				No	ELT(DT) Location ELT with Aircraft 24-bit Address and 3LD in PDF-2

[1)] This value is declared by the beacon manufacturer, and it may be different from the Minimum duration of continuous operation (specified by National Administrations or International Organizations).

[2)] For beacons with an operator-controlled voice transceiver with automatic means restricting the duration of continuous voice-signal transmission the transmit mode test 'on' time shall be stated in the Operating Lifetime section of the Type Approval Certificate.

– END OF ANNEX M –

– END OF DOCUMENT –

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