COSPAS-SARSAT MEOLUT COMMISSIONING STANDARD

C/S T.020
Issue 1
December 2015

COSPAS-SARSAT MEOLUT
COMMISSIONING STANDARD

HISTORY

Issue	Revision	Date	Comments
1	-	December 2015	Approved by the Cospas-Sarsat Council (CSC-55)

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1. INTRODUCTION

1.1 Purpose

The Cospas-Sarsat MEOLUT Commissioning Standard shall be used to verify that a MEOSAR Local User Terminal (MEOLUT) complies with document C/S T.019, "Cospas-Sarsat MEOLUT Performance Specification and Design Guidelines". The national Administrations that wish to connect a new MEOLUT to the Cospas-Sarsat network shall conduct the tests and provide the data, which is specified in this document, to the Cospas-Sarsat Secretariat. The MEOLUT to be commissioned shall be fully described according to the technical file located in Annex A, Appendix 1.

1.2 Scope

This standard specifies MEOLUT commissioning for the 406 MHz data channels that are relayed through the MEOSAR satellites and received and processed by the MEOLUT. Section 2 defines the general commissioning process, section 3 describes the evaluation of the operational requirements, section 4 specifies the commissioning of functional and processing requirements, and section 5 specifies the commissioning of performance requirements. The annexes define the test requirements, signal characteristics, test beacon messages, the format of the test data which is to be collected, and the format of the commissioning report which is to be submitted to the Cospas-Sarsat Secretariat.

1.3 Reference Documents

The following documents contain useful information applicable to MEOLUT commissioning:

Reference	Title
C/S A.001	Cospas-Sarsat Data Distribution Plan (DDP)
C/S A.002	Cospas-Sarsat Mission Control Centres Standard Interface Description (SID)
C/S A.003	Cospas-Sarsat System Monitoring and Reporting
C/S A.005	Cospas-Sarsat MCC Performance Specification and Design Guidelines
C/S A.006	Cospas-Sarsat MCC Commissioning Standard
C/S T.001	Specification for Cospas-Sarsat 406 MHz Distress Beacons
C/S T.006	Cospas-Sarsat Orbitography Network Specification
C/S T.011	Description of the 406 MHz Payloads Used in the Cospas-Sarsat GEOSAR System
C/S T.016	Description of the 406 MHz Payload Used in the Cospas-Sarsat MEOSAR System
C/S T.015	Cospas-Sarsat Specification and Type Approval Standard for 406 MHz Ship Security Alert (SSAS) Beacons
C/S T.019	Cospas-Sarsat MEOLUT Performance Specification and Design Guidelines
C/S T.017	Cospas-Sarsat MEOSAR Space Segment Commissioning Standard

- END OF SECTION 1 -

2. MEOLUT COMMISSIONING

2.1 General

The Cospas-Sarsat MEOLUT commissioning tests defined in this document are intended to be performed in addition to national acceptance tests, and are required prior to fully integrating a MEOLUT into the Cospas-Sarsat Ground Segment. Conducting these tests and assessing the results is the responsibility of the national Administration that desires to commission a MEOLUT.

The tests verify the MEOLUT's ability to receive and process signals transmitted from a distress beacon that is compliant with document C/S T.001, "Specification for Cospas-Sarsat 406 MHz Distress Beacons", relayed by the MEOSAR satellites described in document C/S T.016, "Description of the 406 MHz Payload Used in the Cospas-Sarsat MEOSAR System", and received and processed in accordance with document C/S T.019. A cross reference of the requirements in document C/S T.019 and the corresponding commissioning requirements specified in this document is provided in the "Summary Table" of the commissioning report (Annex A). The tests shall be conducted with the MEOLUT in its operational configuration and location, and connected to the associated MCC. However, the data should not be distributed to other Cospas-Sarsat Ground Segment Operators.

The MEOLUT may provide optional capabilities as described in document C/S T.019, such as:

1. the MEOLUT may provide 406 MHz beacon data to other MEOLUTs according to the specifications contained in document C/S T.019,
2. the MEOLUT may process 406 MHz beacon data retrieved from other commissioned MEOLUTs according to the MEOLUT data exchange specifications contained in C/S T.019 to enhance system performance and support redundancy of the Cospas-Sarsat Ground Segment,
3. the ability to receive and process beacon signals received through downlinks from non-MEOSAR, Cospas-Sarsat commissioned satellites to obtain beacon data.

The MEOLUT must initially be commissioned with all optional capabilities disabled according to the non-optional tests described in Annex A. The optional capabilities, if to be used, must then be commissioned to verify that the MEOLUT meets all requirements as described by the optional tests contained in Annex A.

2.2 Pre-Test Requirements

Prior to commencing the test, the national Administration conducting the test shall coordinate with appropriate authorities in its SAR region, as well as notifying all affected Cospas-Sarsat MCCs, of the periods of operation and the location(s) of each of the test beacon(s). It is also invited to provide this information to the Cospas-Sarsat Secretariat.

Before the commissioning begins, the national Administration shall identify the Declared Coverage Area (DCA) of the MEOLUT, as described in document C/S T.019. The processing of a beacon located within the DCA shall meet the requirements in document C/S T.019. The DCA shall be verified using performance analysis, simulation, or both, and shall be equal to or greater than the Minimum Performance Area defined in document C/S T.019. Assumptions with respect to visibility as per Annex D of document C/S T.019 and TOA/FOA data quality and single-channel throughput used in the analysis or simulation should be validated with data from Annex E.

The MEOLUT shall be commissioned with all assets that comprise the MEOLUT. However, if the DCA assumes fewer assets, for example, fewer antenna beams, then commissioning results shall also be reported for a MEOLUT in that configuration. In particular, if fewer antenna beams are used for the DCA, only data that results from an antenna tracking schedule generated using the fewer number of antenna beams shall be used in generating the results. This may result in the need for two sets of results, one for the MEOLUT with all available assets, and one for the MEOLUT with the configuration needed for the DCA.

2.3 Test Data Collection

The commissioning process for the MEOLUT comprises the collection of specific beacon messages and the specified numbers of solutions. The MEOLUT shall utilize beacon data received directly from downlinks from MEOSAR satellites for the data acquisition and statistical data analysis for the commissioning tests.

Data collection for commissioning a MEOLUT's optional capabilities are as follows:

1. The MEOLUT may provide 406 MHz beacon data to other MEOLUTs according to the specifications contained in document C/S T.019. Data collected directly from downlinks from commissioned MEOSAR satellites that comply with documents C/S T.016, "Description of the 406 MHz Payload Used in the Cospas-Sarsat MEOSAR System" and document C/S T.017 "Cospas-Sarsat MEOSAR Space Segment Commissioning Standard" shall be used for the data acquisition and statistical data analysis for the commissioning tests.
2. The MEOLUT may process 406 MHz beacon data retrieved from other commissioned MEOLUTs according to the MEOLUT data exchange specifications contained in document C/S T.019. Data from every MEOLUT that will provide data to the MEOLUT being commissioned shall be used for the data acquisition and statistical data analysis for the commissioning tests.
3. The ability to receive and process beacon signals received through downlinks from non-MEOSAR, Cospas-Sarsat commissioned satellites to obtain beacon data. Data collected from every non-MEOSAR, Cospas-Sarsat commissioned satellite that will be used shall be included in the data acquisition and statistical data analysis for the commissioning tests.

2.4 Frequency Registration

Administrations should register their MEOLUT's use of the 1544 to 1545 MHz frequency band by "notifying" their MEOLUTs with the International Telecommunication Union (ITU) in accordance with article 11 of the radio regulations. The information required to notify MEOLUTs is identified at Annex H. The ITU only accepts notification requests submitted in electronic format and has developed a software application, available free of charge from their web site, which captures the required information and produces the necessary electronic file.

2.5 Data Collection Limitation

Only the data collected from those satellite channels that comply with documents C/S T.016 and C/S T.017 shall be used for the statistical data analysis. Data from satellites in an Initial Operational Capability (IOC) status should not be used for test data collection.

The data collection limitations for commissioning a MEOLUT's optional capabilities are as follows:

1. The MEOLUT may provide 406 MHz beacon data to other MEOLUTs according to the specifications contained in document C/S T.019. Only the data collected from those satellite channels that comply with documents C/S T.016 and C/S T.017 shall be used for the statistical data analysis. Data from satellites in an Initial Operational Capability (IOC) status should not be used for test data collection.
2. The MEOLUT may process 406 MHz beacon data retrieved from other commissioned MEOLUTs according to the MEOLUT data exchange specifications contained in C/S T.019 to enhance system performance and support redundancy of the Cospas-Sarsat Ground System. Only data that has been retrieved from a commissioned MEOLUT that has also been commissioned to provide 406 MHz beacon data to other MEOLUTs may be used.
3. The MEOLUT may have the ability to receive and process beacon signals received through downlinks from non-MEOSAR, Cospas-Sarsat commissioned satellites to obtain beacon data. Only the data collected from commissioned satellites shall be used. Data from satellites in an Initial Operational Capability (IOC) status should not be used for test data collection.

2.6 Reference System

All location data for the MEOLUT commissioning shall be given with respect to the Bureau International de l'Heure (BIH) geodetic reference system.

2.7 Submission of Results

The results of the MEOLUT commissioning process shall be documented in the commissioning report, in accordance with the format detailed at Annex A.

The complete commissioning report and the data files detailed at Annex E are to be submitted to the Cospas-Sarsat Secretariat for further evaluation, and distribution to Participants for subsequent

review at the Joint Committee. Revisions or updates to commissioning reports should be provided to the Secretariat with a clear indication given on the cover page of the sections that have been revised and a short description of the nature of the revisions.

In order to provide Participants with sufficient time to adequately review the commissioning report, all reports (or updates) must be submitted to the Secretariat a minimum of six weeks prior to the start of the Joint Committee meeting. Submissions received after this date will be considered for review at the following Joint Committee meeting.

2.8 MEOLUT Commissioning and Integration

The test results, as defined in the annexes, shall be submitted to the Cospas-Sarsat Secretariat. The results will be reviewed by the Cospas-Sarsat Secretariat and submitted to the Joint Committee. The MEOLUT will be integrated into the Cospas-Sarsat Ground Segment as described in Annex F and Annex G.

2.9 MEOLUT/MCC Interface

Validation that the MEOLUT/MCC interface satisfies the minimum requirements of document C/S T.019 shall be completed by the national Administration as part of the MEOLUT commissioning.

2.10 Confirmation of Requirements

The national Administration shall confirm compliance to all requirements detailed in this document with either a measurement, a verification, a declaration, analysis or a combination of these methods:

a) A measurement requires the national Administration to conduct a test and include the supporting data as part of the commissioning report.

b) A verification requires a national Administration to test a requirement; however, supporting data does not need to be provided as part of the commissioning report.

c) A declaration of compliance confirms that specific requirements are met although not necessarily tested as part of the commissioning process.

d) Analysis requires the national Administration to provide analysis as part of the commissioning report that confirms that specific requirements are met.

Conformance to all requirements shall be documented in the commissioning report.

The exact method of confirming compliance for each respective requirement is identified in the summary table of the commissioning report (Annex A).

2.11 Change of Configuration

If the configuration, including the location, of a commissioned MEOLUT has been changed, the responsible national Administration shall ensure that the MEOLUT continues to satisfy C/S T.019 requirements prior to resuming operations. Additionally, the national Administration shall:

a) confirm that the level of local interference does not adversely affect MEOLUT performance;

b) verify the performance of the communication links;

c) verify the performance of the antenna and RF subsystems; and

d) update the technical file of the MEOLUT commissioning report (Appendix 1 to Annex A refers) by providing a declaration that the MEOLUT satisfies C/S T.019 requirements and the following information, to the Cospas-Sarsat Secretariat:

(i) Antenna Characteristics (Annex A, Appendix 1, section A.2.1),
(ii) General LUT Indoor Equipment Description (Annex A, Appendix 1, section A.2.2) - identify any changes to the equipment configuration, or indicate “no change” if the configuration has not been changed,
(iii) General Capabilities (Annex A, Appendix 1, section A.2.3), - identify any changes to the general capabilities of the MEOLUT, or indicate “no change” if appropriate,
(iv) Communications Capability (Annex A, Appendix 1, section A.4),
(v) Coverage (Annex A, Appendix 1, section A.5),
(vi) Location (Annex A, Appendix 1, section A.6).

- END OF SECTION 2 -

3. EVALUATION OF OPERATIONAL REQUIREMENTS

3.1 MEOLUT Data Availability

The MEOLUT data availability shall be measured during the commissioning period in accordance with guidance provided at Annex B. If any basic function or requirement is not performed by the MEOLUT, the MEOLUT data shall be considered unavailable.

A reliability assessment is performed by measurement during the commissioning period and by an analysis that predicts the availability for a one-year period to verify that the MEOLUT will meet the availability requirement in accordance with guidance provided at Annex B.

3.2 Data Requirements

The national Administration shall ensure that the MEOLUT provides the data necessary for the associated MCC to distribute alert data according to document C/S A.002 (SID). This shall be verified and noted in the appropriate section of the MEOLUT commissioning report.

3.3 Satellite Tracking and Visibility Capability

The national Administration shall ensure that the MEOLUT shall be capable of meeting the requirements of section 3.4 in document C/S T.019. This shall be declared in the appropriate section of the MEOLUT commissioning report.

3.4 Status and Alarm

The national Administration shall describe the status and alarm functions of the MEOLUT and declare compliance in the appropriate section of the MEOLUT commissioning report.

3.5 RF Radiation and Emissions

The national Administration shall ensure that the MEOLUT does not radiate or emit any radio frequency signals that will interfere with the functioning of the Cospas-Sarsat System. This shall be declared in the appropriate section of the MEOLUT commissioning report.

3.6 Data Archiving

The national Administration shall describe the data archiving capability of the MEOLUT and declare compliance to the relevant section of document C/S T.019 in the appropriate section of the MEOLUT commissioning report.

- END OF SECTION 3 -

4. EVALUATION OF FUNCTIONAL AND PROCESSING REQUIREMENTS

4.1 Functional Requirements

4.1.1 Antenna and RF Subsystems

The national Administration shall verify that the antenna and RF subsystems of the MEOLUT can acquire, track and receive the downlink signals from any Cospas-Sarsat MEOSAR satellites as described in document C/S T.016. This verification shall be documented in the MEOLUT commissioning report.

4.1.2 Time and Frequency Reference Subsystem

The national Administration shall declare in the MEOLUT commissioning report, the MEOLUT's capability to maintain time and frequency subsystems according to document C/S T.019.

4.1.3 Satellite Tracking Subsystem

The national Administration shall declare, in the MEOLUT commissioning report, the MEOLUT's capability to maintain accurate satellite orbital elements and tracking schedules as described in document C/S T.019.

4.1.4 MCC Interface

The national Administration shall verify that the MEOLUT provides timely alert data of the level of quality and detail specified in documents C/S T.019, C/S A.002 and C/S A.005, "Cospas-Sarsat Mission Control Centre Performance Specification and Design Guidelines". This verification shall be documented in the MEOLUT commissioning report.

4.2 Beacon Message Processing

The national Administration shall conduct tests, and record the results in the appropriate section of the commissioning report, which confirm the MEOLUTs compliance to the "channels processing specifications" detailed in document C/S T.019.

These tests require the MEOLUT to process the data described at Annex D.1 in the manner prescribed. The processing consists of bit verification, message validation, message processing and transmission. The specific beacon test messages contained at Annex D.1 can be transmitted by a test beacon or a beacon simulator.

National Administrations should ensure that test beacons or simulators are capable of transmitting the beacon messages at the frequencies described at Annex D.1. Alternatively, national Administrations may arrange for the simulators in the United States or France to uplink the messages contained at

Annex D.1. If the test messages cannot be transmitted during the commissioning period, the national Administration may develop alternative methods of confirming compliance with the beacon message processing requirements and proceed with the commissioning test, and preparation and submission of the commissioning report. For beacon message processing, the unavailability of the test beacon or simulators to uplink the test messages contained at Annex D.1 shall not prevent the MEOLUT from being commissioned, if other adequate methods are used. If alternative methods are used, these methods shall be completely documented in the commissioning report.

- END OF SECTION 4 -

5. EVALUATION OF PERFORMANCE REQUIREMENTS

The national Administration shall conduct the tests defined at Annex C to confirm conformance with the MEOLUT performance requirements detailed at document C/S T.019. The results of these tests shall be included in the MEOLUT commissioning report. Additional guidance pertaining to the tests detailed at Annex C is provided in the remainder of this section.

5.1 Data Collection Test

Tests shall be conducted to confirm that the MEOLUT processing satisfies the performance requirements detailed in document C/S T.019.

All data collected from test beacons during the entire time period of the commissioning test shall be used to generate statistics that validate the performance requirements are met.

All data and results shall be provided electronically to the Secretariat as part of the commissioning report. The required data elements and the format of the files to be included in the commissioning report are detailed in Annex E.

5.1.1 Test Beacons

Beacon tests shall be conducted with type-approved Cospas-Sarsat 406 MHz beacons coded with the test protocol and/or beacon simulators (i.e., not an orbitography beacon), as described in document C/S T.022. The beacons that are used for these tests shall not be used for updating the satellite orbital elements. However, any reference beacon that is not used by the MEOLUT for the determination of satellite orbits may be used as a test beacon during the commissioning of the MEOLUT. The characteristics of all beacons used during commissioning shall be described in the commissioning report.

Each test beacon must be placed as described below at a position that is known to within 100 metres, and shall remain fixed at this position throughout the test. The test beacon locations shall be given with respect to the reference system given in section 2.6.

1) Use test beacon(s) located at the MEOLUT to perform all commissioning tests to verify the MEOLUT meets all performance requirements.
2) Use 1 or more test beacon(s) located as near the edge of the Declared Coverage Area as practical or at least 1,000 km from the MEOLUT, to demonstrate the MEOLUT Declared Coverage Area.

These tests require the MEOLUT to process the data described at Annex D.2 in the manner prescribed. The processing consists of beacon detection probability, probability of DOA location, DOA location accuracy, TOA/FOA measurement accuracy (if applicable), and expected horizontal

error / quality factor. The specific beacon test messages contained at Annex D.2 can be transmitted by a test beacon or a beacon simulator.

National Administrations should ensure that test beacons or simulators are capable of transmitting the beacon messages at the frequencies described at Annex D.2. Alternatively, national Administrations may arrange for the simulators in the USA or France to uplink the messages contained at Annex D.2. If the test messages cannot be transmitted during the commissioning period, the national Administration may develop alternative methods of confirming compliance with the beacon message processing requirements and proceed with the commissioning test, and preparation and submission of the commissioning report. The unavailability of the test beacon or simulators to uplink the test messages contained at Annex D.2 shall not prevent the MEOLUT from being commissioned, if other adequate methods are used. If alternative methods are used, these methods shall be completely documented in the commissioning report.

If test beacons transmit in the operational 406 MHz frequency band or if beacon bursts are transmitted using the normal frame synchronization pattern, the total number of beacons simutaneously active shall not exceed 5.

5.1.2 Satellite Tracking Schedule

Beacon tests shall consist of receiving and processing data on all scheduled passes from the commissioned satellites that are visible during the test period. All available data channels shall be used for the collection of data from available satellites during this data collection test.

5.2 Detection and Location Statistics

Statistics will be reported for beacons identified in section 5.1.1, item 1, and separately for those identified in item 3.

Statistics will be also reported for all orbitography/reference beacons defined in document C/S A.001.

The statistics are defined in Annex A and shall be derived as listed in Annex C.

5.3 Detection and Location Data

The detection and location data from all tracked satellite passes shall be provided for each test beacon used during the test period.

A minimum of 1,000 detection and location data solutions shall be used to establish the detection and location data statistics.

A minimum of 100,000 detections shall be used to establish the processing anomaly statistics.

- END OF SECTION 5 -

ANNEX A

MEOLUT COMMISSIONING REPORT

Country or national Administration: _____

Cospas-Sarsat Identifier: _____

Location of MEOLUT: _____

Start of Commissioning Period: _____

End of Commissioning Period: _____

Section A.1 contains a summary of the commissioning results as well as the analysis (A), declarations (D) and verifications (V), by the national Administration, for requirements not specifically measured (M). The organization of the summary table follows the requirements contained in document C/S T.019.

Section A.2. contains the measurements (M) to support the results presented in section A.1, a copy of the associated data is provided in electronic format as required by this document. A technical description of the MEOLUT is presented in Appendix 1.

A.1 Summary Table

Table A.1: MEOLUT Commissioning Summary Data Table

Paragraph in C/S T.019	Requirement or Test	Pass Criteria	Result or Report Ref	Pass/ Fail	Method of Compliance	Declaration / Verification or Comments
3.1	MEOLUT Data Availability	A≥95	2.1.1		M, A	
3.2	Data Requirements	n/a	n/a		V	
3.3.1	Satellite Data Channels	Minimum MEOSAR	n/a		V	
3.3.2	MEOLUT Data Exchange	n/a	n/a		D	Only applicable to MEOLUTs which exchange data with other MEOLUTs
3.4	Satellite Tracking and Visibility	n/a	n/a		V	
3.5	Status and Alarm	n/a	n/a		D	Include description in technical file
3.6	RF Radiation and Emissions	n/a	n/a		D	
3.7	Data Archiving	n/a	n/a		D	
3.8	QMS	n/a			D	
4.1.1	Antenna and RF Subsystem	n/a	n/a		V	
4.1.2	Time and Frequency Reference Subsystem	n/a	n/a		V	
4.1.3	Satellite Tracking Subsystem	All MEOSAR satellites	n/a		D	
4.1.4	MCC Interface	n/a	n/a		V	
4.2.2	Beacon Message Recovery	Exact match on 9 Bit Frame Synch	n/a		D	Achieve identical match on 9 bit frame synchronization
See para 2.2.4.B to C/S T.001	Bit Rate Tolerance Check Test - BR1	M/N>0.75			M	
4.2.3	Bit Verification Test - BV1	See Annex D.1	2.2.1		M	
	Bit Verification Test - BV2	See Annex D.1	2.2.1		M	
	Bit Verification Test – BV3	See Annex D.1	2.2.1		M	

Paragraph in C/S T.019	Requirement or Test	Pass Criteria	Result or Report Ref	Pass/ Fail	Method of Compliance	Declaration / Verification or Comments
4.2.4	Beacon Message Validation Test - MV1	See Annex D.1	2.2.2		M	
	Beacon Message Validation Test - MV2	See Annex D.1	2.2.2		M	
	Beacon Message Validation Test - MV3	See Annex D.1	2.2.2		M	
	Beacon Message Validation Test - MV4	See Annex D.1	2.2.2		M	
4.2.5	Beacon Message Processing Test - LP1	See Annex D.1	2.2.3		M	
	Beacon Message Processing Test - LP2	See Annex D.1	2.2.3		M	
	Beacon Message Processing Test - LP3	See Annex D.1	2.2.3		M	
	Beacon Message Processing Test - LP4	See Annex D.1	2.2.3		M	
4.2.6	MEOLUT Data Exchange	See C/S T.019 Annex C	n/a		D	Only applicable to MEOLUTs which exchange data with other MEOLUTs
4.2.7	Time and Frequency Requirements	n/a	n/a		D	
4.2.8	Independent Location Processing	n/a	n/a		V	Check generation of location and validity
4.2.9	Transmitting Data to the MCC	n/a	n/a		V	Using MCC message log table as defined in Annex E
5.1	RF Signal Margin	n/a	n/a		D	
5.2	Signal Sensitivity	Signal sensitivity better than 34.8 dB-Hz			D	
5.3	Beacon Message Detection Probability	T≥0.99	2.3.1.1		M	After 10 minutes
5.4	Probability of FDOA/TDOA Location	PL≥0.90	2.3.1.2		M	Single burst
		PL≥0.98	2.3.1.2		M	After 10 minutes
	Probability of FDOA/TDOA Location EOC	PL≥0.75	2.3.1.2		M	Single burst
		PL≥0.98	2.3.1.2		M	After 20 minutes
5.5	Capacity	100 beacons	n/a		D	

Paragraph in C/S T.019	Requirement or Test	Pass Criteria	Result or Report Ref	Pass/ Fail	Method of Compliance	Declaration / Verification or Comments
5.6	Location Accuracy Single Burst -	M/N≥0.90 (5 km)	2.3.1.3		M	
	Location Accuracy Single Burst – EOC	M/N≥0.70 (5 km)	2.3.1.3		M	
		M/N≥0.98 (10 km)	2.3.1.3		M	
	Location Accuracy Within 10 minutes -	M/N≥0.95 (5 km)	2.3.1.3		M	
		M/N≥0.98 (10 km)	2.3.1.3		M	
	Location Accuracy Within 20 minutes – EOC	M/N≥0.95 (5 km)	2.3.1.3		M	
		M/N≥0.98 (10 km)	2.3.1.3		M	
5.7	Processing Bandwidth	406.010 to 406.090 MHz	n/a		D	
5.8.1	TOA/FOA Measurement Accuracy	TOA_{σ}<25µsec TOA_{bias} < 2.5 µsec FOA_{σ}< 0.2 Hz FOA_{bias} < 0.02 Hz	2.3.2.5		M	Only applicable to MEOLUTs which will provide data to other MEOLUTs 34.8 dBHz<C/N_0<37.8 dBHz
5.8.2	External Data Processing	C/S T.019 sections 4.2.9 and 5			D	Only applicable to MEOLUTs which process data from other MEOLUTs
	Transmitting Data to the MCC	n/a			V	Using MCC message log table as defined in Annex E
	RF Signal Margin	n/a	n/a		D	
	Signal Sensitivity	Signal sensitivity better than 34.8dB-Hz			D	
	Beacon Message Detection Probability	T≥0.99	2.3.2.2		M	After 10 minutes
	Probability of FDOA/TDOA Location	PL≥0.90	2.3.2.3		M	Single Burst
		PL≥0.98	2.3.2.3		M	After 10 minutes
	Probability of FDOA/TDOA Location EOC	PL≥0.75	2.3.2.3		M	Single burst
		PL≥0.98	2.3.2.3		M	After 20 minutes

Paragraph in C/S T.019	Requirement or Test	Pass Criteria	Result or Report Ref	Pass/ Fail	Method of Compliance	Declaration / Verification or Comments
	Capacity	100 beacons			D	
	Location Accuracy Single Burst -	M/N≥0.90 (5 km)	2.3.2.4		M	
	Location Accuracy Single Burst – EOC	M/N≥0.70 (5 km)	2.3.2.4		M	
		M/N≥0.90 (10 km)	2.3.2.4		M	
	Location Accuracy Within 10 minutes -	M/N≥0.95 (5 km)	2.3.2.4		M	
		M/N≥0.98 (10 km)	2.3.2.4		M	
	Location Accuracy Within 20 minutes – EOC	M/N≥0.95 (5 km)	2.3.2.4		M	
		M/N≥0.98 (10 km)	2.3.2.4		M	
	Processing Bandwidth	406.010 to 406.090 MHz			D	
	Expected Horizontal Error / Quality Factor	Prediction accurate 95%	2.3.2.4		M	Results reported but will not be judged as pass or fail criteria during EOC
	Processing Anomalies	$< 1x10^{-4}$	2.3.2.6		M	Results reported but will not be judged as pass or fail criteria during EOC. Processing anomalies that consist of a single burst from a single satellite shall be identified separately
5.9	Combined Processing	C/S T.019 sections 4.2.9, and 5			D	Only applicable to MEOLUTs which use non-MEOSAR C/S satellites
	Transmitting Data to the MCC				V	Using MCC message log table as defined in Annex E
	RF Signal Margin	n/a	n/a		D	
	Signal Sensitivity	Signal Sensitivity better than 34.8 dB-Hz			D	

Paragraph in C/S T.019	Requirement or Test	Pass Criteria	Result or Report Ref	Pass/ Fail	Method of Compliance	Declaration / Verification or Comments
	Beacon Message Detection Probability	T≥0.99	2.3.3.1		M	After 10 minutes
	Probability of FDOA/TDOA Location	PL≥0.90	2.3.3.2		M	Single Burst
		PL≥0.98	2.3.3.2		M	After 10 minutes
	Probability of FDOA/TDOA Location EOC	PL≥0.75	2.3.3.2		M	Single burst
		PL≥0.98	2.3.3.2		M	After 20 minutes
	Capacity	100 beacons			D	
	Location Accuracy Single Burst -	M/N≥0.90 (5 km)	2.3.3.3		M	
	Location Accuracy Single Burst – EOC	M/N≥0.70 (5 km)	2.3.3.3		M	
		M/N≥0.90 (10 km)	2.3.3.3		M	
	Location Accuracy Within 10 minutes -	M/N≥0.95 (5 km)	2.3.3.3		M	
		M/N≥0.98 (10 km)	2.3.3.3		M	
	Location Accuracy Within 20 minutes – EOC	M/N≥0.95 (5 km)	2.3.3.3		M	
		M/N≥0.98 (10 km)	2.3.3.3		M	
	Processing Bandwidth	406.010 to 406.090 MHz			D	
	Expected Horizontal Error / Quality Factor	Prediction accurate 95%	2.3.3.4		M	Results reported but will not be judged as pass or fail criteria during EOC
	Processing Anomalies	$< 1x10^{-4}$	2.3.3.5		M	Results reported but will not be judged as pass or fail criteria during EOC Processing anomalies that consist of a single burst from a single satellite shall be identified separately
5.10	Expected Horizontal Error / Quality Factor	Prediction accurate 95%	2.3.1.4		M	Results reported but will not be judged as pass or fail criteria during EOC

Paragraph in C/S T.019	Requirement or Test	Pass Criteria	Result or Report Ref	Pass/ Fail	Method of Compliance	Declaration / Verification or Comments
5.11	Processing Anomalies	$< 1x10^{-4}$	2.3.1.5		M	Results reported but will not be judged as pass or fail criteria during EOC Processing anomalies that consist of a single burst from a single satellite shall be identified separately

A.2 Results of Measurements

This section contains the detailed results of measurements summarized in section A.1. Each of the requirements is referred to in the report by the report reference number. The test procedure column identifies the reference in this document, where the detailed test procedure and pass/fail criteria are provided.

Report Ref #	Title	Test Procedure
2.1	**Operational Requirements**	
2.1.1	MEOLUT Data Availability (A)	B.1
2.2	**Functional and Processing Requirements**	
2.2.1	Bit Verification (test code sequence BV1 - BV2 – BV3)	D.3
2.2.2	Beacon Message Validation (test code sequence MV1 - MV4)	D.3
2.2.3	Beacon Message Processing (test code sequence LP1 - LP4)	D.3
2.3	**Performance Requirements**	
2.3.1	**Stand Alone Statistics**	
2.3.1.1	Beacon Detection Probability (T)	C.2.1
2.3.1.2	Probability of Location (PL)	C.2.2
2.3.1.3	Location Accuracy	C.2.3
2.3.1.4	Expected Horizontal Error / Quality Factor	C.2.4
2.3.1.5	Processsing Anomalies	C.2.6
2.3.2	**MEOLUT Data Exchange**	
2.3.2.1	Beacon Detection Probability (T)	C.2.1
2.3.2.2	Probability of Location (PL)	C.2.2
2.3.2.3	Location Accuracy	C.2.3
2.3.2.4	Expected Horizontal Error / Quality Factor	C.2.4
2.3.2.5	TOA/FOA Measurement Accuracy	C.2.5
2.3.2.6	Processsing Anomalies	C.2.6
2.3.3	**Combined Non-MEOSAR Satellite Statistics**	
2.3.3.1	Beacon Detection Probability (T)	C.2.1
2.3.3.2	Probability of Location (PL)	C.2.2
2.3.3.3	Location Accuracy	C.2.3
2.3.3.4	Expected Horizontal Error / Quality Factor	C.2.4
2.3.3.5	Processsing Anomalies	C.2.6

Table A.2: MEOLUT Test Beacon Location Table

Beacon Number	Beacon Identifier	Longitude (Degrees East)	Latitude (Degrees North)	Altitude (metres)
1				
2				
3				
4				
5				
6				
7				
8				
…				
n				

Appendix 1 - Technical File

A.1 General

This appendix defines LUT information to be provided by national Administrations for LUT commissioning. The following information is required as a minimum:

A.2 LUT Hardware Description

A.2.1 Antenna Characteristics

a) number and type(s) of antennas

b) gain/temperature ratio (G/T) at 5˚ elevation angle above the local horizon, and actual elevation angle at which the G/T was measured

c) operational limitations

d) dedicated or shared

e) site-horizon profile

f) operational-tracking (elevation) limits

g) downlink frequency (S/L band)

Table A.3: MEOLUT Antenna Location Table

Antenna Number	Antenna Diameter (if applicable) (m)	Longitude (Degrees East)	Latitude (Degrees North)	Altitude (m)
1				
2				
3				
4				
5				
6				
7				
8				
…				
n				

A.2.2 General LUT Indoor Equipment Description

a) equipment complement
b) stand alone, shared, or collocated with MCC
c) LUT manufacturer and model number
d) status and alarm functions
e) location – latitude, longitude, altitude

A.2.3 General Capabilities

a) specific processing capability
b) spectrum monitoring capability
c) optional capabilities

A.3 Processing

a) specific-performance capability
b) manufacturer specifications
c) processing bandwidth, signal sensitivity and beacon processing capacity of each data channel

A.4 Communications Capability – internal and external

a) primary-mode configuration
b) backup-mode configuration

A.5 Coverage Area

Describe the Declared Coverage Area of the MEOLUT system.

A.6 MEOLUT Network

For a networked MEOLUT, this section shall include a list of all the other MEOLUTs that exchange data with this MEOLUT and their status (commissioned or not).

- END OF ANNEX A -

ANNEX B

STATISTICS FOR OPERATIONAL REQUIREMENTS

B.1 MEOLUT Data Availability (A)

Measurement during the commissioning period

MEOLUT data availability measures the probability of receiving complete and accurate MEOLUT data at the MCC. Availability (A) is expressed as a percentage and is calculated by dividing the amount of operational time (OT) by the time required to be in operation (OTR). The time required to be in operation (OTR), expressed in hours, is 24 times the number of days in the commissioning period inclusive of all maintenance downtime. Downtime (DT) is that period of time when the performance of the MEOLUT is below the minimum requirements specified in document C/S T.019 over the Declared Coverage Area in the configuration for which the MEOLUT was commissioned. Therefore:

A = (OT / OTR) * 100 = (1 - (DT / OTR)) * 100 and shall be greater than 95.

Prediction

A reliability analysis shall be performed and the results reported to verify that the MEOLUT will meet the availability requirement. The analysis shall be based on industry standard methodology using Mean Time Between Failure (MTBF) and Mean Time To Repair (MTTR) values for all the components and interfaces comprising the MEOLUT.

- END OF ANNEX B -

ANNEX C

STATISTICS FOR PERFORMANCE REQUIREMENTS

C.1 Commissioning Status

C.1.1 General

This annex describes the statistics to be provided to the Cospas-Sarsat Secretariat when commissioning a MEOLUT.

For the 406 MHz solution statistics, the report must include a list of all 406 MHz beacons used for the statistical data analysis.

C.2 406 MHz Statistics

C.2.1 Beacon Detection Probability (T)

Calculate:

$$T = N / B$$

where:

N = number of beacons for which the MEOLUT produced a valid message within every 10 minute window within the duration of the beacon activation period
B = number of test beacons

The value of T using data from all test beacons shall be 0.99 or greater.

C.2.2 Probability of DOA Location (PL)

Single Burst

Statistics will be generated using the test script identified in Annex D.2 to meet the following requirements:

PDL = M/N

where:
M = Number of DOA single-burst locations produced by the MEOLUT for a test beacon
N = Total number of beacon messages transmitted by the test beacons

PDL shall be 0.90 or greater
PDL shall be 0.75 or greater (EOC)

Within 10 minutes
Within 20 minutes (EOC)

Statistics will be generated using the test script identified in Annex D.2 to meet the following requirements:

PDL = M/N

where:
M = number of beacons that produced a DOA location
N = total number of test beacons

PDL shall be 0.98 or greater

C.2.3 Location Accuracy

Single burst solutions

Statistics will be generated using the test script identified in Annex D.2 to meet the following requirements:

M/N shall be greater than or equal to the following:
0.90 where:

M = number of solutions within 5 km
N = number of solutions

EOC Requirements

M/N shall be greater than or equal to the following:
0.70 where:
M = number of solutions within 5 km
N = number of solutions
M/N shall be greater than or equal to the following:
0.90 where:
M = number of solutions within 10 km
N = number of solutions

A histogram for the location accuracy of the correct solutions shall be provided. The histogram shall be in 1 km increments from 0 to 20 km. All solutions with an error greater than 20 km shall be individually listed and an explanation for the error provided. The cumulative distribution function based on the histogram shall also be provided.

Solutions within 10 minutes after beacon activation
Solutions within 20 minutes after beacon activation (EOC)

Statistics will be generated using the test script identified in Annex D.2 to meet the following requirements:

M/N shall be greater than or equal to the following:
0.95 where:

M = number of solutions within 5 km
N = number of solutions

0.98 where:

M = number of solutions within 10 km
N = number of solutions

A histogram for the location accuracy of the correct solutions shall be provided. The histogram shall be in 1 km increments from 0 to 20 km. All solutions with an error greater than 20 km shall be individually listed and an explanation for the error provided. The cumulative distribution function based on the histogram shall also be provided.

C.2.4 Expected Horizontal Error / Quality Factor

Compare each beacon DOA location produced by the MEOLUT with the known location of the test beacon to derive the actual location error.

Check that the Expected Horizontal Error is greater than the actual location error with a probability in the range 0.93-0.97 as follows:

NC = number of locations with an actual location error < Expected Horizontal Error
NL = total number of locations
0.93 < NC/NL <0.97

C.2.5 TOA/FOA Measurement Accuracy

For each received beacon message:

1. Filter out messages with received C/No less than 34.8 dBHz or greater than 37.8 dBHz.
2. Determine the TOA and FOA measurement error using the known beacon position.

From the beacon log data as defined in Annex E (in particular the transmission time and frequency of the transmitted bursts), calculate:

1. The standard deviation of the error of the TOA and FOA measurements for all filtered beacon messages.
2. The bias of the mean of the error of the TOA and FOA measurements.

The standard deviation of the error shall be:

Better than 25 microseconds for TOA
Better than 0.20 Hz for FOA

The bias of the mean of the error shall be

Less than 2.5 microseconds for TOA
Less than 0.02 Hz for FOA

C.2.6 Processing Anomalies

Collect detected messages received on the transmitted test beacon frequency ± 2 kHz.
Count all valid messages (NVM).
Count all anomalies (NA) which are defined as any beacon 15 hex ID that does not match exactly the 15 hex ID of the transmitted test beacons.
Determine the probability (PA) to detect an anomaly:

PA = NA / NVM

Check that PA is less than 10^{-4}.

- END OF ANNEX C –

ANNEX D

BEACON SIMULATOR TEST SCRIPT

D.1 Test Messages to be Transmitted for Beacon Message Processing

Test Code Sequence	Simulator	Transmit Frequency (MHz)	Date/Time (UTC)	Transmitted 30 Hex Transmitted Code (15 Hex Identifier, bits 26-85)	Number of Bit Errors				Comments
					PDF-1	BCH-1	PDF-2	BCH-2	
Bit Rate Tolerance Check (BR)									
BR1	[TBD]	406.025	[TBD]	96EEF9DA0A2BA9EB5F96F400000F19	0	0	0	0	Transmit 20 bursts at the lower end of the permissible Bit Rate Range (396 bps)
	[TBD]	406.025	[TBD]	96EEF9DA0A2BA9EB5F96F400000F19	0	0	0	0	Transmit 20 bursts at the higher end of the permissible Bit Rate Range (404 bps)
Bit Verification (BV)									
BV1	USA	406.025	[TBD]	56EE1100000000037E540000000000	2	0	n/a	n/a	USA, User Test coded beacon with two (2) bit errors introduced at bits 44 and 48 in PDF-1.
BV2	USA	406.027	[TBD]	D6E10E1A4324920458B9D555555555	0	0	0	0	USA, Orbitography beacon with a pattern of A01" in the long message. No bit errors
		406.027	[TBD]	D6E10E1A4324920458B9D555555555	0	0	0	0	Same as above
BV3	USA	406.025	[TBD]	D6EEAAAAAAAAAAA2EA1A24E14CD2F4	0	0	0	1	USA, User Test coded beacon with encoded position (38.8667, -76.933) in PDF-2. One bit error at bit 138.
Message Validation (MV)									
MV1	USA	406.023	[TBD]	D6EE1100000000265F1424DB4CEFBF	2	0	0	2	USA, User Test coded beacon with encoded position (38.8667, -76.933) in PDF-1. Two (2) bit errors at bits 44 and 48 in PDF-1. Two (2) bit errors at bits 133 and 134 in BCH-2
		406.023		D6EE0011100000265F1424DB4CE3BF	3	0	0	0	Three (3) bit errors at bits 52, 56 and 60 in PDF-1.

Test Code Sequence	Simulator	Transmit Frequency (MHz)	Date/Time (UTC)	Transmitted 30 Hex Transmitted Code (15 Hex Identifier, bits 26-85)	Number of Bit Errors				Comments
					PDF-1	BCH-1	PDF-2	BCH-2	
MV2	USA	406.025	[TBD]	96EE0000002729A5E22BB61B842E0A	0	0	0	0	USA, Standard Location Protocol Test coded beacon with encoded position (38. 884, -76.931) in PDF-1 and PDF-2.
		406.025		96EE0000002729A5E22BB61B842E0A	0	0	0	0	Same as above
		406.025		96EE0000002729A5E22BB61B842EOA	0	0	0	0	Same as above
		406.025	[TBD]	96EE00000029299B91383601261D93	0	0	0	0	Position updated to (40.995, 76.851).
		406.025		96EE00000029299B91383601261D9F	0	0	0	2	Two (2) bit errors at bits 141 and 142 in BCH-2.
MV3	USA	406.027	[TBD]	96EF000009B74CE5C3CFF61C080BF5	0	3	0	0	USA, National Location Protocol Test coded beacon with encoded position (38.884, -76.931) in PDF-1 and PDF-2. Three (3) bit errors at bits 88, 96 and 104 in BCH-1.
		406.027		96EF111109B74CE4C2CEF61C080BF5	4	0	0	0	USA, National Location Protocol Test coded beacon with encoded position (38.884, -76.931) in PDF-1 and PDF-2. Four (4) bit errors at bits 44, 48, 52 and 56 in PDF-1.
		406.027		96EF111019B74CE4C2CEF61C080BF5	4	0	0	0	USA, National Location Protocol Test coded beacon with encoded position (38.884, -76.931) in PDF-1 and PDF-2. Four (4) bit errors at bits 44, 48, 52 and 60 in PDF-1.
MV4	USA	406.025	[TBD]	D6EEFEAAAAAAAAA2EA1A24E14CD2B4	3	0	0	0	USA, User Test coded beacon with encoded position (39.000, -76. 867) in PDF-2. Three (3) bit errors at bits 42, 44 and 46 in PDF-1.
Location Protocol Processing (LP)									
LP1	France	406.025	[TBD]	8E3E0000007FDFFC77A376000003DD	0	0	0	0	France, Standard Location Protocol Test coded beacon with default encoded position in PDF-1 and 0s in PDF-2.
		406.025		8E3E0000007FDFFC77A376000003DD	0	0	0	0	Same as above
		406.025		8E3E0000007FDFFC77A376000003DD	0	0	0	0	Same as above
		406.025		8E3E0000002B80372E8BB68E011E5C	0	0	0	0	Encoded position (43.559, 1.482) in PDF-1 and PDF-2
		406.025		8E3E0000002B80372E8BB68E011E5C	0	0	0	0	Same as above
		406.025		8E3E0000002B80372E8BB68E011E5C	0	0	0	0	Same as above

Test Code Sequence	Simulator	Transmit Frequency (MHz)	Date/Time (UTC)	Transmitted 30 Hex Transmitted Code (15 Hex Identifier, bits 26-85)	Number of Bit Errors				Comments
					PDF-1	BCH-1	PDF-2	BCH-2	
LP2	France	406.025	[TBD]	8E3F00000AA20175813BB60F380F6B	0	0	0	0	Encoded position (42.559, 1.482) in PDF-1 and PDF-2
		406.025		8E3F00000AA20175813BB60F380F6B	0	0	0	0	Same as above
		406.025		8E3F00000AA20175813BB60F380F6B	0	0	0	0	Same as above
		406.025		8E3FF0004AE2017491D4360F380F6B	0	0	0	0	France, National Location Protocol Test coded beacon with encoded position (43.559, 1.482) in PDF-1 and PDF-2
		406.025		8E3FF0004AE2017491D4360F380F6B	0	0	0	0	Same as above
		406.025		8E3FF0004AE2017491D4360F380F6B	0	0	0	0	Same as above
LP3	USA	406.025	[TBD]	D6EE1F1E1E1E1E06A383EFE0FF0146	1	0	0	0	USA, User Test coded beacon with default encoded position in PDF-2. One (1) bit error at bit 48 in PDF-1
		406.025		D6EE1F1E1E1E1E06A383E4E14CD2BE	1	0	0	2	Encoded position updated (339.000, -76.867) in PDF-2. One (1) bit error in bit 48 in PDF-1 and two (2) bit errors at bits 141 and 143 in BCH-2.
		406.025		D6EE1F1E1E1E1E06A383E4E14CD2BE	1	0	0	2	One (1) bit error in bit 48 in PDF-1 and two (2) bit errors at bits 141 and 143 in BCH-2.
		406.025		D6EE1F1E1E1E1E06A383E4E14CD2B4	1	0	0	0	One (1) bit error in bit 48 in PDF-1.
LP4	USA	406.025	[TBD]	96EF000049C14CD260D5F608380389	0	0	0	0	USA, National Location Protocol Test Coded beacon with encoded position (38. 996, -76.851).
		406.025		96EF000049C14CD260D5F608380389	0	0	0	0	Same as above.
		406.025		96EFF00049C14CD260D5F608380389	4	0	0	0	Four (4) bit errors at bits 41, 42, 43 and 44 in PDF-1.
		406.025		96EF000049814CD2E947F608380389	0	0	0	0	Encoded position (37. 996, -76.851) updated.
		406.025		96EF000049814CD2E947F60838038F	0	0	0	2	Two (2) bit errors in bits 142 and 143.
		406.025		96EF000049814CD2E947F6083803E9	0	0	0	2	Two (2) bit errors in bits 138 and 139.

D.2 Test Messages to be Transmitted for Performance Testing

This annex provides a description of the beacon signals that have to be transmitted in order to generate the statistics for performance requirements described in Annex C. The script is comprised of no more than 25 beacons transmitting simultaneously 13 bursts. The transmissions shall not use an operational channel of the 406 MHz frequency bandwidth.

The 15 Hex ID of beacon events are coded as follows: 9C9D0000YYD0037

- 9C9D0: fixed value for all beacon events (this is an example using a French country code)
- YY : beacon event serial 01 to 25
- D00: fixed value for all beacon events
- 37: signifies nominal transmission power of 37 dBm

The appropriate country code is to be coded within the 15 Hex ID to indicate which beacon simulator is transmitting the burst.

The script of this test shall implement beacon messages using the inverted frame synchroniser pattern.

D.3 Expected Processing

Test Code Sequence	Message to be Transmitted by MEOLUT	Encoded Location	Comments
BR1	96EEF9DA0A2BA9EB5F96F400000F19	n/a	MEOLUT sends a valid message to the MCC.
BV1	56EE0000000000037E540000000000	n/a	MEOLUT should correct two bit errors and transmit corrected message to MCC.
BV2	D6E10E1A4324920458B9D555555555	n/a	MEOLUT should transmit orbitography beacon message without error correcting the long message.
BV3	D6EEAAAAAAAAAAA2EA1A24E14CD2B4	38.8667, -76.933	MEOLUT should correct error at bit 138 and transmit alert to MCC.
MV1	D6EE0000000000265F1424FFFFFFFF	n/a	MEOLUT corrects both beacon messages (message is confirmed) and transmits corrected message to MCC with bits 113 to 144 set to all A1".
MV2	96EE0000002729A5E22BB61B842E0A	38.884, -76.931	MEOLUT sends the first complete, confirmed message to MCC and calculates Doppler position.

Test Code Sequence	Message to be Transmitted by MEOLUT	Encoded Location	Comments
MV3	n/a	n/a	MEOLUT suppresses beacon alert because no valid message exists and no match available for invalid messages.
MV4	n/a	n/a	MEOLUT suppresses beacon alert because no message has 3 bit errors and is not confirmed.
LP1	8E320000002B8036568C768E010B65	43.559, 1.482	MEOLUT sends updated, confirmed message for Standard Location Protocol beacon to MCC.
LP2	8E3800000AE20177ECCB360F380F6B	43.559, 1.482	MEOLUT sends updated, confirmed message for National Location Protocol beacon to MCC.
LP3	D6EE1E1E1E1E1E06A383E4FFFFFFFF	38.855, -76.951	MEOLUT sends valid short message to MCC, however bits 113 to 144 are set to all A1" because PDF-2 is not confirmed.
LP4	96EF000049C14CD260D5F608380389	38.855, -76.951	MEOLUT send s complete, confirmed message to MCC.

- END OF ANNEX D -

ANNEX E

DATA FORMAT

E.1 General

This annex describes the data format to be provided in electronic files using ASCII format to the Cospas-Sarsat Secretariat when commissioning a MEOLUT. The data is to be provided in a comma separated value (csv) format, and each field shall include an entry. If there is no data for any given field, then the field can be empty. All solution data used in the commissioning testing shall be provided.

A description of the fields is provided below:

Field	Relative position of the data
Description	Description of the information provided
Detailed Format	Guidance on how the data should be provided
Type	C - Character, N - Numeric and L - Logical
Width	The total number of characters for the field
Dec	The total number of digits after the decimal
MF#	Message Field as described in document C/S A.002 (SID)
Comments	

E.2 MEOLUT Satellite Tracking

The satellites tracked by the MEOLUT during the commissioning test period shall be documented using the following format.

1	LUT ID	xxxx	N	4		11	
2	Antenna ID	xx	N	2		71	
3	Satelite ID	xxx	N	3		6	
4	AOS_Time (Acquisition of Signal) (UTC)	yyyy-mm-dd hh:mm:ss.xxx	C	23			
5	LOS_Time (Loss of Signal) (UTC)	yyyy-mm-dd hh:mm:ss.xxx	C	23			

E.3 Beacon Message Data

Beacon valid messages produced by the LUT during the commissioning tests will be documented using the following format.

Field	Description		Detailed Format	Type	Width	Dec	MF#	Comments
1	Burst number (as collected)			N				
2	Raw/ Full 36 Hex message		h...h	C	36		77	
3	Beacon 15 Hex ID		hhhhhhhhhhhhhhh	C	15		22	
4	Time of beacon burst received (UTC)		yyyy-mm-dd hh:mm:ss.xxx	C	23	3		
5	FOA (Hz)		nnnnnnnnn.nnn	N	13	3	68	
6	Freq Offset (Hz)		snnnnn.nnn	N	10	3	70	
7	TOA(UTC)		yyyy-mm-dd hh:mm:ss.xxxxxxxxx	C	29		67	
8	Time Offset (s)		n.nnnnnnnnn	N	11	9	69	
9	C/N0 (dB/Hz)		nn.n	N	4	2	72	
10	Bit rate (bps)		nnn.nnn	N	7	3	73	
11	Antenna ID		nn	N	2		71	
12	Spacecraft ID		nnn	N	3		6	
13	Satellite position (km)	X	snnnnn.nnnn	N	11	4	75	Note 1
14		Y	snnnnn.nnnn	N	11	4		
15		Z	snnnnn.nnnn	N	11	4		
16	Satellite velocity (km/s)	X	snnn.nnnnnn	N	11	6	76	Note 2
17		Y	snnn.nnnnnn	N	11	6		
18		Z	snnn.nnnnnn	N	11	6		

Notes:

1 Associated satellite position data and associated reference frame (preferably Earth-Centered Earth-Fixed frame) may be provided or optionally disclosed.

2 Associated satellite velocity data and associated reference frame (preferably Earth-Centered Earth-Fixed frame) may be provided or optionally disclosed.

E.4 LUT Database for Solution Data

The location and detection solutions produced by the LUT during the commissioning tests shall be documented according to the format defined. If no location is available, the location fields (e.g., latitude, longitude, DOP etc.) would be empty.

Field	Description	Detailed Format	Type	Width	Dec	MF#	Comments
1	Solution ID		N				Note 1
2	LUTID	nnnn	N	4		2	
3	Time stamp of 1st burst used for location (UTC)	yyyy-mm-dd hh:mm:ss.xxx	C	23		14a	
4	Time stamp of last burst used for location (UTC)	yyyy-mm-dd hh:mm:ss.xxx	C	23		14b	
5	Time of location computation or time solution sent (UTC)	yyyy-mm-dd hh:mm:ss.xxx	C	23		3	
6	Beacon 15 Hex ID	hhhhhhhhhhhhhhh	C	15		22	
7	Detection Frequency	406.nnnnnn	N	10	6	49	
8	36 hex message	h...h	C	36		77	
9	Number of bursts used	nn	N	2		80	Note 2
10	Data used T/F/D	aa	C	2			Note 3
11	Antenna IDs	nn ... nn	N			71	Note 4
12	Number of packets used to derive the solution	nnn	N	2		88	Note 5
13	Number of satellites used to derive the solution	nnn	N	3		Derived from MF#14	
14	Satellite IDs	nnn ... nnn	N			83	Note 6
15	JDOP	nn.nn	N	5	2		
16	Horizontal Expected Error	nnn.nn	N	7	3	89	
17	Location methodology	a	C	1			Note 7
18	Latitude(degree)	snn.nnnnn	M	9	5	25	Note 8
19	Longitude (degree)	snnn.nnnnn	N	10	5	26	Note 9
20	Altitude (km)	nn.nnnnnn	N	9	6	82	
21	Location error (km)	nnnn.nnn	N	8	3		Note 10
22	Comment		C				

Notes:

1 This number has not to be generated by the LUT.
2 Number of bursts used in location computation.
3 T – TDOA only, F – FDOA only, D – TDOA/FDOA.
4 Empty or a list of antenna IDs separated by spaces.
5 A packet is a pair of TOA/FOA measurements from a specific satellite/antenna combination (channel) for a beacon burst.
6 A list of satellite IDs separated by spaces.
7 As available, location methodology for the generation of the computed location (e.g., median, mean, weighted average) may be provided or optionally disclosed, but should always be recorded.
8 Latitude to be provided in decimal and ± format (i.e., without North or South indication).
9 Longitude to be provided in decimal and ± format (i.e., without East or West indication).
10 Can be empty.

E.5 MCC message log table

All the location and detection solutions produced by the LUT and intended to be sent to the MCC during the commissioning test period shall be documented according to the same format provided in section E.4. If no location is available, the location fileds (e.g., latitude, longitude, DOP etc.) would be empty.

E.6 Beacon Database Description

Field	Description	Detailed Format	Type	Width	Dec	MF#	Comments
1	Beacon Number	nn	N	2			
2	Location		C	11			
3	Beacon ID	hhhhhhhhhhhhhh	C	15			
4	Beacon latitude	snn.nnnnn	N	9	5	25	
5	Beaconlongitude	snnn.nnnnn	N	10	5	26	
6	Altitude (km)	snn.nnn	N	7			
7	Type of Beacon		C	4			
8	Country Code		C	3			
9	Activation Time	yyyy-mm-dd hh:mm:ss.xxx	N	23			
10	Deactivation Time	yyyy-mm-dd hh:mm:ss.xxx	N	23			
11	Actual Time “On”	yyyy-mm-dd hh:mm:ss.xxx	N	23			
12	Actual Time “Off”	yyyy-mm-dd hh:mm:ss.xxx	N	23			
	Comments		C				

- END OF ANNEX E -

ANNEX F

MEOLUT COMMISSIONING - PRINCIPLES AND POLICIES

F.1 References

The Cospas-Sarsat Council approved the general principles of its commissioning policy for MEOLUTs, provided hereunder in sections F.2, F.3 and F.4.

F.2 General

The following principles govern the commissioning of Cospas-Sarsat Ground Segment equipment:

F.2.1 A State which has notified its association with the Cospas-Sarsat Programme as a Ground Segment Provider assumes the responsibility "to adhere to the technical specifications and operating procedures set by the Council for the purpose of ensuring adequate System performance" and "to provide, as agreed with the Council, appropriate performance data in order to confirm compatibility of its Ground Segment equipment with the System" (section 3.1 of the Letter of Notification).

F.2.2 Cospas-Sarsat performance specification and design guidelines for MEOLUTs and MCCs are defined in documents C/S T.019 and C/S A.005, respectively.

F.2.3 Cospas-Sarsat criteria and test methods for verifying that MEOLUTs and MCCs meet these standards are defined in documents C/S T.020 and C/S A.006, respectively.

F.2.4 The responsible Agency or Administration installing and planning to operate a new MEOLUT or MCC shall plan and conduct appropriate tests, in accordance with the applicable Cospas-Sarsat standards, which may form part of its own acceptance testing.

F.2.5 A commissioning report, including the results of the commissioning tests defined by Cospas-Sarsat, shall be submitted to the Cospas-Sarsat Secretariat, for review by the Joint Committee. The commissioning report must be submitted six weeks prior to the Joint Committee meeting. Reports submitted less than six weeks in advance will be considered at the subsequent Joint Committee meeting.

F.2.6 After review of the commissioning report, the Joint Committee makes appropriate recommendations to the Cospas-Sarsat Council. Formal commissioning is recorded at the subsequent Council meeting, after approval of the Joint Committee recommendation by the Council.

F.2.7 This commissioning and reporting procedure shall be implemented by all Cospas-Sarsat Ground Segment Providers, including Parties to the International Cospas-Sarsat Programme

Agreement, for commissioning new MEOLUTs and MCCs or new equipment or functions which have a significant impact on the Cospas-Sarsat Ground Segment operation.

F.2.8 The cost of implementing the commissioning procedure and reporting to the Cospas-Sarsat Joint Committee is borne by the operating Agency or Administration installing the equipment to be commissioned.

F.2.9 Ground Segment equipment will be commissioned into the Cospas-Sarsat System only if the formal association of the MEOLUT and MCC operator with the Cospas-Sarsat Programme has been notified in accordance with the standard procedure, unless otherwise agreed by the Council.

F.3 LUT Commissioning

The following principles govern the implementation of the Cospas-Sarsat MEOLUT Commissioning Standard (C/S T.020):

F.3.1 The implementation of the commissioning procedure defined in document C/S T.020 is the responsibility of the operating Agency or Administration.

F.3.2 The operating Agency or Administration will be responsible for equipment which may be required for performing the commissioning tests.

F.3.3 A MEOLUT may be commissioned as a stand-alone system, independent of an MCC. However, MEOLUT commissioning may take place at the same time that the associated MCC is being commissioned.

F.3.4 The MEOLUT/MCC interface is part of the MEOLUT commissioning. Therefore, it shall be tested as part of the MEOLUT commissioning procedure.

F.3.5 If the test results in the commissioning report submitted by the operating Agency or Administration do not demonstrate full compliance document C/S T.019, corrective action shall be taken.

F.3.6 If the test results in the commissioning report submitted by the operating Agency or Administration do demonstrate full compliance with document C/S T.019, the alert data derived from the new MEOLUT can be immediately used by the associated MCC for distribution in accordance with document C/S A.001.

F.3.7 Once the alert data derived from the new MEOLUT begins to be used by the associated MCC, a change of System status shall be notified to all MCCs by the associated MCC, in accordance with the procedure of document C/S A.001.

F.3.8 The Joint Committee shall, at its following meeting, review the commissioning report and recommend to the Cospas-Sarsat Council, as appropriate, formal commissioning of the MEOLUT.

F.4 Status of the Cospas-Sarsat Ground Segment

F.4.8 After their commissioning, MEOLUTs are listed and described as appropriate in the applicable System documents and the "Cospas-Sarsat System Data" document.

F.4.8 The Cospas-Sarsat MEOLUTs commissioned in the Cospas-Sarsat System shall be listed on the Cospas-Sarsat website www.cospas-sarsat.int.

- END OF ANNEX F -

ANNEX G

GUIDELINES FOR INTEGRATION OF NEW MEOLUTS IN THE COSPAS-SARSAT SYSTEM

The introduction of new MEOLUTs in the Cospas-Sarsat System is supervised by the Technical Working Group (TWG) of the Cospas-Sarsat Joint Committee whose objectives include:

a) the improvement of the overall performance of the Cospas-Sarsat Ground Segment; and

c) the technical control of the development of the Cospas-Sarsat LUTs.

The guidelines hereunder, and Figure G.1, provide procedures for integrating a new MEOLUT into the Cospas-Sarsat Ground Segment.

1. Installation of New Equipment - The new MEOLUT(s) equipment should be sited to allow the widest possible horizon and to maximize coverage of national SRRs as well as the entire Cospas-Sarsat System. The location of the MEOLUT(s) should also allow for reliable communications with the associated MCC.

2. Ground Segment Description and MEOLUT Coverage - The national Administration should ensure that a description of the new MEOLUT(s) along with (1) coordinates, (2) address, (3) frequencies and (4) MEOLUT antenna masks are provided to the Cospas-Sarsat Secretariat.

   The national Administration should also ensure that their MEOLUT(s) are properly registered with the International Telecommunications Union (ITU). The forms provided in Annex H to this document should be completed and forwarded to ITU through the appropriate national authorities.

3. Commissioning Test - For new Ground Segment Providers, the MEOLUT Commissioning tests may be scheduled to coincide with the MCC commissioning tests. In any case, the MEOLUT should be connected to the MCC and tested in its operational configuration , including optional capabilities, if used. However, statistics for optional capabilities shall be collected separately.

   The MEOLUT Operator should ensure that test beacon(s) capable of transmitting the test code sequences contained in Annex D is (are) available for the commissioning test, or the MEOLUT Operator should coordinate with beacon simulator providers in the USA or France for the transmission of such code sequences. If test beacons/simulators cannot be used during the commissioning test, the MEOLUT Operator should ensure that an alternative method of confirming compliance is identified.

   The relevant sections of this document describe the operational, functional and processing, and performance requirements to be tested. During the test, the data from the MEOLUT(s) should be transmitted to the associated MCC, however, the data should be suppressed by the MCC and not transmitted within the Cospas-Sarsat System.

4. Preparation of Commissioning Report - The results of the tests, along with the proper declarations and verifications for items not specifically tested, should be documented in a commissioning report. Annex A to this document contains the format of the commissioning report.

   The commissioning report should include as a minimum the information requested in this document and in the format contained in Annex A. In addition, information to explain or clarify results should also be included in the commissioning report.

   Any anomaly, or failure to meet a requirement, observed during the commissioning test should be corrected and the requirement re-tested. After the MEOLUT satisfies the requirements of document C/S T.019, the completed commissioning report should be submitted by the national Administration to the Cospas-Sarsat Secretariat.

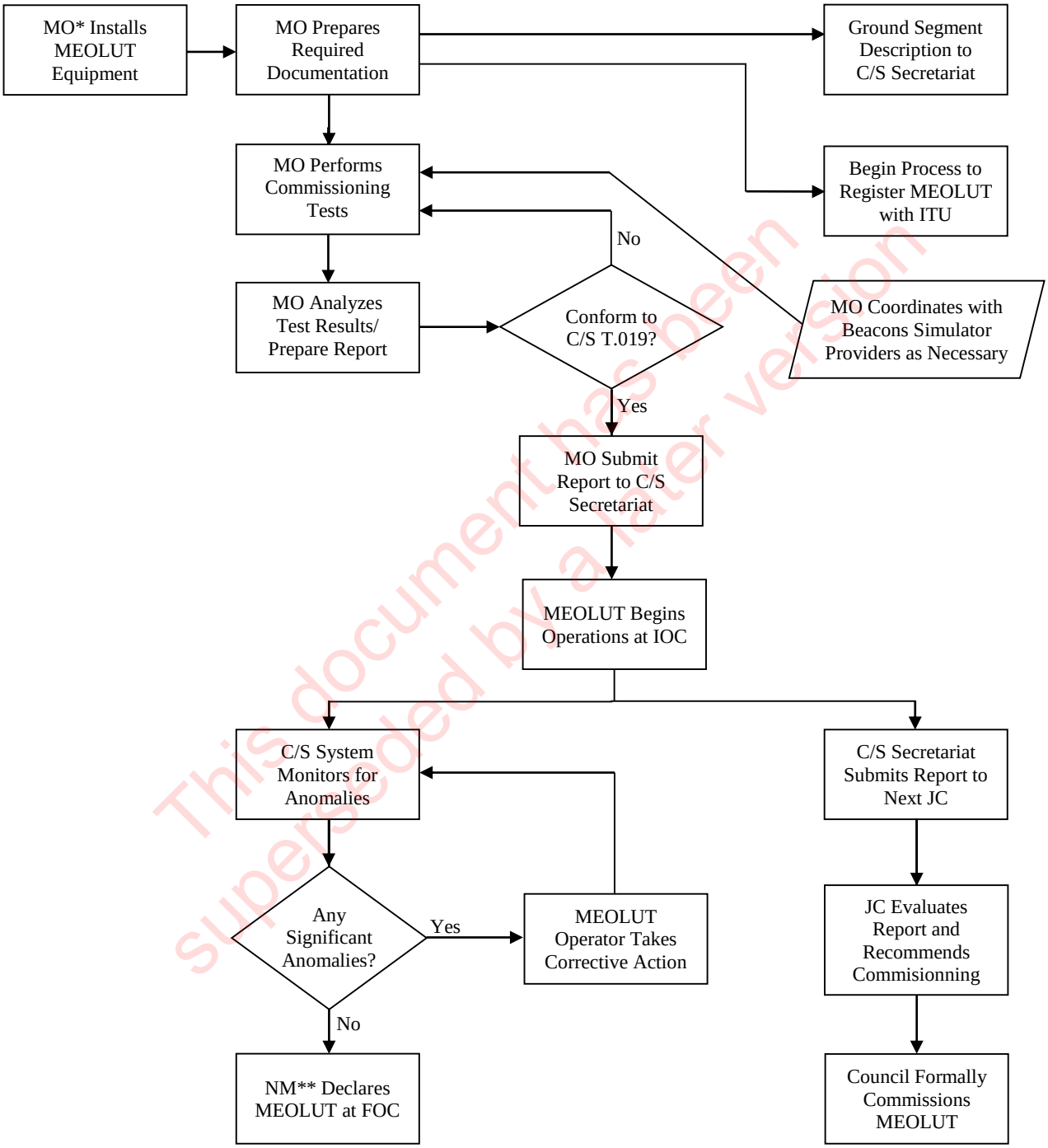
5. Initial Operational Capability (IOC) - If the commissioning test has been completed successfully, and the commissioning report has been forwarded to the Cospas-Sarsat Secretariat, the MEOLUT may begin operations in an IOC status. However, the MEOLUT cannot reach IOC status prior to the MCC IOC date if the associated MCC is also in the commissioning process. The national Administration, through its associated MCC, should notify all Ground Segment Operators of a MEOLUT's IOC status via a System Status message.

   The IOC phase allows a thorough review of the MEOLUT performance. However a MEOLUT shall not remain in an IOC phase for more than one year. MEOLUTs that have not reached FOC within one year will be considered not operational, and documented as "Under Development". To regain IOC status the MEOLUT will require a retest of the elements which prevented it from reaching FOC. The MEOLUT then must operate again in an IOC phase prior to reaching FOC. All Cospas-Sarsat Ground Segment Operators should monitor the data from new MEOLUTs for any significant anomalies that could impact Cospas-Sarsat operations.

6. Full Operational Capability (FOC) - If after 90 days of operation in an IOC state no anomalies are detected in the performance of the MEOLUT, the MEOLUT should be declared at FOC by the appropriate nodal MCC. The transition of a MEOLUT from an IOC status to a FOC status ensures that the MEOLUT performs to Cospas-Sarsat standards and does not negatively impact System operations.

7. Formal Commissioning - The Joint Committee reviews the commissioning report and, pending additional details or explanations, submits the report to the Cospas-Sarsat Council. The Council accepts the commissioning report and the MEOLUT is formally commissioned in the Cospas-Sarsat Ground Segment.

Figure G.1: Overview of MEOLUT Integration



* MO: MEOLUT operator
** NO: Nodal MCC

- END OF ANNEX G -

ANNEX H

GUIDELINES FOR REGISTRATION OF NEW MEOLUTS WITH ITU

[This Annex shall be taken from the corresponding Annex of document C/S T.005 (LEOLUT Commissioning Standard) or document C/S T.010 (GEOLUT Commissioning Standard), with the appropriate changes made to ensure that all references to LEOLUTs or GEOLUTs are changed to MEOLUTs.]

- END OF ANNEX H -

- END OF DOCUMENT -

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