TEST REPORT
for
EMERGENCY LOCATOR TRANSMITTER (ELT)
SURVIVAL TYPE – ELT (S)
121.5 MHz, 243.0 MHz and 406.028 MHz
FAA TSO C126 and TSO C91a

Y3-03-0726

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REVISIONS

Revision	Date	Change Description	Approval
-	3/27/03	ECO #13738	T.COHEN

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1.0 PURPOSE AND OBJECTIVE

This test report describes the inspections and tests performed to demonstrate that the Model SRB-406 survival type ELT beacon (transmitter, antennas and battery pack) meets the minimum performance standards defined by FAA technical standard order (TSO) C126 and TSO C91a.

2.0 SCOPE

This test report describes the inspections and tests performed on a survival type ELT, beacon (PN P3-03-0041 series) that consists of a RF/Digital printed wiring assembly (PN A3-07-1032 series), antennas (PN P3-03-0040-001), lanyard assembly (P3-03-0042-001) and a lithium battery pack (PN P4-03-0001-001). The beacon operates on 121.5 MHz, 243.0MHz and 406.028 MHz. This beacon has a water sensor and does not contain a crash sensor.

3.0 EXCEPTIONS/LIMITATIONS

3.1 Test and Configuration Exceptions

Exceptions to the requirements of RTCA DO-204 are noted below. These exceptions are in addition to the waivers requested within the qualification test plan (Y3-02-0506).

- The Model SRB-406 ELT is not buoyant. The ELT is mounted to inflatable structures, such as life rafts or evacuation slide/rafts, used on commercial and general aviation airplanes and does not require a buoyancy provision. Reference: RTCA DO-204, paragraph 2.1.15.

- The Model SRB-406 ELT does not have a tether. The ELT is mounted to inflatable structures, such as life rafts or evacuation slide/rafts, used on commercial and general aviation airplanes and does not require a tether provision. Reference: RTCA DO-204, paragraph 2.1.15.

- The Model SRB-406 ELT is not designed to meet the impact test of RTCA DO-204, paragraph 2.3.4.2. The ELT is mounted to inflatable structures, such as life rafts or evacuation slide/rafts, used on commercial and general aviation airplanes and is protected from impact since it is stowed within and encapsulated by the fabric of the de-inflated life raft structure during emergency landings. Reference: RTCA DO-204, paragraph 2.3.4.2 and Table 2-2, page 33.

- The Model SRB-406 ELT water sensor (P3-03-0043) was not included in the environmental test sequences. The water sensor assembly uses the same materials and similar assembly processes as the triple frequency antenna but is functionally less complex (no electronic circuitry). The water sensor assembly mechanism consists of a metal contact, electrically connected to the cable and insulated from

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the center conductor such that any water or fluid that bridges the insulated contacts will form a circuit and activate the unit after it is armed. The units under test were physically configured as dual antenna ELTs (P3-03-0041-002), with the second antenna acting as the water sensor.

- The units under test were programmed to operate as single antenna/water sensor ELT (P3-03-0041-001).

- Verification that the Model SRB-406 ELT met performance standards (after exposure to environmental conditions) was deferred after certain environmental tests. This action was taken in order to shorten test schedule. The mechanical/functional characteristics of the unit under test were verified prior to continuing the environmental testing.

- The Model SRB-406 ELT decompression test was not performed per RTCA DO-204 or Eurocae ED-62. The flight crew does not activate the Model SRB-406 beacon after a decompression event has occurred at altitude. The Model SRB-406 ELT is not designed to be activated in flight but after an inflatable is deployed. The beacon was subjected to the decompression event but was activated at ambient pressure.

- Design changes were incorporated into the beacon design after the test configuration was defined and after testing began. These design changes were incorporated as a result of anticipated or actual product difficulties. Design changes that were incorporated into the beacon as a result of anticipated or actual product difficulties are described in an Engineering report provided as Attachment **A** or in specific failure analysis reports.

- Engineering design changes were physically incorporated into the RF and digital printed wiring assemblies using non-standard assembly processes and representative conductors (piggybacked components, jumper wires, etc.) prior to initiation of the qualification testing. The RF and digital printed wiring assemblies were electrically representative of the engineering design intent but did not physically represent the final design.

4.0 REFERENCE DOCUMENTS

4.1 Federal Aviation Administration

Technical Standard Order TSO-C126, 406 MHz Emergency Locator Transmitter (ELT), dated December 23, 1992.

Technical Standard Order TSO-C91a, Emergency Locator Transmitter (ELT) Equipment, dated April 29, 1985.

Technical Standard Order TSO-C142, Lithium Batteries, dated April 4, 2000.

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4.2 Industry Standards

Radio Technical Commission for Aeronautics (RTCA) DO-204, dated September 29, 1989, Minimum Operational Performance Standards for 406 MHz Emergency Locator Transmitters (ELT).

Radio Technical Commission for Aeronautics (RTCA) DO-160D, dated July 29, 1997, Environmental Conditions and Test Procedures for Airborne Equipment.

Radio Technical Commission for Aeronautics (RTCA) DO-178A, dated March 1989, Software Considerations in Airborne Systems and Equipment Certification.

Radio Technical Commission for Aeronautics (RTCA) DO-188, dated November 1984, Emergency Locator Transmitter (ELT) Batteries Guidance and Recommendations.

Radio Technical Commission for Aeronautics (RTCA) DO-183, dated May 1983, Minimum Operational Performance Standards for Emergency Locator Transmitters Operating on 121.5 MHz and 243.0 MHz.

Cospas-Sarsat C/S T.001, Issue 3 – Revision 3, dated October 1999, Specification for Cospas-Sarsat 406 MHz Distress Beacons.

Cospas-Sarsat C/S T.007, Issue 3 – Revision 8, dated October 2001, 406 MHz Distress Beacon Type Approval Standard.

Eurocae ED-62, dated May 1990, Minimum Operational Performance Specification for Aircraft Emergency Locator Transmitters (121.5/243 MHz and 406 MHz).

4.3 DME Corporation

Engineering Drawing P3-03-0041, Revision (-), Single/Dual Antenna, SRB-406 Beacon.

Engineering Drawing P4-03-0001, Revision (-), Battery Pack, SRB-406.

Engineering Drawing A3-07-1032, Revision (-), PWA, RF/Digital, SRB-406.

Engineering Drawing P3-03-0042, Revision (-), Lanyard Pin, SRB-406.

Engineering Drawing P3-03-0043, Revision (-), Sensor, Water Activation, SRB-406.

Engineering Drawing P3-03-0040, Revision (-), Antenna Assembly, Triple Frequency, SRB 406.

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Engineering Test Plan, Y3-02-0506, Revision (-), Design Qualification Test Plan/Procedure for the SRB-406 ELT, provided as Attachment **B**.

Engineering Test Report, Y3-02-0527, Revision (-), Test Report for 1¼ "C" Size, Lithium/Manganese Dioxide, Cell and Lithium Battery Pack, FAA TSO C142.

Engineering Test Procedure, Y1-02-1053, Revision A, Acceptance Test Procedure for the SRB, Model 406, provided as Attachment **C**.

Engineering Report, Y3-03-0718, Revision (-), Engineering Justification for Model SRB-406 Type S ELT Software Level.

Engineering Report, Y1-02-1056, Revision (-), Procedure, Programming, SRB, Model 406, provided as Attachment **D**.

Engineering Report, Y1-02-1054, Revision A, Aliveness Test Procedure for the SRB, Model 406, provided as Attachment **E**.

Digital Data, S2-04-0009, Revision (-), Digital Data, Firmware, Digital, SRB, Model 406.

Digital Data, S2-04-0016, Revision (-), Digital Data, IC, 68HC908, Factory Boot, SRB Model 406.

4.4 US Government

US Army Development Test Command, Electronic Proving Ground (EPG) Publication No. EPG-TR 02-08-003X, dated September 2002, Type Approval Certification Test report for the DME Corporation SRB-406 Cospas-Sarsat Beacon.

5.0 DESCRIPTION OF TEST SPECIMENS

5.1 Triple Frequency Antennas

The triple frequency antennas were purchased from Myers Engineering International, Inc. per DME Corporation final assembly drawing A3-06-2053, revision 01 per DME Corporation P.O. 53152 and per drawing A3-06-2053, revision (-), per DME Corporation P.O. 55016.

The original antenna first article inspection report (P.O. 53152) and latest first article inspection report (P.O. 55016) and certificate-of-compliance are provided as Attachment **F**.

Each antenna was given a unique serial number. The antennas that were subjected to the environmental/performance tests described in Engineering Test Plan No. Y3-02-0506, are listed in Table 1.

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Table 1. Antenna Test Articles

Test Description	Y3-02-0506 Paragraph	Antenna Number
Low Temperature Activation	6.3.1.1	031 and 034
High Temperature Activation	6.3.1.2	031 and 034
Altitude	6.3.1.3	031 and 034
Decompression	6.3.1.4	031 and 034
Overpressure	6.3.1.5	031 and 034
Vibration	6.3.1.6	031 and 034
Long Term Frequency Drift	6.3.1.7	*
Humidity	6.3.2.1	031 and 034
Spray Proof	6.3.2.2	031 and 044
Salt Water Immersion	6.3.2.3	031 and 044
Sand and Dust	6.3.2.4	031 and 044
Salt Spray	6.3.2.5	031, 044 and 026, 029
Operational Shock	6.3.2.6	026 and 029
Crashworthiness	6.3.2.7	026 and 029
Crush	6.3.2.8	026 and 029
Flame	6.3.2.9	026 and 029
Post Crash Immersion	6.3.2.10	026 and 029
Low Temperature Life/Self-Test	6.3.3.1 and 6.3.4.3	059 **
High Temperature Life/Self-Test	6.3.3.2 and 6.3.4.3	059 **
Frequency Stability with Temperature Gradient	6.3.3.3	*
Thermal Shock	6.3.3.4	*
VSWR	6.3.4.2	059 **
Post-Environmental ATP	6.3.4.1	0106 and 0116
Antenna Switching Validation	6.3.4.4	0106 and 0116
Antenna Sealing Salt Spray	NA	099 and 0109

* Test equipment is installed on the transmitter antenna connector(s) during these tests.
** Antenna installed on the “B” antenna position and the test equipment installed on the “A” antenna position.

5.2 Battery Packs

Battery packs were constructed per DME Corporation PN P4-03-0001-001, revision A. The battery pack first article inspection report is provided as Attachment **G.** Component level inspection information and previous first article inspection data is on-file and available for inspection during normal business hours.

Each battery pack was given a unique number. The battery packs that were subjected to the environmental/performance tests described in Engineering Test Plan No. Y3-02-0506, are listed in Table 2.

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Table 2. Battery Pack Test Articles

Test Description	Y3-02-0506 Paragraph	Battery Pack Number
Low Temperature Activation	6.3.1.1	020149
High Temperature Activation	6.3.1.2	020149
Altitude	6.3.1.3	020149
Decompression	6.3.1.4	020149
Overpressure	6.3.1.5	020149
Vibration	6.3.1.6	020149
Long Term Frequency Drift	6.3.1.7	*
Humidity	6.3.2.1	020149
Spray Proof	6.3.2.2	020149
Salt Water Immersion	6.3.2.3	020149
Sand and Dust	6.3.2.4	020149
Salt Spray	6.3.2.5	020149
Operational Shock	6.3.2.6	020149
Crashworthiness	6.3.2.7	020149
Crush	6.3.2.8	020149
Flame	6.3.2.9	020149
Post Crash Immersion	6.3.2.10	020149
Low Temperature Life/Self-Test	6.3.3.1 and 6.3.4.3	0301003
High Temperature Life/Self-Test	6.3.3.2 and 6.3.4.3	020142
Frequency Stability with Temperature Gradient	6.3.3.3	0301001 and 0301002
Thermal Shock	6.3.3.4	020143
VSWR	6.3.4.2	020149
Post-Environmental ATP	6.3.4.1	020131
Antenna Switching Validation	6.3.4.4	020131
Antenna Sealing Salt Spray	NA	020141

* Power supplied by a DC power supply.

5.3 Beacon Assembly

The beacon assemblies were constructed per DME Corporation drawing P3-03-0041, revision (-). The beacon first article inspection report is provided as Attachment **H.** Component level inspection information and previous first article inspection data is on-file and available for inspection during normal business hours.

Each beacon assembly and printed wiring assembly were given a unique number. The beacon/printed wiring assemblies that were subjected to the environmental/performance tests described in Engineering Test Plan No. Y3-02-0506, are listed in Table 3.

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Table 3. Beacon Assembly Test Article

Test Description	Y3-02-0506 Paragraph	Beacon/RF CCA and Digital CCA Serial Numbers
Low Temperature Activation	6.3.1.1	2007/ 002 and 016
High Temperature Activation	6.3.1.2	2007/ 002 and 016
Altitude	6.3.1.3	2007/ 002 and 016
Decompression	6.3.1.4	2007/ 002 and 016
Overpressure	6.3.1.5	2007/ 002 and 016
Vibration	6.3.1.6	2007/ 002 and 016
Long Term Frequency Drift	6.3.1.7	2011/003 and 004
Humidity	6.3.2.1	2007/ 002 and 016
Spray Proof	6.3.2.2	2007/ 002 and 016
Salt Water Immersion	6.3.2.3	2007/ 002 and 016
Sand and Dust	6.3.2.4	2007/ 002 and 016
Salt Spray	6.3.2.5	2007/ 002 and 016
Operational Shock	6.3.2.6	2007/ 002 and 016
Crashworthiness	6.3.2.7	2007/ 002 and 016
Crush	6.3.2.8	2007/ 002 and 016
Flame	6.3.2.9	2007/ 002 and 016
Post Crash Immersion	6.3.2.10	2007/ 002 and 016
Low Temperature Life/Self-Test	6.3.3.1 and 6.3.4.3	2007/ 002 and 016
High Temperature Life/Self-Test	6.3.3.2 and 6.3.4.3	2007/ 002 and 016
Frequency Stability with Temperature Gradient	6.3.3.3	2007/ 002 and 016
Thermal Shock	6.3.3.4	2007/ 002 and 016
VSWR	6.3.4.2	2007/ 002 and 016
Post-Environmental ATP	6.3.4.1	2007/ 002 and 016
Antenna Switching Validation	6.3.4.4	2007/ 002 and 016
Antenna Sealing Salt Spray	NA	2008/ 018 and 022

5.4 Lanyard Assembly

The lanyard assemblies were constructed per DME Corporation drawing P3-03-0042, revision (-). The lanyard first article inspection report is provided as Attachment **I.** Component level inspection information is on-file and available for inspection during normal business hours.

5.5 Software Code

The circuit card assemblies and the beacon were programmed using source code and digital data described in DME Corporation drawings S2-04-0009, revision (-) and S2-04-0016, revision (-). The quality assurance report for these data is provided as Attachment **J**.

5.6 Beacon Test Configuration

Unless otherwise specified, each test unit will consist of a beacon assembly that meets the configuration requirements of P3-03-0041-002 (beacon assembly, with dual

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antennas, battery pack and lanyard). The beacon will be programmed to function as single antenna beacon assembly and has been programmed to transmit the short message, hex serial number and the test protocol bits.

6.0 DISPOSITION OF TEST SPECIMENS

Unless otherwise specified, test specimens/items will be stored for a minimum period of one year after Engineering release of this test report.

7.0 DESCRIPTION OF TEST APPARATUS

Calibrated and ancillary equipment used by DME Corporation is listed in the following paragraphs. Calibration data on internal equipment is on-file and available for inspection during normal business hours. Calibrated and ancillary equipment used by outside laboratories is listed in the laboratory test reports provided as Attachment **K**. All measurements taken with the calibrated equipment were completed prior to the calibration due dates shown below.

7.1 Calibrated Equipment

7.1.1 Instrument: Modulation Analyzer
Manufacturer and Model: HP8901B
SN or Control No.: OR1093
Last Calibrated: 01/30/02
Due Calibration: 01/30/03

7.1.2 Instrument: Power Sensor
Manufacturer and Model: HP8481A
SN or Control No.: OR1092
Last Calibrated: 01/29/02
Due Calibration: 01/29/03

7.1.3 Instrument: Spectrum Analyzer
Manufacturer and Model: Hewlett Packard 8593E
SN or Control No.: 628
Last Calibrated: 9/10/2002
Due Calibration: 9/10/2003

7.1.4 Instrument: Oscilloscope
Manufacturer and Model: HP 54510B
SN or Control No.: OR627
Last Calibrated: 08/29/02
Due Calibration: 08/29/03

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7.1.5 Instrument: Frequency and Time Interval Analyzer
Manufacturer and Model: Hewlett Packard 5371A
SN or Control No.: 2842A00760
Last Calibrated: 06/11/02
Due Calibration: 06/11/03

7.1.6 Instrument: Power Meter
Manufacturer and Model: Hewlett Packard 70100A
SN or Control No.: GFE588
Last Calibrated: 04/12/02
Due Calibration: 04/12/03

7.1.7 Instrument: Power Sensor
Manufacturer and Model: HP8481A
SN or Control No.: GFE 0112
Last Calibrated: 02/22/02
Due Calibration: 02/22/03

7.1.8 Instrument: Frequency Calibration System
Manufacturer and Model: AS-210A-XX
SN or Control No.: OR3042
Last Calibrated: 09/30/02
Due Calibration: 09/30/03

7.1.9 Instrument: Frequency Counter
Manufacturer and Model: HP5345a
SN or Control No.: OR2008
Last Calibrated: 09/10/02
Due Calibration: 09/10/03

7.1.10 Instrument: Spectrum Analyzer
Manufacturer and Model: HP 8568B
SN or Control No.: OR3043
Last Calibrated: 10/18/02
Due Calibration: 10/18/03

7.1.11 Instrument: Modulation Analyzer
Manufacturer and Model: HP8901B
SN or Control No.: 3704A05771
Last Calibrated: 2/11/02
Due Calibration: 2/11/03

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7.1.12 Instrument: Signal Generator
Manufacturer and Model: HP 8656B
SN or Control No.: OR1091
Last Calibrated: 05/08/02
Due Calibration: 05/08/03

7.1.13 Instrument: Digital Oscilloscope
Manufacturer and Model: TDS3034B
SN or Control No.: OR3038
Last Calibrated: 08/21/02
Due Calibration: 08/21/03

7.1.14 Instrument: Data Acquisition Unit
Manufacturer and Model: Agilent 34970A
SN or Control No.: OR3028
Last Calibrated: 2/13/02
Due Calibration: 2/13/03

7.1.15 Instrument: DMM
Manufacturer and Model: Fluke 8012A
SN or Control No.: Or 111-1
Last Calibrated: 6/14/02
Due Calibration: 6/14/03

7.1.16 Instrument: Waveform Generator
Manufacturer and Model: Wavetek Model 395
SN or Control No.: 011583
Last Calibrated: 12/24/01
Due Calibration: 12/24/02

7.1.17 Instrument: DMM
Manufacturer and Model: Fluke 8060A
SN or Control No.: OR1090
Last Calibrated: 6/14/02
Due Calibration: 6/14/03

7.1.18 Instrument: Caliper 0-6 inches
Manufacturer and Model: Mitutoyo Digimatic
SN or Control No.: 7241675
Last Calibrated: 11/13/02
Due Calibration: 11/13/03

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7.1.19 Instrument: 2000 pound Load Cell/Gauge
Manufacturer and Model: Com-Ten Model FG-2000
SN or Control No.: 21297
Last Calibrated: 6/5/02
Due Calibration: 6/5/03

7.2 Ancillary Equipment

7.2.1 Instrument: Scanning Test AM Receiver for 121.5 /243 Mhz
Manufacturer and Model: AOR 8200
Identification Number: Serial Number 553430

7.2.2 Instrument: 20db Attenuator 20Watts, SMA Female – SMA Female
Manufacturer and Model: Inmet 2066-20F
Identification Number: na

7.2.3 Instrument: RF Power Splitter
Manufacturer and Model: HP11667A
Identification Number: SN 06973

7.2.4 Instrument: Detector Diode #1
Manufacturer and Model: HP8473B
Identification Number: SN 16056

7.2.5 Instrument: Temperature Chamber
Manufacturer and Model: Thermotron FX-32-CHV-15-15
Identification Number: SN 17640

7.2.6 Instrument: Power Supply
Manufacturer and Model: Kepco MSK10-10M
Identification Number: DME No. 011441

7.2.7 Instrument: UPS
Manufacturer and Model: APC SU2200net
Identification Number: SN WS9943006289

7.2.8 Instrument: Directional Coupler (20db)
Manufacturer and Model: NARDA 3020a
Identification Number: 02121

7.2.9 Instrument: Directional Coupler (10db) #1
Manufacturer and Model: Narda IF40016-10
Identification Number: na

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7.2.10 Instrument: Directional Coupler (10db) #2
Manufacturer and Model: Narda IF40016-10
Identification Number: na

7.2.11 Instrument: Attenuator (3db)
Manufacturer and Model: MACOM M3933/14-01N
Identification Number: na

7.2.12 Instrument: Attenuator (10db)
Manufacturer and Model: MACOM 2082-6183-10
Identification Number: na

7.2.13 Instrument: Detector Diode #2
Manufacturer and Model: HP8473B
Identification Number: SN 16052

7.2.14 Instrument: Directional Coupler (10db)
Manufacturer and Model: Narda IF40016-10
Identification Number: na

7.2.15 Instrument: Power Supply
Manufacturer and Model: Kepco MSK40-2.5M
Identification Number: DME No. 011443

7.2.16 Instrument: 20db Attenuator 20Watts, SMA Female – SMA Female
Manufacturer and Model: Inmet 2066-20F
Identification Number: na

7.2.17 Instrument: Laptop PC
Manufacturer and Model: KDS Valiant 6370IPT-10
Identification Number: DME No. 011914

7.2.18 Instrument: Desktop PC
Manufacturer and Model: HP Pavilion 7320
Identification Number: DME No. 012067

7.2.19 Instrument: Tape Measure, 25 Foot
Manufacturer and Model: Stanley, Powerlock Model 33-425
Identification Number: na

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8.0 TEST REQUIREMENTS AND RESULTS

8.1 Group A Testing (any unit, any order, see Table 2-2, pp32 of RTCA DO-204).

8.1.1 Low Temperature Activation Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.3.1 (Eurocae ED-62, paragraph 4.4.1.1). The beacon shall activate after the arming pin is removed from the beacon and the antenna water sensor is immersed in water at 0°C. After the beacon is de-armed, the beacon self-test function will be tested. The beacon performance testing is deferred until after the completion of the vibration testing.

8.1.2 Low Temperature Activation Test Results

Beacon SN 2007 passed the test. The outside laboratory test report is provided as Attachment **K**. The post-test mechanical/functional test results are provided as Attachment **L.**

8.1.3 High Temperature Activation Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.3.2 (Eurocae ED-62, paragraph 4.4.1.2). The beacon shall activate after the arming pin is removed from the beacon and the antenna water sensor is immersed in water at 40°C. After the beacon is de-armed, the beacon self-test function will be tested. The beacon performance testing is deferred until after the completion of the vibration testing.

8.1.4 High Temperature Activation Test Result

Beacon SN 2007 passed the test. The outside laboratory test report is provided as Attachment **K**. The post-test mechanical/functional test results are provided as Attachment **M.**

8.1.5 Altitude Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.3.3 (Eurocae ED-62, paragraph 4.4.1.3). The beacon shall activate after the arming pin is removed from the beacon and the antenna water sensor is immersed in water at 40°C. After the beacon is de-armed, the beacon self-test function will be tested. The beacon performance testing is deferred until after the completion of the vibration testing.

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8.1.6 Altitude Test Result

Beacon SN 2007 activated when immersed in water at 40°C tests, but also started the self-test routine after the antennas were immersed (without activating the momentary self-test membrane switch). The membrane switch failure analysis is provided as Attachment **N**. The outside laboratory test report is provided as Attachment **K**. The post-test mechanical/functional test results are provided as Attachment **O.**

8.1.7 Overpressure Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.3.5 (RTCA DO-204, paragraph 2.3.1.5). The beacon must not activate during the test event. The beacon shall activate after the arming pin is removed from the beacon and the antenna water sensor is immersed in water at room temperature. After the beacon is de-armed, the beacon self-test function will be tested. The beacon performance testing is deferred until after the completion of the vibration testing.

8.1.8 Overpressure Test Result

Beacon SN 2007 passed the test. The outside laboratory test report is provided as Attachment **K**. The post-test mechanical/functional test results are provided as Attachment **P.**

8.1.9 Decompression Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.3.4 (Eurocae ED-62, paragraph 4.4.2, modified). With the beacon at ambient temperature, reduce chamber pressure from ambient to 10 psi and maintain this pressure for a minimum of ten minutes. At the end of ten minutes, decrease chamber pressure to 1 psi within a maximum of 25 seconds and hold the pressure at 1 psi for a minimum of ten minutes. Increase chamber pressure to ambient pressure within a maximum of 150 seconds. Activate the ELT by immersing the antennas in water at room temperature, when ambient pressure is reached and verify the ELT is transmitting.

8.1.10 Decompression Test Result

Beacon SN 2007 passed the test. The outside laboratory test report is provided as Attachment **K**. The post-test mechanical/functional test results are provided as Attachment **Q.**

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8.1.11 Vibration Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.3.6 (RTCA DO-204, paragraph 2.3.5). The unit will be tested per RTCA DO-160D, paragraph 8.5.1, Figure 8-2, test curve Z, except upper frequency will be 2000 Hz instead of 1400 Hz. The beacon must not activate during the test. The beacon shall activate after the arming pin is removed from the beacon and the antenna water sensor is immersed in water at room temperature. After the beacon is de-armed, the beacon self-test function will be tested, the operation of controls will be checked, the aliveness test of RTCA DO-204, paragraph 2.3 will be performed and a production acceptance test per Y1-02-1053 will be performed.

8.1.12 Vibration Test Results

Beacon SN 2007 passed these tests. The outside laboratory test report is provided as Attachment **K**. The post-test performance test results are provided as Attachment **R**.

8.1.13 Long Term Frequency Drift Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.3.7 (RTCA DO-204, paragraph 2.4.2.1.4).

8.1.14 Long Term Frequency Drift Test Results

Beacon SN 2011 passed the test. The total frequency drift over 30 days was observed to be 121.62 Hz. The test procedure, raw test data, and graph of the raw test data are provided as Attachment **S**.

8.2 Group B Testing (single unit, in sequence shown, see RTCA DO-204, Table 2-2, pp33)

8.2.1 Humidity Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.4.1 (RTCA DO-204, paragraph 2.3.3). The beacon must not activate during the test. The beacon shall activate after the arming pin is removed from the beacon and the antenna water sensor is immersed in water at room temperature. After the beacon is de-armed, the beacon self-test function will be tested, the operation of controls will be checked and the aliveness and production acceptance test per Y1-02-1053 will be performed.

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8.2.2 Humidity Test Result

Beacon SN 2007 passed this test. The outside laboratory test report is provided as Attachment **K**. The post-test mechanical/functional and performance test results are provided as Attachment **T.**

8.2.3 Spray Proof Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.4.2 (RTCA DO-204, paragraph 2.3.8.2). The beacon must not activate during the test. The beacon shall activate after the arming pin is removed from the beacon and the antenna water sensor is immersed in water at room temperature. After the beacon is de-armed, the beacon self-test function will be tested. The beacon performance testing is deferred until after the completion of the salt-water immersion test.

8.2.4 Spray Proof Test Result

Beacon SN 2007 failed the first and second spray proof tests. The initial spray proof failure was found to be caused by a water leak in the membrane switch and the failure of a solder joint on pin J1-15 that was caused by poor workmanship. Antenna SN 0034 was suspected as contributing to the initial failure, was removed for analysis by the antenna supplier and found to be dry when disassembled. Antenna SN 0034 was replaced by antenna SN 0044. The solder joint was reworked and a damaged component was removed and replaced. The second spray proof test failure was caused by another water leak in the membrane switch that replaced the previously leaking membrane switch. The membrane switch failure analysis results are provided as Attachment **N**. The cause of the membrane switch leak was identified and corrective action was taken and incorporated in the switches and transmitter assembly. Additional design changes were incorporated into SN 2007 at this time. These additional design changes are described in a report provided as Attachment **A**. A third spray proof test was conducted on SN 2007 and the beacon passed. The outside laboratory test report is provided as Attachment **K**. The post-test mechanical/functional results are provided as Attachment **U**.

8.2.5 Salt Water Immersion Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.4.3 (RTCA DO-204, paragraph 2.3.9.2). After completion of the test, the beacon self-test function will be tested, the operation of controls will be checked, the aliveness test of RTCA DO-204, paragraph 2.3 will be performed and a production acceptance test per Y1-02-1053 will be performed.

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8.2.6 Salt Water Immersion Test Result

Beacon SN 2007 failed this test. The beacon was found to activate immediately upon removal of the lanyard pin (arming of the beacon). The failure was isolated to fluid leakage through the press-fit cap on right angle SMA connector installed on antenna SN 044. The SMA connector on antenna SN 044 was removed and replaced and the interior of the SMA connector was potted to seal the connector. The SMA connector on SN 031 was removed and replaced with a sealed connector as a precaution. The outside laboratory test report is provided as Attachment **K**. The post-test/rework mechanical/functional and performance results are provided as Attachment **V**. The reworked antennas and beacon continued the environmental testing sequence.

8.2.7 Sand and Dust Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.4.4 (RTCA DO-204, paragraph 2.3.10). After completion of the test, the beacon self-test function will be tested, the operation of controls will be checked, the aliveness test of RTCA DO-204, paragraph 2.3 will be performed and a production acceptance test per Y1-02-1053 will be performed.

8.2.8 Sand and Dust Test Results

Beacon SN 2007 passed this test. The outside laboratory test report is provided as Attachment **K**. The post-test mechanical/functional and performance results are provided as Attachment **W**.

8.2.9 Salt Spray (Corrosion) Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.4.5 (RTCA DO-204, paragraph 2.3.12). After completion of the test, the beacon self-test function will be tested, the operation of controls will be checked, the aliveness test of RTCA DO-204, paragraph 2.3 will be performed and a production acceptance test per Y1-02-1053 will be performed.

8.2.10 Salt Spray Test Result

Beacon SN 2007 failed this test. After the 48-hour exposure to salt spray and 48 hours of drying time at ambient temperature, the beacon activated immediately after the lanyard pin was pulled. It was determined that both antennas had leaked through the water sensor and antenna whip openings. The antennas SN 031 and 044 were removed and replaced by antenna SN 026 and 029 and the beacon subjected to another salt spray test. The replacement antennas also failed (antenna SN 029 was shorted). Antenna SN 031 and 044 were returned to the antenna manufacturer for analysis. Antenna SN 026 and 029 remained with the beacon and continued the

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environmental testing pending results of the manufacturer failure analysis and implementation of corrective action to seal the antenna. The manufacturer failure analysis report is provided as Attachment **X**. There was no evidence of corrosion and beacon operation was satisfactory after each salt spray test. The outside laboratory test report is provided as Attachment **K**. The post-test mechanical/functional and performance results are provided as Attachment **Y**. The sealing of the antenna was validated after the antenna manufacturer implemented corrective action. The post-corrective action antenna sealing test report is provided as Attachment **Z**.

8.2.11 Operational Shock Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.4.6 (RTCA DO-204, paragraph 2.3.4.1 and RTCA DO-160D, paragraph 7.2.1). After completion of the test, the beacon self-test function will be tested and the operation of controls will be checked. The beacon will then be subjected to the crashworthiness test.

8.2.12 Operational Shock Test Result

Beacon SN 2007 passed these tests. The outside laboratory test report is provided as Attachment **K**. The post-test mechanical/functional test results are provided as Attachment **AA**.

8.2.13 Crashworthiness Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.4.7 (RTCA DO-204, paragraph 2.3.4.1). After completion of the test, the beacon self-test function will be tested, the operation of controls will be checked, the aliveness test of RTCA DO-204, paragraph 2.3 will be performed and a production acceptance test per Y1-02-1053 will be performed.

8.2.14 Crashworthiness Test Result

Beacon SN 2007 passed this test. Handling damage was noted on the battery connector in the transmitter. Numerous individual wire strands had fractured in each wire on the battery connector. The damaged wires were repaired by removing the damaged area and crimped new terminals onto the wires. This damage is normal and expected given the number of connections made during the environmental testing. The outside laboratory test report is provided as Attachment **K**. The post-test mechanical/functional and performance results are provided as Attachment **AB**.

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8.2.15 Crush Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.4.8 (RTCA DO-204, paragraph 2.3.4.3). The beacon operation (self-test and operation of controls) will be tested after completion of the test.

8.2.16 Crush Test Result

Beacon SN 2007 passed these tests. The post-test mechanical/functional test results and applied loads are provided as Attachment **AC**.

8.2.17 Flame Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.4.9 (RTCA DO-204, paragraph 2.3.7.1). The beacon self-test function will be tested after the beacon has returned to ambient temperature.

8.2.18 Flame Test Result

Beacon SN 2007 passed this test. The post-test mechanical/functional test results are provided as Attachment **AD**.

8.2.19 Post Crash Immersion

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.4.10 (RTCA DO-204, paragraph 2.3.9.4). After completion of the test, the beacon self-test function will be tested, the operation of controls will be checked, the aliveness test of RTCA DO-204, paragraph 2.3 will be performed and a production acceptance test per Y1-02-1053 will be performed.

8.2.20 Post Crash Immersion Test Result

Beacon SN 2007 passed the mechanical/functional tests but failed the production acceptance test. The failure was isolated to a ceramic chip capacitor (C103) that failed after exposure to the stress imposed by the environmental tests. This capacitor was found to have been mechanically degraded by the use of excess soldering heating during the manual attachment of the capacitor. The capacitor was soldered to the printed wiring board by DME personnel. The failure analysis results are provided as Attachment **AE**. The outside laboratory test report is provided as Attachment **K**. The post-test and post-repair mechanical/functional and performance test results are provided as Attachment **AF**.

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8.3 Group C Testing (single unit, any sequence, see RTCA DO-204, Table 2-2, pp33)

8.3.1 Low Temperature Life Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.5.1 and 1.6.3 (RTCA DO-204, paragraph 2.3.2.1, 2.3.2.6 and RTCA DO-183, paragraph 2.3.1.1).

8.3.2 Low Temperature Life Test Results

Beacon SN 2007 passed these tests. The low temperature life and low temperature self-test test results and battery pre-condition profile are provided as Attachment **AG**.

8.3.3 High Temperature Life Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.5.2 and 1.6.3 (RTCA DO-204, paragraph 2.3.2.2, 2.3.2.6 and RTCA DO-183, paragraph 2.3.1.2).

8.3.4 High Temperature Life Test Result

Beacon SN 2007 passed these tests. The high temperature life and high temperature self-test results are provided as Attachment **AH**.

8.3.5 Frequency Stability with Temperature Gradient Test

The beacon assembly (less antennas) shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.5.3 (RTCA DO-204, paragraph 2.3.2.3). The frequency stability derived from the measurements must be within the allowable limits defined within paragraph 2.2.2.1 and Table 2-1.

8.3.6 Frequency Stability with Temperature Gradient Test Result

Beacon SN 2007 did not pass this test the first time it was performed. An investigation revealed the test set-up and arrangement of test equipment resulted in the corruption of test data. The investigation findings are provided as Attachment **AI**. Beacon SN 2007 passed these tests after the test set-up and arrangement was modified. The test procedure, raw test data, and graphs of the raw test data are provided as Attachment **AJ**.

8.3.7 Thermal Shock Test

The beacon assembly (less antennas) shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.5.4 (RTCA DO-204, paragraph

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2.3.2.4). The frequency stability, power output and content of the digital message shall be as required by paragraph 2.3.2.4.

8.3.8 Thermal Shock Test Result

Beacon SN 2007 passed these tests. The thermal shock test results, raw data and graphs are provided as Attachment **AK**.

8.3.9 VSWR Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.6.2 (RTCA DO-204, paragraph 2.3.2.5).

8.3.10 VSWR Test Result

Beacon SN 2007 passed these tests. The VSWR test results are provided as Attachment **AL**.

8.3.11 Self-Test Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.6.3 (RTCA DO-204, paragraph 2.3.2.6, ambient temperature).

8.3.12 Self-Test Test Results

Beacon SN 2007 passed these tests. The self-test test results are provided as Attachment **AM**.

8.3.13 Post Environmental ATP Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.6.1.

8.3.14 Post Environmental ATP Test Result

Beacon SN 2007 passed these tests. The aliveness and production ATP test results are provided as Attachment **AM**.

8.3.15 Beacon Post-Programming ATP Test

The beacon assembly shall be subjected to the test specified in Engineering Test Plan No. Y3-02-0506, paragraph 1.6.4, after the beacon has been re-programmed as a –002 beacon.

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8.3.16 Beacon Post-Programming ATP Test Result

Beacon SN 2007 passed these tests. The post-programming production ATP test results are provided as Attachment **AN**.

9.0 CONCLUSION

Based on the environmental and performance testing that has been performed on the Model SRB-406, survival type ELT (S) beacon assembly, we conclude that the beacon complies with FAA TSO C126, 406 MHz Emergency Locator Transmitter (ELT) and FAA TSO C91a, Emergency Locator Transmitter (ELT) Equipment requirements.

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Attachment A
Y3-02-0530
Engineering Report for Qualification Testing Design Changes, Model SRB-406

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Attachment B
Y3-02-0506
Design Qualification Test Plan/Procedure for the SRB-406 ELT

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Attachment C
Y1-02-1053
Acceptance Test Procedure for the SRB, Model 406

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Attachment D
Y1-02-1056
Procedure, Programming, SRB, Model 406

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Attachment E
Y1-02-1054
Aliveness Test Procedure for the SRB, Model 406

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Attachment F
First Article Inspection Results
Triple Frequency Antenna

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Attachment G
First Article Inspection Results
Lithium Battery Pack

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Attachment H
First Article Inspection Results
Beacon Assembly

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Attachment I
First Article Inspection Results
Lanyard Pin Assembly

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Attachment J
First Article Inspection Results
Software Code

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Attachment K
Outside Laboratory Environmental Test Report

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Attachment L
Low Temperature Activation Test Results

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Attachment M
High Temperature Activation Test Results

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Attachment N
Y3-03-0724
Press-To-Test Membrane Switch Failure Analysis

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Attachment O
Altitude Test Result

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Attachment P
Overpressure Test Result

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Attachment Q
Decompression Test Result

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Attachment R
Vibration Test Result

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Attachment S
Long Term Frequency Drift Test Results

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Attachment T
Humidity Test Results

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Attachment U
Spray Proof Test Results

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Attachment V
Salt Water Immersion Test Results

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Attachment W
Sand and Dust Test Results

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Attachment X
Antenna Failure Analysis Report

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Attachment Y
Salt Spray Test Results

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Attachment Z
Test Report for Model SRB-406 Emergency Locator Transmitter
Antenna Sealing

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Attachment AA
Operational Shock Test Results

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Attachment AB
Crashworthiness Test Results

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Attachment AC
Crush Test Results

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Attachment AD
Flame Test Results

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Attachment AE
Post Crash Immersion Capacitor Failure Analysis

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Attachment AF
Post Crash Immersion Test Results

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Attachment AG
Low Temperature Life Test Results

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Attachment AH
High Temperature Life Test Results

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Attachment AI
Test Equipment Induced Test Failure Explanation

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Attachment AJ
Frequency Stability with Temperature Gradient Test Results

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Attachment AK
Thermal Shock Test Results

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Attachment AL
VSWR Test Results

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Attachment AM
Post Environmental ATP, with Self-Test Test Results

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Attachment AN
Beacon Post-Programming Production ATP

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