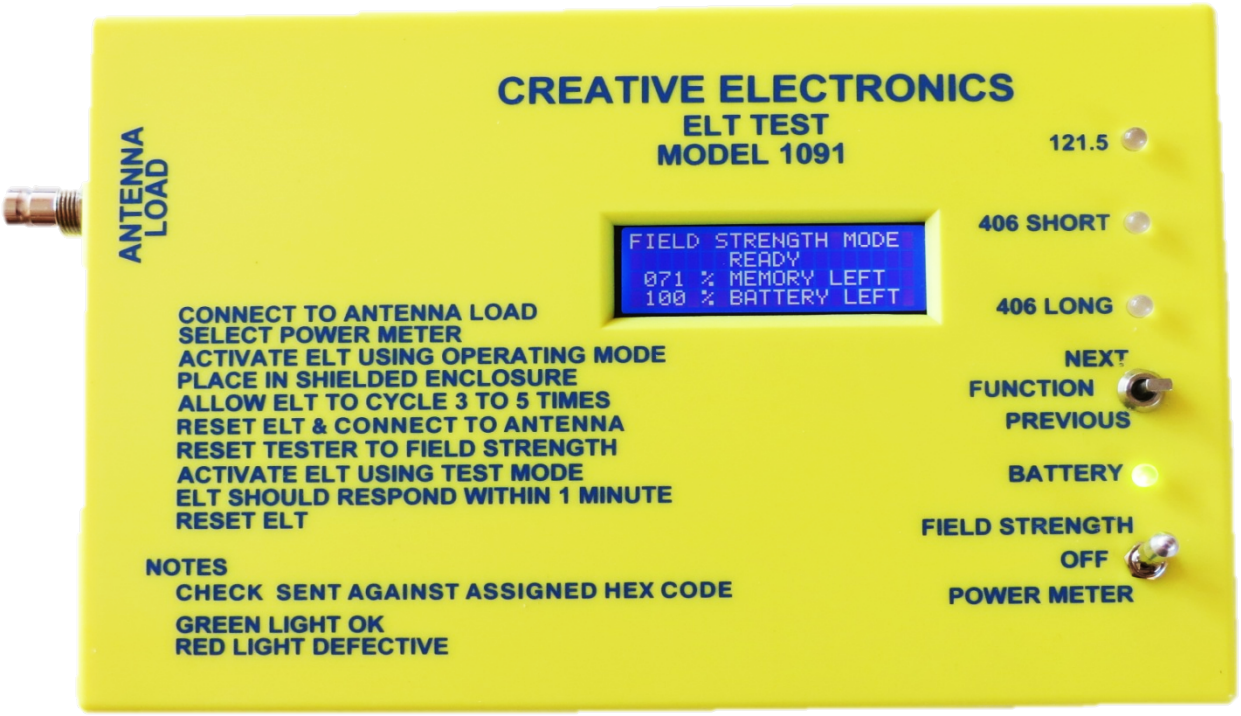
CREATIVE ELECTRONICS ELT 1091

OWNERS MANUAL

Third edition



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QUICK START OPERATING INSTRUCTIONS

1. Turn power on by selecting either POWER METER (direct connection) if using internal antenna load, or FIELD STRENGTH (over the air) if receiving from beacon's own antenna

2. Toggle NEXT to make new tests, toggle PREVIOUS to review previously saved tests

3. If POWER METER was selected, connect beacon to ANTENNA LOAD then skip to step 4, if FIELD STRENGTH mode was selected, toggle NEXT to continue, PREVIOUS to start continuous 121.5 mode.

4. Toggle NEXT to continue saving current series of tests, toggle PREVIOUS to reset memory and then start a new series of tests.

5. Using the toggle, select the operating frequency of the beacon if known following the display prompts, if unknown, select the default UNKNOWN.

7. If frequency selection is correct, toggle NEXT to continue, PREVIOUS to return to selection display and redo

8. The READY message should be displayed along with the battery condition, available memory and that the tester is ready to receive and test a signal

9. Activate beacon

10. Observe the results. GREEN LED = OK, RED LED = ERROR. Use the toggle to select the various displays showing either error messages if any, or the measured results eventually toggling back to the READY message page

NOTE: IT IS IMPORTANT TO COMPARE THE DISPLAYED HEX CODE WITH THE ONE ASSIGNED TO THE BEACON AND THAT THE COUNTRY DISPLAYED WITH THE COUNTRY THE BEACON IS REGISTERED TO. ALSO THAT THE MODE SENT BY THE BEACON CORRESPONDS WITH THE INTENDED MODE OF TRANSMISSION (NORMAL OR TEST). SEE PAGES 12 AND 14. IF DIFFERENT, THE BEACON IS DEFECTIVE.

TESTING PROCEDURE EXPLAINED

The 406 Mhz. emergency beacon system, unlike the previous legacy beacons, has many features designed to enhance reliability and reduce search times. As such, it sends a more complicated signal and it is therefore more important that all aspects of its signal are tested and verified. There are 2 basic types of tests, RF power output from the beacon (power meter), and the amount of power being radiated from the antenna (field strength) and permitting both should be accomplished. The POWER METER mode of testing is an off of the air test and requires at least 3 transmissions from the beacon to complete. This is an actual operational test of the beacon that checks all aspects of the signal it is sending. This method is only possible on beacons that use an external antenna giving direct access to the transmitter typically aviation ELTs, and some marine beacons

The other is an on the air test, FIELD STRENGTH, of the beacon and uses the test mode function required for all beacons. The test function is identified as such to the COSPAS SARSAT system so that it will not trigger a search, but as such not all aspects of the beacon are tested. Instead of measuring the power output of the beacon, this test measures the strength of the RF field the beacon and its antenna are producing. This is a product of not only the amount of power generated by the beacon but also the efficiency of the antenna system.

Unless you want to initiate a search, DO NOT OPERATIONALLY ACTIVATE A BEACON WHILE CONNECTED TO AN ANTENNA, It will set off an alarm and start a search. The Creative Electronics tester includes an ANTENNA LOAD to replace the beacon antenna when testing the beacon and is also used in the POWER METER mode to measure the actual power the beacon is producing. When running this test, the beacon should be placed in a RF shielded container to prevent accidental radiation of a signal that the system could receive, since a plastic enclosure will not shield the signal and the cables used to connect the tester to the beacon need to be high quality double shielded cables.

INTRODUCTION TO 406 MHz BEACONS

Currently there are several types of Emergency locating transmitters or beacons. One of which is the earlier 121.5 MHz VHF band type and another, the newer 406 MHz to 406.1 MHz type. The earlier type transmits a continuous amplitude modulated signal without any information and relied on persons who heard it to use direction finders to locate the source. While better than nothing, the system was prone to many false alarms, and significant delays until the signal was first discovered. The newer system resolved these problems by incorporating an identifying message in the transmission along with optional location information and a system of orbiting satellites that continuously monitor the 406 to 406.1 MHz UHF band and relay the signals back to Earth command centers.

There are two basic messages each having many variations tailored to suit the application using the beacon. One is the short message (440 mS) which has no location information. The other is the long message (520 mS) which can include location information if available. A portion of both messages contain the following basic information; the protocol and format being used, the identity of the beacon, its country of registration, and if it is a normal actual alarm or a test signal. If it is the long message, also included is the last location, if available, within a limited time frame, when the beacon was activated.

Some additional requirements are to be met. When the beacon is activated for an actual alarm, there is a brief delay prior to the first actual transmission. This is to allow the beacon to be deactivated if the activation was inadvertent. Then once the transmission starts, the first 160 mS are to be un-modulated, in other words no data is sent. This is followed by a short synchronizing signal which is then followed by the message sent in a specialized digital format that contains the information needed to help identify and locate the beacon. This transmission is supposed to be made at approximately 50 second intervals which are to be random in nature so as to minimize any two beacons from continuously interfering with each other. There are other features of the system which have been well thought out and implemented; the details of which can be found in the specifications for the system from the COSPAS SARSAT web site their document C/S t.001.

UNIT DESCRIPTION

The Creative Electronics model ELT 1091C ELT tester was designed for use by aviation maintenance technicians and others who have the need to routinely field test ELTs, EPIRBs and PLBs to determine that they will work properly when called on to do so. As such it was not designed to be used as a laboratory test instrument to obtain the original certification of such devices. The tester will however determine if the ELT, EPIRB, or PLB is working properly, and decode and display the message it is sending. The tester has been designed to be simple and intuitive to use and provide a thorough test of an ELT, EPIRB or PLB and supply a simple go / no go indication along with the message information generated by the ELT, EPIRB or PLB. It is up to the user of the tester to make sure that the sent HEX code and country of registration and mode of transmission are correct. (SEE PAGES 12 & 14)

The tester consists of two receivers, one for 121.5 Mhz. and the other for 406.0 to 406.1 Mhz., a dedicated MCU, a clock timing reference source, an 80 character display, 4 bicolor LED's, an audio amplifier with speaker and a substitute 50 ohm antenna load.

The ELT 1091C tester incorporates a power switch which is used to determine which of the two operating modes is desired, POWER METER or FIELD STRENGTH. The other switch, a spring loaded center off toggle switch is primarily used to cycle thru the various display pages as well as control several other functions to be described later. The results of the various tests are provided by 3 red/green LEDs and the 80 character LCD display arranged with 4 lines of 20 characters each.

Power is supplied by 8 AA batteries. A special monitoring circuit turns the tester off if there is no activity for 15 minutes to conserve the batteries. If the battery voltage gets below a level that will affect the accuracy of the tester, the BATTERY LED will turn red, and the display will display a message to replace the batteries, and the tester will become disabled. An additional circuit monitors the internal temperature of the tester and will disable the tester if the temperature is out of the normal operating range that would affect the accuracy of the tester. The display will show either a temperature too high or too low message. The tester will remain disabled until the internal temperature is returned to the normal operating range.

FEATURES

Simple to use

Tests all 121.5 Mhz. and all 406 to 406.1 Mhz. ELTs, EPIRBs, and PLBs

Decodes and displays the message

15 minute inactivity shutdown to conserve the batteries

Internal 50 ohm antenna load for power measurements

Measures RF power output

Measures relative RF radiated field strength

Compliance / Non-compliance green or red LED indication of test results

80 character display (4 lines of 20 characters).

Displays protocol, format, message, and test measurement values

Measures for 121.5 Mhz.

- Frequency
- Modulation
- Power or field strength

Measures for 406 Mhz.

- Frequency
- Modulation
- Power or field strength
- Transmitter output stability
- Transmission time
- Transmission recycling time
- Data clocking rate
- Un-modulated time

Decodes and displays

- Short message
- Long message
- 15 digit hex code
- ELT / PLB / EPIRB type
- Marine protocols
- Aviation protocols
- User protocols
- Standard protocols
- National standard protocols
- PLB protocols
- Country codes (displays country)
- Location protocols
- Operating mode (normal / alarm or test)
- Aux beacon data
- Unit 15 hex identification

Stores the previous test results for later viewing

Utilizes a dedicated imbedded MCU not dependent on WINDOWS ™or any other operating system

Includes an amplifier with a speaker to aurally monitor the received signal

Utilizes receivers that have a sensitivity comparable with a field strength meter to more accurately represent the type of signal a satellite would receive in space at distances of over 400 miles to overhead at orbiting altitude.

Totally and completely self contained. No extra components needed.

CONTROL FUNCTIONS

POWER SWITCH

Power meter mode

Measures the RF power of both the 121.5 Mhz. or the 406 Mhz. to 406.1 Mhz. transmitters

Field strength mode

Measures the relative RF field strength being radiated from the antenna for both the 121.5 Mhz. and 406 Mhz. to 406.1 Mhz. transmitters

FUNCTION SWITCH

On startup

Selects new tests (NEXT) or review previous tests (PREVIOUS)

Selects either continuous 121.5 Mhz. field strength mode or 121.5 and 406 – 406.1 test mode

Selects to continue current test group, or clean memory of previous test results

Used to select the operating frequency of the 406 Mhz. to 406.1 Mhz. beacons

On receiving a signal on 121.5 Mhz.

In continuous field strength mode, selects numeric or bar graph display mode

In normal mode toggles display between the status page, measurements page, and Field strength ready page.

In field strength mode while receiving a signal on 121.5 with the ready page displayed, will mute or unmute the 121.5 audio

On receiving a signal on 406 Mhz. to 406.1 Mhz.

Toggles display between the following in order

Identification / location page

Errors page if any errors occurred

or

Values page with or without errors

Timing page

Ready page

DISPLAY PAGES & ELEMENTS

OPENING PAGE

Displays Source code name, version number and serial number. Prompts to start new tests (NEXT) or review previous tests (PREVIOUS).

FIELD STRENGTH OPTION PAGE

Prompts for continuous 121.5 field strength or normal mode

CONTINUOUS MODE PAGE

Prompts for numeric or bar graph presentation

MEMORY CONTROL PAGE

Prompts to continue a group of test results, or clean the memory of previous test results

FREQUENCY SELECTION PAGE

Prompts for selection of a frequency in the 406 Mhz. to 406.1 Mhz. band

FREQUENCY VERIFICATION PAGE

Display the selected frequency and prompts to accept or reselect a different frequency

READY PAGE

Indicates that the tester is armed and ready to receive a signal and displays current memory available and battery state

121.5 STATUS PAGE

Displays the pass or fail status of each measurement

121.5 MEASUREMENTS PAGE

Displays the measured values of the

Frequency

Percent of modulation

Power in mlliwatts in the power mode

Relative field strength in mV at the receiver input in the field strength mode

406 MESSAGE PAGE

LINE 1

Type of beacon (ELT, EPIRB, PLB)

Identification format

Aircraft nationality and registration markings (tail number)

Maritime user (MMSI or RADIO CALL SIGN)

Radio call sign user

Serial user protocol (ELTs, PLBs, EPIRBs)

Aircraft 24 bit address

Aircraft operator, Serial number

COSPAS-SARAST TC No, Serial number (SHOWN)

MMSI (Last 6 digits, binary)

Protocol

U = User

S = Standard (SHOWN)

N = National

Type of operation * NOTE: OBSERVE THIS

T = Test (SHOWN)

N = Normal (alarm)

Source of location data

I = Internal (SHOWN)

E = External

LINE 2

Beacon identification

Type of auxiliary beacon installed if any

LINE 3

Location information if available

LINE 4

Country of registration NOTE: IT IS IMPORTANT TO COMPARE THIS WITH THE ACTUAL REGISTERED COUNTRY

*This important since the satellite system ignores test transmissions

406 VALUES PAGE

LINE 1

15 digit hex code NOTE: IT IS IMPORTANT TO COMPARE THIS WITH THE HEX CODE ASSIGNED TO THE BEACON BEING TESTED

LINE 2

Measured frequency

LINE 3

Un-Modulation time

Modulation percentage

LINE 4

Data clock rate

Power in watts in power mode

or

Field strength in mV in field strength mode

406 TIMING PAGE

LINE 1

Length of transmission

LINE 2

Previous recycle time

LINE 3

Current recycle time

LINE 4

Recycle time variation or difference

406 Errors display

LINES 1 thru 4 display any errors that were found and lists what they were. If more than 4 errors were encountered the 4th line will display “MORE” and toggling the FUNCTION SWITCH “NEXT” will display the additional items if any or to the 406 values screen. See APPENDIX B Error messages-

BATTERY LOW PAGE

Prompts to replace batteries

TEMPERATURE LIMITS PAGE

Identifies temperature out of limits condition

INSUFFICIENT SIGNAL PAGE

Warns of a signal that is not strong enough to allow reliable measurements

OPERATION

INITIAL TURN ON

The POWER toggle switch has three positions, the center position is OFF, up selects the “FIELD STRENGTH” mode of operation, and down selects the “POWER METER” mode of operation.

FIELD STRENGTH MODE

In the FIELD STRENGTH mode, the tester receives its signal off the air from the beacon’s transmitting antenna or radiating source using the testers internal antennas. If the “FIELD STRENGTH” mode has been selected, a message will be displayed prompting you to select either the “CONTINUOUS 121.5” field strength mode, “PREVIOUS”, on the function switch, or “TO CONTINUE”, “NEXT”, on the function switch. If the “CONTINUOUS” mode was selected, the tester will continuously monitor the 121.5 Mhz. and continuously display the results using either a numeric value or bar graph presentation. This mode is helpful in determining the radiation pattern of a transmitting antenna on 121.5 Mhz. or in identifying the source of an active 121.5 beacon. While in the continuous 121.5 mode, the toggle can be used to select between the numeric or bar graph display (PREVIOUS) or to exit the continuous mode (NEXT). The continuous mode is not useable for the 406 Mhz. signals because of the intermittent nature of the 406 Mhz. transmissions, and is not practical or available. However, the beacon sends an identifying code that the tester will display and can be used to identify the source of the signal.

With the normal FIELD STRENGTH mode selected, when the tester receives a signal on 121.5 Mhz. it measures the frequency, modulation, and relative field strength. Once the measurements have been completed, the display will indicate the status of each measurement as either “OK” or if incorrect for example “Modulation low”, and illuminate the 121.5 LED either GREEN for ok, or RED for defective. If the FUNCTION SWITCH is toggled to “NEXT”, the display will switch to the 121.5 Mhz. values page and display the actual measured values of the received signal on 121.5 Mhz. Now toggling the FUNCTION SWITCH to “NEXT” will return the display to the ready page, while toggling to “PREVIOUS” will return to the status page. Once the 121.5 Mhz. portion of the ELT has been tested, even though it may still be running, or be of an intermittent transmission type, the tester will ignore it until the tester is reset.

If the 121.5 Mhz. ELT is running and you desire to mute out the audio, once the test has been completed, and the ready page is being displayed, toggling the FUNCTION SWITCH, while receiving a signal on 121.5 Mhz, to “PREVIOUS” (down) will mute the 121.5 Mhz. audio, toggling to “NEXT” (up) will activate the 121.5 Mhz. audio. The 406 Mhz. to 406.1 Mhz. audio is not affected with this switch feature.

While in the normal mode, the 406 / 406.1 receiver continuously remains active and as soon as a signal is received it is processed. Once processed the first 406 / 406.1 page, the MESSAGE page, will appear and if no errors occurred the appropriate LED (long or short) will illuminate green. If there were errors, the appropriate LED will illuminate red. Toggling “NEXT” will then change to the ERROR page if there were any errors, or the 406 / 406.1 VALUES page if no errors occurred. Further toggling of the function switch to NEXT will then display the 406 / 406.1 TIMING page, toggling to PREVIOUS will cause the previous screen to display, either the ERROR page if errors were present, or the MESSAGE page if no errors were present.

POWER METER MODE

When selecting the POWER METER mode, the tester functions the same as if in the ready FIELD STRENGTH mode except it will measure the amount of RF power being applied to the built in ANTENNA LOAD located on the side of the tester. If the ELT is not connected to the ANTENNA LOAD, the tester will still receive it, however an error will occur, and no power will be indicated.

If in the FIELD STRENGTH mode, and the ELT is connected to the “ANTENNA LOAD” and a transmission is made, the “SHORT” and “LONG” LEDs will flash alternately and a message will display to warn that the ELT should be connected to its antenna or the tester switched to the “POWER METER” mode.

REVIEW OF PREVIOUS TEST RESULTS

This mode can only be entered when the tester is first turned on. After the opening page, a page will display allowing you to continue making tests, or to view previous tests. Use the FUNCTION switch to make your selection. Once in the review mode, you may toggle between the saved pages which have been stored in the order that they occurred. The lights will correspond to the displayed page. To delete the saved pages (all), another screen will prompt you to either continue with a series of tests, or to start a new series of test. If you toggle previous, the memory will be cleaned off of all the previous tests, while toggling next will add the next tests to those already stored in the memory. Once the memory is full when the tester is turned on, it will automatically reset the memory prior to starting a new series of tests, removing all previously stored test results.

INTERPRETING ERROR MESSAGES AND TROUBLE SHOOTING

While most beacon failures are caused by a single problem and will be evident as such, some failures can cause multiple error indications. For example an unstable transmitter may also result in a modulation error, and/or an incorrect frequency error, along with a garbled message and incorrect hex id or location information. Some errors can also be created by incorrect usage of the tester, as for example by placing the tester too close to the antenna causing the tester to become overloaded resulting in incorrect measurements and errors. In this case, relocate the tester further away and retry the test. If a marginal signal error occurs, try moving the tester closer to the antenna. However, if the distance is closer than normal to get a valid signal, assuming that the power test was normal, the antenna system is suspect.

USING CONTINUOUS MODE TO FIND AN OPERATING BEACON

The ELT1091C tester incorporates a CONTINUOUS MODE of operation which can be used to check the radiation pattern of a 121.5 Mhz. antenna installation or to identify the location of a nearby operating beacon on 121.5 Mhz. The CONTINUOUS MODE can be activated after the tester is turned on in the field strength mode by toggling the function switch to NEXT (up), and then to PREVIOUS (down). Subsequent toggling of the function switch (down) will select between a numeric or bar presentation of the signals strength. Toggling to NEXT will exit the CONTINUOUS MODE and place the tester in the NORMAL mode. While either the numeric or bar presentation will work, the bar presentation is better suited for locating the source of a beacon. The receivers of the tester are intentionally of low sensitivity to provide a better indication of a beacons performance. As a result, when trying to locate the source of a beacon's signal, for example in a large hangar, it will likely be necessary to move around to the various possible sources to find the one that provides the strongest or highest reading.

RECOMMENDED TESTING PROCEDURES

AVIATION

STEP PROCEDURE

1. REMOVE ELT FROM AIRCRAFT
2. CONNECT TO ANTENNA LOAD USING A HIGH QUALITY CABLE
3. SET TESTER TO POWER METER
4. SELECT TRANSMITTER FREQUENCY IF KNOWN, OTHERWISE “UNKNOWN”
5. ACTIVATE ELT BEACON USING IMPACT SENSOR
6. PLACE ELT INTO A SHIELDED CONTAINER TO PREVENT UNAUTHORIZED RADIATION
7. ALLOW ELT TO CYCLE A MINIMUM OF 3 TIMES
8. MONITOR AND NOTE RESULTS AND CHECK THE HEX CODE , COUNTRY OF REGISTRATION AND OPERATING MODE (NORMAL / ALARM OR TEST)
9. REMOVE ELT FROM SHIELDED BOX AND RESET
10. REINSTALL ELT IN AIRCRAFT AND RECONNECT TO ANTENNA
11. RESET TESTER TO FIELD STRENGTH
12. PLACE TESTER A CALIBRATED DISTANCE (APPROX 10 FEET) FROM THE ELT ANTENNA
13. RE-ACTIVATE ELT IN THE SELF TEST MODE USING THE AIRCRAFT FRONT PANEL CONTROL
14. WAIT A MAXIMUM OF 1 MINUTE FOR ELT TO FUNCTION
15. MONITOR AND NOTE RESULTS
16. RESET ELT AND ARM
17. CHECK BATTERY FOR COROSION AND REMAINING LIFE
18. MAKE LOG BOOK ENTRY

NOTES:

UPON THE COMPLETION OF EACH TEST, MAKE SURE THE HEX ID CODE SENT MATCHES THE CODE ASSIGNED TO THE BEACON , THAT THE COUNTRY IS CONSISTENT WITH THE REGISTRATION COUNTRY OF THE BEACON, AND THAT THE CORRECT MODE OF TRANSMISSION WAS SENT (SEE PAGES 12 & 14) AND WHEN REINSTALLING THE BEACON IT IS INSTALLED IN THE CORRECT AIRCRAFT AND ARMED.

Aviation ELTs are made with plastic cases which result in a significant amount of radiated signal even when not connected to an external antenna, enough to be received by the satellite system. As a result when testing these devices, it is important to place the ELT in a metal shielded container (see appendix H) shortly after being activated to prevent inadvertently setting off a search alarm. Once the frequency, RF power, modulation, timing parameters, and

recycle times have been checked, and once reinstalled in the aircraft, The ELT is supposed to be able to send a test transmission utilizing the test function. This transmission is marked as a test transmission and disregarded by the satellite system. The tester will also recognize that it is a test transmission and will display a “T” on the top line of the message page on the right side. If an “N” appears here, the ELT is defective as it transmitted a normal transmission which could set off an alarm. When initially activated in the normal (alarm) mode, COSPAS-SARSAT requires an approximate 50 second delay from the time of activation until the first actual transmission by the beacon is made. This should provide sufficient time to turn off an accidently activated beacon or place the beacon in a shielded container for testing. The field testing of a beacon connected to an external antenna on a metal aircraft from the inside of the aircraft will result in questionable and invalid results and should not be accomplished.

MARINE

Marine EPIRBs come in several types. Some are manually activated, while others are automatically activated by one or more of several different methods. When testing the manual or automatic activation methods, prior to activating the EPIRB, make sure that you can reset it once activated. Additionally some use a removable antenna with a standard connector while others utilize an integral antenna which has no provision for directly testing the RF power being generated by the EPIRB. Therefore the procedure used to test the EPIRB can be a variation of the AVIATION procedure or the PLB procedure and will have to be determined by the individual making the tests. In any event, care should be taken to not radiate any normal (not test) signals.

NOTE: CHECK THE HEX CODE, COUNTRY OF REGISTRATION AND TRANSMISSION MODE, SEE PAGES 12 & 14

PLB

PLBs present a different problem in testing them since they are usually self-contained having an integral antenna and therefore no way to test the actual RF power being generated. Additionally, if activated in the normal mode of operation (not test) they will most definitely trigger an alarm unless placed in a suitable shielded container (SEE APPENDIX G). As with some Marine EPIRBs, it is important to be sure that you can reset the PLB once activated in the normal mode for testing.

RECOMMENDED PROCEDURE

STEP PROCEDURE

1. Set tester to field strength
2. Place the PLB approximately 10 TO 20 inches from the tester

3. Activate PLB in test mode
4. Note results.
5. Check HEX code, country of registration and that the transmission was a TEST transmission. (SEE PAGES 12 & 14)

NOTES: The resultant field strength readings can vary significantly and will depend on how much power the beacon is generating, the efficiency of the radiating source (antenna) and the location of the beacon relative to the tester. Therefore, a specific reading of the measured field strength can only be used by the individual running the test as a guide to tell if a real problem exists with the beacon and or its antenna system.

If using the test mode, the PLB signal is received by the satellite system however it is disregarded and not processed when sent as a test message. When using the test mode function of a PLB, ELT, or EPIRB, the recycling function is not generated and is therefore unable to be tested.

SPECIFICATIONS

Parameters measured

- RF frequency
- Modulation level
- RF power level
- Antenna radiation field strength
- Data clocking rate
- Un-modulated time
- Transmit time
- Recycle times

Message decoded

- Short message
- Long message
- Message protocols decoded
  - User
    - Aviation
    - Marine
    - PLB
  - Standard
    - Aviation
    - Marine
    - PLB
  - National

Frequencies tested 121.5 Mhz. & 406.0 to 406.1 Mhz.

Frequency resolution	+/- 100 cycles
Frequency stability	2 parts per million 0 deg. F to 120 deg. F

Antenna load

- Max 10 watts 10% duty cycle
- SWR @ 121.5 MHz 1.1 : 1
- SWR @ 406 MHz 1.12 : 1
- Impedance 50 ohm +/- 1 ohm

3 red/green LEDs, compliance indicators

80 character message display, 4 lines, 20 characters per line

Inactivity auto shut off (15 minutes)

Continuous field strength mode (121.5 Mhz. only)

Temperature limits	0 deg. F to 120 deg. F
Battery requirement	8 AA batteries

Battery life

Lithium	12 hours continuous, approximately 50 tests @ 15 minutes a test
Alkaline	3.5 hours continuous, approximately 14 tests @ 15 minutes a test

Self- test

Battery level	Warning message and disable when testers battery below accuracy level
Temperature	Warning message and disable until temperature within limits

Minimum signal levels

Size	9 3/4“ Wide, 6 1/8” High, 2 1/2” deep
Weight	1.6 Lbs. Includes Lithium batteries

APPENDIX A OPERATIONAL MESSAGES

STARTUP OPENING

Displays software number, version number, and serial number and prompts to review previous tests (PREVIOUS), or start a new series of tests (NEXT)

FIELD STRENGTH, CONTINUOUS OR NORMAL MODE

Prompts to select continuous field strength function (PREVIOUS) or to continue in the normal operating mode (NEXT)

MEMORY RESET OPTION

NEXT to start a new test series retaining previous tests, PREVIOUS to reset memory

FREQUENCY SELECTION

On startup is used to select the operating frequency of the beacon if known.

INSUFFICIENT TRANSMITTER SIGNAL

The tester is capable of receiving marginal signals which may not be properly processed. The resulting measurements may or may not be valid in this situation. A marginal or weak signal could be an indication of a faulty beacon or antenna system or a tester that is not being properly used. If in the field strength mode make sure that the tester is properly located reference to the correct antenna, and if in the power meter mode, that the connecting cable between the tester and the beacon is O.K.

BATTERY LEVEL

Informs when the tester battery level is below the minimum required to accurately operate the tester and disables the tester.

READY

Identifies that the tester is armed to receive the next transmission. Also displays the current amount of memory available and the current level of the battery charge as a percentage of the maximum and the minimum required to maintain accuracy (10 volts).

TEMPERATURE TOO HIGH OR TOO LOW If the internal temperature of the tester becomes too high or too low to ensure accurate test results, the tester becomes disabled until the internal temperature returns to the normal range and the appropriate temperature warning is displayed.

APPENDIX B ERROR MESSAGES

FREQ, OUT OF BAND

Measured frequency was either lower than 406.0 Mhz. or higher than 406.1 Mhz.

INVALID FREQUENCY

Measured frequency exceeded the selected frequency tolerance limits as specified by the COSPAS SARSAT channel assignments.

UNSTABLE FREQUENCY

Measured frequency exceeded the frequency stability limits as specified by COSPAS SARSAT

ERRATIC TRANSMISSION

Measured transmission was not constant in level or frequency

LOW RF POWER

Measured transmitter power was less than 3.2 watts

EXCESS RF POWER

Measured transmitter power was more than 7.9 watts

LOW FIELD STRENGTH

Received signal is significantly below what it should be for a normal distance from the beacon or beacon antenna, If it is necessary to place the tester much closer than normal, either the beacon is defective or the antenna system is not functioning properly

MODULATION LOW

Modulation was less than 1.0 radians peak

MODULATION HIGH

Modulation was greater than 1.2 radians

DATA CLOCK SLOW

Message bit rate was less than 396 bps

DATA CLOCK FAST

Message bit rate was greater than 404 bps

UNMOD TIME SHORT

Measured un-modulated time was less than 146 mS.

UNMOD TIME LONG

Measured un-modulated time was greater than 176 mS.

XMITT TIME TOO SHORT

Measured transmit time for the short message was less than 435.6 ms.

Measured transmit time for the long message was less than 514.8 ms.

XMITT TIME TOO LONG

Measured transmit time for the short message was greater than 444.4 ms.

Measured transmit time for the long message was greater than 525.2 ms.

REPEATS TOO SOON

Measured time between transmissions was less than 47.5 seconds

REPEATS TOO LATE

Measured time between transmissions was greater than 52.5 seconds

REPEATS NOT RANDOM

Measured timing difference between two sequential transmissions was less than a few seconds over a 5 minute period

INCOMPLETE XMISSION

Transmission ended before all data was transmitted

EXCESSIVE XMISSION

Transmission exceeded 45 seconds

GARBLED MSG DATA

Data received was not consistent with what was expected

GPS DATA INVALID

GPS data was not consistent with what was expected

INCONSISTENT FORMAT

Data received was not consistent with transmitted format

INCONSISTENT PROTO

Data received was not consistent with transmitted protocol

INVALID COUNTRY CODE

Country code received is not consistent with ITU country code listing

INSUFFICIENT SIGNAL INVALID RESULT

Received signal was not sufficient to allow reliable measurements to be made

APPENDIX C REGISTERING ELT, PLB or EPIRB

When testing ELTs, EPIRBs and PLBs operating on the COSPAS SARSAT system it is important to make sure that the unit is properly registered with the country's search coordinating organization and should correspond with the COUNTRY that the beacon is sending to ensure timely starting of a search when the unit is activated. Failure to properly register the unit will delay the activation of a SAR mission until the validity of the signal can be made.

APPENDIX D COSPAS-SARSAT

COSPAS SARSAT is an international organization originally consisting of 3 countries, The Russian Federation, France, and Canada. COSPAS-SARSAT developed, created and manages the system that consists of a group of orbiting satellites, geostationary satellites, and earth stations that are used to receive distress signals on a group of frequencies between 406.0 to 406.1 Mhz., relay the signals to geostationary satellites, which then relay the signals to earth stations which send the alerts to the appropriate countries search and rescue organization. As a result COSPAS-SARSAT established the standards and specifications for beacons using their system and issues a type certificate for devices that conform with the specifications of the system, are expected to comply with the standards and specifications required to obtain a type certificate from them, and which are a part of their document “SPECIFICATION FOR COSPAS-SARSAT 406 MHz DISTRESS BEACONS” C/S T.001 Issue 3. One of the requirements is that each device has a self-test feature which must be limited to one burst only. Subsequently, an impact sensor if required, is not tested as well as one or more of the required specifications are not verified, and often the systems used to test the device are the same used to generate the signals which could result in passing the self- test when in fact a problem exists. Therefore the best way to ensure the proper operation of a beacon is with an independent tester designed to perform a comprehensive test of a beacon.

APPENDIX E 406.0 TO 406.1 BEACON OPERATION AND CHARACTERISTICS

FREQUENCY ON AN ASSIGNED CHANNEL FROM THE FOLLOWING LIST

406.025

406.028

406.031

406.034

406.037

406.040

406.043

406.046

406.049

406.052

406.055

406.058

406.061

406.064

406.067

406.070

406.073

406.076

MODULATION Phase modulated 1.1 rad +/- .1 rad

POWER OUTPUT 5 watts +/- 2 DB (3.2 to 7.9 watts)

UN-MODULATED CARRIER time 160 Ms. +/- 1 %. That time commencing from the start of a transmission to when modulation of the carrier is started.

MESSAGE BIT RATE 400 bps +/- 1%. The rate that data is transmitted at, the number of bits sent per second.

SHORT MESSAGE contains 112 bits of data, and does not include location information. The message length is 280 Ms. +/- 1% long, and with the un-mod time, the transmission time is 440 Ms. +/- 1% long

LONG MESSAGE contains 144 bits of data, and includes location information when available. The message length is 360 Ms. +/- 1% long and with the un-mod time, the transmission time is 520 Ms. +/- 1% long

REPETITION PERIOD shall not be so stable that any two transmitters appear to be synchronized closer than a fraction of a second in a five minute period. The mean period between transmissions shall be randomized around 50 seconds and between 47.5 to 52.5 seconds

MAXIMUM CONTINUOUS TRANSMISSION shall not exceed 45 seconds

BEACON ACTIVATION On activation, the beacon shall not transmit a 406 Mhz. distress message until at least one repetition period (+/- 50 SEC) has elapsed without a transmission.

CARRIER FREQUENCY measured frequency and frequency stability

CARRIER STABILITY stable carrier

APPENDIX F. 121.5 ELT OPERATION AND CHARACTERISTICS

FREQUENCY	121.5 Mhz. +/- 6075 cycles (50 ppm)
MODULATION	Amplitude modulated continuously with a warbling tone
POWER	50 Mw min peak

Continuous or intermittent on activation, included with 406 ELT or may be a separate stand-alone device.

APPENDIX G. BATTERY CONSIDERATIONS

The Creative Electronics ELT 1091C tester utilizes 8 AA cell batteries for power. The tester draws approximately 230 Ma when in use. Tests were made to determine the economics and life of the batteries using Alkaline and Lithium batteries with the following results. All tests were made using a 230 Ma load for a continuous period of time until the battery dropped below the minimum voltage (10 volts) needed to maintain the accuracy of the tester. The Alkaline batteries took 3 ½ hours to fall below 10 volts, The Lithium batteries took 12 hours to fall below 10 volts. Therefore the Lithium batteries outlasted the alkaline batteries by more than 3 times. The Creative Electronics ELT tester incorporates a battery condition monitoring function based on measuring the current battery voltage and converting it into an approximate battery life value. Most batteries will recover some charge when not in use for a short period of time. Once used again this charge is dissipated rapidly and after a short time will level off. This will be evidenced by an initial rapid decrease of the battery state which will eventually become more stable as the battery is used and is both normal and not to be of any alarm or concern. When the level reaches 0% battery life, the tester will become disabled and a message to replace the batteries will be displayed. Turning the tester off for a short period of time will allow the battery to recover some charge and may allow an additional test or two with the current batteries.

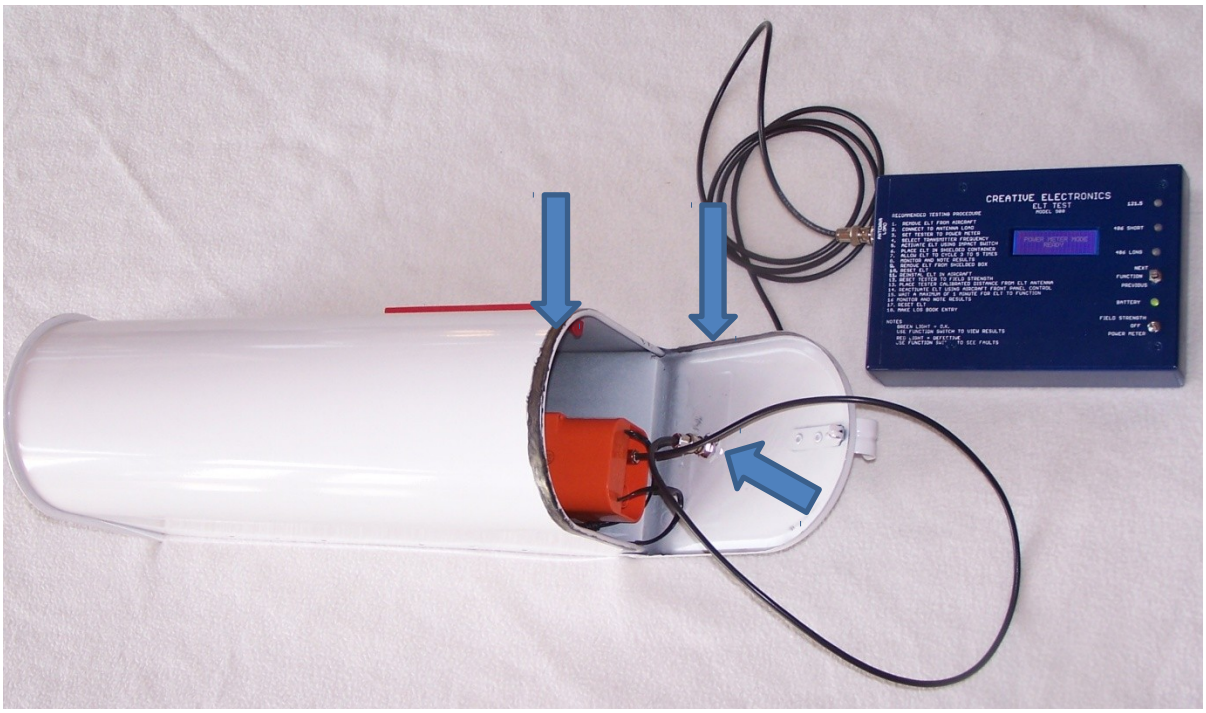
APPENDIX H. RF SHIELDED CONTAINERS

The COSPAS-SARSAT system is designed to receive very weak signals radiating from the surface of the Earth. With distress devices generating approximately 5 watts of RF energy while testing, if this energy is not properly contained, it will be received by the satellite system and trigger an alarm. Therefore when testing these devices it is important to ensure that the device being tested does not radiate a normal/alarm signal strong enough to be received by the system. There are several means to accomplish this. Some are costly while others outright inexpensive but still very effective. Additionally, consideration needs to be made in order to couple enough signal from the device under test to the tester with a signal level insufficient for the satellite system to pick up. The following examples have been used and tested and have proven to be successful.

THE METAL MAIL BOX or METAL AMO BOX

Using a standard metal mail box install, a BNC bulkhead connector on any suitable and convenient surface. Remove any paint from the flange on the door and the mating surface on the box allowing a good contact to be made around the entire door edge and the box. Also remove any paint around the area where the bulkhead connector is installed to ensure a good contact between the connector and the box. When testing beacons that have an external antenna connection, connect it to the bulkhead connector and, using a good quality cable connect the other end of the bulkhead connector to the ANTENNA LOAD on the tester to make power measurements. When testing devices that do not have a provision for an external antenna such as a PLB, use a short coax cable that has had its outer shielded braid removed for at least 7 inches and which has been connected to the bulkhead connector inside the mail box. Place the exposed center conductor of the pick-up cable adjacent to the device being tested and secure with a piece of tape. Connect the Tester's ANTENNA LOAD using a good quality cable to the other side of the connector. Use the FIELD STRENGTH mode and compare the readings to those from a known good device that has been set up with the same configuration since there is no direct means of measuring the actual power being produced by the device.

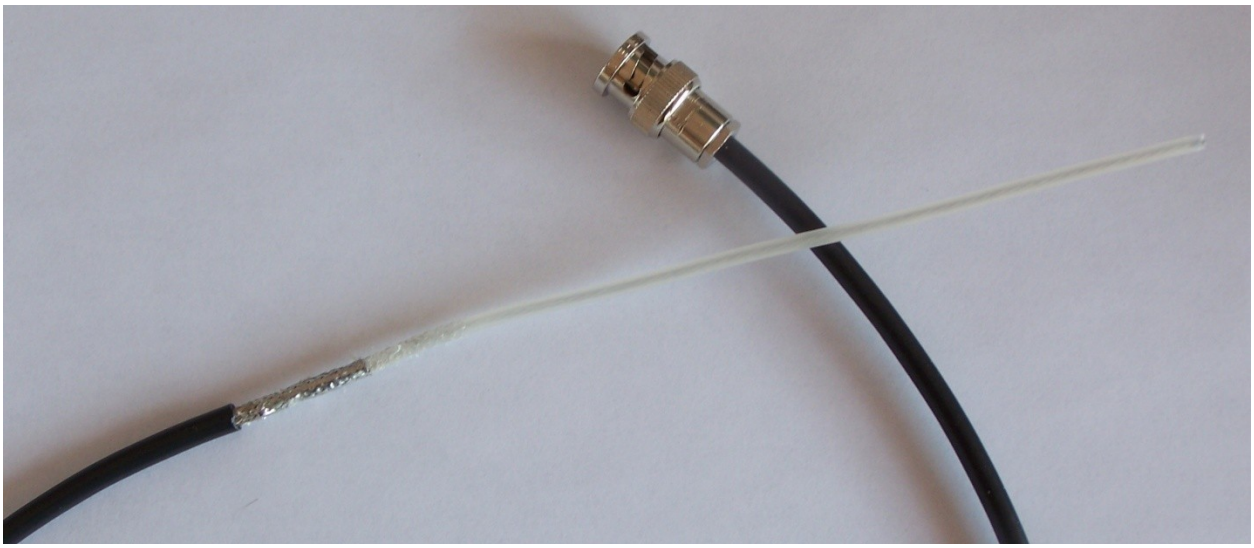
NOTE: A GOOD QUALITY CABLE IS MADE UP USING DOUBLE SHIELDED 50 OHM CABLE SUCH AS RG 223/U, RG 400. CABLES MADE UP WITH THE POPULAR RG58/U HAVE ENOUGH LEAKAGE TO RADIATE ENOUGH SIGNAL TO SET OFF AN ALARM AND SHOULD NOT BE USED.



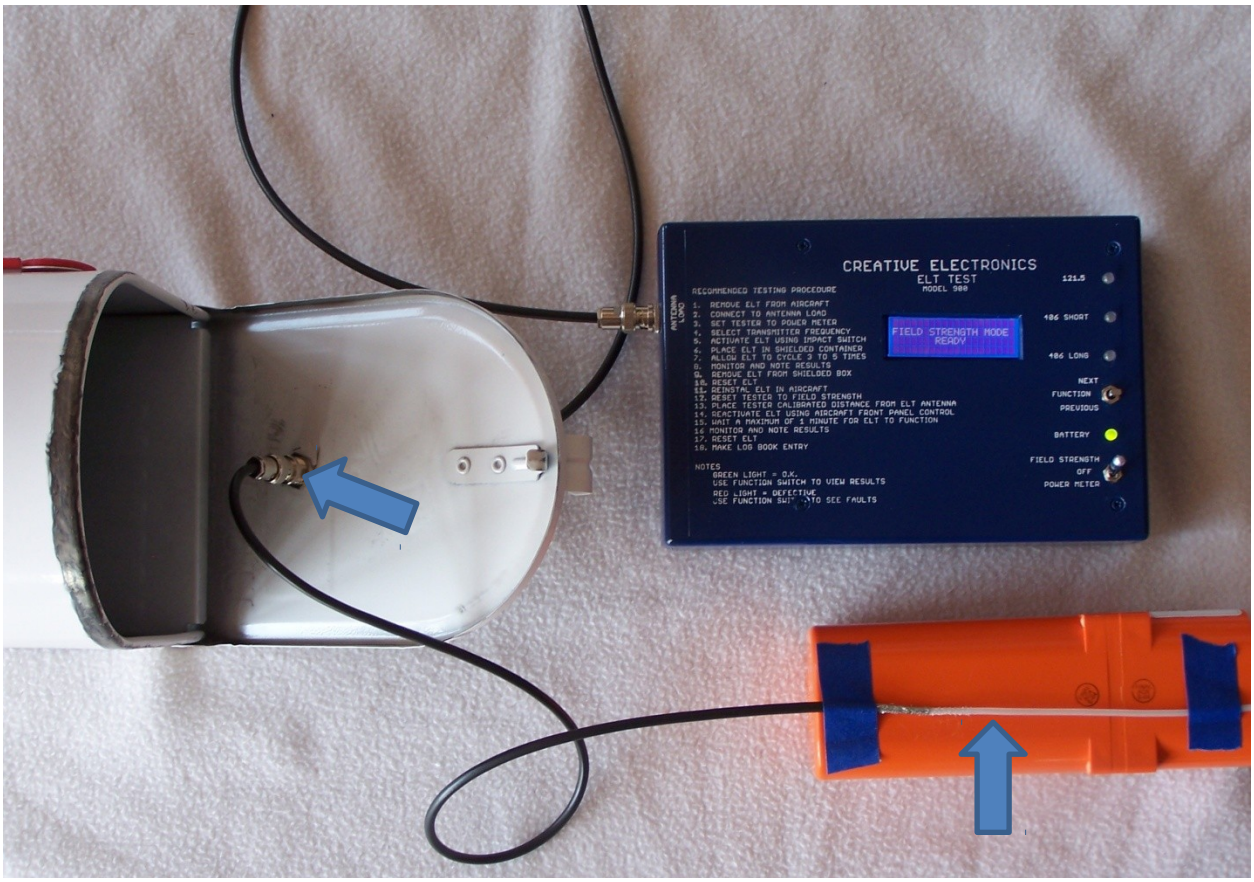
METAL MAIL BOX WITH PAINT REMOVED FROM EDGE AND DOOR FLANGE AND BULKHEAD CONNECTOR IN DOOR

Several sources and manufactures are available to obtain the bulkhead connectors. The one pictured here is available from Mouser Electronics (1-800-346-6873) their part number 530-CP-AD556M

BULKHEAD CONNECTOR



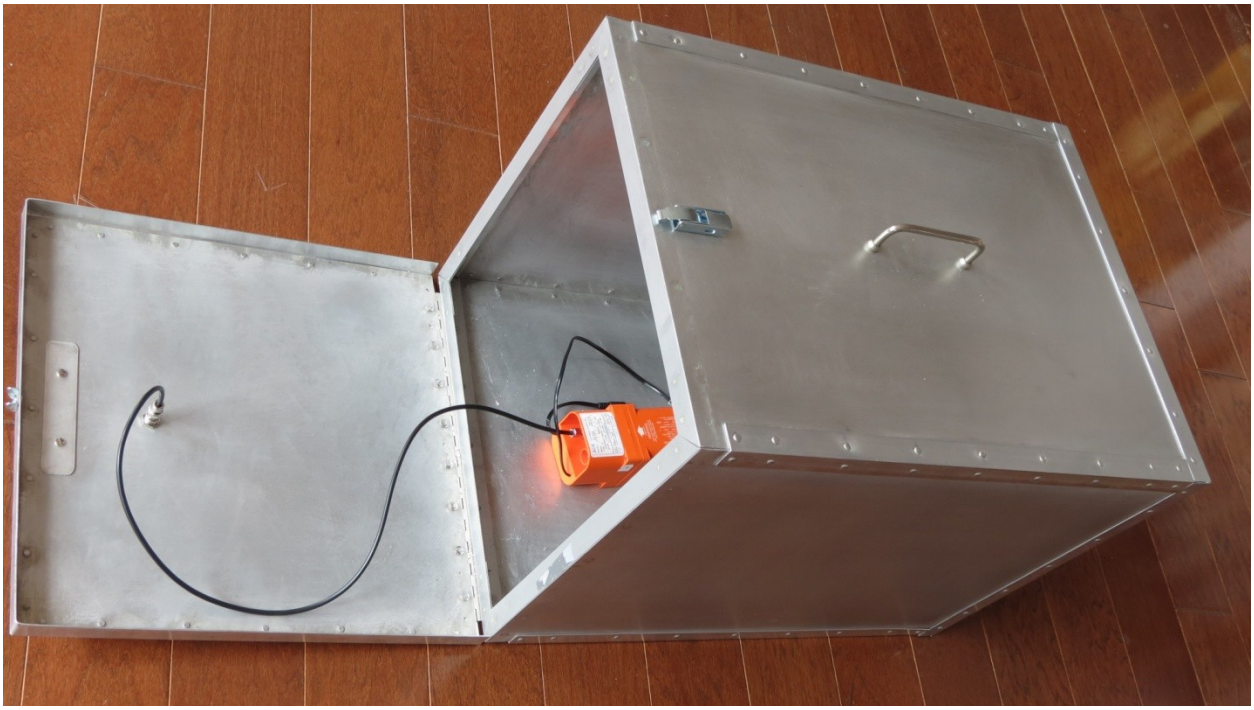
RF PICKUP CABLE



RF PICKUP CABLE SECURED TO ELT AND CONNECTED THRU BULKHEAD CONNECTOR TO TESTER

HOME BREWED METAL BOX

A suitable enclosure can be fabricated out of any convent sheet metal material that one is accustomed to working with. A piano hinge such as can be found at most hardware outlets should be used to fasten the door to the enclosure. It is important that the remainder of the door have a flange which makes good electrical contact with the opening of the enclosure. Failure to have a good contact here will allow excessive radiation to occur, possibly allowing reception by the satellite system and the costly initiation of a SAR mission. As with the mail box method, the same kind of bulkhead connector and RF pickup cable can be used.

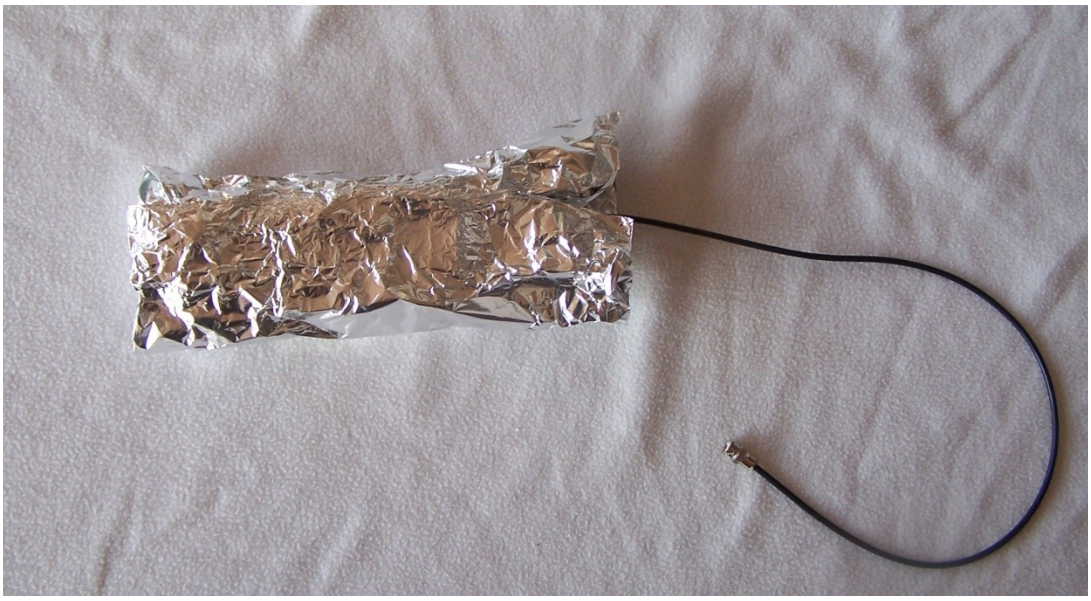


ALUMINUM FOIL WRAPPED ENCLOSURE

Aluminum foil if carefully wrapped around a non-conductive plastic encased distress beacon can be used to adequately shield the distress beacon to prevent inadvertent significant radiation of the signal being tested. It is important to ensure all ends and edges are securely and smoothly folded together, that there are no tears or rips in the foil, and that any connection between the tester and the device or signal probe located inside the enclosure is making a good contact with the aluminum foil used to shield the device.

STEP 1 TAKE A PEICE OF FOIL SLIGHTLY LONGER THAN THE LENGTH OF THE DEVICE

STEP 2 FOLD FOIL OVER THE LENGTH OF THE DEVICE



STEP 3 FOLD SIDE EDGES TOGETHER

STEP 4 WRAP A PART OF THE FREE END AROUND CONNECTOR SHELL AND SECURE THEN FOLD THE REMAINING FOIL TO SEAL THE END AFTER ACTIVATING THE DEVICE.

APPENDIX I FIELD STRENGTH MEASUREMENTS

While standards and procedures have been established for making precise measurements of the field strength of a radiated signal, the intent of field strength measurements with the ELT 1091C tester is to evaluate whether or not a distress beacon is sufficiently radiating a signal that can be received by the COSPAS-SARSAT system. Therefore, it is neither practical nor necessary to utilize the sterile environment utilized in making measurements used to certify various radiating systems, however, a basic knowledge of the variables that can effect such measurements can be helpful.

DISTANCE BETWEEN THE SOURCE AND SENSOR

The amount of measured energy for a given amount of radiated signal remains the same for a given amount of area that the signal is being radiated. Stated another way, if an object in the radiating field reflects some of the energy in another direction, that energy will appear as a reduction behind the reflecting surface, and an addition in the opposite direction. The reflecting surface can be of any conductive material or shape and will have the optimum effect if it its size and location is related to the frequency being radiated. Simply stated, an object that significantly affects 121.5 Mhz. will have a different effect on a 406 Mhz. signal. In any event the most reliable results will be obtained by making measurements where there are no intervening objects or objects located opposite from the radiating antenna. If such objects exist, a point 90 degrees from a line between those objects and positioned abeam the antenna should be used. A distance between the antenna and the tester should be established that will give a baseline to use in determining if an antenna and transmitter are functioning properly and is referred to as the calibrated distance which once determined should be used for all like measurements. A good starting distance is no less than 5 feet and no more than 15 feet.

THE EFFECTS OF DIFFERENT POWER LEVELS

The amount of measured signal on 121.5 will be substantially less at a given distance than that on 406 since the 406 signal can be as much as 20 times stronger than a valid signal on 121.5. While a specific reading on 121.5 Mhz. will be acceptable, it will not be so for 406 Mhz. Put another way, the 406 Mhz signal should be significantly stronger at the same distance than a 121.5 Mhz signal.

TESTER AND ANTENNA ORIENTATIONS

Most fixed installed antennas are vertically polarized and so when making field strength measurements, the tester should be orientated with the long axis also in a vertical orientation.

EFFECTS OF OBJECTS LOCATED NEAR THE TESTER DURING A TEST

As with objects located in close proximity to the radiating source (antenna), so it is with objects located near the tester while measuring the field strength. To minimize these effects and obtain more reliable results, it is best to place the tester on a non-conductive surface at the calibrated distance. This surface can be for example a wooden platform made specifically for this purpose or perhaps a plastic or fiberglass ladder that lacks metallic parts larger than a couple of inches in length. Once set up, the tests should be observed at a distance no closer than 2 feet, and the results will remain in the tester and once completed, can be viewed while holding the tester. Do not attempt to measure the field strength using the tester from the inside of a metal aircraft since the signal will be shielded and the results unreliable.

NOTE: ONLY RUN FIELD STRENGTH TESTS USING THE TEST MODE FEATURE OF THE BEACON. DO NOT USE THE NORMAL MODE AS IT WILL TRIGGER A SEARCH ALARM.

APPENDIX J TESTING LIMITATIONS

STARTUP DELAY The 406 Mhz. devices are required to not transmit an alarm signal immediately on a normal activation but not until one recycling period has elapsed, approximately 50 seconds. Since in many cases it is difficult if not impossible to accurately determine, measuring the delay then becomes more a factor of a random starting point. Therefore probably the best way would be to time this with a second hand of a watch. Note: this requirement does not apply to the test signal when using the self-test function of the beacon.

SELF TEST All beacons on the COSPAS-SARSAT system are required to incorporate a self-test feature. This feature has several limitations. If a beacon is required to have an automatic activation device as a part of its operation, the self- test, while it may check for electrical continuity of the circuit, does not check the actual operation of the automatic device that is used. While some self-tests check for excessive reflected energy from the antenna system, there are some failures of an antenna system which will absorb the RF energy rather than reflecting or radiating it resulting in a good self-test of a faulty system. The only way to verify the proper operation of an antenna system is by measuring its radiated field. Another shortcoming of the self-test is that some key elements used in generating the signal are also being used in the self-test and can result in, for example, one or more of the critical timing parameters being incorrect or if the transmitting frequency is wrong and can't be detected when the testing reference is the same as the source being used to generate the signals. The self-test can't check the recycling rate of the transmissions since it only sends one transmission, therefore, it can't determine if the beacon will send additional repeated signals following the first one. There are beacons that do not have a test position on a switch. These beacons when activated, usually with a switch, will initially send a test transmission and should be turned off after the test transmission has been completed or a maximum of 30 seconds after activation. If it is not turned off, then following the first recycle period, a normal or alarm transmission will follow and set off an alarm Finally, while the correct information may be internally presented to the transmitter, the self-test does not check the resultant signal to verify that the message has been properly sent, in other words the transmitter has been properly modulated and the message is correct.

APPENDIX K CABLE and CONNECTOR CONSIDERATIONS

Though they look the same not all coax cables or connectors are the same. As a result a cable that works O.K. on VHF frequencies (121.5 MHz) may not work well on UHF frequencies (406 MHz) which are more critical. It is important since it can affect the testing results. Subsequently we recommend using cables fabricated using RG 223/U or RG 400 and high quality connectors. This also applies to the cable used to connect the beacon to the antenna. When replacing a legacy 121.5 MHz beacon with a 406 MHz beacon, unless you know the type and condition of the cable, it should be replaced with the correct cable and connectors.

APPENDIX L CALIBRATION PROCEDURE

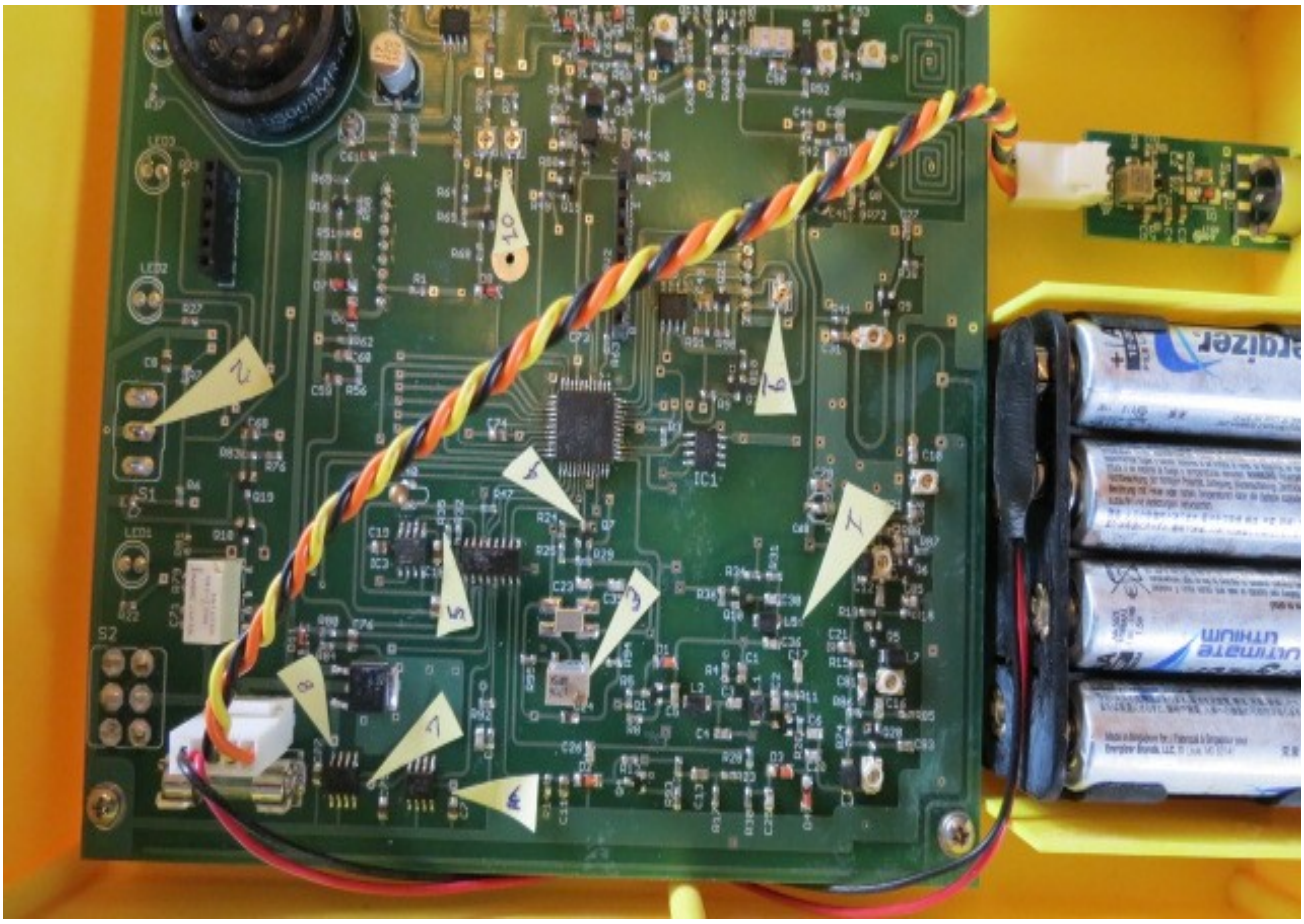
NOTE: If you are not proficient with the test equipment or familiar with using the following procedure, DO NOT attempt it.

REQUIRED EQUIPMNET

1. 10.000000 Mhz signal source NIST traceable
2. 2 Channel Oscilloscope with a 50 Mhz band width
3. Digital counter with .1 cycle resolution NIST traceable
4. Digital voltmeter with a resolution of 1 Mv

STEPS

1. Remove rear cover (6 screws)
2. Connect 10 Mhz signal source to either channel of scope
3. Connect scope ground to the ground location on the tester board (location 2)
4. Turn beacon tester on to either FIELD STRENGTH or POWER METER mode
5. Connect the other scope probe to hole in the board located next to “L5” on board (location 1). A small wire can be inserted in hole to facilitate connecting lead.
6. Adjust multi turn trim pot (location 3) until both the TXCO from the beacon tester and the reference signal are synchronized. NOTE: a small amount of shifting back and forth is acceptable.
7. Remove scope probe from Beacon Tester and connect the counter to the same locations (1 & 2)
8. Set counter to measure 1/10 of a cycle resolution.
9. Measure and note the actual frequency. A variation of up to 2 cycles is acceptable, however, variations of less than .5 cycles are not uncommon



10. Measure the voltages at the following locations
    Location 5 5.000v +/- .003 v NOTE: This chip is the reference for the ADC and all analog measurements
    Location 6 3.3v +/- .15 v
    Location 7 5.0v +/- .2 v
    Location 8 8.0v +/- .2 v
11. Record the results. NOTE: None of the above voltages are adjustable. If out of limits the respective chip will have to be replaced.

There are several other adjustment that can be made and will not affect the accuracy of the tester.

Location 9 Controls the intensity and contrast of the display

Location 10 Controls the audio level of either the 121.5 or 406 receivers

12. Re-install the back cover