

MEASUREMENT OF ELT 200 IN THE ELECTROMAGNETIC ATTENUATION CHAMBER AND ANALYSING IT UNDER IN REAL USE

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In the article, authors deal with present situation about the issue of emergency locator transmitters 'ELT' or 'EPIRB's'. The centre of their interest is to verify the correct functionality of those devices in condition of attenuation in electromagnetic attenuation chamber, which is the avionic department of faculty of aeronautics equipped with. The authors consider measuring of that devices within of the study program as an appropriate environment for experimenting but they also want, by the implementing the knowledge from practice to foreshadow the options of searching the improvements. It is mostly about solving of different sort of problems connected mainly with unintentional transmitting of emergency signal or self-activating of 'ELTs'.

Key words: Emergency locator transmitter, ELT malfunction, ELT self-activating, false emergency signal

1 INTRODUCTION

An increasing of the volume of aviation transport has brought also bigger hazards of to create the air incidents and not least to create aviation accidents and catastrophes. This state has made a pressure on international aviation organizations, which has taken a precautions and procedures for manufacturers and for operators of aeronautical technics. One of those things is to inevitability of installing different kind of anti – collision and anti – crash equipment's with an intention to identify and turn away of dangerous situation and states. These devices have had still some limits of their working. Of course there is the same impossible to turn away of the failure or some air situation, which lead to unfulfilled of mission or when it is impossible to fly further and pilot has to land or it has happened some catastrophe or accident.

Separate categories of avionics equipment are emergency radio beacons *EPIRB* or the more known term is *ELT*. These emergency locator transmitters has to be regularly tested because of verification their correct functionality and their standby state. Overall process of testing is limited by international procedures, which make an effort to suppress of false reports about emergency state or some other occurrence. In this article, authors deal with the possibility to make tests in special laboratory conditions.

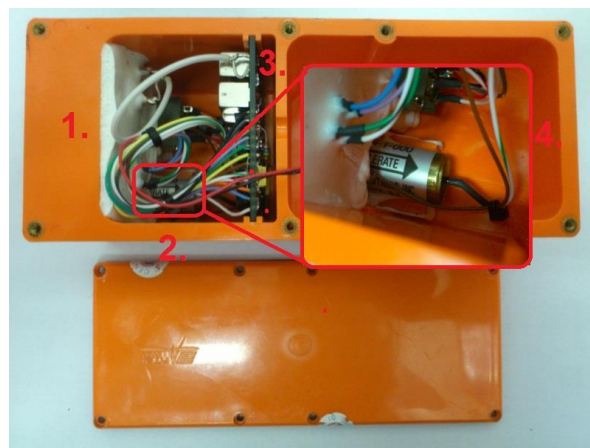


Picture. 1: view at activated emergency transmitter

2 BASIC INPUT FACTS ABOUT ELT

ELT or emergency locator transmitter is the device, for quick and exact localizing of persons in case of emergency. These devices are installed mostly on board of ships, helicopters and planes. However the miniaturization of electronic elements has brought also to option for using them by common people, for instance for hiking, extreme sports, and so on. In this article the attention will be focused to *EPIRB (ELT)*, the transmitter used on aeronautical technics.

The *ELT 200* transmitter is available at the department of avionics at faculty of aeronautics. It is more or less the older device which after its activation works simultaneously on 2 emergency frequencies: *121,5 MHz* and *243 MHz*. Transmitter can be activated in two ways. The first is manually by the switch, situated in cockpit in the range of pilot hands, or the second way is to activate it automatically, by the signal of run over the *G* - forces from built in accelerometer, which are specified by manufacturer. The evaluation logic watches overreaching of *30g* or the speed of velocity change more than *3,5 ft* per second.



Picture. 2: 1.) Transmitter body, 2.) accelerometer (G-switch) 3.) PCB of transmitter, 4.) space for the battery pack

Device is consisting of several elements. Except the solitary transmitter it is also the antenna, situated on the surface of each aircraft, coaxial conduction wire and control panel in cockpit. The control panel includes switch with 3 positions: *ON* – the device is transmitting

emergency signals, *OFF* – the device is non -active, *ARMED* – the device is ready and waiting for the overreaching the level of overloading. Its value depends on each model of *ELT* and its manufacturer.



Picture 3: view at front side with connectors (for antenna and cabin switch) and main switch

Due to the fact, the emergency transmitters are the object of study in several study programs at Faculty of aeronautics. It was decided to put the *ELT* to run and subsequently to impose it institutional process as a study auxiliary or tool.

3 CONDITIONS FOR STANDARD TESTING

On the base of international agreements were accepted rules about the conditions when it is possible to transmit on emergency frequencies without the false emergency reports about emergency situation. In general it is possible to transmit in each from 12 month of the year, still after the entire hour, maximally until the 5 minutes after. During this time doesn't have to be dispatched more than 3 cycles of emergency signal. On the United States area is possible to transmit in other times than it was written before but only after the arrangement with the local air traffic or with the office of *FAA*.

Because the schedule of each study program has its own limits, it has been necessary to find the suitable way how to demonstrate a principle of working the emergency transmitter to students. One of the options was the utilizing of the EMW attenuation chamber at department of avionics in combination with the newest measure equipment supplied by the project "Construction of a research & development laboratory for airborne antenna equipment".

4 ELECTROMAGNETIC ATTENUATION CHAMBER

Attenuation chamber is a bordered space, which is protected before the inputting of any electromagnetic emission from the outer environment which is surrounded by this room. Simultaneously it is impossible to emit any electromagnetic wave or energy into the outer area. What is more, the interior of the chamber is designed for the purpose of non-reflection of the wave from the walls. As it seems to be from that information, the chamber is the ideal environment for testing the emergency transmitters without any false emergency signal report.

5 MEASUREMENTS

Steps of the overall measure are described in following lines. As a first it was necessary to make a battery pack as a power supply for the transmitter as it needs voltage of 9 Volts to be operational. The battery pack was made by the connection of 6 pieces of the type C battery, with the connector ending to sample of genuine pack.

For the verification, if emergency transmitter is really working a spectral analyser *Rohde & Schwartz FSH8* was used. That analyser was switched on in *Network analyser* mode and set the range of measure at value from 100 to 300 MHz. Then it was plugged – in, by the connecting the cable to the transmitting antenna. Next the chamber was closed with *ELT's* switch in *OFF* position. By the spectral analyser it was checked if it had not activated the transmitter. As a control indicator of operation of the transmitter the *LED* diode situated in switch is used. Subsequently that switch was switched in to the position *ARMED* and also checked if transmitter had not been activated. As a last step the switch was switched in to the *ON* position. In that moment two expected frequencies emerged on the display of spectral analyser: 121,5 and 243 MHz.

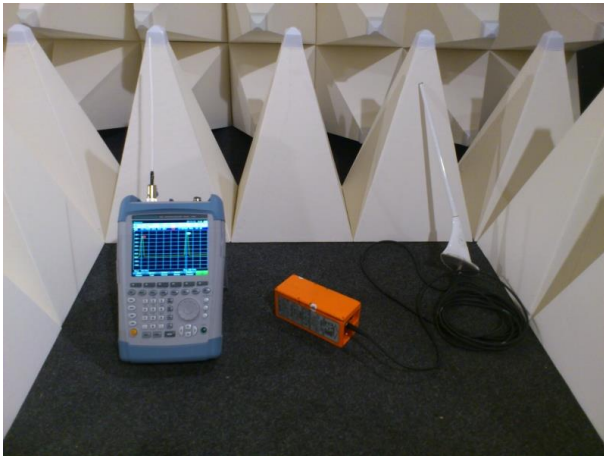


Picture 4: view on spectral analyser display with received emergency signals

Next the switch was switched in to the *ARMED* position, and emergency transmitter was dropped on the floor by 3 different positions, however that type of *ELT* is

able to activate only by overreaching the overloading only in one axis as it is demonstrate in picture 2.

As it was have expected, in two axes the transmitter have non - reacted. On the contrary after the fall in third axis, the transmitter started to work and became activated. After that experiments we pointed out, the emergency transmitter is functional in all its modes.



Picture 5: view on an experimental set

To verify of the fact if there is really any electromagnetic emissions behind the chamber, the other control measurement was done. During this time, the transmitter was switched on inside the chamber. The control measurement affirmed no emission of radio waves into the area out of the chamber.



Picture 4: verifying of „radiopaque“ of the signal

6. FROM LABORATORY TO PRACTISE

Our experiment indeed affirmed, the fact, our *ELT* is functional and ready for use. As it can be seen from our experiment, one of our guide line is to implement that simple measurement into the study programs in the area of that issue. Practices from real condition shows us and suggest us to use that measure and impress its importance mostly in real usage. That state comes on the one hand because of verifying of correct working of *ELT* but mainly of purpose to early stop, non-correct activity, which can lead to generate the false emergency signal. No doubts about the evidence of huge wide spreading of emergency locator transmitters. The reasons for it are several. Firstly it is the impact of general aviation transport increasing. In the next there are flight rules and procedures of ICAO, which demand the installation of *ELT* on boards of vast majority of the aircraft as a requirement for their flight competence. As a not least there is so-called voluntary installation of *ELT* on the aircrafts, which do not need them inevitable as a requirement for the obtaining of flight competence. The owners and operators of that aircrafts just from their own will, with intention of improving the safety, they buy the *ELT*, in the better case keep the specialist to mounted it on, in the worst case, they install it by themselves.

In air transport one come across with huge types of aircraft. Everyone tends to transport people or cargo by the aircraft of high effectiveness and safety of course. To modern avionics built – in up on the boards, which should fulfil that requirement, we often meet with the installation by non- specialists. These avionics systems, work more or less properly by keeping them in the common conditions.

Problems begins when we installed one, which is due to not-correct installation or due to other reasons, out of the tolerance of procedures or it is electromagnetically incompatible with other devices which have been installed on board yet. Following influence of each other can leads until their improper function to total un-functionality. One of these exposes is so – called self-activation of emergency locator transmitter, *ELT*.

7. FALSE EMERGENCY SIGNALS

Offices for safety of flights of all around the world continual monitor the emerging of generation of emergency signals. The ratio of intentionally and unintentionally activates transmitters is by the NTBS really high as it is shown in next table:

Activating <i>ELT</i> in 2005 - 2007	
Unintentionally activated <i>ELT</i>	75%
Intentionally activated <i>ELT</i>	25%

Table 1: The reasons of *ELT* activation

If in the next it can be dealt only with the failures of *ELTs* can be find out, that these huge part of unintentional activation or also of total malfunction of

overall *ELT* during the real neediness to transmit an emergency signal. The reasons of malfunction are several. From the reachable sources and by our analysis the following nine facts can be defined which cause, that functionality of the *ELT* was limited or not correct:

1. Insufficient G's
2. Improper installation
3. Low battery
4. Battery contacts corroded
5. Improper installation of battery
6. Incorrect type of battery
7. Damage by the impact or by fire
8. Damaged antenna or unplugged from the block
9. Internal failure – un-functionality or tendency to self-activate

8. SELF-ACTIVATION

The list above shows us a complex situation in the issue about the usage of *ELT* transmitters on aeronautical technics. The point number nine reflects the reality of existence the reasons due to them comes up to self-activation of the transmitter, while there were keep all the procedures during the installing of the transmitter. That eventuality is very hard to predict, or uncover. Producers of that devices test the circuit and functions of each piece, but during the usage in real condition, for instance in the high humidity or changing of temperature or by influence the vibration have caused, that as times goes by, the device not have a parameters which had been certificate by producer's output control.

Knowledge from practise had shown us the occurrence which can be called as a self – activation. The most often it happens by the combination of several factors. It is caused mostly by degradation of parameters the *ELT*, length of the coaxial lines, position of *ELT*, position of *ELT* antenna distance the *ELT* from other radio equipment and distance from other antennas.

The observation affirms that to unintentional activation comes by transmitting by on board radios or by switching on of the navigation equipment working on frequencies close to 121,5MHz and 243MHz. The vast majority is caused by transmitting the radio with bigger power when after that, it comes to generating the false emergency signal. It is really unique if almost new *ELT* is self – activated.

9 CONCLUSION

The device *ELT* is admittedly necessary equipment for the help to fast location of the people or the aircraft in emergency situation, mainly if there is no other way how to localize them. Nowadays, in purpose to improve the characteristics of that transmitter in air traffic it is mostly used also the new frequency 406,025Mhz,

which allows also to use built – in *GPS* module, to transmit also its position data.

By the all positives things of that kind of transmitter there are also the phenomenon's as a self-activating. So it is inevitable to sear for them in the process design, manufacturing and installation of the *ELT* on board of the aircraft. The measurement by the help of spectral analyser in attenuation chamber and next experiments in the area of searching for the dangerous frequencies, powers, situation of antennas, devices can properly add and contribute to improvement of the situation not only for that type for the *ELT*, which is for that purpose used.

Though this sequence of the measurement within the frames of the study programs has added another dimension due to its real contribution to increased reliability of avionics systems and the safety of flight, too.

ACKNOWLEDGMENT

This work was funded by the European Regional Development Fund under the Research & Development Operational Programme project entitled "Construction of a research & development laboratory for airborne antenna equipment, ITMS: 26220220130."

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