# - ELT: A Solution to Localize Crashed Aircraft? –

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ELT is the acronym for Emergency Locator Transmitter.

It is an equipment which may occupy slightly less volume of a normal shoes box. It is inserted in a metallic hermetic box with the traditional red and yellow colors of emergency equipment.

It is a transmitter that operates in civil aviation on 121,5 MHz and 406.0MHZ, employing about 1.5 W for transmission on 121.5MHz and 5W on 406MHz. The ELT installed in military aircraft also operates in the frequency of 243.0MHz.

Since 2009, it is mandatory to install the ELT, with the frequencies above, in the civil aircraft registered in Brazil (RBAC 91,207).

Other regulatory agencies (FAA, EASA) also require the installation of ELT with the mentioned frequencies.

It is also required that one of the lifeboats available in the aircraft has an ELT.

For those people unfamiliar with the device, we can say that it is a transmitter which sends emergency signals to another aircraft and satellites after the impact of the aircraft with the ground. The satellites, in turn, relay those signals to ground receiving stations, which send the information to mission control centers. Finally, the information is passed to the centers of rescue coordination, which then begin to search.

The indication accuracy of the ELT can reach to less than 10 meters.

Now, a surprising information: only 25% of the ELT has functioned after an accident, in most cases probably because it was not correctly activated or not activated on impact with the ground or destroyed in the accident..

Since the crash of the Air France Airbus in the Atlantic Ocean, on the route Rio-Paris on June 1, 2009, we have thought of writing something about it. Some people have questioned us why the ELT on board the aircraft did not transmitted signals which could have allowed the location of the crashed aircraft.

We also remember that when we were working in the Division of Aerospace Products Certification, we received an application for certification of an ELT installation in a fleet of the Air Force aircraft.

On occasion, we informed the applicant for certification that because most of the aircraft operation scenario be the space on the sea, the probability of a fatal accident occurs in such environment was high, with a subsequent dip of the aircraft in the sea.

We also said that following the impact, the equipment probably would work, but the electromagnetic waves emitted would not go out into space, being fully absorbed in the sea. As a joke, we said that "the fishes would eat the wave."

Very well, now let's show why the transmission to the outer space does not occur when the transmission comes from inside the sea.

In General, when an electromagnetic wave is propagated in any medium, its electric field (which carries the information) suffers an attenuation, which depends on the electrical characteristics of the medium.

The attenuation is greater the higher the frequency of the wave. The mathematical expression (Ref. 1) for this attenuation is given by:

$$\mathbf{A} = e^{-\delta x} \qquad (1)$$

Where,

**A:** ratio between the amplitude of the electric field at a distance **x** from the transmitter antenna and the amplitude of the electric field on the antenna;

**δ:** **absorption coefficient** = **2π (30σ/λ)$^{1/2}$** ($m^{-1}$), being **σ** the conductivity of the propagation medium (Siemen/m or S/ m), **λ** the wavelength (m ), and further **λ** = **c/f**, where **c** = 3 × 108 $ms^{-1}$ f: wave frequency; and

**x:** distance (m) from the ELT antenna to the point at which the field is being evaluated.

In the case of sea water, $\sigma = 4$ S / m.

Considering the best case (less attenuation), ie the lowest frequency of the wave emitted by ELT, 121.5 MHz, we have:

$$\delta = \mathbf{43.8\ m^{-1}}.$$

With this data, one can calculate the distance to get a reduction, for example, of 106 in the amplitude of the wave emitted by the ELT, reduction that practically already makes unfeasible the capture by the receivers known at present time.

$$e^{-43,8.\mathbf{x}} = 10^{-6} \Rightarrow -43,8\ \mathbf{x} = -6\ \ln 10 \Rightarrow \mathbf{x} \cong \mathbf{0,32m\ \ ou\ 32cm.}$$

As we see, the reduction is drastic.

If we make the same calculation by using the 406MHz frequency, we have:

$$\mathbf{x} \cong \mathbf{0,17m} \text{ or } \mathbf{17cm.}$$

Now imagine the Airbus - Air France Flight 447, one Airbus 330-200, which plunged into the Atlantic Ocean in a depth point between 3.000me 4.000m, with the ELT that it had aboard. Even if the device had operated, the electric field at the surface would be virtually null.

The Airbus aircraft have, within their Flight Data Recorder (FDR), fixed on its memory unit, a sort of radio locator beacon, the Underwater Locator Beacon (ULB), which under immersion transmits an acoustic signal in frequency of 37.5 kHz in one second intervals.

With such low frequency and even in deep water, the signal can reach the surface. Today, studies are being done to reduce the frequency even more, trying to get about 9kHz, and as we have seen, as lower is the frequency better is the signal propagation through the sea water.

Airbus is also conducting studies to equip their aircraft with an automatic free floating deployable ELT, attached to the external part of airframe, automatically deployed away from aircraft and activated either on impact, manually from the cockpit or by water detection. This would undoubtedly an excellent solution.

We stop here. See you.

References:

DOLUKHANOV, M. Propagation of Radio Waves, Mir Publishers, Moscow (USRR), 1971, pp. 26-30.

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