# What's in a Number?

# 121.5 MHz versus 406 MHz ELTs

by Matt McDaniel

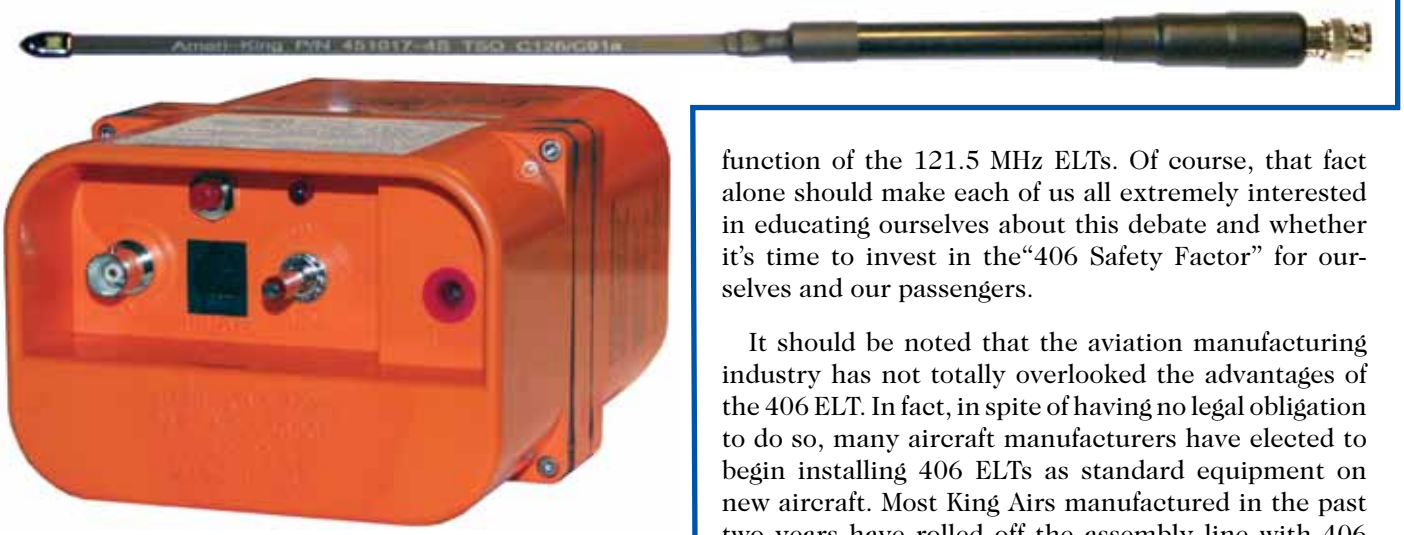
It has been 37 years since Emergency Locator Transmitters (ELTs) were first made mandatory equipment on U.S.-registered general aviation aircraft. Those first-generation ELT units were notorious for their incredibly high false alarm rate (estimated as high as 97%). They also had an equally uninspiring record when it came to activating properly when needed; only working correctly in about 25% of crashes according to a statistic published by the Aircraft Owners & Pilots Assoc. (AOPA). As with most equipment aboard U.S. aircraft, ELTs are subject to FAA Technical Standards Orders (TSO). Those early ELTs were governed by TSO-C91 and remained in primary service from 1973 until 1985.

The many shortcomings of the original ELTs were recognized, and in 1985, the FAA instituted TSO-C91A. The revised TSO was aimed at providing higher levels of reliability. These improved ELT units did have a positive improvement in activation rates during crashes. But, the exact level of improvement is hard to gauge as it varies tremendously between sources, ranging from as low as 30% to as high as 73%. False alerts from hard landings also decreased with TSO-C91A ELTs. Regardless of the specific improvement numbers quoted, this second-generation of ELTs was certainly an easy upgrade decision, as they were relatively cheap to purchase and install. The majority of GA aircraft, including most varieties of King Airs, are flying with TSO-C91A-compliant ELTs today.

The third generation of ELTs first came on the scene over a decade ago. With them came dramatic improvements in operation, reliability, accuracy and coverage.

These new ELTs are built to TSO-C126 and are commonly referred to as "406 ELTs". The 406 refers to the Megahertz (MHz) frequency the units transmit their signal over. The first two generations of ELTs were 121.5 MHz units, while this new generation operates at 406 MHz (or, technically speaking, 406.025 MHz). Some sources indicate these ELTs activate properly during crashes at least 80% of the time. That particular point is countered by other sources stating that insufficient hard data exists to back up that claim, mainly due to the relatively low number of actual crash activations. Either way, to date, the FAA has still not made them mandatory equipment in general aviation aircraft. Rather, in spite of having already been around for so long, 406 ELTs remain an optional upgrade for existing 121.5 ELT users. Because 406 MHz units are a relatively expensive upgrade even today (and very expensive for the earlier 406 MHz models), aviation advocacy groups such as AOPA have vigorously fought all proposals for making them mandatory in the United States. Their positions have generally been that the upgrade from a 121.5 MHz ELT to a 406 MHz ELT should be voluntary and left to the discretion of the aircraft owner/operator, mainly to forego imposing any unnecessary financial burden upon them. In contrast, 406 MHz ELTs have been mandatory for some time in Europe and elsewhere.

The National Transportation Safety Board (NTSB) has made multiple recommendations to the FAA to mandate the use of TSO-C126-compliant ELTs (406 MHz) in the United States, dating as far back as early 2000. NTSB recommendations on this matter have always stressed the distinct safety advantages of the 406 units, while often giving specific examples of accidents where the 121.5 ELTs proved to be essentially useless versus specific examples of accidents where 406 ELTs were directly credited with providing



*AmeriKing's AK-451 series of 406 ELTs is fully approved by the following: FAA TSO C-126/91a, European EASA ETSO 2C-126/91a, Transport Canada and Industry Canada, and Brazil Anatel.*

the necessary information which resulted in lives saved. To date, the NTSB's recommendations have not been sufficient to force the FAA's hand or to sway the official stance of several aviation groups. Surprisingly, that opposition has continued even after the phase out of 121.5 MHz satellite monitoring in early 2009, which, for all practical purposes, eliminated the alerting function of the 121.5 MHz ELTs. Of course, that fact alone should make each of us all extremely interested in educating ourselves about this debate and whether it's time to invest in the"406 Safety Factor" for ourselves and our passengers.

It should be noted that the aviation manufacturing industry has not totally overlooked the advantages of the 406 ELT. In fact, in spite of having no legal obligation to do so, many aircraft manufacturers have elected to begin installing 406 ELTs as standard equipment on new aircraft. Most King Airs manufactured in the past two years have rolled off the assembly line with 406 ELTs installed. However, prior to that, 121.5 ELTs were still standard and there's been no mandate to upgrade those aircraft.

## Why Upgrade?

If you fall into the category of an owner/operator or pilot utilizing an aircraft without a 406 ELT, what's in it for you or your passengers if you upgrade? Table 1 (on page 16) shows a synopsis and is quite self-explanatory. Nonetheless, the primary reason mentioned above is the most compelling, in my mind. In February 2009,

the international satellite system which monitored the 121.5 and 243 MHz frequencies ceased doing so. The motive for the cession of monitoring are many, but the main reason stated was the high percentage of false signals transmitted. As a result, distress signals transmitted over the 121.5 or 243 MHz frequencies now have no satellite detection services and are only monitored by ground-based sources, such as local airport and air traffic control facilities. Of course, airborne aircraft monitoring those frequencies would also have the ability to detect an ELT signal on those frequencies (*if* they happen to be monitoring it and *if* there are no line-of-sight limitations imposed on the signal). However, in such cases there is still no Doppler location capability and all the overflying aircraft's crew can do is report hearing an ELT.

Therefore, while still perfectly legal, 121.5 MHz ELTs now provide *extremely* limited support in any aircraft accident scenario. That is particularly true if the accident occurs in remote areas or in vicinities where surrounding terrain or obstructions would impose severe line-of-sight limitations on the ELT's distress signal. Because 406 MHz continues to be monitored via satellite, distress signals on that frequency can still provide both worldwide distress alerting and much better location accuracy. Additionally, as can be seen in Table 1, 406 ELTs are far superior in terms of pinpointing the position of the distress signal (i.e., locating the survivors). Most 406 ELTs are capable of being fed GPS data. This allows them to transmit very precise location coordinates along with the other data they would automatically transmit in an emergency. The 406 ELTs can receive that GPS information from most modern GPS units, via a simple connection between the ELT and the on-board GPS, which can be added at the time of ELT installation. With GPS input, the 406 ELT can pinpoint your position within 300 feet

**TABLE 1: Comparing 406 MHz and 121.5 MHz ELTs**

| 406 MHz | 121.5 MHz |
|---|---|
| **POWER OUTPUT** | |
| 5.0 Watts – Easy to detect, "sees" through many types of overhead cover and improves accuracy. | 0.1 Watt – No satellite monitoring. Extremely low wattage also makes signal much more susceptible to interference between the source and ground-based monitoring facilities. |
| **COVERAGE** | |
| Global via low-earth orbiting satellites.<br><br>Between 70 degrees North and 70 degrees South latitudes via geostationary satellites (provides nearly instantaneous detection). | Via ground-based sources and overflying aircraft only. Both limited to line-of-sight. No satellite monitoring. |
| **ALERTING** | |
| First location alert warrants launch of SAR assets. Earlier launches puts assets on scene sooner – an average three hours saved in maritime, six hours saved on land. | High false alert rate makes first-alert launch unfeasible. Absent independent distress information means RCCs must wait for additional alert information. |
| Average initial detection/alerting by orbiting satellites are about 45 minutes, with maximum of 90 minutes. | No satellite monitoring. |
| Average subsequent satellite passes every 60 minutes, with maximum of 90 minutes. | No satellite monitoring. |
| Beacon ID combined with registration data and point of contact information allows rapid verification and launch or stand-down. | Alerts are anonymous. Analog technology not capable of transmitting data. |
| Allows false alert follow-up to continuously improve system integrity/reliability. | No false alert follow-up capability. |
| Near instantaneous detection by geostationary satellites. Beacon ID combined with registration data and point of contact information allows potential for near real-time immediate launch of SAR assets even without beacon derived location information. | No satellite monitoring, No digitial beacon ID info transmitted. |
| **POSITION INFORMATION** | |
| One to three nm (two to five km) accuracy on average. Position calculated by Doppler shift analysis. Position information on first satellite pass. | No satellite monitoring, so no Doppler location. |
| Better than 300 feet accuracy with GPS-equipped beacons. GPS position processed with initial alert, near instantaneous via geostationary satellites. | No GPS capability. |
| **SURVIVOR LOCATION** | |
| Position accuracy (non-GPS) limits initial search area to about 25 sq. nm (65 sq. km) or better. | No inherent survivor location. |
| GPS-equipped beacons reduce search area to virtually pinpoint area. | No GPS capability. |
| Homing signal facilitates final short-range survivor location by radio detection finder equipped search units. | Signal facilitates survivor location by radio detection finder equipped search units. Large search area makes this more difficult and problematic. |
| **FALSE ALERTS** | |
| All alerts come from beacons. Satellite beacon transmissions are digital, coded signals. Satellites process only encoded data, other signals are rejected. | No satellite monitoring |
| About one in 12 alerts are actual distress. | Even with previous satellite alerting, fewer than two in 1,000 alerts were actual distress. |
| Beacon-unique coding/registration allows rapid incident corroboration. Registration mandatory since 1994. Ninety percent of beacons are registered. About 70% of false alerts are resolved by a phone or radio call to registration point of contacts prior to launching SAR assets. | Since beacons transmit anonymously, the only way to ascertain the situation is to dispatch resources to investigate – a costly disadvantage that puts SAR crews at risk unnecessarily.<br><br>High false alert rate and no satellite monitoring make first-alert launch unfeasible. |
| **THE FUTURE** | |
| International standard for the foreseeable future. | NO FUTURE |
| Next generation system already being fielded is 100% backward compatible and results in improved accuracy and shorter alert times with current available beacons. | Satellite processing ceased on February 1, 2009.<br><br>Use of 121.5 MHz EPIRBs by U.S. boaters was illegal effective January 1, 2007. |

(down from its already impressive one to three nm without GPS input). All these monitoring and accuracy capabilities make for faster search-and-rescue (SAR) operations, which translate directly into quicker evacuations and access to medical treatment. Finally, each 406 ELT is registered and, therefore, SAR personnel have access to significant data about the specific aircraft that it's transmitting a distress signal and location information from.

The price of 406 ELTs for general aviation aircraft has been fairly steady in the $1000 range for some time now. However, just in the past year or so, some are beginning to enter the market in the $500-$600 range. Many ELT manufacturers are now developing models that can be installed as drop-in replacements for previous 121.5 MHz models, which greatly simplifies installations, lowering both labor costs and aircraft downtime. Given the price point of owning/operating even a smaller model of King Air, this upgrade would account for a very small percentage of typical operating/maintenance costs. As with most upgrades, you should educate yourself on the options and make the decision that is best for you and your operation.

There is no single source that I am aware of that is better for educating yourself on 406 ELTs, Personal Locator Beacons (PLBs) and all manner of survival equipment than *Equipped To Survive (www.equipped.org)*. Doug Ritter does an excellent job of reviewing the various options available to pilots, as well as the requirements of using each. He also designs a variety of survival gear for pilots and provides links to other seller's sites. [Note: I am not affiliated with ETS in any way.] I think after doing even a moderate amount of research you will discover that upgrading to a 406 ELT is a pretty cheap insurance policy. Should you ever find yourself in the highly undesirable situation of being involved in a crash scenario, I'm sure

you'll be glad to have the digital accuracy and satellite monitoring that only a 406 ELT can provide. KA

**About The Author:** Matthew McDaniel is a Master & Gold Seal CFII, ATP, MEI, AGI, & IGI. In 20 years of flying, he has logged nearly 11,000 hours total, over 4,000 hours of instruction-given and over 2,500 hours in King Airs & the BE-1900D. As owner of Progressive Aviation Services, LLC (*www.progaviation.com*), he has specialized in Technically Advanced Aircraft and Glass Cockpit instruction since 2001. Currently, he's teaching clients nationwide, via personal flight training and seminars, providing contract pilot services in a wide variety of corporate aircraft. He's also an airline and corporate pilot, having flown a wide variety of airliners & corporate jets and holds five turbine aircraft type-ratings. Matt can be reached at: *matt@progaviation.com* or (414) 339-4990.