406 MHz ELTs:

U.S. Coast Guard photo by Lt. Jon Bartel

They Work . . .
When Mounted Correctly

STORY BY DAVE HIGDON

The word spread within general aviation circles like a wildfire on the prairie: Alaska's former senior senator, Ted Stevens, was in a missing bush plane.

But, the 406 MHz emergency locator transmitter installed in the DHC-3 Turbo Beaver provided no help – not a peep was detected by the overhead satellites tuned to listen for these electronic cries for help.

According to many critics and debaters, this proved the fallacy of the regulations requiring all new ELT installs to employ the 406 MHz ELTs, which broadcast their beacon signals on the frequency with satellite-based sensors.

As the saga quickly unfolded, the DeHavilland was found the old-fashioned way, by searchers following the expected route between the departure and arrival points.

The naysayers, meanwhile, thought they had an "Ah, ha" moment, refuting the admittedly glowing promises of the new-tech emergency beacons.

But, that moment dissolved during the investigation by the National Transportation Safety Board.

And, in the interim, the 406 ELTs slowly, incrementally began to establish a success record in American aviation circles to match the patterns long-prior established in other arenas.

The problem is convincing a skeptical public of the benefits – a debate that exists nearly 40 years after the Federal Aviation Administration mandated 121.5 MHz units.

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>
> *Bruce McPherson*, president of Pointer Avionics

Failure Logic

The logic had long prior permeated international flight operations, the maritime community and millions of hikers and campers: the 406 can be more-easily pinpointed by itself and, when informed with coordinates from a GPS sensor, so precisely that searchers start with a search area defined as less than a mile square – and closer to the area of a football stadium.

A lot better, came the promise, than the relative needle-in-haystack search area defined by a satellite receiving the old, still legal 121.5 MHz beacons long required in aircraft.

The decision to require emergency locator transmitters was born of another Alaska accident that took the lives of two American lawmakers, Rep. Hale Boggs of Louisiana, at the time the Majority Leader, and Rep. Nick Begich, Alaska's first-term at-large House of Representatives member. Begich's aid, Russell Brown, and pilot, Don Jonz, also presumably perished when their Cessna 310 vanished on a flight between Anchorage and Juneau.

Extensive search work failed to produce any sign of the aircraft – an aircraft which remains missing today.

The FAA eventually mandated the addition of internationally accepted 121.5 MHz locator beacons, in part, because of this accident. Subsequently, the search and rescue satellite aided tracking system – SARSAT – came on line thanks to the efforts of the National Aeronautics and Space Administration.

Several states had already enacted their own limited ELT requirements by the time the FAA moved forward.

The subsequent history of 121.5 MHz units proved less than stellar – even while producing many lifesaving results.

When the U.S. Coast Guard and international authorities began pushing for use of the 406 MHz systems in the 1990s, maritime operators and others started gravitating to the newer, more flexible units.

Eventually, in February 2009, satellite monitoring of 121.5 MHz ended by international agreement. The FAA issued a new technical standard order for new installs of ELTs. But, the agency stopped short of mandating wholesale replacement of those units, and searchers, pilots and air traffic control facilities still monitor the frequency.

A step by the Federal Communications Commission to outright ban sale and use of 121.5 MHz ELT was beaten back in 2010, in large part due to the efforts of the Aircraft Electronics Association and others. The AEA enlightened the commission about the impossible logistics of a short-term mandate to convert more than 300,000 aircraft to the new 406 technology.

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In the meantime, the avionics industry has worked to resolve the early complaints of aircraft owners and pilots about the relative lack of available units, the relatively high costs, in both pure terms and when compared to the old-technology 121.5 units, and the belief that the new units offer no better protection or better functional reliability than the old technology.

A significant problem, according to Bruce McPherson, president of Canada's Pointer Avionics Ltd., is the lack of information.

"There's no real factual data on ELTs – not by the FAA, NTSB or Transport Canada," McPherson said, whose company makes 406 MHz ELTs with integral, self-powered GPS. "After a crash, nobody says, 'Yeah, the ELT was powered correctly, mounted correctly, connected correctly,' so people tend to believe, 'See those darned switches don't work like they should,' and they write off the value of the ELT."

Such a scenario arose after the DHC-3T Turbo Beaver failed to arrive at the fishing lodge expecting it. The staff followed protocols for overdue aircraft and called back to the departure point about four hours after its expected arrival.

In the interim, the COPAS/SARSAT satellite system heard nothing from the 406 MHz ELT installed in and registered to the aircraft.

The critics seized on their perceived vindication.

Many naysayers claimed the new ELTs aren't any more reliable at triggering than the old 121.5 MHz units with their notoriously unreliable mechanical inertial switches – often little more than a weight on a hinge that in a crash was supposed to pivot forward to flip a simple toggle switch.

But, allegations of the technology's failure were unfounded, even as the apparent failure of the ELT alarmed the NTSB; the lives of four survivors were risked because of the delay in locating the crash site.

Unacceptable, indeed. However, investigators subsequently found that the Airtex unit installed functioned as designed and promised.

The board also found that the failure occurred because of improper mounting, which allowed the ELT to dislodge from its position and detach from the antenna.

"Any first-year electronics tech knows an antenna is a necessary accessory for any transmitter or receiver to function optimally," McPherson said.

There was no antenna to help the satellites hear the 406 MHz cry for help.

The ELT signaled, but lacking antenna integrity, the signal went nowhere.

"Antenna problems can occur for other reasons, including removal and reinstallation for annual maintenance," McPherson said.

Location, Orientation and Securitization

Bolt it down correctly and properly oriented, ELT manufacturers universally concur, or else all the work to meet and earn TSO approval becomes moot. "That's a test unit, then," said one ELT-maker representative. "These can't be jury rigged to fit a space or an installer's 'idea' of how they should mount because of the installer's prior experiences. The functionality of the inertial switch and the integrity of the antenna connection depend on proper mounting, period."

Do it right, and the mount should withstand G loads in the hundreds, horizontally and vertically.

Do it wrong, and the switch may still work. But, if it detaches from the airframe and disconnects the antenna, it's just dead weight.

"Too often, people mount these things without actually testing the strength of the mounting surface or without adhering to other parts of the instructions," McPherson said. "Mount it right, and it should stay where it's mounted."

Meanwhile, success stories stemming from the use of personal locator beacons and maritime saves offer what should be convincing evidence of the benefits of the newer technology.

Authorities around the world have been successful in quickly, efficiently locating sailors, hikers, explorers and remote workers because a 406 MHz beacon sent searchers to tiny, well-defined areas.

Still, as McPherson noted, the lack of good tracking data means details about successful searches with 406 MHz aircraft ELTs remain frustratingly scarce – even as reports of and searches for falsely triggered 121.5 units continue. This is because the 121.5 units remain legal, and no regulation mandates an end to its use, nor its replacement with new 406 MHz units.

Newly delivered aircraft remain the largest pool of users, followed closely by aircraft operating internationally, where regulations long ago mandated the conversions.

What Customers Need to Know: Arguable Benefits Meet Arguable Advantages

Manufacturers, however, continue to assert the superiority of the triggering mechanisms, response time and search accuracy of the 406 MHz units.

The 24-character hexadecimal code broadcast gives authorities instant contact information on units properly registered, including make, model and color of the aircraft, and the name, address and phone number of the registered owner.

So, in the event of a triggering, search authorities can use the information to confirm whether a signal is real or a false alarm. It's worth noting, the new 406 MHz units also broadcast on 121.5 MHz to help guide ground crews the final few yards, since the 406 MHz bursts aren't as audible to ground receivers.

Thankfully, false alarms are less frequent among the admittedly few units installed, thanks to switching mechanisms that must meet more-stringent TSO standards.

Mechanical metal marble-spring-and-tube switches, such as those made by Aerodyne or Select Controls in the U.S., are employed because they are the most reliable, in the words of ELT makers. They have proven more reliable than many of the switches used in old-style ELTs remaining in use and continuing to be the largest source of false alarms, according to various sources.

For transport-category aircraft, at least one manufacturer, Kannad, developed an electronic G-Switch, patent protected, for its Kannad 406 ATP ELT specifically developed for Airbus aircraft. This G-Switch employs batteries and must be regularly checked during maintenance operations, according to the company.

But, the advantages in an accident for both general-aviation and commercial operators flying remain considerable, whether flying

domestically or internationally, where most countries now require their use.

First, there are the previously stated benefits in search speed and accuracy, which we won't repeat, and the worth-repeating reality that satellites can't hear 121.5 MHz ELTs. Neither can searchers until they get within a few miles, an area far larger than where the 406 MHz unit will take them.

"Flying around with a 121.5 unit is a lot like having an empty fire extinguisher in your kitchen when a grease fire starts … you've got an extinguisher, but it's not useful," McPherson said.

Second, the false-alarm and test functionality, which includes a buzzer that audibly indicates that the 406 ELT is operating, gives the pilot or bystanders a quick clue of the unit's triggering.

Third, the battery life of new 406 ELTs helps reconcile the price difference over the old technology. Manufacturers universally employ new lithium ion battery technology, which requires replacement only every five years – not every two years as with the old 121.5 units, many of which employ very expensive proprietary batteries.

It takes only three two-year cycle passages for the old units to cost an owner as much as a replacement 406 MHz beacon; by 10 years the differences are vastly more dramatic.

Fourth, the 406 MHz units increasingly are available with an integral GPS receiver using ship power, as well as Pointer's fully self-contained unit, reducing the costs for installing one that requires external GPS input.

Aircraft owners should also be educated about the differences between those with integral GPS and external, and how a specific unit's GPS works, so they understand any limitations – such as the time lapse between activating a long-dormant integral GPS receiver and it receiving sufficient data from satellites to accurately report its position via the beacon's data burst.

Finally, owners should be briefed in detail about test procedures, limitations and, most importantly, the requirement to register their new beacon with authorities. Optimal functionality of the system depends as much on the registration as it does on a properly functioning unit and a by-the-instructions installation.

It's not only their lives at stake, but the lives of anyone with them and those searching for them. Noted a Civil Air Patrol pilot, "Our people go out at night and lousy weather to find only a false alarm; the new ELTs could cut that down if more people adopted them."

While the survivors of the Ted Stevens accident were fortunate, the odds of such a fortunate outcome deteriorate rapidly after 24 hours and shrink to almost nothing after 72 hours missing.

This is something the minutes-brief response and calculation time of a properly installed, properly functioning 406 MHz ELT can help avoid. ❑