*Discussions on ADS-B Antennas*

*“So, let’s look at the correct installation of a TSO’d antenna.  It’s mounted on the top surface of a metal aeroplane where the metal forms a ground plane and results in the correct impedance and radiation pattern which is nominally a hemispherical response above the aircraft.  In composite aircraft, the correct installation is to mount the antenna on the top of the aircraft and then introduce a ground plane using copper radials on the inner surface of the aircraft and to a specific size, or at least a minimum size.  As far as I can tell, those are the only solutions that meet the TSO.  Now, there’s a real world out there, and the antennae are mounted all over the place, most of which do not meet the TSO but they still work.  RV’s often have them mounted inside near the back rest and they assume the metal of the aircraft will provide the necessary ground plane.  Since the ground plane does not comprise the correct radial pattern the antenna will not have the required radiation pattern.  In the Cozy, such as yours, Marc, having a large ground plane on the floor of the Cozy and putting the monopole, behind the front seat back is equally non-compliant since there is a human body (saline sack) only inches in front of the antenna, and there is a grounded firewall directly behind it albeit a few feet back, makes such an installation non-compliant too, but it will still work to some level.  Since it is almost impossible to be compliant with the TSO whilst keeping the antenna, inside the aircraft we try to do what is most sensible.  Dipoles are well understood antennae, and they provide coverage, both above, and below, the crashed aircraft.  The impedance function is also well understood.  Metal aircraft cannot easily use dipoles so the TSO’s are written around what can be done for the most common aircraft types, so since none of our antennae will be compliant it seems logical to do what is known to work.*

*VSWR is more about protecting the driving amplifiers than getting signal out there.  Antenna radiation resistance is the thing that gets the energy into the sky and omnidirectional beam pattern is the key to having the downed aircraft detected.  The beam pattern is much like a water balloon so when there is a low signal in one direction this usually means the signal level in another direction will be enhanced.  Poke the balloon in one spot and all other directions get better.  There is no cost-effective way to measure the resulting beam pattern and secondly, it will probably be completely different when the aircraft crashes.*

*The use of coax cable as an impedance transformer is well known and understood and since the ELT only transmits on two frequencies, its use is a very simple way to go, unlike the COM & NAV antennae where there is a wide band of operation.  Mike Satchell has indicated a simple tool that can be used to optimize the cable length at minimal cost.* [*https://youtu.be/xa6dqx9udcg*](https://youtu.be/xa6dqx9udcg)

*So Marc’s statement:*

*“Knowing that part "A" is 7.3" long and that it SHOULD fit into part "B" at that length is not the same thing as having PUT part "A" into part "B" and VERIFYING that it does, in fact, fit. That's what I'm looking for - not theory, not lab measurements, but actual verification……”*

*whilst true, still applies to any installation of an ELT antenna in a Cozy.”*

**Ron Larock added: “***The little NanoVNA testers are available for about $70.

The one I have was $59.00. It is supposed to be capable of up to 1500 mHz. You can tune your ELT, ADS-B and 1090 Transponder antenna or any antennas we use. I haven't used it yet, so can't say how good it is, but from what I read it sounded pretty good.”*

**Lee Devlin:** *“As a ham radio operator, I know it is possible to create a short rubber duck helical antenna that works on multiple bands that would be more than adequate for this application in a composite airplane.  For example, handheld ham radios commonly work on the 430 and 144 Mhz ham bands using a single antenna less than 7" in length.  I've communicated with LEO satellites with these antennas while riding on my bicycle.  I would not be surprised to find that one of those antennas would be more than adequate and have reasonable performance on 121.5 and 406, and have no threat of damaging the ELT.  No ground plane would be needed.  And I'm pretty sure a short dual band antenna could be designed that was optimized for 121.5 and 406 Mhz that would work for composite aircraft. The real challenge would be to get the FAA to approve it.”*

**Later Marc Zeitlin: “***So Phillip's long discussion back on 8/4/2020 made me think about my installation and its capabilities. I decided that I needed to verify that it would work correctly (to the extent testable), so I purchased a "[www.406test.com](http://www.406test.com)" account, which allows you to determine if the satellites are receiving your signal when you perform a self-test of the Artex 345 ELT (I believe it'll work with ANY ELT, but I'm not sure about that).*

*Yesterday, I dragged the plane outside and sat in it (so that my conductive saline sack of a self would be close to the antenna behind the seatback) and poked the "Self-Test" button a few times. While I got an error message indicating that the unit isn't receiving GPS data from the Skyview EFIS (got to work that out), within a few seconds of each test I also got an email indicating that they had received a test message, which obviously could only occur if the unit was, in fact, communicating with the satellites.*

*So while I've got a little bit of debugging to do, at least I know that to the extent possible, my system is working. I'd recommend that anyone installing a non-compliant ELT antenna system do the same - it's useless to spende $500 - $1K on an ELT and not know if it's actually doing what it's supposed to be doing. Maybe it'll work with dipoles, maybe it'll work with no ground plane or a small one, maybe it'll work with the portable antenna, maybe it'll work with horizontally polarized antenna - for $39 (or $49 - don't remember what the 406test account cost/year) you can find out.*

*So thanks to Phillip for pointing out issues with ANY antennae in our composite aircraft, and forcing me to re-evaluate my installation and actually test it. I feel more confident in the unit's ability to locate me if necessary. With Flight Following, ADS-B output, and APRS, someone will find my body :-).”*