

Getting the Signal

Tuning Into Changes in Antenna Installations

BY JAMES WYNBRANDT

The next-generation communication, navigation and information boxes coming online mean lots of work for avionics shops, as they retrofit aircraft with everything from multi function displays (MFDs) to satellite TV receivers. But the one item that will assure these sophisticated installations get a great reception when the customer comes to pick up the aircraft often gets overlooked: the antenna.

Antennas are often taken for granted in the world of aftermarket avionics installations. After all, usually the antennas come TSO'd as part of a package that's being installed, so what's to think about? And if the installer is selecting it, as long as he doesn't confuse a com antenna with one that picks up glide slope signals, an antenna is an antenna, right? And there's no mystery to mounting them on an airframe, is there?

While there's some basic truth behind these rhetorical questions, the real answers to them are "plenty," "no," and "sometimes." But more important, changes are being felt in the antenna installation realm that shops have to be ready to deal with. Consider this:

- As aircraft get stuffed with more new avionics, they sprout more antennas, and shops report that finding a good location to mount an antenna is becoming an issue.

- A generation of installers is retiring or otherwise disappearing from the workforce, and the younger generation's knowledge of this end of the avionics installation business has yet to be proven.

- The FAA's rules on antenna installations are vague and subject to interpretation, and the headaches this can cause are likely to get worse as FAA personnel are asked to approve installations of ever more complex equipment they're unfamiliar with.

- And finally, the entry of composite aircraft into the fleet adds a new wrinkle to the challenges of antenna installation, due to issues of grounding and



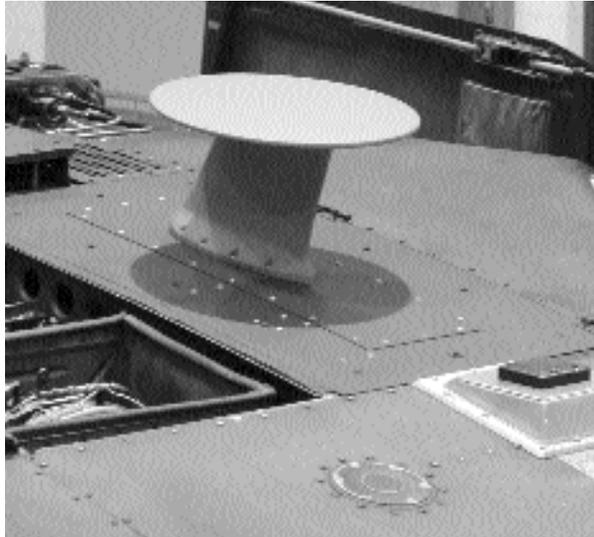
View of the bottom wing skin of a Lancair Columbia 300 prior to the installation of a transponder antenna, with a conductive gasket contrasting the expanded aluminum foil ground plane.

preserving the integrity of the airframe.

Even in the absence of the changes cited above, antennas deserve more attention than they often get. A substandard, or improperly installed or positioned antenna can interfere with reception, corrode the surface of an airframe, or in some cases actually create in-flight hazards (e.g., by not properly dissipating lightning strikes). Thus, antennas and their installation deserve as much consideration as the boxes that they're going to link to the outside world. Fortunately the great majority of antennas are, according to experts we spoke with, installed properly. Antenna manufacturers said most of the aftermarket installation work they see is done correctly. Repair stations we talked to vouched for the antenna installations they check on aircraft under their care. And the FAA's Kansas City region, where Service Difficulty Reports (SDR) of faulty antenna installations in GA aircraft are funneled by field offices around the country, reports only 17 SDRs on GA antenna installations in the past five years, a statistic an FAA spokesperson interprets to mean "that antenna installations have been almost trouble free." But as the points outlined above indicate, changes are coming, and what worked yesterday may not work tomorrow. Which is why those in the avionics business need to be receptive to considering these issues.

Let's start by deflating the Gertrude Stein proposition: While a rose may be a rose, the same doesn't hold true for antennas.

"People look at antennas as a commodity," said Mike Crow, director of sales and marketing at Sensor Systems Inc., which makes antennas both under its own name and for use with OEMs such as Boeing. "A lot of times they'll spend \$20,000 on the box for their airplanes, and then they buy the cheapest



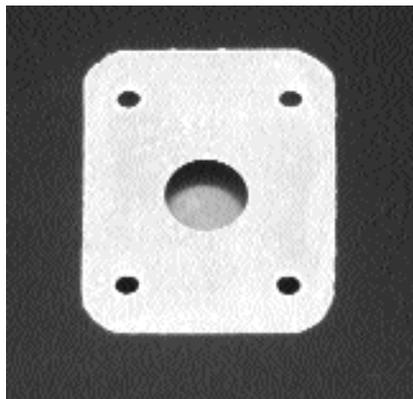
This is a Sensor Systems UHF/Satcom antenna installed on a UH-60 Black Hawk helicopter.

antenna they can find. Then they say, 'I hate this piece of equipment, it's never worked right.' But if you don't have a quality antenna, it doesn't matter what kind of a box it is, it won't work to full capability."

So now that you're tuned in to the subject, here are some points that should be considered with every antenna installation.

Corrosion

Contact between differing kinds of metal, such as that of an airframe and a metal antenna, cause corrosion, and this is a problem manufacturers are becoming more concerned about. "The industry is looking heavily at antenna-to-skin corrosion," one expert



View of the bottom wing skin of a Lancair Columbia 300 with the paint removed, exposing the diagonal cross hatch pattern of the expanded aluminum foil.

said. "It needs to be more widely addressed. Lots of (installers) are asking if they should be using gaskets and corrosion inhibitors, but (aircraft) manufacturers are reluctant to approve them."

Of course corrosion can also result from the contact of moisture, air and metal, so antennas need to be well-sealed at their point of contact. Many installers use a polysulfide adhesive such as Pro Seal to caulk around the base. And don't forget belly-mounted antennas. These can exhibit internal corrosion if they're positioned at low points on the airframe (the ideal location for a belly antenna to minimize shadowing) where condensation collects. Installers need to pay attention to where drains are and where water collects on the underside of the airframe in such installations.

Proper Spacing

"With the advent of Orbcom, WSI weather data-type systems, Iridium, XM satellite, and Sirius, more and more antennas are having to be installed on small GA aircraft," noted Don Jeckell, manager of sales and marketing for Comant Inc., the southern California-based antenna manufacturer, "and they're finding due to

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interference issues, it's becoming more and more difficult to accommodate the customers wishes."

Without proper distance from other RF (radio frequency) sources (such as other antennas), antennas may exhibit interference, signal drop-outs or other reception problems. That's why installation manuals mandate minimum distances between antennas. So as airframes become more crowded with antennas, shops need to pay closer attention to their positioning; move an antenna far enough away to meet the spacing requirements, and it may be in the shadow of the empennage or other structure that can block reception and transmission.

"Most of the manufacturers in their installation books will tell you to stay three feet away from other antennas," said a senior technician at one avionics shop. "That's not reality; reality is you try to do the best you can, and the real test is when you turn (the avionics) on."

Fortunately, manufacturers are now making combo antennas which, for example, bundle a com antenna and a GPS antenna together with a built-in notch filter, eliminating the need for two different antennas and for maintaining the distance between them. Comant and Sensor Systems recently introduced combo antenna product lines. But not all shops think a combo antenna is always the way to go. Combo units can be expensive, and if one antenna in the combo unit goes bad, the whole unit has to be replaced. And some shops aren't convinced combo antennas work as well as individual antennas.

Rules and Regs

Antennas have to be installed in accordance with guidelines laid out by the FAA in AC 4313-C. If you examine this Advisory Circular, you'll see

the antenna used in the illustration is an old boomerang-style model, indicative of the last time these regs were updated, back in the late 1980s; GPS didn't even exist then. The guidelines themselves are open to interpretation, which can be a good thing, a tacit admission from the FAA that the avionics professionals in the field know best.

"Some OEMs don't follow them," said Paul Mooney, of EDO Corp. in Deer Park, Long Island. "They have their own procedure; [The AC] is a guideline." (Yes, in addition to floats, EDO makes antennas, selling them to OEMs including Boeing, Raytheon, Cessna and Bombardier.)

But leaving the rules on the vague side cuts both ways, and impede approvals of perfectly legal installations.

"You'll have a DER or FAA field office in one region who will completely contradict the way to do it in another region," said Crow of Sensor Systems. "Individuals in each area are making decisions based on best of their ability or knowledge, but there's no general consensus, no overall guidance. One of the calls I get all the time," Crow continued, "is the installer will do it one way that's OK with my antenna, and the DER or local office that's doing the approval says, 'I don't like it, so take it off and do it again.'"

The FAA says it's trying to rectify the problem.

"I think there is a responsibility at the national level (for the FAA) to apply standardization across the offices," said David Hempe, the FAA's manager of Aircraft Engineering Division. "To some extent there's a balance between a prescriptive rule and a performance based rule that allows for creativeness of business, so the challenge is to find that balance, and assure a level of standardization. We do try to assure standardization

across FSDOs and ACOs."

Yet some technicians admit they themselves have a hard time keeping up with all the new avionics products and innovations, and question how the FAA can ever set national standards for aftermarket installations involving new and ever more sophisticated equipment. Some manufacturers are trying to assist by getting STCs for their installations covering multiple aircraft, obviating the need for installers to secure FAA approvals.

Neil Nederfield of C&W Aero Services in Fairfield, N.J., which does many aftermarket avionics installations, recently sought approval for installation of a Honeywell Integrated Hazard Avoidance System (IHAS) unit from the FAA. "I had everything all filled out and submitted it to them, and they told me, 'You're going to have to get engineering [analysis done to support the proposed installation] for this,'" Nederfield said. After a call to Honeywell, he found the company had gotten an STC covering the system's installation in more than 100 aircraft makes and models, and the paperwork could be downloaded from their website.

Composite Airframes

With composite aircraft joining the fleet, issues of proper grounding and securing of antennas to the airframe become further complicated.

"People need to remember that dealing with a composite fuselage is like dealing with an egg shell," said Terry Flatebo, director of avionics at Lancair Inc. in Bend, Ore. "It's incredibly strong, but when you start drilling holes you have to be incredibly careful. It's not as simple as installing a doubler plate on a metal airframe."

"It definitely changes how you put an antenna on," concurred EDO's Mooney.

Each make of composite requires its

own individual methods for attaching antennas because of the unique properties of the composite material they use in the airframe.

“We have our way of doing it, I would imagine Cirrus and Glassairs would have their way,” Flatebo said.

Grounding methods also have to be adapted to each make and model of composite. On the Lancair 400, a sheet of aluminum foil one-eight-thousandth of an inch thick is wrapped around the airframe underneath the paint to provide the metal for grounding antennas. But exposing the foil requires a lot more care than stripping paint off a metal airframe; sand through that thin coat of metal, and the installer has a foil patching job added to the antenna installation.

On fiberglass, as opposed to carbon fiber or graphite composites (which can create electrical interference), installations can be relatively easy, and the antennas can even be mounted inside the aircraft. But some fiberglass composites contain carbon fiber parts that can affect the operation of antennas. To find out if a fiberglass airframe has such carbon composite parts, experts recommend walking a 30-foot circle around a composite aircraft with a field strength meter. The meter can detect dead spots these parts can cause, which sometimes play havoc with reception and transmission. Improper antenna positioning on any airframe can result in dead spots, areas on the aircraft where signals aren't picked up or transmitted as efficiently as they should be. This can be the genesis of squawks from pilots who tell a maintenance shop, “I couldn't pick up Phoenix on the radio until I was 10 miles away from it, but it was coming through clear as a bell on my way back home.”

Back to Basics

But as we consider the brave new world of antennas, let's not forget the

basic installations shops are still dealing with today. On any installation involving an antenna, consider the quality, the cost, and the cost of ownership and the application. Consider the aircraft and the operating environment, too. How high will it fly, how fast, pressurized or non? You don't have to worry about precipitation static caused by high speed flight on an antenna installed on a C-172, but it's going to be a factor on a G-IV. And speaking of turbines, you better use a conformal antenna (one that mounts virtually flush with airframe) in an application where you don't want a chunk of ice breaking off a mast antenna and getting ingested into a jet engine. And pay attention to the basics of installation, the proper sealing and proper tie-in to the airframe.

Dean Sounders, a senior technician at Piedmont Hawthorne Aviation Services in Monroe, N.C. says he sees improper antenna installations more often than he'd like. Among the problems he's noted: not a sufficient number of rivets used in mounting the antenna, insufficient distance from rivets to the edge of the sheet metal backing, and the wrong thickness of backing metal used. Could this be the work of some of those younger generation installers? Surely they're out there.

“Most (installers) know what to do, they've been in the business,” said Crow. Then he added with a chuckle, “But there's always that split where the aviation business went bad for awhile, and then there's a lot of changeover, so I see some new and interesting installations all the time.” q