

AVIONICS FOR KITPLANES

It shouldn't be "us vs. them."

BY GARY PICOU

There are as many ways to go about selecting and installing avionics in a homebuilt/kitbuilt airplane as there are different airframes to choose from. And, like the airplanes, there is no general "right" answer. It is a very personal decision that is based on all the same factors that made you move from "cookie-cutter" airplanes made in Florida, Minnesota or Kansas, to one made in your hangar with your own hands.

This article can't solve your dilemmas. But we can make a few suggestions based on experience and the observations of customers who have experienced difficulty simply by ignorance or bad information.

The builder experience

Most builders are making the commitment to homebuilding because they want the experience, the satisfaction, and a very personal product when they are done. The selection and installation of the avionics suite is a big part of that experience. The problem is, most builders don't understand the part that avionics plays in relation to the whole project.

Although pound for pound the most expensive part of the airplane, many pilots and builders consider avionics only a small part of the airplane. In fact, the avionics and instrument suite is as vital as the engine and tail feathers, especially in today's airspace system.

Photos provided by Aerotronics.



What Package?

What level of avionics should you install? The regulations simply state that for IFR flight, you'll need equipment appropriate to the navigation aids you intend to use. So does that mean you can eliminate the ADF and DME? Probably, in the USA. Drop VOR? No, we expect that most of the existing navaids will be around for at least seven years, probably more.

Your choice should be based more on the flying you do TODAY, than betting on the future navigation system. If your Sherpa is bound for the Arctic polar bear hunts, a dual ADF is not a bad idea.

Talk to your avionics shop about the trends in new avionics, and what others are buying.

Required Skills

In contemplating the decision to build a Lancair or an RV, the builder will decide between becoming a first class composite sander, or rivet bucker. Many builders don't also understand that if they tackle their avionics installation they will need another set of skills that are very different than the airframe. Things like soldering, stripping and crimping of wires, and reading schematics.

Dexterity

Installing avionics is a fine-motor skill, much like engine and airframe repair. But it's different. The parts are much smaller. Frankly, by the time many of us have maturity to build our airplanes, the near vision is no longer what it ought to be for comfortable close work. This is a nice way to say

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that I'm too old to see some of this stuff! Connectors and part labels that have to be read with a magnifying lens on the bench are impossible to see in the hangar!

OK so you have an electrical engineering degree from Cal Poly, you think you can install avionics in your Kitfox? OK, you probably can. But with such a knowledge base, you will probably understand that there is a difference between digital design and avionics installation. You will understand that there is a learning curve. Would you rather tackle the curve, or let an avionics pro do the installations while you advance to flight sooner?

When I hear "I'm an electrical engineer" on the phone, the next question is usually one that is so fundamental that I know the caller is out of his element.

Map Reading

Just because you can build a complicated machine from plans, you probably think you can read a schematic and a set of drawings? I bet you can. But there is no standard set of avionics nomenclature. When you sit down to figure out how to connect the transponder to the encoding altimeter (easy), or the autopilot to the HSI (complicated), you will be faced with a variety of different function names. And most won't match. There is no, "Connect green wire to green wire," in general aviation.

If you install a full avionics suite of the latest stuff, you will be faced with terms that are foreign to people outside the industry. Do you think that if you buy everything in one brand that the labels will match? Nope, sorry. Many times, avionics "brands" are actually units designed and certified by other companies, with their own lingo. But even within the same company the nomenclature on a particular

function may not be the same.

Terms like "Low," "Ground" and "Minus (-)" are often the same thing, but not always.

In the avionics shop, the first thing an installer will do is make a pin to pin correlation between the units based on their function. His experience will enable him to connect the dots for a functional system, and the most complicated avionics package shouldn't take more than a few hours, regardless of the manufacturer. That's because he speaks the avionics language and all the various dialects.

There are many connections that aren't used on many, or any installations. Plus, not all units will work together without other interfaces. For example, you can't hook a KX155 to an HSI; you need a VOR/LOC converter to make this popular combination work.

So, if you don't understand the function of the various wires between the HSI and glideslope converter, you can easily connect the flag minus to ground, and burn out the drive circuits in the unit to ruin the indicator. The cost savings is erased, but you have gained some valuable experience.

Some people may think that we in "the business" come up with this abstruse nomenclature as a way to keep our little world cloistered from the flying public. I wish it were that organized. In fact, we confuse each other regularly too. However, we have relationships with manufacturers and other shops that enable technicians to overcome the "language barrier."

Tools

Avionics installations require specialized set of tools too. These are not readily available in builder catalogs, let alone the local Home Depot.

A decent set of crimpers can easily cost \$200, and you will need several different types. Cheap ones won't work, and will inevitably lead to inter-



mittent connections, and expensive visits to the avionics shop.

Test equipment

The typical avionics shop contains about \$100,000 worth of test equipment. However, the installation team will routinely use only about \$30,000 of it; the rest is for bench troubleshooting. This isn't your Cousin Ed's chainsaw, however. You aren't going to borrow it when time comes to test your project.

Even if you could, the test gear is rather esoteric in nature. You won't find an "AVIONICS TEST" button. Even though the most modern sets have simplified menu driven procedures, the operator still has to have a fundamental idea what a framing pulse is, and why 21 microseconds is important.

National Airspace

This brings us to the next cogent point. We are all sharing the same airspace, regardless of airframe, engine or avionics manufacturer. Be it Boeing or Bob's Basement, we all have to use the same navigation and identification aids to be SAFE.

The transponder system, for instance, is predicated on precise electromagnetic pulse pairs to and from the aircraft, which contain ever increasingly complex data regarding the status of our air machines.

If your Sky Pup is transmitting a bogus signal, because of a misunderstood note on an installation diagram, it can wreak havoc with the airspace

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for miles. When you install a transponder and encoding altimeter, which must be connected to the static system, there is no way to tell if it is installed properly without running a test to exercise the system throughout the altitudes. A miss-wiring can generate errors in your reported altitude of hundreds to thousands of feet.

Every TCAS-equipped aircraft that shares the airspace with you is depending on that altitude to make avoidance decisions. Your precious airplane, completed after years of toil, becomes a hazard to the rest of us.

Warranty

Many manufacturers will not provide a warranty on their equipment unless it is either installed, or checked by an avionics professional. Regardless of the company policy, every warranty I've seen specifically excluded damage from misuse. Hooking the thing up wrong is misuse, in any book.

There is some good news for home-builders on the warranty front. Many avionics manufacturers have warranties that don't begin until the airplane flies, or are based on hours of service. This means that when your project takes a bit longer than expected, you don't lose warranty protection. Read the warranty policies, and take this into consideration when buying your avionics.

Timing is something

Homebuilders are focused on critical time issues; when the various sections are completed, inspected, closed, and when the first flights will begin. During the planning process it is critical to consider the avionics and instrument installation.

You may not be ready to install the instrument panel before the cabin closing portion, but there are some avion-

ics items, like antennae, flux detectors, servos, etc., that must be considered in their proper order.

On the other hand, there are risks to buying the avionics and instruments too early. The most obvious one is obsolescence. You buy the latest GPS at Sun 'n Fun, and at the AirVenture show you pick up a copy of AEA's *Pilot's Guide to Avionics* that explains that the best gear was enhanced between April and May.

Don't sweat it. The solid technical foundation and good sense decision you made before April is still valid. Avionics isn't "trendy." The stuff you bought will be serviceable for as long as you need it; the typical lifetime of avionics is over 20 years.

Instruments

Aircraft instruments, especially gyros, do not like to sit around. They need to get exercise. They need to get their juices flowing so the bearings will be evenly lubricated, and not develop flat spots.

Although we like to think of aircraft parts as robust, gyroscopic instruments are delicate and vulnerable when they are not spun up. In flight, spinning at 20,000 rpm, the gyro is very stable; vibrations don't bother it. But on the bench or table, it is another story. If you set an artificial horizon or DG down hard enough to hear it bump, it is damaged. The bearings will get a tiny dent, called brunelling. This introduces friction, and accelerates wear. A 2,000 hour gyro life becomes 50 hours (or less).

Builders spend good money for an instrument that has been trucked from somewhere, manhandled who knows how many times, and then taken home to sit on a shelf, perhaps for years.

Do your gyros a favor. Wait until you really need them, and then buy from a reputable instrument shop. Leave them in the double-foam box until ready for installation. Don't

bump them, leave them on a hard surface, or (gasp!) wheel them around on a tool box.

Remember that an overhauled instrument is as good as a new one too, if not better.

"Show specials"

Finally, we'd like to make a few comments about buying your avionics at the aviation gatherings, such as those in Florida or Wisconsin. These shows are terrific places to see and compare all of the avionics. They are a wonderful opportunity to speak with the manufacturers, for personal advice. You will also find retailers there, most of whom can give you the lowdown on what works best, what has good response from users and what fails.

These companies would also like to sell you the avionics to take home (or even ship it later). These deals are frequently fiscally alluring. All your avionics professionals back at home would ask for is a courtesy call. Before you buy into a baggage compartment full of avionics, new, used, or uncategorized, talk to your avionics shop about the price and the package. It may be wrong for you. Or the price may be matchable at home, and save you the hauling.

The avionics shop on your field, or nearby, is a trained professional, with skills and knowledge that you'll need for a successful installation. They are also business persons. Imagine asking your dentist for some tools and compounds so you could do your own crown. Then call back for some advice on performing the procedure. Call back later to complain that it isn't fitting properly. Does this sound improbable? It happens all day long in avionics shops, and not just for kit builders, either. Just because people can buy parts through the mail, they believe that they are qualified to install the equipment in certificated aircraft.

As an aircraft builder, you should work on a long term relationship with your favorite avionics shop. Give them the benefit of your consideration for purchases and installations. Let them know that you are interested in the best possible outcome, and that you are willing to pay for their expertise. If you ask them for a quote on your avionics installations, be aware that this will take some hours of preparation. To turn this into a "shopping list" at the show is guaranteed to cause hard feelings.

Treat the avionics shop with the sincere respect that a professional business deserves, and you will have a return on your investment that will show up in the panel for many years. Q