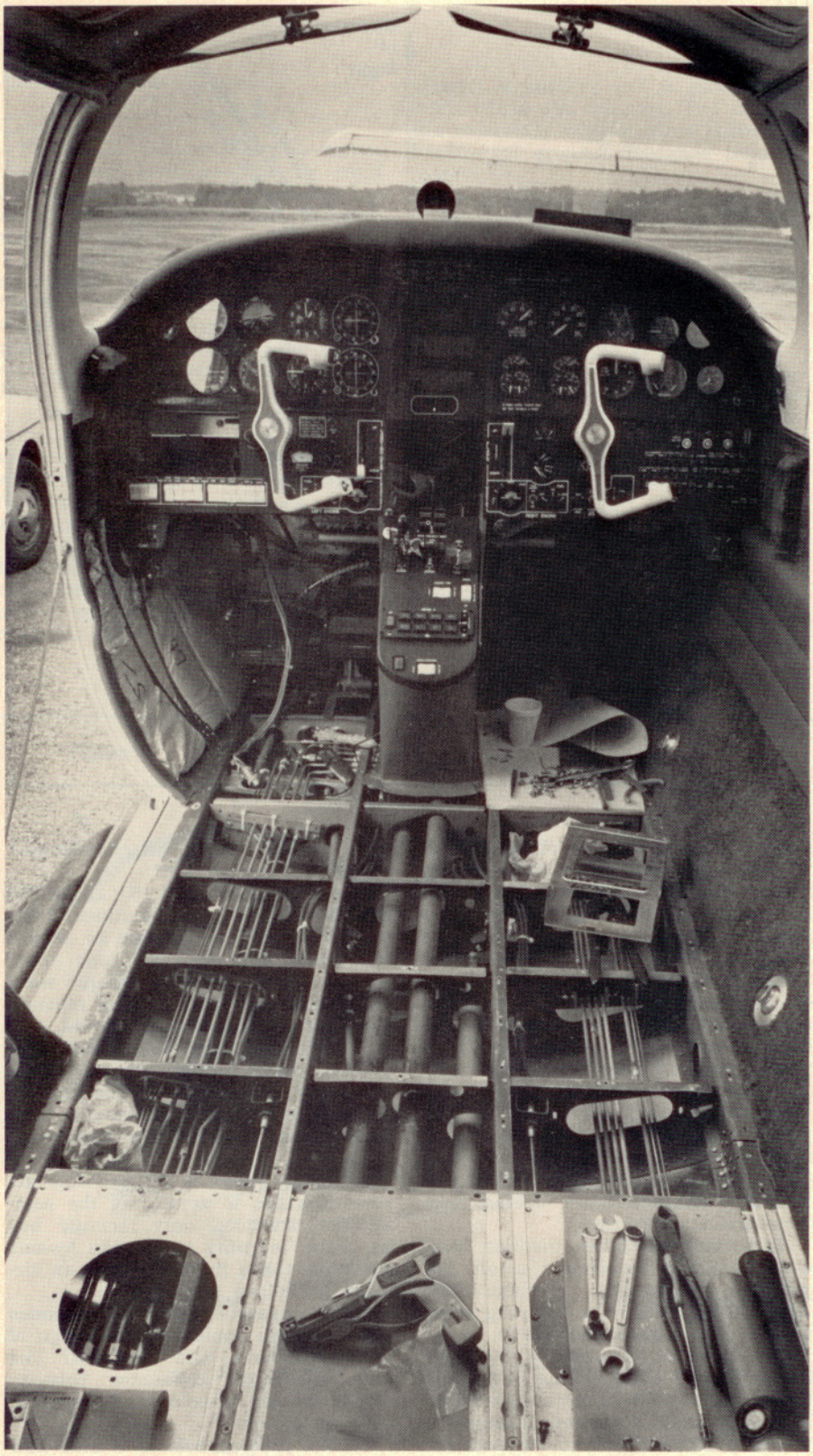


Every pilot has an idea of a dream avionics package and the more extensive the dream the more extensive—and expensive—the installation, especially if it's done after the airplane leaves the factory.

Where Your Avionics Money Goes

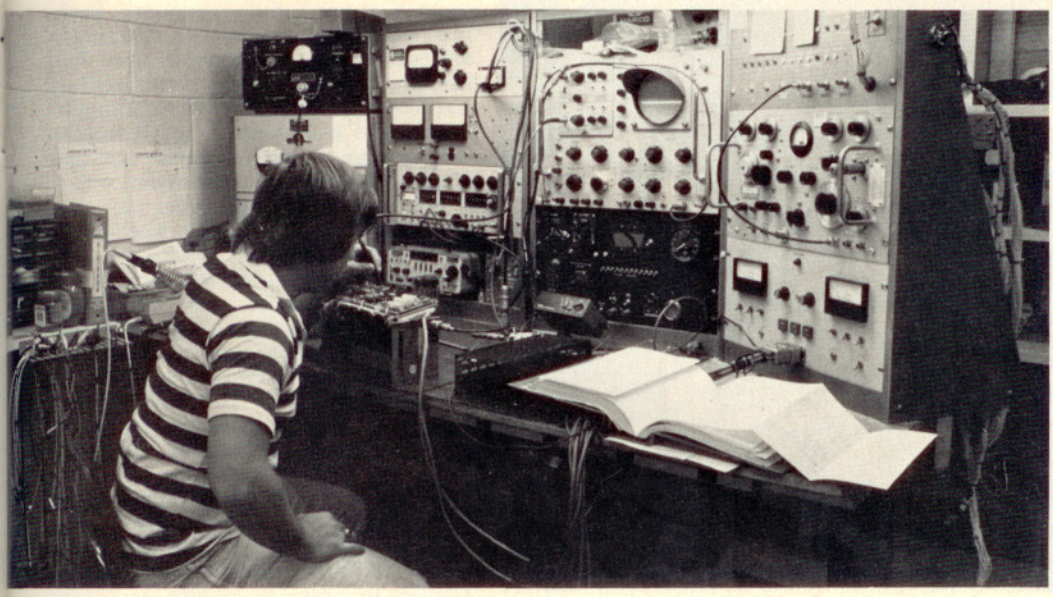
Not into someone's pocket, contrary to what many may think

by ED TOMBERLIN / AOPA 374253

■■ With avionics costs increasing each year, many fliers have asked themselves where the money goes. Frequently, when compared with television and home entertainment equipment, aircraft electronics can appear unusually expensive, leading to the suspicion that someone is reaping landslide profits. A look at some of the problems unique to the avionics industry indicates that this is not the case.

The research for a new radio usually begins at least two years prior to its first flight in a consumer's airplane. The engineering must be done, prototypes built and flown, and the all-important TSO and FCC type-acceptance tests passed before the first unit is sold.

Parts selection consumes a great deal of time. The new miniature components are always carefully studied, since they can be abused in the rugged aircraft environment. Mechanical elements, circuit assemblies and final prototypes are exposed to "burn-in" tests. Environmental chambers simu-



One reason for the high cost of avionics service and installation is the heavy investment a shop must make in test equipment and trained technicians.

late the heat, cold, humidity and vibration likely to be encountered during the life of a new product. Any recurrent parts failures are analyzed and eliminated by redesign or outright replacement.

Since no income is realized from the development phase, it absorbs much of the profit from existing products. Additional funds must frequently be borrowed; and, with interest rates soaring, speedy development is essential to a low unit cost.

The constant search for new products only partially explains their cost background; another reason is low volume.

The economics of scale rarely apply in avionics due to the small numbers of radios actually built. Frequent model changes to incorporate technical improvements make it difficult for an assembly plant to achieve high levels of automation.

A sheet metal machine, for example, which costs $50,000 may be amortized by producing one radio or 50,000. Obviously the cost per radio is more favorable at the 50,000-unit production level. Consider that the venerable King KX-170 series radio has just passed the 70,000 mark after nearly 10 years of production. To contrast this with another industry, remember that Detroit usually *recalls* more cars than this yearly.

Tight federal regulations and marginal volume have combined to produce a profit structure that few industries would find acceptable. That is one reason that the avionics field has been remarkably immune to foreign competition over the years; overseas investors find other consumer products, which sell in the millions, much to their liking.

Assembly labor is yet another part of the cost because avionics and aircraft radios are still largely handcrafted products. The frequent model changes dictate that flexibility be retained in the assembly process.

The use of automatic wave and flow soldering machines has been standard for some time, eliminating countless hand operations. These machines neatly solder entire circuit boards in one operation. Many components are still mounted by hand, however, since large scale automation of board assembly is not yet cost-effective.

In the test and burn-in area where final inspections are made, computers and automatic test equipment have been introduced and speed final checkout while opening new areas of quality control. Tests which were previously too time-consuming, or subject to human error, are now completed with ease. This has not only cut the outright labor costs, it has also dramatically reduced warranty claims from out-of-box failures. However, these machines are expensive and very specialized.

Additional costs are added in order to get the radio from the factory to a retailer. Two distribution techniques are currently employed. Some avionics manufacturers sell to distributors who inventory goods and redistribute them to retailers. Other manufacturers sell directly to retailers.

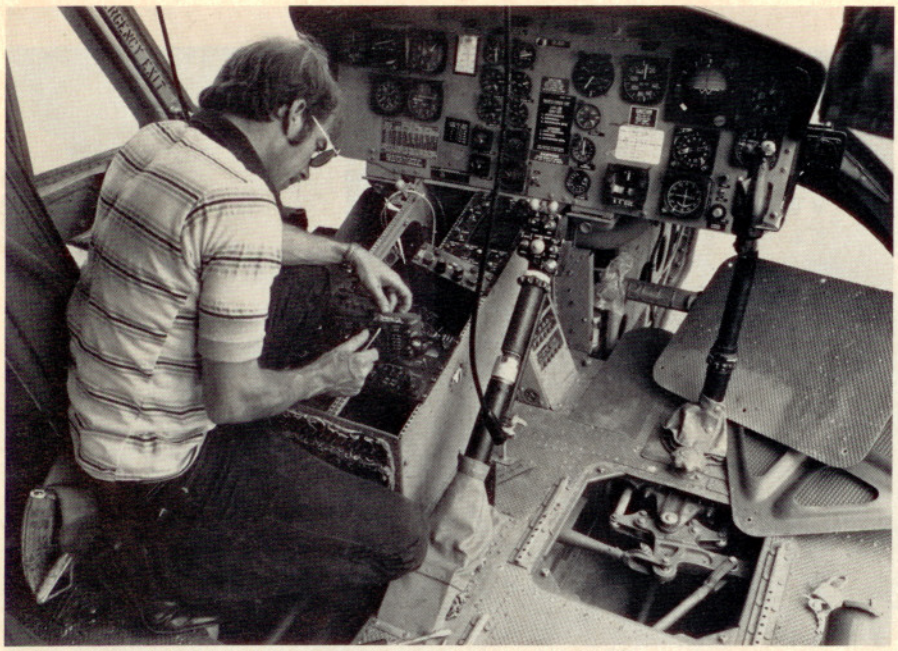
Wholesale distribution offers the convenience (to the retailer) of ready product availability and local service. However, with several competing wholesalers selling the same brand, marginal retailers can sometimes be allowed to get deeply in debt by building up charges with several vendors. Single-source distribution by the factory encourages tighter credit, since it is centrally controlled and monitored. Credit losses are just one more cost which consumers must bear.

Unless carefully watched, long radio delivery times and slow parts availability can work to the disadvantage of factory-direct distribution. If parts and finished goods are out of stock at the factory, a retailer can be "all dressed up with no place to go."

Wholesaled goods are marked up by the wholesaler; then installation costs are assessed by the retail shop.

Airframe manufacturers buy their equipment, usually in large quantities, directly from the avionics manufacturers at preferential discounts. They, too, however, must mark up enough to cover the installation costs and a reasonable profit. Frequently, original equipment manufacturer (OEM) avionics are sold in a package deal whereby the installation in included "free" in the list price.

When the finished radio leaves the factory, bound for its home in someone's aircraft panel, the cost of installation is yet to come. The airframe manufacturer or field installation shop must painstakingly mate avionics and airframe. Every pilot has an idea of a dream package and panel layout; and, consistent with some attempt at uni-



Each custom avionics installation is a handcrafted exercise in ingenuity and judgment to properly integrate controls, black boxes, antennas, autopilots and speakers into a cohesive system.

formity, each customer's needs must be met.

Threading their way like nerves throughout the airframe, avionics wires must be patiently and painstakingly laid behind upholstery, punched through pressure bulkheads, strapped, tied, and routed in place. Each installation is a custom, handcrafted exercise in ingenuity and judgment.

Autopilots are interfaced with controls, antennas are mated to airframe, speakers hung and disguised, jacks mounted and switches blended to satisfy one major goal—flight perfection.

For a retail avionics shop, the situation can be much more difficult. Add to the list the task of *removing* old avionics, some of which may have been built into the aircraft during factory assembly. The operation is compounded by the interface complexity of mating items of several manufacturers. No interface drawings are likely to exist, and each job must be properly planned and problems solved as they arise.

If this still sounds easy, consider that competing brands don't fit the same mounting rack, nor will existing antennas likely fit a new radio. There must be considerations made for every antenna configuration and mounting rack for *every* avionics manufacturer. At this point the avionics dollar becomes greatly diluted. The lack of any standard for mechanical and electrical compatibility costs a great deal for which the consumer receives no direct benefit.

The width of panel-mounted avionics has been standardized at 6¼ inches. Imagine how avionics stacks would look without this minor concession.

Many older aircraft had few provisions, or none at all, for panel-mounted avionics. The shop may literally have to hang the new equipment under the dash. This means more custom work, with the associated high installation cost. Persons skilled in sheet metal and interior work, who can dismantle and reassemble aircraft during the installation process, demand substantial wages.

Avionics costs attributed to sales and distribution must also pay for warranty service. The availability of nationwide warranty service is so widespread that most shops handle warranty for some, if not all, of the avionics companies. Few aircraft are based in such out-of-the-way places that they need fly more than one hour to an equipped and willing warranty repair station. All shops are not equipped for full service; but, considering the volume, repair capability is surprisingly good.

To get a grasp of the problem the shops face, look at a typical production of a fictional radio. Assuming a production of 50,000 units with a failure rate of 20% per year, there will be 10,000 radios in need of repair. Dividing these among the shops (perhaps 500) which would be equipped for repairs at any one time, the average operation will see one or two radios per month. Keeping technicians trained is extremely difficult when repair volume is this limited. Add this to the fact that test harnesses alone cost $100 each to purchase, and it becomes a small wonder that enough specialized repair business comes along to keep the shop alive.

Manufacturers, who must pay shop repair bills out of warranty allocations, are putting stringent requirements on new dealer applicants. Factory schools are held regularly, and compulsory attendance is becoming the rule rather than the exception. Avionics and airframe manufacturers are seen taking a stronger stance in aftermarket maintenance and sales by opening regional service centers to support their new products.

Manufacturers want shops to be capable of satisfactorily accomplishing the repairs of their respective equipment. According to King Radio's "Bud" Glover, in order to qualify as a warranty station for their products, the shop must be FAA approved; be located on an airport; be a full-time operation; have the test harnesses for the equipment line handled; and, have trained technicians for each category of radio to be serviced. Obviously the financial commitment from the shop is significant.

Bendix, for example, has 295 warranty repair stations, but only 179 of them are equipped for warranty work on BX-2000 equipment. On the other hand, 232 are authorized for servicing Weather Vision radar.

Manufacturers also express uncertainty about the ability of shops to cope with the rapid onset of too much new technology, since it demands better trained technicians and more sophisticated test equipment.

The introduction of large-scale integration to avionics has just begun. This combination of several circuits into one chip will further reduce labor costs; and, to some degree, aid in trouble-shooting since the component count will be reduced.

"Microprocessors and digital displays make it possible, for instance, to do something that can not be done with mechanical configurations — memory storage and display of frequencies," explained Mike Maloney, regional sales manager for Collins Radio. He predicts an increase in the utilization of advanced technology in avionics equipment.

Ken Ross of Narco Avionics said it well: "Avionics customers are getting the best buy in history." This trend has been true as long as there has been a profit motive to encourage innovative thinking among competitors. □