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The Aviation Consumer

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Recurrent Training for A & Ps? Why Not?

Even with the aviation economy only crawling along, I'm constantly amazed by the technological changes. Cessna has hung a diesel engine on a production airplane, Rotax engines are mainstream, lean of peak operations—largely forgotten since the 1940s—have been rediscovered and are saving owners thousands on fuel and maintenance costs. And those aren't even new.

Constant change has always been reality. Yet, over the last generation, the combination of computers, and more and more creative people using them, has probably caused the pace of change to increase.

Many of our professions have dealt with change by requiring recurrent training of its members—doctors, lawyers, pilots, flight instructors—because failure to keep up has adverse affects on those served by the professionals.

There is a respected group of professionals who work in a high-tech field where errors can mean death, yet they have absolutely no obligation to undergo recurrent training of any sort—A & P maintenance technicians. While A & P candidates undergo rigorous training and must pass written and practical examinations, once they get their certificates, they never have to do anything to keep them current and effective.

Back in the 1960s and 1970s, most of the airframe and engine manufacturers put on free one- or two-week classes aimed at those maintaining their products. Shops sent their mechanics and kept framed completion certificates prominently displayed on the wall to showcase that their techs were up to date on the latest.

By the late 1980s, the big aviation downturn meant that most of those classes went away. Financial pressures on shops ratcheted up, and they couldn't afford to let their mechanics have the time off to go to what schools were left.

The one-person shops have had a very hard time. They're busy, owners will complain about prices even if the proprietor cuts the shop rate to a dollar an hour, and they're expected to be able to work on anything from a new Cessna 172 through an exotic two-seater from the 1940s.

The result is that too many maintenance technicians have not kept up with what technology is teaching about the care and feeding of airplanes and engines. Within the last year I've had techs tell me, in all seriousness, that lean of peak operations cause burned valves (not possible, temperatures go down when lean of peak) and that there's no need to use a borescope because you can tell when to replace a cylinder with a compression check. That one was not familiar with the engine manufacturers' service bulletins warning against making a cylinder replacement decision based just on compression checks.

One unneeded cylinder replacement due to lack of current knowledge on the part of a mechanic is expensive. Worse is that the top overhaul, replacement of all cylinders, is almost never necessary—a sick cylinder is not infectious—yet it is still done with alarming frequency.

Maintenance technicians are professionals. Part of being a professional is recognizing that continuing education in one's field is an essential part of carrying on that profession.

I'm not crazy about regulations, but I recognize that there are some things we humans won't do unless compelled. Recurrent training is one of them. Lawyers don't go to continuing education classes unless required. Most Part 91 pilots only do the very bare minimum recurrent training mandated by regulations, a biennial flight review. So, for the maintenance profession, it's time that the insurance companies start the process by requiring some degree of continuing education for A & Ps in order for a shop to get insurance and that the FAA mandate some recurrent training—perhaps a weekend class every two years—in order to exercise those certificates. The upside is obvious, the downside is minimal. —*Rick Durden*

Aircraft Tugs

I've had an Aero Tow E-200 for over 10 years. It works great and Terry Railing's customer service is all anyone could hope for. It's nice when you talk directly with the owner/manufacturer. He's sent me battery rechargers long after any warranty had expired and I still call him with questions. He's always happy to help.

He's told me his philosophy of using kitty litter on ice rather than chains as you described in the article. In my experience, chains are the only thing I've found that works—and they still don't work that well on a ramp that is solid ice. You've got to be a lot more talented than I am to be able to spread 20 feet of kitty litter or sand precisely along the path you intend to pull the nose gear.

I assume that I'm not alone in turning the aircraft 90 degrees as I pull out of the hangar to avoid blowing junk into the hangar when I start the engine. That requires more precise kitty litter spreading along a defined radius. That also requires performing geometry, which I can't do when it's nice and warm out, let alone 10 degrees.

Jim Gorman
Via email

Thank you for the article on aircraft tugs. Of the various accessories that I've purchased (mostly silly, fad and unused) for my airplanes, the tugs I've owned have proven their worth time and time again.

From my point of view, you omitted the coolest, cleanest, sexiest, best-engineered (I'm an engineer, so I can include that) and best-built drillmotor tug of them all: the Sidewinder from Redline Aviation. I use it to move a Piper Meridian around.

It folds up in half so that it can be carried in the airplane. It has plenty of power, even with inclines, lips and snow—backward and forward. Its small size hides its ruggedness. The battery life is unbelievable and it's very easy to use—instant slip on and slip off. The shiny red paint and chrome color scheme gets lots of comments.

I'm not affiliated with Redline, but I recommend the Sidewinder to anyone who asks me about mine.

Thank you again for the article and magazine.

Michael Johnson
Via email

CO Poisoning

I just finished reading David Wagner's letter about pulse oximeters and CO poisoning in the May issue. I had a very nasty experience with CO poisoning and can attest to how fast it can come on.

I've owned a Cessna T310R for 25 years and have kept it meticulously maintained. I've never had a hint of CO in the aircraft.

A few weeks ago, I made a 15-minute flight from Westchester County Airport in New York to Morristown, NJ. It was very turbulent. When I felt nauseated, I attributed it to the turbulence and lack of breakfast. By the time I landed, I felt a little dizzy, which I attributed to the nausea.

By the time I'd finished lunch, the symptoms had gone away, vindicating my belief that the problem was turbulence with an empty stomach.

On the return flight, the air was smooth, but the nausea and dizziness returned. When I landed, I guessed the problem was CO, but did not know why.

I went to the hospital, where it was determined that my blood CO level was severely high from the 15-minute flight. I'm glad it hadn't happened on a flight I make routinely, which takes me 200 miles offshore.

It turned out the gas-fired heater fuel injector was clogged, so gas was dribbling rather than spraying into the combustion chamber. The partially burned fuel was sending CO and CO_2 into the cabin.

Heater performance had never been a part of the checklist on the annual—it is now.

John Rolls
Via email

Engine Heaters and GPS

After reading your article on engine heaters in the April issue, I wanted to pass along what I did for heating my airplane's engine here in Wisconsin. I'm cheap. I got a 750-watt space heater, some metal duct work, a few screws and a timer and built a system that blows warm air into the aft, lower cowl of my airplane.

The timer comes on each day at 6 a.m. and runs the heater until 9 a.m., warming the engine to 70 degrees. An old rug over the cowl holds the heat in well. Even on a warm morning, the engine temperature never gets above 90 degrees.

Thank you for all of your helpful articles, especially the recent ones about software and GPS for iPad. You've helped me make good decisions and save time and money.

Mike Hartz
Via email

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Diamond DA52: A Six-Place Diesel Minivan

It's bigger and faster than the DA42, but don't call it inexpensive. Diamond's probing a global luxury and business market niche.

by Paul Bertorelli

When Piper morphed the Apache into the Aztec in 1960, it was a precursor of sorts for an idea yet to be invented: the minivan. You could say the same of the Seneca, but whichever analogy appeals, Diamond Aircraft's new DA52 VII goes to the same place. It's meant to be a people or thing hauler capable of high cruise speeds, but with a fuel economy and speed Piper could only dream about.

But the minivan comparison goes just so far, for the DA52, when certified sometime next year, will be an expensive ride. A price a bit north of a million dollars puts it in the rarefied league of Beechcraft's still-viable Baron, albeit the DA52 is an airplane with seven seats. Powered by the latest version of the Austro AE300 Jet-A burning engine at 180 HP per side, the DA52 represents Diamond's most ambitious piston-engine aircraft yet and one pitched at what may be a smaller niche market than the DA42 found.

When we visited Diamond's Wiener Neustadt, Austria, headquarters in late April, the DA52 was in full-blown testing and we were given a demo ride in the single test article.

Powered by 180-HP Austro diesels, the DA52 is Diamond's most ambitious piston aircraft yet.

When Diamond introduced the DA42 twin concept at the Berlin Airshow in 2002, we thought they were a little nuts. Although it used the same basic fuselage as the successful DA40 single, the DA42 was a new airframe. But the radical part was the airplane's twin Thielert TAE 1.7 Centurion diesel engines at 135 HP each. The engines were based on the same powerplant used in the massively numerous Mercedes A-Class supermini. Thielert cut a deal with Mercedes to re-engineer the 1.7 using an aluminum rather than a cast-iron block and it designed its own clutch and gearbox to isolate the diesel's torque pulses from the prop.

The joke turned out to be on us. Between the diesel's economy and a reviving training market, Diamond hit a sales sweet spot and was selling the DA42 at three a week by 2005, despite what we thought was a high asking price. (The come-on intro price was $360,000, but by 2005, real invoices were around $452,000.)

There turned out to be a brisk demand for new twin trainers and customers liked the Thielert's ease of operation and impressive fuel economy.

The project ran off the rails in late 2007, when significant maintenance issues with the Thielert engines surfaced and owners complained that neither Diamond nor Thielert were stepping up to address these. By early 2008, what appeared to be flawed economics caught up with Thielert and it declared bankruptcy. It remains in insolvency five years later, but is still supplying parts and engines.

Yes, there are seven seats in the DA52, right. The second row accommodates three abreast while the rear-most seats will hold two smallish people. Gone is the DA42's forward-hinged bubble, lower photos, replaced by gullwing doors. The give-up is A-pillars that obstruct the forward view slightly.

But even before Thielert's crisis, Diamond had had its fill of outside engine vendors. Investing what would eventually be $100 million, the company formed a separate unit called Austro Engine GmbH and fast tracked its own certified diesel based on the same OM640 Mercedes engine Thielert used as a base.

However, for durability and the option of overhauling rather than replacing the engine at the end of its service life, Austro stuck with the Mercedes' original cast-iron block and it engineered heavier gearbox and clutch mechanisms that don't require the recurrent maintenance that so irritated owners of Thielert engines. Years later, Thielert still hasn't improved maintenance intervals much, while the Austro AE300 variant used in the DA52 is rated at 180 HP and current AE300s have a 1500-hour TBO that Diamond's Christian Dries says may increase to 1800 by year's end. All told, about 750 Austro engines are flying in Diamond twins and singles.

RESURRECTED DA50

Seven years ago, Diamond proposed a follow-on to its successful DA40 single in what was then called the DA50. It was larger than the DA40 and was originally to have a Rotax-designed V-6 engine. But Rotax bailed on the project and because Diamond didn't want to commit to major development using avgas-burning Continental or Lycoming engines, it shelved the idea.

But now, the basic fuselage is coming back as the DA52. The immediate distinguishing factor—besides its larger size—are the generous gullwing doors that replace the DA42's forward-hinged bubble canopy. The rear hatch for access to the rear seats is there, but it's much larger, affording step through into both the center seats and the two rear-most seats.

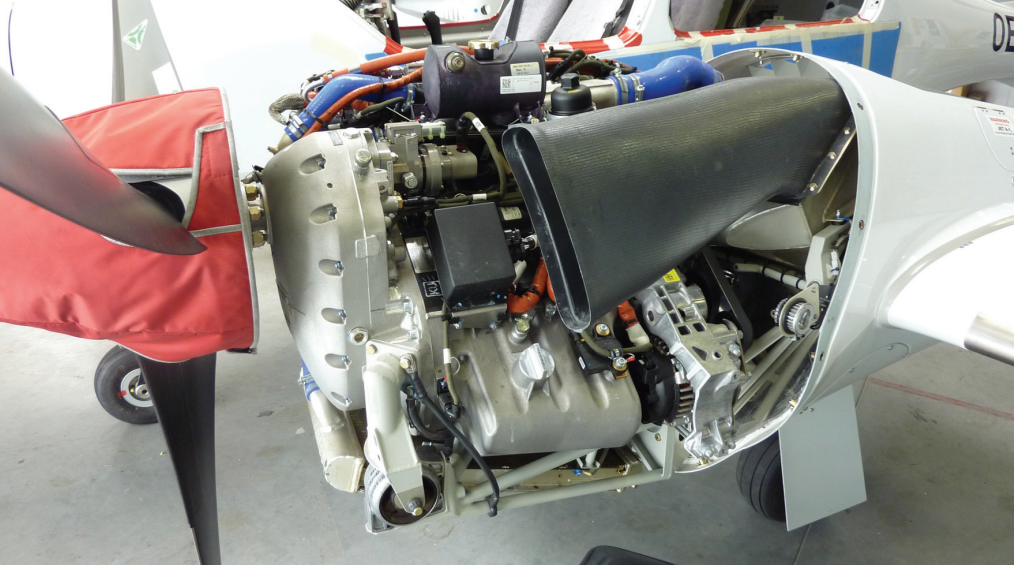
For the test airplane we flew, dimensions may not be final, so what we're presenting here should serve only as a general idea of the airplane's size. The same caveat applies to the performance numbers.

As with its previous aircraft, Diamond will build the DA52 fuselage in two molded halves joined at the center. But it essentially inserted a widening plug between the two halves, so the cabin is about 14 cm wider (5.5 inches), with the added width tapering slightly to the rear. This is noticeable in the front seats, almost giving a large-aircraft flight deck feel to the pilot seats.

The test aircraft had no interior or rear seats, but the photos show Diamond's mock-up interior displayed at Aero Friedrichshafen. The rear-most seats, by the way, will accommodate small adults or children, albeit with limited leg and shoulder room.

The DA52's overall dimensions are larger than the DA42. The fuselage length is 9.2 meters (30.1 feet) versus 8.6 meters (28.1 feet) for the DA42. Span is 14.6 meters (47.9 feet) for the DA52 versus 13.4 meters (43.9 feet) for the DA42. The wings have gracefully upswept tips and a couple of degrees of washout to improve stall characteristics to accommodate the airplane's larger CG envelope.

While we're on the subject of weight, Diamond had only test-article weight-and-balance data, but engineers told us the envelope is wide enough to allow filling all the seats,



The DA52 has a pair of 180-HP Austros, left. As with other Diamond aircraft, the fuel is exceptionally well protected in aluminum tanks sandwiched between massive spars and plumbed with armored hoses.

but with a 120 kg limit (264 pounds) for the rear-most seats. The center seats fold forward to allow carrying long or bulky cargo. Gross weight and payload will depend on the country where the airplane is intended to be used. The fundamental structure is engineered for 2500 kg or 5511 pounds, Dries told us.

For Europe, says Dries, the limit will be 2000 kg (4409 pounds), mainly because EASA cert rules require vastly more budget to certify above that weight, not to mention operational user fees for aircraft above 2000 kg.

For other countries, Dries said the target weight will be between 2150 and 2200 kg (4738 to 4850 pounds) against a projected empty weight starting at or a little below 1400 kg or 3080 pounds. "But this airplane will have 400 pounds of options," says Dries, "so it's not possible to say what a typical empty weight will be."

Those options include TKS, weather radar, air conditioning, infrared camera and electrically adjustable rudder pedals, to name a few. Pick 200 pounds worth, and the empty weight might be around 1490 kg or 3284 pounds. Best case, then, the useful load would be about 1570 pounds (714 kg), plus or minus.

With the tanks full of 90 gallons of Jet A, that could leave as much as 960 pounds of payload, or five people and bags or four people and 280 pounds of stuff. Loaded with options, the real-world airplanes may be heavier, so subtract a half person from that estimate.

How about six people? Well, yes, but not six adults of typical American girth and gross. "The DA52 is a minivan concept. If you take a minivan, you can put in seven people, but not all of them are adults. This is a little bit the same. It will be a very comfortable four to five seater," says Dries.

FLIGHT DEMO

We took a tour of the Alps in the DA52 with Diamond's chief test pilot, Ingmar Mayerbuch. The airplane we flew weighed about 1750 kg at takeoff and had just basic seats, with no rear cabin fittings at all. It also had a DA42 panel and glareshield, whose width fell short of spanning the DA52's cabin, showing how much wider it really is. The extra shoulder room is immediately noticeable.

The Austros start with car-like smoothness and well they should, since they're engineered by one of the largest carmakers in the world. At the light weight, the airplane practically bolts off the runway—it was difficult to hold a camera against the acceleration. With a 15-degree deck angle on climbout, two-engine climb rate is a healthy 1500 FPM on what was close to a standard day. At 10,000 feet, despite some bumps, we saw as much as 1900 FPM in climb. Fuel flow in climb—or at max output for the Austros—is about 9.3 to 9.5 gallons per side.

Cruise setups offer some interesting options. With everything forward, the DA42 is a 200-knot airplane, and then some. At 10,000 feet, we noted 204 knots on 9.3 gallons per side, which is 97 percent power and is considered maximum continuous. Throttling back to something more sane, the airplane tooled along at 177 knots on 6.1 gallons per side; that's about 65 percent power. With full fuel, that's 6.5 hours of endurance—with 45-minute reserve—or 1150 miles of still-air range with five people and bags. Even if the airplane gains some weight, it will probably do that distance with four people and heavy bags.

Just for fun, we re-

duced to max range cruise of 50 percent and checked the G1000's range map. With only 34 gallons aboard, we had range sufficient to reach well past Ukraine to the east, into Scandinavia to the north and the eastern UK from Austria, near the Czech border. That setting pegged the speed at 160 knots at 4.5 gallons per side.

One of Diamond's stated design goals is safety and crashworthiness and beyond question, we think the company has achieved this. Three points are worth considering: As with other Diamond airplanes, the DA52's fuel system is well protected against crash forces by having aluminum tanks situated between two robust spars and plumbed with armored fuel lines. Second, Diamond airplanes typically have benign stall characteristics and, heavy as it is, so does the DA52. Holding it in an aggravated stall barely provokes bobbling, much less a break. Like the DA40, it has an easy-to-manage parachute mode, with little tendency to fall off on one wing.

With single-lever power, engine-out management is as simple as it gets. Simply switch off the engine master switch, the prop spins down and autofeathers and you're done. There's no flurry of fingers and hands over the control pedestal to secure an engine. To bring it back, just reverse the process. Let the engine build some oil pressure and warm up and you're back in business. At our weight, we saw single-engine climb rates as high as 500 FPM or more. But it was too bumpy to gather reliable data. Suffice to say the DA52 does well on one engine, critical (left) side or not.

The DA52 has good roll and lateral stability. In turns, you can keep your feet on the floor and notice no undue yawing. If released in a turn, it tends to right itself rather than banking into a departure and once trimmed, it stays put on airspeed, even when bouncing around in light turbulence.

CONCLUSION

Diamond's Dries is blunt about the DA52. He's not sure who the buyers will be, given its high price. On the other hand, he doesn't seem too worried, either. "You know, in a lot of regions, people don't care how much it costs. They want to fly in a very comfortable way," Dries told us. One region Diamond is doing well in is Russia. He expects China will go likewise, eventually. Besides, says Dries, the special missions market—airborne sensing—is a major part of Diamond's business and for that market, the DA52 might be an attractive 2800 kg option. Buyers of airborne sensing aircraft like high payloads.

If Beechcraft finds 30 or 40 buyers a year for a Baron G58 selling for $1.4 million, is there any reason to believe Diamond can't do as well with a slightly less expensive airplane that's faster, carries more and is cheaper to operate? When Diamond introduced the original Thielert-powered DA42s, we presumed that people who could afford to buy $460,000 airplanes wouldn't care about operating costs. We presumed wrong.

Low fuel consumption does something else: it adds range and load flexibility, which is something that avgas engines burning 40 percent or more of fuel don't do as well. Further, Jet A is the aviation fuel of the future, avgas of the past. As Dries sees it, that's an important part of the DA52's attraction. We'll see if he's right once the DA52 is certified and available.

For more on the Diamond DA52, see the company's European Website at www.diamond-air.at. Obtain further details on other Diamond aircraft at www.diamondaircraft.com.

DIESELS BIG AND SMALL

By our rough count, there are something like 2500 general aviation aerodiesels flying in the world, most of them Thielert 1.7 or 2.0 models, followed by Austro AE300s and a smattering of SMA's SR305, plus a few experimental installations. An unknown number of Thielert engines are flying in General Atomics' MQ-1 drone.

Virtually all of these are four-cylinder diesels, either purpose designed for aircraft (SMA) or adapted from automotive designs by Thielert and Austro. Despite nearly a decade of experience, the higher horsepower segment of the potential market—greater than 300 HP—is only now coming into view. At Aero in Friedrichshafen, Germany, in April, we saw three engines of note.

SMA was showing a mock-up of a proposed six-cylinder version of its Jet A engine to be called the SR460 intended for single- and twin-engine applications. According to SMA's Thierry Argaud, the new engine will be in the 330- to 400-HP range with a displacment of 460 cubic inches or 7.5 liters. Its dry weight will be about 455 pounds (206 kg) and like the smaller SR305, it will be air and oil cooled. Argaud said the engine hasn't run yet, but SMA expects to put it into the test cell later in 2013.

At Austro, Peter Lietz reports that the company has its own large displacement engine project, an eight-cylinder design that's been running in the test cell for a number of months. The engine is being developed in a joint project with Eurocopter under the European Union's Clean Sky project. It's intended to be a replacement engine for turbines used in helicopters. Austro has another project with Austria's Steyr Motors to develop a six-cylinder truck engine for aircraft use. But when we toured the Austro plant a year ago, we heard concerns that the engine may prove too heavy to be practical.

Another automotive conversion was unveiled at Aero. It's called the FlyEco engine and is adapted from the three-cylinder diesel used in the European version of the Mercedes Benz SmartCar. It's an 80-HP powerplant with common rail injection and an ECU. It uses a purpose-made clutch system to isolate torque pulses from the prop drive and a toothed belt drive for speed reduction. FlyEco gives the weight as 81 kg (178 pounds) with fuel consumption of about 7 liters (1.8 gallons) per hour. The engine is flying in an FK9 LSA and for the time being, says FlyEco's Arnim Wegener, it will be limited to light sport and experimental applications.

Choosing a Shop

Look for competence, effective communication and willingness to provide written estimates before doing any work and evidence of recurrent training for techs.

by Rick Durden

The time will come when you're faced with selecting the shop to do the majority of the maintenance on your airplane. Choosing well can mean the difference between a good ownership experience and a level of frustration that causes you to give up on aviation.

In this article, we'll give you suggestions on making your initial search, then how to narrow it down; a list of attributes of professional shops, guidelines for making your selection as well as shop practices that are red flag alerts to avoid.

PARTNERSHIP

Successful and effective aircraft maintenance is a partnership. Your mechanic/maintenance technician works for you, at your direction—because FAR 91.403 makes you ultimately responsible for maintenance on your bird—while the tech puts his or her career on the line with every logbook signature. Each of you needs to know what the other is doing and have a good working relationship.

THE SEARCH

Begin the process by networking. There is no master list of good and bad shops, so get out and talk to pilots in the area and get recommendations. Take advantage of type clubs, get on the boards and ask questions. Go to a meeting of local pilot groups, everything from the EAA chapter to a CAP meeting to safety seminars and ask about the shops. You're looking for a list of names of A & Ps and shops that other pilots say do good work.

Narrow down the search by determining which shops on your list have knowledge and experience swinging wrenches on your type of airplane. Put simply: there are far too many types of airplanes out there for any A & P to know the intimate details of maintaining all of them. The philosophy that went into the design of the airframe and systems of a Mooney is significantly different from that of a Cessna, a Cirrus or a Navion.

CHECKLIST

- A reputable shop will give an estimate and get approval for all repairs.
- Choose a shop with experience working on your airplane type.
- Avoid shops that make repair decisions without your specific approval.

INTERVIEW

Once you have limited your search to a few shops, it's time to have a face-to-face visit with the head of each one—that might be the sole technician at a small shop or the head of maintenance at a large one.

During the interview, plan on discussing the topics below, communication, experience, recurrent training, written estimates, scheduling maintenance, your presence on the shop floor and prices while paying attention to his or her willingness to work with you.

COMMUNICATION

An absolute deal-breaker with any shop is if the tech says for you to drop off your airplane and he'll call you when it's done. That's a virtual guarantee that you'll get bills that can generate immediate need for a defibrillator. A professional shop will troubleshoot and then discuss the problem and potential fixes with you. Before making any repairs, a reputable shop will give you an estimate, in writing, of the cost of

Before the intimate areas of your airplane are exposed, do some homework on the shop that is to do the work. Do the techs have experience on the type? Will you be kept in the loop or will the bill be an ugly surprise?

repairs and get your approval for the work.

Written estimates and approvals (email works well) are important. We think that failure to agree to that basic practice is a no-go item on your shop selection checklist.

The biggest problems we've seen between owners and maintenance shops have involved lack of communication. Too often a shop does involved, expensive maintenance that it felt was necessary, and an owner was stunned by a huge bill.

A professional shop will never surprise an owner with a bill. The owner will know what is coming and have expressly approved the work and the estimate ahead of time.

COMPETENCE/EXPERIENCE

What experience does the tech/shop have on your type of airplane? What recurrent training have the techs taken? Are there any certificates of graduation from courses relevant to your airplane hanging up in the office? Ask for names of customers who have airplanes similar to yours and call them up to get their take on the shop and the quality of the work.

There is no requirement for recurrent training for A & P maintenance technicians. For those with Inspection Authorization, there is an annual recurrent requirement, but it is not terribly involved.

Talk with the mechanic you are thinking of using about some of the technically advanced features of your airplane. For example, if he or she is not familiar with the benefits of lean of peak operation or how to interpret the download from an engine monitor, it's probably time to terminate the interview.

If the shop doesn't have and regularly use a borescope, move on.

TURBINE SHOP?

The rules for maintaining turbine aircraft over 12,500 pounds are more rigid than those for pistons operated under Part 91. Piston airplanes are maintained under Part 43 and Part 43 Appendix D which, simply put, means that many items are "recommended" rather than "required" as they are for turbines, particularly when it comes to the time for repair or replacement. We've observed that turbine shops often get into the "required" mindset and start inappropriately applying it to pistons, making for some eye-watering bills.

Some of the worst maintenance

MANAGED MX: ASK YOUR SHOP FIRST

In the corporate and for-hire aircraft world, seldom does the owner deal directly with a maintenance shop. Maybe there's a director of maintenance or an aircraft management service that oversees and calls the shots on the owner's behalf. This service isn't just available for multi-million dollar biz jets. You can have a pro manage the maintenance on your lesser aircraft, too.

For some, there might be several good reasons to have an outside party manage the maintenance of your aircraft. Maybe you don't have the time to coordinate the maintenance, don't have the confidence or knowledge to make decisions on a complex aircraft, or perhaps you believe that a managed maintenance program can save you money.

That's the sales pitch that SAMM (Savvy Aircraft Maintenance Management) sells—for a fixed annual fee, based on aircraft type—to owners of owner-flown aircraft. SAMM is run by Mike Busch—a long-time maintenance advisor to the Cessna Pilots Association, the FAA's National Aviation Maintenance Technician of the Year for 2008 and founder of the Savvy Aviator Seminars on aircraft ownership.

In mid-2008, he founded Savvy Aircraft Maintenance Management, which claims to professionally manage the scheduled and unscheduled maintenance of most models of owner-flown aircraft. (Full disclosure; our editor, Rick Durden, did legal work for SAMM some years ago and has been a customer.)

Clients of SAMM we've spoken to over the years say they're quite pleased with the service and see reduced maintenance expenses, along with increased confidence.

Instead of actually turning wrenches, SAMM acts as the owner's maintenance advisor and advocate to ensure the aircraft receives first-rate maintenance at the lowest possible cost.

It handles everything from picking the shop and giving them their marching orders to reviewing and approving the invoice for payment—a plan that doesn't sit well for some of the mechanics that actually do turn the wrenches, and have to sign their names in the logbooks. None agreed to be named. We could tell that, to them, managed maintenance is a sore subject.

Fran Neligon, who operates Total Aircraft Maintenance in Hartford, told us that his shop has good and bad experiences with managed maintenance, and noted that some of his better experiences has been with Busch's SAMM. "SAMM rarely second guesses our technicians, although there is some disconnect when a mechanic finds cracks in a fairing, for example. SAMM will likely defer the repair to the next annual event, even though they aren't physically on site to see the cracks," said Neligon.

He also noted that working with managed maintenance companies creates a huge workload for his shop, given the level of communication and coordination that the service creates.

Our advice to owners interested in working with such a service is to first talk with your shop, if you have one you normally or would like to deal with. Be up front and get a feel for how they might entertain the idea of an outside party calling the shots on their ultimate sign-off. Our experience is that the relationship between owner and shop can become stressed if the synergy goes wrong.

—Larry Anglisano

Be cautious before assigning your piston-engine bird to a shop that specializes in turbines—there can be expensive confusion between the maintenance "required" world of turbines versus maintenance "recommended" world of pistons.

horror stories we've heard have been with piston twins in turbine shops.

LOGBOOKS

We strongly recommend that you not keep the logbooks for your airplane at the shop. Lost logbooks knock from 10-20 percent off the value of the airplane, so those books are worth a minimum of $2000 on a $20,000 Cessna 150. Keep electronic copies of your logs with the originals locked up.

Reputable shops are used to getting electronic copies of logs. They will give you the maintenance endorsements on stickers for you to place in the original books. If your prospective shop doesn't do this, it's a yellow flag.

We've seen too many shops hold logbooks hostage to force payment of a bill for work the owner didn't agree to. We've also seen too many times where logbooks simply disappeared from the shop.

OWNER-FRIENDLY

There should be nothing that keeps you from being present or helping when work is done, and getting an explanation as to what is happening. Be aware that you should expect to pay for the mechanic's time if you're slowing things down—after all, a tech's stock in trade is knowledge, judgment and experience; the way she or he has to bill for it is by the time spent putting that knowledge to work.

PRICE

The price for shop work should be stated up front, with no hidden charges. That being said, the more expensive hourly rate may not be more expensive than the cheaper rate—the quality of the result is what matters. We've seen too many "inexpensive" shops that take three months to do an annual on a Cessna Cardinal—something that should take no more than three to five days.

CONVENIENCE

Can you get your airplane scheduled in for work in a reasonable period of time when it breaks? How much trouble is it going to be to get your airplane to the shop and then get home? By the same token, there are specialty shops for certain types of aircraft that have such good reps that owners fly their airplanes halfway across the country and remain there for each annual inspection.

RED FLAGS

Any of these are a signal to stay away: a cluttered, dirty shop; a tech who makes promises regarding work on your airplane without ever seeing it; a tech who is willing to work on anything; a shop that has more than one airplane that has been there for more than a month with no apparent progress.

THE ANNUAL

Because the annual inspection is usually the big money contact you'll have with a shop, it's a good idea to know what it does and does not involve.

A mechanic with Inspection Authorization inspects the airplane, maintenance records and applicable ADs, creates a list of unairworthy items and other squawks (the list is not put in the aircraft logbooks) and stops. A professional shop will then give you that list along with an estimate to repair each squawk.

You and the tech go over it. The airworthiness items—the tech makes that call—must be repaired. You, the owner, make the call on repairing or deferring the remainder of the squawks. A good tech will make suggestions, but it's your decision.

The IA signs off the inspection itself. The repairs of the items on the squawk list can be made and signed off by the IA or by an A&P.

If done in this fashion—inspect, squawk, estimate costs, approve, repair—you have no surprises when the annual is complete. It is the way a good shop operates. If your prospective shop is unwilling to do an annual in that basic, organized fashion, your wallet may at risk.

If a tech tells you that he or she inspects a little and repairs a little, or inspects and fixes everything without talking it over with you, it's a giant red flag. That means you don't know what the annual is going to cost until it's all over, something that puts you well into the area where it's going to hurt, or even where you may wind up in a lawsuit simply because the tech is not professional enough to communicate effectively.

CONCLUSION

It's your maintenance dollar and your responsibility under the FARs when work is done on your airplane. When selecting a shop, choose one that recognizes the partnership between you and the shop, is willing to communicate openly, gives estimates in writing and gets approval before doing any work, understands the difference between recommended and required, is owner-friendly, has experience with your type of airplane and is willing to keep learning.

FlyCool Electric AC Light, Efficient

But AMT's satellite-derived cooling technology might still be too heavy for the LSA market.

by Rick Durden

The Light Sport world is getting a new air conditioner making use of technology trickled down from the space program. It was developed by an aggressive young company that is already supplying micro-cooling components and systems to NASA, the military and experimental aircraft builders.

Air Management Technology, Inc. (AMT) of Englewood, CO, is the creator of FlyCool, a lightweight, all-electric, vapor cycle air conditioning system that is capable of 9500 Btu per hour and moving 350 cubic feet of air per minute—about the same as in a mid-sized automobile.

AMT told us that they expect final approval for installation of FlyCool in the Flight Design CTLS and the Sport Cruiser before this issue reaches readers.

The system uses hermetically sealed, brushless DC motor/compressors similar to those used to spot cool components in satellites, and which have very low EMI output so they do not interfere with avionics. There are two versions of the FlyCool: a permanent installation and a modular unit that can be removed during cool weather months.

Both versions mount in the baggage compartment. AMT reports that the unit will drop the cabin temperature 20 degrees in six minutes.

WEIGHT

Weight of the system is 25 pounds for the modular unit and 22 pounds for the permanent installation. FlyCool requires a 28-volt power supply and draws 36 amps, which runs up against a shortcoming of the Rotax engine powering most LSAs—it only has a 14-volt alternator. That means that a 28-volt, belt-driven Plane Power alternator, producing up to 150 amps, has to be installed as a second alternator in the airplane, adding 12 pounds to the system. The second alternator requires less than 1 HP to operate. Some beef-up of the baggage compartment floor is required, so the full weight of an LSA system is just under 50 pounds. The modular unit is 20 x 10.4 x 12 inches in size.

Because the compressor is not driven by the engine, as is the case with other air conditioning systems, there is no requirement to shut it off during takeoff, there are no lines through the firewall and the system does not have to be bled down for engine maintenance.

As AMT is a supplier to the military and NASA, it is AS9100 compliant. AS9100 is the standardized quality management system for the aerospace industry and requires sophisticated tracking of materials and quality assurance. All components of the FlyCool are aviation grade and are circuit breaker protected.

INSTALLATION

AMT has worked closely with U.S. Aviation Group in Denton, TX, in getting the Flight Design approval. U.S. Aviation will be an installation and service center, as will Lockwood Aviation in Sebring, FL.

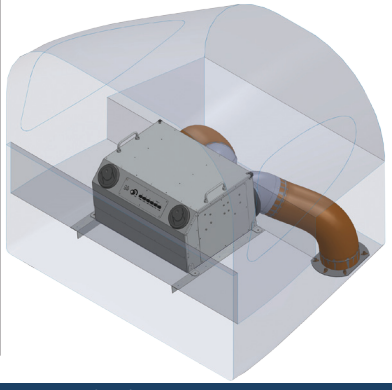
Prices are $14,750 for the installed unit in the CTLS and $12,900 for the modular unit in the Sport Cruiser.

Fifty pounds of added weight to an LSA is a big deal, in our opinion, turning most of the airplanes into single-place machines. We're curious to see how that affects demand.

However, we are impressed by the technology and capability of FlyCool and can't help but think that a healthy percentage of Part 23 airplanes have 28-volt electrical systems, so wouldn't need the weight of a second alternator and wouldn't need a baggage floor beef up.

A 30-pound, all-electric air conditioning system (with a few pounds for duct work), would not be a big weight gain for piston singles and twins. We can't help but think that Cirrus, Cessna, Piper and Beech will be taking a hard look at offering FlyCool units in their airplanes.

FlyCool installation takes up much of the baggage area of the Flight Design CTLS, below left; cold air outlets are behind and between the seats, left. 3D depiction of the FlyCool modular unit in a Sport Cruiser, below.



Combined ADS-B/EFIS: Impressive Performers

The Stratus II is the top value but Sagetech's Clarity SV leads in performance and features. But don't rely on any of them for real backup.

by Paul Bertorelli

CHECKLIST

- All three products delivered good AHRS/EFIS performance.
- WAAS GPS and ADS-B reception proved excellent.
- Heat's an issue. Stratus allows remote mount; Clarity has sunshade.
- None are reliable enough for true AI backup. Apps are too unstable.

If ever you harbored doubts that the iPad and its progeny would eventually be all things to all pilots, a herd of new ADS-B portable products last spring might erase them. No fewer than three new gadgets hit the market and we suspect more are in the wings. The "all things" part is that these new devices are equipped with functioning AHRS so the polymath tablet is now not just a navigator, but an EFIS, too.

So much for the glitter, but is the EFIS one you can really depend on? We'll get to that in a moment. For now, suffice to say in this market, there's a box for every budget and for under a grand, you get impressive navigational performance, FIS-B weather, limited traffic awareness and the EFIS, one version of which even includes synthetic vision.

For this review, we wrung out three ADS-B portables, the iLevil from Levil Technology at $1195; the Stratus II from Sporty's/Appareo at $899 and, from newcomer Sagetech, the Clarity SV for $1400.

With $500 separating the top tier from the bottom, it's natural to wonder if there's that much value difference in features, given that all three units perform basically the same tasks. We're not sure we can answer that, but we will say you're not likely to go wrong with the cheapest choice. Now, on to the details.

ILEVIL

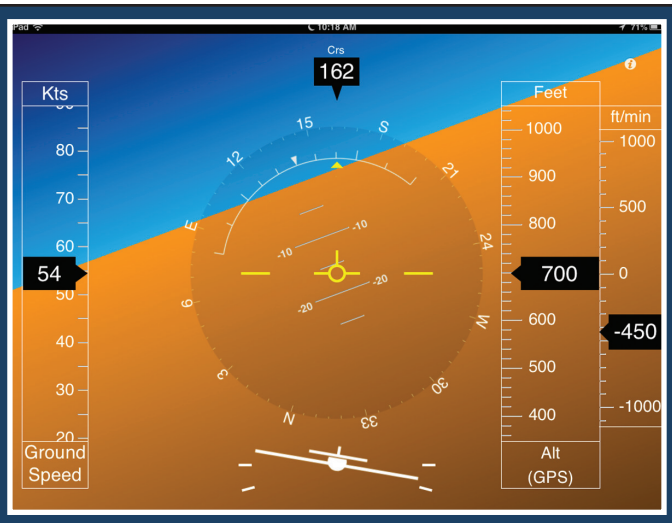
Levil Technology is a small, family business in Florida that, oddly, specializes in desktop CNC equipment. As a sideline, the company has developed a series of aviation products including a pair of miniature AHRS products that output attitude information to other devices or directly to a smartphone or tablet via a wireless link.

The iLevil is the company's first combined ADS-B/AHRS product. Like the other devices, it's a self-contained, battery-operated unit that contains, in addition to the AHRS, single-channel ADS-B traffic (978 mHz) and WAAS GPS.

It's designed to perch on the glareshield, where it can see both GPS satellites and ADS-B tower signals. Power is provided by an internal lithium-ion battery with about three hours of capacity, according to Levil. One quirky touch is that the iLevil has solar cells on top of its chassis, which the company says will extend the battery life to four hours. (We didn't test battery endurance.) Charging time, via USB, is about four hours.

The iLevil measure 4 by 2.5 by 1 inch high and has a small whip antenna on one side for the ADS-B signal. While the other two products have gel mounting pads to secure them to

iLevil, far left, includes solar cells to extend battery life. Clarity SV, center, is the smallest, but Stratus II, right, runs the coolest of the three.



Although they share basic functions, the look of the EFIS displays is quite different. On the left is WingX's output of Clarity SV. The screen is split to show the attitude indicator on one side, the synthetic vision on the other. iLevil output on WingX is similar to the left screen; attitude indicator only. In WingX, the EFIS output is integrated into the app.Note that GPS groundspeed, heading and GPS altitude appear along the top edge. Stratus Horizon, right, has a more traditional EFIS look, with tapes for speed, altitude and rate values. But Horizon is a separate app; it doesn't work within ForeFlight.

the glareshield, the iLevil doesn't, so a spot of Velcro will hold it fast. For the Apple iOS, the iLevil communicates via wireless protocol, but for Android, it uses Bluetooth.

We ran the iLevil with the latest iteration of WingX Pro and found the device takes about 20 seconds to find itself before shipping data to the app for display. On WingX Pro, the output appears as a basic PFD gyro with the standard blue-brown iconology, pitch and bank angle indicators and, along the top edge of the screen, GPS groundspeed, altitude and AHRS heading reference.

The display response seems accurate and relatively smooth, although it doesn't have the damped-in-oil feel of a certified EFIS. The iLevil retains lock through steep turns and 360 degrees of roll, but give it quick shake by hand and it red-Xs. Ten seconds of straight and level recovers it. Levil says the iLevil's max G rating is four, so we doubt if anything but the most severe turbulence will disrupt it.

To keep the SV Clarity cool, right, the SageTech has devised a small fan-equipped cooling shade.

The iLevil is single-channel ADS-B only, meaning it will receive FIS-B weather—NEXRAD, text weather, AIRMETS and so on—but only ADS-B traffic nearby that's equipped with ADS-B Out and is communicating with a nearby tower.

STRATUS II

Although SkyRadar introduced the first portable ADS-B in 2011, it soon got competition from device maker Appareo, which teamed with Sporty's and ForeFlight to offer the Stratus. Introduced in 2012, the Stratus was a seamless wireless box with an internal battery that eliminated the wiring hassles with the SkyRadar. But it had no traffic and certainly no

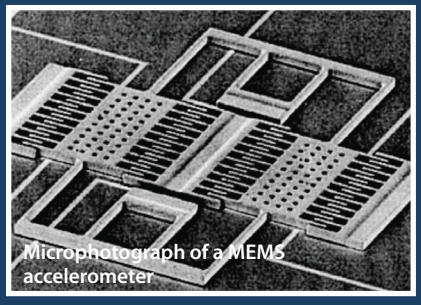
PRODUCT	PRICE	SIZE	ADS-B	BATTERY LIFE	APPS	COMMENTS
SAGETECH CLARITY	$1150	2.5 X 2.5 X 1.5	978 MHZ 1090 MHZ	6 TO 8 HOURS	WINGX, ADVENTURE PILOT, GLOBAL NAV SOURCE, IPAD EFB, SKYVISION EXTREME	THIS MODEL IS ADS-B ONLY; NO AHRS
SAGETECH CLARITY SV	$1400	2.5 X 2.5 X1.5	978 MHZ 1090 MHZ	6 TO 8 HOURS	SAME AS CLARITY	TOP OVERALL PERFORMER FOR GPS, ADS-B AND EFIS; SMALLEST PHYSICAL SIZE; RUNS WARMEST
ILEVIL	$1195	4 X 2.5 X1	978 MHZ	3 TO 4 HOURS	WINGX, AHRS UTILITY	GOOD PERFORMER; LACKS DUAL FREQUENCY ADS-B
STRATUS II	$899	6 X 2.6 X1.25	978 MHZ 1090 MHZ	8 HOURS	FOREFLIGHT ONLY; HORIZON FOR EFIS	BEST OVERALL VALUE; RUNS COOLEST; REQUIRES TOGGLING TO SEPARATE APP TO USE EFIS

THE MAGIC'S IN THE MEMS

Why so many of these ADS-B/AHRS gadgets at once? It's due to a confluence of developments that include a flood of iPads and tablet-type computers fueled by intense competition in apps for these devices.

Just as tablets come into their own as must-have cockpit accessories, the FAA built out the ADS-B ground network to cover more than two-thirds of the U.S, making ADS-B's FITS-B weather broadcast a market player. Further, when SkyRadar introduced the first practical ADS-B portable based on a license from the Mitre Corporation, the door for competition in the field was propped open.

As for the sudden influx of AHRS, timing again. Thanks to cheap—really cheap—microelectromechanical systems, or MEMS, gyros and accelerometers are widely available and readily adaptable to build small, inexpensive AHRS. And we're talking really small and cheap. We were told that the MEMS parts for one of these gadgets cost less than $10. Sagetech's AHRS, says the company's Kelvin Scribner, weighs only about a gram.


Microphotograph of a MEMS accelerometer

"MEMS for the last decade has really been making big strides," says Scribner. "Around 2000, you could get the kind of rotation sensors we use in Clarity and they were about one-inch cubes. Now, we get three of those things in the size of your tiny fingernail."

Tablets themselves—and smartphones—have contributed a sort of reinforcing feedback loop since they use MEMS parts in the millions, further driving costs down and quality up. Reliability has improved, too.

"There's some cool things that happen when you miniaturize things. They get ultra rugged; they're just stiffer," says Scribner. But as the hardware reliability improves, software may still be the weakest link, especially in how apps interact with the tablet operating system. And the other part of the magic is software development, which is expensive and time consuming.

When we asked Appareo's CEO Barry Batcheller if this type of hardware was suitable for a backup AI in lieu of an electric gyro, he was unequivocal: "Absolutely not. We haven't done the depth of testing for that."

AHRS. Like Levil, Appareo is primarily an AHRS maker with products in the military and training markets, so it simply added ADS-B to its solid-state gyro expertise. The result is the second-gen Stratus II, which bears little resemblance to the launch product. At 6 by 2.6 by 1.25 inches, it's the largest of the three with a form factor reminiscent of an early cellphone, with a weight to match.

Like the Sagetech Clarity, it has a gel pad mount, but all the antennas are internal. For those who wish to mount the Stratus away from the glareshield—not a bad idea to keep it cooler—the device has optional remote GPS and ADS-B antennas.

Once linked through the Stratus wireless network, the device sends position data via its WAAS GPS and attitude data via the onboard AHRS. However, rather than displaying through a navigation app such as ForeFlight or WingX, Stratus requires its own dedicated app called Horizon, a freebie from Appareo.

That means you have to toggle from one app to another to use it, so it's not running in the background. Further, it works only with ForeFlight and the minimum recommended platform is the iPad2 or mini. Because it requires higher charging voltage, the Stratus has to be charged via line voltage through a provided USB cable and charger. Charging time is about five hours with a claimed eight-hour battery life.

The payoff of the dedicated app is that the display is larger and presents attitude data in a way that's more consistent with panel EFIS design. GPS groundspeed and altitude are presented in tape displays and there's also a vertical speed tape. Heading is via compass rose and there's also a virtual turn-and-bank indicator.

The Horizon app offers some minimal manual calibration adjustments which its competitors don't offer. For example, if you're using Stratus in a taildragger, as we did, you can manually adjust the pitch on the ground to read straight and level once you're airborne. Another button allows instantaneous straight-and-level calibration if you know you are and the unit thinks you aren't. WingX provides this, too.

Dynamic response appears similar to the iLevil in pitch and roll, but one touch we liked was pitch warning chevrons. At 30 degrees of pitch up or down, the app displays red chevrons commanding corrective pitch inputs. Still, a quick shake will upset the AHRS lock, but it will recover in under 10 seconds.

For ADS-B, the Stratus II is dual-frequency—978 and 1090 MHz. That means like the iLevil, it will see ADS-B Out traffic talking to nearby towers, but it will also see 1090ES targets directly. Currently, there are more of the latter than the former, so dual-band or not, ADS-B is but a limited traffic solution.

continued on page 32

CONTACTS

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Flight Training Cockpit: Roll Your Own Sim

PilotMall's add-as-you-go tabletop flight simulator lets you create a custom training panel. The only thing missing is FAA approval.

by Larry Anglisano

You can retrofit instruments and avionics in your aircraft panel, so why not custom retrofit your own simulator to match the layout? That's the concept behind the new Flight Training Cockpit Advanced Panel, which is sold by PilotMall.com.

The tabletop simulator—which uses Saitek ProFlite electronic instruments, avionics and controls—allows for a custom layout, thanks to a modular and interchangeable design. The simulator's instrument panel is made of 14-gauge steel and mimics a real panel, which even includes a glare shield.

"We've been selling the Saitek flight training instruments and avionics panels for years, but customers have recently been asking for an easy way to mount the instruments to make the suite look and function like an actual aircraft panel," said PilotMall's Neil Glazer.

The Advanced Training Cockpit is appealing to owners who might rearrange the instrument and avionics panel in their own aircraft and want to practice flying the new layout. The simulator is designed for easy configuration of new instruments—from a basic six-pack layout for a new student pilot—to an advanced layout for the instrument pilot, for example. Owners can purchase a full package today, or can simply buy the panel and build as they go.

Adding components is as easy as removing the pre-configured slots (no cutting required) and inserting the instruments and avionics. Components are installed with Hex cap screws and nuts. There's even an annunciator panel, with 24 status and warning lights that are customizable to match the equipment being flown. The system uses an electrical panel with nine programmable toggle switches to command specific systems.

FLYING TABLE

The advanced panel hardware and the Saitek electronic instruments work with Microsoft Flight Sim X and with X-Plane, when third-party plug-ins are used.

The advanced panel can accommodate a variety of external controls, including Cessna and Mooney-style throttle, mixture and propeller controls as well as a Piper-style quadrant. There's also an optional retractable landing gear control, twin-engine throttle quadrant and trim wheel. The controls simply secure to a table or other surface, using supplied C-clamps.

We flew a fully equipped Advanced Panel sim and were impressed with its realistic and high-end feel. The panel sells for $399 and a fully equipped simulator—including controls, instruments, avionics autopilot and annunciator panel—is around $2500.

Unfortunately, the simulator is not FAA approved for satisfying required proficiency time, instrument experience or training for certificates or ratings. Visit *Pilotmall.com, 800-249-5730.*

The Advanced Panel simulator uses Saitek LED flight instruments, which are easily installed in the 21-by-31-inch metal instrument panel, complete with glare shield and pop-out instrument cutouts, lower photo. The system uses Saitek radio panels and controls—including an autopilot, annunciator, trim wheel and various throttle quadrants.

iPad Mount Options: No Slam Dunk

There's no perfect solution for securing the iPad in the cockpit. We favor the versatile RAM ball-and-socket and the MyGoFlight folio.

by Larry Anglisano

We thought switching to Apple's iPad mini for cockpit use would be the cure-all for the shortcomings of the bulkier, full-size iPad. As it turned out, it created a new set of problems. While the smaller mini is less obtrusive, the little sucker just won't stay put if you plop it in your lap. On a recent trip, ours slipped under the seat, dropped on the floor and became wedged between the seat and the circuit breaker panel in a Pilatus. We thought it was gone for good.

Convinced that any cockpit iPad—full-size or mini—needs to be secured, we set out to find the perfect mounting solution. We gathered various mounting hardware and accessories, to include yoke mounts, all-purpose surface mounts and kneeboard mounts to evaluate in different cockpits. We couldn't come close to covering all available options here, so if you have a favorite mount or process, let us know.

cockpit ready

That's how CEO and co-founder of MyGoFlight Charlie Schneider defines his iPad mounting solutions. We think his philosophy can help in making logical decisions when selecting iPad mounting hardware.

"Pilots ask why they need to secure their iPad while flying until they experience it falling on the floor and the device becoming unreachable," said Schneider.

MyGoFlight offers a wide variety of durable mounting options for the iPad, as well as high-quality accessories that help tame the unit in the cockpit, including bundled packages to include Bad Elf GPS receivers, storage bags and anti-glare screen covers. They even offer specialty mounting solutions for large aircraft—including a universal jet mount—for attaching to the flat surface area on the control yoke of a Citation, TBM, BeechJet and Boeing, to name a few.

The iPad mini is almost the perfect size for yoke-mounting in the preferred landscape position. One problem: Our trials found it to be a tight squeeze between the Piper control yoke horns—hindering control grip.

MyGoFlight is methodical when it comes to suggesting a mounting option and doesn't believe there is a single best way to secure an iPad in the cockpit. According to Schneider, there are many factors that buyers rarely consider—including aircraft model—plus the existing avionics configuration. After that, it's all about pilot preference. Ask yourself some qualifying questions before spending money on a mounting option. Do you want the iPad fixed-mounted on a hard surface or are you the kneeboard-wearing type? You should also consider the apps you wish to use, your body size and evaluate how close you sit to the controls. Certain apps that display a PFD or synthetic vision are often best used within your line of sight. This will likely require a mount that's close to your primary scan.

RAM IT ON THE YOKE

Unless it's an iPad mini, we say forget about mounting to a traditional control yoke. We think it's too awkward and a full-size iPad blocks primary instruments. In fact, at 5.8 by 7.7 inches, the iPad obscures just about anything in its path. Mounting

CHECKLIST

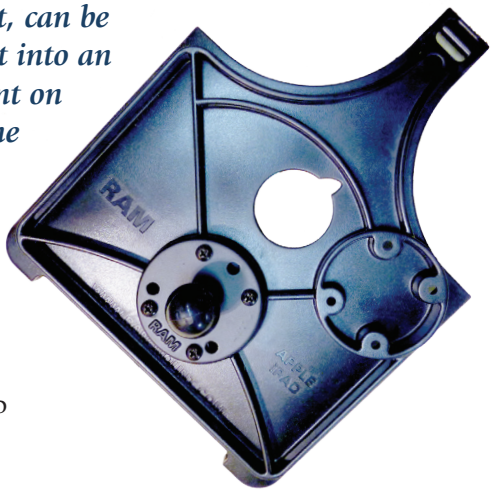
- ⊕ RAM ball and socket hardware is rugged and versatile.
- ⊕ There's a good selection of kneeboard mounts, an option we prefer.
- ~ iPad screen glare remains a problem no option can seem to cure.

it on the copilot's yoke is a slightly better option, if you can live with the reach and a side viewing angle.

That's where RAM (which stands for Round-A-Mount) comes in handy, with articulating arms plus socket-and-ball mounts. The RAM mounting system uses a hard rubber ball, injection molded onto a marine-grade aluminum post and an adjustable clamp that has incredible gripping pressure. These mounts are so durable they have a lifetime warranty. The ball-and-socket design enables the iPad to be positioned in the vertical or horizontal. There's a wide variety of clamps and arm lengths to choose from—including glare shield clamps, yoke clamps and suction cup mounts. Most kits are under $100.

RAM offers various cradles, including the $23 EZ-Roll R, for both the full size iPad and the mini. The EZ-Roll R cradle has two tabs at the bottom and one at the top of the cradle that we've seen stress and snap off on more than one occasion—something to think about if you remove the iPad after every flight, although it appears that newer cradles have strengthened retaining latches.

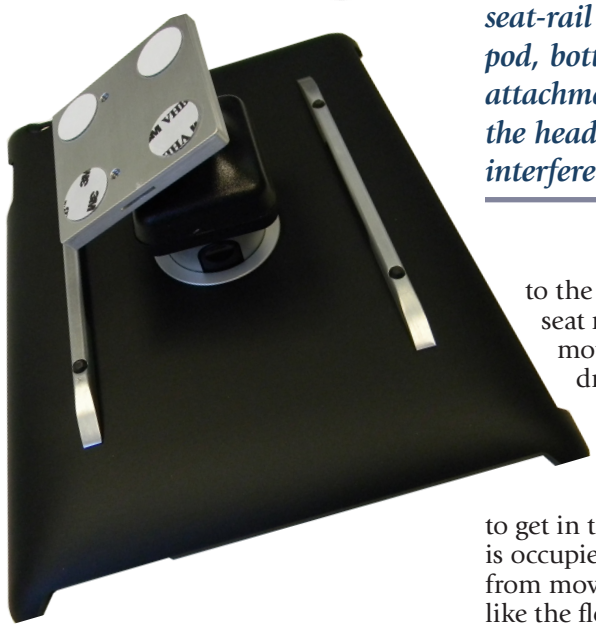
One design feature we like about the RAM cradle is the ability to offset the ball mount to one side (or in the lower center of the assembly). Whether mounting on a glare shield, side pillar or on a yoke, this affords flexibility. RAM also makes the X-Grip universal cradle for large tablets and the Tab-Tite cradle, which we didn't evaluate. RAM makes a unique seat-rail mount that clamps



The RAM EZ-Roll R cradle, right, can be offset by screwing the ball mount into an available corner attachment point on the assembly. The cradle holds the iPad securely but we broke the upper retaining clip, which RAM replaced under the lifetime warranty.

A LEG UP ON THE PAD

Clockwise from lower left, the MyClip elastic leg strap is the most basic way to secure an iPad to your leg. It's even approved by some airlines. Sporty's tri-fold case has handy storage pockets and a tilt bracket for raising the iPad, but the full-size iPad obstructs the control yoke. MyGoFlight leather Folio works well with the mini—enabling easy rotation for portrait and landscape view. It's available with a writing board and clip.



An iPad hung from a window with a RAM suction cup mount, top photo and inset, isn't our idea of crashworthy. The MyGoFlight universal jet mount ($368) can connect to the company's Sport cradle, middle photo. The machined aluminum plate uses 3M adhesive to grip the flat surface of modern jet yokes—including the Pilatus and TBM. The RAM seat-rail mount with flexible pod, bottom, anchors to seat stop attachment points. We don't like the heads-down position and its interference with right-seaters.

to the floor between the two seat rails, secured with a steel mounting plate with holes drilled for the seat-stop locking pins. While it works best in the cabin of a high-wing Cessna, we're not fans because it tends to get in the way if the copilot seat is occupied. It also hinders the seat from moving fully forward. We do like the flexible stalk—fitted with a rubber ball at one end—that threads into the clamp.

ForPilotsOnly makes unique mounting systems for both the mini and full-size iPad. The $69.95 iPro Navigator—which is an articulating clipboard and iPad cradle—utilizes the RAM yoke mount clamp, RAM double-socket and one-inch ball. When the clipboard is in the down position, it provides a hard writing surface. When it's up, it's designed to shield the iPad screen—minimizing the problems of overheating and shutdown caused by direct sunlight—a long-standing wart for cockpit iPad use. We found that it also helped reduce screen glare, but not completely.

The clipboard hangs in the downward position on two stainless steel pins and plastic tracks that we initially found awkward, but once we figured out how it's supposed to work, we liked it—especially for writing. To access the iPad, simply swing the clipboard upward and slide it into position across the top. This provides complete access to the iPad while shielding it from sunlight. The clipboard easily slides forward and backward in this horizontal placement. Since it is perpendicular to the iPad, you sees only the edge of the clipboard, in most seating positions.

During our evaluation, the assembly blocked the sun without blocking the view of the instrument panel in a Cessna twin. The clipboard is easily pulled down again, allowing it to drop into position for use.

Speaking of dropping, we thought we would have the piece broken in short order, given our clumsy cockpit habits, but the clipboard was designed for clumsy pilots—and for crashes—since it's engineered to break free of the mount under forward or downward force.

The $99 MyGoFlight Sport is a durable polycarbonate cradle with aluminum mounting rails on the underside, for mounting a leg strap. The Sport, for full-size tablets, allows for flexible mounting options, adapting to a seemingly endless variety of MyGoFlight hardware—much of it made with high-end machined aluminum parts. MyGoFlight makes a $138 yoke mount for Beech applications and includes a wide attachment clamp, extension arm and adapter, which fits the Sport cradle.

KNEE MOUNTS

Strapping the iPad to the knee can be a good solution, and a few companies bring good ingenuity to the design. ForPilotsOnly.com first developed a custom iPad kneeboard in 2010 and has since expanded the knee-mount line with several new models.

The $139.95 iPro Aviator/A houses the iPad 2/3/4 models in a durable, T4 aluminum housing with an external clipboard. On the inside, the assembly uses flush rivets and rubber padding that's gentle on the iPad. The $79.95 iPro Aviator/M fits the mini. This would be one of our favorites; it didn't get the way while strapped to the leg, it's durable and it has a writing board. The only prob-

lem we have is that the iPad can only be viewed in portrait mode.

Sporty's offers the FlightGear tri-fold case—an option we like for storing small accessories, including a flashlight and GPS receiver, for example. The case tilts the iPad up for a better viewing angle, but we couldn't pull a traditional control yoke full aft without it getting in the way. For a more simplistic approach, they offer the $27.95 rotating Slimline iPad kneeboard. It has an adjustable elastic strap and a built-in swiveling mechanism for using the iPad in either landscape or portrait mode.

Of course, the simplest mount of all is the $39.95 MyClip from Tiet. This is nothing more than a leg strap with two padded clips on elastic. The clips attach to either side of the iPad—in either portrait or landscape—and hold it securely.

The $45 Sky High Gear Genesis X iPad kneeboard and case has been made to fit all generations of iPads, and it accommodates all plug port locations. The main frame is made of ABS and the corners are made of Polyurethane. When not flying, the case converts into an iPad stand with unlimited angle adjustments.

MyGoFlight's $189 Kneeboard C has a thin clamshell with magnetic clipboard. Depending on which leg you strap to, you can set up the case with the iPad and clipboard on the left or the right, or you can have the iPad inside and the clipboard on the cover, similar to the Genesis. Our favorite, the $139 Folio, is made of leather and has the aluminum rails on the underside. The C-model, with clipboard, starts at $159.

AIR GIZMOS

Gizmos recently introduced a version of the panel dock for the iPad mini, plus a surface mount for full size iPad's. The $99.95 surface mount secures to the panel using the standard instrument mounting holes.

The mini panel dock fits the standard 6.25-inch radio stack width and occupies 8 inches of stack height. This, of course, is a lot of real estate, which will likely require sizeable amounts of rework to accommodate. The mini dock can work with the Gizmos angle adapter, helpful when mounting the unit on the copilot panel, for example

Speaking of accommodations, Gizmos built a cooling inlet to the back of the dock to accommodate an avionics cooling fan. Given the heat that builds up in most panels—and the issue with iPad shutdown— this is a smart idea.

For the original iPad and iPad 2, Gizmos makes the $149.95 knee dock—an articulating (tilting) kneeboard that's based on the panel dock design. It has a drop-down writing surface with chart holder, similar to the iPro Navigator product.

The ForPilotsOnly iPro Navigator yoke mount isn't as awkward as it appears. The articulating clipboard serves double-duty as a glare shield for the iPad, top photo, and as a writing surface/chart holder when it's stowed in the down position, inset photo. The Sky High Gear Genesis X, lower, works well as a cockpit kneeboard and as an everyday case.

TRIAL BY ERROR

That's what it might take to find the iPad mounting solution that suits you. The iPad mini will present less of a challenge than a full-size iPad. Fortunately, the market is blossoming with a lot of mounting options for both. Unfortunately, we don't think any of the solutions we tested here is perfect, although we do have favorites.

Our top pick for mounting a mini on a control yoke is the RAM ball-and-socket with RAM EZ-Roll R cradle. The ForPilotsOnly iPro Navigator/M comes in second.

We prefer strapping the iPad to the leg. For that, we like MyGoFlight's Sport case for full-size iPads and the MyGoFlight Folio-series for the mini. The Folio—which is available with a clipboard—has a high-quality feel, easily rotates the iPad for portrait, landscape and all angles in between, plus it works well outside of the cockpit.

CONTACTS

Air Gizmos
972-671-8001
www.airgizmos.com

MyClip (Tiet)
877-746-7997
www.tietco.com

MyGoFlight
303-364-7400
www.mygoflight.com

RAM Mounting Systems
800-497-7479
www.rammount.com.com

Sky High Gear
801-390-5501
www.skyhighgear.com

Sporty's
800-776-7897
www.sportys.com

Fixing Old Avionics: Think Long Term

Repairing old avionics is a short-term solution. Before committing to a repair, shop the used market and get a quote for new and used replacements.

by Larry Anglisano

CHECKLIST

- The used market has good deals on avionics—especially HSI systems.
- Exchange units can reduce downtime and keep costs in check.
- Repairing orphaned equipment is questionable, if you can find parts.

Considering that a major avionics upgrade could outprice the aircraft, it makes sense to consider repairing—instead of replacing—your existing equipment. While this might seem like a good short-term solution, you might be throwing good money after bad.

The repair versus upgrade decision might depend on your mission and whether the unit will be used for primary or backup. Consider three questions: How much does a like-exchange cost? How much serious IFR do you fly? Does the manufacturer still support the equipment? Be careful of using the excuse that you might sell the aircraft soon—selling with old radios works in the buyer's favor.

In this article, we'll address the repair versus replacement decision. We won't address autopilot systems because we covered them in the May 2013 issue of *Aviation Consumer*.

NAVCOMM 101

Back in the day, you were the envy of the airport if your panel sported dual King KX155 or Narco MK12D digital navcomms. These days, that same panel begs to be upgraded. But there's still a place for standalone comm and nav radios—especially for secondary backup.

How old is too old? It depends. First, there's the Narco dilemma. There are still plenty of Narco MK12D navcomm radios in service (as well as Com810 transceivers and Nav825 nav receivers), but with Narco out of business, the remaining supply of service parts is approaching depletion. If you're lucky, the failed electronic components might be substituted with generic replacements. However, the supply of common parts—including displays—are difficult to find.

Still, before rendering the unit a boat anchor, we think it's worth having your shop evaluate it. Our local shop recently sourced a new display for an MK12D. It came from an individual who once stashed it in his spare parts inventory. It sold for nearly $300. With labor and paperwork, it turned into a $500 repair. That's about the most we would spend on the orphaned navcomm.

You're in far better shape if you own a King KX155. However, failures of the gas discharge displays are routine maintenance events that tally a shop invoice of around $400 to $500. Still, that's a repair we think is worth it. The KX155—which is built

There comes a time when some avionics need to retire. That time has come for the King KR86 ADF, right. If you must have ADF, the King KR87 is the better option. The King KI525A HSI, left, is still a keeper. It's part of the KCS55A slaved compass system and is easily found on the used market.

with and without integral glideslope receivers and in 14 and 28 volts—make fine secondary radios. We would be hard-pressed to scrap one unless it needed a new transmitter or receiver board or any other bench repair that ran the tab higher than $1000 or so.

Other common radios include the Collins MicroLine. These are the square-bezel, standalone comm and nav radios. If repairs will exceed anything more than display segment replacements—which might cost $200 per digit—we think an exchange radio might be a better choice. But, be sure to find a replacement with a high serial number and high mod status. Experienced shops know which mods make these decent radios, at least for backup.

What about Cessna radios? RT300 and 400 series radios are simply easier to exchange than repair. As of 2011, Texas State Technical College's avionics repair station assumed the repair and servicing operations of Airwich Avionics—once the leader in all things ARC, Sperry and Cessna radio repair and exchanges. We can't vouch for the same quality of repair and exchange service that Airwich was known for, but Airwich.com lists the RT385A—that's the 28-volt ARC navcomm—exchanged for $595.

Speaking of exchanges, the used market has reasonable deals on the TKM MX-series slide-in replacement radios. These are the digital nav and comms for sliding into the racks and the existing wiring of King KX170, Cessna RT300 and some Narco navcomm installation.

TRANSPONDERS

When it comes to old transponders, replacement is often the best option—unless the repair entails a basic alignment or other minor work. Cap transponder repairs at $500. That's because budget transponders offer a long list of modern features and growth potential (see our coverage of them in the October 2012 issue of *Aviation Consumer*).

Models worth repairing—or retaining for a backup—include the venerable Bendix/King KT76A. The unit's 200-watt power output is oscillator driven, meaning it's not solid state. Its analog tuning doesn't win any awards for gee-whiz appeal, either. But later versions of the KT76A was built with surface-mount technology—a more efficient design, but difficult to repair without having to shotgun entire circuit board assemblies.

Since the KT76A isn't solid state, the cavity oscillator tube is a costly replacement—near $1000 total—and you may face that if you keep this unit long enough. The cavity is also a source of heat. The KT76A was, however, the first of its kind to utilize LSI (Large Scale Integration). LSI reduces weight, allowing longer service life and increased performance. It's no surprise that these units remain the workhorse of the transponder fleet.

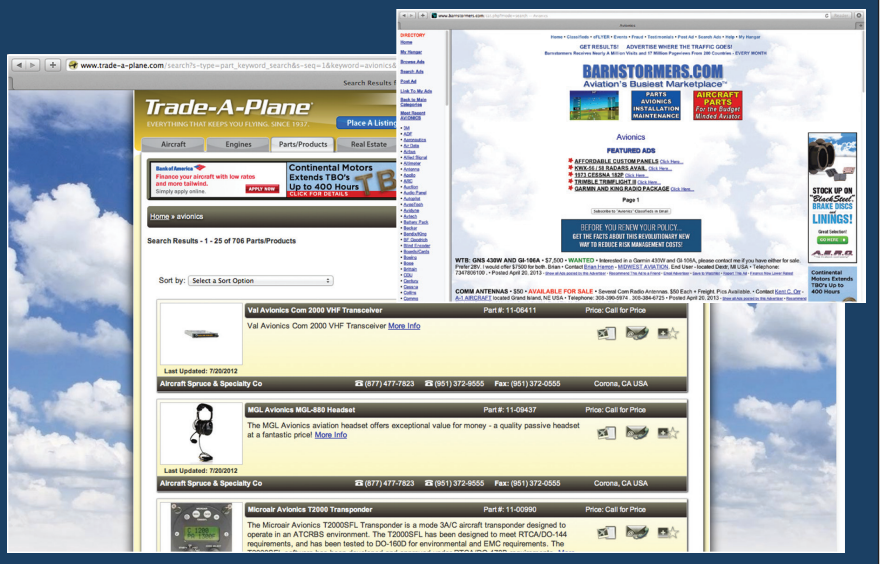
When faced with a transponder repair, we strongly suggest getting a quote for a new replacement. In many cases, you can get into a new, entry-level unit for under $2000. This is a good long-term plan—and one you can still use when the ADS-B mandate hits. That's because traditional transponders will still be required in a full-up ADS-B world.

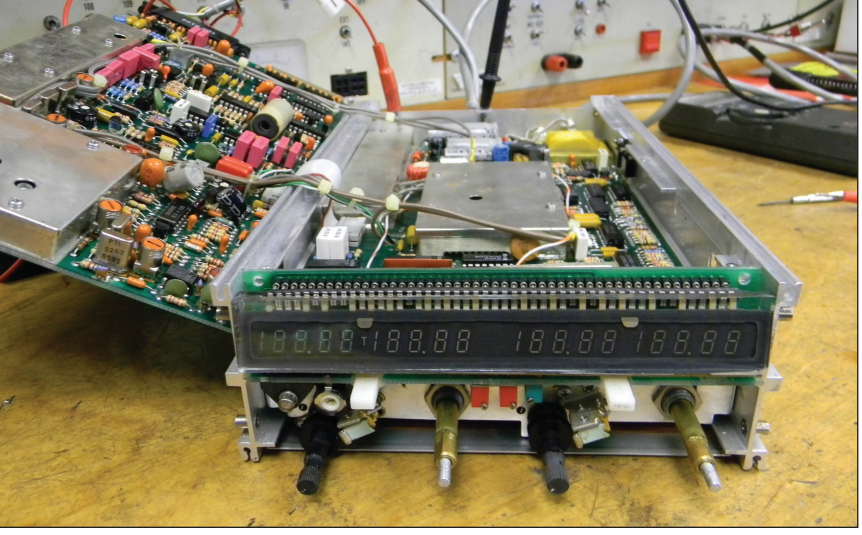
What about major repairs to the popular Narco AT50 and AT150 line of transponders? Forget it. They just aren't a long-term solution given the lack of support. On the other hand, they are good performers. Ask your shop how healthy it is when they

SOURCING USED AVIONICS

The Internet has made searching for used avionics a double-edged sword. On one hand, it's easy to access a wide variety of databases to find the exact model and part number of the replacement radio you're looking for. On the other hand, it's not always clear exactly what you'll get. That's because the unit that's advertised as "removed in working condition" could have been sitting in a box in a hangar for years. Most sales are final. Still, that's not to say you won't find sweet deals on popular sites like Barnstormers.com, Trade-a-Plane.com and Controller.com, to name a few. But once you find the bargain of your dreams, you'll need to do some investigating to make sure you won't get stung. It's best to team with an avionics shop during your used equipment search, as they'll know what to look for. They can also bench test and certify the equipment once it arrives.

Speaking of avionics shops, it's not just individual owners who peddle used avionics on these sites. Avionics shops often use the sites to list their inventory—a source we prefer over end users. Most avionics shops operate as an FAA repair station and can provide the FAA 8130-3 airworthiness paperwork during the sale. This is the paper chase that has to go into the aircraft logbooks following the installation. You'll pay a bit more for this service, but it can reduce the stress of sourcing used radios and ensure you end up with equipment that's airworthy.





Successful bench repairs to the Narco MK12D navcomm, top, are few and far between. Narco is gone and so is the supply of service parts. The King KT76A transponder, bottom, is the workhorse of the transponder fleet. Later models were built with surface-mount technology—which limits component-level repairs. Price a replacement before dropping more than $500 on one.

perform routine FAR 91.411 certifications and plan accordingly.

HSI DREAMS

A failed HSI system may seem like a good excuse for upgrading to a PFD and in many cases, it is. No matter what model HSI you have, you owe it to the airplane to at least price the Aspen EFD1000 retrofit glass. But even bottom-line pricing for an entry-level flight display retrofits is far more than it will cost to overhaul or even replace an existing 30-year-old mechanical HSI.

Aspen's EFD1000Pro PFD will set you back $15,000, on average. While this is arguably a sizeable bang-for-the-buck upgrade, it may not make sense for some panels needing other more pressing work.

We think there are two analog HSI systems worth keeping, or even installing in the right circumstances: the Century NSD360A and the Bendix/King KCS55A. But each system comes with caveats. The NSD360A can be a slaved or non-slaved (that latter means you need to correct for gyro precession as you would a plain-vanilla DG), vacuum-driven and self-contained model that's found in various flavors.

The double-edged sword with these is that the low entry cost comes with limited life between overhauls and a complicated design of finicky belts, gears and meter movements. A complete overhaul of this unit from a top-drawer instrument lab is just shy of $3000. Some shops might attempt a repair, yielding a sizeable savings over a complete overhaul. But others, including Mid Continent Instruments and Avionics, almost always find a problem that requires a complete overhaul. Whether you agree with this shotgun overhaul mentality or not (we don't) eventually, most every NSD360A will require an overhaul.

Bendix/King's once-flagship, all-electric KCS55A system has a longer service interval. But when the system does fail, get ready for an impressive shop bill. That's because there are two high-priced components: the KI525A HSI and KG102A remote electric heading gyro. An overhaul or exchange of either one is several grand. Some earlier KG102A gyros aren't worthy of exchange or overhaul due to parts obsolescence, so your only choice could be a new or salvaged one.

The good news: The market is flooded with good KCS55A systems at reasonable prices, since many of these systems have been removed during PFD upgrades. Before dropping $2500 on a complete overhaul, search the market for a serviceable replacement.

As for vintage HSI systems, no shop in their right mind would attempt doing any kind of billable repair to old Narco models like the DGO series and later HSI100. In our view, these should have been in the rubbish barrel years ago. Luckily, most of them are.

DO THE MATH

The rule of thumb is to limit repair costs to the price of an exchange. When old avionics finally bite the dust, it's natural to consider replacing the stack with used GNS430 and GNS530 all-in-one navigators. In our estimation, this is a good plan. For plain-vanilla IFR, a single GNS430, audio panel and transponder can make a fine avionics package. It also makes economic sense for some missions and aircraft.

Replacing an ancient navcomm with a new Bendix/King KX155A can cost upward of $7000, after installation. Garmin's new GNC255 series navcomm might be a tad cheaper, but neither option adds IFR GPS. That's why the GNS430—either legacy or WAAS—still represents a good bang-for-the-buck upgrade. These units are discontinued, of course, but we have no concerns about Garmin's long-term support.

Don't expect many stellar deals on used GNS WAAS units. Our search of the used market found GNS430Ws selling for around $7000, while the GNS530W can sell for nearly $9000. Legacy GNS430s might be had for around $5000 and legacy GNS530's for around $7000. This isn't chump change, but for aircraft that need an upgrade, we think it's a better long-term solution than repairing orphaned equipment. It can also make the aircraft more attractive during resale.

ForeFlight Mobile 5.0: Terrain, Runway Advice

ForeFlight's latest iPad app brings NASA-level terrain mapping plus interractive guidance in the runway environment.

by Larry Anglisano

It seems that tablet apps are looking more like advanced GPS navigators. That's certainly the case with ForeFlight's Mobile release 5.0, with high-end terrain mapping and a slick runway advisory feature that guides you into the traffic pattern.

ForeFlight's new Hazard Advisor is a terrain and obstacle awareness system that highlights hazardous terrain and obstacles, based on the aircraft's GPS altitude. We tested the terrain feature using position acquired from the Bad Elf Pro remote GPS receiver and noted accurate terrain painting. The obstacle warning is dynamic, meaning terrain and obstacle features seamlessly appear on screen as they become threats, in real time.

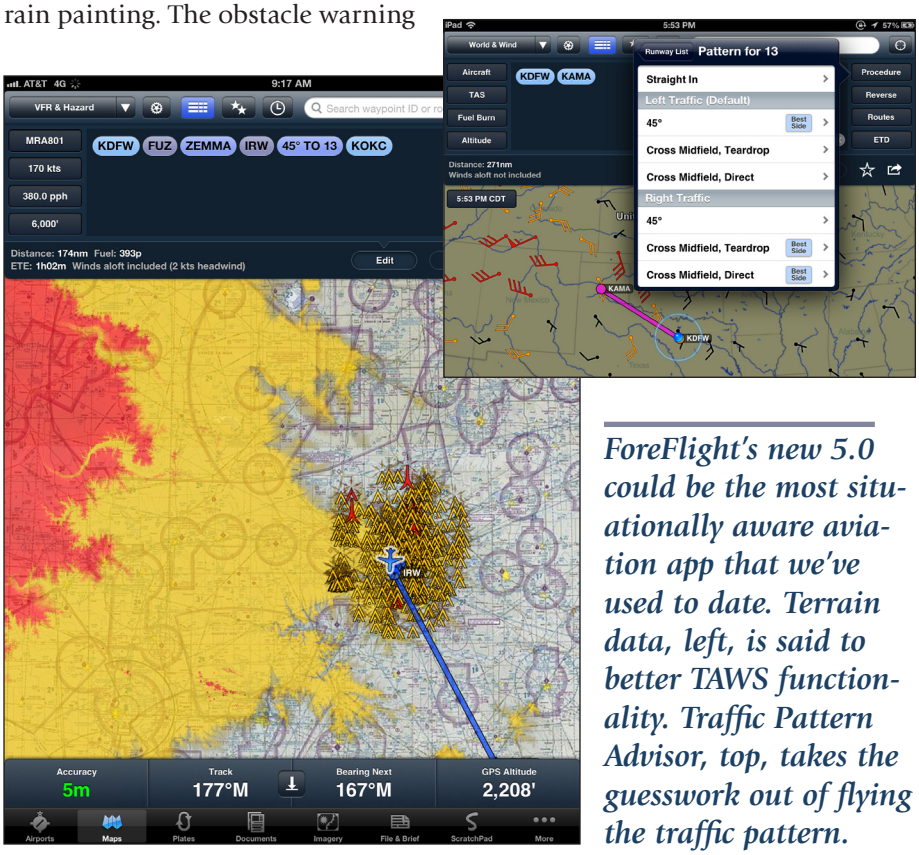
The terrain function uses familiar terrain alerting colors—with terrain and obstacles within 100 feet presented in red—while hazards within 1000 feet are colored yellow.

VOID-FREE TERRAIN

ForeFlight notes that not all terrain data is created equally, and it's the terrain data sourcing that makes the difference. For example, free data sets used by some applications have voids that miss important features—like mountain peaks, for example.

But ForeFlight's terrain database is void filled, which adds a higher level of terrain contour accuracy. Appareo Systems—the makers of the portable Stratus ADS-B receiver—provides the terrain data for the ForeFlight Mobile 5. Appareo corrects the terrain data void to ensure that the missing terrain is actually represented in the terrain data set.

Appareo's worldwide, three-arc-per-second terrain database was produced by NASA during its Shuttle Radar Topography Mission. The end result is a terrain data specification that's of higher resolution than the data used in most Terrain Awareness and Warning Systems.



ForeFlight's new 5.0 could be the most situationally aware aviation app that we've used to date. Terrain data, left, is said to better TAWS functionality. Traffic Pattern Advisor, top, takes the guesswork out of flying the traffic pattern.

TRAFFIC PATTERN ADVISOR

Need some help maneuvering into the airport traffic pattern? The app's extended runway centerline feature—which helps visualize runway layouts when approaching—can help.

This smart function helps you select runways based on wind data, and then helps select the appropriate runway entry pattern. Pattern entry options include straight in, 45 to the downwind, crossing midfield with a teardrop entry, and crossing midfield with a direct entry for both standard and right-hand traffic patterns. The default pattern direction for a given airport is also displayed.

The runway winds feature graphically shows the headwind and tailwind components, so you can better select the correct runway when your favorite control tower closes.

Foreflight added options for map orientation, offering the choice to select track up or north up. In fact, there are two track up modes: track center and track forward. In track center mode, the aircraft is positioned in the center of the screen, while track forward positions it lower on the screen. When you approach a terminal area, the Auto-Taxi system is armed. When the aircraft's speed drops below 40 knots, the airport diagram is automatically loaded and displayed in the apps Plates view.

ForeFlight Mobile subscriptions start at $74.99 per year, downloaded from iTunes. There's also a 30-day free trial. Visit *Foreflight.com*.

Tailwheel Maules

Rugged, reasonably priced STOL machines that carry a good load and can go almost anywhere—but watch the ground handling.

Still the only production four-seat or side-by-side, conventional gear airplanes being built in the U.S., Maules have been attracting owners who march to a slightly different beat for over 50 years. In general, the airplanes are easy and forgiving to fly when in the air, yet not so much on the ground—the runway loss of control accident rate is distressingly high. They're simple to fix, good at going slow but capable of decent cruise speeds, although the published speeds for many in the line are considered humorously optimistic.

Baggage and cabin access is spectacular with up to four doors. The useful load is okay, but don't tell that to bush pilots who, according to legend, carry 1500 to 1800 pounds—about double the legal limit—and get away with it most of the time. There have been a number of Maule accidents in which the airplane either did not get off the ground in the runway available, hit obstructions shortly after liftoff or simply refused to climb, so they are not infinitely forgiving of overloading.

A good tailwheel checkout and recurrent training is a must in these short wheelbase airplanes, as our most recent accident sweep showed 58 percent of Maule accidents were groundloops or smacking into something after careening off the runway. On top of that, at least five percent were crashes that came about after getting back in the air on a go around following directional control issues on landing. The accidents were not limited to low-time tailwheel pilots—a Maule must be respected when the wheels are on or near the ground.

A Maule must be treated with respect when the wheels are on or near the ground.

MODEL HISTORY

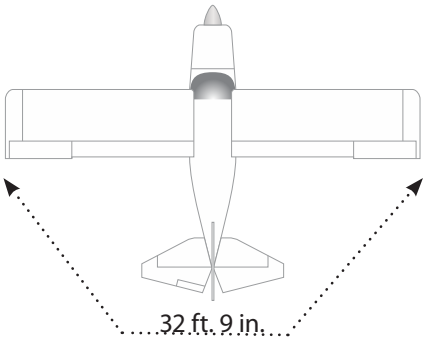
Inventor B.D. Maule started coming up with airplane designs when he was in the Army assigned to a dirigible base. He formed his first airplane company in 1941, but it didn't last. The family business dates back to the 1950s, when Maule developed the basic design of the current series. A stubby-winged, round-ruddered fabric tailwheel machine with a welded steel tube truss fuselage and a metal spar wing, that bore striking similarity to the Piper Clipper/Pacer. It won an EAA prize at Rockford (before the EAA was at Oshkosh). Maule obtained FAA type certification in 1961, calling the airplane the Bee Dee M-4. It was powered by a 145-HP Continental O-300-A.

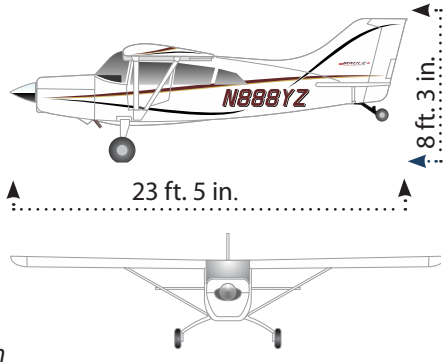
Mr. Maule has passed on, but his company hums along after decades spent tweaking the design to create new models that aren't much different from each other except for their engine options (from that first fixed-pitch Continental to 160-, 180-, 210-, 235- and 260-HP Lycomings, a 210-HP Continental and a 220-HP Franklin) and landing gear choices (oleo struts or heavy-duty spring gear).

On some models, there also have been constant-speed and fixed-pitch options and a choice between fuel injection or a carburetor. There's a trigear model and was even a turboprop.

The airplanes evolved from the first M-4 Jetasen into the M-4 Rocket, which had a 210-HP Continental,

MAULE M-4,5,6,7



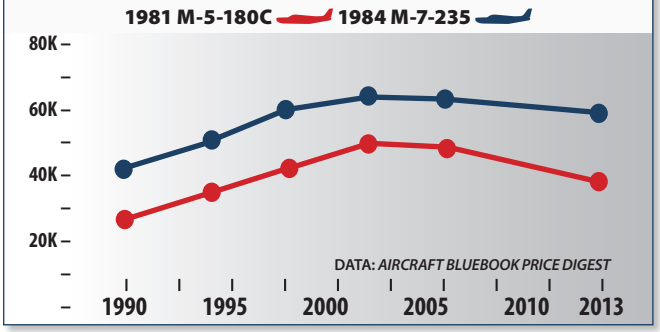


Drawings courtesy www.schemedesigners.com

MAULE SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1962 M-4	145-HP CONTINENTAL O-300-A	1800	$20,000	42	1000 LBS	130 KTS	±$15,000
1966 M-4-210C	210-HP CONTINENTAL IO-360-A	1500	$25,000	42	850	143 KTS	±$22,500
1970 M-4-220C	220-HP FRANKLIN 6A-350-C1	1500	$20,000	42	1020 LBS	152 KTS	±$27,000
1975 M-5-210C	210-HP CONTINENTAL IO-360-D	1500	$30,000	40/63	950 LBS	137 KTS	±$35,000
1980 M-5-235C	235-HP LYCOMING O-540-J1A5D	2000	$30,000	40/63	900 LBS	150 KTS	±$42,000
1981 M-5-180-C	180-HP LYCOMING O-360-C1F	2000	$21,000	40/63	1000 LBS	136 KTS	±$38,000
1982 M-5-210TC	210-HP LYCOMING TO-360-C1A6D	1800	$40,000	40/63	900 LBS	170 KTS	±$43,000
1987 M-6-235	235-HP LYCOMING O-540-J1A5D	2000	$30,000	40/63	1075 LBS	157 KTS	±$50,000
1984 M-7-235	235-HP LYCOMING I0-540-W1A5D	2000	$34,000	40/70	1000 LBS	148 KTS	±$55,000
1990 MX-7-180	180-HP LYCOMING O-360-C1F	2000	$21,000	40/70	1150 LBS	140 KTS	±$55,000
1996 MXT-7-180	180-HP LYCOMING O-360-C1F	2000	$21,000	40/70	895 LBS	135 KTS	±$78,000
2000 MX-7-160	160-HP LYCOMING O-320-B2D	2000	$21,000	40/70	870 LBS	135 KTS	±$59,000
1999 M-7-235B	235-HP LYCOMING IO-540-W1A5	2000	$34,000	73	895	139 KTS	±$101,000
2005 M-7-260	260-HP LYCOMING IO-540-V4A5	2000	$34,000	73	890	142 KTS	±$129,000

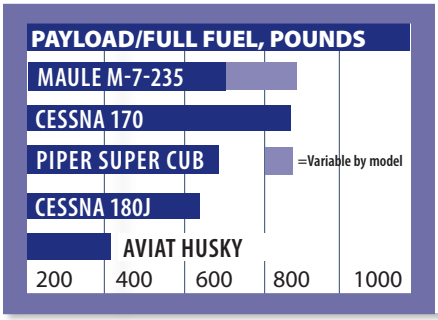
RESALE VALUES

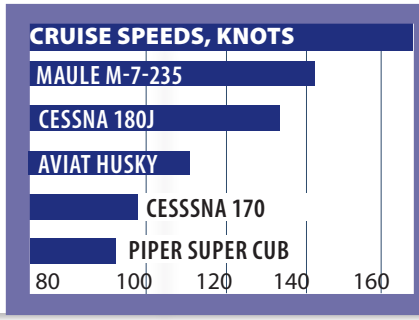


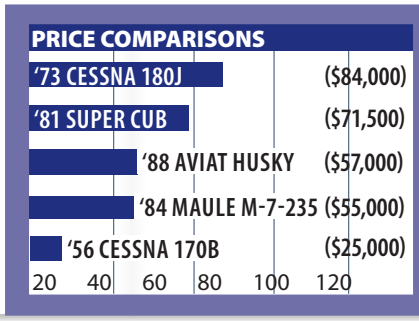
SELECT RECENT ADs

AD 2008-24-02	POTENTIAL REVERSED ELEVATOR CONTROL RIGGING
AD 2000-09-06	INSPECT CRIMPING OF CONTROL CABLE SLEEVES
AD 95-15-18	INSPECT WING LIFT STRUTS FOR CORROSION
AD 81-14-02	INSPECT RUDDER PEDAL V-BAR FOR CRACKS
AD 79-12-01	INSPECT TAIL-TO FUSELAGE ATTACH TUBE FOR CRACKS

SELECT MODEL COMPARISONS







Maules are renowned for their back-country versatility, left. Taking off from within the hangar, middle left. Four capital letters say it all, bottom left.

into the heavier 2300-pound Strata Rocket with a 220-HP Franklin. In 1973, the Lunar Rocket replaced it with a return to the 210-HP Continental. The Astro Rocket, meanwhile, had joined the fleet in 1970 with a 180-HP Franklin. It lasted two years, but 180-HP versions reappeared as one of the M-5 variations in 1979, morphing, in 1985 into both the M-6-180 and MX-7-180, which had the M-7's longer fuselage and wings and longer ailerons to maintain roll response. A 160-HP Lycoming version was offered from 1995 to 2004.

The M-5 first appeared in 1974 with either a Franklin 220 HP or Continental 210 HP as options. It had a larger tail area and the choice of 63-gallon tanks instead of 40. The demise of Franklin Engine Co. brought Continental's 235-HP O-540 into the picture in 1977. Starting in 1998, a 260-HP version of the Lycoming O-540 was also offered.

The M-6 appeared in 1981 with structural changes that increased gross weight to 2500 pounds, including wings that were two feet longer than the M-5's. It offered more flap settings, up from two positions (20 and 40 degrees) to four: 24, 40 and 48 degrees and minus 7 degrees for reduced drag in cruise.

M-5s were made until 1988; the last new M-6 was made in 1991. There was an M-8 briefly (1993). The most recent new model is the 235-HP M-9.

MARKET SCAN

Maules are considered a bargain, even new. A long-of-tooth Cessna 180 can cost more than a newer Maule. The *Bluebook* puts a 1967 180 at $74,000; a 1977 M-5-235C is priced at about $39,000.

The *Bluebook* shows an average retail price for the earliest M-4 of $15,000. Prices range up to $32,000 for a 1973 M-4-220C. The first M-5s run from around $34,000 with the first Lycoming O-540 variant about $39,000. Prices rise for various models through the mid 1980s ranging from just above $50,000 to $60,000 with the O-540 variants the priciest. The first 180-HP models (1979-1981 M-5s) fetch $36,000 to $38,000; later versions run in the $40,000 plus range up to around $46,000 for the last year of the M-5, 1987. A 180-HP, 2010 model M-7 is valued at $145,000.

235-HP M-7s run from $55,000 average retail for the oldest (1982) to $170,000 for a 2010 model, according to the *Bluebook*.

PERFORMANCE

More than once, B.D. Maule took off from inside his company's hangar in an M-4, breaking ground before getting to the door and transitioning into a steep climb once outside. We are aware that others have repeated the demonstration. His successful marketing message was that this baby gets off the gravel bar and climbs away over the ridgeline like a rocket.

The Maule wing does love to fly and the higher-powered models can leave the ground in somewhere around 250 feet when light (a couple of hundred feet more for the 160- and 180-HP models). At Vx with 20 degrees of flaps, they climb away at a pitch that will make a Cherokee pilot blanch. The combination of high power loading (plenty of horsepower for the weight hauled) and low wing loading (lots of wing area for the weight) do the trick.

Maule has long marketed a 250-300 foot ground roll, and then qualified it by saying it was at reduced weights. We do not know how much the weight has to be to reduced to get that performance. Maules are, in our opinion, STOL airplanes with very good takeoff performance—so we feel the company should be honest in its advertising and give the ground roll at gross weight, rather than some arbitrary, reduced weight.

The company's odd approach to publishing performance information extends to cruise numbers, espe-

Although the pilot sits under the wing, blocking the view into a turn, lots of glass makes for a great view in other directions.

cially in its earlier models. Customer comments to us consistently said that they were nowhere near reality. As one owner said, "My M-5-220C couldn't reach book cruise numbers in a vertical dive with the clutch in."

Some years back, *Aviation Consumer* loaded up a Piper Dakota and an M-5-235C to compare them. In cruise, with both engines firewalled, the monocoque-hulled Dakota was 5 MPH faster despite book numbers that showed it to be slower. It also climbed better, again despite book numbers that would have given the steel-tubed Maule the edge.

Readers report leaving the ground in the 235-HP version within 500 feet and climbing out at better than 1000 FPM every time. As for a 180-HP model, the *Bluebook's* specs give an M-5 a 900-FPM climb.

In our chart on page 25, we provided published cruise speeds—they should be taken with a large grain of salt. For example, the Franklin-powered M-4-220C has a published cruise speed of 152 knots—reality is closer to 120-125 knots.

Reader reported cruise speeds are all over the place, from 140 to 165 MPH (a lot of Maules have airspeed indicators marked in MPH) for the 235-HP versions. One reason, in part, is that earlier models had highly variable airspeed indications because static ports were affected by small differences in the cowling caused by manufacturing variations and wear. The ports were in the aft part of the cowling, and an ice pick was the tool of choice for adjusting them by creating a lip on one side of the hole or the other to eliminate high or low readings.

Readers say 120 to 125 knots and a 12- to 13-GPH burn at cruise are typical for the 235-HP Maule at 65 percent power. That would be about 10 knots slower than a 182Q burning about the same amount of fuel. A 210-HP M-5 owner said 120 MPH at 60 percent was standard.

While the two rear doors and removable rear seat option make it easy to throw a lot of big stuff in the back, some well-equipped Maules can be left with a useful load down around 800 pounds. The legend is that the airplane easily outperforms its book load limits. However, takeoff accidents involving failure to break ground on the available runway, impact with obstacles after takeoff and failure to climb after takeoff indicate that the airplanes will not carry everything you can put in the doors.

The low wing loading translates into low stall speeds on the Maule (33 knots for an M-5 with 40 degrees of flaps, 30 knots on an M-6 or M-7 with 48 degrees) and low takeoff and approach speeds.

That means a crosswind will be that much more of a factor than it is in a faster airplane. A slideslip to prevent drift and firm, quick rudder inputs to keep the nose straight are vital to avoiding groundloops. Owners reported that the light wing loading makes the airplanes susceptible to gusts and recommended not trying to land in a crosswind above the demonstrated number.

Another issue is getting enough drag to allow a steep descent over obstacles without building up speed. The post-1981 Maules with the greater range of flap settings address this concern—but watch the flare. As with any airplane approaching the runway steeply, slowly and with a lot of drag, timing will be critical and power will probably be necessary to prevent a pancake or hard landing.

Maules are considered to have lots of control power but not too much stability—a moose-chasing pilot's dream. Some have been annoyed, however, by a tab on the rudder that automatically deflects to counteract yaw when aileron is applied. The problem is it works well at only one speed, maybe around 90 knots. At slower speeds, you'll still need to apply rudder to keep turns coordinated.

At higher speeds, too much rudder is applied automatically, which makes for "proverse yaw" or, to put it simply, a skid. "I have owned two Maules so far," one owner wrote in reply to a chat-room request for comments. "There is not much to complain about. The only thing I would change is to get rid of that tab on the rudder. It is there for those who don't know how to fly coordinated and is a pain in a crosswind."

The problem is an apparent reduction in rudder power at slow speeds just when you need rudder power, say for a slipped landing.

CABIN AND COMFORT

Access to the two front seats is normally awkward, as can be expected in any airplane that sits at a tilt. The Maule's nose pokes lower in profile than many other tailwheel airplanes, however, so pilots can taxi it without S-turns to see ahead. Access to the rear seats (for up to three people in some models) and the baggage area is exceptional with big doors on each side.

MAULE ACCIDENTS: GROUNDLOOPS

Among the tailwheel set, Maules have a reputation for having reasonable manners. That's why the number of Runway Loss of Control accidents—ground loops and general swerve-off-the-runway-and-go-crunch events—that we found in our survey of 100 Maule accidents surprised us. That 58 out of 100 wrecks of Maules were due to pilots being unable to keep them straight on landing—usually, there was one on takeoff—made us scratch our collective heads.

We felt badly for one pilot. He knew he wasn't current, so he prudently hired an instructor to fly with him. Unfortunately, the CFI was too optimistic about the pilot's competence and didn't react when the pilot demonstrated that he really wasn't quite up to keeping things under control on rollout.

Two of the ground loops may not have been the fault of the pilot, although their preflights were in doubt. In both cases, some of the tailwheel steering mechanism was missing after the dust settled.

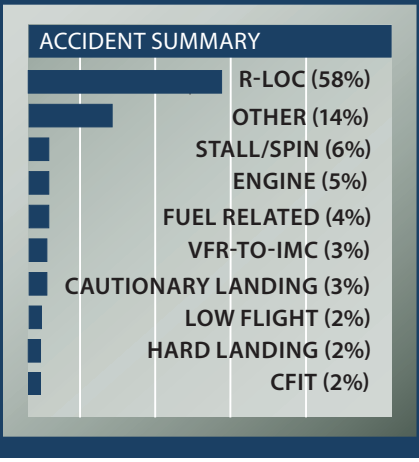
To add to the runway woes, another two landing accidents involved hard landings that took out the landing gear.

What was just plain sad to see was that the "Other" category of accidents was made up so heavily of landing or takeoff crashes that were what seemed to be the macho-induced, bad judgment that affects some pilots who get anywhere near STOL airplanes. There was the selection of runways—dirt roads that had trees or signs close enough to snag wings and lure the airplanes into ditches, or strips that had snow that was just a little too deep. There were the pilots who were certain that the laws of physics and aerodynamics were more like guidelines—so if the book said 300 feet was enough for takeoff, they could do it in 250 feet—and they promptly smacked into something that terminated the endeavor. A few pilots were sure that they could land on the short strip but forgot that to do so, they must come down final on-speed and touch down on the first part.

A number of the stall-related crashes were shortly after takeoff. In some, the airplane showed a reluctance to climb—probably a result of overloading.

There were only two low flying accidents; in one, the airplane continued aloft after hitting an obstruction and scattering some wing ribs and portions of the spars on the ground nearby. The pilot landed on a friend's strip and hid the airplane in a hangar until local law officers tracked it down six weeks later.

We had to admire the honesty of the pilot who remarked, after he survived impact resulting from his takeoff runway selection, that the tailwind must have been stronger than he thought.



The pilot sits behind the wing, so lateral visibility on turns is poor. Plexiglas doors and a skylight are a factory option that give spectacular visibility down and straight up and received raves from readers. Maules are noisy, especially those with bigger engines. Heating is from a standard exhaust muff, but the back seats in older models, especially, get cold in winter.

MAINTENANCE

Maules are considered sturdy and reliable with few maintenance issues. The factory in Georgia is friendly and responsive. It buys and sells used Maules, so parts are readily available. No Maule is an orphan.

Corrosion in wing lift struts prompted a 1995 AD requiring biennial inspections and treatment or replacement, if necessary. Many owners have opted for replacement. Crimping on control cable sleeves, problems with an aileron control pulley, fuel line corrosion and the rudder trim tab control were among the subjects of other ADs.

Cracking paint on the fuselage fabric has been a complaint. So have cracking mufflers. Some tailwheels began breaking after gross weight went to 2500 pounds in 1981, a problem corrected on later models with beefier gear.

Fabric has to be inspected and eventually replaced. It's not always easy to find a shop that still does it. The factory will, but one owner told us of looking for some alternative to a $27,000 price tag.

Consistent service difficulties and short life spans were reported for the mufflers and exhaust stacks.

MODS, OWNER GROUP

Vortex generators to reduce stall speed even further are a common mod to make Maules even better in the STOL department, available from Micro AeroDynamics, Inc. (www.microaero.com or 800-677-2370). Otherwise, the factory (www.mauleairinc.com or 229-985-2045) offers lots of options, from full swing-up windows, glass doors, window and skylight, three-blade prop for the 235- and 260-HP models, straight and amphibious floats, skis, IFR packages, autopilots and engine analyzers.

The website www.maulepilots.org bills itself as non-profit and unconnected to any commercial operation. A regular in its chat room is "Jeremy the Maule Guru," former bush pilot and now long-time dealer Jeremy Ainsworth, whose own strictly commercial website is www.maules.com.

OWNER FEEDBACK

We bought a new, 2002 M-7-235C with a 235-HP Lycoming O-540 in 2003 and have since put 1600 hours on it. We love it! As they say, there are faster airplanes, there are airplanes that carry more and there

Three doors on the right side make for unrivaled cabin access.

are airplanes that cost less, however, nothing matches this well-rounded "Renaissance airplane" in doing so much, so well.

After looking at the type of flying I do, I decided on a tailwheel, high wing with at least two doors. I felt having a tailwheel and low stall speed would minimize forced landing risk. I read all the airplane ownership books I could get my hands on, including the UAG compilation, and narrowed it down to the Pitts S2C, Aviat Husky, American Champion series and the Maule. The Maule had the best combination of features, plus side-by-side seating—important to my wife and me as we are both pilots and share the duties.

I learned that airplanes are like tents—sure, you can put two guys in a two-seat airplane, but you can't do it with bags and 3.5 hours of gas. In the Maule you can (or three adults and a bit of baggage). Useful load for ours is 761 pounds, so the fifth seat in the back isn't practical.

With 235 HP, the airplane is ridiculously overpowered, at least until you get to density altitudes above 10,000 feet. If you are not going to the high country or wanting to climb up high quickly, the 180-HP versions will save you some gas money and give you more useful load.

We've taken ours all up and down the East Coast, across the Midwest, to Idaho, Colorado and California and still love every minute.

The observer doors—clear from top to bottom of the door sill on both front doors and the middle door (right side) can be retrofitted. The "picture window" on the left side of the fuselage and the skylight have to be built in at the factory. What a view! The only way to get a better view is to fly open cockpit.

Likes: Fun; inexpensive compared to a twin or retract; manual flaps; solid cross-country and IFR flyer. The tailwheel makes me a better pilot. It has great visibility and is quiet outside with a three-blade prop. Oversize tires mean landing on grass, gravel or up to six inches of snow is a snap. Everybody likes to see a Maule show up. B.D. Maule was a genius, and the family has steadily improved the product over the years without overextending the company.

Gripes: Loud inside (need ANR headsets); easy to overfuel because it's hard to see the fuel level as the tank nears full; crosswind capability; mufflers and exhaust stacks—have replaced several. The ones repaired by aftermarket shops such as AWI lasted much longer than the ones I got from the factory. When the flap notch bracket got bent, I found that the Maule factory doesn't keep everything in stock—however, they are still in business and recently they've seemed more responsive. At six feet tall, I'm glad I'm not taller when it comes to fitting in the airplane.

Tricks we've learned: Maximize hot air flow to the front seats by cracking open the front fresh air cabin vent; pick your fuel stops by price, but if there is more than a 12-knot crosswind, go elsewhere and don't worry about fuel price. Install an oil quick drain; when the Maule tailwheel starts to shimmy, replace it with an ABI tailwheel.

Andy and Sandy Travnic
Via email

I purchased a Maule MXT-7-180 about two years ago and really like it. It has been difficult to get "good" information regarding maintenance and operation of the aircraft. The

Panel layout has not changed much over the years, including the angled subpanels. Fuel selector is on the left sidewall.

Maule factory provides very little information other than basic checklists. The only chart or graph information seems to be the weight and balance data. In the military and other civilian aircraft I've flown over the years, there have been charts and graphs for just about everything—not with the Maule.

I found the airplane a bit challenging to land given the large wing surface and its susceptibility to gusts. For night landings, the landing light provides minimal illumination—I replaced it with an LED.

Insurance has been about $1000 per year, and the annual a similar amount prior to additional maintenance that might be required. Fuel flow normally runs about 12-13 GPH at 5000 feet. The fuel quantity indicators are fun to watch during flight as they bounce around in any sort of turbulence.

Having said all that, the Maule is a great plane. It certainly lives up to its name "Star Rocket," as it takes off in STOL type distances, 300 feet or so, and having 73 gallons of usable fuel gives a lot of flexibility.

Rich Green
Via email

Maule has an extensive STC list that allows for a seemingly endless combination of fuselages, wings and powerplants, which can be seen on the mauleairinc.com website.

Two shops specialize in maintaining and refurbishing Maule aircraft: Ray Maule (www.mauleflight.com) and former Maule employee, David Wright (www.wrightaircrafttechnology.com). Both do excellent work—you couldn't ask for more knowledgeable folks.

Oh, and the published cruise speeds for Maules must be a figment of someone's imagination. My M-5-220C couldn't reach book cruise numbers straight down with the clutch in.

Gary Miedema
Via email

My wife and I bought "Serenity" in November of 1999. She is a 1985 Maule M5-235 with 360 hours total since new. At the time, I had 250 hours in airplanes (10 hours tailwheel) and 30,000 hours in aviation magazines. I wanted near-182 performance and got it: 120 knots, four people, full fuel (60 gallons with long-range tanks), decent useful load and decent range (13 GPH). We also got that fourth baggage door that will let you easily load folded bikes or a footlocker. And because of that tailwheel, I only paid $55,000.

Insurance was about $2300 the first year until I proved I could land, then back to $1400 per year (but now it has crept up to $2200 in spite of no problems). It really is easy to land. Just stay nervous and pay attention.

I put 300 hours on it the first two years flying for business. I collected a little ice twice climbing out Mountain City, Tennessee, but climb rate remained good. One VFR day, I cruised briefly at 14,500 feet and Serenity was still climbing at 500 FPM when I leveled out. With just me and full fuel, I always get off in 500 feet and climb at 1000 feet per minute. That fat wing loves to fly. The Lycoming O-540 has been great. I replaced one vacuum pump, brakes and master cylinder, engine gap seals and magnetos. Annuals have been very reasonable.

The only problem has been cracking paint on the fabric, which I touch up (not hangared until recently).

ADs have been minimal. I re-swagged the cables and sprang for new sealed wing struts rather than endure the expense of the punch test. After hundreds of my landings, the tailwheel came off during a landing on a grass strip. I ordered a new horn, reassembled, rebolted, no more problems.

The cabin is tight but comfortable. I'm six feet and fit fine with a headset, but obesity is not allowed. Both front windows open and ventilation in flight is great. I added the quick-release backseat for rapid loading of bike or camping supplies.

Steve Preas
Conyers, Georgia

I purchased the M-5-235C because I lived in Flagstaff at 7000 feet, where the summer temperatures often produce density altitudes of over 10,000 feet. I was not disappointed with its performance.

The M-5 would comfortably cruise at 125 knots at 2150 RPM and 21 inches and burned 12 GPH. With auxiliary tanks full (63 gallons in my plane), I planned for four hours with one-hour reserve. For a small person (five feet, six inches), comfort is moderate. The seats are a bit too upright for me and more padding was necessary. With a full-sized passenger, elbow room is cramped.

Visibility is good for a high-wing. The cockpit is noisy. Headsets and intercom are required. For Midwestern winter flying, the heater was only fair.

My plane had the "up gross" kit installed, increasing the gross weight from 2300 to 2500 pounds. My useful load was about 950 pounds.

Where the Maule excels—VFR, enjoying the scenery and being able to land almost anywhere.

One could fill four seats with 170 pounders (and carry a few charts) if you just filled the main tanks (40 gallons). With full fuel, it is comfortable with two adults, two children and baggage.

The plane lived the first part of its life in Louisiana and consequently had some trouble with corrosion in the cabin area that was repaired. Though the Maule was always hangared at home, it was unfortunately stuck out in a severe hailstorm in Colorado. It cost $10,000 to recover the wings and repaint the tail surfaces and fuselage. The repair was covered by insurance, but it was difficult to find anyone interested in repairing a fabric airplane locally. If I were to do it again, I would return it to the factory. Maules like mine did not have the best paint. While the rest of the plane held up well, the paint did not. Annuals ran anywhere from a low of $1200 to up to $3000 (complying with the one-time strut AD and Hartzell prop AD). Insurance ran $1800 to $2500 for $1 million.

David A Shields
Sioux Falls, SD

In 1999, I bought a Maule 7-235 brand new from the factory. It has been a great airplane and it has taught me more about flying than I have learned from instructors.

The Maule Company certainly is right in all it touts about this being an incredible load-carrying STOL aircraft in tailwheel configuration, but you must first learn how to handle it. I recommend Maule instruction from someone who has 500 hours of bush experience.

This plane can easily lift 1800 pounds of people, fuel and baggage and has a climb rate of 400 FPM on a standard day. The problem is lack of room and the FAA certification only allows 870 pounds. At the FAA max weight on a standard day, you could easily expect 1200 FPM. If you fly this five-seat Maule loaded like a Super Cub—two people and half fuel, expect 2000 FPM from a good pilot on a standard day. I emphasize pilot training is everything on this airplane.

I have the spring gear and it is super heavy duty, as is the tailwheel. This machine is rugged, easy to maintain and repair. Parts are readily available and a lot are marked NAPA auto parts from the factory.

In 2002, I put the Maule on Wip 3000 floats and easily lost 25 knots of cruise. I lost only 100 pounds of certified carrying weight. This plane truly lacks the power as an amphibian. When temperatures reach 95 degrees F, this airplane is useless. The Wip 3000 is just too big for the 235-HP Maule.

Matthew J. Clemente
Troy, New York

The Aviation Consumer

ADS-B EFIS

(continued from page 14)

CLARITY SV

With its Clarity product, Sagetech is the newest arrival in the portable ADS-B realm and like Appareo, it leverages an extensive background in military and UAV technology as a trickledown to GA. Sagetech has two products, the basic Clarity, which offers dual-channel ADS-B ($1150) and the Clarity SV, which adds AHRS.

The Clarity SV wins the small form factor race and without really intending to, reveals how tiny and light the AHRS packages actually are. The Clarity SV measures 2.5 inches square by 1.5 inches high and weighs 5.5 ounces. The Clarity—without AHRS—has exactly the same dimensions. (Sagetech says the AHRS adds a mere gram to the weight.)

Springing as it does from the military UAV market, the Clarity has that dense, packed-with-tech feel you expect from military equipment. There's no remote antennas, just an on-off button and a charging jack. The top of Clarity has a precisely machined grooved grid for heat rejection and the outer case is white, for the same reason.

Sagetech claims a battery endurance of six to eight hours with a charging time of four to eight hours, depending on the voltage used. It's faster using the wall charger, slower using computer USB. Sagetech says the Clarity will correct for minor position errors on the glareshield, but it does need to be mounted facing forward. (This is true of the others, too.)

Using the Clarity SV with WingX in our Cub, we had to calibrate to straight and level in flight. For its higher price, the Clarity SV seems to deliver marginally better performance. Its dynamic response is somewhat smoother and while the other two products could be sensor saturated with a quick shake or two, the Clarity SV simply shrugged this off. Its GPS and ADS-B reception also appeared more robust; it easily tracked overhead 1090ES targets from inside a building.

The Clarity has a unique feature it calls Data Burst. If you let your iPad sleep during the cruise phase, it won't be updated with current ADS-B data. The Clarity's Data Burst feature catches everything up when the iPad wakes.

CONCLUSION

In evaluating any gadgets, we think it's important to keep one's feet wired to the ground with regard to capability. Portable ADS-B offers limited traffic awareness; you simply won't see many if not most of the transponder-equipped targets around you. You will see most airliners, since they generally have 1090ES output.

ADS-B weather, while a nice-to-have, isn't as complete or up-to-date as that offered by XMWX Satellite weather. But the price is right: it's free. In our view, FIS-B-delivered NEXRAD is of limited utility for tactical weather decisions. Also, it can't be received on the ground.

That leaves the AHRS function. All of the companies providing these products insist that they are for situational awareness only and haven't been tested sufficiently to serve as a backup gyro in place of something that has been tested, such as an electrical, vacuum mechanical gyro or an electronic gyro. We agree. In one of our flights with the Clarity, WingX locked up and tanked completely. We had to land and update the app to bring it back. You can't afford this sort of failure if you're depending on a gyro for backup.

With these caveats, the Stratus II, at $899, is the best value of the group, in our view. It performs well, has adequate battery life and is well supported. On the downside, it only works with one app and requires a separate app for the EFIS.

If cost is no object, we pick the Clarity SV as the best performer. We suspect its electronic innards are a cut above the competition, given its good GPS reception and resilience against sensor overload. Its small size is a plus.

The iLevil is certainly adequate, but its shorter battery life and single frequency ADS-B make it less competitive against the other two.

FEEDBACK WANTED

PIPER MALIBU/MIRAGE

For the September 2013 issue of *Aviation Consumer,* our Used Aircraft Guide will be on the Piper Malibu/Mirage series, the classy, speedy, cabin-class, pressurized single. We want to know what it's like to own and fly these planes, how much they cost to operate, maintain and insure. If you'd like your airplane to appear in the magazine, send us any photographs you'd care to share. We accept digital photos e-mailed to the address below. We welcome information on mods, support organizations or any other pertinent comments. Please send correspondence on the Piper Malibu/Mirage series by July 1, 2013, to:

Aviation Consumer
e-mail at:
ConsumerEditor@hotmail.com