March 2010
Volume XL
Number 3

The consumer resource for pilots and aircraft owners

The Aviation Consumer®

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The Aviation Consumer

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AVIATION CONSUMER (ISSN #0147-9911) is published monthly by Belvoir Aviation Group LLC, an affiliate of Belvoir Media Group, 800 Connecticut Avenue, Norwalk, CT 06854-1631. Robert Englander, Chairman and CEO; Timothy H. Cole, Executive Vice President, Editorial Director; Philip L. Penny, Chief Operating Officer; Greg King, Executive Vice President, Marketing Director; Ron Goldberg, Chief Financial Officer; Tom Canfield, Vice President, Circulation; Michael N. Pollet, Senior Vice President, General Counsel.

Periodicals postage paid at Norwalk, CT, and at additional mailing offices. Revenue Canada GST Account #128044658. Subscriptions: $84 annually; single copies, $10.00. Bulk rate subscriptions for organizations are available.

Postmaster: Send address corrections to AVIATION CONSUMER, Box 420234, Palm Coast, Fl 32142. In Canada, P.O. Box 39 Norwich, ON NOJ1PO, Canada. Publishing Agreement Number #40016479

Death By a Thousand Cuts

True or false: You are required to have current charts in the aircraft with you.

The answer is "false," you're only required to have the right data. So that 2002-vintage sectional is fine so long as you know the CTAF for your destination was changed three years ago to 123.05. Howie Keefe built a business on this premise with his Air Chart Systems. These were spiral-bound books with the sectionals and en route charts for the entire lower 48. You got the book once and then subscribed to the updates—delivered via mail with stickers you could put in the chart atlases as needed. This system was far cheaper than buying all those charts every time they were revised, and it was far more convenient to use if you regularly traversed wide swaths of the U.S.

Keefe (who has since sold Air Charts) contacted me after reading our Portable GPS Roundup (February 2010 *Aviation Consumer*). "Your great article stated that many users don't bother updating their GPS. In selling aviation atlases via mail order houses, I was always surprised that only about 50 percent returned an attached card for a free update service ... It might be that the high cost of updating their GPS units has made even more pilots take a cavalier attitude towards the FAA's 28-day update cycle."

His logic is probably spot on. In our survey, about 14 percent of the GPS users subscribed to aviation data for their portables. Depending on how you read the data, somewhere around half the users update their aviation data once in a while. Yet we know far more than half the GPS users out there grab data like airport frequencies or expect valid obstacle warnings from those portables. This paradigm is no different than out-of-date charts, yet somehow we don't see it that way. Maybe it's because there's no cheap fix. Keeping a portable current can cost hundreds of dollars a year.

It's worse for the panel-mount equipment. We got this letter from subscriber Marc Wiese: "A critical article on subscribers services for GPSs and MFDs is sorely needed. The overhead for the charts is killing us all. There needs to be more choices where we get these services ... One GNS 480 and one GMX 200 is over $1300/year. That is outrageous. We need to be complaining to the highest levels. It should not cost this much for free government information we *already* paid for ... If Anywhere Map can do it for far less, as can places like Flitesoft, then something is seriously wrong with the business model being foisted upon us." He didn't even mention the subscription for datalink weather. Note to self: Include the data subscription costs in all future product evaluations.

I'd love to know the real subscription rates for panel-mount products, especially on the G1000 where data subscriptions are granular. I know many G1000 owners who let things like SafeTaxi expire to save some bucks. Same with Cirrus pilots who don't update the Avidyne MFD database regularly and rely on the Garmin 430s.

As more and more pilots depend on the data in their GPSs, this gets to be more of an issue. Back when ADS-B was still an amorphous plan in the mind of the FAA (oh wait, it's still kind of an amorphous plan), free weather data was the carrot to entice aircraft owners to pay for the ADS-B upgrade. Datalink weather made that far less compelling, but it may start looking pretty good to pilots trying to escape the yoke of so many monthly bills. The situation also makes me wonder if there's a market for cheap, "aftermarket data" for portables, or even for panel-mounts presuming that's certifiable. Any takers?

I don't have anything against a business making its profit by selling razor blades rather than razors, but there comes a point when all those little cuts add up. —*Jeff Van West*

SMA Numbers

I have been intrigued by the SMA Jet-A conversion since I've known about it. It was interesting to actually hear about the result in your article and video in the February 2010 issue. Still, analyzing the $85,000 for conversion versus $25,000 for an overhauled Continental, it's a tough sell.

I can do three Continental overhauls for the price of the conversion. So, even at a lower cost per block hour to operate the SMA diesel, it's hard for me to imagine someone recouping the $60,000 additional cost of the conversion during a reasonable period of ownership, assuming you do it at a normal O-470 TBO.

Have you run the numbers to see how many years it would take, assuming one flew the airplane 100 hours per year? Just curious, thanks for the tour.

Dean Siropoulos
Via-mail

We have run the numbers and we agree. For a private owner flying 100 hours a year, the economics of the conversion are not favorable. The payback extends to more than 10 years. However, if the airplane is flown in a part of the world where avgas isn't available or if avgas becomes unavailable everywhere, Jet-A engines look attractive at any price.

ENGINE TECHNOLOGY

SMA Diesel Revisited: The Numbers Are Solid

A New Jersey flying club took a gamble in converting its Skylane to diesel power. An early assessment suggests it will pay off.

by Paul Bertorelli

think of it: If you had an aircraft engine that burned two to three gallons less than the competition, delivered the same horsepower, weighed more or less the same and burned fuel that isn't threatened with extinction, as 100LL is, wouldn't you sell the hell out of it? You'd think so.

But while SMA, the French daughter of aerospace giant SAFRAN, has such an engine in the SR305 aerodiesel, buying one is at best a rarified experience. There aren't many of these engines flying, so judging their merits has been largely a paper exercise.

So when the Paramus Flying Club, a long established New Jersey co-operative, invited us to examine their SMA-converted Cessna 182, we realized it represented a rare opportunity to take the measure of this engine in the wild.

The club has been operating it for nearly a year and while it's too soon to declare it a walk-away success, the airplane has proven to be the most popular among the club's 46 members, its dispatch reliability has been excellent and the engine's initial operating costs look promising.

So why aren't there more of these things flying in the U.S.? It's a fair question and one that's not simple to answer. In this report, we'll examine Paramus's experience and you can make your own assessment.

SLOW BOIL

While the glamour boy of aerodiesels, the Thielert Centurion line, was making a giant splash that soon led to self-immolation, SMA has had the SR305 on a slow simmer for years. The engine first flew in 1998 and it appeared that year at the Paris Air Show, well ahead of Thielert's Centurion coming out of the ground. Although fully certified by 2002, the SR305 has found a lukewarm conversion market in Europe, but just a trickle in the U.S. OEMs have sniffed at the project, but in the U.S., only Mattituck signed on to certify it in the M7/M7-230 variants, which deliver credible performance.

The 305 is a 230-HP compression-ignition engine approved to run on Jet-A. It's a four-cylinder, four-cycle design and uses a combination of air and oil cooling, compared to the Centurion's (née Thielert) water/oil cooling. Unlike the Thielert automotive adaptation, however, the 305 is a purpose-built aircraft engine that requires no reduction. It also swings a composite three-blade MT prop.

Thielert's conversion of an automotive engine had disadvantages with regard to weight, torque curves and complexity, but the automotive world brings one large advantage: the benefit of millions of Euros in research into cutting-edge diesel technology, specifically FADEC-controlled high-pressure common rail injection. While the SMA engine has direct injection and it does have a FADEC, it doesn't have the electroni-

CHECKLIST

- At $80,000, the conversion is expensive, but a fuel savings of up to 5 GPH offsets it.
- Initial operating experience suggests that routine maintenance costs will be lower.
- Aircraft range is vastly extended compared to the gasoline version.
- Although product support has been excellent, SMA seems ambivalent about expanding the market.

Paramus Flying Club's SMA-converted Cessna 182 delivers dramatically better fuel economy over the stock O-470. Giant and unmistakable placards on fuel fillers moved one nervous lineman to comment, "This feels so wrong."

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Many vendors charge an annual fee for this data. We believe when all the costs are considered, our free database updates make for a much lower cost of ownership and encourage safer flight planning when pilots regularly update their data.

Regarding the FlightPrep Online Planner, it is a completely separate product offering. Sometimes people get confused in that we offer both online and software-based planning options. Most pilots who select the Online Flight Planner tell us they want full flight planning features without performing any software installation.

The Online Flight Planner approach also eliminates the need to apply updates or otherwise maintain any program installation. It works from any internet-connected computer with a browser. As you pointed out, it permits pilots to print out a variety of reports from the TripKit option. Airport lookups are accomplished using the Find button on the left-side control frame below the route list.

Thank you for providing such a well-rounded review. We welcome answering questions about any of our products.

John Bouyea
FlightPrep

Flight Planner Feedback

Thank you for including FlightPrep Golden Eagle Plus in the "For-Pay Flight Planners" review article published in the January 2010 issue. We have two comments on our products as described in the article.

The FlightPrep Golden Eagle Plus flight planner utilizes the VFR and IFR planning databases sponsored by CSC DUATS. What this means to pilots is free VFR and IFR database updates for the flight planning process.

Credit Where Due

Some time ago, I bought a noise-canceling headset made by DRE Communications. After using it for some years and many flights, I started to get some fraying on the cord, which is modular and not easy to repair.

I was able to track down the maker and they not only offered to send me a replacement cord, but waived the $40 cost if I would pay the shipping, which I gladly accepted.

So this is a story about customer service above and beyond the call and I wanted to share it with you. I will certainly look to DRE Communications for my piloting and portable communications needs in the future.

Jerry Grainger
San Carlos, California

Prop Prices

I feel compelled to respond to Mr. Nielson's letter in the January 2010 issue written in response to the article in the December issue about composite props. I agree with Mr. Nielson that it was a good article and it's nice to see someone reporting on composite propeller technology, but Mr. Nielson also makes some assertions that are misleading.

Regarding pricing, Mr. Nielson quotes Hartzell's catalog list price for a replacement Cirrus SR22 propeller. Since this prop is installed standard on the SR22GTS and Turbo, it is included in the price of the airplane. The consumer doesn't purchase this propeller separately, so the price Mr. Nielson quoted is not relevant.

Cirrus chose this propeller on its technical merits, performance and the value it offered to their customers. The numbers speak for themselves, with over 1000 Hartzell advanced composite props now in

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Avgas Replacement: Chicken, Meet Egg

GAMI's new G100UL may be a drop-in replacement for 100LL. The challenge will be devising a test program to fast track it and get refiners interested.

by Paul Bertorelli

CHECKLIST

- Test cell runs indicate that G100UL has detonation margins equal to 100LL.
- The fuel is a little heavier than 100LL but has higher per-volume energy density, thus it's nearly a wash with 100LL.
- Test project came out of nowhere and the FAA is resisting fast track development.

FUTURE FUELS

Compared to piston aviation fuels research, mushroom farming is a daylight operation. That's not to say the fuel work is secretive, it's just that it goes on more or less constantly, but nothing meaningful seems to come of it. At least you can have the mushrooms on your salad.

Against this backdrop of apparent non-action comes yet another entrant into the 100LL replacement sweepstakes, this one called G100UL. This new fuel comes at the problem from far out in left field from a company known more for burning fuel than creating it: General Aviation Modifications, Inc., the Ada, Oklahoma, mod house that shook up the hidebound world of aircraft engine research with its radical ideas on lean-of-peak operation and an almost religious conviction that turbonormalized engines are better than turbocharged engines.

With G100UL, GAMI is again running against the grain and, to a degree, challenging the accepted notion that before a new fuel can be widely tested, it has to be certified. But, says GAMI's George Braly, that's backwards. There's no point in reducing entire forests to pulp to certify a fuel if refineries aren't interested in or can't build the stuff profitably, thus GAMI's idea is to field its new developmental fuel to a select fleet under an STC while simultaneously pursuing regulatory approval. To a degree, that will test the economics, too, since production will have to rise to at least the pilot-plant level to supply a small fleet experiment.

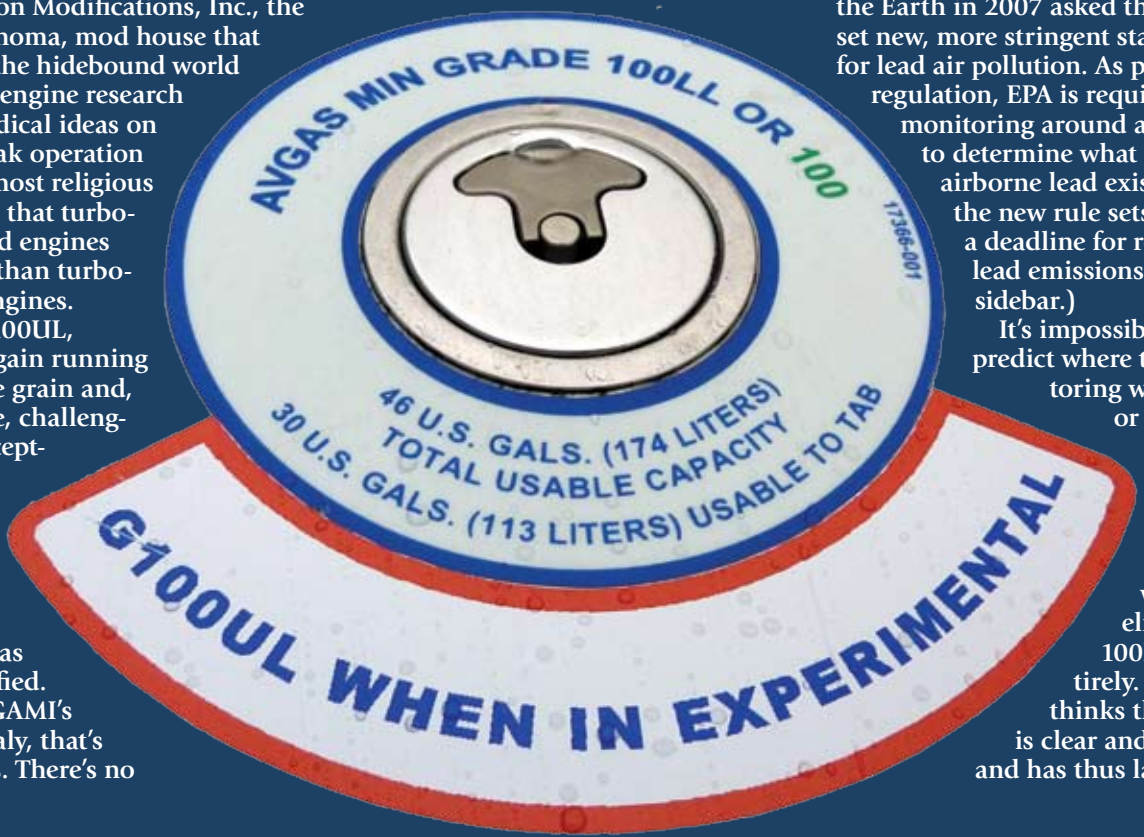
WHY THE PUSH?

The very existence of 100LL has been under threat since amendments to the Clean Air Act of 1970 eliminated the use of tetraethyl lead as an octane enhancer in motor fuels. Because it couldn't be shown that aircraft engines could safely operate on lower octane unleaded fuels, general aviation has operated under a "temporary" lead-content waiver for the past quarter century.

Year after year, the government has been talked out of or just hasn't shown committed interest to drop the hammer on TEL once and for all. However, the current urgency to find a replacement for TEL's octane pop comes from a new lead initiative by the EPA.

A petition filed by the Friends of the Earth in 2007 asked the EPA to set new, more stringent standards for lead air pollution. As part of that regulation, EPA is requiring air monitoring around airports to determine what levels of airborne lead exist, but the new rule sets 2011 as a deadline for reducing lead emissions. (See sidebar.)

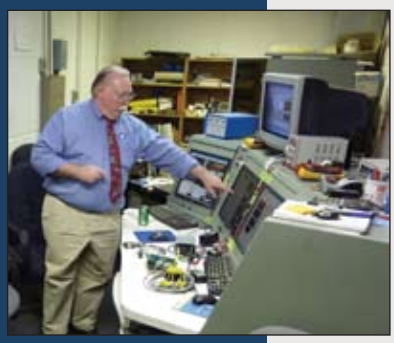
It's impossible to predict where this monitoring will lead or how fast it may develop into a regulation that would eliminate 100LL entirely. Braly thinks the danger is clear and present and has thus launched



his own fuels research project on an engineer's hunch that the solution may reside in current technology.

In fairness, it's not like the industry hasn't been trying. Between the engine manufacturers, the FAA's Atlantic City William J. Hughes Technical Center and the oil companies, lead-free experimental blends in the dozens have been tried.

More than a few have proven promising, although none have the attractive combination of TEL's seamless octane enhancement and relatively cheap price. An insistence that a lead-free fuel exactly meet the avgas standard, ASTM D910, has complicated the search for a replacement by eliminating some near-hit choices. Braly believes G100UL meets D910 with no significant departures.



WHAT IS THIS STUFF?

GAMI invited us to the company's Ada, Oklahoma, research facility to observe some test cell runs and actually fly with G100UL. So what is the stuff? Braly declined to reveal the exact formulation due to proprietary and competitive concerns, but says he will reveal more when further testing is completed.

Braly did confirm that G100UL is largely high-octane, unleaded gasoline feedstock blended with components that are more or less standard hydrocarbon chains from materials that any refinery can derive from known petroleum refining techniques. It's not bio-derived, as Swift Fuel is.

However, in the recent past, some fuel formulations have been proved to work including ethyl tertiary-butyl ether (ETBE) or methyl tertiary-butyl ether (MTBE). Although these compounds are out of favor for being implicated in groundwater contamination, research indicates they do provide the required octane. In Europe, Hjelmco Oil has developed an ETBE-laced 100-octane fuel that the company's Lars Hjelmberg says could be

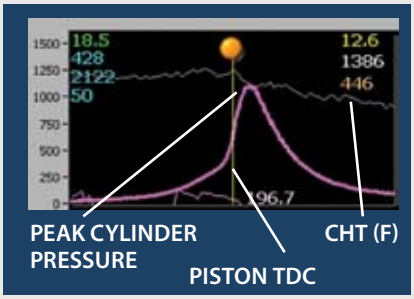
TEST CELL RESULTS

Setting aside lesser considerations like energy density and distillation points, the Holy Grail of aviation gasoline is octane and the graphs on this page tell the story. For low-power engines, lower octanes–about 95 MON—will suffice. But larger displacement, high-power and turbocharged engines require higher octane because higher cylinder pressures and temperatures reduce detonation margins. Higher octane fuels, because they burn with a slower, more consistent flame front, increase detonation margins.

GAMI's sophisticated test cell is configured to run detonation tests by using sensitive pressure transducers that sample cylinder pressures many times a second and analyze patterns in near real time. Detonation is detected as the onset of pressure spikes that indicate the flame front is burning explosively. So-called light detonation isn't much of a concern, but medium and heavy detonation can damage rings, pistons and valves.

The labeled graph at upper left shows three key test cell parameters—peak cylinder pressure, CHT and piston top dead center. The test cell's software is configured to sample pressure and plot the onset of detonation as a dot on the TDC line whose color corresponds to intensity. (Yellow is light detonation.)

During our demo, we were shown detonation profiles on several fuels,

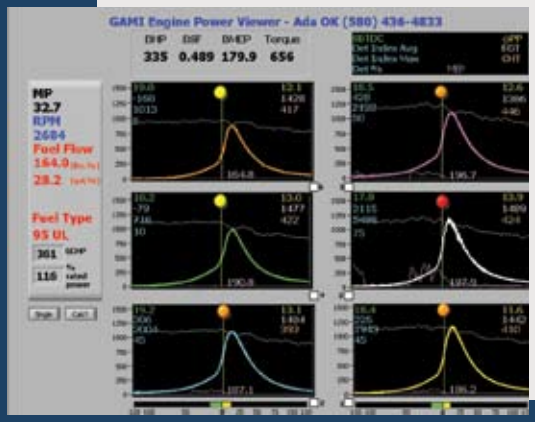


including 95UL, min-spec avgas, FBO 100LL and G100UL. Because of space limitations, we've chosen to show a detonation comparison between G100UL and 95UL. The left graph below shows the onset of detonation in all six cylinders of the IO-550 test article, with high power set (116 percent) and CHTs creeping above 400 degrees, but below the published redline limits for the engine.

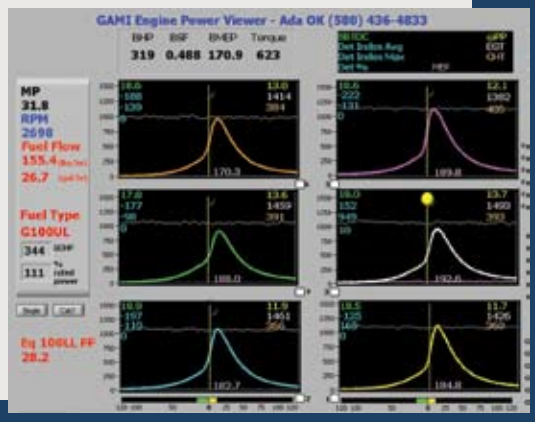
The graph on the right shows the same engine running on G100UL at 111 percent power with the hottest CHT at 405 degrees F. During a series of runs, we saw higher CHTs than this, without serious detonation.

Although we don't have room for the graph, the 100LL detonation profile was all but indistinguishable from the G100UL graph, indicating to us that its detonation margin is close enough to be called the same.

One other parameter not shown here is so-called ThetaPP, the difference in angular crankshaft rotation at which peak cylinder pressure occurs after TDC. A larger angle indicates a later pressure spike which is, all things considered, desirable. The tests indicate G100UL has a slightly larger ThetaPP, something that octane alone might not necessarily indicate.



95UL



G100UUL

EPA: HOW SERIOUS?

For at least three decades, the Clean Air Act's prohibition against lead in fuels has been somewhat toothless. Year after year, amendment after amendment, the Environmental Protection Agency has given leaded fuel for aviation a pass on further regulation.

It has always been assumed that the complete banning of lead was an inevitability and a consortium of environmental groups called Friends of the Earth is spending dollars to make that happen. In 2006, FOE petitioned the EPA to examine the environmental impact of leaded aviation fuels and later asked for more stringent regulation.

As part of that study and a subsequent tightening of lead air pollution standards, the agency began looking at emissions and contamination around airports, with some controversial sampling at the Santa Monica Airport in California.

The EPA has identified avgas as "a significant source of lead," but AOPA has argued GA airplanes produce only .1 percent of all lead emissions in the U.S. The latest development that raises worries about the EPA's seriousness is that it has ordered new air monitoring at airports to support its findings from the Santa Monica study. In all, 55 airports have been named as potentially exceeding proposed lead content thresholds.

This sounds ominous, but is it really? Yes and no. AOPA's Rob Hackman told us the association is monitoring the new EPA initiative, which it sees as cause for concern, but not alarm. Yet.

"Does it mean the immediate death knell of 100LL? Probably not," says Hackman. For one thing, the 55 airport list will probably be winnowed down and this is not yet a full-blown federal assault. The EPA is leaving the air testing up to state environmental agencies, so local airports shouldn't bear the cost burden.

GAMI's George Braly says EPA's presentation at AOPA Summit last fall "scared me to death." He believes GA could get caught flat footed, which is why is launched the G100UL project.

certified in the U.S. The FAA has no beefs with ETBE, but EPA might.

Another possibility tried before is the so-called high aromatics, such as toluene or the benzene groups. This is essentially how Swift Fuel is blended, using bio-derived acetone as a feedstock. It seems plausible that the same thing could be done using petroleum-derived feedstock by simply manipulating the distillation process, which is what refining is all about anyway.

"Yes, it might work, I suppose," says Rob Midgley, Shell's global technology manager, when we asked about the plausibility of a Swift Fuel approach derived from oil instead of saw grass. And what of the economics?

"Oh, who knows?" he said, which mirrors the reaction we get from other oil refining insiders when asked how plausible the numbers are. The problem is that refineries, despite buying billions of dollars worth of crude a year, operate on tiny margins. A misplaced decimal point in a feasibility study can turn what looks like an acceptable profit into a disaster.

Braly concedes that this is a major hurdle that G100UL will have to leap. "This has always been a chicken and egg problem," he told us. "If you're going to get the refiners interested, you have to show them a fuel that works, but if you're going to show them it works, you have to build enough of it to test it widely."

TESTING

Toward that goal, by early February, GAMI had run about 25 hours of test cell work on a beaten down IO-550 used for its Cirrus turbo work. In addition, it has flown three test flights, one of which we came along on to help collect data and observe results.

The single largest concern—apart from economics—is motor octane rating. The ASTM D910 spec for avgas calls for 99.6 MON minimum, but most FBO 100LL is a bit over that, at 101 to 103 octane. Presumably, G100UL would have similar variability due to vagaries in the refining process, but Braly told us in the laboratory test version, the fuel easily exceeds the D910 minimum.

At that octane, you'd expect G100UL to have good detonation characteristics and it does. In the test cell runs we observed, 100LL and G100UL had detonation profiles that were too close to distinguish and both have more than enough margin to meet typical FAA detonation standards.

Braly also ran some 95-octane unleaded fuel and some so-called "min spec" avgas, whose octane was actually at the lowest end of the ASTM requirement. Both of these induced light to medium detonation at cylinder head temperatures not much above what most of us would consider the high side of normal. A couple of octane points make a dramatic difference in delaying the onset of the detonation.

MEETING THE SPEC

ASTM D910 has a number of other requirements including vapor pressure, boiling and freezing points, sulfur content, corrosion characteristics, aging and oxidation requirements and water reaction qualities. A significant worry about fuels with high aromatic content is seal, hose and O-ring swelling.

"There have been problems with aromatic contents higher than about 40 percent in aviation fuels. It's not just as simple as raising the octane number," Shell's Midgley told us. So-called phase separation of water has been an issue in fuels with ethanol but it appears not to be in G100UL. In fact, Braly told us G100UL meets the D910 spec line for line with the exception of having no lead, slightly lower energy per unit of weight and some departures on distillation end points. As for seals and hoses, soak testing was underway when we visited, including containment in a compos-

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AC TV

For a complete video report on *Aviaton Consumer's* visit to GAMI for the G100UL tests, log onto our sister publication, www.avweb.com, then click the video button in the upper right of the home page and scroll down to the G100UL test video.

Upgrading to WAAS: Only a Few Options Exist

A WAAS buy-in adds real mission capability and workload reduction. But walk-away costs vary wildly with glass cockpits taking the biggest hit.

by Larry Anglisano

CHECKLIST

- For IFR aircraft, the operational benefits are plentiful and growing.
- WAAS boosts autopilot capability to an impressive level.
- The installation is pricey and complex for traditional gauges, and can be prohibitively high for glass panels.

In February 1996, the FAA's Technical Standard Order (TSO) C129 put IFR GPS navigation on the map. It was a complex installation with equipment that was quirky to program, but early adopters gained GPS-direct flight plans and GPS approaches—even though GPS was "supplementary navigation."

Today's IFR GPS installations are all about the augmented WAAS signal that's worthy of sole-means navigation. They're still a source of confusion and expense, but WAAS installations yield impressive automation and capability. Before you decide if WAAS is for you, you need to understand some behind-the-scenes facts and why you could be disadvantaged without WAAS GPS in your aircraft.

WAAS pays off for instrument flying where LPV approaches offer near or equal-to ILS minimums with rock-solid stability. GPS approaches in general are becoming the only option for some airports. The economics of WAAS in the panel makes little sense for a VFR-only aircraft.

IT'S ABOUT SIGNAL QUALITY

WAAS and precision-GPS equipment, procedures and regulations are covered in TSO C146a. The technical and operational benefits of a WAAS interface are many, and the new WAAS GPS engines, processors and software are reliable and highly accurate. WAAS not only enhances GPS accuracy but also corrects the errors in GPS signals caused by ionospheric effects.

WAAS provides less than 1.5-meter horizontal accuracy and 3-meter vertical accuracy. Class 3 WAAS sensor capability means no other navigational gear is required. If this sounds like putting all the eggs in a single basket, it is. These owners are relying completely on quality installations.

Operational WAAS also doesn't require user to check RAIM—receiver autonomous integrity monitoring—which was an early GPS system for alerting a pilot if the GPS signal quality had gotten too poor for navigational use. All WAAS GPSs use Fault Detection and Exclusion (FDE), which detects satellite failure and ignores the failed satellites. This ultimately affects the signal integrity and performance of the unit, and may mean the box will only offer you an LNAV approach with no vertical guidance rather than the LPV you were hoping for. That's because the boxes are smart enough to "downgrade" a WAAS GPS approach back to a basic non-precision GPS

approach 60 seconds prior to reaching the FAF. This possibility is why the FAA is so particular of the placement of mode annunciation that alerts the pilot to GPS messages.

If a WAAS outage is predicted and NOTAM'd, then you should use the FDE program in the Garmin desktop simulators, the on-board RAIM prediction of the GPS itself, or using tools such as www.raimprediciton.net to see if you'll have adequate GPS signal at your destination at your planned arrival time. We've found that downgrades do happen, but not often and WAAS outages are a truly rare event.

On the flip side, WAAS GPS receivers can be sensitive to stray RF noise. Strobe noise, com radio interference, pulse noise and cell phones are a few enemies. We recall a certain Cessna Skyhawk with a WAAS unit that would lose satellite reception when flying in wet clouds. Seems the location of the antenna—directly aft of the windscreen—was being affected by precipitation static. Moving the antenna back another foot solved the problem. Garmin engineers admit that WAAS for small airplanes can cause some challenges given the close quarters of installed antennas and other systems.

What were once called GPS approaches are being renamed RNAV approaches, with the non-precision GPS approach minimums called LNAV (lateral guidance). The addition of WAAS means the unit can display a glidepath the way you'd expect with an ILS approach. These come in two official flavors: the LNAV/VNAV and the LPV. Without getting into the details, both function the same way from a pilot's perspective—you fly them to a decision altitude (DA) just like an ILS—but the LPV will let you fly to lower minimums if your GPS offers it. A properly interfaced WAAS panel-mount navigator can fly all of these procedures.

Garmin has also added "advisory guidance" to many LNAV approaches that they annunciate LNAV+V. This causes some confusion as it's really just a path you can follow to a reasonable visual descent point, but the approach is still technically a non-precision approach with an MDA, not a DA. The FAA has an entire section dedicated to WAAS procedures in AIM section 1-1-20. It's a must read for existing owners and for those contemplating WAAS GPS upgrades.

If you've flown RNAV approaches you'll know that the signal quality and resultant needle action is far more stable than a traditional ILS approach. There's no scalloping that can cause grief with a coupled autopilot, glideslope oscillation as you get close to the pavement. Given our choice between flying an ILS or an LPV to the same runway, the choice is a no-brainer.

Most autopilots must fly in raw approach mode (like an ILS) to capture a GPS glidepath. That means no GPS steering laterally or vertically. When Garmin WAAS units are interfaced with a Bendix/King KAP140 and KFC225, you must manually enable vertical guidance on every approach when intercepting the final approach course.

THE GARMIN STANDARD

It's no secret that Garmin owns the GPS market with two of the most popular panel units ever made: the GNS 400W- and 500W-series navigators. These are WAAS-equipped right out of the box. The G1000 integrated suite has LRU GPS systems that are essentially remote GNS units. Early G1000s were not WAAS capable and upgrading them will empty the wallet. More on that later.

The first panel navigator with WAAS was the CNX80/GNS480 series, but Garmin pulled the plug on them after they bought UPS-AT. Remaining units on the used market are capable but orphaned machines. Garmin-AT still supports these systems with open arms, but we would have to think long and hard about dropping our coin on one at this stage.

Honeywell's KLN94 standalone color GPS doesn't have a WAAS engine and it probably never will. You can still purchase a Garmin GPS155XL and com-equipped GNC300XL. They can't be upgraded to WAAS either, and adding the accessories and parts to satisfy the old C129 (A1) standard will drive the price up to a questionable level.

There are plenty of used GNS430 and 530 units on the used market that can be upgraded to WAAS. Garmin does the upgrade for $2995, plus $800 if the trip to the factory reveals any discrepancies that need to be fixed. If an upgrade is your game plan, we say don't pay more than four grand for the used GPS to start.

Remember, you'll still need to buy an appropriate navigational indicator. In some applications, you'll need other pricey accessories that can easily snowball an otherwise routine although complex installation.

ACCESSORIES, AUTOPILOTS

Since WAAS GPS outputs lateral, vertical and nav flag data you'll need a navigational indicator. There are several indicator options here. Garmin's GI106A (made by Mid Continent Instruments) is the stand-alone indicator for displaying the data, as well as analogue VOR/LOC/glideslope information which is switched internally by the navigator.

Bendix/King has the KI209A that can work with Garmin navigators and most HSI systems will work, too. Of course, you can go all out and display the WAAS data on an Aspen PFD, Garmin G500/600 PFD, Sandel EHSI or other EFIS display. If you have an older Bendix/King EFIS 40, the software can be upgraded to properly play the GPS glidepath data. The trip to Honeywell will cost a few thousand.

Nearly any autopilot that couples to a traditional ILS signal can fly a GPS glidepath. Diligence is critical when wiring this interface, however, because changes to autopilot wiring modification of the autopilot computer may be needed. Some inexperienced shops have turned out upgrades where autopilots won't fly the GPS glidepath.

Some autopilots aren't fully capable. S-TEC's popular System 30 and 50-series systems can't fly any glideslope, ILS or GPS. They will accept roll steering commands with the ST-901 GPSS steering system, and in our view this is a worthy option as it greatly improves autopilot tracking ability, and adds the ability to anticipate turns and fly procedure turns and holds. For non-S-TEC autopilots there are generic roll steering systems made by Icarus and DAC International. External roll steering add-ons can add several thousand dollars to an installation and won't be included in a bid for a basic installation.

Aspen's EFD1000Pro or Garmin G500/600-series PFDs have integral GPS roll steering activated with a push of a button. In this case, the concern is more how well the PFD itself plays with your autopilot.

Pilots are growing accustomed to this hands-crossed approach automation. It's important to discuss the autopilot interface with the installing shop so you understand what capabilities you will or will not have, after all the wires are crimped.

A FEW OTHER DETAILS

While your non-WAAS Garmin is taking its $2995 factory vacation, the avionics shop will replace the legacy GA56 GPS antenna with a new WAAS antenna that sports the same mounting holes but has a wider footprint. Accessing this antenna can be easy or it can be bloody hell, depending on the design of the headliner and overhead. Single-piece headliners like those found in many Beechcraft models could be the worst since they're susceptible to sagging after removal and reinstallation.

Any old, single-shielded coaxial cabling must be replaced with twin-shielded, low-loss cable. Owners underestimate this task and are often shocked by the labor price.

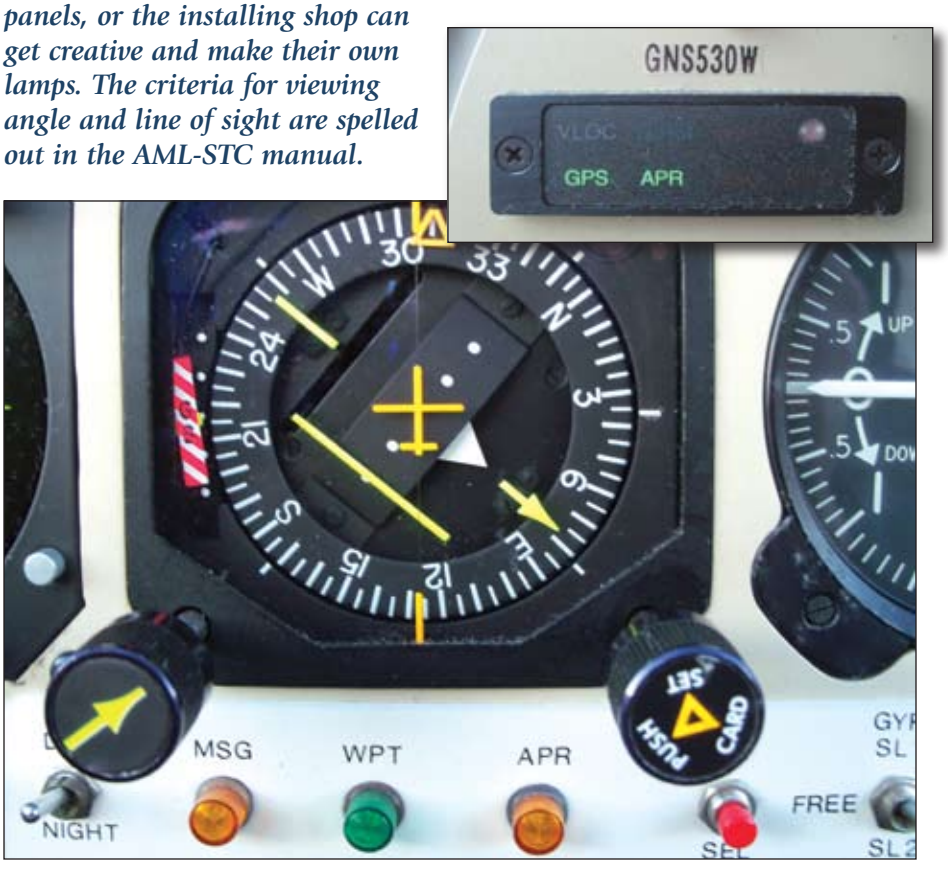
A remote mode annunciation might be required if the GPS is too far from the pilot's field of view. The shop will need to access the unit's main connector to wire lamps which could mean sizeable teardown and associated expense.

The paperwork and final testing chase shouldn't be underestimated as it's billable time. The existing GNS Flight Manual Supplement is replaced with an updated version, and final testing includes an evaluation flight. If the aircraft is on the AML for the installed system and there were no deviations to the criteria stated, there should be no need for an FAA field approval.

DOLLARS AND NONSENSE

While the lucky might escape a complete WAAS upgrade for under $4000, expect a non-glass cockpit project to be at least $5000 including the cost of the box upgrade. No matter what, be sure the shop offers an accurate proposal after they evaluate the existing installation.

For aircraft where the radio stack is displaced from the pilot's field of view (as in many Bonanzas and Barons), remote and redundant GPS mode annunciation must be installed. There are formal mode annunciator panels, or the installing shop can get creative and make their own lamps. The criteria for viewing angle and line of sight are spelled out in the AML-STC manual.



UPGRADE TO WAAS AND ADS-B?

Since ADS-B is on the horizon, you may wonder how to best leverage a WAAS upgrade to comply with the ADS-B mandate. We have no idea.

Actually, that's not entirely true. The final rule on ADS-B compliance will not appear for another month or so and we'd hold off on any upgrade until then to be sure, but it's pretty clear that basic compliance can be done with a WAAS GPS and the Garmin GTX 330ES transponder.

The GTX 330ES has ADS-B output but gets its position data from a WAAS GPS, such as the 400W, 500W or GNS 480. Garmin says legacy non-WAAS GPS systems won't cut it because WAAS is required in the ADS-B mix due to requirements in vertical accuracy and overall integrity. The connection is via an RS-232 serial bus and GNS software version 3.30. The software upgrade is available in the field at no cost to owners. If you already have a GTX 330 and legacy GNS product you'll need to upgrade both units for ADS-B output.

As we've said before, the rub is that this is ADS-B out, but you won't get any ADS-B in—you won't see any traffic targets or get free weather data. The Garmin-AT GDL90 Universal Access transceiver (UAT) has been available for years and will give you both. It has a built-in WAAS GPS, but you can't use that GPS for navigation and you'll need an MFD or compatible GPS screen to display the data. The GDL 90 will also run you about $7000 plus installation.

Garmin's new GTS 800-series TAS/ADS-B combination traffic system (see November 2009 *Aviation Consumer*) show both active traffic and ADS-B traffic if paired with the GTX 330ES. The entry-level GTS 800 is $9995 plus installation. As with the GDL 90, you'll need a display to show the traffic as well. As we go to press, the GTS 800 lacks the software needed to display ADS-B targets in true ADS-B symbology. It still processes ADS-B traffic but the symbology is from the active traffic side of the house. More capability and enabling software should be available in the coming months. Avidyne has announced an ADS-B upgrade to their TAS600 traffic system, too. Note that non-WAAS GNS units will work fine with the GTS 800 for active traffic, but that won't help your ADS-B compliance.

So a GTX 330ES factory upgrade for $1900 and a WAAS upgrade for $2995 (plus labor to change the antenna) is the least expensive step into the ADS-B world. But to see ADS-B targets, you'll need the GTS 800 system or a GDL 90 UAT.

While the ADS-B discussion is certainly turning heads, the continuing uncertainty and costs are turning some of those heads the other way. Perhaps some avionics manufacturer will seize this opportunity to offer a one-box solution that sweetens the upgrade to WAAS by offering full ADS-B built in.

The step up to WAAS in a glass cockpit has been a controversial and heated topic for owners because the costs are shocking. Garmin and Hawker Beechcraft offer an upgrade path for non-WAAS G1000 G58 Baron and G36 Bonanza aircraft. Each GIA63W LRU for the suite is $11,495 and Garmin offers a $1750 credit for the legacy GIA63 that's removed. There's also the GDU1045 MFD that's exchanged for $11,595 minus $1000 credit for the old MFD. That's just north of $30,000 in parts before a technician even picks up a screwdriver. Cessna's Service Bulletin SB07-34-07 lists the GPS/WAAS modification kit for upgrade at $18,295 for single-engine G1000 models. Manpower is listed at approximately 11.5 hours.

Any Avidyne/Garmin-equipped Cirrus aircraft not equipped with WAAS will need the standard GNS factory upgrade, but some will need extra antenna work performed by Cirrus service centers. Depending on the software level of the Avidyne Entegra displays, factory software upgrades will be required. We're talking thousands here, too. While it's hard to imagine such capable glass-cockpit aircraft without WAAS the upgrade pricing is staggering to say the least.

CONCLUSION

Summarizing these findings is easy: If you want WAAS, there aren't that many options and all cost some real coin. For new installations, Garmin's 400W and 500W units set the standard. A new installation of a 430W starts at around $12K while a 530W demands around $15K. Upgrading an existing Garmin shaves some thousands. But these units still won't show airways or high-resolution weather. For airplanes that haven't seen a radio upgrade in years the 430W is a good value, in our view.

You could buy Bendix/King's KLN94 but we're getting vibes that this is a dead-end product without any WAAS potential. The same could be said for Garmin's GPS155XL and 300XL. The long-promised Honeywell KSN770 NMS system will have WAAS and could threaten the Garmin navigator monopoly, but it could be another year before we see it. A lot can happen in a year. We'll keep you posted.

Engine Shop Survey: Zephyr Gets Top Marks

Penn Yan, Poplar Grove, and RAM also saw customer accolades. Good communication and responsiveness clearly matter more than a problem-free overhaul.

by Jeff Van West

It's just a sad fact that a wear item could have a replacement price tag up to a third of the value of your aircraft. That's the way it is with engines, yet most owners accept this and worry more about surviving the engine-change experience with a reliable motor that will last rather than finding the cheapest solution.

But the best path to getting that reliable motor isn't clear cut. Should you do a field overhaul or get an engine from the factory? Is it worth shipping the engine cross-country for that overhaul or is a local shop just fine? Does it matter who does the engine installation itself?

Every few years, we ask our readership, and that of our sister publication AVweb.com, to weigh in with their real-world experiences on engine overhauls. The latest results are consistent with the past: Your best bet is a field overhaul from a shop with a solid track record for quality work and after-the-sale support.

TOP OVERHAUL SHOPS

We think a good field overhaul offers more options and our survey respondents must agree. About 80 percent chose a field overhaul over buying an engine from the factory.

Field overhaul is a nebulous term, meaning anything from assembling the engine in your garage to sending it out to a rebuild shop. Nine respondents did the job themselves or at the local shop. "Where did this idea of sending an engine somewhere for a major start? It's ridiculous. I am not an A&P but majored this engine twice with no problems. If your mechanic is incapable, get another one. It's 1930s technology."

While he's got a point, you may not have a local shop you trust with such a large investment. Customer support is the strongest argument for sending out your engine to a trusted shop. Any company can look good when nothing goes wrong, but, in this survey, a surprising 28 percent of the engine jobs had a warranty issue of some kind. It's really telling to see what a shop does after it comes to light that they screwed up.

"The original crankshaft was improperly machined by Poplar Grove Airmotive, resulting in total engine failure at 1.4 hours and 500 feet AGL over the field," a Navion owner told us. "Poplar Grove Airmotive paid for the engine's removal, round trip shipping from the West Coast to their Illinois facility, complete teardown and replacement of the defective crankshaft, reassembly and extended bench testing." While this customer (understandably) says he won't go back to Poplar Grove, he rated them a four out of five in overall satisfaction and warranty support. Given the circumstances, that's pretty good.

Other shops that ranked well (see page 13) consistently had positive comments on responsiveness and support after the sale. "[Victor Aviation] was very communicative and professional, and concerned that I was happy. They did the job on time and to the exact quote. They recommended a great shop to remove and replace the engine." "[Western Skyways] was flawless in every respect; technically and customer relations." "Aircraft Cylinders and Engines is extremely methodical in the work and responsive to concerns. It's a very small shop, but it does fabulous work."

CHECKLIST

- ⊕ Field overhauls from a good shop offer competitive prices and the best customer service.
- ⊕ Using a shop known for great communication and support pays big dividends if there's a problem with the engine.
- ⊖ Factory-supplied engines fare worse than field overhauls in our data.

YOU'LL PAY A PREMIUM FOR FACTORY MOTORS

One surprise to us over the two engine surveys we ran in 2000 and 2005 was the increase in the cost of field-overhauled engines. For example, a Penn Yan Aero O-470 that was $12,000 in 2000 was $20,500 in 2005, a 70-percent jump. TCM's factory price for the O-470 in 2000 was $20,019 and the factory engine from AirPower ($300 over factory invoice) was $23,960 is 2005.

Factories have been putting pressure on the aftermarket with lower new and overhaul pricing for a decade now, and the 2005 to 2010 price jump is a more equitable increase of about 10 percent across the board. In 2000, Penn Yan was a low-price leader. In 2005, Poplar Grove held the title. Our calling around for prices had differences between vendors so small the leader varied on an engine-by engine basis.

Overall, you'll pay about 30 percent more for a factory-new engine versus a field overhaul with new cylinders, or about 20 percent more for a factory overhaul versus a field overhaul with overhauled cylinders. Boutique engines such as those from Victor Aviation will approach or exceed the cost of a factory engine.

Keep in mind these are not apples-to-apples engines, in parts, customization or a zero-time logbook, even though all are to new-engine tolerances. It's up to you if the paperwork, prestige and potential resale value is worth the investment.

	O-470-U	O-320	IO-550-G
FACTORY NEW	$31,000	$22,200	$39,500
FACTORY OVERHAUL (OH)	$26,500	$19,500	$32,800
FIELD OVERHAUL/NEW CYL	$21,000	$17,000	$31,000
FIELD OVERHAUL/OH CYL	$24,500	$15,500	$26,000

But even the high-ranked shops saw some negative reports and a few tales of woe. This just reinforces our belief that a shop known for good communication is critical. If you can use a shop that's relatively close to you, that's a plus as amicable solutions are far more likely face-to-face.

Seventy percent of the field overhauls used new cylinders, with a slight preference for ECI. We picked ECI and Lycoming factory cylinders as best choices in earlier reports. New cylinders add $1000-$3000 to the price of the engine.

As for whether corrosion is enough of an issue to pay the extra amount for cylinders like ECI's Nickel+Carbide or if steel barrels are just fine, we have mixed data. Rebuilders tell us they are seeing plenty of corrosion issues on low-use aircraft. But in our survey, premature corrosion showed up in only four percent of the engines.

Field overhaul of cylinders is a money-saving option that may make sense with a first-run engine and mid-time cylinders. This can save real dollars if done properly on cylinders with little wear. One O-470-U owner actually saved bucks twice with this option, as the new TCM cylinders that he could have used instead of the overhaul ended up being subject to an expensive AD. Some shops will supply overhauled cylinders rather than overhaul yours. In this case, we'd look for a shop that guaranteed these were only first-run (one-time overhauled) cylinders.

Along those lines, you have two options with field overhaul tolerances: new tolerances and service tolerances. All the major shops we spoke with rebuilt to new tolerances and we recommend you demand the same. Given the overall expense of the rebuild the savings aren't worth the potential for shortened lifespan on the rebuild. We recommend only FAA-certified shops or the factory for overhauls and would shy away from low-ball estimates you might see in *Trade-a-Plane* or on the web. These shops can't compete in quality or follow-up.

A good shop may throw in some money-saving perks to get your business. Penn Yan Aero offers free shipping for engines within the lower 48. Another example was, "Aero Engines delivered the airplane 800 miles to me in exchange for an airline ticket to their next destination. That saved me a lot of time and money."

You also want a shop that has experience with your engine. For common motors, this isn't an issue. If your Stinson has a six-cylinder Franklin in it, that's a different story.

THE FACTORY OPTION

Only three percent of our respondents bought a factory-new engine. However, 10 percent spent for a factory remanufactured (zero-timed) engine. While technically not new, these engines get a new logbook. If a new or zero-time engine matters to you, the factory is the only option.

A factory replacement may be the right choice for an engine that has seen several rebuilds. The field overhaul quotes assume usable subassemblies. If it turns out that your crank is toast, for example, expect a significant charge for the replacement that may negate any gains over the factory price. Turning that engine

CONTACTS

Penn Yan Aero
800-727-7230
www.pennyanaero.com

Poplar Grove Airmotive
800-397-8181
www.poplargroveairmotive.com

RAM Aircraft
254-752-8381
www.ramaircraft.com

Tim's Aircraft Engines
www.timsaircraft.com
562-634-6120

Triad Aviation
336-227-1467
www.hhtriad.com

Victor Aviation
650-354-1399
www.victor-aviation.com

Western Skyways
800-575-9929
www.westernskyways.com

Zephyr Aircraft Engines
800-204-0735
www.zephyrengines.com

THE BEST SHOPS RISE TO THE TOP

Drawing compelling conclusions from small surveys is challenging at best. One customer with an axe to grind could tank the ratings for any single shop when there aren't a bunch of positive experiences to balance that out. By the same logic, a high rating might not be justified. Zephyr Aircraft Engines got a 5 out of 5 rating on warranty support, but that's based on a single customer's opinion.

So here's our take on interpreting these numbers. The first column shows the number of survey respondents using that shop or company, and the number of those who had to make some kind of warranty claim. The next columns are ratings on a scale from one to five with one being "awful," three being "acceptable" and five equaling "terrific," or, in the last column one being "No #$%! way" to five being "Absolutely." The shops are ranked here by the "Overall Satisfaction" value with the best on the top of the chart.

We think ratings in the mid to high fours are indicators of a worthy shop. This is supported by the corresponding comments of readers and why we're confident with Zephyr, Poplar Grove and RAM taking top billing. But we're impressed with the high ratings for the shops at the top of the Additional Shops part of the chart. We just don't have as much data here, but if one is near you, it's probably worth a look.

We find the ratings of factory engines particularly interesting. Overall, the satisfaction with these engines was lower than field-overhauled ones. Lycoming factory engines fared far better than Continental, with overall satisfaction and customer support dipping below the "acceptable" mark of 3.0 for Continental factory overhauls.

Warranty claims on factory engines is also telling. With the overhaul shops, some of the warranty claims are from problems in the build and installation, and some are from failure of components that may have come from Lycoming or Continental. This makes the warranty rate for the field shops a bit higher than it should be. But the claims on the factory engines are entirely failure of components. Lycoming saw three issues from 22 engines, or about 14 percent. Continental saw 10 out of 25 engines, which equals a whopping 40 percent. Issues with Continental parts may account for the unusually high rate of warranty work with RAM Aircraft even though they get high ratings. Customers may feel warranty issues were not RAM's fault.

Our takeaway from these figures and reader comments is that a top rebuild shop is a better bet than a factory engine, especially if something doesn't go as planned. A good shop wants business from you and anyone else you talk to.

	TOTAL RESPONDENTS/ WARRANTY CLAIMS	OVERALL SATISFACTION	CUSTOMER SERVICE RESPONSE	WARRANTY PERFORMANCE	OVERHAUL QUALITY OF OVERHAUL	WOULD YOU GO BACK TO THIS SHOP AGAIN?
MOST-USED ENGINE SHOPS (SIX OR MORE CUSTOMER REPORTS)						
ZEPHYR AIRCRAFT ENGINES	7/1	4.9	4.9	5.0	4.9	4.7
POPLAR GROVE AIRMOTIVE	13/4	4.8	4.7	4.9	4.5	4.4
RAM AIRCRAFT	26/9	4.8	4.9	4.6	4.7	4.5
PENN YAN AERO	14/3	4.7	4.5	4.0	4.6	4.4
VICTOR AVIATION	22/2	4.7	4.6	4.4	4.6	4.6
TRIAD AVIATION	8/3	4.6	4.7	4.8	4.9	4.4
WESTERN SKYWAYS	17/5	4.6	4.5	4.6	4.7	4.4
TIM'S AIRCRAFT ENGINES	6/0	4.5	4.4	--	4.3	4.3
ADDITIONAL SHOPS (THREE TO FIVE CUSTOMER REPORTS)						
AIRCRAFT CYLINDERS & ENGINES	3/1	5.0	4.0	5.0	4.7	4.7
BOLDUC AVIATION	3/0	5.0	5.0	--	5.0	5.0
CUSTOM AIRMOTIVE	5/0	4.8	4.8	--	4.8	4.8
POWERMASTER ENGINES	5/0	4.8	4.7	--	5.0	4.5
AERO ENGINES OF WINCHESTER	3/1	4.7	4.7	5.0	4.7	4.7
D & B AIRCRAFT ENGINES	3/0	4.7	5.0	--	4.7	5.0
DON'S DREAM MACHINES	3/0	4.7	4.7	--	4.7	4.7
AMERICA'S AIRCRAFT ENGINES	5/3	4.6	4.8	5.0	4.4	4.4
G & N AIRCRAFT	5/1	4.3	4.3	5.0	4.7	4.3
LYCON AIRCRAFT ENGINES	3/1	4.0	3.0	4.0	4.7	4.3
TELEDYNE MATTITUCK SERVICES	4/2	3.8	3.0	2.5	3.8	2.7
FIREWALL FORWARD	3/1	3.3	2.3	1.0	3.3	2.3
AIRCRAFT ENGINE SPECIALISTS	5/3	3.0	3.3	3.0	4.0	3.0
LYCOMING FACTORY ENGINES						
FACTORY OVERHAUL	10/1	4.3	4.4	5.0	4.2	4.5
ZERO-TIMED	10/1	4.3	4.2	5.0	4.5	4.3
FACTORY NEW	2/1	4.0	4.5	4.0	4.5	4.5
CONTINENTAL FACTORY ENGINES						
ZERO-TIMED	14/6	3.9	3.9	3.5	4.1	3.8
FACTORY NEW	5/1	3.2	3.5	4.0	3.4	3.4
FACTORY OVERHAUL	6/3	2.8	2.8	3.0	3.2	3.3

back to the factory for a core credit would require reassembly, which would be all on your dime. Our survey contained one horror story with exactly this scenario. (As an aside, 21 percent of the respondents got a new crank with their engine.)

We've heard mixed reports of quality from Teledyne-Continental Motors (TCM) over the past few years. In this survey, one owner who rebuilt a Continental E-225 for his Bonanza told us, "The bottom end is great, but half the new TCM cylinders experienced valve leaks and head separation at 750 hours. After much 'discussion,' TCM agreed to replace these at no charge." There were similar comments from some other TCM customers. Reported satisfaction with TCM engines was on the bottom end in our survey, and the number of warranty issues was far higher than with Lycoming (see page 13). We have also seen customer satisfaction with what's now Teledyne-Mattituck Services slide ever lower in surveys over the past 10 years.

One final note is that Lycoming or TCM rarely stand by a warranty beyond the stated period. We had numerous reports of field shops supporting their work beyond warranty.

THE REST OF THE JOB

Overhauling the engine itself is only half the job. There's also the small matter of removal and reinstallation. About half our respondents had the removal and reinstall done by the overhauling shop and paid a single price. For those that didn't, there was too wide a range of local shops for us to make any real recommendations. We did see a few big complaints.

"PennYan that did the engine was great but the maintenance shop sucked. They overcharged us big time. We paid $19,000 for the engine. We did an owner assist, yet the shop charged us $23,000 with us doing all the uninstall work and part of the renistall. I refused to pay that amount as the flat rate was only about $5000-8000 at the time. We finally settled. I will never do business with that maintenance shop again."

"Factory overhaul by Lycoming is great; R&R work by Flightlevel sucks! Subsequent inspection by a third-party IA revealed shoddy workmanship in installing the new engine: oil filler tube loose and missing a gasket, exhaust flanges not flush and leaking, fuel strainer not safety wired, original brittle fuel and oil hoses re-used and original poorly-functioning air filter re-used."

Our advice here as simple: Even if you're just using the local shop for the removal and reinstall, get an estimate in writing that clearly states what will be replaced, what will be reused and what the whole job should cost, barring any surprises. There's nothing wrong with reusing parts that are in good shape as long as you know what you're getting for your bucks up front.

But that's a good plan for this whole process. Know what you're getting for your money and do business with the folks who have a proven record of respecting their customers.

Plate Reader Roundup: Many OK, None Ideal

Until someone invents a new approach plate designed for the screen, we're stuck with pixels emulating paper and trying to make plates work on e-book readers.

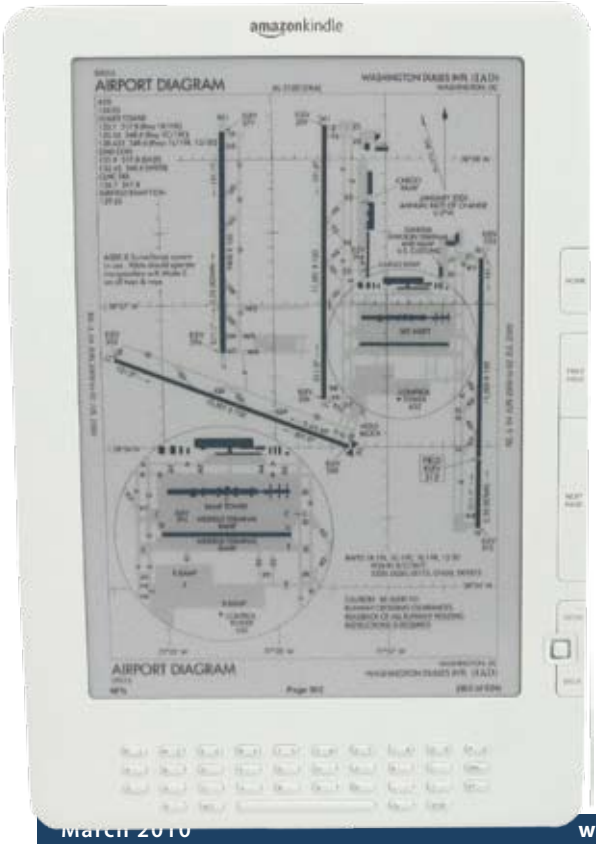
by Jeff Van West

Call us overly picky, but we have yet to find a digital approach-plate solution we can completely endorse. Perhaps the problem is that they have yet to surpass the bar. That is, they're almost as good as paper when what we really want is something better than paper.

In fairness, the e-reader solutions for approach plates are superior in three critical ways: You can carry plates for the entire country without risking a hernia, updates are a breeze (so long as you've got some free time and a good internet connection) and there's no wasted paper. The readers all support PDF documents, so you can also load useful items like your aircraft handbook or maintenance manual if there's space to do so.

Beyond that, we enter the realm of compromise. The common e-readers are all lightweight and have batteries that last for weeks. But the screens that allow this have less contrast than paper—the white is really light gray—and no internal backlight. Readers that fit easily in your hand have viewing areas most pilots find too small to view a complete plate, which necessitates panning and zooming. Bigger screens mean devices with the dimensions of a clipboard, and now use behind a yoke or finding a way to mount it becomes an issue.

Until the perfect hardware appears, or someone steps up with a new approach plate actually designed for a digital display, here's where we stand with e-readers available today. As there are many sources for the plates to view on an e-reader, we'll only cover the bigger players.



CHECKLIST

- ⊕ Several companies have easy-to-use packages at excellent prices.
- ⊕ Jeppesen plates can be had from one vendor (but for a premium price).
- ⊖ No piece of hardware hits the right combination of speed, size, weight and ease of use.

KINDLE DX

Amazon's Kindle DX is the big version of its successful e-book platform. The DX will display an entire approach plate slightly larger than the real paper, so it's easy to view. Switching pages requires three or four seconds for the new page to appear. This is noticeably slow when you're paging through the procedures for an airport, but not a show stopper. Battery life is fantastic.

The Kindle DX will go to sleep after 10 minutes, which means you might look down partway into an approach to see an etching of Edgar Allan Poe instead of the ILS Rwy 12, but it comes back in seconds when re-awakened. The DX has a full keyboard, which helps with selecting procedures, but numbers are done with an awkward Alt key that requires prompt button-pushing to work correctly.

Given the explosion in the consumer eReader market, black-and-white solutions like the Kindle or Sony Reader may become real bargains on eBay. Our tests found both solutions functional, but only the DX was easy enough to become a primary source for plates.

Your two sources for plates optimized for the Kindle are ReaderPlates and Airbrief. Both offer monthly subscriptions for the contiguous U.S. for $9.95/month that include everything

Your only choices for Jeppesen plates is Jepp's own JeppView running on a laptop or Tablet PC, or SOLIDFX's FX10. Of the two, we think the FX10 is far superior. It's easy to use, with a crisp display and reader that's (barely) fast enough not to annoy. It's about the same size as the Kindle DX—still bigger than we'd like.

you'd get in NACO books and all AF/Ds. Both offer a one-step update via a download manager you install on your computer, but only ReaderPlates offers a Mac version.

The native Kindle search isn't up to the task with these huge plate books, so finding your airport is a chore that these companies approach differently. Readerplates uses the native Kindle format, which results in a table of contents that lists airports by name and by identifier. You can also use the Kindle's bookmark function to tab your commonly-used airports. Airbrief formats in PDF, which is a bit more limited. You must find your airport in a list of airport identifiers and use the go-to function to jump to the correct page.

ReaderPlates can fit two complete charting cycles for the U.S. on the Kindle DX (so long as you don't have store any annoying e-books) or you can just load the region you need to save space and download time. ReaderPlates integrate the AF/D and departure text with the approaches for an airport to show all the information for the place without changing "books" on the Kindle.

In Airbrief's kudos column is their LiveBrief function. This lets you request both the charts and the current weather for an airport via the Kindle's cell network connection. No WiFi needed. You will incur Amazon's charge for data, however. Regular updates are done via the internet like ReaderPlates.

Airbrief also supports the smaller Kindle and Kindle 2. We feel the size and storage limitations of the small Kindle make it unrealistic as a plate reader, especially because there is no true zoom function. The makers

DEVICE	VENDOR(S)	SCREEN SIZE (INCHES)	GEOREF?	PLUSES FOR THIS READER	MINUSES FOR THIS READER	HARDWARE PRICE	SUBSCRIPTION FOR U.S. CHARTS*
READER ONLY							
KINDLE DX	AIRBRIEF, PDFPLATES, READER PLATES	9.7	NO	DISPLAYS FULL PLATE, LIGHT WEIGHT	SIZE, PRICEY, LIMITED SEARCH CAPABILITY	$489	FREE - $120
SONY READER	READER PLATES, PDFPLATES	5 - 7.1	NO	COMPACT AND LIGHT. LOW COST	SMALL SCREEN, NO ZOOMING	$170 - $399	FREE - $120
FX10 (IREX)	SOLIDFX	10.2	NO	JEPP PLATES, CRISP DISPLAY, GREAT SOFTWARE,	SIZE, PEN-DRIVEN, EXPENSIVE	$1595	$710
IPHONE	PDFPLATES, WING X	3.5	NO	CONVENIENT, MAY ALREADY OWN	TOO SMALL FOR REGULAR USE	$99 - $299	FREE IN PDF FORM, $99.95 INTEGRATED INTO WINGX
READER INTEGRATED INTO EFB PACKAGE							
ATC	ANYWHERE MAP	4.3	YES	OFFERS MUCH MORE THAN CHARTS, PRICE	SIZE, SPEED OF SCREEN REFRESH	$595	$145
AV8OR ACE	BENDIX-KING	7	YES	OFFERS MUCH MORE THAN CHARTS	WE WISH SCREEN WAS 1/2-INCH WIDER	$1999	$399**
FLIGHT CHEETAH FL210-S	TRUEFLIGHT	6.5	YES	OFFERS MUCH MORE THAN CHARTS, CAN SEE ENTIRE CHART	BIG AND HEAVY, UNUSUAL OPERATING LOGIC, COST	$2195	$298**
GPSMAP 696	GARMIN	7	NO	OFFERS MUCH MORE THAN CHARTS, CAN SEE ENTIRE CHART	BIG AND HEAVY, COST	$3595	$395
TABLET PC OR LAPTOP	ANYWHERE MAP, CHART CASE, VOYAGER, RMSTECK, JEPPESEN, TRUEFLIGHT AND MANY OTHERS	6-15 INCHES, DEPENDING ON HARDWARE	USUALLY	OFFERS MUCH MORE THAN CHARTS, CAN SEE ENTIRE CHART	BATTERY LIFE, SUN-LIGHT READABLITY, AND EASE OF USE IN COCKPIT VARY WIDELY	VARIES	$145 TO $775

*** FOR CONUS CHARTS. PRICES ARE ANNUAL SUBSCRIPTIONS. SOME VENDORS OFFER BUNDLED OR LIFETIME DISCOUNTS.**
**** INCLUDES ADDITIONAL NAVIGATION DATA BESIDES APPROACH PLATES.**

of Airbrief also offer a kneeboard specifically for the Kindle DX at www.forpilotsonly.com. The Kindle DX is big enough you wouldn't want to hold it unsupported for more than five minutes, and it takes up most of your lap if you put it down.

PDFplates offers a PFD pack, similar to what you get from Airbrief, but without the download manager or LiveBrief. But PDFplates is free (with a request that you donate).

SONY READERS

There are several Sony reader models, but the popular one for plates is the PRS-505, with a six-inch screen and a price of $279. The size and weight are great and the screen is crisp. It's also small. If you've got great eyes, you can read the shrunken plate when you view it in portrait orientation. The rest of us mortals must use landscape view. This lets you see the entire width of the plate and scroll up and down to see its length. There's no zoom function.

On the plus side, the unit seems robust and battery life is terrific. The size means it's easy to pull out as a backup. With practice (and patience) it could be a primary plate reader, but we wouldn't recommend it. The buttons on the side are fine for paging around and the PDF bookmark function is supported on the Sony, so it's easy to find and jump to the airport you want. Creating your own bookmarks, for your favorite airports, for instance, isn't as easy as with the ReaderPlates on the Kindle DX.

Both ReaderPlates and PDFPlates have PDF files optimized for the Sony 505. ReaderPlates is also investigating plates for the larger Sony PRS-900, which sells for $400.

SOLIDFX FX10

The number-one selling point for the FX10 is it's the only solution that lets you see Jeppesen plates on an e-reader. It's also the priciest solution in terms of both hardware and the Jeppesen subscription. If you don't need Jepp plates, we think you should move on to some other solu-

IPAD: THE PERFECT PLATE READER?

Whether you think Apple's soon-to-be released iPad will revolutionize digital reading or evaporate in the heat of its own hype, one thing is clear: It sure looks a lot like the hardware we've all been searching for as a perfect digital plate reader.

We haven't gotten our hands on one yet, but the specs hit several critical marks. Battery life is good enough for an entire day of flying. The screen is readable in all lighting and the refresh rate is lightning fast. Storage is good and solid state, so altitude isn't an issue. It's got a highly accurate, multi-touch screen with an operating system designed to use that to its full potential. That OS already supports excellent aviation apps from companies like ForeFlight, WingX and Garmin, as well as plate readers that use PDF. In fact, the biggest complaint about plates on an iPhone is the size, which just became a non-issue. The GPS and compass are built in and it has Bluetooth, so position on georeferenced plates and, maybe even datalink weather is a possibility.

Items that could spoil this bliss? Well, the iPhone OS is a bit locked down and it can't multitask. This may throw a wrench in the works of sophisticated features or making the iPad a full-blown electronic flight bag (EFB), but it won't prevent it from working as a good plate reader. We asked a developer at one of the EFB vendors if they were planning an iPad version of their software. His reply: "Let's just say I made a stop at the Apple Store on my way home the other day." It will remain to be seen if the software that generates the Jeppesen plates used by SOLIDFX can port over, but if it can, the iPad could eliminate the issues of the iRex reader.

Then there's the dark horse of the Android OS. There are Android-based tablets in the works. They face the uphill, chicken-and-egg battle of getting users without as many apps, and no one is making apps without users (the ironic opposite of the Mac-versus-Windows battle) but that might not matter for aviation use. When users might buy the hardware for nothing more than cockpit use, any other apps are just a bonus. Android tablets might prove even better and more flexible (and cheaper) than the Apple solution.

One of our subscribers wrote in saying that he thinks Garmin ought to be quaking in their boots with this latest turn of events. We respectfully disagree. While there is all the potential for a great aviation tool in the iPad, it'll still be aviation apps running on a broad-use platform. No matter how good the aviation apps might get, there's still a compromise in the end. We'll invoke chaos theory here and point out that the more variables in the mix, the more of a certainty it is that things won't work as reliably. We think there will always be a market for something that's purpose built and works perfectly for the task right out of the box with all the mounting and connecting hardware already figured out.

Will the iPad or Android tablets steal some market share from products like the Garmin aera? Almost certainly. But a smart company will make more than that up in selling their own iPad app and data subscriptions.

From an aviation perspective, we see the iPad and like tablets as platforms of great potential that multiple vendors will try to inhabit. We'll let you know how well the first generation of these products work in practice as soon as we can get our hands on them. If you're contemplating an eReader approach plate solution, it might pay to wait.

But don't sell your Garmin stock just yet.

Electronic Flight Bag (EFB) solutions like ChartCase (left), have plates integrated with moving maps, datalink weather and more. The same is true for portable GPSs that can display plates, such as the AV8OR Ace (above right) or GPSMAP 696. That extra capability requires true computer power and the cost, weight, battery life and LCD screen limitations that come with it. Look for a comprehensive EFB review in a future issue.

tion. But if you need Jepps, the FX10 does a great job of displaying them.

The FX10 software is the best e-reader system of the lot because it was purpose-built to be a chart reader rather than a hijacked e-book reader. You can search by identifier or name, with the FX10 showing an ever-narrowing list as you type. You can put the plates for several airports on quick-access tabs and then further subset those onto a clipboard for faster access. The net effect is like those colored tabs you could put in your old Jepp binder or pulling out plates to have easily at hand. The plates appear near full-size, but the zoom and pan is so simple on the FX10 that's not an issue.

The FX10's performance is only limited by the iRex 1000 hardware it runs on. Screen display is crisp, battery life is good and the redraw delay of about three seconds is typical. Unlike the other readers, the FX10 works with a specialized pen like a tablet PC. This can be a pain in the cockpit, as you must keep it on a tether that can get in your way or risk dropping it. You can control the FX10 without the pen using buttons on the side, but they're hard to use and are best deactivated before flight, which makes the pen essential until you restart the unit.

Just like the Kindle, we found the FX10 is too big to hold for long periods, yet big enough it took up the whole of our lap.

CONTACTS

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PDF Plates 540-200-8620 www.pdfplates.com	WingX 866-429-4649 www.hiltonsoftware.com
Reader Plates 512- 850-5510 www.readerplates.com	

OTHER OPTIONS

We know of two solutions for the iPhone. One is through the iPhone app WingX, which offers a full moving map, weather integration, flight planning and more. Even though it's iPhone-based you can use it in flight. Just realize it's going to eat a bit of your iPhone's storage memory to hold all that data. WingX can be used in flight when you don't have a cell connection.

The other iPhone option is to combine PDFPlates with an iPhone PDF reader called Goodreader (available via Apple's App Store). This makes for a low-cost solution to get plates on your phone. In both these cases, the plates are small and cumbersome enough to use—you'll be zooming and panning quite a bit—that we see them only as an emergency backup. But in a pinch, they could certainly get you the information you needed.

If you're also in the market for a GPS moving map solution, then you have a few more options. The Anywhere Map ATC, Bendix-King AV8OR Ace and Garmin GPSMAP 695/696 all have approach plates as part of their portfolio. We've reviewed all in the past issues of *Aviation Consumer* and found each functional but not ideal. We wouldn't recommend any of these if electronic plates were your primary objective.

There are also multiple variants of the Electronic Flight Bag (EFB) out there—far too many to list here. These give you approach plates, VFR and IFR charts, a GPS moving map, terrain awareness and full flight-planning software. Many add datalink weather and 3D views with highway-in-the-sky guidance. This is where you'll find the other option for Jeppesen plates in the form of Jeppesen's own JeppView (now part of Jepp NavSuite).

If you already have a computer you're comfortable using in the cockpit, these could offer cost-effective solutions. Several vendors offer complete software/hardware packages.

HOW ANXIOUS ARE YOU?

What's our recommendation? Hardware is the limiting factor here, and that's undergoing a big shakeup (see sidebar). So if you already own a compatible device, the price is right for subscribing to a source for plates and trying them out.

If you don't already have that reader in your hands, we think it's best to wait and see. We don't know if the perfect reader will appear in the next two months or the next two years, but we're pretty sure it's coming and that it will end up being worth the wait.

Product Support: There's a Limit

Should we be steamed when companies stop supporting our 20-year-old headsets and radios? Yes, but to expect anything different is unrealistic.

by Joseph E. (Jeb) Burnside

CHECKLIST

- Technical advances make new products better with more capabilities, but...
- ...new capabilities mean existing parts become obsolete and too expensive to replace.
- Exceptions abound, but most aviation companies support products well into obsolescence.
- Yes, it sucks that you can't get parts for your 50-year-old Omnigator.

The term "product support" means different things to different people. For example, someone in the market to buy a new aircraft may worry about whether the local FBO has personnel trained to maintain it. Meanwhile, a renter pilot buying a new headset wonders what will happen if an earcup cracks five years from now. Both pilots may also be in the market for a handheld GPS: Will database updates for it still be available in a few years?

Perhaps because of the relatively high prices we pay for these and other products, there's often the expectation of manufacturers supporting them forever. And Jeppesen should continue offering custom database updates long after the memory space required outstrips that available in the hardware. Good luck with both. So, how long can we expect to receive a manufacturer's support for their products? What factors into a manufacturer's decision to discontinue support of a product? Are our expectations unrealistic? If so, why?

OBSOLESCENT MOUSE TRAPS

In the bargain of always pressing for better technology, we also have to accept some obsolescence. Put another way, better mousetraps come along. The problem that many aircraft owners and operators can't get their heads around is that the old stuff still does the job for which it was purchased, so the idea of junking a navcomm because of a failed circuit board—even if that board may be 30 years old—doesn't seem rational when the airplane it's in is 50-something years old. After all, parts for the airplane are still available, why not the radio? Lycoming supports engines they made in the 1960s.

With electronics, however, it's different. A poster-child example is the wildly popular-in-its-day Northstar M3 Approach GPS navigator. First available in 1996, production of the M3 Approach was discontinued long ago. But it was only last year when then-current parent company, CMC Electronics, ended support and the M3 became a doorstop.

CMC said in a March, 2008, notice that it "evaluated several technical alternatives to extend the life of the product and...determined there were no cost-effective solutions." Solutions to what? Trying to squeeze 10 pounds of aeronautical data into a five-pound sack, that's what.

Another example is Garmin International's well-regarded GPSmap 396. This portable navigator, introduced in 2005, was the first such product to feature a color screen and datalinked weather information, including near-real-time NEXRAD weather radar imagery. Late in 2009—early November, to be exact—the company stopped producing and selling new 396s. Why?

According to Garmin spokesperson Jessica Myers, the company's decision to discontinue any product—portable or panel-mounted—"may include... parts availability, the introduction of new products that superseded an existing product and/or a decrease in overall sales volume that no longer supports continued production."

A classic example of a spiral into unsupportable obsolescence is the once-popular Northstar M3. The company never followed up with improved products and the unit died a slow death. Garmin did follow up the GPSmap 195, upper photo, but color maps at affordable prices pushed it off the support desk.

Garmin inherited the GX-55 from Apollo, which one shop told us it could still sell. It was axed to simplify the product line. David Clark, on the other hand, still supports every headset it ever made while Bose stopped fixing the early noise cancelling products due to lack of parts.

What Garmin is saying makes business sense for Garmin and, in this case, it's clear to us that introduction of the aera portables led at least in part to the 396's demise. But is it a fair deal for the customer? It depends on how long the old product is supported. Although you can't buy a new 396 now, repair support for it will continue. "Garmin's objective," Myers told us, "is to support all aviation products with repair services for the longest period possible. The standard objective is a minimum of seven years for panel-mounted avionics after the last date of production."

According to Myers, Garmin intends to support the 396 for at least that seven-year period. She points out the company has been able to exceed that objective significantly, and "only recently discontinued service for our oldest panel mounts, which had gone out of production over 10 years ago."

What about database updates for the 396? Scott Reagan, Jeppesen's director of OEM Client Management, told us, "As long as we have a means to supply databases, we will do so." In the case of the 396 and other versions of the company's portables, Jeppesen runs so-called "packing" software owned and supplied by Garmin against its own proprietary data. The results are what gets loaded into the device as a database update.

The trick is whether or not the hardware manufacturer—Garmin, in this case—decides it can no longer support the unit, Reagan told us. "The manufacturer decides whether to support the packing software," which is the manufacturer's property in the first place, he added. Think about another popular product, Garmin's GPSmap 195. Its production was long ago discontinued, but Jeppesen still supplies database updates, even though the 195's memory capabilities aren't the same as for other Garmin portables and, in fact, have been far outstripped by major improvements in hardware digital storage. "Memory capabilities can also dictate how long we can offer updates," Myers added. Is there a threshold number of users below which it's not economical for Jeppesen to supply database updates? Apparently not. According to Reagan, Jeppesen currently is "continuing support of several units for which we have less than a dozen subscribers. The OEM continues to support that packing software thus we continue to support the data services." That's analogous to Microsoft continuing to provide upgrades for people still using a TRS-80 from Radio Shack.

Which brings us back to the M3. It was designed at a time when large-volume digital memory was both rare and expensive. As a result, the M3 used a two-megabyte data card. A 2008 notice announcing discontinuation of database updates for the navigator notes, "Jeppesen databases have exceeded these limits due to normal growth of aviation data. Furthermore, flash cards have become nearly obsolete and Jeppesen no longer has the parts necessary to build Skybound adapters for flash cards." When manufacturers introduce new avionics, they fully realize that the components they use will eventually become unavailable. To provide a reasonable length of ongoing service, they purchase a supply of spares. But to keep products profitable, only so many spares can be stored.

When it designed and built the M3, Northstar's use of a two-megabyte storage card was a business decision, probably based partly on then-current database sizes and partly on the technology available when it was designed. Since then, of course, things have changed. For one, more navigation fixes have been created thanks to the popularity of GPS approaches, stretching the M3's memory card beyond the breaking point. For another, moving map popularity—something the M3 never will be able to do—along with the unavailability of flash card components, made it obsolete.

HEADSETS

Some products are supportable almost forever. A call to David Clark revealed that an ancient passive headset with a broken volume knob is still repairable. "If we make it, we can repair it. Just send it in," we were told. That's likely to be less true with noise-can-

celing headsets, whose electronic components, like those found in GPS units, have a definite shelf life.

In 1989, Bose stunned the aviation world with its $1000 Aviation Headset, the industry's first noise-canceling product. But owners who thought a $1000 headset ought to last forever were just as stunned when Bose dropped support for the original headset in 2008, 13 years after production ended.

Bose's Jon Previtera told us, "We had to stop offering repairs on our original aviation headset, Series I…due to the fact that we exhausted our supply of electronic parts and could not procure the old electronic components any longer. However, we continue to make available customer replaceable items such as microphones, cables and wear items such as ear cushions."

LightSPEED, Bose's chief competitor, is famous for its free repair service, yet even that can go on for only so long. The company has offered an innovative solution that others have tried, too: When a new model appears, LightSPEED offers a generous trade in on a new model. Even if the trade knocks the margin down, LightSPEED figures it had made a good investment in customer loyalty.

IT'S JUST BUSINESS

Like it or not, companies like CMC, Garmin and Bose are in business to make a profit. That fact may be in stark contrast to the industry-centric altruism that many of us who own and operate personal aircraft expect the navigator we paid good money for 15 years ago to be fully capable until the last GPS satellite burns up on reentry. The reality is that if companies can't make money or at least break even supporting legacy products, buyers shouldn't expect them to do so.

One avionics shop manager told us it's ridiculous to think Garmin can't get displays for the GX-55 they inherited from Apollo but have now discontinued. "You can get anything you want made if you're willing to pay for it. They're just not willing to do that," he said. But in the next breath, he added that he views this as a legitimate business decision based on cost control and the profit motive. It is, after all, why companies exist.

Garmin's introduction of a new product line made the GPSmap 396 an unwanted competitor. As Garmin's Jessica Myers put it, "Think of it in terms of your computer, camera, cellphone, MP3 player or any other consumer electronic item—a specific model number isn't usually manufactured for seven years. The capabilities exist in future models made by those consumer electronic manufacturers, but their older models are discontinued as newer products and capabilities are introduced."

Another way of saying that is when a better mousetrap comes along, we all go out and buy one. As we use it, technology improvements march on. At some point, the best mousetrap you could find 10 years ago is eclipsed by a new all-composite, high-resolution mousetrap. Yet, our old mousetrap still does the job. Should we expect the mousetrap's manufacturer to continue supplying the low-tech metal springs it requires, even if the rest of the industry has moved on to carbon-fiber springs, which work much faster? Yes, for awhile. But not forever.

Supporting legacy products usually isn't a significant profit center for a manufacturer. Yes, there's the need for them to establish a reputation of providing support after the sale so customers will consider their newer products in a few years, especially in a market as small as general aviation. But it's unrealistic to expect all companies to offer upgrades or even spare parts for ancient navigators, even if some still do. Buyers should go into the deal understanding this and although we might rail against it, it won't change the reality.

After all, the resources they will consume to keep alive that 15-year-old GPS would be better spent developing a new one, taking advantage of all the technical advances since then. And we'd be better off buying the newer, more-advanced product: We'll get better performance from it while rewarding the company for its innovation and for continuing to develop new products focused on our market.

Regardless, eventually that whiz-bang box in your panel or strapped to your yoke will be obsolete and unsupported, just as it is with eight-track tapes and the A-N radio range. As Jeppesen's Scott Reagan put it, "This is one of the things like death and taxes. You know it's coming and neither are welcome."

PERPETUAL SUPPORT

When Hawker Beechcraft in November announced its new CLASS program (for Classic Legacy Aircraft Service and Support), under which the company would begin charging for technical support and services for its out-of-production models, some owners concluded their older Beech products soon would be abandoned. But Greg Graber, Vice President, Global Product Support for Hawker Beechcraft, told us, "By charging a nominal fee, we are ensuring that we can continue to support the airplanes and help resolve issues as they emerge." Graber added HBC has no plans to stop supporting its legacy aircraft.

The bottom line being the bottom line, it's expensive and usually not profitable to provide free support to aircraft which, as HBC's CLASS program announcement noted, have been in service for decades. "Many of the airplanes operating in this fleet have been resold numerous times and have seen service all over the world. Some of these models were delivered over 40 years ago."

One question HBC's new policy raises involves parts. For years, Beech operators have noted high parts prices and spotty availability. Will the CLASS program raise those prices even higher? The good news is it shouldn't. "The parts pricing model is not based or affected by the CLASS Program," Graber said. "Rather, the parts price is dependent on a completely different set of criteria." The better news? There won't be a charge for researching the part if the operator then buys it from RAPID, HBC's parts distributor: "If we provide the information and the part is purchased from RAPID, we will waive the CLASS fee," Graber added.

Other airframers are watching HBC's new program. For its part, Cessna isn't following Hawker Beechcraft's example."It's not Cessna's intention to charge for support," according to the company's Doug Oliver. Whether airframe manufacturers will eventually adopt HBC's support policies for older aircraft will probably depend on a variety of factors, not the least of which is their own bottom lines.

PiperSport LSA: Sleek, Comfortable

And also no surprises, which might make it the ideal entry level sporter that Piper wants to its higher-priced models.

by Paul Bertorelli

For the established manufacturers, the light sport evolution has presented an opportunity and a dilemma. The opportunity is that LSAs might gin up the market for certified aircraft by offering buyers a low cost of admission. The dilemma? How to capitalize on that. Do you leave LSAs to the upstarts or build your own?

Cessna built its own, Cirrus stuck a toe in the LSA water and withdrew it—or at least delayed the plunge—and now comes Piper with the announcement that it will offer the former Czech Aircraft Works SportCruiser as a rebranded PiperSport. The announcement came at the U.S. Sport Aviation Expo in January in Sebring, Florida.

Piper's new CEO, Kevin Gould, explained that buying and marketing someone else's design made more sense than spending hard-to-come-by developmental dollars to ultimately build an airplane that's not much different from the dozens already out there. Point taken.

The original SportCruiser was designed by American Danny Defelici, whose company, Sport Aircraft Works, is still overseeing its construction and importation. In the late 1990s, as the Soviet Bloc was collapsing, Defelici saw an opportunity to build aircraft in Eastern Europe and worked out a deal to build what became the SportCruiser.

This design is an all-metal, side-by-side-seating with a large bubble canopy hinged at the front, à la the Diamond Star. Power in the Piper version is a Rotax 912UL, with a three-blade composite prop. The version we flew was an actual SportCruiser tarted up in Piper livery but, we were told, is generally representative of what Piper will ship.

Piper's Bart Jones told us the aircraft will be manufactured in the Czech Republic, assembled there and test flown. They'll then be crated and shipped directly to dealers for final delivery. Although Piper will support the aircraft with parts supplies, the airplanes won't ship through the company's Vero Beach factory.

According to Piper's specs on the PiperSport, it will be available in three trim levels, starting at $119,000 for a steam-gauge version with a Garmin GPSMap 496, a transponder and an SL40 comm; $129,000 for a version (PiperSport LT) with a single Dynon D100 EFIS and $139,000 (PiperSport LTD) for a pair of Dynons, an autopilot and steam gauge backups.

The airplane is unique for a couple of small baggage lockers in the wings, each with a capacity of 40 pounds. These are accessible via forward-hinged panels fastened with quick-turn fasteners. Although they would be more than capable of holding a weekend's worth of clothes, they come at the expense of having fuel in the relatively unprotected leading edge of the wing. There's also a 10-cubic foot baggage compartment behind the two seats, a split-level affair with an upper turtle deck.

And speaking of the seats, they don't slide fore and aft but as with Diamond, the rudder pedals adjust via a little trigger switch under the panel lip. This is one of the better executions of this design that we've seen and once settled into the cockpit, the ergonomics are comfortable.

With the standard LSA gross weight limit of 1320 pounds, the PiperSport we flew had an empty weight of about 820 pounds, for a useful load of 500 pounds. With 30 gallons of fuel aboard, that means there's 320 pounds left for people and stuff—fairly typical for an LSA. Down fuel it 10 gallons for an additional 60 pounds

CHECKLIST

- ⊕ The airplane is sleek and sexy looking, with a rakish cowl and bubble canopy.
- ⊕ Cockpit vis and comfort are superb. Canopy shade is a nice touch
- ⊕ Pitch forces are light, roll heavy, but overall handling is sporty.
- ⊖ Wing lockers are a plus, but it puts fuel in front of the spar, where it's less well protected.

of payload and you still have a little less than four hours of endurance for a 400-mile still-air range.

FLYING IT

Getting into the PiperSport requires the same practiced art needed for the Diamond line, the Tecnam Sierra and the Gobosh 700S. In other words, it requires an awkward pirouette from the wing walks into the depths of the cabin. Fortunately, the designers realized this and provided a handy handhold on the glareshield and a beefy T-handle between the seats. Right below the T-handle is another T, for the canopy latch.

Once seated, the cabin combing is higher than you might expect, but the bubble canopy gives breathtaking visibility on the ground and in the air. But what bubble plastic giveth, it also taketh: Even on a cool January day, the cabin was hot with the canopy closed. The designers thought of that, too. A sunshade extends like a Venetian blind along the top of the canopy. It doesn't look like much, but it shades the occupants nicely.

One design intent for the SportCruiser was a spacious cabin and the airplane does have that. But so do other LSAs, including the Skycatcher and the new Tecnam P2008. Designers are listening to customers who want comfort.

Given their weight limits, ubiquitous Rotax engine and size, LSAs fly pretty much alike—except not exactly. The PiperSport turns out to be exceptionally light in pitch, but heavy in roll. Jones warned us about this on takeoff, but we still PIO'd it before getting the feel in time to do an acceptable landing.

AC TV

For an in-depth video report on the PiperSport, log onto our sister publication, www.avweb.com, then click the video button in the upper right of the home page and scroll down to the PiperSport flight-trial video.

Panel at right is the PiperSport's top-of-the-line offering, with two Dynons, a GPSmap 496 and an SL40 comm. Throttle, center photo, has a pinch-to-release tensioner that works well. Although the bubble canopy, lower photo, offers fantastic visibility, it creates a warm cabin. The solution is a retractable sunshade.

The airplane is hardly trim hungry, but it does require a deft touch on the electric-only trim buttons on the top of the stick. The stick itself is the typical European tall stalk, so you can rest your control hand on your knee and still have six inches of rubber grip above that. It could do with being shorter, in our view, so the lazy louts among us don't have to lift a thumb for the trim button.

When we flew the SportCruiser two years ago, we found control forces light to the extent that the airplane was neutrally stable, not necessarily a good thing. In this version, the airplane still had the light control forces, but also definite positive stability, with a phugoid that damped about like any other LSA we've flown. Light elevator forces make steep turns child's play.

Clean stalls—published speed 33 MPH—come with an unmistakable buffet and a clear break. With full flaps—30 MPH—however, there's not much buffet and what there is comes near the break. We used to think that stall horns were for sissies, but recent research we've done into stall accidents convinces us otherwise. In LSAs in general, pilots will need good stall awareness training and the PiperSport is no exception.

CONCLUSION

Demo pilot Bart Jones described the PiperSport as an unsurprising, unremarkable airplane and we would agree with that assessment. It's solidly in the middle of LSA performance and handling. It's not exceptional,

but no slouch, either. Cabin comfort is good, visibility is phenomenal and the avionics package is comparable to the competition, with the exception that it's not nearly as customizable as offerings from, say Tecnam or Flight Designs. In our view, the PiperSport gives Piper an LSA entrant as worthy as any.

CONTACTS

Piper Aircraft, Inc.
772-567-4361
www.piper.com

Mooney K-Model: Goes Fast, Sips Gas

Short on interior space and payload, it rewards proper management with outstanding performance and value.

If age mellows people, the same thing might be said of airplanes, at least if the airplane in question is Mooney's M20K series. The airplane arrived in the GA market at a time when turbocharging was relatively new and the demand for high flying aircraft was thin.

Mooney didn't get the M20K's turbocharging system right on the first try and the airplane developed a reputation as a maintenance hog. Thirty years later, that reputation has been mostly burnished and the fact that the M20K bores along between 160 and 200 knots on relatively little fuel has improved the model's used price.

Still, the cabin is small and with a single door, hard to get into. For that reason and others, Mooneys have a bit of cult status to them. They are in no way everyman's airplane in the way that a Cessna or a Piper is. But if cruising fast yet miserly is your wont, the M20K models—the 231, the 252 and the Encore—are strong contenders.

MODEL HISTORY

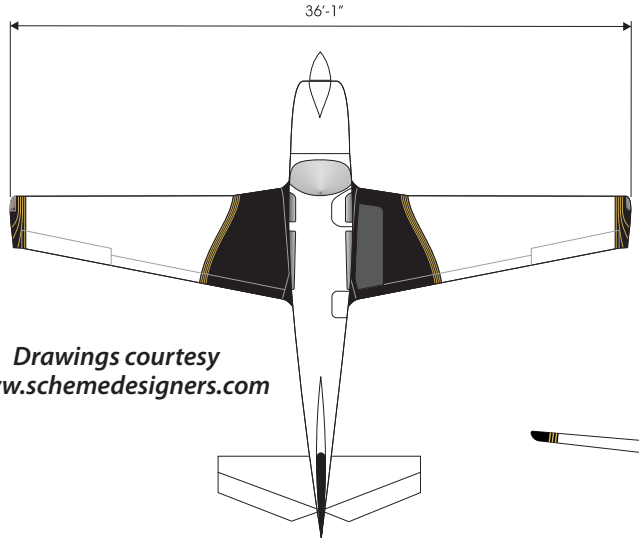
Mooney came into the turbocharging game relatively late compared to other manufacturers. In 1966, Cessna pioneered the market with the T210 and made a strong showing in the single-engine, high-altitude market. Beech brought out the V35TC in 1966, but it was never as strong a seller as the A36. Mooney wasn't completely flat footed during the 1960s, introducing the 310-HP M22 Mustang in 1967, a big brute of an airplane that was as ugly as it was unsuccessful.

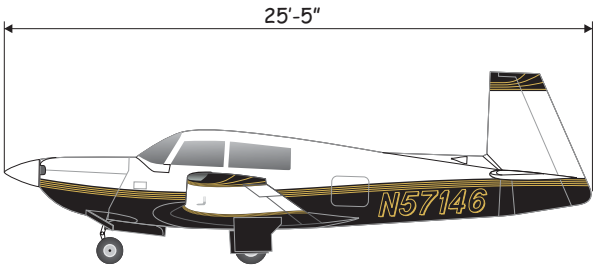
Mooneys have a bit of cult status to them, but their reputation for economical speed is well deserved.

Through the 1970s, Mooney did well with small, efficient airplanes powered by Lycoming four-bangers. Mooney's big breakthrough came in 1977, when the M20J 201 was introduced as the fruit of a clever Roy LoPresti-led aerodynamic cleanup of the venerable F-model. The 201—named for its maximum speed in miles per hour—marked a turning point for Mooney, even if the claimed speed was somewhat optimistic. As early as 1977, Piper had the Turbo Arrow and Mooney realized it needed to compete in this market.

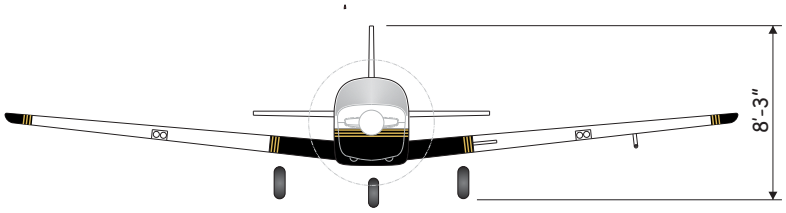
The result appeared in 1979 as the 231—again, named for its top speed—or M20K. It was essentially a 201 with a six-cylinder, 210-HP Continental TSIO-360-GB in place of the 201's 200-HP Lycoming IO-

MOONEY 231/252



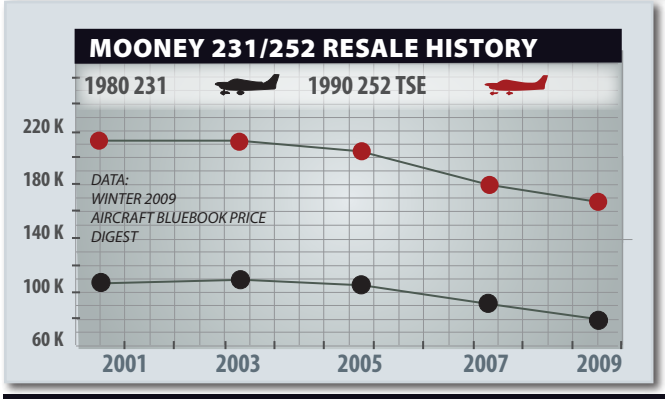


Drawings courtesy www.schemedesigners.com



MOONEY 231/252 MODEL HISTORY

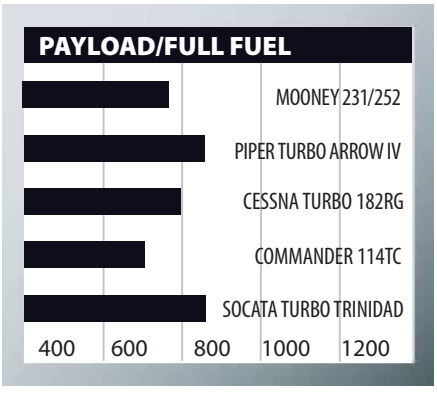
MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1979-1980 231 (M20K)	210-HP TCM TSIO-360-GB	1800	$33,000	75	1100	191 KTS	±$82,000
1981-1983 231 (M20K)	210-HP TCM TSIO-360-GB	1800	$33,000	75	1100	191 KTS	±$87,000
1984-1985 231 (M20K)	210-HP TCM TSIO-360-LB1B	1800	$33,000	75	1100	191 KTS	±$97,000
1985 231 L/M (M20K)	210-HP TCM TSIO-360-LB1B	1800	$33,000	75	1100	191 KTS	±$75,000
1986-1987 252TSE (M20K)	210-HP TCM TSIO-360-MB1	1800	$33,000	75	1100	201 KTS	±$130,000
1988-1989 252TSE (M20K)	210-HP TCM TSIO-360-MB1	1800	$33,000	75	1100	201 KTS	±$150,000
1990 252 TSE	210-HP TCM TSIO-360-MB1	1800	$33,000	75	1100	201 KTS	±$165,000
1997-1998 M20K ENCORE	220-HP TCM TSIO-360-SB	1800	$40,000	80	1100	197 KTS	±$195,000

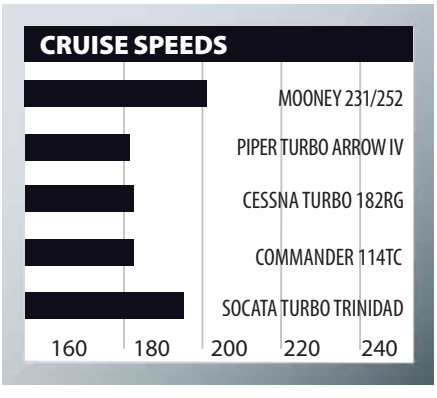


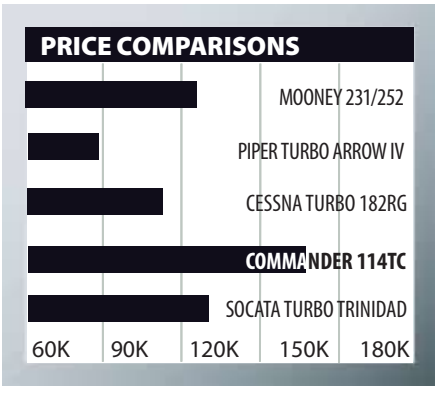
SELECT HISTORICAL ADs

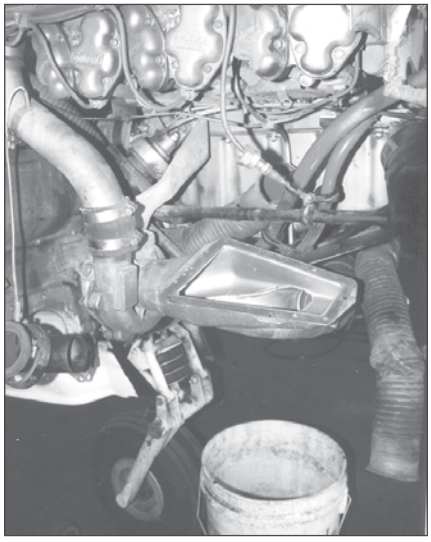
AD 2009-24-52	INSPECT/REPLACE RECENTLY INSTALLED HYDRAULIC VALVE LIFTERS
AD 98-24-11	INSPECT AILERON CONTROL LINKS FOR GUSSET OR CRACKS
AD 98-21-26	INSPECT MAIN LANDING GEAR LEG BRACKET FOR CRACKS
AD 95-17-06	INSPECT ROCKET CONVERSION EXHAUST AND TURBO MOUNT FOR CRACKS

SELECT LATE-MODEL COMPARISONS









The M20K's six-cylinder TSIO-360 developed an early rep as a problem child, thanks to a turbocharger installation that lacked a conventional wastegate, left. Careful owners could reach the advertised TBO, but most require mid-run top overhauls. In elevation view, below, O. Fernandez's 231, the K-model is sleeker looking than the 201 for its longer cowl. Otherwise, the airplanes are nearly identical.

360. The airframe had a lot going for it. It was strongly built of welded 4130 steel, the gear system was all but indestructible and the handling was mannerly, easily flown by a pilot with minimal retract experience. By modern standards, Mooney had a smash hit on its hands. It sold 246 airplanes the first year, outdistancing the 201 by nearly two to one. The fact that the two airplanes were so similar simplified the build process and likely made the project profitable from the first year.

The differences are in minor aerodynamic refinements. The K-model's fuel capacity is 10 gallons more than the J-model, and both empty and gross weights are 160 pounds higher. Design-wise, the 231 was exactly what the buyers were looking for: a turbocharged 201.

But if buyers were hoping for the 201's excellent dispatch rate, they got something less. Problems with the 231's Continental engine were several fold and hurt the model's initial reputation. The new cowling didn't cool the engine adequately; the fixed-wastegate turbo required constant attention and was easy to mismanage; overboosting and high heat put undue stress on the engine, and it was prone to cracking cylinders and cases.

The connecting rods were prone to failure and the original magnetos were unpressurized, and would arc at high altitude. On top of all this, the TBO of the first engines was a miserly 1400 hours, later upped to 1800 hours, where it still stands.

Even with all these faults—and they were considerable—some owners achieved impressive maintenance reliability by obsessive attention to operating technique. Specifically, that meant careful leaning and attention to cowl flaps and preventive maintenance of the turbo. But not all owners were so careful and premature engine crumps were common.

IMPROVEMENTS

With a couple of years of experience under its belt, Mooney undertook some improvements, adding a split rear cargo seat in 1982, while in 1984, a new variant of the engine —the LB1B, which is approved as a replacement for the GB—was introduced with better cooling and overboost protection. Mooney also

The 231 panel, above, is well organized but tight. (This one has been upgraded to look like a 252 panel.) Some shops won't work on them because of the close quarters.

included some aerodynamic tweaks that added 3 to 5 knots: sealed nose gear doors, a belly pan, a more streamlined tailcone and removal of one of the vent intakes. The alternate air intake system changed to address reports of icing-induced power loss.

While these fixes certainly helped, the improvements were hardly night and day. By 1986, further retooling produced the 252TSE for Turbo Special Edition. The 252, while still an M20K, is significantly different from the 231. Another variant of the engine was fitted, the -MB1. The induction and cooling systems were reworked and a new intercooled, density-controlled, variable wastegate AiResearch turbocharger replaced the original, fixed wastegate Rajay/Rotomaster unit. Other changes included infinitely adjustable electric cowl flaps to replace the original dual manual flaps. There was a vernier throttle control, more elbow room and new-look radiused windows.

The 231's original 60-amp, 14-volt electrical system was upgraded to a 70-amp, 28-volt system. This was much needed, since a fully loaded K-model could max out the electrics long before the days of moving maps. An electrically driven backup vacuum pump was made standard equipment.

The 252 also got further aerodynamic tweaking in the form of gear doors that fully enclose the wheels when retracted and cover the wells when the gear is extended. The 252 also got an increase in gear-extension speed to 140 knots, up from 132 knots. Maximum speed with gear extended is 165 knots for the 252. In all, 889 231s were produced between its introduction in 1979 and 1985. The 252, introduced in the middle of the GA slump of the 1980s, is less numerous. Production totaled, ironically, 231 airplanes.

The K-model made a brief resurgence in 1997 as the Encore, when Mooney was going through yet another of its many reorganizations. But it was not to be and the model was dropped again in 1998. Meanwhile, the so-called long-body models, specifically the M20M TLS and later the M20R Ovation and Acclaim eventually came to dominate the Mooney line.

PERFORMANCE

The K-model lives in a league of its own when measured against the narrow market segment of four-place, turbo retractables. At cruise, the 231 outstrips its competitors—the turbo Arrow, the 182 RG and Commander TC—by roughly 20 knots, despite the fact that the 231 MPH (196 knots) top speed isn't reachable under real-world conditions and probably at all.

Realistic max cruise is about 190 knots for the 231, but 170 to 175 knots is more like it. The 252 is about 10 knots faster, thanks to intercooling. Both M20Ks win the

altitude battle as well, with a maximum operating altitude of 24,000 feet for the 231 and 28,000 feet for the 252, versus 20,000 feet for the Cessna and Piper. The Mooneys outclimb the others by about 150 FPM.

Due to physiological considerations, however, high teens to low 20s are the airplane's best envelope. At lower altitudes, turbocharged airplanes aren't much faster than their normally aspirated siblings. In fact, the 231 is actually slower than the 201 below 8000 feet, due to cooling drag. The J-model will also outclimb the K-model below 8000 feet.

Many owners operate 252s conservatively. One owner told us that 65 percent power yields 170 knots at 10,000 feet and 200 knots at FL210, burning 11.5 GPH. The 231's numbers are proportionately lower at high altitudes, although the difference lessens the lower one goes.

With 75.6 gallons of usable fuel, the 252 can climb to FL280 and operate a total of 4.9 hours, or just under 990 nautical miles still-air range with reserves. The 231 has comparable range and endurance, but can't fly as high.

231/252 DIFFERENCES

The improved powerplant installation makes for a significant operational difference between the 231 and 252. The engine still produces 210 HP, but it does so at a markedly lower manifold pressure: 36 inches for the 252 versus 40 inches for the 231, thanks to the improvements in the tuned induction, cooling and turbo systems.

The 252's induction and cooling air intakes are separate from one another. Induction air enters through a NACA scoop on the side of the cowling, is turned 90 degrees to minimize induction icing through inertial separation and passes through a larger, less-restrictive air filter. It's then compressed and run through a 42-square-inch intercooler.

The result is dramatically lower temperatures for the induction air, from 60 degrees F at lower altitudes to 120 degrees F up high. That means more power at higher altitudes and a wider detonation margin. The 231's critical altitude is only 14,000 feet, while the 252's critical altitude is 24,000 feet. In practical terms, this means that the 252 can continue to climb at about 1000 FPM into the mid-20s, can fly higher and is faster once up there.

The most important difference between the 231 and 252 lies in engine management. The revised powerplant installation in the 252 made an enormous difference and makes the 252 a more desirable airplane. Because the 231 has a fixed wastegate, the pilot must constantly monitor manifold pressure and fiddle with the throttle to keep it within limits. Bootstrapping and overboosting are constant worries. Thanks to its automatic wastegate, the 252 doesn't suffer these foibles.

The K-model's baggage compartment is adequate, but hardly generous. The high sill requires a reach to stow stuff.

HANDLING

The 231/252 series handle like typical Mooneys: relatively heavy in roll and pitch, with good stability. The K-models have greater pitch authority, thanks to a slightly larger elevator and the longer engine makes it somewhat nose heavy. That can make flaring a challenge with a forward CG, but nothing like, say, a Cessna 182.

Pitch change with gear extension/retraction is slight, but flap extension produces a nose-down moment. Transition from full flaps to trimmed for go-around takes heavy pressure on the yoke and fast action on the trim. Using the electric trim, anticipation of configuration changes helps reduce pilot effort.

Speed control is essential when approaching and landing any Mooney. Approach too fast and the K-model will float. Try to plant it on the ground and it will fight back, porpoising vigorously and striking the prop if uncorrected. This is a common accident for all Mooneys, not just the K-model.

Because of its ability to fly fast, some owners say the best addition ever devised for Mooneys are speed brakes. These are especially useful for the 231, which doesn't have the 252's higher gear limits. (Speed brakes are standard on 252s.)

Ground handling isn't great. The airplane is low slung and the Mooney's stretched-out seating position hinders visibility on the ground. It also makes gaining purchase on the brakes difficult. The wing span (36 feet, 1 inch), combined with the wide turning radius of 41 feet, makes negotiating a crowded ramp challenging. One other caution: Many Mooneys suffer damage to the nose gear trunion when towing turn limits are exceeded via power towing. Owners learn to watch the ramp rats carefully.

PAYLOAD, CABIN

On paper, the 231 and 252 have the same loading characteristics. In reality, however, the typical 252 weighs more, simply because it has

more equipment. Neither airplane is a stellar load-hauler. Gross weight is 2900 pounds and basic empty weight is 1800 pounds, usually more. Real-world, full-fuel payloads are on the order of 400 to 500 pounds, making the M20K a useful two-place airplane, with generous baggage. Thanks to its fuel efficiency and good endurance, however, there's flexibility built into the load-carrying equation. The latest M20K, the Encore, has about 200 pounds of additional load, thanks to beefed up landing gear. Staying within the CG is easy and there's no worry of aft-tending CG as fuel is burned off.

The baggage compartment is large, with a capacity of 120 pounds, although the high sill door makes it difficult to wrestle large objects into the airplane. Baggage capacity can be increased by folding the rear seat backs down together or individually.

Mooneys are fast and efficient because they have low-drag airframes with a small frontal area. That translates into cramped quarters. The seating position is quite different from that of most airplanes. It's more of a sports-car posture than an upright seating regime. There's plenty of leg room fore-and-aft, but less lateral room. Those of below-average height may find that they can't reach the rudder pedals without a booster cushion behind their backs or pedal extensions.

Early Mooneys tended to be Spartan in interior arrangements. But by the time the 231/252 appeared, Mooney recognized the need for more modern if not luxurious appointments. Thanks to a bit more elbow room and somewhat plusher finish, the 252 is more comfortable than the 231. The 252 is also quieter and many feel it's the quietest of all Mooneys, thanks in part to the induction system and the fact that things quiet down the higher you fly.

The panel layout is quite good, with one seemingly obvious feature that has probably averted many incidents: The gear selector is located high in the middle of the panel so it's hard to miss. The flap switch is located low on the center console, along with the trim/flap indicators and, in the 252, cowl flap controls.

The power gauges are on the far right and angled toward the pilot.

Engine gauges are well-placed, right under the glareshield in front of the pilot. The panel also has a good selection of annunciator lights at the top of the radio stack.

MAINTENANCE

Airframe-wise, Mooneys are relatively trouble-free. Long-standing caveats include the potential for corrosion of the cabin frame tubes—particularly if the windows develop leaks—and the typical fuel tank leaks that plague all Mooneys. Systems in general are simple and robust. The steel gear legs gear have no oleo struts, relying instead on rubber donuts for shock absorption. These need to be replaced periodically. There's no complex electro-hydraulic system driving the gear as is found on Cessnas—Mooneys are electro-mechanical. The flaps, too, are electric, both are relatively trouble-free.

The powerplant, however, is another matter. Difficulties fall into several categories: magnetos, con rods, cylinders and turbos. Most airplanes have been retrofitted with pressurized mags but check any used model to be sure. The same applies to connecting rods. The suspect rods are Continental part number 626119 and have a C logo with a circle around it. Only a barn dweller would still have the old ones.

Many turbocharged models encounter mid-run cylinder problems of some sort and the K-model is no different. These include the full litany: worn valves and guides, broken rings and cracked jugs. Mid-time turbo and magneto replacements aren't uncommon, but they aren't a sure bet, either. The 231's fixed wastegate means the turbo is working constantly and the engine is susceptible to overboosting.

One popular mod that still turns up on the used market is the Rocket conversion—a K-model equipped with a TSIO-520-NB with a three-blade, feathering prop.

The 252 doesn't suffer these problems, although it had trouble with cracked tubes in the induction system before Continental came up with flexible tubing. Even though the 252's engine installation is less troublesome than the 231, temperatures and stresses on turbocharged engines are greater than on normally aspirated engines. Regular inspections and proactive maintenance is a must for reliable dispatch rates.

MODS, CLUBS

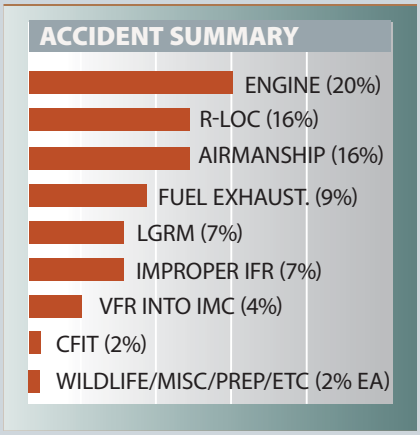
By far the most desirable mods for the 231 are those that make it more like the 252. These include intercoolers from Aircraft Modifications, Inc. (253-851-6440) and the Merlyn Black Magic upper deck controller; contact www.merlynproducts.com or 800-828-7500. Both work as advertised and help eliminate the 231's engine problems. They also make the 231 perform almost as well as a 252. We consider the Merlyn a must-have for the 231.

There are fewer speed mods for the K-model than for earlier Mooney types, such as the C, F and J models. Single-piece belly skins, minor speed mods, rudder and elevator hinge covers and oversized bushing kits for the nose gear are available from Lake Aero Style and Repair (www.lasar.com, 800-954-5619).

Precise Flight (www.preciseflight.

ACCIDENT SCAN: POWER PROBLEMS AND BASIC AIRMANSHIP

We've highlighted the Mooney 231's problematic powerplant, at least as it was before the improved -LB1B and -SB versions became available. Nevertheless, we were a bit surprised to discover the highest single accident category involving 10 years of 231/252 mishaps involved partial or total engine failure. We looked at 45 accidents in the NTSB database for the 10-year period ending in 2009 and came up with nine accidents—20 percent of the total—resulting from full or partial engine failures. That tells us either all the problems with the TSIO-360 installation haven't been worked out, pilots still haven't learned how to operate this engine or a little bit of both. It's something to think about if considering the 231/252.



The next-highest category wasn't a surprise: Our old favorite, runway loss of control (RLOC), which usually results from a pilot's inability to handle a crosswind or unusual landing surface. We actually thought this might be higher, given a Mooney's reputation for being a floater. But perhaps awareness and training have won out.

Still, basic airmanship issues—landing short, or failing to abort a takeoff—are still with us and the 231/252 models aren't immune. The same is true for fuel exhaustion—running out of gas—landing gear-related mishaps (LGRMs) and for improper IFR operations, including trying to fly visually into instrument conditions. Finally, controlled flight into terrain (CFIT), a wildlife collision, failure to remove the engine cowling plugs and other miscellaneous events rounded out our 45 total accidents.

With exception of the engine issues, few of these accident causes can be blamed on the airplane. Which is a surprise of sorts, given the Mooney's reputation for being slippery.

com, 800-547-2558) offers speed brakes for the K-models. LoPresti Speed Merchants (www.speedmods.com, 800-859-4757) has an HID landing light for K-model and hub caps with filler valve access holes.

Mooney Mart claims to sell a range of speed mods, including gear doors and aileron gap seals. Contact www.mooneymart.com or 941-484-0801 to see if these mods are still active. Mod Works, another well-known Mooney house, retains some 39 STCs for Mooneys. However, the facility was wiped out during Hurricane Charley in 2004 and is out of operation indefinitely. Mod Works can still be reached at 941-637-6770.

A big dollar mod, the Rocket conversion, replaces the TSIO-360 with a 305-HP Continental TSIO-520-NB, yielding 220-knot plus cruise speeds. Although the conversion is discontinued, these turn up on the used market. Contact www.rocketengineering.com. The thirstier engine in that mod will benefit from larger fuel tanks. Monroy Aerospace (www.monroyaero.com) has an STC to raise capacity to 106 gallons. Hartzell offers three-blade prop conversions (www.hartzellprop.com).

Currently, there are two Mooney Associations, the Mooney Aircraft Pilots Association and Mooney Owners of America. Both have membership benefits, technical support and magazines. Contact MAPA at www.mooneypilots.com and MOA at www.mooneyowners.com.

OWNER FEEDBACK

In 30 years of flying, I've flown a wide variety of single-engine aircraft. I've always been impressed with Mooneys and previously owned an M20E model. Eight years ago I acquired a turbocharged Mooney 252 and it is without any near comparison, the finest aircraft I've ever flown. Mooneys are known for speed. Professional test pilot data reveals average speeds at 5000 feet of 168.5 knots, 184 knots at 12,000 feet and 191 knots at 18,000 feet.

The 252 is a highly maneuverable airplane and once one masters some of the intricacies of flying a high-performance aircraft, it is easy and forgiving in flight. The only area where it is somewhat unforgiving is in managing approach speed in landing. Mooneys are floaters, so if you are only a few knots too fast in landing, you'll watch the runway sail by underneath while you hang in the air. Also, the 252 is not a big load hauler. If you wish to carry four people you'll either have to put them on a diet or offload fuel.

The M20K -252 comes with speed brakes, built-in oxygen, dual alternators, back-up vacuum system, and prop deice. The TSIO360-MB1 engine in the 252 runs cool, smooth and is one of the easiest engines to start; often one blade of turn.

Unlike the 231, it requires no incremental advancement of the throttle to prevent overboosting. Fuel consumption in cruise is usually 12.8 to 13.1 GPH. Not bad for a high-performance, high-flying speedster. The expense of annuals have varied widely from about $2000 to $25,000, however, my estimate is an average of about $4000 here in the Northeast. There have been no recurring maintenance headaches. Insurance has run $2300 to $2700.

I've had to seal tanks on the 252 and on the earlier M20E, and this is one common fault with Mooneys.

In terms of raw speed, fuel economy, reliability, maneuverability and ability to perform well in a wide altitude envelope, the Mooney 252 simply shines. A total of 231 of these aircraft were built and were then replaced by the slightly faster, less fuel efficient, more maintenance-hungry Mooney Bravo. To cite former Mooney test pilot Bob Kromer, "The 252 is simply one of the top Mooneys ever built."

Bob Motta
Melville, New York

I purchased my 1980 M20K, 262 conversion [231 with MB engine mod] in April 2008 and could not be happier. I wanted a 252 but was deterred by the price, but once I determined the 262 conversion would give me all the 252 capability at a lower cost, I monitored the ads until N231NL came on the market in January 2008.

My main mission is flying from the San Francisco area to the San Juan islands in Northwest Washington, and sought a plane to make the 670-mile flight nonstop and under four hours with two people and minimal baggage.

I fly mid-teens and have been to 19,000 feet on occasion, topping weather. All but local flights are IFR. I climb at 800 FPM at 110 to 120 KIAS, then cruise at 175 KTAS and 13 GPH at 16,000 feet with CHTs between about 330F to 385F.

We stay out of convection, but are often in clouds. It is, after all, the Northwest and ice is a factor year round. The few times that ice accumulation required an escape plan, the turbo performance allowed us to climb back out without a problem.

I previously flew a Mooney M20E, what I would call the Mooney sports car. The 252 is not as quick on the controls as the M20E and has more longitudinal stability, which seems to be just about neutral.

This plane opens up the teens for routine travel, a region practically devoid of other traffic, such that you can go direct most of the time, almost always with no turbulence whatsoever. The payload isn't all that great, but if you're fortunate enough to have a later model 252, there's an STC permitting an increase in gross weight for the same exact engine/airframe combination as my Mooney 262.

Scott Burkhart
Livermore, California

I have been the proud owner a 1986 M20K 252 S/N 25-1024, for the past three years. When I purchased the plane in 2006, it had been grounded with a seized engine and various other mechanical shortcomings. I had the engine removed, rebuilt and reinstalled.

I flew the airplane to Evanston, Wyoming for further reconstruction. The project included new avionics (Garmin 530/430 stack, 330 transponder, 340 audio panel, JPI 930 engine monitor, rebuilt steam gauges), new gear discs, new interior, new windows and a complete inspection and repair of all systems. I have been very pleased with the updates and navigational capabilities of the airplane.

Living in the Mountain West, a turbocharger is a plus, enabling plane and occupants to climb safely above threatening peaks. The 252 is at home here, while its low-altitude performance is acceptable, it was designed to fly high. At 73 percent power and 15,000 feet, the airplane conservatively turns in 180 knots on 12 GPH.

Perhaps the most prevalent complaint I hear about Mooneys is their landing characteristics, and maybe those complaints are well deserved. The slippery Mooney does not lose speed quickly, especially in ground effect. Good speed management and patience are required to avoid a multitude of landing pitfalls..

My biggest complaint is useful load. With full fuel of 74 gallons I have 360 pounds of precious useful load, which too often is not nearly enough.

Annuals have averaged $3000, a bit higher this year because of leaking pushrod tubes. Insurance is in the neighborhood of $2100 annually. Useful load complaints aside, the 252 is a wonderful aircraft. Fast, efficient and predictable. It's always ready to go when I am.

Bob Holt
Salt Lake City, Utah

The Aviation Consumer

New Fuel

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ite tank. Braly said no problems had cropped up.

The fuel's energy density produced some interesting results in the test cell and in the airplane. At equivalent power output, in one case about 319 HP, we noted that fuel flow for G100UL was 26.7 GPH but 28.2 GPH for 100LL.

But because G100UL is heavier, there's a payload hit—it would be about 30 pounds for a 75-gallon fill-up. But you can get the same range for less fuel volume, so the overall impact on range is under 5 percent. With full tanks, range is extended by about the same amount. In other words, G100UL is almost a wash against avgas. You'd hardly need to factor it into flight planning. Swift Fuel is considerably heavier at 7 pounds per gallon. The same 75-gallon tank would be 75 pounds heavier and although Swift also has a higher energy density—13 percent—the volume-against-weight equation means slightly less range. In our view, this isn't a significant operational consideration, either.

WHERE TO?

The FAA doesn't quite know what to do with G100UL, because it's being developed in a sort of business-to-business model and not the historic FAA/Coordinated Research Council network. Braly has proposed to the FAA that G100UL be fast tracked by approving an STC to test it in a limited number of Cirrus aircraft. He argues that these airplanes are equipped with sophisticated engine monitoring, providing no better opportunity for accelerated fleet testing while GAMI pursues ASTM approval.

However, the FAA is pushing back on this idea, preferring to leave all fuel approvals to the ASTM process, which could take months, if not years. Meanwhile, the EPA's lead-regulation clock appears to be ticking.

At this point, it's too soon to declare G100UL the winner of the new aviation fuel sweepstakes. We don't know enough about its formulation and economics. But given that it's petroleum derived rather than biomass derived, it looks for promising for now. The to its future is how fast a testing and refinery project can move forward to prove it out. Or not.

Letters

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service on Cirrus aircraft. A more appropriate price comparison would be to look at Van's Aircraft catalog prices. They sell new Hartzell ASC-II advanced composite propellers to their builders—a three-blade for the RV-10 at $15,220 and a two-blade for the two-place RVs at $10,920.

Yes, it's a bit higher than MT pricing, but the composite structure (carbon fiber and/or Kevlar) of the Hartzell blade is a technically superior product, providing greater durability and repairability than MT's wood structure blades.

The MT meets the dictionary definition of composite being "of two or more materials," but wood probably isn't one of the materials most people would think of when they hear it referred to as a composite.

Furthermore, the MT is not the only prop approved for use on diesel power plants. Hartzell has a composite propeller approved for use on the SMA diesel engine which will soon be added to their STCs. In addition, Hartzell composite propellers consistently win in the Red Bull races, have seen millions of hours of service on regional airliners, such as the Beech 1900, and are used on the high-performance Pilatus PC-21 turboprop trainers.

Finally, in the propeller business, the Hartzell engineering team's ability to mission-optimize the design for any given airplane is second to none, which is why we have more propellers being flown on more aircraft applications than anyone else in the business. But I, too, am biased.

Mike Disbrow
Senior Vice President
Hartzell Propeller Inc.

FEEDBACK WANTED

CESSNA 182

For the June 2010 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the Cessna 182, the all time do-it-all single. We want to know what it's like to own these workhorse airplanes, how much they cost to operate, maintain and insure and what they're like to fly. 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 Skylane by April 1, 2010, to:

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