

The Aviation Consumer[®]

HEADSET FRIENDLY
SUNGLASSES... PG 23



Super Legend

Like the Super Cub, but newer ... page 4



Altitude nags ... page 12



GAMIjectors ... page 8



Turbine conversions ... page 16

8 GAMIJECTORS
A fresh look at precision fuel injectors

15 GARMIN GLO
A nifty little dual-system remote GPS for tablets

20 GLASS-PANEL UPKEEP
It's not just routine inspections, but software, too

12 ALTITUDE MINDERS
It's standard in glass panels, but there are other options

16 TURBINE CONVERSIONS
Performance and reliability at a princely price

24 PRE-201 MOONEYS
A bunch of performance for not much money

EDITOR

Rick Durden

MANAGING EDITOR

Larry Anglisano

EDITORIAL DIRECTOR

Paul Bertorelli

CONTRIBUTING EDITOR

Jonathan Doolittle

SUBSCRIPTION DEPARTMENT

P.O. Box 8535

Big Sandy, TX 75755-8535

800-829-9081

www.aviationconsumer.com/cs**FOR CANADA**

Subscription Services

Box 7820 STN Main

London, ON 5W1

Canada

Back Issues, Used Aircraft Guides

203-857-3100

REPRINTS: *Aviation Consumer* can provide you or your organization with reprints. Minimum order is 1000 copies. Contact Jennifer Jimolka, 203-857-3144

B **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.

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. Copyright © 2012 Belvoir Aviation Group LLC. All rights reserved. Reproduction in whole or in part is prohibited. Printed in the USA.

Postmaster: Send address corrections to AVIATION CONSUMER, P.O. Box 8535, Big Sandy, TX 75755-8535. In Canada, P.O. Box 39 Norwich, ON NO1J1PO, Canada. Publishing Agreement Number #40016479

FIRST WORD

The Turboprop Conversion Market

During my brief time as a freight pilot in the mid-1970s, there were almost no turboprops to be seen. In my corner of the world, it was either piston equipment where, loaded, you sagged into the air and clawed your way to about 8000 feet. That put you in midst of whatever weather was along your route. The only turbine option in those days was 20-series Learjets with their addictive rates of acceleration and climb and the pleasure of looking down at most of the weather.

About the time I was moving on to other endeavors, the first turboprop conversions of the Beech 18 were showing up on the ramp. The big power in a small package of those turbines fascinated me, but how the shoestring operators I knew could afford them was beyond me.

As years went by, I watched the "growler" Twin Beech become a rarity and learned that even with the large initial capital investment of turbine engines, the converted airplanes

were cheaper to operate because of the long engine TBO and, as one operator told me, "I don't have to surround the thing with mechanics after each trip."

It wasn't long before nearly all of the piston-powered working airplanes of Beech 18 size or larger were either converted to turboprops, scrapped or in museums. I wondered if such changes would be coming to smaller machines, Bonanzas, 210s and Malibus.

In 1985, I got to fly a proof-of-concept turboprop conversion of a Cessna P210 and marveled at the sheer performance of the thing: The rate of climb left the piston version in the dust and, down low, it could exceed redline in level flight. At the same time, I learned the grim reality regarding "trickle-down" of turboprop technology to airframes the size of that 210: Specific fuel consumption is significantly higher than piston power and the fuel itself is more than 10 percent heavier than avgas, so it's very difficult to not only find enough room to put the needed fuel, but once you do so, there's precious little weight left for payload.

In addition, because converting to a turboprop also included the never-ending quest for more power, it meant making structural changes to the airframe to handle the horsepower jump and changed vibration/harmonics and flutter environments, an expensive effort.

Yet, there were and are those determined to hang turboprops on smaller airframes. They have pushed the technology and the result, covered in more detail starting on page 16, is that there is a remarkably good selection of load haulers and personal transports.

During volunteer flying in Central America, I became acquainted with a man who owned and flew Soloy-converted Cessna 206s. He was never grounded for a lack of avgas. (Flying pistons, there were times I was parked.) Plus, as one who had spent my share of time sweating takeoffs from short runways in 206s and 207s, watching him blast off and climb out at well over 1000 FPM generated more than a little lust for that kind of performance.

In the utility airplane world, Soloy has found a good mix of power, speed, range and payload.

On the personal transport side, when you compare full-fuel useful loads between piston airplanes and their turbine modified brethren, there's not a heck of a lot of difference. Range is roughly the same, but time to climb and cruise speeds are heavily on the turbine side of the ledger.

I don't know what the future of diesels will be, but in a world where avgas is increasingly hard to find, and where 400 to 500 HP powerplants are desired, there are turboprop mods that fill the bill today. —Rick Durden



Pipistrel Problem

I really enjoy your publication and find it well worth the money. However, I must disagree with your Gear of the Year choice in the July issue.

Flying a Piper Archer II, I drooled over the gas mileage of your best LSA pick, the Pipistrel Virus. So I flew to the SLA showcase in early 2012 at Sebring, Florida



airport to get a closer look at the Virus. Once I got into the pilot's seat, I wondered who would buy this airplane?

To me, it is downright dangerous, as the main wing spar intrudes into the cockpit, crossing just a little bit in front of and above your head. (I am only 5 feet 9 inches.) In a not-too-perfect forced landing, your head could easily be crushed by the impact with the main spar.

I mentioned my concern to the salesman who responded that, "You lean forward in front of the spar just before impact"... then I surmised the back of my head could be crushed as the indeterminate G forces toss my body and head around in milliseconds, seatbelts notwithstanding.

I thought it a silly assumption that I could control where my head was in an uncontrolled crash with water or a fixed object like a tree. I surmise that not even a motorcycle helmet would save my life as my neck would be broken.

In my opinion, this airplane would never comply with the safety portion of FAR Part 23 certification and it certainly does not meet "common sense" certification. (I can just hear fellow pilots at my funeral, "Too bad his head got crushed, but he sure did get great gas mileage while he flew.")

We as consumers must consider all of the possibilities—airplanes do crash, both on land and in the water. And when they do, you may not be in control when you strike a stationary object as the G forces will be just too great. It is sort of like the fool who does not wear his seatbelt

in a car because he thinks he can control how his body will react in accident. Anyone who has been in a bad accident knows the folly of that thinking.

New LSA airplanes are great and viva la innovation, but I have to thank Piper, the FAA and Part 23 certification for really considering—and testing—the crashworthiness of my Archer II.

John A. Valldejul
via e-mail

Our view is that if you want a Part 23 airplane, buy a Part 23 airplane. One purpose of the light sport rule was to simplify certification requirements to reduce cost. Although the intent wasn't to produce less safe airplanes, it's not reasonable to believe an 800-pound airplane will have the same protective structure as one weighing 500 or 1000 pounds more.

Nonetheless, we think your point is a good one. The Pipistrel design is hardly ideal from a crashworthiness perspective, in our view. We should have pointed this out in our coverage.

We contacted Pipistrel for a reply and the company's Tine Tomazic told us the Virus cockpit design is of Kevlar and reinforced composites and the seat belts are designed so that the head passes below the main spar in a crash. Further, Pipistrel argues that the spar's location actually enhances safety because it will stop a tree branch from injuring the occupants. The aircraft's A-pillars/spar cage and collapsible fuselage ribs provide more crash protection.

Stormscope Interface

In your July edition of *Aviation Consumer*, I think you have got one paragraph wrong in the Garmin Retrofit story. "For real-time lightning data, either system accepts input from the proven L-3 WX500 remote Stormscope without enablement."

Maybe I have it wrong, but I have

a G500 with most options, driven by two GNS430W GPSs. I also have an L-3 WX500 Stormscope. The Stormscope data will only show on the GPS screens.

I am led to believe that there is no enablement or option to have the Stormscope data shown on the G500 MFD. Would you please clarify this?

David Curtin
Via e-mail

Larry Anglisano replies: We asked Garmin tech support and they confirmed the WX500 can play on either system without having to buy an enablement/unlock option. Ask your installer if they wired and configured this input.

One More Bike

I enjoyed your bike review in the July issue and for serious riding, I would probably get the Brompton. But at Sun 'n Fun earlier this year, I couldn't resist ordering the cute little Carry-Me from the Aircraft Spruce booth, which arrived courtesy UPS a few weeks later.

It is the lightest bike I know of at 8 KG (18 pounds) and of mostly aluminum construction. Once you do it a few times, it folds and unfolds in a couple minutes. But if

continued on page 32

CONTACT US

Editorial Office

E-mail: consumerEditor@hotmail.com

Subscription Department

P.O. Box 8535
Big Sandy, TX 75755-8535
800-829-9081

Online Customer Service:

www.aviationconsumer.com/cs

Back Issues, Used Aircraft Guides:

203-857-3100
E-mail: customer_service@belvoir.com

For weekly aviation news updates, see www.avweb.com

Super Legend: Lycoming O-233 Debut

With 115 HP and an aggressive prop, the Super Legend rivals Super Cub performance. A cabin door on each side makes it ideal for float flying.

by Paul Bertorelli

Other than having wings, an engine and a tall sticker price, certified and light sport airplanes don't have much in common save one thing: People who buy both will pay for higher performance. And that's the idea behind the new Lycoming O-233-powered Super Legend.

After a fashion, the Super Legend is to the standard Legend as the Super Cub is to a J-3. The Super Legend is based on Piper's venerable PA-18 and, according to Legend's Darin Hart, some of the parts are directly interchangeable. (That's true of the O-200 Legend, too.)




With the Super Legend, American Legend is going after that strata of the market to whom performance, features and cache matter more than price. That turns out to be the dominant share of buyers, according to LSA market summaries. When we visited Legend's Sulphur Springs, Texas factory in late August, it was

in the final stages of LSA approval for the Super Legend. Hart told us despite the higher price tag, every other buyer is opting for the Lycoming version over the Continental O-200 model. In this report, we'll take a look at how the O-233 (and flaps) transforms the Legend airframe.

LIKE A CUB, BUT DIFFERENT

Although sales have been tanked by the downturn, Legend Aircraft has established itself as one of the most successful LSA manufacturers, with about 200 aircraft in the field. The appeal of the airplanes—rag-and-tube construction, tailwheel, sticks and heel brakes—is timeless and not just for those full-circle pilots who learned to fly in Cubs half a century ago and who can afford to get back to their roots with a new airplane. The Cub mystique transcends generational boundaries and Legend has found some buyers among younger

CHECKLIST

-  The O-233's additional power noticeably improves takeoff and climb.
-  Super Cub-style flaps and larger tail surfaces yield impressive slow flight.
-  O-233's inability to run on PMA power at low idle could stand a fix.

pilots, plus some flight schools.

The airplane and the company springs from Darin Hart's interest in seeking a kit Cub for his own use in 2004. When he and future partner Tim Elliott scoured Oshkosh and couldn't find anyone who could deliver a Cub kit in under 18 months, they decided to build their own, direct from Piper's original drawings. Two airplanes led to more ideas, the LSA rule emerged and Legend Aircraft was the result.

The Super Legend is an iteration of the original Legend Cub which is itself based on the Piper Super Cub. The fuselage is three inches wider and instead of one clamshell cabin door on the right, there are two. But the Legend is otherwise nearly a Super Cub clone. The Super Legend is yet closer. At the company's factory, Hart gave us a spinner-to-tail tour of the new airplane.

The most obvious change is the engine. Lycoming announced the

O-233 in 2008, but its developmental pace has been more simmer than rolling boil. Only a handful of manufacturers are offering it and Legend is one of the first. The O-233 is essentially a shaved-down O-235 with the addition of a simplified electronic ignition system in place of heavier mags. It has cylinders with reduced cooling fins to save weight and a redesigned accessory case, the result of having to accommodate just a single permanent-magnet alternator for the ignition system rather than two magnetos. As we reported in the February 2012 issue of *Aviation Consumer*, Precision Airmotive developed a fuel injection system—essentially a downsized Bendix RSA constant flow design—but the Super Legend has a conventional updraft carburetor rather than injection. Hart thinks the injection system would add complexity—and perhaps weight—for no benefit and a potential downside for floatplane ops where quick starts for a short burst of power for docking and water taxi are essential.

As it is, the O-233, at about 209 pounds in the Super Legend, gives away 10 pounds to the O-200 and as much 35 or more to the much lighter Rotax 912 series. At 115 HP, the O-233 has a power density of .55 HP per pound compared to .5 for the O-200. The Super Legend we flew had a new, 76-inch carbon fiber ground-adjustable prop from Sensenich, which felt like it had more bite than the 72-inch prop on the Legend. But the feel could have been due to both the additional power and the prop.

NEW ENGINE MOUNT

The O-233 is hung on a centerline-thrust mount which Hart says is a favorite among owners in Alaska. To improve visibility over the nose, the Super Cub's mount is offset 4 degrees downward, but the Super Legend's is on the longitudinal centerline. This improves performance slightly because less elevator trim moment—and less drag—is required to keep the nose in level flight. It also means that the Super Legend's nose cowling is a few inches higher than it would otherwise be, but in our view, this doesn't hinder-taxi visibility. The Super Legend will eventually be offered as both an amateur-built or E-LSA kit. In the former, a builder could opt for up to 180 HP, says Hart, because



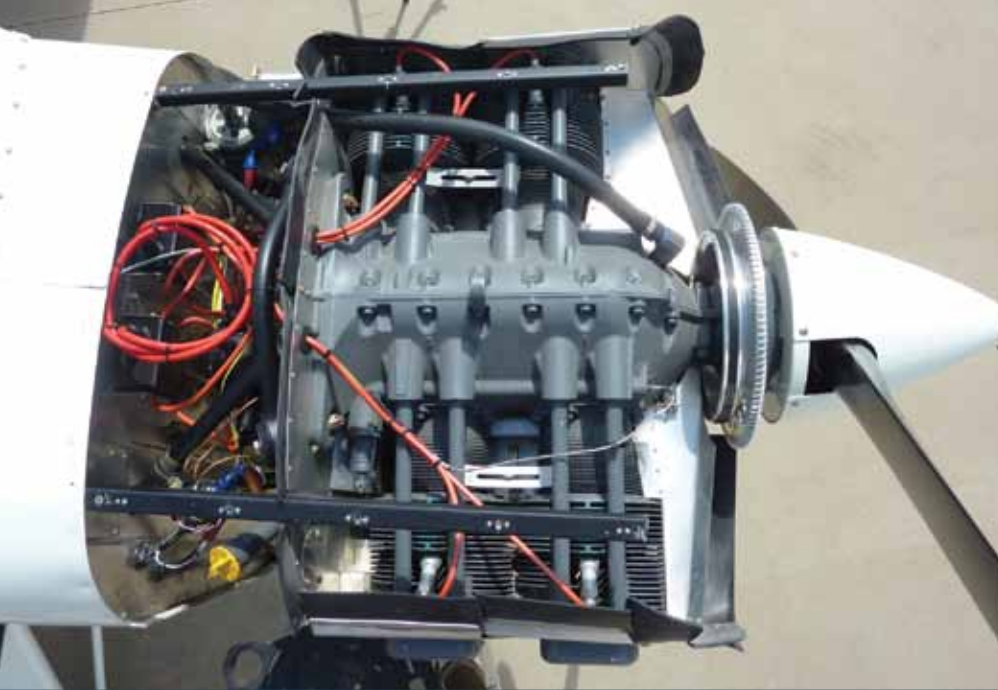
Super Legend's panel, top, has been redesigned to provide more knee room on either side of the center. The airplane's most distinctive feature may be its greenhouse baggage area, right. One weight-saving measure is a novel bungee seat, lower photo. It's comfortable and can be covered in leather or fabric.



the airframe is engineered to accommodate the power. It could also be flown at a maximum weight of 1650 pounds. The airplane we flew had an empty weight of 862 pounds for a useful load of 460 pounds. With two people aboard, that allows for 20 gallons of fuel against the Super Legend's total capacity of 30 gallons usable in two wing tanks. Legend is looking for another 15 pounds of weight in order to accommodate amphibious floats on an empty weight of 995 pounds. One easy place to find that would be to replace the lead-acid starting battery with a lithium-ion battery. (See the sidebar for more.) Elsewhere on the airplane, Legend has trimmed weight at every turn. The two side doors are carbon fiber

as are the floorboards and the engine cowl components. In place of composite or traditional upholstery, the sidewalls are made of sail cloth and simply snapped into place. We also noted that the flap hinge mounts are drilled with lightening holes.

Aft of the rear seats is perhaps the most noticeable change in the airplane, other than the engine. The Su-



The O-233's electronic ignition is on the firewall, under those red wire bundles. The Sensenich carbon-fiber prop is ground adjustable with insertable cartridges, middle photo. The Super Legend has Super Cub-type tail feathers, yielding better pitch authority.



snap-on fabric cover. For now, the baggage compartment—which has a hinged outside door—has a 50-pound limit. But Hart says once final weight-and-balance calcs are done, capacity will increase to 100 pounds, if not a bit more.

Further aft, the Super Legend sports a tail design identical to the Super Cub, meaning it has an aerodynamic elevator whose tip leading edges extend ahead of the hinge line. Overall, the horizontal stabilizer/elevator provides about 18 percent more surface area than the Legend Cub has. This is noticeable in flight.

The Super Legend has some interior changes, too, including a redesigned instrument panel and a novel bungee seat that we found comfortable. The new panel has higher lower edges on each side of the center, yielding more knee room for tall pilots.



per Legend has a greenhouse over the baggage area and a fold-forward rear seat. "That's another Alaska favorite," Hart said. "You can look back and see the tail, you can see what's behind you and what's above you." It also sheds plenty of light into the baggage compartment and into a turtledeck storage area suitable for skis, rifles or fishing poles accessible through a

It's also tilted back slightly to improve viewability of the avionics. Speaking of which, as with most LSAs, you can spec about what you want for electronics in the Super Legend. The choices include Garmin's aera line, the GPSmap 696 or a Dynon Skyview. The demo airplane we flew had the 696, plus a JPI EDM-730, an all-in-one engine monitor that graphi-

cally displays engine temperatures and pressures, OAT, carb temperature and fuel flow, among other data. In short, in a small, colorful package, it displays engine data usually found only in full-up EFIS systems and certainly not something you'd expect to find in a Cub.

While the Legend is soloable from either seat, the Super Legend is front-seat solo only. That's not due to weight-and-balance, but because the fuel selector and ignition switch can't be reached from the rear seat. While the rear seat folds forward for long cargo, the front seat can be adjusted fore and aft via a rail-and-pin arrangement, another upgrade over the standard Legend. Heel brakes remain standard, toe brakes are optional.

FLYING IT

The O-233 doesn't have a primer, but the carburetor has an accelerator pump and one shot on the throttle richens the intake enough for an easy start. We did a couple of hot starts and found them effortless, probably due to the electronic ignition's more energetic spark. But the system does have one quirk: Its default power source is the ship's bus or battery. If that fails, the engine's own PMA takes over to power the ignition system. However, if engine RPM drops below 800, the PMA lacks the output to power the ignition modules and the engine will quit. While that scenario is unlikely, we still see it as undesirable.

Ground handling in the Super Legend requires a touch. From the front seat, the slightest neck crane will deliver good visibility over the nose, so S-turns aren't really necessary. If they're used, however, they should be shallow because if you don't anticipate stopping the turn with opposite rudder, the Super Legend tends to go its own way whether you like it or not. The best technique seems to

be to worry the turn reversal with a touch on the heel brake.

With 15 additional horsepower over the standard Legend, we didn't expect a noticeable performance bump from the Super Legend, but we might have sold it a little short, at least for takeoff and climb. We're not sure if the larger prop was responsible, but the Super Legend has a brisk takeoff roll and requires a surprising stab on the right rudder to keep it tracking straight once the tail comes up.

It will happily climb about 900 FPM at 50 MPH indicated right after takeoff and then settle into 700 FPM at 60 MPH, which is close to best rate. The higher speed yields a better view over the nose, but at either speed, the EDM 730 indicated no hot cylinders during climb.

Handling is not quite like the Legend. With the larger tail feathers, the Super Legend has solidier pitch feel and probably has a higher pitch rate, although we didn't measure it. It definitely requires less fussing with the trim. A couple of turns on the window crank occasionally does it. This was most noticeable in flying takeoffs and landings; the pitch force excursions aren't great enough to require much retrimming. Cruise speeds are about 100 MPH true between 4000 and 5000 feet on a fuel flow of 5.1 GPH, using the JPI's lean find function.

We weren't quite prepared for how slow the Super Legend will fly before stalling. The ASI touched about 20 MPH indicated just as the buffet appeared, but Hart said the tail actually stalls before the wing. The airplane retains mushy roll control with ailerons through the buffet with no tendency to fall off on one wing. Like other LSAs we've flown, the Super Legend has a benign parachute mode.

There's a perceptible pitch change when the flaps are deployed via a manual lever above the pilot's shoulder, but not much trim change. Getting the 18-degree flap notch is easy, but because the lever is located too far aft, cranking it to 45 degrees is almost painful. Hart says he's planning a flap handle



Two Battery Choices

The Super Legend's battery lives inside the cabin, high on the firewall above the rudder pedals. This photo shows a lead-acid starting battery, but the airplane can be equipped with an optional lithium-ion battery. While the Li-ion saves some nine pounds of weight, these batteries also represent a degree of fire risk.

Legend says it's offering Li-ion batteries from Voltphreaks, whose products are equipped with both electronic overcharge and discharge protection. We view this feature as a must in any Li-ion battery used in aircraft and we would also like to see robust thermal containment as a secondary safety feature. Legend says the Li-ion battery costs about \$900. For more on Li-ion batteries, see the August 2012 issue of *Aviation Consumer*.

redesign that will fix that. Landings in the Super Legend were somewhat of a revelation. The original Legend isn't exactly slick, but without flaps, it takes effort to get it comfortably slowed down. That means a bounce—if not several bounces—until you get the range dialed in. Not in the Super Legend. With full flaps, the default speed is 50 MPH indicated unless you aggressively trim it faster.

We were comfortable crossing the fence on a grass runway at 45 MPH indicated and touching down with so little residual energy that landings were satisfyingly agita free.

With a little careful braking, they can also be impressively short. Hart told us he has talked to Piper about bringing back the Super Cub under some sort of

license arrangement. We can see the sense of that.

Although the Super Legend's useful load is limited by arbitrary LSA rules, it's structurally capable of carrying 330 additional pounds—nearly two people. It's apparent why the Super Cub has endured as a popular utility airplane, despite its small size.

The Super Legend's base price is \$146,800, but the typical invoice would likely be \$160,000 to \$170,000, compared to about \$140,000 for a Continental-powered Legend. The LSA market remains anemic at best, but we've learned that if there's any sweet spot to it, it's at the higher end of the price spectrum. Cirrus learned that with the SR22 and American Legend aims to repeat the trick with the Super Legend. In our view, the airplane probably has the stuff to pull it off.

For more, contact American Legend at www.legend.aero or 903-885-7000.



GAMIjectors: Precision Fuel Injection

GAMI's tuned fuel injectors brought lean-of-peak EGT operations to GA. Owners confirm claims of smoother engine and better fuel economy.

by Rick Durden

Back in 1996, when General Aviation Modifications, Inc., (GAMI) of Ada, Oklahoma, announced that it had developed tuned fuel injectors called GAMIjectors, we were skeptical of claims that these gadgets made the engine smoother and more economical through lean of peak EGT (LOP) operation. After all, we'd seen our share of bolt-on engine devices that promised to enhance





engine performance, longevity and cut fuel use than we liked to recall. Few if them worked.

But GAMI was persistent and it published detailed engine operational data which helped sell the product to a pilot community accustomed to "trust-us, it-works" marketing. GAMIjectors developed a strong following, with more than 1000 selling in the first year. Loyal acolytes praised them to the skies, insisting that they were burning less fuel and their engines were running cooler.

A devoted core of skeptics took the opposite view, arguing that owners were going to burn up their engines, cylinder life would be measured



CHECKLIST

-  GAMIjectors allow each cylinder to receive the same amount of fuel.
-  Installation takes less than an hour and one flight to verify fuel flows.
-  GAMIjectors allow lean of peak EGT operation, saving fuel and keeping the engine cooler.
-  To get the benefit of lean of peak operation, an all-cylinder engine monitor is a must.

in double digits and the engine manufacturers would deny warranty claims on modified engines.

But, 16 years later, none of that has happened and GAMI is still selling its tuned fuel injectors. To our knowledge, neither Continental nor Lycoming ever denied a warranty claim simply because GAMIjectors were installed.

According to *Aviation Consumer's* research, owners are almost universally thrilled with the product and many have owned several engines equipped with GAMIjectors. In this article we'll take a fresh look at GAMIjectors and highlight some of the product improvements.

DEVELOPMENT

The idea of tuned fuel injectors came about when GAMI founder George Braly began doing research into why Continental engines tended to run rough, especially as he tried to lean to near peak EGT. What he found was that the fuel injection nozzles, straight from the factory, varied significantly in the amount of fuel each delivered.

Braly also observed that the pipe-and-riser induction system was effective at consistently distributing air to the cylinders, however, it was not

GAMIjectors are sorted by flow rate, upper left. Once installed, a placard on each cylinder identifies the specific GAMIjector for that cylinder.

so good at delivering the same amount of air to each cylinder. Further, the continuous flow nature of the fuel injection system meant that some of the fuel injected

against the closed intake valve of the rear and middle cylinders got carried forward, to the middle and front cylinders, causing the rear cylinders to run leaner and the front richer.

The combination meant significant variations in power output among the cylinders, which meant a lack of smoothness in operation. Further, it meant that when the pilot leaned to find peak EGT, the first cylinder to reach peak usually did so at a much lower fuel flow than the last, sometimes by as much as three GPH. (This difference became known as the GAMI spread.)

George Braly brought in engineer Tim Roehl and together, using some of the most sophisticated test equipment in general aviation, they explored fuel distribution in Continental engines. They found that by assuring there were no induction leaks—which negatively affect air distribution to cylinders—and using fuel injectors engineered to provide precise fuel flows and installing the correct injector in each cylinder, fuel and air flow imbalances among the cylinders could be corrected. This allows each cylinder to produce the same power at the same mixture setting.

BENEFITS

These tuned fuel injectors, GAMIjectors, each installed in its correct cylinder, yielded overall smoother engine operation, lower fuel burns when ROP (none of the cylinders are running over rich) and meant the engine could be run LOP, opening up the full spectrum of engine operation, not just the ROP side of the engine leaning curve.

For the owner interested in installing GAMIjectors, the Website provides guidance, initially directing the owner to run a GAMI lean test, recording the fuel flow at which each individual cylinder peaks. That information is provided to GAMI and which then selects fuel injectors that have been bored and flow tested to

Calibrated reamers (right) are used to obtain the precise inside diameter of a GAMIjector. Each tuned injector is then tested to confirm its output on a flow bench (lower right).



assure specific fuel flows and packages each injector with a small plaque to attach to each cylinder so that the numbered injector is always matched with its respective cylinder.

Installation, under an STC, is carried out by the owner's mechanic and takes less than half an hour, with paperwork. The owner then flies the airplane and conducts another GAMI lean test looking for the fuel flow difference between where the first and last cylinders reach peak EGT. The actual temperature of peak EGT for each cylinder is absolutely irrelevant. The important bit of information is the fuel flow at which each cylinder peaks.

ACCEPTABLE GAMI SPREAD

The GAMI spread should be 0.5 GPH or less if the injectors were selected correctly and there are no induction system leaks.

Our experience with GAMIjectors in a number of airplanes is consistent with what readers report to us: the engine runs more smoothly from taxi through all flight phases.

Once installed with a satisfactory GAMI spread, the initial benefit for owners who run ROP is usually a slight fuel savings, as much as one GPH, because there are no cylinders running way too rich.

What has turned out to be the most valuable application of GAMIjectors is the ability to take advantage of the so-called right half of the engine power curve, and run LOP. Because each cylinder is putting out nearly the same amount of power, the engine will run smoothly and predictably lean of peak EGT, typically saving at least two GPH, according to GAMI customers.

Because of the nature of the power curve (discussed on page 10), the engine also runs significantly cooler LOP and for a given power setting,



the internal cylinder pressure is lower because the power pulse is spread out over a longer period and peaks lower than it would ROP.

GAMI did its initial research on Continental engines, but as the success of GAMIjectors grew, owners asked about installing them on Lycoming engines. Because of the nature of the Lycoming induction system, the fuel/air mixture in each cylinder is more evenly distributed than in Continentals.

GAMI found that some Lycoming engines would run LOP straight out of the factory. Nevertheless, on many, the GAMI spread was significant enough that tuned injectors could bring it down to where the en-

CONTACTS

General Aviation Modifications, Inc.
888-359-4833
www.gami.com



A panel shot during lean of peak cruise (inset, left), showing head temperatures at or below 380 degrees. Full shot of engine monitor (lower left) shows all operating parameters.



imum power is generated. The fact that the very high internal cylinder pressures and head temperatures that accompany this mixture setting is of concern for engine longevity. During the last 16 years, owners who have installed GAMInjectors have consistently reported smoother operation and fuel savings generally in the range of two to three GPH when

operating LOP, lower cylinder head temperatures, greatly reduced lead deposits, fewer fouled plugs and longer cylinder and engine life. Naturally, GAMI has taken to calling this operating "green of peak."

LEAN OF PEAK SUCCESS

We are aware of a number of engines that are running well beyond TBO with LOP operators. Cirrus and Beech call for LOP as standard operating procedures for their piston aircraft. Continental now offers position-tuned fuel injectors.

Reports we get from engine overhaulers tend to be consistent with what we heard from Powermaster Engines in Tulsa, Oklahoma. Owner Bill Cunningham advises that the engines he receives that have been run LOP display far fewer signs of heat distress and lead buildup. He noted that it is not unusual for him to get an engine that did not need to be overhauled.

Another benefit reported to us by users who run LOP with GAMInjectors is that saving some three GPH means that on a four-hour trip, they have 12 more gallons of fuel available as reserve or that they can safely avoid the hassle of a fuel stop. Based on our observations and the com-

gines could be run LOP. Accordingly, in the last several years, GAMInjectors have become available for virtually all Lycoming injected engines.

ENGINE POWER CURVE

A brief digression into the engine power curve is appropriate here. Starting, for example, with the engine running at cruise power with the mixture full rich and then leaning progressively, power output increases to its maximum about 35 degrees rich of peak EGT. It then begins to drop off. Power output at 50 degrees LOP is about 10 percent less than at 35 degrees ROP.

EGT increases to peak and drops off at about the same rate as it increased. Internal cylinder pressures, a critical factor in detonation, increase slowly, reaching their highest point about 40 degrees rich of peak and then drop off rapidly. CHT increases and reaches a peak about the same time as internal cylinder pressures and power output are at their peak, about 40 degrees rich of peak.

The greatest risk of detonation and damage to the engine occurs in a range centered on about 35 to 40 degrees rich of peak EGT. However, that is also the area in which maxi-

ments of readers, we think that an all-cylinder engine monitor is essential for safe operation lean of peak.

COST/BENEFIT

A set of GAMInjectors for a normally-aspirated Continental engine is \$799; for a turbocharged engine it's \$949. For Lycomings the price varies between the four-, six- and eight-cylinder models. See GAMI's Website at www.gami.com for pricing. GAMI holds an STC and PMA for some 300 types of engines.

We also note that using GAMInjectors and running LOP, an owner can safely operate the engine at some 85 percent power because of increased detonation margins thanks to lower temperatures and internal cylinder pressures. On a 300-HP engine, that works out to be a power output increase of 30 HP or 10 percent, according to GAMI claims.

It also means that GAMInjectors create an effective increase in engine power-to-weight ratio. From what we can tell, the last time general aviation had an increase in power to weight ratio was when Cessna developed the turbocharged Models 320 and T210 in the early 1960s. Getting a 10 percent power increase for the price of a set of installed GAMInjectors is not to be dismissed lightly.

GAMI offers a 30-day, no-questions-asked, full-price refund policy. Assuming that a user saves just two GPH and flies 100 hours a year, that means, at \$6 a gallon fuel, the user has saved \$1200, more than the price of purchase and installation of the GAMInjectors.

GAMI reports that it has sold some 22,000 sets of GAMInjectors. While there's no way of knowing how many of those 22,000 sets have been installed and are still flying, if we round the number down to 17,000, use two GPH in savings and cut the flying time to 50 hours per year, at our six-buck-a-gallon fuel, that's some \$10.2 million in fuel savings in the last year. That seems pretty good to us.

Field Survey

GAMIJECTOR FEEDBACK: MOSTLY RAVES

During the 16 years GAMIjectors have been on the market, the product has earned a loyal following composed mostly of Continental owners, but with a smattering of Lycoming drivers, too.

To sample customer satisfaction with GAMIjectors, we published a short survey on our sister publication, www.avweb.com, in early August 2012. We heard from 225 GAMIjector owners, most of whom have owned the product for five years or more.



We would rate customer satisfaction as exceptionally high, with more than three-quarters of the owners who replied to our survey reporting that they would be very likely to buy GAMIjectors again. Nearly as many—69 percent—told us they consider GAMIjectors to be a great value for the cost of buying and installing them.

As GAMI confirms, the market is tilted toward Continental engines and more toward the larger displacement O-520/O-550 engines. In our survey, these engines were owned by about two-thirds of the respondents, while the remainder owned Lycomings (20 percent) or smaller-displacement Continental engines.

When GAMI first introduced its custom injectors, fuel savings were only

part of the marketing pitch, but since lean-of-peak-EGT operation has become standard for many owners—not to mention \$6 avgas—fuel economy has become a driving reason for many owners to purchase GAMIjectors. And for those who fly as few as 50 hours a year, the payback on the investment comes quickly.

According to our survey, 72 percent of owners operate their engines lean of peak EGT and more than half say the fuel savings are at least 3 GPH. But some owners report better economy.

“The only fuel savings option in your survey was 3 GPH. I run 80 to 85 percent power in cruise with my Turbo Cirrus and save much more than 3 GPH,” one owner told us.

Said Scott Dyer, who flies a Cessna 210: “I can’t imagine pouring 17 to 18 GPH through my turbocharged engine when I can fly nicely at 14 to 15 GPH, depending on temperature and altitude. Flying 400 hours a year, that’s an annual savings of at least 400 gallons of fuel.”

Owners told us there are other reasons for running lean of peak that aren’t necessarily obvious: “Cylinder head temperatures are lower. Oil consumption is lower. Oil is cleaner at

oil change,” wrote David Rogers. Adds Brian Conway, “It’s more the ability to increase range than cost savings. The 2 GPH translates to 10 gallons extra reserve after five hours of flight.”

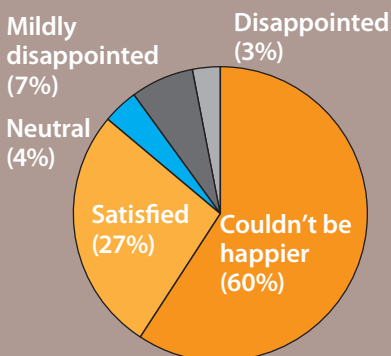
Although owners who took our survey are overwhelmingly impressed with lean-of-peak operation, not everyone is. We heard from skeptics, too, but not many. “In cases where the engine is extremely rough lean of peak, I assumed the GAMIjectors would help. But we noticed they didn’t make much of a change,” reported one owner.

“I do not get consistent temperatures between my cylinders using GAMIjectors. I talked to the factory several times, moved injectors around, but no help,” said owner Greg Holland.

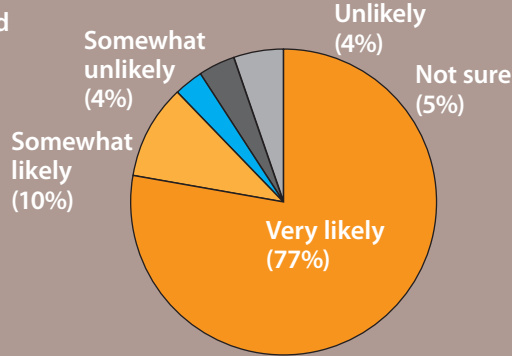
Speaking of the factory, GAMI gets all but unblemished raves about customer support after the sale. “John-Paul at GAMI is great to work with. Just recently, we had a problem with the left engine on our T303 Crusader and he sent us another set of injectors to make sure we had the correct flow. It ended up we had a badly overhauled flow divider from Kelly Aerospace. He let us keep the set and send back the others at no charge. That’s the kind of business I like to do business with,” said Robert Towe.

“The GAMI guys worked with me to diagnose a lean condition that was actually caused by an injector line,” said Dennis Callaghan. “The product works well and the guys know their stuff.”

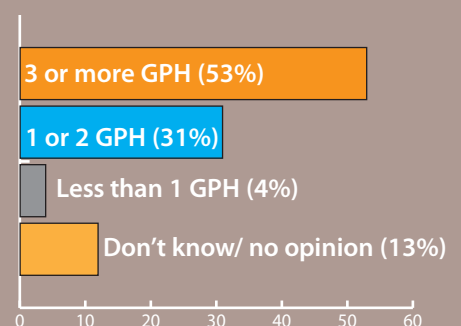
How would you describe your level of satisfaction with GAMIjectors?



How likely would you be to buy GAMIjectors again?



How much do you estimate you save in fuel with GAMIjectors?





Altitude Minders: Portable, Panel Mount

Altitude alerting systems are one defense against altitude busts. We like the Icarus Sam and the S-TEC SA-200 autopilot preselector.

by Larry Anglisano

At some point, many pilots answer to ATC for blowing through an altitude restriction. Altitude busts can be costly and easy to commit—made easier by the distraction of programming complex avionics and falling behind speedy aircraft. Altitude alerting technology comes from the jet world, where climbs and descents happen at a brisk pace. While similar systems are less common in basic aircraft, PFDs and autopilot integration provide helpful altitude bugging, preselect and aural annunciation.

You can also install a dedicated altitude alert system. Here's a look at some worthy choices, including an affordable portable option, autopilot integration and ways you might enhance altitude buffering while using your PFD.

SHADIN AMS-2000

The \$2495 AMS-2000 Altitude Management System is a feature-rich

alerter that dates back to the early 1990s—a long production run that owes to its proven reliability and straight-forward feature set. We like the simplicity of its single function knob, where each press intuitively scrolls through the menu structure. We didn't need to reference the pilot's guide when we flew with the Shadin.

The rectangular, half-inch ATI footprint is rugged and houses a bright LED display for visual alerts, while outputting adjustable audio alerts into the aircraft audio panel. We wish the unit came in a round configuration for mounting in an instrument hole. This could eliminate the space requirement and sheet metal work that's required in many retrofits.

The Shadin displays altitude data in 100-foot increments but connecting to a high-resolution, serial altitude encoder tightens the accuracy to 10-foot tolerance and enables a real-time, instantaneous vertical speed (IVSI) function. Serial altitude

The Shadin AMS-2000 gets high marks for being easy to use, but it only comes in a rectangular footprint. That complicates the installation.

data provides several enhancements, including real-time level-off warnings. These alerts are delivered 15 seconds before reaching a target altitude and are based upon the present rate of climb or descent. Serial data eliminates having to enter a baro setting into the unit. Instead, simply set the airport field elevation and the system automatically calculates the current altimeter setting.

Much of the AMS-2000 data programming is accomplished prior to takeoff. For example, entering a target altitude while on the ground arms the altitude buffering, while entering the field elevation for the destination airport programs gear-down reminders plus MDA and Decision Height alerting. Once airborne, the unit always displays the present altitude, and pressing the control knob twice within one second sets that altitude as the new target altitude.

When approaching your target altitude, the display flashes LEVEL, accompanied by an audio tone to warn that you're 200 feet below the target. If you deviate 200 feet from this target, you're warned with an audio tone and presented on-screen arrows indicating whether to climb or descend to get back on altitude. The Shadin seamlessly connects to most audio systems and has adjustable volume control.

ICARUS SAM

The Icarus SAM Steering Assist Module evolved from the since-discontin-

CHECKLIST

-  Altitude alerters could save you from committing costly altitude busts.
-  The S-Tec SA500 preselector offers good autopilot automation and alerts.
-  AirSport portable is good for renters, but we think it's too big.

ued Icarus AltAlert system. SAM was designed as a GPSS steering system, but has altitude alert functions and other features. The SAM-02 model doesn't have GPSS and functions as a dedicated altitude alert system. Both versions are available in several mounting configurations. There's a round 2.25-inch mount, a half-ATI mount and a standalone, one-inch display that's controlled by remote knobs.

Icarus keeps the alerter function simple with intuitive voice callouts. For example, as you approach a preset altitude of 9000 feet the unit calls out "Approaching 9000 feet." If you blow through it, it warns "Check altitude 9000 feet." A mute switch silences all verbal alerts plus the unit can repeat the last alert, if you were snoozing.

We like that the SAM requires minimal button pushing and menu hopping to set a new altitude. Simply turn the control knob either way to change target altitude in 1000-foot or 100-foot increments. Dialing the reference baro setting along the way is just as easy—simply tap the knob and then turn it to the new setting.

Down low, the SAM offers Decision Height alerting. Serial encoder input enables the unit to measure 10-foot increments—a feature that Icarus says mimics a radar altimeter.

For landing, the SAM offers more helpful features including landing gear check warnings that can trigger when you descend below the destination airport traffic pattern. A time of day clock—that captures the time stamp from a connected GPS—displays in the lower right of the LCD or in other configurable locations.

The SAM display can be configured to show any two of 13 GPS parameters in the upper and lower window. Some of these includes distance to waypoint, ground speed, ground track, time to waypoint, total flight plan time and bus voltage. The SAM-002 has an AML with

Since the AirSport portable alerter monitors your transponder and Mode C replies, it can warn you of failure before ATC does.



The Icarus SAM provides a one-two punch with GPSS and altitude alerting. The S-TEC SA-200 altitude preselect, pictured right, drives the 55X autopilot, providing voice callouts along the way. It's a whopping \$10,666 option.



850 aircraft—including a few Part 23 jets, so no field approvals are required. The SAM with GPSS has a list price of \$2795 and the alerter-only version is \$1795.

AIRSPORT PORTABLE

For plopping on the glareshield, AirSport Avionics makes a line of portable, battery-operated alerters. We tested the \$899 IFR/VFD model and were impressed with its bright, 32-character LCD display and easy-to-use logic. The AirSport—which is available in multiple models based on display quality and operating altitude—has an integral 1090MHz receiver and antenna, which monitors the aircraft's transponder and Mode C replies. This means the unit won't function outside of radar coverage. It also means the unit can offer use-

ful transponder health monitoring, warning of an inoperative system.

The display is divided into six data fields, showing current Mode C altitude, squawk code, target altitude, the difference between present and target altitude and the system's current mode. We found the basic visual alerting prompts—LEVEL, DESCEND, CLIMB—easy to use at a glance. But the system is more than basic. It calculates density altitude, plus vertical speed, which is based on changing Mode C output. It also has an approach mode for gear, DA and MDA alerting. Audible alerts can play in headsets using the supplied adapter or from the built-in speaker.

The only nit with the AirSport is the size of the case. It weighs a bit over one pound and measures 5x5x2 inches—a sizeable presence on every glareshield we put it on, using supplied Velcro mounting pads.

AUTOPILOT AND PFD

One benefit of flying with a PFD is the ability to bug altitudes using



BUSTED! LESSONS FROM THE PROS

Ever have the eye-widening experience of busting an assigned altitude? You're not alone. We thumbed through the NASA Aviation Safety Reporting System database and as we expected, found more recent altitude deviations than we could digest in one sitting.

To our surprise, the pages of reported deviations we read were committed in heavy-iron aircraft—possibly equipped with high-end altitude alerters and piloted by professional and highly experienced flight crews.

The circumstances surrounding some of these deviations included crew distraction and miscommunication, the misreading of charts, misunderstanding departure and arrival procedures, and autopilots that might have been programmed incorrectly. Some were simply the result of sloppy airmanship.

Still, we think investing in any of the alerters reviewed here might reduce workload while offering additional protection against altitude deviations. But like all things avionics, these

devices aren't foolproof. You still need to properly program them and pay attention to their prompts.

Alerters with autopilot interaction require constant crosscheck for correct setup. The good news is all the units we tested are designed for limited programming and data entry.

The buying decision was easy for one pilot we talked with who stepped up to a fast-climbing and pitch-sensitive twin. Since his home airport lies in the shadow of Newark Liberty Airport, which has multiple, local altitude restrictions he'll face on every flight, he's hoping the Shadin AMS-2000 in his panel will keep him out of trouble and out of the NASA ASRS databases.



the altitude tape display and alert function. For example, the Aspen EFD1000 retrofit PFD has an altitude alert field that sits at the top of the altitude tape. When set to a desired target altitude, the alerter illuminates a yellow flag adjacent to the target altitude in the tape, the altitude field illuminates and the PFD outputs an aural tone—depending on rate of climb or descent—at 15 seconds or 200 feet before the target



altitude. If the aircraft deviates more than 200 feet from the bugged altitude, another tone and visual alert is generated. The Aspen PFD can be used for presetting a minimum altitude in a dedicated field below the glideslope indicator. The minimums feature provides visual annunciation using a series of triangular markers on the altitude tape that change color when approaching the set minimum altitude. Garmin's G500, G600 and G1000 PFD systems offer similar altitude bugging functions. Aspen is working on a future inter-

A high-resolution digitizer upgrade like the 35,000-foot-Sandia model pictured left, is a behind-the-scenes box that tightens altitude alerter accuracy to 10 feet.

face where the PFD will command the S-TEC 55X and Avidyne DFC90 autopilot for altitude preselect. The APS4A altitude capturer, from Avionik Straubing, uses the Aspen PFD's alerter outputs to engage the altitude hold mode on a variety of autopilots. Garmin offers altitude capturing in the G500 and G600, commanding the S-TEC 55X autopilot to transition from vertical speed to altitude hold, based on a preset altitude.

Speaking of autopilots, we're fond of the S-Tec SA-500 altitude preselector and alerter. Its easy-to-use control head references an encoding altimeter to command the 55X autopilot. It provides preselected level-off with voice callouts on the way to your altitude. This system is much improved over the lesser ST-360—a selector that, in our view, is user-hostile.

PUTTING IT ALL TOGETHER

We think the AirSport portable would be better if it was smaller. It's a good option for renters, however, and it performed well for us.

For panel-mounting, we favor the Icarus SAM for its GPSS capability and convenient mounting. If money is no object, we recommend the S-TEC SA-200 for driving a 55X autopilot. We're impressed with its voice prompting and accurate command of the autopilot's pitch axis.

If you have a PFD, we think you can skip a standalone alerter. Most retrofit and OEM systems can keep you from busting altitudes with standard features.

CONTACTS

Shadin Avionics
800-328-0584
www.shadinavionics.com

Icarus Avionics
800-320-1971
www.icarusavionics.com

Cobham S-Tec
817-215-7600
www.s-tec.com

AirSport Avionics
866-215-2295
www.airsport-corp.com

Garmin GLO: Dual-System Remote GPS

It kicks up tablet app performance by receiving both GPS and Russian GLONASS. Long battery life makes it a practical accessory.

by Paul Bertorelli

The GPS chips found in consumer-grade products like the iPad seem to suck less than they did two years ago, but there's still a bustling little market for external or remote receivers like the new GLO just introduced by Garmin.

It's called GLO, we surmise, because it's the only remote we know of that receives both the U.S. GPS constellation and the Russian GLONASS system, both of which have 24 satellites on orbit. Garmin says this gives GLO a 20-second faster lock-on compared to a GPS-only receiver and the position update is 10 times per second and 10 times faster than the GPS chips used in most consumer electronics.

With that many satellites in view, marginal position geometry is about impossible, so GLO's signal calc sticks like glue. Whether this really matters or not is debatable, but if you're relying on a smartphone or tablet to navigate, a better GPS engine makes sense if it's cheap. And at \$99 suggested retail, the GLO certainly is.

Right out of the box, the GLO Garmin sent us was charged and ready to rock. Switching it on paired it with an iPad in the time it took to open the settings menu to wake things up. Like other remotes on the market, it links via Bluetooth. Pairing it proved seamless.

The device is small—3 inches by 1.5 inches or about the size of a large electronic key fob. Much of that size is taken up by a lithium-ion battery that Garmin says will power the GLO for 12 hours. It's rechargeable via ship's power or USB voltage.






To keep it from careening bank shots across the glareshield or car dashboard, the GLO has a friction pad. Nice idea, but we found that it works well on smooth, polished surfaces, but not as well on textured material. It held on to the car dashboard, but barely.

GLO is usable with any app requiring GPS, not just Garmin's new Pilot app for the iPad and Android tablets. It will work with any Bluetooth-capable device, including smartphones.

On a flight trial with Pilot running on an iPad, GLO performed as claimed, finding itself quickly and showing no tendency to lose lock when switching from one app to another, the standard test for lobotomizing onboard GPS receivers.

In a future issue, we'll compare it to competing units: the Bad Elf and DUAL offerings. For more, see www.garmin.com.

CHECKLIST

-  Small, light and easy to set up, the GLO is almost foolproof.
-  Receiver is dual system, so it sees dozens of satellites for fast, robust lock-on.
-  What, no ADS-B, no AHRS and no free weather? How pedestrian...

GLO, below at actual size, retails for \$99 and runs on a Li-ion battery with 12-hour endurance. It pairs via Bluetooth and works with Garmin's Pilot app. A friction pad, lower photo, anchors it to glareshield or dash.



Turboprop Conversions: Pricy, Capable

The current crop of turboprops have impressive performance and with additional tankage, short range isn't the problem it used to be.

by Rick Durden

Power and speed—two of aviation's touchstones—have been pursued as long as there have been airplanes and people willing to throw money at them. Aftermarket designers have hung ever-larger piston engines on factory airframes, with varying levels of success, for decades. By the 1980s mod shops were bolting on turboprops in place of reciprocating engines and achieving impressive speeds, despite the challenges of assuring the airframe could handle the horsepower and juggling the fuel/payload equation on the small airframes.

HIGH POWER DENSITY





The small size and high power density of turbine engines makes them

attractive, as does the increasing difficulty of obtaining avgas outside the U.S. However, there's no free lunch; jet fuel weighs .7 of a pound per gallon more than avgas. That adds up because turbine engines have higher fuel specifics than piston pounders.

For each horsepower output, the turbine uses more fuel than does a piston engine. The result is that the light weight of turbines is offset by the need to carry more, heavier fuel to achieve reasonable range. This becomes particularly acute in the relatively small, piston-powered airframes, and their correspondingly small wings and fuel tanks, designed for piston fuel consumption specifics.

Generally, until the airframe reaches the size of a TBM 850, it's

CHECKLIST

-  Increase in power adds substantial performance to established airframes.
-  Ideal for the parts of the world where avgas availability is iffy.
-  High fuel burn rates and fuel versus weight issues can limit range.
-  To get range and speed available, the airplanes must be flown high.

difficult to find enough space to carry sufficient fuel to get practical-range out of a turbine-powered airplane with any useful load left for carrying people.

Nevertheless, persistence has paid off and there are now a number of attractive aftermarket, turboprop conversions of piston airplanes. In this report, we'll look at the better-known ones. The performance data we quote comes from the companies themselves, so we recommend a degree of skepticism. Our experience is that such data can be a trifle optimistic, especially when it comes to cruise speeds and useful loads. We urge prospective buyers to confirm actual empty weights of delivered airplanes, as cabin payload with full fuel is almost always tight on small turboprops.

We note that adding significant horsepower to an airplane usually requires beefup to the airframe and examination of flutter margins so it can handle power never intended by the designers. For example, marketing literature from O & N Aircraft Modifications, maker of the Silver Eagle turboprop-modified Cessna 210, clearly describes the structural changes it makes as part of its upgrade to the airframe.

A Soloy Mark II turboprop conversion of a Cessna 206 on amphibious floats getting onto the step on takeoff.



SOLOY AVIATION

It's easy to get the impression that Soloy Aviation Solutions has been doing turbine conversions since there were turbine engines. While not quite the case, Soloy has been at it for over 40 years, starting with helicopters. In the 1980s, Soloy branched into converting the Cessna 206 and 207 to turbine power, doing so for both land and seaplanes. The Mark I conversion of the Cessna 206 involves installation of a 420 SHP Rolls Royce 250-C20S turboprop. Engine TBO is 3500 hours.

The conversion can be performed on any version of the 206G (last model with Continental engines), although 1979 and later is preferred due to the 28-volt electrical system and 88-gallon fuel capacity, as well as the 206H series (the Lycoming powered models), excluding those with Garmin G1000 glass panels.

Price for the basic conversion is on the order of \$600,000, although we could not get exact details because the price of the engine fluctuates and, when we called Soloy to discuss this article, CEO Dave Stauffer declined to speak with us.

The prop is a full-feathering, non-reversing three-blade Hartzell. Options include a supplemental cabin heater for cold climates, float adapter kit, heavy-duty landing gear and a choice of two aux fuel systems, a 52-gallon Sierra system or 30-gallon Flint tip tank system that also provides a 200-pound gross weight increase. The airplane is approved on amphibious floats.

Gross takeoff weight for the Mark I is 3600 pounds and advertised empty weight is 1908 pounds, giving a useful load of 1692 pounds. Carrying the full 88 gallons of usable jet fuel (590 pounds) means 1102 pounds in the cabin. Not bad for a six-place airplane, although it's not a fill-the-seats-and-fill-the-tanks machine.

At gross weight on a standard day at sea level, Soloy publishes 1063 feet for takeoff distance over a 50-foot obstacle, which is consistent with our observations. Landing over the same obstacle is published at 1094 feet. Max cruise at 8000 feet is stated as 167 knots while burning 30.5 GPH, giving basic VFR range, with 45-minute reserve, of 350 miles and endurance, with 45-minute reserve of just over two hours. Slowing to



The Soloy conversions of the Cessna 206, Mark I (above) and Cessna 207 are approved for amphibious floats or wheels. They use variants of Pratt&Whitney's PT6A free-turbine engine, right.



piston 206 cruise speed of 139 knots pulls the fuel burn back to 21.4 GPH and bumps the range with 45-minute reserve to 440 miles and endurance, with 45-minute reserve, to 3.4 hours.

At FL200, the max operating altitude for the Mark I, max cruise is 156 knots with fuel flow at 20.4 GPH, generating a VFR range of 620 miles and endurance of 4.1 hours, each with 45-minute reserve. As with almost any turboprop, to get range and endurance, higher is better.

We have observed the Mark I Cessna 206 conversion in use in the U.S., Canada and Central America. We note that props on Soloy Mark I conversions of the 206 have about the same degree of erosion as piston 206s, perhaps due to the relatively low prop RPM of the Soloy installation—max RPM is 1810, and taxi RPM is about 1200.

We've also observed that a Soloy 206 on takeoff is far quieter than a piston-powered 206, something important as population pressure continues to affect airports and lakes.

MARK II

In October of 2008, Soloy received the STC for the Mark II conversion of the Cessna 206H series. The

Mark II mod has a Rolls Royce 250-B17/2 developing 417 SHP for five minutes and 322 SHP continuously. TBO is 3500 hours. Props are full-feathering and reversing and feature a choice of either a three-blade Hartzell or five-blade MT; we are quite interested in the noise footprint of the latter installation, as we suspect it's low.

This could be especially valuable as Soloy is marketing a version of the airplane with a law enforcement package where the ability for low-noise loitering at reduced power could be valuable and might make inroads into the law enforcement helicopter market.

Max takeoff weight for the Mark II is the same as the Mark I, 3600 pounds, with an advertised useful payload with full fuel (88 gallons usable) of 1085 pounds. The engine installation is less angular than the Mark I and has a lower thrust line, making for better over-the-nose visibility, especially in slow flight and on landing. Soloy specs show a max cruise of 179 knots at 18,000 feet and 170 knots at 10,000 feet with a max VFR range (45-minute reserve) at max cruise at 15,000 feet of 422 miles.

Published price for the conversion is \$615,000. It is also available on amphibious floats.

Rocket Engineering



Rocket Engineering of Spokane, Washington, uses Pratt & Whitney turboprops to power its Jetprop (upper left) which comes in DL and DLX versions. The PT6 also goes into the Turbine Air conversion of the Beech B36TC Bonanza (above, right) and it's developing the Turbine Cougar Baron (lower right).

TURBOPROP CESSNA 207

Soloy also makes a turboprop conversion for the Cessna 207, using the Rolls Royce 250-C20S engine as in the Mark I, developing 420 SHP with a full-feathering, non-reversing Hartzell three-bladed prop. As with the Mark I, cruise RPM is 1810. Fuel capacity is less than that of the 206, at 73 gallons usable with an optional 52-gallon aux tank system. Soloy certified its turbine mod 207 on floats as well as wheels. The piston airplane is only certified on wheels.

Max gross weight is 4000 pounds, with Soloy publishing an empty weight with eight seats at 2175 pounds. With full fuel (490 pounds), 1335 pounds can be carried in the cabin. There's no zero fuel or max landing weight.

Cruise speed at 10,000 feet is published at 160 knots while burning 24 GPH, so range and endurance is

limited with standard fuel; VFR, with 45-minute reserve, figure on 350-mile range and two hours endurance at 10,000 feet. From what we can tell from Soloy's Website, the price for the conversion is similar to that for the 206 conversions.

ROCKET ENGINEERING

Rocket Engineering of Spokane, Washington, currently carries out turboprop mods for three series of aircraft with a fourth under development. The modifications fall under separate names; we won't try to sort out what company owns what other companies, suffice to say that if you go to www.rocketengineering.com, you'll find further information on all the mods.

If you're seeking a cabin-class single that goes high and flies fast, Rocket Engineering converts the Piper Malibu and Mirage to turbine power. Known as the JetPROP DL (economy) and DLX (performance) and equipped with a Pratt & Whitney PT6A-21 (550 HP) and -35 (560 HP) engines, respectively, the JetPROP series, at some 268 airplanes in the field, is currently the most popular general aviation turbine modification after the DeHavilland Beaver and Otter series, which aren't commonly owner-flown and are beyond the scope of this article.

Published TBO is 3600 hours with the hot section requirement dropped if trend monitoring is used. A four-

blade, reversing, full-feathering prop is standard with operating RPM at 2190, reducing flyover noise significantly. The 5.3 PSI pressurization system of the Malibu is retained. At the FL270 max operating altitude, the cabin is at 9500 feet. The fuel system is modified via a purchased STC from the original 120 gallons to carry an additional 10 gallons in each wing, plus a Rocket Engineering-developed 11.5-gallon header tank in the fuselage, which directly feeds the engine. Usable fuel is 151.6 gallons. Gross weight for the DLX is 4300 pounds or 4350 pounds, depending on the model year of the airplane being converted (ramp weight 4318 pounds), with an advertised empty weight of 2950 pounds. Loaded with full fuel, 350 to 400 pounds can be carried in the cabin.

The maximum landing weight is 4100 pounds, so on any gross-weight takeoff, about 30 gallons of fuel has to be burned off before landing. The zero-fuel weight is also 4100 pounds.

Looking at the DL, the economy version of the JetPROP, climbing to FL250 and operating at max cruise power generates a published true airspeed of 231 knots on a fuel burn of 28.4 GPH.

At that power, VFR range with 45-minute reserve is about 1000 miles. Endurance, with 45-minute reserve, is about 4.3 hours. With that kind of range and endurance, fuel can be traded for cabin weight, making a decent compromise as to number of passengers versus distance to travel. Conversion price for the DL is \$520,000; for the DLX, \$590,000.

TURBINE AIR

Not one to sit on its laurels, Rocket Engineering doesn't limit its work to the JetPROP. It also converts Beech B36TC Bonanzas into the Turbine Air via installation of a 500 HP PT6A-21.

At \$499,000, the airplane has a published cruise speed of 250 knots at FL250 while burning 29 GPH, according to Rocket Engineering. Filling the 128-gallon fuel system generates a max cruise VFR range, with 45-minute reserve, of about 950 miles and endurance of about 3.9 hours.

Max gross weight is 4021 pounds which, with full fuel on top of an advertised standard empty weight of

CONTACTS

Soloy Aviation Solutions
360-754-7000
www.soloy.com

Rocket Engineering
509-535-4401
www.rocketengineering.com

O & N Aircraft Modifications, Inc.
570-945-3769
www.onaircraft.com

2800 pounds, allows 416 pounds to be carried in the cabin.

ROYAL TURBINE

The Royal Turbine is a conversion of the Beech B60 Duke. Two PT6A-35 engines rated at 525 HP are hung on what has long been considered a draggy airframe, turning it into an attractive hotrod.

Thus far, 17 airplanes have been converted to fly at what Rocket shows as a max cruise of 290 knots at FL270. With 45-minute reserve up high, range is about 1000 miles and endurance about 3.5 hours.

Gross weight is 7050 pounds, max landing weight is 6775 pounds and the published empty weight is 4650 pounds. With a total of 260 gallons aboard, 658 pounds can be carried in the cabin. Cost of the conversion is \$980,000.

TURBINE COUGAR BARON

Finally, Rocket Engineering is flying a prototype pressurized Baron conversion it refers to as the Turbine Cougar Baron. It has PT6A-21 engines rated at 500 hp. The company is reporting a max cruise speed on the order of 300 knots. The conversion is currently priced at \$895,000 with certification targeted for the spring of 2013.

O & N AIRCRAFT

By installing a 450-HP Rolls Royce 250 B17F/2 in place of a TSIO-520 on a Cessna P210N and making numerous airframe mods, O & N Aircraft Modifications, Inc., in Factoryville, Pennsylvania, created the Silver Eagle. A total of 96 have been delivered.

It keeps the 3.35 PSI max differential pressurization of the P210 and its max operating altitude of FL230. The standard conversion includes a 26.8-gallon fuel tank in the baggage compartment on top of the standard 90 gallons in the wings, giving 116.8 gallons of fuel. According to the O&N folks, most owners also opt for Flint tip tanks, adding 32.5 gallons of fuel, for a total usable of 148 gallons.

Gross weight is 4000 pounds; our test flight in 2010 showed an empty weight of 2699 pounds. With full standard tanks (no tips), 524 pounds can be carried in the cabin. With the optional Flint tip tanks full, cabin load is 310 pounds. O&N advertises

The O & N Aircraft Silver Eagle conversion of the Cessna P210 is powered by a 450-HP Rolls Royce 250 B17F/2.

a max cruise for the Silver Eagle of about 220 knots at FL220 while burning 22 GPH. During our flight test we observed 180 to 190 knots at 17,500 feet. With 45-minute reserve at max cruise with standard fuel, VFR range is about 850 miles; endurance about 3.9 hours.

Using the optional Flint tip tanks, figure on a 45-minute reserve VFR range of 1175 miles and 5.6 hours endurance, at max cruise. Price to convert an existing P210N is \$839,500 and includes an astonishing amount of work on the aircraft beyond the engine installation, such as a Garmin 600 package for the flight deck; new wiring throughout the aircraft; new, heavier horizontal and vertical stabilizer mounts; dual elevator trim tabs; air conditioning and new interior. O&N provides a one-year warranty on all parts they touch in the airframe, with two years on the engine and avionics.

SILVER EAGLE II

O & N recently obtained an STC to carry out its Silver Eagle conversion on non-pressurized Cessna 210s. O&N advertises a 215-knots cruise at 16,000 feet and a range of 900 miles. While the conversion is similar to a pressurized airframe, total usable fuel is less, 106 gallons and empty weights are lower because the airframe is not pressurized. With the 4000 pound gross weight, about 750 pounds can be carried in the cabin with full fuel, a respectable load.

TURBINE 340

O & N has also installed the same 450 HP Rolls Royce turboprops on a Cessna 340. After four years of work,



the STC was obtained in August 2012. The first airplane has been delivered. At press time, all we know is that the fuel system holds 252 gallons and the price of the conversion, if you provide the airplane, is \$1.5 million.

CONCLUSION

Turboprop conversions are not cheap. Despite turbine engines being significantly lighter than the piston mills they replace, the grim realities of higher specific fuel consumption and heavier fuel mean that the modifiers face a tough task in both finding space to carry sufficient fuel for any kind of range while still being able to carry anything in the cabin.

We like what we see. While we sometimes agonize over range and useful load, each of these airplanes has a reasonable tradeoff between cabin load and endurance. Plus we consider the sheer ability to get up and out because of the extra horsepower to be a significant safety factor.

For those who fly regularly where the avgas supply is iffy or who want a big performance bump and turbine reliability in an airframe that is as familiar as an old boot, these mods are worth serious consideration.



The interface wiring for the MFD in this early-gen SR22 was stressed and required labor-intensive repair. Biennial pitot and static system certification, lower photo, is still required of all glass panels. This usually increases the cost of the inspection.

Glass Panel Upkeep: Inspections, Software

Maintaining glass panels means complying with FAR inspections, upgrading software and swapping pricey sensors. Consider an extended warranty.

by Larry Anglisano

While stepping up to a glass panel may appear to offer lower maintenance bills and downtime, it's just as likely that when the all-in cost of ownership is added up—including data revisions—glass could cost more than a

well-kept steam gauge panel. Glass ownership is fraught with unexpected costs that many owners seem unprepared for.

Routine costs might include optional upgrades, which offer system improvements and additional features. Some of these are free through manufacturer-provided software downloads, but cost several hours of billable shop labor to perform. For aging systems, some repairs could run thousands of dollars, especially if you haven't purchased an extended warranty. In this article, we'll take a look at some of the maintenance issues you might expect with glass panel ownership.

PERCEIVED RELIABILITY

We're often asked if glass panel upkeep is cheaper than traditional instruments. The answer isn't easy and often depends on the existing in-

strumentation. For example, complex autopilot gyros, such as the Bendix/King KI256 Flight Director and KG102A remote heading gyro, might cost thousands of dollars each for overhaul exchange, while a plain-vanilla Sigma Tek horizon gyro might only cost a few hundred dollars, plus labor and freight costs.

When we conducted our glass panel owner survey in 2009, 41 percent of the respondents reported lower than expected maintenance issues. That may not be the case now. To get a feel for more current trends, we recently spoke with several avionics shops and Cessna service centers. All reported an increase in glass panel maintenance issues, including AHARS component failures, software corruptions and engine monitoring sensors. Some attributed the trend to the aging fleet of glass panel aircraft. The dual-screen Avidyne Entegra glass suite appeared in Cirrus and some Piper models around 2003, while Garmin's G1000 was offered in 2005 and beyond. The G1000 easily outnumbers the Avidyne Entegra suite, present in everything from Skyhawks, Bonanzas and Barons to Diamond DA20s. In our survey, roughly 8 percent of Avidyne Entegra owners had major service complaints, compared to roughly 6



CHECKLIST

-  Glass panel instrumentation can be more reliable than steam gauges.
-  Software upgrades and FAR IFR inspections add to the upkeep costs.
-  Without an extended warranty in place, repairs can be expensive.

percent for Garmin owners. We're planning another survey to freshen up those numbers.

If you're eyeing the used aircraft market, destined for an existing OEM-equipped glass panel, we suggest focusing a sharp eye on the system's maintenance history. This should include verifying software and hardware updates, while considering if its been upgraded to WAAS—an upgrade that can have a staggering bottom line, given the required antenna mods, plus GPS receiver and software upgrades that might be required for most systems.

The aftermarket includes a variety of retrofit glass systems, from the stark but technically complex Bendix/King KI825 and Sandel SN3300-series EHSIs to the popular Aspen EFD1000 and Garmin G500 and G600 PFD systems. Each of these systems requires regular maintenance with varying degrees of complexity. They've also evolved substantially. Bringing older flavors up to current standards might yield a sizeable investment. In our view, a thorough avionics inspection should be accomplished by a qualified shop during the prebuy inspection.

AIRWORTHINESS

Did you know that the components in a glass avionics suite need yearly inspection? If not, you aren't alone. An important document that chases a retrofit—and one that's often overlooked—is the Instructions for Continued Airworthiness, or ICAW. This might be found in the systems flight manual supplement and provides specific guidance for maintaining the system on a yearly basis. While the ICAW deals mainly with inspections, it might also address mandatory component replacement.

For example, the internal backup battery in the Aspen EFD must be tested once every 12 months and replaced every 3 years or 800 hours. The RSM, or remote sensor module, that's part of the Aspen system should be visually inspected for damage and wear, including the sensor's lightning suppression strip. In most aircraft, this sensor is bolted to the top of the fuselage where it endures the elements just as antennas do. We suggest looking at it during every preflight walk-around.

The ICAW for most glass suites

There's a lot of software flowing in an integrated panel. The G1000 in this Cessna lost all communications, restored by reinstalling the software files that command the LRUs. The G500 and 600 retrofit PFDs might require similar shop intervention.



provide guidance in checking for damage, chafing or excessive wear of harnesses and structural integrity of remote components. Sound trivial? Think again. We know of an airplane in which the glareshield chafed through the static line going into the Aspen's air data computer, causing failure while flying in IMC. Regular inspection—and a correct installation in the first place—would have avoided this damage.

PITOT-STATIC INSPECTIONS

Forget the rumor that glass-cockpit-equipped aircraft are immune from biennial IFR pitot and static system inspection—FAR 91.411 still applies. Glass panel aircraft usually have pitot-static systems and a traditional altimeter, both of which require certification. Further, most PFD-equipped aircraft have an air-data computer. This remote box or self-contained component within the display, as it is with the Aspen EFD1000 PFD, handles nearly all of the altimetry and airspeed computations, based primarily on pitot and static air input. Air-data computers feed pressure altitude, or Mode C data, to the displays and any other boxes needing pressure-altitude input.

Each manufacturer has its own guidelines and procedures for testing their systems. Aspen has an air-data alignment and calibration tool for its display. If your shop finds that the system is out of tolerance, they'll need to

calibrate it using this software tool.

Since the PFD has both pitot and static inputs, leak-checking is part of the drill. This testing must be accomplished on initial installation and whenever a display is replaced.

Electronic display of flight instrumentation might be more reliable and accurate than old-fashioned steam gauges. But some of this data is only as good as the pitot-static system. For this reason, thorough biennial inspections on glass airplanes are essential.

NAV DATA NITS

Glass panels require no shortage of

WAAS upgrades to OEM and aftermarket glass can be pricey. Antenna replacement could mean sizeable teardown, while the software upgrade that enables vertical guidance on the Sandel SN3308 EHSI costs \$3000-plus.



EXTENDED WARRANTY: WORTH IT?

We think so. That's because the factory flat-rate repair pricing on a single component from your glass suite will likely cost well over a grand to repair—and that doesn't include shop labor to yank the box and reinstall it once it's repaired. That's why an extended warranty could pay for itself in one repair.

Consider a repair to one of the many LRUs in a Garmin G1000 panel. Out of warranty, an exchange can easily push the \$2000 mark. But Garmin's FliteLevel three-year replacement coverage for all of the LRUs—which includes labor—is around \$6000 for basic G1000 suites.

Now that many of Aspen's popular retrofit PFD systems are out of warranty, owners are learning that the \$795 two-year extended warranty is far less than the \$1995 flat-rate exchange cost of a single display.

Avidyne offers more comprehensive coverage options for their product line, including the Entegra glass suite. This FlexCare Service Plan offers one, two or three years of coverage, which can pay for itself in a single repair. For instance, the flat-rate repair on a EXP5000PFD—which is one of two screens in the Entegra suite—is \$3240. That doesn't include shipping or shop labor costs. \$1850 buys you one year of coverage for the entire suite, \$2750 for two years and \$3700 for three years of coverage. Additionally, Avidyne offers several tiers of coverage options, including the Platinum Advanced Exchange program. Under this program, Avi-

dyne picks up the dealer's removal, installation and calibration costs that are associated with a repair event. This is nearly a no-questions-asked policy, where Avidyne ships a replacement component to the dealer prior to the dealer sending the failed component to the factory. This additional service comes at a \$400 premium, which covers freight costs and product expedition. How about display glass coverage? There's an option for that,

too. For \$1300, Avidyne will replace both the main bezel and glass screen assembly for the covered display. We know an owner who trashed both of the display lenses on his Entegra suite by spraying them with commercial-grade glass cleaner. A word of advice to other clean-freaks: don't do this. It won't be covered under any warranty.

As with any extended warranty, there are terms and conditions that you'll need to read carefully. Shop repair of system wiring defects, while rare, usually isn't covered. One potential zinger is the additional \$750 recertification fee that Avidyne will charge if they determine that the returned component is fully functional.

Our advice is to work with a shop that has lots of experience troubleshooting your particular suite. They'll need to get it right or you'll pay.



won't even transfer to his Mac. The Garmin G1000 might be easier to manage, since it uses a single nav data subscription that costs around \$500. You'll also need to consider how often you'll update the terrain and obstacle data. Another glass cockpit owner flagged us down in the Jeppesen tent while at AirVenture. He was elated—sharing his experience of

a successful and ornery haggling session with Jeppesen for the renewal of the data that's required for the Entegra glass suite in his Cirrus. According to him, Jeppesen saved him a few hundred dollars over his existing subscription cost, calling it a show special. Maybe a trip to Jeppesen at one of these shows may be worth your while. Thinking of upgrading your Aspen display

to ESV synthetic vision? This requires a Jeppesen database for mapping the synthetic terrain. It costs a few hundred dollars per year, above and beyond the initial \$2995, per display for the ESV software.

While some of the software updates that are available for a glass suite are provided by the manufacturer for free, most shops charge their standard hourly labor rate to load the software and revise the aircraft paperwork. You should ask about this when you request a software patch.

DO YOUR HOMEWORK

The new owner of a first-generation Cirrus underestimated the upkeep that might be required with the older retrofit glass displays in his airplane. The jaw-dropper came when he upgraded one of his GNS430 navigators to WAAS. Turns out the software level in the Sandel EHSI was incompatible with WAAS, requiring a \$3000-plus software upgrade so it could display GPS VNAV data. Another owner of a G1000-equipped Columbia learned that the unlock card for the onscreen approach plates was missing. It took nearly a year to get this squared away with the previous owner so he didn't have to pay over \$2000 for a new unlock card.

He also learned that working with a maintenance shop that's trained for supporting this complex glass suite is as valuable as the extended warranty he purchased. It's paid for itself in a couple of visits to their shop.

navigational data—a major source of dissatisfaction for most owners we speak with, with Jeppesen taking a brow-beating for the costs of their subscription services. In our last survey, nearly two-thirds of glass cockpit owners said they purchase the revision on a "grin-and-bear-it" basis, while 29 percent termed the revisions worth it and a good value.

We heard from one disgruntled

owner who calculated that his data costs average \$2500 per year. His airplane has dual GNS530 navigators, a GMX200 MFD, Garmin G500 retrofit PFD and a portable GPS. He admits that updating the data in this glass suite is almost too much to manage, given the number of different databases that need to be downloaded and then uploaded into the equipment. Many of the updates



FLYING EYES: HEADSET FRIENDLY

New templeless sunglasses from Flying Eyes get the ache out while enhancing vision and cutting glare.

by Larry Anglisano

We like the combination of our ANR headsets and Oakley M-Frame sunglasses for short trips but not for long, non-stop hauls. That's because the clamping pressure and resulting ache it creates on the noggin is unbearable. Sunglasses maker Flying Eyes has an alternative, with pilot glasses that are designed with webbing straps instead of traditional temples.

We gave them a try and liked what we saw and felt. When we reviewed sunglasses in the December 2010 issue of

Aviation Consumer we judged them, in part, for comfort while wearing headsets. While some brands—including the Oakley M-Frame wrap design—offered exceptional comfort, none were immune to eventual discomfort after hours of headset and temple clamping.



But the adjustable webbing on the Flying Eyes gently wraps around your head and under the tops of your ears. We found the strap to be soft and comfortable. We expected the strap to tug at our hair, but that wasn't the case. Instead, the strap

The Flying Eyes have removable temples that are replaced with straps.

They provide a snug fit without achy clamping.



CHECKLIST

-  Rugged frames, display-enhancing lenses and comfort for long hauls.
-  Interchangeable lenses would offer more versatility.

held the glasses securely on our face without sliding down the nose like traditional glasses do—especially when the face gets sweaty. Speaking of slides, we tested the glasses for ruggedness by accidentally sitting on them as we slid into the seat. They survived this, as well as a slide off the cowling and a drop onto the pavement without damage.

We were impressed with the performance of the non-polarized, shatter-resistant and scratch-resistant polycarbonate lenses. They complemented the crisp color displays in the Cirrus cockpit and helped to cut glare when the sun reflected from the glass. In fact, the lenses provide UV400 protection—the highest UV protection that's available. The lenses are a neutral gray color that we found a bit too dark when the sky and cabin darkened. We think these glasses could be more versatile if they were offered with interchangeable lenses.

Speaking of versatile, the glasses come with traditional temples that are easily converted simply by pressing release tabs on the straps and sliding the temples in place. Selling for \$199 but initially discounted at \$179, the Flying Eyes sunglasses are the result of company founder Dean Siracusa's frustration with the lack of comfort in his own flying missions. He's convinced his new templeless design is the ticket to increased comfort without sacrificing performance or breaking the bank. Based on our testing, we agree.

CONTACTS

Flying Eyes Sunglasses
www.flyingeyes.biz
 888-568-8978

Pre-201 Mooney

Less refined than late-models, earlier Mooney M20s offer economy, speed and sports-car-like appeal.



Owners who have the eventual need for more speed might eyeball the used Mooney market. The search might logically start with the M20J or 201, which first appeared in 1978. While lacking some creature comforts and panel space, these machines are known for having respectable cruise speed, fuel efficiency and simple systems, while delivering the flying sports-car appeal that pilots love about flying Mooneys. If you find an older pre-201 Mooney that's been well maintained, has a low-time engine and the most popular mods, there's a lot to love.

But it's not all roses. Since the biggest numbers of pre-J models were produced in the 1960s, age is a concern, as is Mooney's serial bankruptcy and perceived economic instability, although most shops we spoke with have little trouble getting parts and support. The earliest models had wooden wings.

Some of the rest had corrosion problems, fuel tanks with sealant trouble and an aftermarket bladder

mod from O & M Aircraft that has an AD. Resale value is another issue. The 3700-plus 1977 J and later models, from the 201 onward, keep a lid on the prices of earlier M20s, no matter what their condition, airframe mods and avionics upgrades. But for the owner on a tight budget who wants a fun airplane that's a long-term keeper, a pre-J Mooney answers the call.

While lacking some creature comforts, the pre-201 Mooneys offer excellent speed while sipping fuel.

MODEL HISTORY

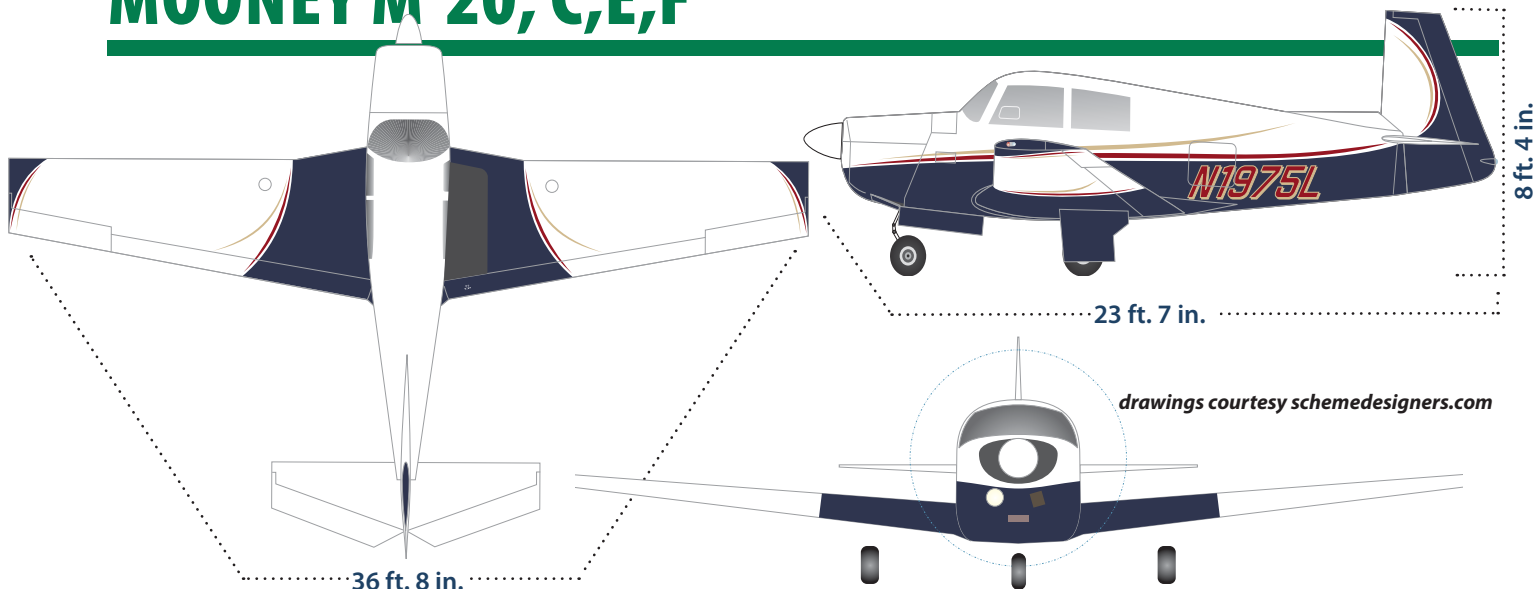
The M20 series evolved in 1955 from Al Mooney's "Wee Scotsman," the Mooney Mite M-18. This is a single-seat, low-wing, speedy little airplane with manually retractable gear cushioned by so-called rubber donuts. Mooney designed it in the 1940s for simplicity, speed and efficiency. In addition to the donut cushions and the Johnson bar for

operating the gear—which would remain an M20 model feature until 1969—the Mite introduced the famous, backwards vertical stabilizer. This backwards stabilizer supposedly improved spin recovery and remains the Mooney's trademark.

The pre-201 Mooneys, launched as a four-seat version of the Mite, are those that came before the Roy LoPresti aerodynamic redesign with the J model in 1977, which boosted cruise speeds about 10 to 15 knots. The first M20, the four-seat Mark 20, built from 1955 through 1958, had a wooden wing and tail. Powered by a 150-HP Lycoming O-320 with a constant speed prop, it gave way in 1958 to the metal-tailed M20A, powered by a 180-HP Lycoming O-360 A1A. It still had the wooden

Says Alex Romero of this 1970 C-model, above: "She does 145 knots on 9 GPH and has taken me to the Bahamas and Mexico. Hard to beat that."

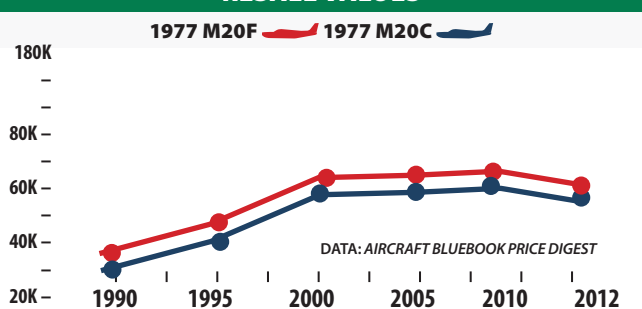
MOONEY M-20, C,E,F



MOONEY M20 MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1955-1957 M20	150-HP LYC O-320-A	2000	\$22,000	35/52	1035 LBS	143 KTS	±\$20,000
1958-1960 M20A	180-HP LYC O-360-A1A	2000	\$22,000	35/52	1010	157 KTS	±\$21,000
1961 M20B	180-HP LYC O-360-A1A	2000	\$19,000	52	925	158 KTS	\$26,000
1962-1968 M20C	180-HP LYC O-360-A1D	2000	\$23,000	52	1050	158 KTS	±\$35,285
1963-1966 M20D	180-HP LYC O-360-A1D	2000	\$22,000	52	1,045	117 KTS	NA
1969-1978 M20C RANGER	180-HP LYC O-360-A1D	2000	\$23,000	52	1050	150 KTS*	±\$45,000
1964-1975 M20E	200-HP LYC IO-360-A1A	2000	\$26,000	52	975	160 KTS	± \$46,200
1967-1977 M20F	200-HP LYC IO-360-A1A	2000	\$26,000	64	1100	156 KTS	±48,555
1968-1970 M20G	180-HP LYC O-360-A1D	2000	\$22,000	52	940	147 KTS	±\$45,600

RESALE VALUES

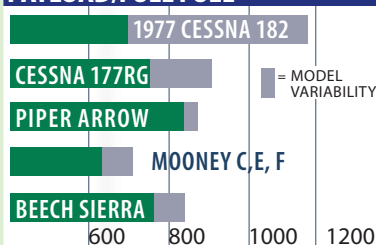


SELECT RECENT ADS

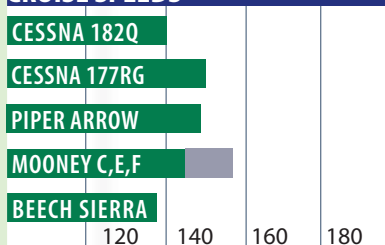
- AD 2012-05-09** TRIM FITTING, HINGE, FILLER PLATE
- AD 2004-25-4** AILERON CONTROL LINK CRACKS
- AD 1985-24-03** FUEL TANK BAYS AND RIB INSPECTION
- AD 1981-15-03** AIR FILTER SCREEN, GASKET FAILURE
- AD 1977-17-04** CONTROL WHEEL SHAFT FAILURE

SELECT MODEL COMPARISONS

PAYLOAD/FULL FUEL



CRUISE SPEEDS



PRICE COMPARISONS

1977 CESSNA 182Q	(\$64,000)
1977 CESSNA 177RG	(\$49,000)
1977 PIPER ARROWIV	(\$64,000)
1977 MOONEY M20C	(\$51,000)
1977 BEECH SIERRA	(\$38,000)

Price points: 25K, 50K, 75K, 100K



Pre-201 Mooneys don't have a lot of panel space, but they've got enough to accommodate most of what you might want. Kier Shapiro's C-model, top photo, has been nicely reworked with a modern panel and leather seats. That's Eric Davis's C-model in the lower photo, with a new panel and modern instrument arrangement.

wing. These two models, of which nearly 700 were built through 1960, had the worst in-flight breakup record of any small airplane and ADs that required inspections of the wing and tail for rot. You can buy one for less than \$25,000, though,

and cruise at better than 140 knots.

The B-model Mark 21, made only in 1961, got rid of the wood and boosted the standard fuel capacity from 35 to 52 gallons. Its metal wing design, with few changes, is still in production. The B quickly

gave way to the most ubiquitous of all M20 models, the C, in 1962. It had an engine change to the O-360-A1D, more rudder travel, a hand-pumped hydraulic flap actuator instead of a mechanical linkage, increased flap deflection and a 125-pound increase in useful load. The C remained in production until 1977. More than a third of the 6200 pre-J M20s were C models.

Mooney's success inspired it to try an economy version: the Model D Master with fixed gear, which cost the design 20 knots or so. Only 60 were made from 1964 through 1966 and it's rare to find one that hasn't been converted to retractable gear. The same year saw Mooney try a pricier package, too. The Model E Super 21 Chaparral introduced the 200-HP Lycoming IO-360-A1A, making it the first of the Mooneys without a carburetor heat control.

In 1965, Mooney introduced its Brittain wing-leveler autopilot as a standard feature on all models, calling it Positive Control because it was always on unless the pilot pressed a disconnect button on the control yoke. No matter how owners felt about this odd system, it probably prevented some graveyard spirals and remained a feature until the 201 came along. Today, the ancient Brittain autopilot may be tough to find service for, although there are some sources for repair.

Known for its tight fit as well as speed, the M20 fuselage got a foot-long stretch with the Model F Executive in 1966. Three were made as that year ended and 536 in 1967, more in one year than any model before or since. Like the C and E, the F remained in production until the paradigm shift of LoPresti's 201. In 1969, they all got one-piece windshields, a popular mod now for earlier models.

The M20G in 1968 matched the C model's 180-HP engine with the longer fuselage and lasted two production years. A more notable and costly loser was the M22 pressurized Mustang. Introduced in 1968, it looked like a tank and helped tank the company, which went bankrupt in 1969. Butler Aviation bought Mooney and stopped production in 1972. Republic Steel bought in and started making Mooneys again in 1974. Republic spun off the design

for a Mooney 301, which Socata built as the TMB700, and merged the company with a French firm in 1984.

There was another bankruptcy in 2001 and another in 2004 followed by reorganizations and a surprising addition to the line around 2006—the M20TN Acclaim—which remains on the company website today. It has a G1000 glass cockpit and blistering speed that some have labeled as the fastest production piston single. Powered by a 280-HP Teledyne Continental TSIO-550G with twin turbochargers and dual intercoolers, it's fast and expensive. If a limited budget has you considering a pre-J M20, you'll lust for this speedster.

MARKET SCAN

The current Bluebook average price range for C models ranges from \$28,000 to \$37,000, \$40,000 to \$42,000 for E models and \$46,000 to \$58,000 for F models. For contrast, when we looked at the market in 2006, a later F-model booked for \$72,000. Nothing quite compares to a Mooney for speed and efficiency but other step-up airplanes that are close in class are generally priced higher. Such is the case for earlier Cardinal RGs, Piper Arrows, and Beech Sierras.

PERFORMANCE

Mooneys are all about getting speed without burning a lot of gas. Most older models have a 180-HP engine and some have a 200-HP fuel-injected Lycoming. The owner who steps up from a Skyhawk to a mid-1960s Model C is going to be fat, dumb and happy watching the world slip under the leading edge at a noticeably higher pace while flight planning for 10 or so gallons per hour.

The pre-1977 Model-C Ranger, for example, cruises at 150 knots, the Bluebook says somewhat optimistically. It has a sea level rate of climb of 860 FPM. Takeoff over a 50-foot obstacle is listed as about 1400 feet and landing over one requires 1550 feet.

Mooneys perform well on 180 HP by having low drag, which requires sacrificing space. It feels like you wear a Mooney and, to some, that's part of its pleasure. There's a sports-car slouch required to slip behind the controls and the



Mooneys aren't really hard to land, but they'll bite if forced on all three wheels with too much speed. The Johnson bar gear handle, right, is reliable, but it takes a touch. Get stuck in mid-stroke and you'll be starting over again.

pilot sits low with their legs stretched under the panel—a possible problem for short pilots. Those used to sitting up high and having a good view out and below will feel a bit claustrophobic. Because the cowling may not be in the pilot's field of view, different sight cues are needed during landings.

These airplanes are rumored for being difficult to land. That may have more to do with poor basic training and bad habits that pilots might get away with in slower aircraft. Still, the Mooney, with its rubber-donut gear, is easy to grease on if the approach is stable, speed on short final no more than 75 knots, the roundout is not made too high and the nose is held off. At higher speeds, its slippery design will float in ground effect. That's where pilots get in trouble, overcontrolling or dropping it on, inducing a bounce, then letting the nose fall through and hit the runway.



That's how pilot-induced oscillations start and woe to the transitioning Mooney flier who dumps the nose on the runway.

In crosswinds, there is also a legend that Mooneys are tricky. Again, good speed control, cross-control technique and judgment make up for any quirks, especially in C and later models, which have more rudder authority than the early M20s.

Short-field operations can be a challenge. Pilots used to Cessna flaps, for example, will find the Mooney's almost absent and, as noted, the airplane will float if ap-

ACCIDENTS: ENGINE FAILURE TOP CAUSE

When we were sifting through 100 pre-201 Mooney wrecks, spread out over a 10-year period, it was apparent that engine failures—30 percent in our survey—would rank at the top of the NTSB accident parade. Part of this may have to do with the old Lycoming O-360 variants that power these old birds. But the NTSB descriptions of shoddy maintenance issues got our attention, making us wonder if owners were skimping on the quality of maintenance.

The engine failure that led to the crash of one C-model Ranger was, according to the NTSB, the result of a connecting rod separation due to its improper installation during major overhaul. The connecting rod in another engine failed after oil exhaustion, while the crankshaft in another failed due to inadequate quality of material and workmanship during the rebuild, said the NTSB. Another engine failure and crash was blamed on a mechanic who signed off an annual inspection without adding oil and installing an oil filter to the engine, while also failing to reinstall the belly skins. So much for preflight inspections. There were other similar mentions of inspection and deficiencies in mechanical work, including an overlooked separated P-lead, and improper inspection of cabin boot-covers—which resulted in a flashlight falling through the floor and jamming the landing gear jack screw. Another engine

had an improperly installed oil pan quick-drain that quickly caused oil exhaustion and engine failure.

As the graphic shows, R-LOC or runway loss of control, brings out the worst in some Mooney pilots, with runway prangs tallying 26 percent of accidents we studied. Many of these were improperly managed crosswinds, botched go-arounds, loss of control and a subsequent uncontrolled trip off the runway on landing, the result of speed mismanagement.

Speaking of uncontrolled trips, we were surprised at the high number of stall/spin events—13 percent—which might prove that pilots need to pay close attention to airspeed, especially when faced with engine failure. Several engine failures occurred on takeoff and initial climb and these resulted in departure stalls and spins.

As simple as the pre-201 fuel system is, some of the crashes were the result of fuel exhaustion, with pilots improperly operating the fuel selector valve plus some boneheaded pilots who simply ran the tanks dry.

Seven percent of the crashes were related to landing gear issues, either collapses the result of hard landings, questionable maintenance practices and pilots who simply forgot to work the Johnson bar. There were also the usual eye-rolling low-flies that met terrain, mid-air and one pilot incapacitation. We found a couple of continued VFR into IMC conditions, as well as a couple of encounters with icing, that resulted in fatalities.

In fact, of the 100 crashes we researched, 26 included fatalities, although there's nothing that leads us to believe the aircraft are inherently unsafe. Still, pre-201 models may be more basic than later models in the Mooney line, but they are still high-performance, complex singles that require skill, judgment and proper maintenance for safe operation.

proach speeds are too high. Speed brakes are a popular mod in later models. The problem with them is a tendency to sink in the pattern and have to drag it in on final. The fix there is to carry more power than you're used to once those brakes are deployed.

Mooniacs, as the devoted call themselves, love the older models with the Johnson bar for operating the manual gear. However, this gear has low operational speeds, so it can't serve as a speed brake for en route descents. It also takes a lot of muscle to retract if the pilot lets the speed build too high on departure.

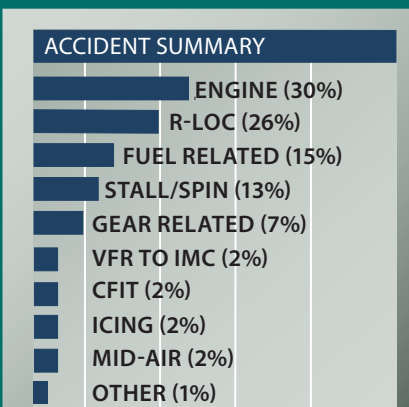
There's not a lot of room in a Mooney, but load-carrying ability is not bad. Squash four people into the airplane, fill the tanks and you're in trouble in most four-seat airplanes. The useful load of a Mark 21 Model C is 1050 pounds not counting any mods and new equipment, which are common on these older models. That leaves, at most, 738 pounds for people and baggage. Pilots have commented that these airplanes are perfect cross-country machines for one or two people and their bags.

Roll response is heavy. The Mooney is controlled with push-rods, not cables, and some pilots like their solid feel. Its heavy aileron feel makes it a good IFR airplane and the Positive Control feature, on those models that have not had autopilot upgrades, is simple and helpful when there's work to do in the cockpit. Cobham S-TEC has an STC for a variety of aftermarket, rate-based autopilots that can add sizeable automation to the cockpit.

Good rudder control to prevent yaw is crucial when practicing stalls in a Mooney. The airflow over that clean wing breaks abruptly and one wing often will drop. Lower the nose, pick it up with aggressive rudder and all will be well. Spins are not for the faint-hearted (or legal-minded). You'll need at least 1000 tense feet to recover.

MAINTENANCE

Pre-J shoppers should study up on a number of issues involving these models and check log-books carefully. For the pre-buy, use a mechanic who really knows Mooneys. Problem number one is the old wood wing and tail. Avoid





it. Problem number two is corrosion in the fuselage tubing. The Mooney is known as a well-built and strong airplane. It has a notably low break-up rate and a virtual roll cage around the cabin. Watch out especially for models built in the late 1960s and early 1970s, before Republic bought the company. Cost-cutting as bankruptcy loomed shortchanged rust-proofing techniques. Be familiar with Mooney Service Bulletin M20-208B from August 1989, which calls for corrosion inspections.

Another common problem is deteriorating fuel-tank sealant that contaminates fuel and causes engine failure. A 1985 AD covers the tanks. Other ADs include one in 2004 for airplanes with the popular O & N bladder fuel cell mod, the result of reports that rainwater was entering the fuel bladders. O & N addresses the fix, explained on their web page.

Over the years, there also have been ADs involving cracked aileron control links, the original Dukes fuel pump, the electric gear, the control wheel shaft, ingestion of air filter screens and gaskets and corrosion in the control rigging and landing gear. There have been few recent ADs, however. Good logbooks or a good mechanic (and perhaps a big check for catch-up work) should be vital to any buyer. Watch out for nose gear damage as a result of line personnel exceeding the turn limits while towing the airplane, which requires a wide radius.

MODS, OWNER GROUP

Lots of help for Mooney buyers

J-model Mooneys had inner gear doors but earlier models have only an outer door, as visible above.

and owners is available on line. Owners can start on the company Website, www.mooneyaircraft.com. It's a good resource for locating other Mooniacs and product links. There's also the Mooney Aircraft Pilots Association, which is partly sponsored by Mooney and Falcon Insurance Company. Visit it at www.mooneypilots.com. The Mooney Owners of America (MOA) claims to be member owned and managed, publishes *Mooney Pilot* magazine and can be visited at www.mooneyowners.com. Although the association has a Website, we're not sure how active it is.

The mods for older Mooneys to make them look and behave just like J and later models are almost countless. Speed mods, one-piece windshields, new wingtips, an alternator to replace the old generator on early models, fuel bladders, larger fuel tanks, speed brakes, new panels to replace the awful old ones, soundproofing and new engines are just some of the improvements available.

Lake Aero Styling (www.lasar.com and 703-263-0412) offers the LASAR line of mods, including a 201-style windshield and wingtips plus a healthy selection of approved, custom-created replacement parts. O&N Aircraft Modifications (www.onaircraft.com, 570-945-3769) sells six interconnected



READER SERVICES

TO VIEW OUR WEB SITE

Visit us at:
www.aviationconsumer.com

FOR BACK ISSUES

See:
www.aviationconsumer.com/backissues

FOR QUESTIONS ABOUT YOUR SUBSCRIPTION:

Phone us at: 800-829-9081

TO CHANGE YOUR MAILING OR E-MAIL ADDRESS, RENEW YOUR SUBSCRIPTION OR TO CHECK PAYMENT STATUS, VISIT OUR ONLINE CUSTOMER SERVICE:

Log on at:

www.aviationconsumer.com/cs

To change your address by mail, attach your present mailing label to this form (or a copy of this form) enter your new address below and mail it to:

THE AVIATION CONSUMER

P.O. Box 8535
Big Sandy, TX 75755-8535

Name _____

Company _____

Address _____

Address 2 _____

City _____

State _____ Zip: _____

E-mail _____

To order or renew a subscription, enter your name and address above and check the subscription term you prefer:

1 year (12 issues) \$69

6 months (6 issues) \$34.50

Check enclosed AMEX

MasterCard Visa

Card # _____

Expiration Date _____

Signature _____

YOUR RENEWAL IS JUST A CLICK AWAY!

www.aviationconsumer.com



Eric Davis transitioned from a Cessna 150 into this 1963 M20C and says, "I couldn't be happier. For the money, there simply isn't anything that can touch it."

fuel bladders to replace the tanks. LoPresti Speed Merchants in Vero Beach is in the game, of course, with a new cowling, gap seals and other fixes (www.speedmods.com, 877-565-1731). Precise Flight offers speed brakes; see www.preciseflight.com, 800-547-2558.

When it comes to avionics—as in most aircraft—anything goes, although the instrument panel and radio stacks in some older models isn't always accommodating for loading lots of gear. Areas of usable space on the outside of the panel are often hindered by available depth behind the panel, with airframe support structure getting in the way. Avionics shops need to get creative during installation and many chide of the so-called Mooney factor when pricing upgrades.

OWNER COMMENTS

I'm an airline pilot and have a 1965 M20C that I use to commute 500 nautical miles, from Topeka to my crew base of Huntsville, Alabama. I chose the Mooney for its low initial and operating costs, relative high speed and high-altitude capability.

These aircraft are well built with pushrod controls—similar to single-seat formula racing cars—

plus a smooth, partial laminar-flow wing. They have reliable, simple, mechanical gear that lack electric motors. My aircraft has most of the available speed mods, which adds a total of roughly 10 knots. The instrument panel has been updated to the post-201 design, with basic T configuration and circuit breakers that are grouped together. It has a Garmin 250XL VFR GPS plus a Hilton ADS-B receiver that's coupled to an iPad. Most of my flights are flown IFR.

This airplane will climb direct to 10,000 feet on a summer day and cruise at 144 knots initially, with 150 knots attainable at lighter weights. I only count block fuel burn, which is 9.4 GPH, averaged over one year. With 50 gallons usable, the airplane has long legs.

For my mission, there is no other certified aircraft that can be had for under \$50,000 that matches the performance and simplicity of these older Mooneys. Although not in the Bonanza class for speed and comfort, a pre-201 is an excellent alternative to current generation light aircraft when distance flying is a requirement.

George R Clark
via-email

The D-model Mooney is often overlooked because almost all of them have been converted to C-models. But there are three known unconverted D models still flying and I own one of them.

While a fixed gear Mooney seems like an oxymoron, it's still a very

capable machine with most of the major Mooney characteristics.

Scott Peterson
Santa Rosa, California

It was a long journey owning N4073N, a 1968 M20C Ranger short-body, with the manual gear Johnson bar. I left it factory stock until I got the Mooney pilots' addiction to speed. I tweaked and modified it so it was essentially a short 201, with a 200 HP engine and all the mods you could possibly install. My advice? Don't do this. Instead, buy the best airplane you can afford because you will never get the upgrade money back during resell.

My unmodified M20C was a great airplane and quite efficient at altitude—burning about 8.5 GPH cruising at 142 knots. I could get into and out of a short, 1600-foot grass strip and was reasonably comfortable in the front seats for any distance traveling.

So why did I sell this good airplane to buy a 1998 M20J Allegro? With the old M20C, my long trips from Connecticut to Florida were made longer, since every flight needed a fuel stop to have fuel reserves using the 52 gallons it held. For comparison, my new 201 holds 64 gallons and burns the same 8.5 GPH at altitude. I can get seven hours of endurance.

The carbureted engine in my M20C, like others, seemed to have uneven fuel distribution, the back seats had minimal leg room that prevented passenger comfort on long trips and the radios were old—until I upgraded them but still didn't have a HSI. The small instrument panel was the non-standard arrangement and this took some getting used to.

The manual landing gear was a low cost and low maintenance system that, if properly greased and limits set, was a joy to use. The lack of speed brakes on the M20C meant that IFR descents required my request for a few descending turns, since the slippery airframe readily picks up the speed in a descent.

The 201 has a quieter cabin, with far better soundproofing and it can travel from my home base in Connecticut to Florida nonstop, unless the winds are against me. The

interior is more modern and spacious and the modern avionics look cool—plus I finally got my HSI and flight director. I do miss the short field performance of my M20C—I need about 500 more feet of runway with my Allegro.

Robert McGuire
via e-mail

I own a 1963 Mooney M20C. I was originally looking at Cherokee 180s as my first airplane but noticed a local ad for a Mooney. I had around 100 hours of piloting time and was worried it would be too much airplane for me. From the moment I sat in it, I knew it was the airplane for me. It has a sporty, Corvette feel when you sit in the seats, since your legs are deep under the panel.

I am 6 foot 3 inches tall and have plenty of legroom, despite the warnings that I am too big to fit in a Mooney. As for handling, the pushrod controls—as opposed to cables—have a solid feedback. I learned that the Mooney has a roll cage, which from a safety standpoint, was appealing. The airplane is solid and mine has a three-blade prop. I never have any trouble slowing it in the traffic pattern, despite all of the stories that say otherwise. However, it's so slippery that it is very common for it to cruise in the yellow arc, unless you pull the power way back.

Since I live about one hour north of Los Angeles and travel to various clients to the south, the Mooney gets me there in 30 minutes, as opposed to two to five hours each way sitting in the notorious traffic. Since the fuel burn is 10 GPH—comparable to an SUV—my clients have no problem paying for my travel time. The aircraft cruises at 135 knots.

There are more mods for these airplanes than any other that I know of. I have quite a few of them, including a model 201 windshield retrofit from LASAR, Wing Root Leading Edge Fairings from LASAR, Cowl Closure Fairing from LASAR, Wing tip Fairings from LASAR, a Vernier Mixture Control mod and the O&N Bladder Fuel System.

The wings of these aircraft are notorious for leaking and there are frequent debates about whether to strip and reseal them or spend

the extra money to buy the retrofit bladders. You can try stripping and resealing and there are a lot of resources online for do-it-yourself people, but I found it too daunting and finally had my mechanic install the bladders.

The cost to insure it is about \$1400 per year for a hull value of \$65,000.

Kier Shapiro
Oxnard, California

I owned a 1969 M20F for about 20 years and was very happy with it. It nearly made book numbers and I would plan for 145 knots at 5000 to 9000 feet. There were a few maintenance surprises, so inspections by someone familiar with older Mooneys is essential to avoid simple problems from becoming bigger ones. There are some good comments on some of the Mooney modifiers' sites, plus excellent sources of information and service from Paul and Sherry Loewen of LASAR.

I learned to fly in Grumman and transitioned to 201s while renting, so the M20F wasn't a problem for me, although I can see where pilots trained in other types would have some adjusting to do. You really want to manage airspeed on approach—trying to force the plane onto the runway just doesn't work. Practicing to get 100 MPH indicated on downwind, 90 MPH on base and stabilized 80 MPH on final make landing much easier.

The full-time Brittain wing-leveler is simple and effective. I never found the need for an aftermarket autopilot. Maintaining the rubber boot aileron servos is not that difficult or expensive compared with all the electrical stuff of later designs.

Corrosion is becoming an issue, typically due to trapped water in the wing and control surfaces. I had to have a flap rebuilt for this reason. Another area for corrosion is the steel tube cabin frame. An AD addresses this and calls for the moisture-trapping insulation to be removed. I upgraded the interior with a kit from Airtex and made sure I looked at every piece of the frame that might trap water.

Doing some maintenance myself

continued on page 32

AVweb+

AVweb's TOP FIVE

- **Podcasts** – *Biweekly podcasts with aviation newsmakers*
- **Brainteasers** – *Put your aviation knowledge to the test with these interactive quizzes*
- **Video of the week** – *Some of the most interesting plane and pilot videos around*
- **Picture of the week** – *A showcase for our readers keen eyes an impeccable taste in aerial photography*
- **The Pilot's Lounge** – *Need we say more!*

All this and more
FREE
at AVweb.com



**SUBSCRIBE
TODAY!**
at
AVweb.com/register

Used Aircraft Guide

(continued from page 31)

helped to keep costs down and offered confidence that all was well inside. Compliance with the landing gear actuator AD takes a bit of a learning curve, as does understanding how to properly adjust the manual gear. You want someone who knows Mooneys to do this every year, or train you, so you can assist. These are not hard processes to master, but having done it a few times will reduce the time required.

If the turning angle limits are exceeded while being towed with a tug, some of the tubes that form the nose gear truss are crushed together. Later models—and replacement parts through STC—have turn stops to prevent this damage. If you spot any dents or deformation in the tubes, the nose gear is likely weakened and can collapse.

David Josephson
via e-mail

I bought my M20C in the middle of my flight training and, against all advice, switched to it from a rented 172 and ultimately got my private certificate in it. It took me a little longer, as it has a constant speed prop and retractable gear. Compared to the Cessna, it's hard to land—with a prop clearance so minimal that landing mistakes can easily lead to a prop strike. I avoided touch-and-go's with this airplane, so landing training took a lot longer.

I acquired the aircraft in September 2009 and paid \$37,000. Annual inspections average \$2000

to \$4000. Fuel consumption runs a consistent 10 GPH, on average.

For mods, I installed the fuel bladders and feel they are a must for every pre-201 to avoid tank re-sealing headaches. Another must is speed brakes, as these are fast machines that are hard to slow down when coming from high altitude.

For looks and more speed, I have a 201 windshield and a one-piece belly skin that saves some dollars during annual. The three-blade prop looks awesome, makes for a quieter cabin and increases climb performance.

What do I love about my Mooney? It's a great value when considering its speed and fuel consumption. It has a beautiful profile and is stable and responsive. On the negative side, it's a bit small and parts are difficult to acquire.

The aircraft's previous owner told me something about how to land this bird, and that's to keep the speed at 80 MPH on final and you'll grease every landing. If you fly over 80, the airplane just wants to keep flying and will bounce. Any slower and you'll get a hard landing.

Daniel Arroyo
via e-mail

Letters

(continued from page 3)

you haven't done it recently, it takes longer to remember the steps.

It is a breeze to pick up or throw in the baggage compartment of my Beech F33A or the trunk of the car.

FEEDBACK WANTED

PIPER ARROW



For the January 2013 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the Piper Arrow, a popular entry-level retractable. We want to know what it's like to own these popular mainstays, 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 Arrow by November 1, 2012, to:

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

Its biggest drawback is a top speed of about 10 MPH. That's adequate for tooling around the airport.

Another is the tiny 8-inch wheels, which means pavement only and then not with very good stability. One reviewer had a bad back and didn't like the forward riding posture.

I think I am going to order the dual-speed version, which goes about 14 mph, but brings the weight up to 9 KG. They are expensive. A single-speed (Model SD) is \$650 while the dual-speed Model DS sells for \$910.

Check them out at www.pacificcycles.com.

Robert Briggs
Los Altos, California