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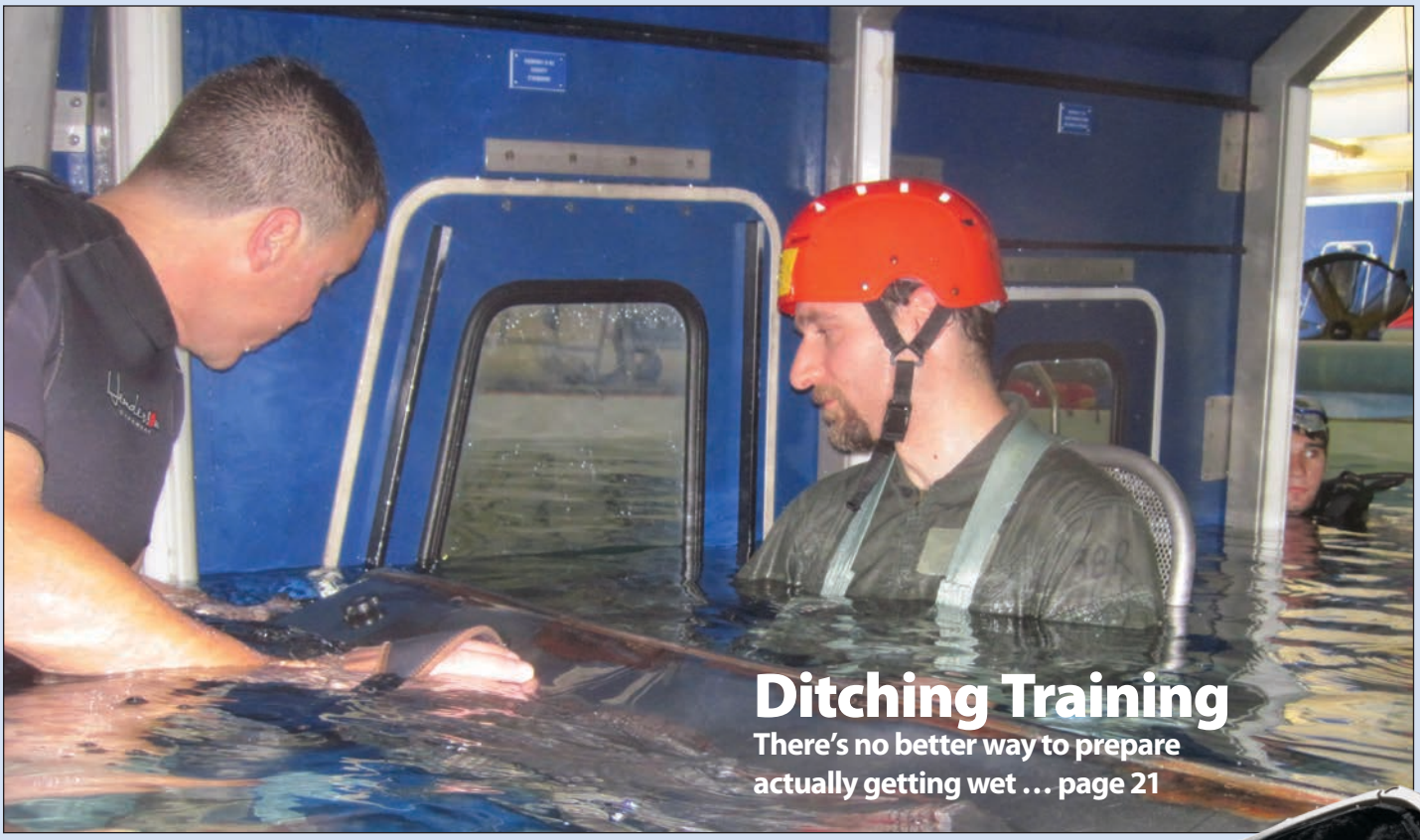
The Aviation Consumer®



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The Aviation Consumer

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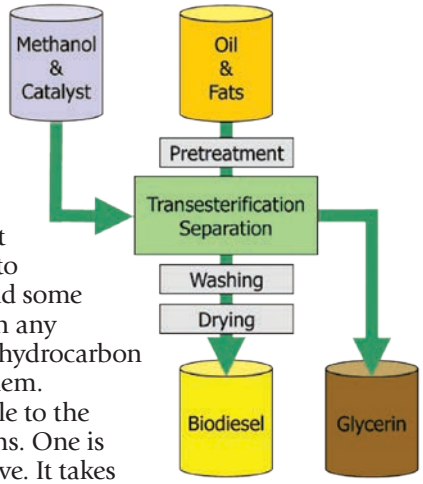
AIRPLANES AND ENERGY: %$#@!&^ AGAIN?

In my continuing quest to assure a fatal overdose of information about avgas, I've been doing wider reading on the oil and energy industries in general. I've plowed through several volumes, but the most intriguing is *The Bottomless Well: The Twilight of Fuel, The Virtue of Waste and Why We Will Never Run Out of Energy* by Peter Huber and Mark Mills. Notwithstanding the ridiculous subtitle no doubt written by some publishing marketer trying to sex up a dense topic, the book challenges basic assumptions about energy and how we use it. It's theoretical stuff, but with reams of production data as factual underpinning.



It leads naturally to a worrying question: When will the world reach peak oil production and what will happen when it does? Huber thinks there's enough oil on the planet locked up in various forms such as tar sands to last a century or more, after which nuclear and some form of solar may be the dominate sources. In any case, there's more cause to worry about what hydrocarbon prices will do and less that we'll run out of them.

Aviation is, no surprise, uniquely vulnerable to the decline of cheap oil reserves for several reasons. One is that as transportation goes, it's energy intensive. It takes a lot more BTUs to move a Cirrus at 200 knots than a Smart Car at 60 MPH. Second, and relating to a critical megatrend Huber and Mills describe, world economies are tilting rapidly toward the purest form of energy—electricity. Just look around. Hybrid gasoline cars are making inroads. Plug-ins that rely primarily on stored grid power, not a combustion engine, are appearing. Almost anything that can be electrified has been or will be. Electricity does far more in the modern airplane than it did even 10 years ago. The Lycoming IE^2 we covered in the August issue has an electric prop governor, an electric waste gate and electrical fueling.

But what it does not have and what we can't see on the horizon is fully electric primary power. The electric airplanes we're seeing now are reflections of the megatrend, but they are years from being anything other than curiosities. For the foreseeable future, airplanes will rely on liquid fuels of some kind. Hydrogen may eventually be a player, but for now, it's gasoline and Jet A, a lot more of the latter than the former, as noted in the chart on page 5 of this issue.

Aviation's third vulnerability is that piston airplanes and biofuels don't mix and if some version of peak oil actually occurs, biofuels will suddenly be not just attractive, but economic in ways that they aren't now.

Take ethanol. (Please, take it…) The ethanol industry is a political distortion having nothing to do with the reality of energy markets. It has been foisted on the country by a political class willing to delude constituents with the misguided notion of energy independence in exchange for pork barrel subsidies. We can't burn it in our airplanes, nor can we use it even if mixed with gas.

Second, biodiesel. It sounds wholesomely green, but as oil prices soar and more of it finds its way into Jet A, the diesels we report on in this issue may be in trouble. Just as conventional airplane engines can't burn E10, aircraft diesels need a minimum cetane fuel. By happy circumstance, Jet A has that, but it's not a required spec. But biodiesel *may* drive cetane down, depending on blends and sources. Jet engines don't care about cetane. Will the aircraft piston market ever be big enough to have the clout to force minimum cetane requirements on a cost-driven airline industry that doesn't care about it? You can easily answer that for yourself.

So, as the budding diesel industry gains momentum, we ought to be thinking now about how all new aircraft diesels can be dual-certified for Jet A and road diesel. We might also think about how to get road diesel onto airports so we don't repeat the mogas fiasco. —*Paul Bertorelli*

Are You Kidding Me?

I've been following the EFB debate for years—often considering but never committing to buy a device to take with me on IFR trips, yet reading everything available on the subject.

I was amused by your "Gear of the Year" awards (July 2010 *Aviation Consumer*) in which you awarded fully three different devices to do the job of plate reading, flight planning and enroute EFB. It seemed as if my own reservations were validated by your conclusions: There just isn't any one device that does the whole job well.

Buy all three? When I'd have to carry paper for a secure backup anyway? While the gadgetophile in me says yes, common sense is saying, "are you kidding?"

Anthony Nasr
via e-mail

Why, of course we are perfectly serious that you should buy all three. What are you, some kind of cheapskate who doesn't want to support aviation?

Where's the Love?

I have had a subscription to *Aviation Consumer* since the early 1980s. I have enjoyed the magazine and I have found the information provided in the magazine over the years to be both helpful and accurate. However, when I read your recent article on the iPad, I was surprised how poorly the author of the article researched the subject.

I have been using an iPad since early May and, as a result, I had been looking forward to the promised review. Unfortunately, when I read the article, I found it to be inaccurate and poorly researched. As I understood the article, the author liked the design and ease of use of the iPad, and its sharp readable screen. However, he was critical of the iPad's size and the difficulty with mounting the iPad in the cockpit.

Unfortunately, had he done his research you would have discovered that RAM has already designed a mounting system for the iPad.

Further, a local pilot in Camarillo recently designed a kneepad for the iPad which is available at the Cardinal Air Center in Camarillo. The other major criticism of the iPad was that it could not be used as a moving map. That is simply not correct. Both WingX and ForeFlight have moving maps. Both companies have recently upgraded their systems specifically for the iPad. I have used both systems in flight and found them to be very accurate when I compared them with the data on my Garmin GNS530W.

The only criticism that I found to be correct was that the iPad cannot update weather during flight. However, the product has been on the market for two months and I have little doubt that within the near future, inflight weather will be available for the iPad.

I very much enjoy the magazine, but this time I think you got it wrong.

Gary Jacobs
Ventura California

Paul Bertorelli replies: *Just off the phone with Van West talking about the iPad. He had lots of four-letter words for Steve's perfect little jewel, so suffice to say neither of us will be mistaken for fan boys.*

By the way, we mentioned the RAM mount in the caption on page 10. We're told by them it's still not available. As for the map, ForeFlight is still downplaying it for that purpose.

Here's the Love

I got a huge laugh out of your comment and examples regarding typing on the iPad in the current *Consumer.*

I have the exact same problem with my iPhone and often accomplish the duplicates of your examples. Great writing, as usual!

King Sims
via e-mail

Belly Rub

I read your article on belly degreasers with great interest, since I owned a Cessna 310Q for 14 years which has under-the-wing exhaust tubes that are very hard to clean.

You failed to include the "Gojo Original Formula Hand Cleaner" which I found to be the most effective cleaner of them all, far easier to use and more effective than Carbon-X .

You just dip a paper towel into the cleaner and rub off the exhaust stains, oil stains, whatever. It leaves a nice glossy sheen and it does not harm aluminum or paint.

Mike Busch of Savvy Aviator is the one who pointed this product out to me, and I completely agree with him that it is by far the best, most easy-to-use cleaner. A 4.5 pound jar costs about $10 and is available at most automotive parts stores.

Rolf H. Scholz
via e-mail

CORRECTION

In the August 2010 report on the Lock and Key Navajo mod, we incorrectly reported that the quoted price doesn't include the cost of the airplane. However, the price does include the aircraft and will thus be different for an owner who already has a candidate aircraft.

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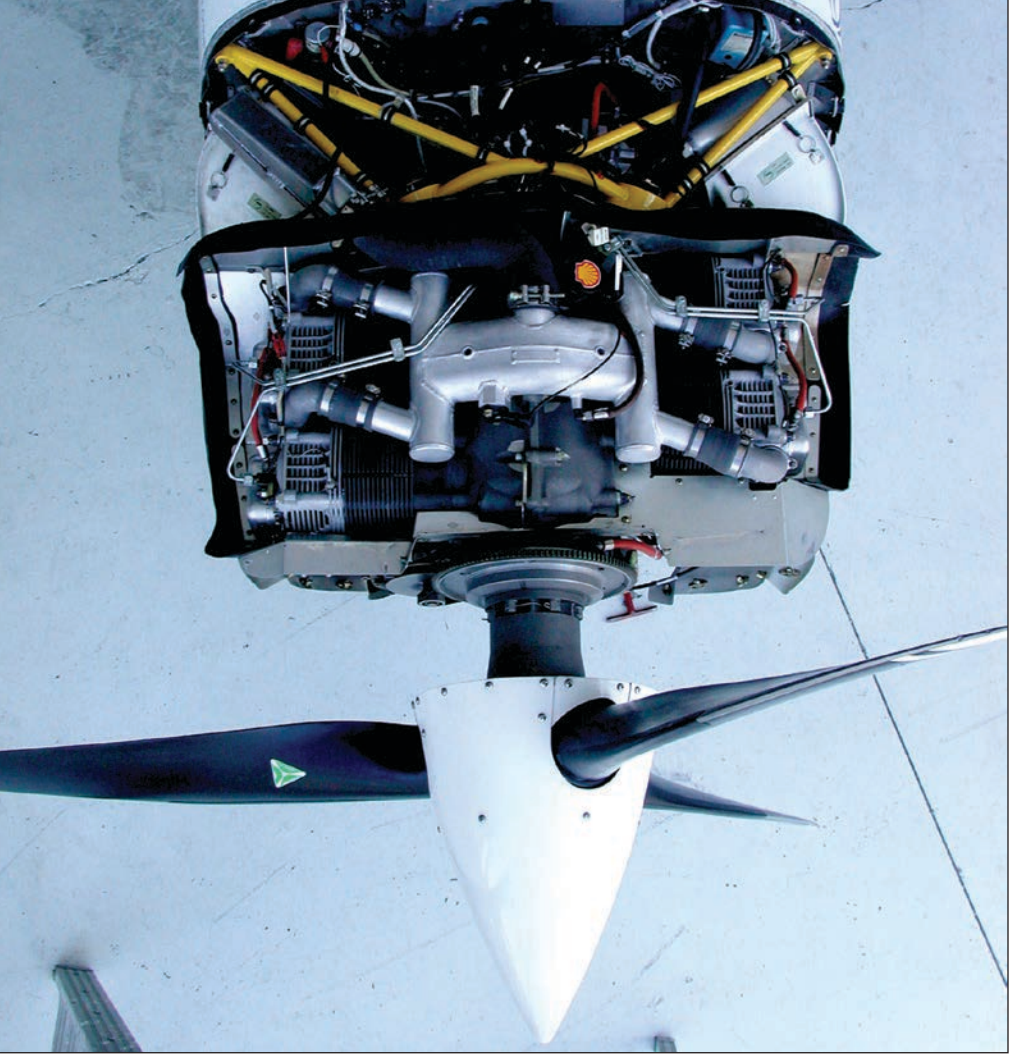


Aircraft Diesels: Still No Slam Dunk

Despite having an overwhelming advantage in fuel volume and availability, aircraft diesels have yet to overcome a persistent pattern of market failure.

by Paul Bertorelli

CHECKLIST

- **Fuel trends are irreversibly in favor of heavy fuel engines.**
- **There's plenty of market activity in diesel. Continental's entry elevates the game.**
- **Although economy is proven, practical durability in large fleet operation isn't.**
- **Power density issues are a mixed bag. SMA matches gasoline numbers, Centurion and Austro don't.**
- **Jet A supplies are assured, but low-cetane biofuel components are a legitimate worry.**

FUTURE FUELS

When Continental announced in May that it planned to develop a diesel engine for the light aircraft market, it was boldly going where many have gone before. Unfortunately, the many have had their diesel entries ground to a bloody pulp by a fickle market more interested in speed than economy and unconvinced that diesel's supposed longevity is worth the higher purchase price.

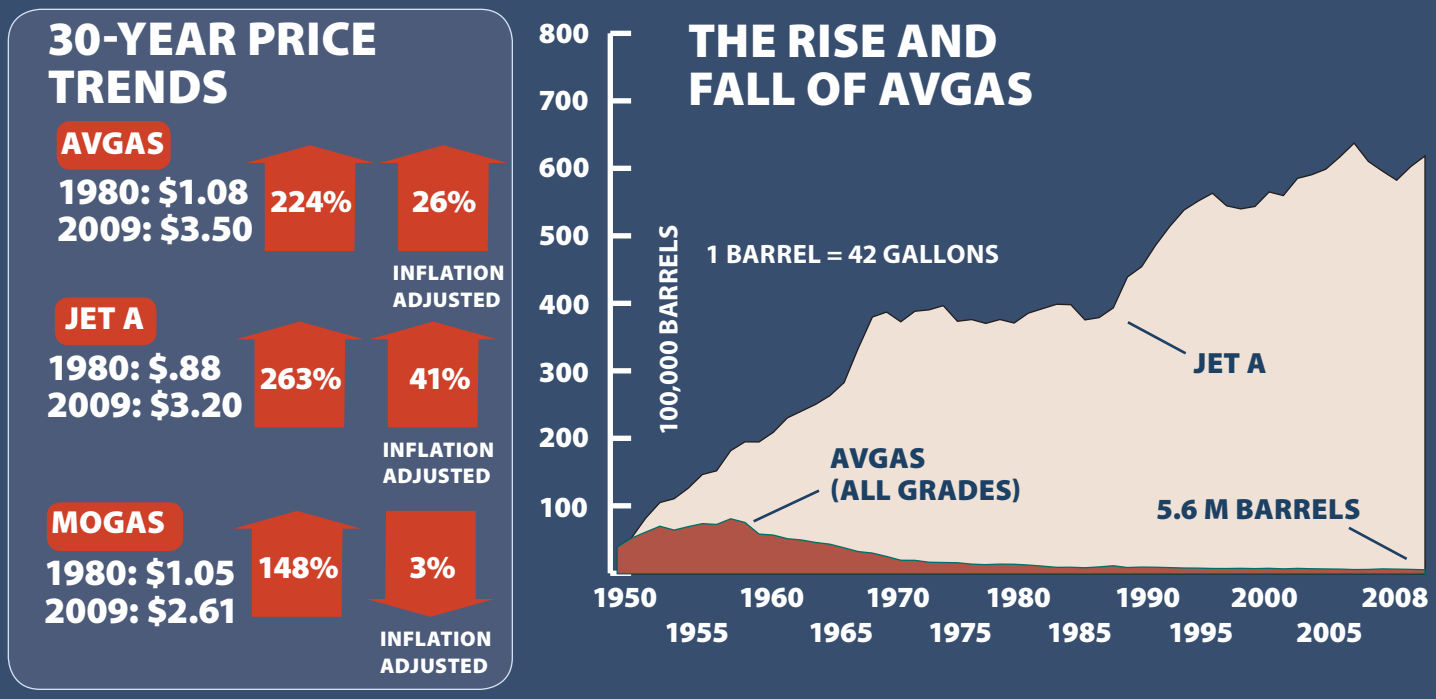
A historical fact: Depending on how you define commercial success, there has never been a commercially successful diesel engine for aircraft. The Thielert/Centurion line launched in 2005 comes closest, but the company went belly-up and although it's building engines again, it remains insolvent.

Our idea of success is defined by having enough engines in the market to represent a sustainable economic bloc and/or a company that's still viable. In that regard, Pratt & Whitney's round engines might qualify as a continuing success while Centurion remains in the iffy column.

So what is it about diesels? They seem like such a terrific idea in theory. But in practice, they've consistently failed to deliver. They're usually heavier than gas engines, have poorer power density and have proven substantially more expensive to build. That much hasn't changed since Packard tried the Dr-980 radial diesel in 1928. So what possible market trend could rewrite the equation? Only one: fuel availability.

FAILURE TO LAUNCH

History has a way of repeating itself and that certainly seems to be true in the diesel market. The first serious effort in aircraft diesel was launched by Packard in 1928 in the form of the Dr-980, a nine-cylinder radial intended to compete with the IO-550 of the day, Wright's 225-HP Whirlwind J-5. Although the Whirlwind gained indelible fame for reliability by powering Lindbergh's flight across the Atlantic, it had terrible fuel specifics. At 0.6 pounds of fuel per horsepower hour, its thirst was closer to a turbine than a modern, relatively efficient gasoline engine. Designers using the J-5 had to find a



Diehard diesel supporters may think that avgas is just now teetering on the ropes, but they're a little late to the party. Avgas production has been in steady decline since reaching its peak production of 814 million barrels in 1958, according to data maintained by the Energy Information Administration and the American Petroleum Institute.

A caveat here: Obtaining accurate data on avgas and Jet A production and prices is a best-guess effort. API, EIA and FAA/DOT statistics don't necessarily agree nor do they match year-to-year claims. But the directionality is unmistakable: In the world of petroleum production and refining, high-octane avgas is a mere drizzle in a sea of Jet A, which is itself a fraction of motor gas volume.

Avgas's small volume is reflected in its unhappy price trend. While motor gas is actually cheaper in real dollars than it was 30 years ago, avgas is well ahead of inflation. While some of this is due to rising production costs because high octane isn't required by modern cars, the larger driver is almost certainly fewer suppliers serving a shrinking market. There's not much incentive to compete on price, as with mogas.

lot of room for fuel and even then, gasoline-powered aircraft were range challenged. Further, in 1928, just as now, the world was worried about running out of oil, since discoveries of new major fields—especially the Black Giant in East Texas—were still in the future.

Even by modern standards, the Dr-980 was an impressive effort. According to Robert Meyers' The First Airplane Diesel, the Dr-980 matched the Whirlwind on weight, power density and overall size, something that no modern diesel can claim. It crushed the J-5 on efficiency, running at 0.40 BSFC, a 50 percent improvement in fuel economy. No modern diesel can claim that kind of improvement over the gasoline competition, either.

Nor was the Dr-980 some back-hangar project. Packard invested the contemporary equivalent of $8 million in a plant designed to build 500 engines a year. Yet like many other diesels to follow, the Dr-980 failed. By 1930, it was a soon-to-be-forgotten historical footnote. As is usually the case in business plans, the Dr-980 failed for multiple reasons. To lighten it, Packard nibbled structure to the minimum and had trouble keeping

The Austro, upper right, is an adapted automotive diesel design developed in a crash program by a company spun off of Diamond Aircraft. One shortcoming in the diesel market is that it lacks high-horsepower offerings. Centurion's 4.0, lower, was supposed to address that, but the engine's weight and complexity make it a non-starter against modern gasoline powerplants.

BY THE NUMBERS

ENGINE	HORSEPOWER	WEIGHT	POWER DENSITY	FUEL SPECIFICS	DIESEL COST PREMIUM
WRIGHT WHIRLWIND J-5	225 HP	510 LBS	2.26 LB/HP	0.6 BSFC	N/A
PACKARD DR-980	225 HP	510 LBS	2.26 LB/HP	0.4 BSFC	34%
SMA SR305	227 HP	430 LBS	1.9 LB/HP	0.35 BSFC	12-15%[1]
CONTINENTAL O-470	230 HP	410 LBS	1.78 LB/HP	0.46 BSFC	N/A
CENTURION 2.0	135 HP	295 LBS	2.18 LB/HP	0.36 BSFC	UNKNOWN
AUSTRO AE300	168 HP	407 LBS	2.42 LB/HP	0.36 BSFC	22%[2]

[1]Estimate based on best case mass production for new airplanes. Costs for converting a legacy airplane are much higher.
[2]Our estimate based on price Delta between Lycoming-powered and Austro-powered Diamond DA42s.

In the intervening years since Packard attempted mass production of aero-diesels, engine performance parameters have advanced incrementally, but a revolution awaits.

Note that in competing with the Wright Whirlwind, Packard got some things right—weight, power density and fuel economy. But it got two things substantially wrong: cost and durability.

The engine just wasn't mature enough to make it in a market soon dominated by the superior performance of 87-octane and later higher octane fuels. Its stinky exhaust and vibration didn't help. Evidently, operators weren't interested in putting up with those shortcomings in exchange for greater range, which the Packard had in abundance.

Modern diesels are more sophisticated and have better economy and power density, with the exception of the Austro AE300, whose power density is worse than the Packard. But this is the tradeoff against durability.

The Austro has a heavy cast-iron block, something that's all but unheard of in aviation. The heavy block is intended to give the Austro better reliability and it can be overhauled rather than exchanged, as with the Centurion.

the cylinders on. Seventy-five years later, Thielert repeated the mistake, although differently in detail.

The Dr-980 had a four-cycle design with a single valve which resulted in a smoky exhaust that filled the cabin with objectionable fumes and ruined clothing. But what finally killed the Dr-980, according to Meyers, was the development of 87-octane fuel and later even higher octanes that made possible gasoline engines with overall power and power density that diesel couldn't match.

Not that this kept companies from trying, including Junkers in Germany. The Jumo 205 is often cited as a highly successful design, but that's debatable. The 205 was a creative six-cylinder, 12-piston, two-cycle design with two crankshafts located where the valve covers would normally be on a typical horizontally opposed aircraft engine. Although the 205 had exceptional power density—1.5 pounds per horsepower—even for a two-cycle, it was complex to build and maintain. (Think about the gearing to join two crankshafts to a single output.)

The Jumo 205 found commercial and military application before and during World War II, but it's unclear how many were built. One source suggests more than 900. Sustained by the artificial market of a war economy, the 205 met the same fate as the Packard. It was done in by gasoline engines—and turbines—with performance so superior as to outweigh diesel's fuel economy advantages.

At least two proposed diesels are two-cycle designs, including the DeltaHawk, left, and the Gemini, below.

THEN, NOW

Advance the clock 80 years and you might assume modern technology would have so improved aircraft diesel engines that they would capture the market in a walk. But that hasn't happened. The test case is the Thielert Centurion that Diamond chose for its DA42 twin. The airplane got a warm market reception, sold well—especially outside the U.S.—and was economical and easy to fly. But just as with the

Packard, the engines were expensive to buy and they developed significant maintenance issues that eventually caused Diamond to go its own way and develop the automotive-based Austro AE300. Thielert's problems were so significant that it eventually went bankrupt and has been reconstituted as Centurion. Only recently has Centurion announced life extension programs that reduce the onerous routine maintenance on clutches and gearboxes, but even at that, Centurion's diesels don't match typical gasoline engine TBOs and the Centurion is still a replacement/exchange engine that can't be overhauled in the field.

Centurion engines, although economical, lack the power density of the best gasoline engines. The market badly needs a high-performance diesel, which Centurion has in its 4.0. But at 600 pounds, it's 150 pounds heavier, larger and more complex than the gasoline competition.

In its SR305, SMA has a strong diesel performer, with good fuel specifics, excellent power density and a direct drive design that eliminates the complexity of a gearbox. Our surveys of operators of SMA-powered aircraft—conversions only—reveal satisfied customers who believe the engine has merit. Continental thinks the same thing, since it acquired SMA's technology as a seed for its own aggressive heavy fuel engine line.

IT'S THE FUEL, STUPID

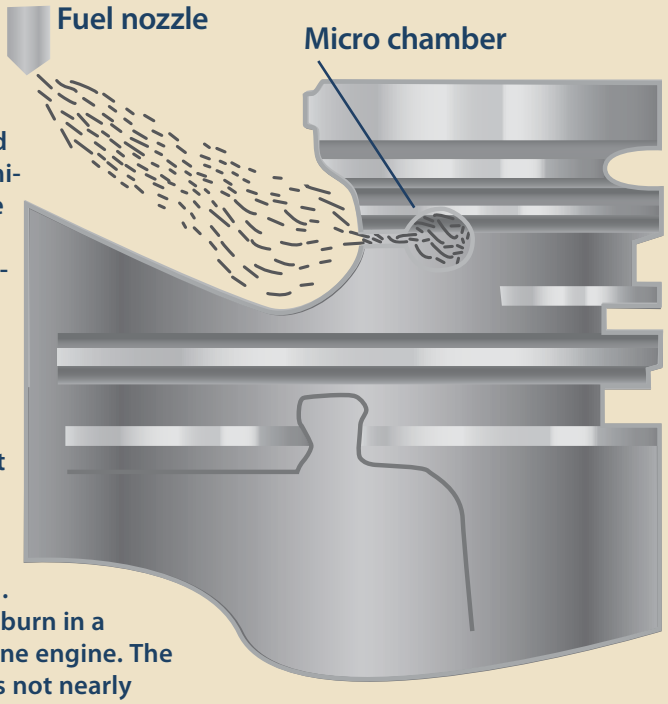
The bet here seems to be that even if diesels continue to have power density, power output and short TBO issues, the impending demise of 100-octane gasoline—and maybe just the perception of its demise—has tipped the balance permanently toward heavy fuel engines. As the graphic on page 5 shows, Jet A is the world fuel of the future; avgas a boutique fuel suffering a long decline. Globalization will hasten this because increasingly, the world aircraft market will eclipse North America as the dominant driver.

"Sixty percent of the world's small piston airplanes are on the U.S. registry," says Andre Teissier-duCros, an engineer who edits the DieselAir Newsletter. "It was 70 percent in the 1970s. It will be down to 50 percent in 2040 and the number of U.S. light

continued on page 32

CUTTING EDGE TECH

OTTO+DIESEL=RADICAL



Thirty years ago, the only place to buy diesel fuel was at a truck stop. But once diesel cars and light trucks made minor inroads into the U.S. market, so did something else: diesel misfueling. The distracted motorist swipes the credit card and stuffs the wrong nozzle into the filler. They don't get far before the engine coughs and sputters on its way to a giant repair bill.

Diesel just won't burn in a conventional gasoline engine. The compression ratio is not nearly high enough, the injection pulse is mistimed and a spark plug is no help. But that's not to say burning diesel (or Jet A) in a piston engine as light as the typical Lycoming or Continental can't be made to work. It just takes the right kind of piston and cylinder and careful control of the fuel pulse timing. The result is a combustion process that's almost exactly a mix of the diesel and the Otto gasoline cycle.

At least that's the idea behind something called the Sonex Combustion Auto Ignition concept developed by a company by the same name. This idea has been in the works supported by Daimler-Benz for a number of years and is now coming into public view. Sonex's Andy Pouring, a former Naval Academy engineering instructor, ran us through the basics of SCAI.

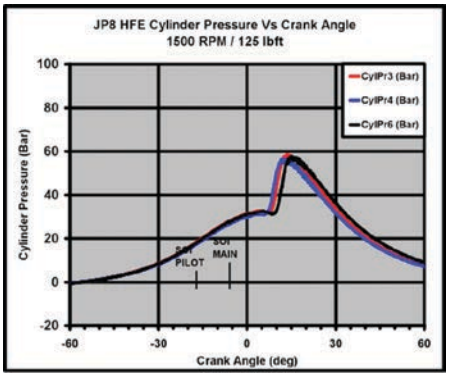
The underlying principle involves something called radical ignition. And no, that doesn't refer to the edginess of the idea, although it is that, but to chemical radicals. The piston and combustion chamber are so shaped to allow the injected fuel—the pulse timing is critical—to morph into two chemical radicals during the compression and pre-ignition portion of the stroke. The two chemicals of interest are hydrogen peroxide and formaldehyde.

According to Pouring, the formation—and retention throughout the combustion cycle—of these chemicals encourages total envelopment of the fuel/air charge rather the flame front normally associated with piston engines, including diesels. Conventional Otto cycle gasoline engines function

with a constant volume combustion process while true diesels work on the constant pressure principle. Radical ignition is a combination of the two and its cylinder pressure trace, page 8 , has a characteristic double peak that looks very different than a conventional gasoline engine pressure trace.

The shape of the piston is critical and represents the overwhelming manufacturing challenge of building a radical ignition engine. In addition to getting the shape of the bowl just right, Pouring told us the piston design calls for a series of microchambers around the circumference of the piston bowl.

Think of these as small storage chambers that absorb part of fuel charge and the radicals during the intake process. When the combustion cycle starts, the microchambers store a portion of the radicals which are then made available as kind of a seed for subsequent cycles. Radical ignition can run on a four- or two-cycle design, but Pouring says the two-cycle version is less efficient, just as with a conventional gasoline two-cycle.



Diesel engines require compression ratios of as much as 20 to 1 to autoignite the fuel, which is the chief reason that diesel engines are so heavy. They need a lot of beefy structure to contain cylinder pressures as high as 1500 PSI. Pouring told us that radical ignition cylinder pressures don't spike above about 800 PSI, which is comparable to gasoline engines, thus they can be built as lightly as a conventional aircraft engine.

Does that mean that a radical ignition engine might look like a typical Continental or Lycoming and weigh about the same? That's about right, says Pouring.

Although such an engine would look outwardly conventional, it would have only fuel injection and no throttle body—power is modulated by fuel. As a result, radical ignition runs ultra lean, according to Pouring—the fuel/air ratios are as lean at 28 to 1, compared to about 19 to 1 for a gasoline engine running well lean of peak.

This yields fuel specifics of a diesel-like .35 to .36 pounds per horsepower hour, compared to about .39 to .41 for the more efficient gasoline engines.

Pouring says Sonex would like to commercialize its technology but, so far, no takers. A derivative of the SCAI idea is now being used in a UAV called the ScanEagle made by InSitu for civil and military use. For more SCAI technology, see www.sonexresearch.com.

AVIONICS MARKET SCAN

GPSS Retrofits: Automation to the Max

Digital roll steering converters can bring old autopilots into the modern age, but to get the most out of them, you need WAAS GPS.

by Larry Anglisano

Nearly every proposal for a new autopilot installations—which these days means S-TEC upgrades—should include a GPSS option. And *optional* is the key word because unless you buy a flagship S-TEC 55X autopilot, GPSS won't be included with the base system. For most customers looking to upgrade GPS and autopilot equipment, GPSS hardware is grossly misunderstood.

Although hardly a major system, GPSS is considered an accessory that plays a huge part in total autopilot automation. Impressively, it emulates the tight performance found with big-airplane inertial navigational systems.

Upgrading to GPSS is pretty easy, since there are several aftermarket GPSS systems to choose from. They can be interfaced into a new autopilot installation or tacked on to an existing 30-year-old autopilot. They'll work in a limited way with older GPS navigators as well as newer ones.

Let's do a brief rundown with a

CHECKLIST

- If you want hands off from takeoff to nearly touchdown, GPSS is a must.
- Roll steering inputs can be added to most autopilots, even older ones.
- Aspen and Garmin G500/600 already include GPSS.
- Without WAAS GPS, the interface will be hobbled. Just know that going in.
- If you're already pinching pennies on an autopilot upgrade, GPSS isn't going to make it cheaper.

simple explanation of GPSS along with a look at the current market offerings. To cut to the chase, if you buy a new Aspen PFD or Garmin G500, GPSS is included as a bonus.

GPSS 101

It's easy to see why GPSS systems cause so much confusion. To understand the theory of operation, you need to understand the relationship between an analog and a digital interface. Most general aviation autopilots (with the exception of Garmin's integrated GFC700 that's part of the G1000 suite) are analog-based systems.

This 1980s and earlier analog circuitry knows nothing about high-speed databuses or RS232 serial waypoint data that stream from most modern GPS units. Instead, when autopilots track a course, they follow the analog left/right needle action from a mechanical CDI or HSI. Analog autopilots chase the needle just like a hand-flying pilot would. But this game of needle-scalloping cat and mouse can be decisively won with the more precise tracking of digital GPS steering, which takes the CDI out of the picture and digitally connects the GPS with the autopilot computer over a databus.

Instead of tracking a course, a GPSS anticipates course changes along the way by commanding a coordinated new course heading without overshooting or undershooting. Since the GPS navigator calculates exact turn initiation points from waypoint to waypoint based on GPS groundspeed, leg transitions in a flight plan are seamless. It's pretty smart stuff.

SIGNAL CONVERSION

Because GPSS systems are really signal converters, the digital signal received from the GPS gets converted to a language that the autopilot understands—and that's a heading error signal. The resulting magic to the interface is added precision. So much precision, in fact, that the system will tightly fly procedure turn course reversals, holding patterns and even nail steep intercept angles both enroute and on a GPS approach. The pilot's job is to monitor and stay ahead of the interface.

The mechanical interface consists simply of a remote control box and panel-mounted mode switch. You won't need much panel space to house the mode switch—it's reasonably small. The remote control box is about the size of an altitude encoder and can be mounted anywhere there's room under the panel. Experienced shops should be able to complete an average GPSS retrofit in about two days. The biggest effort is accessing the GPS in the main stack to connect to the databus.

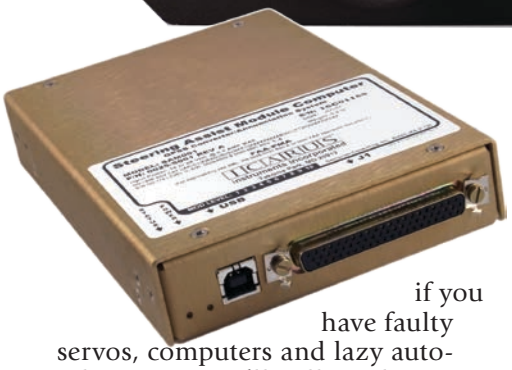
Garmin's GNS430W, top photo, will nicely display a holding racetrack, but without GPS roll steering, lower photo, your aging analog autopilot won't track the course very accurately.

SPARSE MARKET

The logical choice when installing a new S-TEC autopilot is to include the S-TEC ST-901 GPSS steering system. It's a remote box with a square, panel-mounted annunciator control switch. Again, the flagship System 55X comes with self-contained, integrated GPSS. But other S-TEC systems don't.

There's nothing wrong with adding GPSS steering later, except the autopilot computer might need to be modified to accommodate the GPSS, which adds to the bottom line. S-TEC's ST-901 costs $2184, plus installation.

DAC International's GDC31 is similar in design to the S-TEC system. The GDC31 shines in that it's compatible with a broad range of autopilot models, including the old but durable Bendix/King KFC200, plus models from Century and Cessna. It will also interface with an S-TEC autopilot. It's important to understand that a GPSS *won't* solve autopilot problems inherent with some of these old systems, so



if you have faulty servos, computers and lazy autopilot gyros, you'll still need to get these fixed. The DAC GDC31 has a liberal AML/STC and the system is built with quality and ease of installation in mind. The GDC31 has a price tag of $1989.

The Cadillac of GPSS is the $2295 Icarus Instruments Steering Assist System (SAM). While performing the same steering functions as the S-TEC and DAC, the Icarus system includes some nifty functions, including altitude alerter, landing gear warning and other interactive warnings. For instance, when a destination altitude is set, a check gear alert will be provided at the pre-established height above that altitude. There's other annunciation, too, including voltage, oil pressure, vacuum pressure, engine monitors, stall warning and audible voice prompting of waypoint passage. These options also mean extra installation effort, so a close eye on your shop's quote is in order when spec'ing this system. The SAM uses a larger control head than the other brands to accommodate these functions, so more panel space is required. The Icarus steering system works with a variety of AC- and DC-based autopilots.

CONCLUSION

Flying an entire flight plan hands-free without manual heading changes or spinning the course pointer is what GPSS is all about. But without WAAS GPS in the mix, the interface could be limited for approach operations. Sure, you can still sit back with crossed arms while the autopilot flies doglegs in the flight plan and intercepts a GPS approach as if it's on rails, but it can't fly a procedure turn or holding pattern.

While older legacy navigators output composite roll commands, they don't output guidance in the hold segment of the approach procedure. Garmin WAAS navigators (including the discontinued GNS480/CNX80) incorporate this functionality.

A WAAS upgrade for the legacy GNS430 and 530 units could run a few grand, on top of the few grand it costs for a GPSS steering installation. These numbers are often tough to swallow for many owners already stretched by expensive autopilot upgrades. If an Aspen or G500 is in your future, we suggest holding off on GPSS upgrades. Still, GPSS automation is so impressive and capable addition, it's worth considering for auto-pilot-coupled, cross-country missions.

If you're tight for panel space, GPSS doesn't get much simpler than DAC's $1989 GDC31, below. Installation is reasonable, too.

For the ultimate in roll steering sophistication, the Icarus SAM, left, is unbeatable. For not much more money than the others, it has a ton of high-level features. But these will add substantially to the installation invoice. That's a standard ATI panel display; the processor box hides elsewhere.

Larry Anglisano is Aviation Consumer's *crack avionics editor. He works at Exxel Avionics in Hartford, Connecticut.*

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Avidyne's DFC90: One Smart Autopilot

Avidyne's fully digital autopilot delivers on its claims of terrific performance and improved safety. But the cost-benefit equation won't work for everyone.

by Jeff Van West

Cirrus Aircraft's installation of the Avidyne Entegra PFD in 2003 was really the turning point for glass cockpits in GA. But at the time, there was no attitude-based autopilot on the market capable of using the digital gyros (AHRS) from the PFD to fly the aircraft. That meant that Cirrus (as well as Columbia, Piper and anyone else who used the Avidyne system) hid an electric turn coordinator behind the panel and used it to drive the S-Tec 55X rate-based autopilot.

We've always seen the S-Tec 55X as an acceptable, but not stellar performer. Its weaknesses are most pronounced on coupled ILS approaches in strong, gusty winds where it will often hunt left and right to try and find a heading that keeps the needles centered. GPS steering (GPSS) largely fixes this issue, but that doesn't help on an ILS. Nor does it work well on an LPV because the 55X was conceived before the days of GPS approaches with vertical guidance so it can't combine vertical guidance, with GPSS.

Owners have adapted, sometimes muttering to themselves as they manually "helped" the autopilot get settled in on approaches or harsh intercept angles. They also got really good at pushing the 55X's buttons just right when arming an altitude or navigation capture—or let out another muttered curse when they leveled off accidentally instead of climbing.

A DIGITAL ATTITUDE

Avidyne now has an alternative, designed as a slide-in replacement for the S-Tec 55X. The DFC90 uses the same tray, wires and servos as the 55X, but gets its data directly from the PFD. This means it's an attitude-based autopilot with access to additional data, such as the winds aloft. The result is an autopilot that can outperform its predecessor in performance and safety.

Avidyne kept as much of the buttonology as possible from the S-Tec 55X to ease the transition. The new buttons are color-coded to show what modes are active or armed.

The performance gain is two-fold. Using aircraft attitude, the autopilot should ride more steadily through turbulence. We tested the DFC90 on a relatively calm day, so we can't verify that. But we do know the S-Tec 55X wasn't a gold medalist in this category compared to even older attitude-based systems, such as the Century.

The gain we could see was in intercepts and approaches. Avidyne makes the rather tongue-in-cheek claim that the maximum intercept angle for the DFC90 is 179.9 degrees. We tried a 90-degree intercept with a quartering tailwind to a GPS course and an ILS, and saw perfect joins both times. The winds weren't challenging on the coupled approaches, but there wasn't even the minor hunting for the correct pinch and heading as we descended like we're used to with the 55X. It was also unfazed by any flap or power changes we put in or took out while on glideslope.

The only place we did see the autopilot get behind was on a non-precision approach using the new airspeed-hold function. It works through a new airspeed bug on the PFD controlled by a dedicated knob

CHECKLIST

- ⊕ Significant performance improvement for intercepts and approaches over the S-TEC 55X.
- ⊕ Addition of straight-and-level mode is a tangible gain in safety.
- ⊖ While the install is simple, the total upgrade cost is substantial for safety and smoothness with no gain in mission utility.

PFD annunciations now show in green for active and blue for armed, and there's a new airspeed bug. The system will handle any intercept angle you throw at it. It also won't reverse its direction of turn in HDG mode if you swing the heading bug more than 180 degrees.

on the face of the DFC90. We commanded 100 knots at the FAF and chopped the power. The DFC90 held 100 in the descent just fine, but had trouble when we powered up and punched ALT to level off, dropping to as low as 89 knots before speeding back up.

This is probably a result of the DFC90 installation retaining the existing servos rather than replacing them with high-speed-capable digital servos, like those found in a Garmin G1000/GFC 700 autopilot. Steve Jacobson, VP for Product Management, told us, "We agree DC brushless motors would be best. But for this mission, the existing servo motors are adequate … and they keep the installation cost down."

We'd have to agree. We asked Jacobson if future plans included digital servos and got a polite "no comment." Such servos would probably only be for new OEM installs, however.

We tried the underspeed, overspeed and straight-and-level recovery in flight. All performed exactly as advertised.

ENVELOPE OF PROTECTION

On our flight, Jacobson pointed out that the airspeed bug has a safety function, too. He leaves it parked on Cirrus' best glide speed of 88 knots. If the engine were to fail, the autopilot could hold 88 knots in a slow descent with one button push, while the pilot got busy with the emergency checklist.

Bigger news is the Straight-and-Level button. Similar to the Level button on the G1000-based Cirrus Perspective system, if a pilot gets into an unusual attitude, pushing the button engages the autopilot and returns the aircraft to level flight. Officially, Avidyne states it has demonstrated recovery from 60 degrees of bank and 30 degrees of pitch. Given that part of the recovery logic includes knowing to unload the wings before attempting an extreme roll and not exceeding more than 2.3Gs on the pullout, we suspect it's designed to attempt much more extreme recoveries if needed.

In addition, the autopilot won't let the aircraft fly too slow or too fast. We pulled the power to 35 percent and commanded a climb of 1600 FPM in the SR22 testbed aircraft. It pitched up in an attempt to climb until it slowed to 88 knots. At that point the automated voice (they call her Gina) announced "Speed protection active" and annunciations flashed on the PFD. The aircraft gave the best climb it could without slowing down any further. We tried a full-power descent as well, and the autopilot held us at Vne, pitching up as needed to keep us from going any faster.

Avidyne retained the hidden turn coordinator from the original S-Tec installation as a fault comparator. If the DFC90 sees a mismatch between the PFD attitude and the turn-rate information from the old system, it will disengage and alert the pilot. The pilot can manually reengage the autopilot if he feels the error was in the turn coordinator rather than the PFD's AHRS.

There is some redundancy loss. In the event of AHRS or PFD failure, the S-Tec 55X could still fly the aircraft through an non-precision GPS

AC TV

Come along on a flight to see the DFC 90 in action. Log on to www.avweb.com and select the video index. Demo pilot Steve Jacobson shows us the new features including straight and level recovery.

approach. With the DFC90, AHRS failure will disable the autopilot as well.

USER INTERFACE

The buttonology of the DFC90 will be familiar to anyone who has used an S-Tec 55. This is by design as Avidyne wanted the simplest transition possible for 55X owners. There are a few new buttons in addition to Straight-and-Level. Airspeed mode is engaged through an IAS button above the knob that sets the airspeed bug. There's also a new GS button to manually disengage glideslope capture if you don't want vertical guidance on an LPV or ILS.

There is an Approach button, but it's only really needed for VOR approaches, as the autopilot automatically sets its approach sensitivity and arms vertical capture if it sees you are flying a GPS approach or intercepting a localizer. Likewise, there is a GPSS button, but it engages automatically if you're following a GPS course. Maybe Avidyne figured 55X experts would miss the double-NAV push to engage GPSS.

Forget about pushing VS and ALT just right to climb and capture an altitude. If the press of VS and ALT overlap at all (and in any order) the aircraft will climb at the set rate and level off at the target altitude. The same is true with HDG and NAV. Gone as well is the gradual transition to 300 FPM at altitude capture. The commanded rate is kept until the last moment that still allows a smooth capture. There's no knob to correct the altitude in 20-foot increments. When you change the baro setting, the DFC90 corrects the altitude automatically.

The autopilot buttons and the PFD display are color coded: green for active, blue for armed and white for inactive. The DFC90 also has a pitch and roll mode where it will hold the current pitch and bank, as well as a true flight director. In fact, like traditional attitude autopilots, the autopilot controls really drive the flight director, which you can follow manually or have the autopilot follow on its own.

NOT A NO-BRAINER

Cirrus owners can upgrade to the new system today. Avidyne plans to certify the autopilot in all airframes where a significant number of Entegra systems were installed (Adam A500 owners may be out of luck). The system relies on the Entegra PFD, so there are no plans to create a standalone version for the aftermarket.

The DFC90 is $9990. The modification to the PFD to send new signals on the old S-Tec wiring harness is $3600 if you're already running Release 7 software. It's $5800 for earlier (non-WAAS) PFDs. Installation runs between three and six hours including removal of the PFD, for the upgrade and the flight test.

That means between $14K-$16K for the complete job. For some, the safety enhancements alone will be worth it. The day-to-day performance gains will sway some more buyers. But we think for many this upgrade is far from an easy call. The new autopilot doesn't add more mission utility. Aside from the envelope protection, the old system can do most of what the new one can—albeit with the grace of Jerry Lewis, at times, rather than Fred Astaire.

But if you're tired of cursing the shortcomings of your 55X, at least you have options, and the final result won't disappoint.

CONTACTS

Avidyne Corperation
www.avidyne.com
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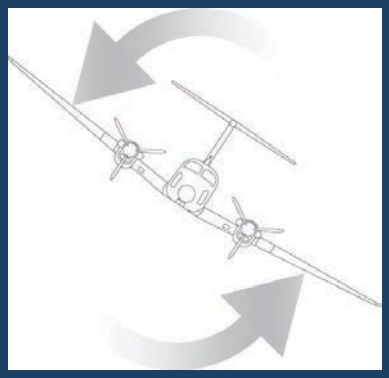
GARMIN'S AUTO-HELPING-HAND



Garmin has extended the bounds of what we generally think of as the role of an autopilot with its new Electronic Stability and Protection (ESP) system that uses the autopilot servos to "nudge the pilot back to safe flight" when the autopilot is *off*, but the system senses the aircraft is departing controlled flight.

What constitutes departing controlled flight varies from airframe to airframe, but the numbers for a Cirrus SR22 with a Perspective system are more than 45 degrees of roll and about 17 degrees of pitch. Exceeding those parameters results in the system putting force on the stick, in the direction of a return to straight and level flight, using the autopilot servos, even though the autopilot is off. The forces in the Cirrus start at about six pounds and increase as the degree of bank or pitch increases. Some installations will have an option to engage the autopilot if corrective forces are applied several times in succession, the theory being that a pilot that keeps needing such assistance is probably disoriented.

The stick pressures are designed so they can always be overridden by the pilot. The system deactivates when the aircraft is taking off or landing, and can be disabled for flight training.

ESP is basically a software upgrade, but exact availability and pricing will be up to each airframe manufacturer.

New Premium Headsets: Bose Comes Back Strong

Lightspeed's Zulu has been our favorite, but the Bose A20 could unseat it as champ. Lightspeed's new Sierra also brings power features at a lower price.

by Jeff Van West

Bose has always held a place at the top end of noise-canceling headsets, with a history dating back to 1989. The company has been virtually silent in the aviation arena for the past 12 years, resting on the continuing strong sales of their Headset X.

But even the Bose devotees have been getting restless due to the lack of auxiliary music input and a Bluetooth connectivity for phones (to be used, uh, on the ground only, of course).

All the while, Lightspeed Aviation's Zulu has been steadily increasing its dominance in the premium headset market by offering active noise reduction (ANR) on par or exceeding that of the Bose, along with music and phone connectivity.

At Oshkosh of this year, Bose answered with the new Bose A20. Except for the basic design of the headband, this is an entirely new design, bringing some of the technology from Bose's consumer headsets to aviation—and finally offering the music and phone connections.

NEW MICS, NEW SPEAKERS

Bose claims the new headset is quieter and more comfortable than the quite-capable Headset X. Trying them side by side at the Bose demo theatre and in the airplane, we'd have to agree. The new earcup design addresses a common complaint that the Headset X was too narrow for big ears. Our big-eared editor confirms this is fixed in the A20. The headset is also noticeably lighter. Even though the clamping force is the same as the Headset X, the new earcups and the new foam pads distribute the force better, so it feels less tight.

The new ANR system employs two mics on each earcup (four mics total) to sense cabin noise and create the cancellation signal to squelch that noise for the pilot. There has always been a mic on the inside of the earcup, to sense sound right at the pilot's ear, but now there's also one on the outside of the earcup to sample cabin noise directly. We played with switching headsets between a Headset X and the A20, as well as covering the external mic. We didn't detect a significant difference with low-end engine noise and vibration, but the new system seemed better at blocking high-end whines and whistles.

Bose points to new electronics that process this two-point sample to create a better noise canceling profile, and new speakers they developed that have a dynamic response sensitive enough to actually reproduce that profile as sound (maybe anti-sound is better term). Bose politely declined to give us any further details of these steps.

In addition to the terrific ANR, the headset sound quality for speech and music is flawless. But that's pretty much what you'd expect from Bose. As with the previous Bose headset, with a screwdriver and a few minutes work, you can switch the boom mic from the left side of the headset to the right.

NEW CONTROLLER

The A20 has an entirely new controller to handle the added functions. While not dwelled on by Bose, we were big fans of the new volume controls. The curved wheels are easy to

Bose was listening to the complaints folks had with the Bose X. The A20 has wider earcups than the X. It has the same measured clamping pressure, but lighter earcups and new foam makes it feel noticeably lighter and less tight on the head. The new external mic for ANR is the grey spot toward the bottom of the earcup.

DELUXE HEADSET SMACKDOWN

The obvious comparison is between the new Bose A20 and the Lightspeed Zulu. We've fingered the Zulu as our top-pick headset in the past, but our reader surveys have shown a strong loyalty and satisfaction from Bose owners. Their biggest complaint was about the lack of Bluetooth and music. The new A20 has both, plus an improved ANR, but it's still not a walk-away winner.

Having hauled some long days (over six hours flight time) with both headsets, we say that both are plenty comfortable, but we're going to give a confirmed nod to the Bose, mostly for a lighter feel over the ears and less of a pressure point on the top of the head. The Bose mic can also be mounted on either the left or the right. The Zulu is fixed on the left.

The ANR in both headsets is phenomenal. While a test cell might be able to detect the difference, we're not convinced we could. The Bose seems better at higher-pitched sounds—it was noticeable when listening to the air conditioner in our office—and this may translate into less long-term noise fatigue in the cockpit. The Zulu has clearly better passive noise reduction for those dead-battery days.

BOSE A20

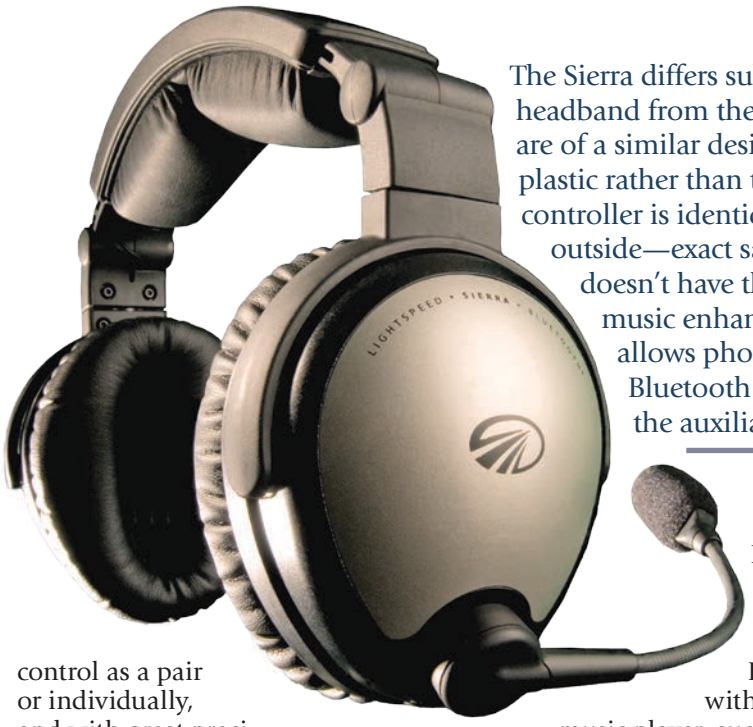
Music through the wired input was of equal and exceptional quality in both headsets to our ears. Serious audiophiles may feel differently. Zulu has a slight advantage here, however, in that its wired input can accept music or a wired cellphone connection. As most phones have Bluetooth this isn't a big deal, but it's one less technical issue to go awry (if one more wire to carry). Zulu gets a nod for Bluetooth connectivity for both phones and music devices (or both music and voice when linked to a smartphone). Music over Bluetooth chews down the batteries, and there is a noticeable hit to audio quality (more of an issue with arias than, say, Joe Strummer). People we called on both headsets via Bluetooth consistently told us the Bose connection sounded less digital, but both were perfectly understandable. The addition of sidetone to hear your own voice as you talk on the phone is a nice plus with the Bose.

The A20 has two pluses for people who fly multiple aircraft. If the headset is purchased with a six-pin plug to run the ANR off of ship's power, you get an adaptor to convert the same headset to a standard two-plug system and run off the batteries in the controller. Bose also supplies a headset case with a carrying strap. The Zulu case looks cool, but it's hard to carry.

The one place where the Zulu walks away, however, is price. The Bluetooth-equipped Bose is $245 more than a Zulu.

If both headsets were lying on the table, we'd grab the Bose to go fly (unless we needed Bluetooth music). But if we were coughing up the cash, we'd probably order the Zulu.

LIGHTSPEED ZULU



The Sierra differs substantially in the headband from the Zulu. The earcups are of a similar design, but they are plastic rather than the metal Zulu. The controller is identical to the Zulu on the outside—exact same button—but it doesn't have the Front-Row Center music enhancement, and it only allows phone connections via Bluetooth and only music via the auxiliary plug.

control as a pair or individually, and with great precision, all with one thumb. The wheels are guarded by plastic sides so the volume never changes accidentally, either.

Power for the ANR and activation of the Bluetooth are controlled by separate buttons. Pairing of your phone to the Bluetooth is the usual drill of push and hold a button on the headset and then enter the pairing passcode on the phone. We had a moment of trouble testing it as the headset jumps immediately into pairing mode the first time Bluetooth is used. Once we figured it out, it worked fine. There's also a convenient system to clear stored pairings if need be.

A nice touch with the A20 is a sidetone when you make calls. This means you can hear your own voice as you speak and it helps keep you from shouting at the briefer you're calling from the cockpit.

The A20's Bluetooth only supports the headset protocol, though. It won't pair with a Bluetooth music player, such as your iPod Touch. Even if you pair with a smartphone that does both phone and music, the Bluetooth connection will only play audio from phone calls.

Music is connected through a standard 3.5mm jack on the controller, so you will have that patch cable (included) to deal with. Music volume is also controlled at the music player, so you'll need to keep that somewhere accessible. A switch on the controller sets whether music is muted for radio or intercom, or if it just plays. We prefer the latter, just keeping the music low enough that a radio call overrides it enough to hear. This switch can also disable the Bluetooth sound. The music jack is input only.

Bose has kept their headset pricing right about $1000 for the entire run of the Headset X, and they're sticking with that plan for the A20. It's $1095 with Bluetooth and $995 without it (both versions have the auxiliary music).

That price point makes the Bose A20 the most expensive circumaural (over-the-ear) headset, on the market. Admittedly, this is a steady price in the face of 12 years inflation. Running that through the inflation calculator, the A20 would only be $750 in 1998 dollars. Too bad you can't get those dollars anymore.

A LIGHTSPEED BARGAIN

Lightspeed remains confident their Zulu can hold its own against the new Bose (see page 15 for our comparison). In fact, the day after the new Bose was announced, Lightspeed was inviting people to do side-by-side tests of the two headsets at their Oshkosh tent.

The company feels there is a market for the features such as Bluetooth and music input but at a lower price than their $850 Zulu. Their answer is the $650 Sierra. The Sierra resembles the Zulu in many ways, but the comparison is largely skin deep.

The earcups use plastic in many of the places Zulu uses lightweight metals, and the headband design is different. Lightspeed claims that the Zulu has less side pressure than Sierra, but our testers felt the Sierra seemed less tight on the head than the Zulu. The Sierra also seemed to have a looser ear seal and weaker passive noise reduction. The headband pads are much stiffer on the Sierra, and we found them less comfortable. We stopped noticing it after a while, but we think the headband design is inferior to the Zulu's. The earcups share the Zulu's soft foam and area large enough for any ear.

BLUETOOTH HEADSET OPTIONS	WEIGHT	BLUETOOTH	WIRED INPUT	PLUG TYPE	WARRANTY	PRICE
BOSE A20	12 OZ	PHONE ONLY	MUSIC ONLY	6-PIN & 2-PLUG OR HELO	FIVE YEAR	$1095*
LIGHTSPEED ZULU	13 OZ	PHONE/MUSIC	6-PIN OR STD PLUGS	6-PIN, 2-PLUG OR HELO	FIVE YEAR	$850
LIGHTSPEED SIERRA	16 OZ	PHONE ONLY	MUSIC ONLY	6-PIN, 2-PLUG OR HELO	FIVE YEAR	$650
PILOT AVIONICS BLULINK ADAPTOR	N/A**	PHONE/MUSIC	N/A	6-PIN, 2-PLUG OR HELO	ONE YEAR	$260**

* $995 WITHOUT BLUETOOTH ** ADAPTOR ONLY TO CONVERT AN EXISTING HEADSET

The noise canceling is equal to, or better than, most headsets in this price range. It's an improvement from Lightspeed's XL series, so if you're trading up, you'll be satisfied there. But if you try it side-by-side with a Zulu or Bose, you won't have to be an expert to hear a difference. One plus of the Sierra is the mic is reversible by simply flipping it around. We don't know of another ANR headset that offers that feature.

The controller is visually identical to the current Zulu design, but it's had a few features stripped away. Like the Bose A20, the Sierra Bluetooth is phone only, and, like the A20 you can't cheat that by pairing with your iPhone and then running iTunes.

The Sierra also has a wired music input, but again, like the Bose A20, it's music in only. You can't use it to connect a phone. Music playback quality was excellent, indistinguishable from the Zulu with that headset's music-enhancing Front Row Center (FRC) system turned off. FRC was a feature of the Zulu that users could turn on or off with a button. It's now always on for new Zulus and is not an option at all for the Sierra.

Our walk-away feeling for the Sierra was that it's a strong option against other ANR headsets in its class. But none of them have Bluetooth. The Sierra is comfortable enough for everyday use. It would be a great headset for passengers if you wanted to pamper them but also wanted to save a few bucks of outfitting an entire airplane with top-of-the-line models. But we have to admit we found it hard to step down to the Sierra right after test flying the Zulu and the Bose A20.

HOW TO CHOOSE

In terms of comfort and quiet, we feel Bose has earned bragging rights for the top spot in aviation headsets. Whether that level of performance is worth the $1095 price tag is the question that we simply can't answer; it's too much a personal choice. We can't imagine anyone being disappointed with the performance of the A20, however.

On the other end of the high-performance headset scale, the Sierra offers a compelling range of features for a competitive price. There's no other headset at that price point with Bluetooth connectivity to a phone. There are several with comparable ANR and music input, so if the Bluetooth isn't that compelling to you, there are many other options.

The other item worth mentioning is a module to add Bluetooth phone and music to a headset you already own. We reviewed the Blulink system in the January 2010 issue of *Aviation Consumer* and found it delivered on all its promises. The system runs $260-$310, depending on the connector you need. That's not peanuts, but it's cheaper than a whole new headset if you're fine with what you've currently got.

No matter what you choose, we strongly recommend you try all the headsets you're interested in, preferably for several hours of flight time before you make the final call. They're all good performers, but only you can put a price on what that performance is worth to your head.

CONTACTS

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Lightspeed Aviation
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www.lightspeedaviation.com

Pilot Communications USA
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www.pilotblulink.com

Silver Eagle P210: A Turbine That Works

The numbers on O&N's turbine conversion pencil out because the Rolls Royce 250-B17F/2 is exceptionally light and not as thirsty as other turbines.

by Paul Bertorelli

The turbine engine is impossibly alluring. No thrashing pistons, grinding cams, clicking valves—just far fewer exquisitely balanced parts all whirring in the same direction. But turbines are expensive and they guzzle fuel, which means that with very few exceptions, they don't work well in small airplanes. One of those exceptions is O&N Aircraft's re-engining of the Cessna P210 and 210 with the Rolls Royce (formerly Allison) 250-B17F/2 turbine engine, a powerplant that's been around awhile and one that Rolls is trying to evolve into more GA applications with the advent of a new version, the RR500. Mooney expressed interest in that engine, but thus far, the project hasn't materialized and it may not for the same reasons that turbines have stumbled before: difficult-to-manage fuel specifics and small airframes with no place to put the fuel.

The Rolls Royce 250-B17/F/2 is not only light, but compact. It's longer than the engine it replaces but weighs only about 200 pounds. Inlet, top photo, is heated to prevent icing.

Meanwhile, more than 100 of O&N's Silver Eagle-modified 210s are flying and we recently visited the company's shop in Factoryville, Pennsylvania, to evaluate the mod and do a flight trial.

No sugar coating here: The Silver Eagle, at $980,000 complete, is not a cheap mod. On the other hand, it's superbly engineered, performs well and has just enough range to make it practical. The 250 engine has proven reliable and relatively easy to maintain. In fact, given its weight and power output, it has significant advantages over the competing engine, Pratt's PT6.

HISTORY

This mod is no latecomer, having been perking along since about 1992, when industry veteran Myron Olson made it a signature product of the O&N shop, whose history dates back to 1986. O&N is a general maintenance shop with expertise in the Cessna 210 and P210 models, but with a line of mods including extended-range fuel tanks, con-

CHECKLIST

- **There's nothing quite like 450 horsepower to gin up climb and cruise performance.**
- **Silver Eagle is a turnkey mod done with excellent workmanship.**
- **At $980,000 complete, it's a high dollar mod, but still cheaper than new manufacture turbines.**

The Silver Eagle will typically be refitted with glass. Panel in top photo has Chelton FlightLogic system while more recent mods have the Garmin G600. Vacuum pump, lower photo, drives the pneumatic deicing boots.

trol modifications for Cessnas and nacelle wing tanks for Navajos and Senecas.

In order to make turboprop conversions work in light singles, the engine has to meet a narrow set of parameters with regard to weight and fuel consumption. There were only two practical choices, Pratt & Whitney's PT6 and the then-Allison 250, which eventually evolved into the 495-HP 250-B17F/2 when Rolls got hold of it.

For the Silver Eagle, it's derated to 450 HP, but that's still a ton of thrust for an airplane that originally had a 310-HP Continental TSIO-520, which some owners complain was never quite up to the task of high-altitude pressurized flight.

The turbine engine was originally developed in the 1960s by Allison as a helicopter powerplant and it found a ready market for that purpose. Like the PT6, it's a reverse airflow engine, meaning the incoming air makes a 180-degree turn into the combustion section, where it expands to drive a turbine wheel connected to a stub shaft that then drives the prop gearbox.

The 250 series is valued for its small size and incredibly light weight—about 125 pounds dry, plus another 75 for related hardware for a total nose weight of just over 200 pounds. The lightest of the PT6s weigh nearly twice as much. Of course, the weight cuts both ways, since the 250 is lighter than the gasoline engine it replaces, batteries and other gear have to remain forward.

Rolls has evolved the engine to produce better power and efficiency through an improved turbine and burner can, giving as much as 15 percent more power at altitude. That used to be an added cost option, but it's now standard.

Most of the Silver Eagle conversions have been performed on P210s, which was manufactured from 1978 to 1986. Of late, to expand the market, Olson told us O&N is starting to convert T210s and normally aspirated models as well. Obviously, these don't have pressurization, so onboard oxygen is a must. That said, the Silver Eagle does its best in the high teens to low 20s. It doesn't need to get to airline altitudes for speed and economy. Max altitude for the converted P210 is 23,000 feet, but higher with supplemental oxygen. At 23,000, it can maintain a 12,000-foot cabin.

WHAT'S INVOLVED

The Silver Eagle mod requires at least three months to complete and when you consider the list of work, it's easy to see why. O&N will take an owner's 210 or find one on the market and perform the conversion, which is essentially a remanufacture. When we visited the shop a couple of years ago, a 210 was stripped to its underwear and getting new wiring, a landing gear rebuild, air conditioning, a new interior and fresh paint. It gets new heavier vertical and horizontal stab mounts, too, plus reconditioned windows, new glareshield lighting and soundproofing. As required by cert standards, the elevator gets twin trim tabs.

The power quadrant is modified, of course, to replace the throttle/mixture/prop with the traditional turboprop power and condition levers. State-of-the-art avionics are options and lately, says Olson, O&N has been installing Garmin G600 suites with an S-TEC 55X autopilot. The version we flew had the Chelton FlightLogic system. TKS deicing is an available add-on and so are conventional boots driven by a 400-series pump. The engine has plenty of bleed air to blow up the cabin, but can't spare much for deicing.

Because their fuel specifics aren't quite as stingy as piston engines, turbines require more fuel…a lot more fuel. Here's where the 250's light weight comes into favorable play.

With the Continental shelved in place of the Rolls, the 210's empty weight decreases by 140 pounds, allowing total tankage—including wingtip add ons and a baggage compartment aux—to total 148 gallons. Most owners, says O&N, opt for both the wingtip and baggage tanks, Allowing for ground idle, climb and

Where to put the gas? All over the place. The Silver Eagle has wingtip tanks, upper photo, and a large baggage compartment aux tank, lower photo.

descent, that's about 5.5 hours of endurance. That still leaves enough room in the baggage compartment for a moderate amount of stuff. In the airplane we flew, the empty weight was 2699 pounds against a gross of 4016 pounds for a useful load of 1317 pounds. Full of gas, it's two people and light bags.

At cruise speeds typically in the 200-knot range, O&N claims a still-air range of about 1000 miles, which the airplane will do under ideal temperature conditions with a comfortable reserve. But like most turbines, it gives up performance to high and hot, so with wind considered, 800 miles with comfortable reserves might be a better all- around average, unless the wind is pushing.

FLYING IT

While 310 HP is hardly a piddling amount of power, 450 HP is just a whole hell of a lot better. And it shows immediately on takeoff. When we lined up on Seamans Airport's 2500-foot runway, it felt awfully short for something as heavy as a 210. With the power lever forward, however, it was obvious after 50 feet of takeoff roll, 2500 feet is a cakewalk. O&N claims a 600-foot takeoff and although we didn't measure it, we'll accept that on face value.

Max climb at gross weight is claimed at 2200 FPM and although we didn't see that, the 210 had no trouble loafing along at 1500 FPM, so the climb into the flight levels is typically going to be under 20 minutes, which is a must for milking max range out of the airplane. Although it's not sharply fuel limited, it also doesn't have fuel to spare so on long-range flights, pilots want unrestricted climbs to milk the best range out the available fuel.

By piston standards, initial takeoff and climb fuel flows are higher, but not insanely so. Olson told us he figures on 32 GPH for the first hour, then 21 to 23 for every hour thereafter. It's not practical to draw the power back to 17 GPH as you'd do in a piston aircraft by running lean of peak, so cruise flows are higher.

As you'd expect from the higher power, cruise speeds are higher, too, when compared to the Continental-powered P210. Owners tell us they fly the piston version at 175 to 190 knots true, but the Silver Eagle bores along on 210 to 215 knots. The piston version is often described as under-engined, but you'd never say that about the Silver Eagle. It has power to spare at any altitude.

But it is temperature limited. For our trial flight with O&N's Carl Reynolds, we arrived at 17,500 feet in 14 minutes at a cruise climb of 130 knots. The OAT was -5 degrees C, which is ISA +14. Fuel flow was 23 GPH for 180 knots TAS. On a standard day or a colder than standard day, says Reynolds, the airspeed would be as much as 10 knots higher. The engine's performance gradient relative to temperature is greater than the true airspeed gain with altitude. Winter cruise speeds in the 220s are doable. Cabin noise is whisper quiet, with no detectable vibration. If you didn't want to wear headsets, you wouldn't need to.

For as fast as it climbs, the Silver Eagle can come down just as fast. Chop the power to flight idle, point the nose over and down you go at 1500 FPM. Not enough? Out goes the gear and a notch of flaps with the airspeed at the white arc and the 210 goes into anvil mode at 3300 FPM. A piston engine might or might not tolerate this abuse, but for a turbine, it's just another day at the office. As far as ease of flight, there's not much to think about—just push the throttle forward and pull it back and keep tabs on the fuel.

If there was any surprise about the Silver Eagle, we would say landing it was the eye opener. Not to put too blunt a point on it, but the 210 is not the lightest pup in the litter when it comes to handling. It's moderately stiff in roll and almost truck-like in pitch. You can one-hand the flare, but it takes effort. It therefore feels like the airplane should approach at a high speed—it's not a jet-like 120 knots, but Reynolds recommended 90 knots on final.

Once again, confronted with Seamans' 2500-foot narrow runway, it feels like an overrun is just two

continued on page 31

AC TV

For a video demonstration of the Silver Eagle 210, log onto our sister publication, www.avweb.com, and click the video button in the upper right of the home page. Scroll down to the Silver Eagle video.

CONTACTS

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

Survival Systems: Unforgettable Training

Call it the ultimate in scenario-based training, Survival Systems teaches you to exit a ditched aircraft by strapping you in and dunking you underwater.

by Jeff Van West

Denial can be a useful thing when it comes to getting the job done. I've done my fair share of flying overwater and out of gliding distance to land, and just rationalized that the odds were slim of ditching and I'd figure it out when it happened.

The reality was that I didn't have a clue what being immersed in an aircraft would be like. I had no plan, and that meant that if the aircraft did anything other than stop upright and floating, I probably was going to the bottom wearing a 3000-pound aluminum suit.

The point of egress training like we sampled at Survival Systems Inc. is to give you that plan. It doesn't so much teach you how to egress your specific aircraft (although they do their best), but it gives you a system to stay oriented and get out. And, more importantly, it gives you a chance to practice while clothed, upside-down and underwater.

THEORY AND PRACTICE

Survival Systems has been around since 1982 when the company was founded in Halifax, Nova Scotia. Their current headquarters is just a short walk from the ramp at Groton Airport in Connecticut. They also have a seasonal location in Kenai, Alaska, and several military installations. In fact, military and government agencies represent 50 and 20 percent of their clientele respectively. The remaining 30 percent is almost entirely corporate aviation.

GA pilots taking their aircraft ditching course (they offer many other non-aviation survival courses) represent just a small fraction of what they do, and this shows in the classroom session that takes the first half of the one-day program.

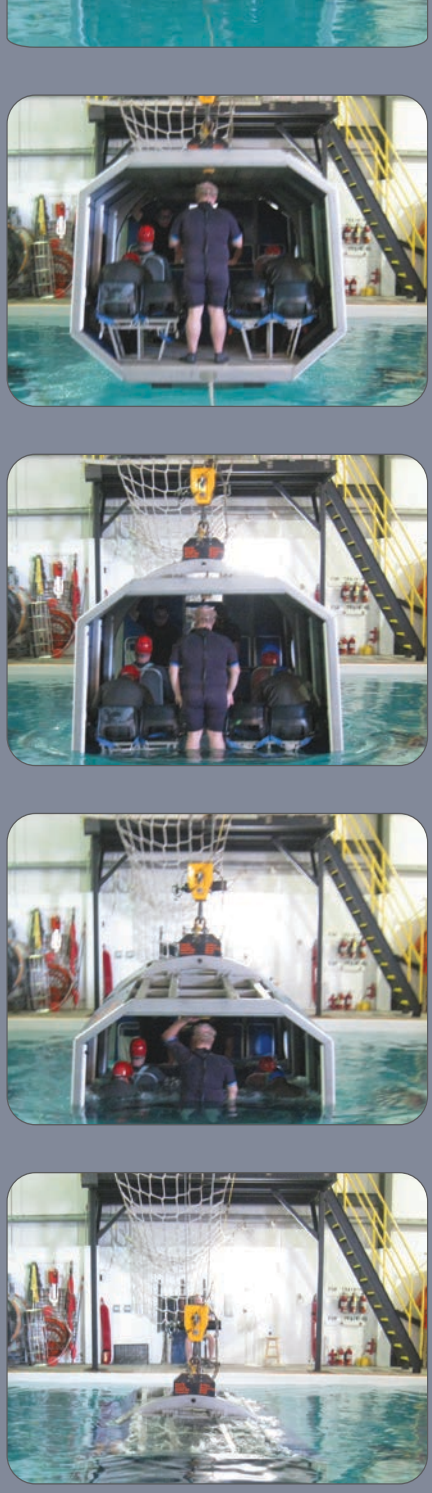
The class uses up the obligatory Powerpoint slides bulletpointing the stages of hypothermia and common aircraft survival equipment. There are written materials, but we felt they were poorly integrated into the live presentation.

Far more motivating is an effective use of video. They have both the footage of a CH-46 helicopter rolling off a ship and into the ocean during a botched landing in 1999 (it sank in 40 seconds) and the gripping, first-hand account of one of the Marines on board who managed to claw his way out. It's about this time you starting getting nervous about the afternoon's practical session.

There's also some telling video on Cold Shock Response that'll remove any illusions you might have had that you could perform just fine after a dunk in the Atlantic in January (although if you've got a bit of extra body fat, your odds do go up).

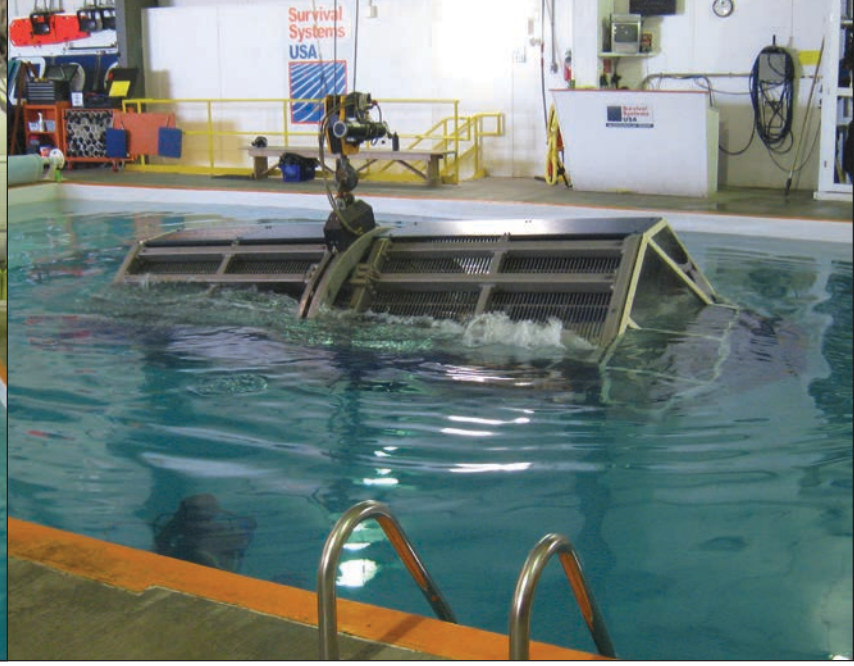
One thing we wished we'd seen more of in the morning was information on the actual ditching of the aircraft. The course covers securing yourself for the ditch, but there's nothing on the flying technique involved in making a good ditch.

We understand that this may simply be too far outside their field of expertise, but you may want to supplement your study with some other sources for a full ditching plan. The course also feels pitched more to rotary wing than fixed wing, but given



CHECKLIST

- ⊕ Nothing matches the experience of actually egressing underwater.
- ⊕ Instructors excel in teaching practical skills and allaying fear.
- ⊖ Classroom portion not optimized for pilots and omits what to do before hitting the water.



The METS (a.k.a., the Dunker) can roll to up to 180 degrees after it hits the water. The egress technique is the same whether you're right side up or fully inverted (below).

that offshore oil companies flying helicopters are a big customer, that's not surprising.

The classroom time did offer some information gems. Which side of the aircraft do you deploy the raft on? (Hint: Downwind is wrong.) Survival rafts have a sponge to get out the last of the seawater that gets inside. Cut this in half before you use it, so the unused half can be used to collect fresh water for drinking. The class time also allowed for good sharing between the participants and working out of questions the instructor didn't have a ready answer for.

The critical part of the morning, however, is prep of the techniques you use in the afternoon. Survival Systems' method is all about keeping a reference point to stay oriented to the aircraft, no matter what position it's in or whether you can see the exit or can see nothing at all.

You're briefed to stay belted in until you've found your door and opened it. Then you get a reference on the aircraft with one hand before unbelting and having your own buoyancy roll you about. Sounds easy enough in the classroom. You start feeling less sure when you change into the flight suits and water shoes you'll be wearing in the pool.

IN THE TANK

Any shortcomings of the morning are more than made up for in the afternoon. Our instructor, Glenn LaMarque told us that morning, "You will get water up your nose," and he wasn't kidding.

The Modular Egress Training Simulator (METS) used for the Groton course is reminiscent of a 10-seat aircraft fuselage configurable with various types of doors at every seat. It's attached to a hoist that can position and lower it into a 14-foot-deep pool. Survival Systems also has several smaller METS systems to represent different helicopters and other vehicles that might end up the wrong way in a deep pool someday.

The dunking doesn't happen right away. The big METS also has couple of flame trays in the ceiling to practice putting out a fire. This is coupled with a smoke machine isn't particularly frightening, but does get the point across about how challenging smoke and fire in the confines of a cockpit would be. Step two after the fire is getting out of the METS sitting on the water's surface and into a life raft. Practice for the next time you're floating on the Hudson.

Then it's dunk time and there's little bother with warming you up. The first dunk will be underwater and inverted, although they cut you the slack of leaving the door removed—the first time. Five runs in the sim are done, with it going under and rolling to different orientations.

In addition to one wet-suited instructor for every two students, there are also two divers in the water ready to help if needed.

For the last two, it's assumed your primary door is jammed and you must work across the sim to a secondary door.

The course is tailored to each student, so if you'd be expected to assist unknowing passengers out in the real world, you can practice it here. Fewer students can mean more runs. You can do it with your eyes closed or in real darkness, too.

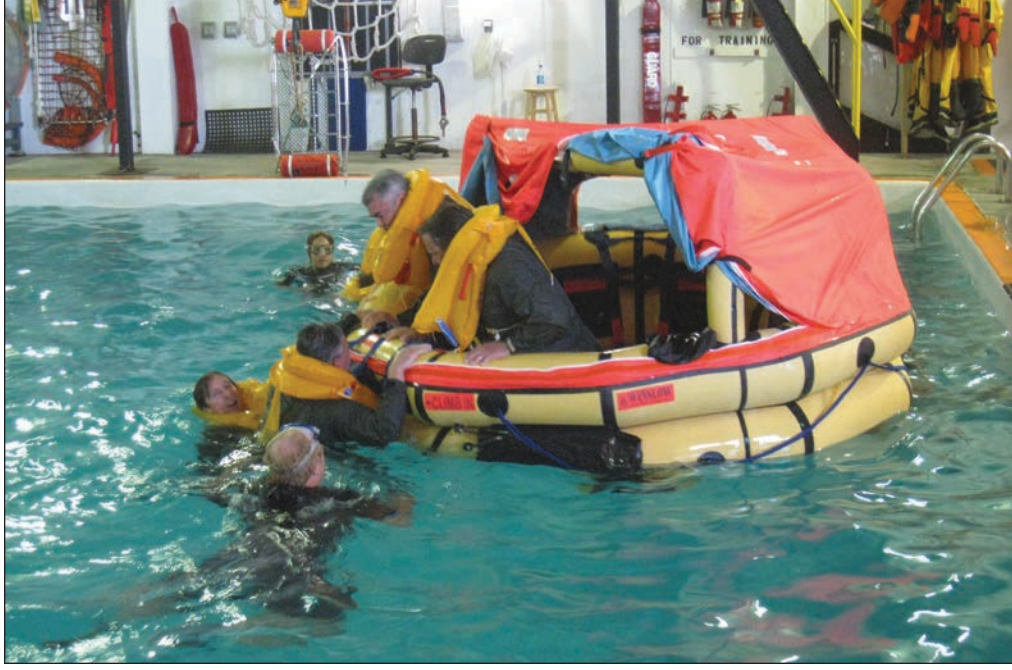
The METS layout and door options offer enough variability to practice having doors next to you or working your way back to a cabin door. You won't care that the door handle doesn't match your bird, and the body memory of the practice won't suffer for it. Practical tips are drilled here too, such as unwrapping your thumbs from the control yoke so they wouldn't break were it a real ditching and impact.

The first dunk is a shock and we partially botched the procedure, but it turns out there is more time than you might think to get oriented before acting. They are right when they say you need to stay strapped in to get and keep a reference before finding a way out. If you follow the procedure, you'll usually be up to the surface in 10 seconds or so.

That frame of reference is probably the most valuable take away from the course. Five dunks in the METS isn't going to make you an expert at getting out of your aircraft in a real-world ditching, but it gives you some concept of what it might be like. The experience is realistic enough to be seriously unnerving and lock the techniques into your memory, but not so real that you might actually, well, drown.

AC TV

To see the dunker in action, log on to www.avweb.com and select the video index. Pay no attention to the face of the worried and wet editor. It's not that bad. Really.



Your pool time includes techniques to stay alive in the water until help arrives, with or without a life raft. It also lets you practice a water rescue via a suspended basket. Participants all wear flight suits and shoes during the practical session. What? You think you'll be wearing a bathing suit the day you actually have to ditch?

There is at least one wetsuited instructor for each two students and there are two divers in the water as well. If you need help getting out, they'll provide it, but you'll pay for it by doing that simulation again. We saw that these folks were great at projecting calm and allaying fears. One instructor told us he's seen people in tears before getting in the tank and underwater 20 minutes later.

With the dunking done, the course continues to include a drop to the water, inflating life jackets and getting into life boats. There's also an opportunity to climb into a basket and collar to simulate a helicopter rescue from the open ocean. The pool is a balmy 85 degrees, but after a few hours of this you're ready for the final rescue and a trip to the showers.

NET TRAINING VALUE

At $650 for the day the course isn't cheap, but we think the course offers real value despite improvements we'd like to see. Survival Systems will run the course on demand, and will schedule it with even just one student. They also have a small mobile system that can travel to a pool near you for $250 per person plus travel expenses.

There are some competing companies out there. The Marine Survival Training Center at the University of Louisiana uses a METS made by Survival Systems. There are several small outfits as well in the Gulf region and some in Canada (Aviation Egress Systems and Pro Aviation Safety Training). These smaller outfits tend to use one-person dunkers, but they may offer better convenience for you or a lower price.

It's hard to argue with Survival Systems' experience, though. Since they started the business and combining the numbers for all their civilian and military facilities, the company has run about 70,000 people through different underwater egress courses.

Company lore tells of one student who finished the course and ended up ditching for real 36 hours later. We're told his first thought was simply, "I'm going to get water up my nose again." If that's what the fear of ditching can be reduced to, we'd consider the training time and money well spent.

CONTACTS

Survival Systems Inc.
www.survivalsystemsinc.com
888-386-5371

Grumman Tiger

A sporty balance of snappy handling, class-leading speed and a sliding canopy that has earned a cult-like following.

The Grumman Tiger owner culture is as unique as the airplane. To say these folks are enthusiastic about these airplanes is to understate the case. Most owners will energetically attest to the Grumman's sports car-like handling, healthy climb and slide-back canopy that slides back for open-air flight. There's arguably lots of appeal to these little cruisers. Non-Grumman enthusiasts just won't understand. Some call them silly little airplanes.

The population of Tiger airplanes is an aged batch—born in 1975, so owners were enthusiastic when the airplane went back into production in 2000 as Tiger Aircraft, LLC. It was a rejuvenated remake with some later copies sporting G1000 glass cockpits. But that was a rocky return and it ended in 2007 with financial turmoil and ultimate bankruptcy. Since, there's been lots of buzz of the airplane coming back but nothing close to real production has resulted.

With its slide-back canopy and snappy handling, the Tiger is truly a unique design.

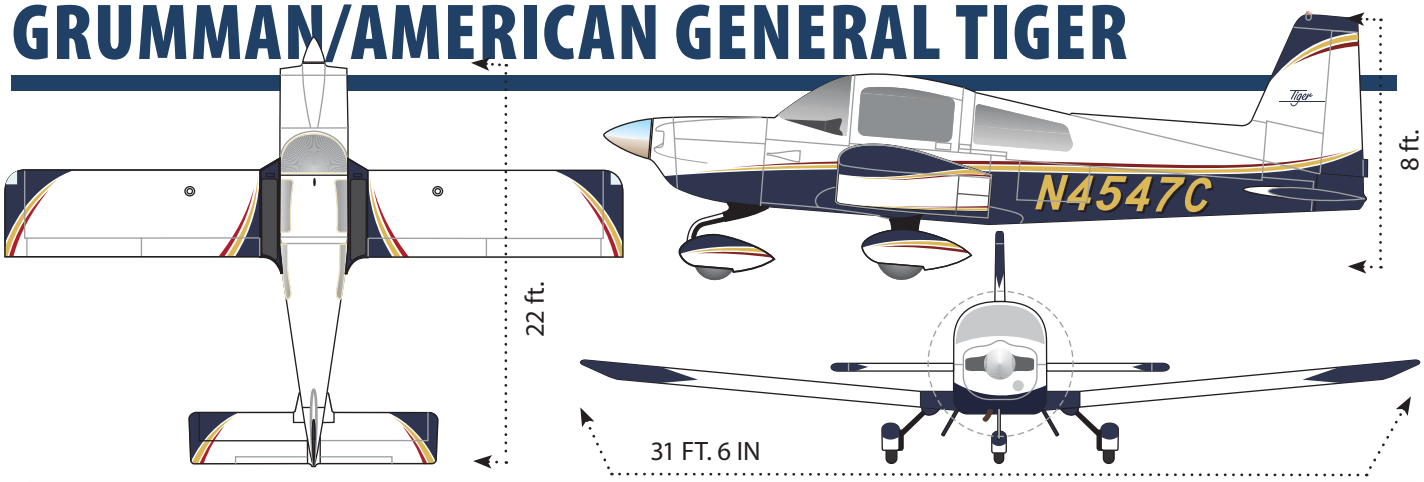
EARLY HISTORY

Flashback to the late 1960's when the model AA-1 Yankee designed by Jim Bede came on the scene. This was a two-seat airplane that was innocently targeted at student pilots but that proved to be a bad idea. The airplane was a bit too hotrod-like for students who were still on page three of their logbook. The Yankee featured revolutionary construction, aluminum-honeycomb sandwich fuselage panels and bonded skins. The fuel tanks were housed within a tubular wing spar.

Following the Yankee was the four-seat AA-5 Traveler from American Aviation. It had 150 horses under the cowl and

Jim Viola's 2003 AG-5B, foreground of upper photo, won best of show at the American Yankee Association convention in 2009. That's a Cheetah in the number 2 slot.

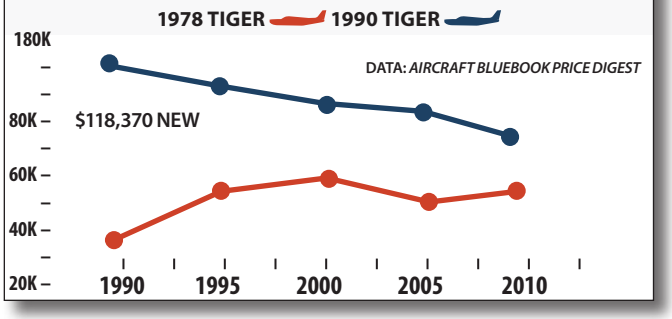
GRUMMAN/AMERICAN GENERAL TIGER



TIGER SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1976-1979 AA-5A CHEETAH	LYC. 150-HP O-320-E2G	2000	$20,000	38/51	800 LBS	128 KTS	±$36,000
1975 AA-5B TIGER	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	$41,000
1976 AA-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	$43,000
1977 AA-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	$45,000
1978 AA-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	$47,000
1979 AA-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	$49,000
1990 AG5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	$69,000
1991 AG5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	$74,000
1992 AG5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	$79,000
1993 AG5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS.	135-140 KTS	$84,000
2002 TIGER AG5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	900 LBS	135 -140 KTS	$120,000
2003 TIGER AG5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	900 LBS	135 -140 KTS	$130,000
2004 TIGER AG5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	900 LBS	135 -140 KTS	$140,000
2005 TIGER AG5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	900 LBS	135 -140 KTS	$150,000

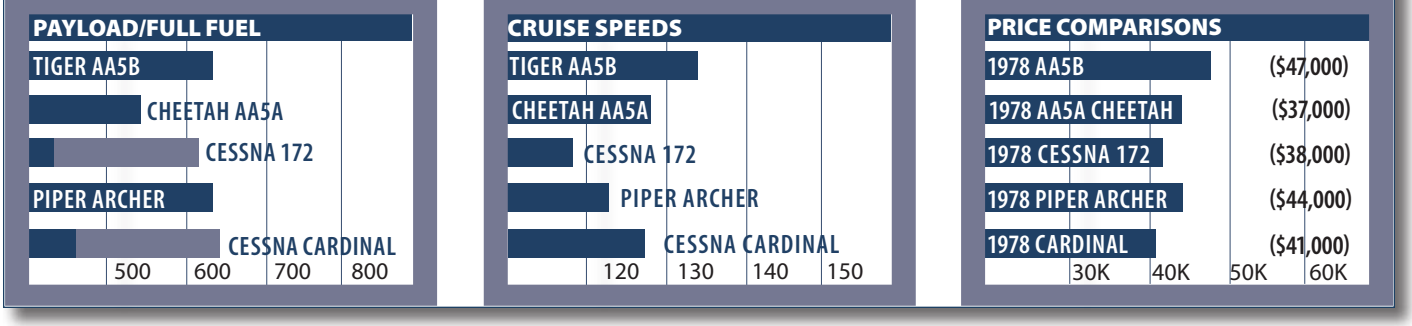
RESALE VALUES



SELECT RECENT ADs

AD 81-24-03	CARB AIRBOX INSPECTION
AD 79-22-04	AILERON TRIM TABS
AD 77-08-03	STATIC SOURCE VALVE OVERHAUL
AD 76-22-09	OIL COOLER CHECK, REPLACEMENT
AD-76-01-01	UPPER ENGINE COWL HINGES

SELECT MODEL COMPARISONS



The Tiger's panel is exceptionally well designed with clearly labeled switches readily at hand and a large, center-mounted pedestal. Note the fuel switch, with the you-can't-possibly-miss-this gauges and labeling. Still, one pilot mispositioned the selector, killing the engine.

more traditional fuel tanks. Gone were those dangerous sight-gauge fuel gauges that held avgas inside of the cabin. It was a different airplane.

The Traveler tried to compete with so-called complex aircraft such as the Cessna 177 Cardinal and Piper's PA28R-series Arrow with little success. It wasn't until Grumman stepped in, threw its money on the table and involved the famous Roy LoPresti to work his aero magic on the design. The result: the AA-5B Tiger.

The inside and outside of the cowling saw some changes including a 180-HP O-360 Lycoming that runs hot. More on that wart later. There was more fuel capacity and a different elevator plus some signature LoPresti and slick airframe mods. Many of these smooth mods made their way to the Traveler to mold the model AA-5A Cheetah (the Cheetah retained the lesser 150-HP Lycoming). To this day, the Tiger is the preferred machine and clearly more desirable than the Cheetah to many buyers.

The airplane was a reasonably brisk seller until production ended in 1979 after Gulfstream bought the line, where the focus was on building posh jets. Clearly, Gulfstream is a success story with or without the little Tiger but perhaps Gulfstream knew something Cessna didn't when it pulled the plug on the Tiger, because the industry subsequently tanked and Cessna threw in the towel shortly thereafter on its single-engine line of pistons. It was an ugly climate.

REBIRTH

Flash forward to the late 1980s when the Tiger was born yet again at American General, who introduced the AG-5B around 1990. This lasted until 1994 when the company flat-lined. The parts inventories and rights were sold to Fletchair, one of the two main suppliers of Tiger support and a licensed distributor for new factory parts.

Original production for the AA-5B was 1323 airplanes, while 900 AA-5As were built. A total of 834 AA-5 Travelers were produced, as well. American General built around 150 AG-5Bs before it folded. There were no major design changes during the Tiger's production run, although there were some refinements. In 1977, much-needed soundproofing was improved and windshield thickness doubled to a quarter-inch. Other changes included minor aerodynamic refinements, including rubber fairings on the landing gear, improved windshield sealing and the addition of a nose-strut shock absorber. In 1978, the iron-butt-inducing seats were improved, and U-strips were added to the trailing edges of the control surfaces to prevent delamination of the bonds.

NO FRILLS

We wouldn't exactly call the Tiger a Cadillac of the skies. It's stark and a relatively no-frills dwelling but this adds to some of the appeal. As with most airplanes, anything goes in the avionics retrofit world with owners loading oodles of electronics into the panel, including glass displays, autopilots and multiple IFR GPS systems.

Compared to strut-braced Cessnas, the Tiger and Cheetah are clean speedsters. The Tiger has a published book cruise speed of 139 knots but owners generally plan on real world speeds of 130 to 138 knots. This isn't chump speed, since the AA-5, by virtue of its slab-sided honeycomb panel fuselage, is hardly slick in the drag department. Hard chines run along the lower corner of the fuselage, and the wing-fuselage junction has no fairing to smooth interference drag.

The saving grace here is the bonded construction with flush rivet heads. The Tiger is the fastest of the line since the Cheetah makes 12 knots slower, with the Traveler bringing up the rear and slower yet, but will still blow away a 150-HP Skyhawk or older Warrior. Later 160-HP versions of the Warrior, with

speed pants, can just about run with a Cheetah, however.

Where Skyhawks and Cherokees could have a slight edge is in climb. At sea level and standard temperatures, the Tiger moves out at 850 FPM, about on par with the competition. (With a climb prop, a Tiger may see 1000 FPM.) But throw in high density altitude and the Tiger's climb performance sags behind the Archer and Cessna's strutless Cardinal. The Cheetah, with 30 fewer horsepower, can be a dog in hot weather climbs.

Some energetic and skilled Tiger owners tweak as much climb as possible from their airplanes—essentially ignoring the book procedures and climb with some flaps hanging out. If the takeoff includes clearing some obstacles on the other end of the runway, taking off with one-third flaps might get the job done less the pucker factor.

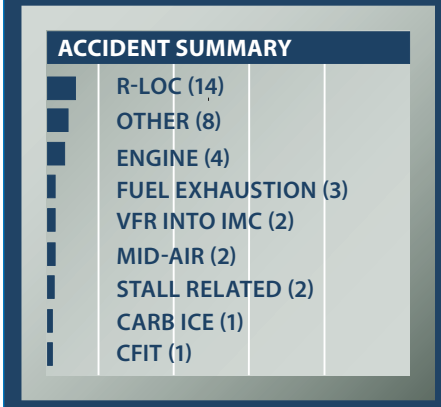
ACCIDENT SCAN: LOW INCIDENCE OF FATALS

Two things were surprising about our review of Tiger accidents. First, there weren't that many of them and second, if you want to kill yourself in one of these airplanes, you have to work at it.

The incidence of fatal accidents for most airplanes we review is between 25 and 45 percent. But the Tiger's fatal incidence—the number of accidents that are fatal compared to the total—is a remarkably low 13.5 percent. Moreover, Tiger occupants have survived crashes that are fatal in other airplanes. We found, for example, one stall/spin and one CFIT in which the occupants survived.

Otherwise, the accident record is unremarkable, with runway loss-of-control (R-LOC) leading the list. The "other" category is number two, containing a range of accident causes too weird to classify.

The R-LOCs include a number of overshoots and undershoots, plus the usual mayhem involving crosswind mishaps and simple loss of control, further evidence of one enduring truth in aviation: The single most reliable consistency in aviation is that at the runway/sky interface, some pilots simply aren't good at maintaining control reliably.



PAYLOAD, RANGE, HANDLING

Gross weight of the Tiger is 2400 pounds and typical IFR aircraft run 1450 to 1500 pounds empty. That leaves a useful load of about 900 pounds for the 180-HP four-placers. That's enough for full fuel (51 gallons) and three adults, plus a little baggage. The Cheetah has an empty weight only slightly less and a gross of 2200 pounds with useful loads around 750 pounds. Since the Cheetah is a weak climber, loading full fuel into the optional 51-gallon fuel tanks makes it a two-place airplane.

But loading might not be a huge issue anyway since the Cheetah lacks any remarkable baggage space. Any heavy items like large golf bags or snowboards need to come into the cabin and be laid over the back seat. Center of gravity is normally not a problem in either the Cheetah or Tiger, which is a good thing.

The Tiger's 51-gallon fuel capacity yields about four hours of endurance with reserve—a pretty good fit for the aircraft.

Realistically, you'll need to plan on still-air range with full fuel in the tanks to be about 500-plus miles. The standard-tank Cheetah, by comparison, has shorter legs. The 38 gallons you pump into it is good for a bit less than four hours, with reserves. This equals about 450 miles. As a two-placer with the optional 51-gallon tanks full of fuel, the Cheetah will fly a lot longer than you'd be comfortable staying in it. As for handling, proud owners are spot on when they say the Tiger is a sports car of the skies. It's light and responsive with somewhat touchy controls, which really makes it an autopilot airplane for hard IFR. The popular autopilot for the airplane is of course the S-TEC 20 or 30 with altitude hold.

Landing is a reasonably easy affair in a Tiger (the Yankee, on the other hand, sinks like a flying manhole cover when the power is pulled off). Owners will say the airplane floats and adding insult to injury, coming in with extra speed in the airplane is a setup for the classic runway overrun—a common thread in the wreck reports.

These airplanes have a swiveling nosewheel (it doesn't caster all the way around) so taxi is accomplished with brakes. As with any castoring nosewheel, this takes some skill. Experienced Grumman pilots know just the right amount of speed to make the rudder effective for most turns.

If you try to push a Grumman back into its tiedown without a tow bar to help, you'll risk both damaging the nosewheel and create a comedy show on the ramp. And when it comes time to chock the airplane, put the chocks under the mains and not under the nosewheel.

The drill for slipping the surlies in the airplane consists of riding the brakes a few seconds until the rudder comes alive after angling the airplane a bit right of centerline. Once engine torque starts kicking, the wheel straightens and it's off the brakes pretty quickly. Pilots new to the Grumman get all kinds of tense about that castoring nosewheel, but there isn't really much to it. Admittedly, castoring nosewheels can play with your emotions.

OPEN CANOPY

Talk about Grumman Tigers and the first thing that comes to mind is that fighter-jet-like sliding canopy. We've all seen the ads of pilots with both arms out the canopy in flight grinning like goats. This slick canopy makes getting in and out of the airplane a minor challenge if you have stiff muscles. Technicians curse them. Plus, you'll get wet in the rain, but rewarded with excellent ventilation on hot days during taxi (and in flight).

That show-off canopy, however, can take its toll in a crash situation. There's a chance pilots will get trapped in the aircraft if the fuselage

The phrase "sports-car-like" is probably over-applied to aircraft, but it's true of the Tiger. That's Dave Ferrell's AA5B based in Ocala, Florida, above. The price to be paid is semi-awkward ingress, lower photo. Pop the seat cushion off its pan to spare the upholstery.

bends or warps to the point where the canopy can't slide open. Keep a hammer in the aircraft to smash your way out of the thing if you wreck.

The Tiger's interior and panel have stood the test of time, although many airplanes sport cracked interior pieces and broken instrument panel trim and overlays. This is true of most vintage airplanes, but there's lots of plastic in a Grumman. The fuel selector is idiot-proof, although without a "both" selection, it does require switching tanks. For the fuel-management challenged, the switch is intuitive with arrows pointing to the active tank. The selector is conveniently located and quite visible.

Working the electric flaps is accomplished with a toggle switch up on the center pedestal/console, but you'll need to look down at the indicator to see how much flaps are hanging. Experienced Tiger pilots tend to simply count to five for half flaps. A slight quirk of the switch is that if you hold it down to extend the flaps and let it go, it snaps back over center and retracts them again. Gotta watch this.

The Tiger/Cheetah interior is comfortable, and the panoramic visibility and canopy view makes it feel roomier than it really is. Linebackers will complain about lack of shoulder space. A unique and useful feature of the cabin is the fold-down rear seats, which provide a six-foot-long cargo compartment that will hold a couple of mountain bikes, several golf bags or ski equipment for those excursions to the mountains.

MAINTENANCE

Mechanics access the engine through the split cowling and in general, the Grumman is designed to be easy to service. It's a simple airplane with no retractable gear, hydraulics or other complicated systems. As a result, owners boast of low operating costs and excellent dispatch records.

A wart in the design is the absence of cowl flaps and the tightly-cowled engine has been known to run hot. Caring for the engine baffling is a must and many owners advocate engine monitoring systems. These monitors have been known to register upwards of 450 degrees, a big number for a low-output four-cylinder.

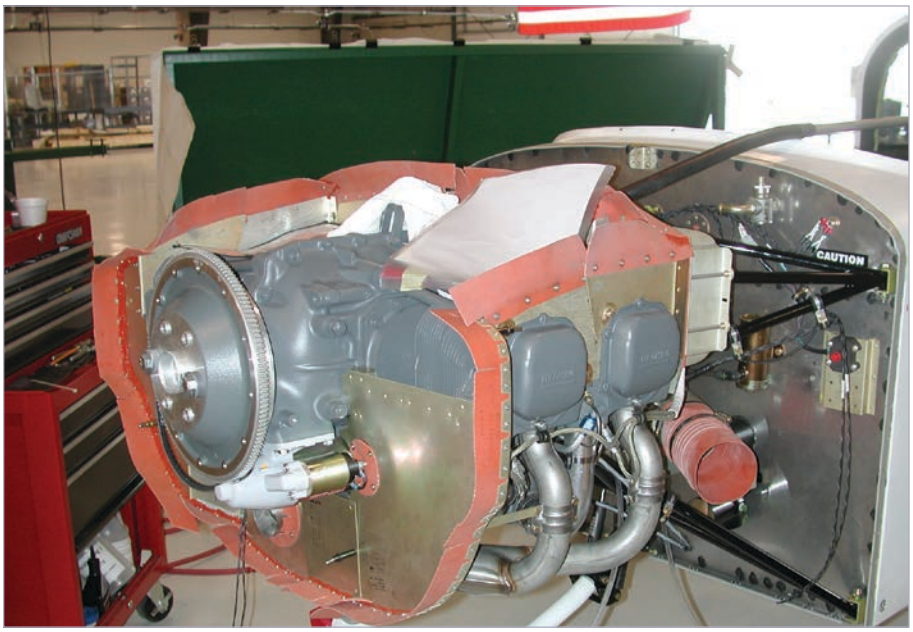
Although it shouldn't be a problem for any current airplanes still flying, bond-line separation plagued a few early models. The culprit was an improper bonding sealant, American Cyanamid FM-123, known as "purple passion" among production employees. The FM-123 was used in all Grumman-American aircraft built between April 1974 and December, 1975—including Tigers up through about serial number 125.

At least one delamination occurred in flight in a 1975 Tiger, but no accident resulted. At least two Tigers, serial numbers 15 and 19, were virtually rebuilt from scratch because of bonding problems. According to a former production employee, 30 or 40 honeycomb fuselage test panels somehow found their way into production aircraft, possibly affecting Tigers with serial numbers below about 30.

A 1976 AD required rivets along bond lines and the problem has since receded. But any buyer of a 1975 or early 1976 Tiger should be aware of the potential for problems. You can check for the defective glue by pulling off the wingtip and inspecting the bonded seam at the spar-to-rib or rib-to-skin joint. If there's a purple line, you may have a problem.

The Tiger/Cheetah castoring nosewheel can induce shimmy. Improper tensioning in the spring washers, sloppy torque tube struts, worn tires and loose axle nuts all contribute to nosewheel shimmy. If there's a single piece of hardware on the Grumman that requires attention and extra care, it's this nosewheel. Lube it and adjust it by the manual is the requirement. (Not many shops have the manual and readers tell us that improperly performed maintenance on used airplanes for sale is common.)

The 1977 and later models have a shock absorber in the nosewheel, which helps, but these make removal of the nose gear a pain in the shorts.



Lycoming's parallel valve 180-HP O-360, top, is a reliable choice for the Tiger, but tends to run hot. Access is easy through the split cowl.

If you have persistent shimmy problems, see a mechanic who specializes in Tigers. And this is a good time to mention something odd: We're not sure why, but some mechanics and shops in general shy away from Grummans—a snub of sorts. Several shops told us that some Grumman owners tend to bellyache about maintenance costs when they surface because they're caught up in the "little airplane" mentality. The Grumman may look like a little toy, but it's a real airplane that requires real maintenance. Don't expect a free ride from most mechanics when the airplane hits the shop.

Pre-1979 Tigers (s/n 1047 and below) had problems with cracking spinners, possibly related to propeller vibration. Virtually all Tigers in the field have been retrofitted with improved spinners, but check to make sure. One experienced Grumman mechanic who wrote to us says that even the new spinners have problems.

The Tiger was an early pioneer of the current trend toward castoring nosewheels and that means brake pads wear quickly. Although savvy pilots learn to taxi with minimum braking, good brake maintenance is important. Several owners reported repeated breaking of the rudder springs, and one owner told us he always carries a spare, just in case.

Just like Mooneys, Tigers have wet wings and it's not uncommon to smell leaking fuel. An AD addresses the fuel tank sealant.

The airplane is relatively AD-free but there are two significant inspections: one 200-hour inspection of the McCauley prop hub for cracks and a 100-hour inspection of the ailerons.

One potentially onerous AD cropped up in 1998: AD 98-2-8 calls for inspection of the hollow crankshafts bore for corrosion pits or cracks. It's a shotgun AD that applies to a number of airplanes with Lycoming engines. If nothing turns up, an anticorrosion treatment takes care of the AD once and for all. If cracks are found, the crank needs to be replaced, and if corrosion pits are found, the AD becomes a 100-hour repetitive inspection until a new crank is put in at overhaul.

PARTS, MODS, CLUB

The Tiger is unusually well sup-

Larry Tatsch's Tiger in cruise flight over Lake Michigan. "Even without that complexity, I routinely cruise at 135 knots and could wring another couple of knots out of it if I didn't mind wasting fuel."

ported, in our view. Fletchair (800-329-4647 and www.fletchair.com) has long specialized in Grummans. When American General folded, Fletchair acquired the parts inventories and manufacturing rights. FletchAir, Inc. is known worldwide as the single largest manufacturer and distributor of parts for American, American General, Grumman-American, and Gulfstream-American copies.

David Fletcher, President of FletchAir, has grown up with the Grumman family of aircraft and has been a stocking Grumman dealer since 1974.

Air Mods NW (www.airmodsnw.com) does wing repairs, refurbishments and upgrades, and has a number of STCs for the Tiger. Air Mods also sells oil coolers and a baffle modification that reduces oil temps by 25 to 40 degrees. This is a worthwhile mod in our view, given the heat these engines throw.

Air Mods can turn Travelers and Cheetahs into Tigers with a 180-HP conversion. They also can convert Travelers and Cheetahs to constant-speed props and install split nose and lower cowlings, plus wingtip and wing-skin embedded halogen landing lights and roller canopy tracks. They can also handle honeycomb and wing repairs as well as interior and engine work.

Fletchair has a split nose cowl STC, which eliminates the need to take off the spinner and prop to get at the starter, alternator and front engine baffles. This applies to the 1975 Traveler up through the 1979 Tiger. The AGAC Tiger already has a split nosebowl, as do the newer Tigers that came from Tiger Aircraft.

Another recommended mod is a Sensenich propeller in place of the AD-plagued McCauley. This also eliminates an annoying RPM restriction between 1850 and 2250 RPM in descending flight—right at the usual ILS approach speed. Unfortunately, installation is not intuitive and common installation errors have led to problems with the bulkhead and/or propeller attach bolts.

Other mods of note: Approach Aviation (www.approachaviation.com has a ram air induction kit; Powerflow (www.powerflowsystems.com) has a tuned exhaust system; Dallas Metroplex Aviation or DMA has speed mods for the Grumman (www.dmaspeedmods.airweb.net).

And of course, LoPresti Speed Merchants has their signature cowling (www.speedmods.com).

Grumman owners enjoy one of the best owners groups around, the American Yankee Association. It has an excellent newsletter, sponsors regional fly-ins and serves as a pipeline to technical expertise. The group also has a special group insurance plan that may save you money and can direct you to approved instructors for Grummans. Contact www.aya.org.

READER FEEDBACK

I'm now over 200 hours in Grumman Tigers, and they are a consistently dependable and simple aircraft to fly. Admittedly, learning to fly a Tiger after training for 70-plus hours in a Piper Warrior, my first reaction was that they were a bit touchy and difficult to control.

Now (and after only a few hours with a Grumman savvy instructor), I understand that they respond well to a light touch, are truly a sports car of the air and are safe when flown with an eye to some key numbers on approach. The agile handling and extreme ground maneuverability are a fine combination. These are fun, fast aircraft to fly.

The best safety recommendation I heard when learning to fly then was: "Don't land these aircraft too fast." Many C and P brand pilots don't have experience with aircraft with smooth skins, and are more used to the draggy flight characteristics of planes with rivets on the wings and fuselage.

The Tiger will glide better and will not bleed off speed as fast as some aircraft. Speedwise, 70 knots crossing the threshold is a good target, which generally equates to somewhere near 1500 RPM with full flaps on final. If you bring it in too fast, it will not just flop to the runway. Set up a controlled approach and manage airspeed for a highly predictable result.

The compact cowling can create some cylinder overheating problems if the mixture is too lean or the baffles are in bad shape. Cowl mods are available from a number of sources that offer better cooling and lower drag than the square inlets native to Tigers.

It's important to keep cylinder temps under 400 degrees F in cruise to minimize coking on the valve guides and reduced cylinder life. Lean aggressively on the ground to avoid lead build-up on the lower plugs and use a lead scavenging run

at the end of the flight (run up to 1800 RPM, lean, wait 30 seconds) to keep things clean.

Older aircraft typically do need parts to replace some of the original ABS plastics, and I've replaced the horizontal stabilizer on two different aircraft with fiberglass. Parts and support are very available with great customer care from Fletchair and a cadre of talented A&Ps that can handle these birds is easily reachable through simply asking on the Grumman Gang (www.grumman.net). Painting requires working with someone who knows how to handle the bonded wings, but there are many of those shops around.

These aircraft flight plan at 130 knots almost universally. They typically get 700 FPM climb at lower altitudes and 90 KIAS even in warm weather. Burning about 11 gallons per hour at 8000 feet, leaned out, they have almost a four-hour cruise capability (maintaining reserves) on their 52-gallon tanks, of which only 50.5 are usable. Still, that's bladder-busting endurance.

I pay about $1000 a year for insurance for a VFR pilot. Annuals run about 20 to 24 hours of time (I have a great A&P in Forest Hill, Maryland) and unless I'm installing a new tach or fuel flow or doing something else that's an upgrade, I can predict a reasonable annual expense.

Two full-sized bicycles fit well into the cargo bay (front wheel removed) when the rear seats are folded down or removed. Simple, fast, and capable of hauling three 200-pounders even with full fuel (mine has a 930-pound useful load), this versatile aircraft is a great value and performer.

Peter Langlois
Leesburg, Virginia

We purchased our Tiger new at the West Virginia factory in November of 2003. Since that time, we have flown the aircraft 500 hours; day, night, IFR and VFR. The aircraft has been fool-proof. The only unscheduled maintenance we have had to confront was a failed ship's battery at about 300 hours.

The aircraft consistently burns 9.2 GPH while truing 132 knots. The only operational concern we have experienced is a tendency for the cylinder head temperatures to reach into the yellow when climbing heavily loaded at high OAT.

The aircraft came from the factory equipped with dual Garmin 430s, transponder, audio panel and S-TEC 30 with altitude hold and nav tracker.

Options we have added to N50BX include pulse lights, four-probe EGT and CHT, fuel totalizer, Stormscope, air/oil separator and fine-wire spark plugs. We have also mounted a Garmin 496 to provide XM radio and weather. We accomplished the dual WAAS upgrade as soon as it became available.

Knowing what we know now, would we purchase another Tiger? Absolutely and without hesitation.

John L. Geitz
Roanoke, Texas

After earning my private pilot license in 1997, I joined a flying club and flew a 1974 Cessna 172 and a newer Piper Archer II. After a year, I realized that we could make good use of an airplane if it were available on our schedule. I read about the Grumman Tiger, and was impressed with owner comments and its speed relative to others in its class.

After a brief search, I found a 1977 Tiger that was in good condition but could use some avionics, paint and interior upgrades. I've continued to upgrade my Tiger since purchase, adding a Garmin GNS430W, an EGT/CHT gauge (which I consider a necessity), new paint and interior. My Tiger is IFR certified. It is a very competent instrument platform.

I've had my Tiger for 12 years now and have flown between 70 and 100 hours per year. Among the more lengthy trips my wife and I have taken were from Princeton, New Jersey, to Cody, Wyoming, Fredericksburg, Texas, and last year to Red Deer, Alberta. We did the return trip from Texas to New Jersey in one day—about 12 hours with two fuel stops.

Maintenance and annuals are pretty straightforward, with no more than the usual surprises. The simplicity of the design and lack of constant speed prop and retractable gear reduce maintenance costs and improve reliability. Even without that complexity, I routinely cruise at 135 knots and could wring another couple of knots out of it if I didn't mind wasting fuel.

The American Yankee Association, the club for all Grumman aircraft, is a great support group, with lots of helpful experts willing to share their expertise and a great annual convention.

Larry Tatsch
Ringoes, New Jersey

Silver Eagle

(continued from page 20)

or three knots of excess speed away. Ah, but there's a method to this madness. Fly short final at 90 knots, slow it toward 80 over the numbers and plop it on the runway. It's a bit graceless, but when you pull the prop past the detent into Beta and stop in 500 feet, you get over that. It's an absolute agita reducer to have the reverse thrust available. Between it and amount of takeoff power available, the Silver Eagle can get into and out of runways where the Super Cubs are parked.

CONCLUSION

Unless our Berkshire Hathaway stocks pay off beyond our wildest dreams, we're unlikely to be able to afford a mod like the Silver Eagle. But we nonetheless concede a fondness for it. It's a nice match of the right size powerplant to an airframe that's not made anymore and that slots it into a unique niche.

Further, O&N is old school, meaning Myron Olson comes from the days when a mod business considered customers as long-term clients, not just one-off opportunities for a sale. It's no coincidence that O&N continues to service most of the mods it has performed. It has also picked up support for the products of one of its competitors, the Tradewind Tubines Bonanzas, which also use the Allison turboprop.

When we visited O&N in June, the company was completing work on yet another conversion—turbines for the popular Cessna 340 pressurized twin. We'll take a look at that mod in a future issue.

No Slam Dunk

(continued from page 7)

aircraft will be stagnant or perhaps even dropping by some 1 percent a year between now and 2040," he adds. He rightly notes that avgas has and is vanishing outside the U.S. and is even threatened in the U.S. This, in part, is why Continental decided to buy diesel technology it could rapidly develop rather than invent its own. It wanted a nimble response for the U.S. market but also to remain a player in offshore sales growth, which is almost certain to demand heavy fuel engines.

"Diesel," adds Tiessier-duCros, "when debugged, will be much more reliable and less costly to maintain. So, if TCM working on the SMA license decides to go all the way and finally come out with a reliable diesel, I estimate that they will equip still only 10,000 planes in 2016, of which only 800 will be in the U.S., but 50,000 airplanes in 2020, of which 5000 will be in the U.S."

We know that just about every aircraft manufacturer has looked or is looking at diesel powerplants. Alan Klapmeier told us that Cirrus took a run at both the SMA engine and Thielert's 4.0. The former had cold weather start issues, he said, while the 4.0 was just too heavy. Cessna announced a Thielert-powered 172 in 2007, but drew back just as Thielert was going under, saving itself untold grief, we're sure. Cessna's Bob Stangarone told us the company is still examining diesel, but he declined to say which ones.

Among the diesel cognoscente, it's accepted that the threatened extinction of avgas is market force enough to sustain heavy fuel engines, despite their shortcomings. But can the shortcomings be fixed?

Luc Pelon of SMA thinks so. Part of that will be educating both buyers and aircraft manufacturers of diesel advantages, including that they aren't always heavier than gas engines and that they don't smoke and vibrate. In other words, he thinks diesel shortcomings are more perceived than real.

Thus far, among modern diesels, the SMA SR305 is the only engine with power density similar to gasoline engines. Thus far, it doesn't appear to have the short service cycle and maintenance headaches of the Thielert, but only about 100 SR305s are flying, compared to more than 1000 Thielert/Centurion models, including many in military UAVs. Pelon concedes that the cost of converting existing aircraft to diesel is too expensive.

"If you do as many engines as Lycoming and Continental have in the past, then you are going to get your return on investment for manufacturing castings and forgings and so forth," says Pelon. But you can't change the laws of physics; compression ignition will always require higher compression ratios and cylinder pressures and that translates to more structure. Minimizing that structure to save weight requires careful application of technology and that, in turn, requires more investment. Pelon says SMA's market surveys suggest that buyers will opt for a diesel that's up to 15 percent higher in cost than an equivalent gasoline engine, so that's the market target. Reliability and durability are assumed—say at least a 2000-hour TBO—but the crunch comes because buyers are expected to take that on faith. It hasn't been demonstrated yet.

And that's why Continental's entry into the market is so significant. It's a major engine company with the clout to sell diesel to an OEM or two. Cirrus seems a likely candidate. If Andre Tiessier-duCros's numbers are close to reality, diesel will ramp up slowly and will still rely to some extent on North American sales.

To benefit from the economy of scale that Pelon sees as necessary to drive down purchase costs, some magic volume number is a must, although no one knows what that is. We agree with the diesel optimists about the inevitably of the trend lines that point to aircraft diesel being sustainable, but we also note that it hasn't happened yet. Sustainable means the company making the engines doesn't go bankrupt and that it can demonstrate sales in the hundreds and thousands, not in the dozens.

FEEDBACK WANTED

ROBINSON R22

For the December 2010 issue of Aviation Consumer, our Used Aircraft Guide will be on the Robinson R22 , the world's most popular light helicopter. We want to know what it's like to own these helos, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like yours 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 information on the R22 by October 1, 2010, to:

Aviation Consumer
e-mail at:
avconsumer@comcast.net