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The Aviation Consumer®

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The Aviation Consumer

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THE ANR HEADSET MARKET IS SHRINKING

While I was recently shopping at BestBuy for a wireless music speaker, a salesperson who arbitrarily remarked that Bose was the best got me thinking about pilots shopping for premium aviation headsets, a market dominated by Bose and also Lightspeed for as long as I can remember. While Bose may be the most recognizable name in both the consumer audio and aviation headset markets, don't forget that Lightspeed Aviation was a major force in shifting the market from passive to active noise cancelling headsets in the early 1990s. It sold something along the line of 300,000 sets before eventually trying its hand at wireless and software-driven models (both greeted with lukewarm reception), then recently shifting focus to the more utilitarian Zulu3 model. At $850 it easily holds its own against the pricier $1100 Bose A20.

Meanwhile, a sizable chunk of competitors, including Sennheiser, Beyerdynamic and Harmon AKG, threw in the towel. These are long-established and respected specialty audio companies (I use Sennheiser gear in the guitar studio and consider it benchmark quality), but couldn't survive against Bose and Lightspeed in the premium headset space. Veteran David Clark still stands with the credible $695 Pro-X ANR model.

In the July 2017 issue of *Aviation Consumer*, we awarded the Lightspeed Zulu3 an editor's choice award and said it was the best mid-priced ANR headset, but Lightspeed's Allan Schrader was quick to counter that the company doesn't consider the Zulu3 a mid-priced model. Depending on what you're willing to pay for a headset, you might feel the same way. Still, with a price of $850, it's $250 less than the Bluetooth-equipped Bose A20. That's a sizable spread and when talking about premium aviation headsets, some might consider the Zulu3 to be mid-priced when the most expensive one is $1100. Who knows? As grim as it may sound, with no fewer than three major brands vacating the under-$1000 category, maybe someday there won't be enough choices to even have categories. The shrinking pilot population isn't the only reason the headset market is thinning out. The market is simply saturated.

Lightspeed's Schrader recognizes that the pool of qualified buyers needing a premium headset continues to shrink because the majority of them already have them. Moving forward, I wouldn't expect to see much of a change. If you haven't shopped for headsets in a while, you won't have to worry about being swayed by standard features because the Bose A20 (the flagship model equipped with Bluetooth) and Lightspeed Zulu3 are nearly an equal match when it comes to battery life, volume controls and other features buyers expect in a premium headset.

Schrader, who spends most of his time when he's at tradeshows working in dealer booths (sometimes selling competitors' headsets when buyers want them—which has got to be painful) admits that quietness just isn't the biggest distinction among premium ANR models these days, and after trying them on, buyers usually concur. Instead, the fighting ground ultimately comes down to comfort, which is determined by personal fit. There's also the durability factor, something Lightspeed has addressed in the all-metal Zulu3 by adding Kevlar audio cables and extending the warranty to seven years.

After watching ANR headsets evolve and ultimately mature over the past 20 years, I'm not sure Lightspeed or Bose can make a headset that's substantially quieter or even more comfortable than they are now, which are the two main metrics that drive a buyer's willingness to upgrade. If you're among the willing, how might you choose either a Bose or Lightspeed? Just like picking a music speaker, it's simple—try them both. No matter your brand loyalty or budget, you will know which one is the best only after you fly with each. —*Larry Anglisano*

DIAMOND VS CIRRUS

I read the report on the Diamond DA50 in the June 2017 *Aviation Consumer* with interest. Diamond is ambitious and impressive. I also notice that the DA50 has a steerable nosegear.

As a current Diamond DA40 owner who has experienced a pilot seat sliding backward in the seat rails while climbing out (in a Cessna), I very much appreciate the non-moving seats in my Diamond. The airplane came with a three-point seatbelt airbag and overall seems like an extremely crashworthy machine.

As for whole-airplane parachutes, I've given quite a bit of instruction in a Flight Design CT LSA and once found the sky ahead filled with seagulls and wondered if I would shortly need to pull the red handle, but I'm ambivalent about it when I'm flying the Diamond. For me, the cost of servicing the CAPS in the Cirrus was one of the negatives in buying a used one.

Will Hubin
via email

In your recent Diamond coverage you touched upon a pretty important point that could eventually give Diamond an advantage over Cirrus, and that's autonomy.

As you pointed out, Diamond has being flying with an autoland system in the DA42. As a charter pilot who has dealt with my share of skeptical passengers, the idea of an airplane being able to land itself could have more credibility than a whole-airplane parachute, which on the surface is pretty crude by comparison.

Chuck Loeberman
via email

MORE ON THE CESSNA CJ2+

As a longtime *Aviation Consumer* subscriber and the owner of a 2008 Cessna CJ2+ light jet, I agree with your conclusion in the HondaJet article sidebar (July 2017 issue) that the CJ2+ is a great value in the used light jet market.

As for the Alpine Edition, Cessna announced it for the CJ2+, but to date has not had it certified. The company had one demo Alpine Edition CJ2+ flying, but none have been delivered to customers.

What was not mentioned is that Rockwell Collins recently certified and completed the first customer deliveries of the Proline Fusion in the Cessna CJ3. It is expected that the company will next be working on a certified Fusion interface for the CJ2+. The expected cost is around $350,000 and the Proline Fusion has ADS-B and WAAS LPV capability as standard equipment.

The cockpit picture you used in the article was an older CJ2 panel with Garmin GNS530. The CJ2+ has Proline 21 avionics and the FMS3000 nav system.

Finally, for folks shopping the Citation market, a valuable resource is the Citation Jet Pilots (CJP) owner pilot association. It's at www.citationjetpilots.com.

Allen Wolpert
via email

IGNITION BOOSTING

Sorry, but after reading Jim Cavanagh's article in the July 2017 *Aviation Consumer* about the Champion SlickStart ignition booster, I don't get it. I have owned three turbocharged Piper Aerostars—a 601P, 602P and a 700P—and all three of them had the will-not-start-when-hot problem. In the summer, I timed my fuel stops with long lunches.

Finally, by the time I owned the 700P there was a solution: a better starter. As an electrical engineer, it was clear to me that if the starter turned the ignition faster, the built-in stock magneto would put out more spark. A quick search found Sky-Tec starters, which work on normal and counter-rotating engines.

I found that since they spin so fast, my hot and cold starting problems were gone. My point is why further complicate last century's design with an unnecessary bandage. The engine simply needs a modern starter. I have no affiliation with Sky-Tec (and Hartzell Engine Technologies)—I've never even spoken with the company. I simply bought its starters and found that they just worked for me.

Perhaps there should be another article that digs deeper into my theory.

Dennis Wisnosky
via email

We've heard similar stories from other readers, but also from ones who have fast-turning starters and still have problems with hot starts. We'll dig deeper in an upcoming article. While the iStart product isn't an ignition booster, product developer Damon Berry weighed in.

"Engines with very slow-turning Delco starters may be part of the problem and might benefit from a faster turn rate because there is prop momentum carrying it through when there is uneven cylinder firing at the beginning of a start sequence," he said.

Remember that the real problem with hot starts is not necessarily getting it to fire, but instead getting it to keep running after it starts. A faster spinning starter won't be much help.

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Navcomm Buyer's Guide: Equip For How You Fly

If you use ground-based navs, Garmin's GNC255 is a modern standout, while PS Engineering's PAR200A saves space as an integrated comm and audio panel combo.

by: Larry Anglisano

On the verge of extinction nearly 10 years ago, the standalone navcomm radio barely soldiers on today. While there are few choices for new ones (there's a much larger market for standalone comm radios), a navcomm installation could make sense for basic panels and for advanced ones to back up a GPS.

AVIONICS MARKET SCAN

Hang on to your wallet. If the panel hasn't seen a radio upgrade in a while, you could shell out more money than you anticipated to upgrade the antenna system and gut out old wiring.

In this upgrade guide, we'll scan the VHF radio market and first talk a bit about upgrade strategies.

BUY WHAT YOU NEED

Before diving into a navcomm installation, consider how you fly. If you haven't dialed in a VOR frequency or flown an ILS approach in years, you probably don't need a full-up navcomm. For VFR missions, tablet navigation apps and portable GPS navigators might be good enough to skip ground-based navaids altogether.

But even for light IFR, you might want two comm radios and will need one navigation radio with approach capability, including glideslope.

Another upgrade scenario might be a well-equipped panel flown IFR with a modern primary system (maybe a Garmin GNS, GTN or Avidyne IFD navigator), which has a secondary navcomm that's on the fritz. Maybe it's an old Narco or King KX170B. Here you'll need to decide if replacing it with a modern comm radio is all you really need.

Save some money and shop the used equipment market. There are plenty to choose from, but knowing what's compatible is key. You'll want to solicit help from a trusted shop because radios come in different voltages and various versions that might not have a glideslope receiver, audio amplifier or the circuitry to properly work with the existing OBS indicator. This is true of the venerable BendixKing KX155 series—a popular used-market seller that falls in the $3000 price range for a newer model that's been well cared for. As we'll point out, a single bench repair can add $1500 to the investment.

Maybe a WAAS GPS installation is the better choice and more so if an ADS-B upgrade is done at the same time. If you've priced an ultramodern navcomm installation like Garmin's GNC255, you'll know the price can soar above $6000. For that buy-in, it could make sense to consider a used Garmin GNS430W. It will cost more, but the ability to fly GPS approaches is generally worth the price delta, plus it's an approved position source for interfacing with an ADS-B Out system. We've heard from buyers who scored decent ones for a $7000 investment, after install.

If you determine that a standalone navcomm (or comm transceiver) fits your flying and budget, you'll need to determine if it fits the existing stack without pricey rework. There are plenty of options for avoiding that. Here's a rundown of the latest gear.

CHECKLIST

- Garmin's ultramodern GNC255 is a cost-effective alternative to a second GTN navigator.
- PS Engineering's PAR200A includes two choices of transceivers in a feature-rich audio console.
- For older aircraft, budget modestly for antenna and wiring upgrades.

GARMIN

The two transceivers in Garmin's lineup are the $1995 GTR225 and $4495 GNC255, which has a VOR, localizer and glideslope receiver.

In the stack at the top, the Garmin GNC255 navcomm backs up the GTN650, but ask yourself if you really need a second navigation radio. A standalone comm is cheaper and easier to install.

The internal comm and nav boards trickle down from Garmin GTN-series navigators. We like that the radios have chassis-mounted cooling fans, USB ports on the bezel and are available with 16-watt transmitters (10 watts is standard) for high-flying applications. This higher power spec is common in the jet world where talking longer distances is a requirement.

You won't find touchscreen on these radios. Instead, they use traditional buttons and knobs that have a rugged feel. The volume control, squelch control and navigation radio IDENT control layout and functionality is carried over from Garmin's old GNS430 and 530 navigators. Both radios are the same size, measuring 1.65 inches high by 6.25 inches wide by 10.4 inches deep.

Garmin built some smart tech into the radios, starting with an internal frequency database (airport and VOR frequencies) that's loaded through the bezel USB port. You can search the database by airport identifier just like you do with a GPS navigator, and since the radios accept GPS position through a serial data connection, the radio shows distance, speed and time to the station. For ground-based navigation duties, the GNC255 has an onscreen CDI.

As we would expect in a modern radio (and carried over from the SL30 and SL40 radios they replaced) the GNC and GTR radios allow you to monitor the audio of the standby frequency without having to tune off channel. Contact www.garmin.com.

PS ENGINEERING'S INTEGRATED PAR200A

A couple of years ago, PS Engineering teamed with U.K.-based Trig Avionics and designed the PAR200A. On the surface, this is a signature PS Engineering audio control system, IntelliVox four-seat intercom and wireless cabin entertainment controller. Smartly, PS Engineering also included comm radio control in the feature set. It doesn't manufacture the VHF radio; the PAR200A connects with Trig's TY91 remote transceiver through an RS-232 serial data interface. Frequency tuning and radio control is done directly on the audio panel's backlit LCD display.

Since it's a two-piece system (it's actually three systems in one, if you count the intercom) and requires audio jack wiring throughout the cabin, plan on a sizable installation. The remote radio is 5.5 inches long and 1.7 inches high, the right size for mounting in an avionics bay or behind the instrument panel. But combining all of the audio functions in a single control head makes it a worthy option if you want a simple and uncluttered radio stack.

Icom's A220, top, was born from the company's land-mobile product line and has durable controls, a bright display and a smart feature set. The PS Engineering PA-R200A, middle, channels the Trig TY91 remote transceiver, bottom. The transceiver is also channeled with Trig's miniature control head, shown in the middle.

While integrated, there's at least some failsafe built in with redundant power inputs to the VHF radio and audio panel. Standard features include Bluetooth connectivity, a duplex telephone interface that generates a ringtone for incoming calls, a five-frequency comm radio storage and memory bank, plus unswitched audio inputs for connecting attention-getting aural alerts.

We found the PAR200A's feature set intuitive and easy to navigate, which is the way a comm radio and audio panel has to be. Saying that, there is a lot to the user interface, but the features you use most—like changing comm frequencies—are kept simple. Tuning the radio is done with dedicated channeling knobs on the right side of the bezel. Tune it in the standby side and push the outer button to transfer it to the active window.

Select which VHF audio you want to listen to (and which radio you want to transmit on) with selector keys to the left of the display. The audio panel can accommodate two comms and two nav radios, although Trig doesn't make a VHF nav receiver; the system takes audio input from an existing standalone radio.

The intercom is full functioned

WHICH NAV DISPLAYS WILL PLAY?

Before EFIS, navcomm installations were straightforward. Simply wire to the OBS indicator or for advanced panels, connect to an analog HSI like a King KCS55A or Century NSD360. These days, retrofit EFIS—especially new ones like Garmin's G5—have digital databuses that might not be readily compatible with analog nav receivers. This could have you rethinking your upgrade strategy if you're sourcing an older radio on the used market. Some navcomms might share a mechanical CDI with a GPS, using external switching relays. EFIS installations are much cleaner because all of the switching is handled digitally, without external relays and mode source switches. But the software has to be compatible.

Aspen Avionics made the upgrade process easy early on when it designed the Evolution retrofit PFD. While the display doesn't accommodate analog nav signal inputs directly, its optional external ACU (analog converter unit) converts raw analog data to a digital format. This is what makes traditional radios like the KX155, for example, Aspen compatible.

Garmin's recently introduced G5 directional instrument with EHSI doesn't have an external converter for analog nav input. Instead, it connects directly with Garmin's own GNC255 navcomm, plus the discontinued Garmin AT SL30 radio over a digital databus. Since it can't receive analog nav data, it's not compatible with vintage radios including the BendixKing KX155 or the current KX155A. That technical snag misses a sizable chunk of the budget upgrade market, in our estimation. The G5 will work with all vintages of the GNS430 and 530, plus the current GTN650 and 750 navigators because they can be wired in directly over the digital bus.

If you don't have EFIS at all, Garmin's GI-106B (and older GI-106A) is fully compatible with the GNC255. Of course, ditch the nav altogether and compatibility isn't an issue.

and includes many of the features PS Engineering builds into its flagship audio panels, including entertainment input with custom muting control, allowing you to set when and how the entertainment audio mutes. There's also a music volume control.

The PAR200A is priced at $2995 with the TY91L and installation kit. The base system has a 6-watt VHF transmitter (this isn't a powerhouse), and the $5095 version has the high-powered (16 watts) TY91H. Contact www.ps-engineering.com.

TRIG AVIONICS

If you already have an audio panel, Trig sells the TY series with a space-saving miniature control head. It fits in a standard 2.25-inch instrument cutout or any area on the panel that can accommodate the 2.4-inch-wide by 1.8-inch-high chassis assembly. Total system weight is roughly one pound. The controller only occupies roughly three inches behind the panel, which offers flexible mounting options, especially for backup.

For stack mounting, the 10-watt TY96 comm transceiver stands 1.3 inches high, has a two-place stereo intercom with auxiliary inputs for aural alerts, a built-in playback recorder for listening to the last transmission and Trig's "push step" function, which speeds frequency tuning.

The TY96 can interface with Garmin GPS navigators to display frequencies based on position, plus there is an internal airport database (CSV files are loaded through a bezel-mounted USB port) capable of storing 200 frequencies and identifiers.

The TY97 is a version with a 16-watt comm transmitter. The TY96 is street priced at $1998 and the higher-powered TY97 is $2699. Contact www.trig-avionics.com.

ICOM IC-A220

You might recognize the Icom name from the amateur radio market and from its long-standing line of aviation portable transceivers. But Icom's

panel-mounted A220 VHF radio is a lost ball in the tall grass, perhaps the result of shops not suggesting it as often as other brands. That's unfortunate because we think Icom's latest A220 has a decent blend of quality and generous features. Installation might be streamlined because Icom offers wiring adapters for plug-and-play with some vintage radios.

The two-pound A220 fits in a standard radio stack and measures 6.0 by 1.0 by 10.0 inches. It has an 8-watt transmitter and like its portable brethren, comes standard with a frequency memory bank with programmable six-character channel name (it can store 200 channels), a NOAA weather channel receiver, plus one-touch 121.5 MHz emergency frequency access. The Dual Watch function monitors the active and standby channels simultaneously.

The newer OLED (organic LED) display is a big improvement over the display used in older versions of the radio. It provides better wide-angle viewing (the specs say almost 180 degrees) and better contrast when splashed with bright sun.

The radio can be wired for a two-place voice-activated intercom and the feature set includes a timer, plus an option for external frequency transfer with a yoke-mounted switch.

The A220 helps battle receiver noise with a function Icom calls ANL, for automatic noise limiter. This is internal filtering for stray noise that might work into the receiver. This might be some help in fabric aircraft where the VHF comm antenna has a marginal ground plane. It shouldn't be used as a substitute for substandard wiring.

Speaking of wiring, the A220 can be connected with Garmin and BendixKing GPS receivers through an RS-232 serial port for loading in frequencies, based on position. Got fat fingers in turbulence? The radio has a dial and key lock so you don't inadvertently tune it off frequency.

Icom offers a TSO'd version, which may not be required. We've seen the non-TSO A220 street priced as a low as $1100 and the TSO version around $1500. Contact www.icomamerica.com.

BENDIXKING, TKM

Once the king of all navcomms, the BendixKing KX155 (and KX165, which is compatible with mechanical HSI systems) is officially out of production. We still consider them good used market deals, but consider that replacement gas discharge displays—a common failure item—aren't available. Instead, there's an upgrade path that modifies the KX155/165 radio with an LED display, and the later KX155A/165A with LCD displays. It can run just north of $1500.

Another option is BendixKing's KX155/165 factory refurbishment program. For $1750, you get the new display, new display lenses, a new bezel, control knobs and a one-year warranty. Despite recent rumors, there is still field support for repairs that may be needed for these radios.

If you don't want to sink big money in an old KX155, TKM Avionics is working on the new MX155 navcomm, a digital plug-and-play replacement with modern processing and touchscreen. It's expected later this fall in the $3000 price range and the company says aircraft owners can easily do the swap out and sign it off with a logbook entry. We'll cover the MX155 and the updated line of TKM radios when the MX155 is certified.

TKM Avionics has been showing the MX155 prototype, top photo, which is designed as a direct replacement for the venerable King KX155, shown on a repair bench in the bottom photo.

As a primer: Based in Scottsdale, Arizona, the company was saved from the ashes a few years ago by a new buyer who invested big in updating the MX-series replacement radio line, which includes the MX300 for replacing old Cessna 300-series navcomms. The product line also includes models for replacing old Narco radios, including the MX11 and MX12.

TKM sells direct to customers, plus it's building a dealer network. The idea of a plug-and-play radio upgrade isn't new. The company sold over 37,000 of them over the years. Visit www.tkmavionics.com.

BendixKing still sells the KX155A/165A navcomms. The radios operate on 28 volts, so if you have a 14-volt electrical system, the installation will require a voltage converter. BendixKing recommended the Mid-Continent Instruments TC-series converters, which sell for around $900.

BendixKing still sells the "flatpack" standalone KN53 nav radio and KY197A (14-volt) and KY196A (28-

PRODUCT	TYPICAL RETAIL	RECEIVER	COMMENTS
BENDIXKING KX165A BENDIXKING KX155A	$5990 $5500	VHF comm, nav and glideslope.	Earlier-generation KX155 discontinued.
BENDIXKING KY196A BENDIXKING KY197A	$5590 $5990	VHF comm.	Standalone flat-pack comm radios that differ by input voltage.
BENDIXKING KN53	$7290	VHF nav.	Standalone version of the KX155, with built-in glideslope.
BECKER AR6201	$1700	VHF comm.	Two-piece radio, compact.
GARMIN GNC255	$4495	VHF comm, nav and glideslope.	Advanced feature set including frequency and facility database, plus databus for GPS interface.
GARMIN GTR225	$1995	VHF comm.	Comm-only version of the GNC255.
ICOM IC-A220	$1100 non-TSO $1500 TSO'd	VHF comm, NOAA Weather.	Generous feature set, high-quality display, low price.
PS ENGINEERING PAR200A	$2995	Remote VHF comm via Trig TY91 or TY92.	Combines audio control, four-seat intercom and VHF comm control in one console.
TKM MX155	TBD	VHF comm, nav and glideslope.	Designed as a plug-and-play replacement for the KX155. Expected Fall 2017.
TRIG TY92/91 TRIG TY97/96	$2999/$1325 $2699/$1998	VHF comm. VHF comm.	TY91/92 are remote mounted and the TY97/96 are stack mounted.
VAL COM 2000 VAL NAV 2000 VAL INS 429	$1125 $1295 $1995	VHF comm. VHF nav. VHF nav.	Slim footprint, budget priced. COM 2000 is plug-and-play with SL40 comm radio.

volt) comm transceivers. Equipped with a glideslope receiver, the KN53 has a eye-widening price of $7290. The KY197A starts at $5990. Contact www.bendixking.com

MORE SPACE SAVERS: VAL AVIONICS, BECKER

While it gets little exposure, Salem, Oregon-based VAL Avionics has been in business for over 30 years and makes the COM 2000, which is plug-and-play compatible with the discontinued Garmin AT SL40 radio. It's a slim radio that stands barely 1 inch tall and weighs 3.25 pounds.

The COM 2000 has an 8-watt transmitter, 15-frequency storage bank with user-defined alphanumeric channel identifiers, plus it has an RS-232 serial port for communicating with experimental EFIS displays. The accompanying nav radio is the $1295 NAV 2000, which shares the same slim footprint as the COM 2000 and is equipped with a VOR and glideslope receiver. It's also compatible with a variety of OBS indicators, including the BendixKing KI209 and Garmin GI106A/B.

Worth mentioning is VAL's $1995 INS 429 integrated navigation system, which has a self-contained VHF nav receiver and electronic CDI. It fits in a standard 3-inch instrument cutout and is also compatible with a variety of GPS navigators. Contact www.valavionics.com.

As part of the Compact Line of products, which also includes a transponder, Becker sells the two-piece AR6201. With a blue-on-white LCD display, the radio transmits 6 watts of power in a 12-volt electrical system. It also has a four-place voice-activated intercom, entertainment input capability, plus a 99-frequency storage bank, which will automatically store the last nine frequencies used.

The VAL Avionics COM 2000 and INS 429 nav head are budget-priced space savers. The INS 429 display has a self-contained VHF nav receiver, including glideslope.

We like that the RT6201 (that's the remote radio) supports two control heads, which may be useful in tandem-seat aircraft. It also has a scan mode, which monitors for chatter on the standby frequency. We found the radio advertised for around $1700, which we think is a decent value. Contact www.beckerusa.com.

A BIT ON PERFORMANCE

Keep in mind that none of the radios we cover here will provide acceptable performance without healthy antenna systems, which also includes the coaxial cable and connectors. If the aircraft hasn't seen an avionics upgrade in a while, you should plan on a complete rewiring job and be pleasantly surprised if the shop thinks the old wiring is good enough for flawless performance. That doesn't happen often.

Comm and navigation antenna replacement can get into some money, especially on pressurized and fabric-covered aircraft. As we've discussed in previous technical articles, you can often judge the health of a VHF antenna by eyeballing it. You'll know when an antenna has reached the end of its life when the fiberglass's coating wears off, revealing a brownish core and perhaps sizable cracks and peeling in the fiberglass itself. Nav antennas live especially tough lives since they're often installed at the top of the vertical tail in a fairing where they build corrosion. They might also connect to signal splitters to feed more than one nav receiver. They can deteriorate.

A symptom common to worn comm antennas is scratchy background noise in the radio receiver. Transmit and receive range might suffer as well. Our advice is to troubleshoot first before shotgunning radios.

While any of the equipment covered here will get the job done, our top pick is Garmin's GNC255 if you need a full-up navcomm. We think it has enough features and new technology to justify its price. For basic panels needing an intercom upgrade and a new comm, we think PS Engineering's integrated PAR200A is a solid value that saves panel space.

LED Lighting: Ever More Choices

As LEDs get more efficient, they're gaining market share. Look for expanding applications, but not lower prices.

by Paul Bertorelli

CHECKLIST

- There's now an LED replacement for just about every application.
- Brightness has improved and so has efficiency. Long-term durability means they can be left on.
- We're less impressed with expensive navigation and position lights. Incandescents are cheap and durable enough.

Been in a new car showroom lately? You'll be hard pressed to find a lowly incandescent bulb in so much as a dome light. The same is true for new aircraft. Not many are sporting old-school filament lamps for landing, taxi and position lights. As a byproduct of an avalanche of LED manufacturing, we've found more applications for these lamps than ever for legacy aircraft.

If you can't find the exact replacement for that old GE burner in your wing mount, stick around. It'll be along pretty soon. And the new products are brighter and more efficient than the previous versions and in many cases, they consume less power than first-gen LEDs did.

What they are not, however, is cheaper. For all their advantages, even the least expensive LEDs are still many times more expensive than the incandescent bulbs they replace. Although the manufacturers claim—and can support—that LEDs are basically lifetime bulbs, the $400 for a LED equivalent of a GE4509 will still buy more than 60 of the incandescents. Some owners, understandably, find the economics underwhelming.

TRENDS

Nonetheless, the aviation LED market is enjoying significant traction, with new products and applications appearing almost monthly. In fact, there are now so many offerings that testing them all has become a logistical impossibility. For this article, we're scanning the market's new products with an eye toward brightness measuring in a future article.

As in the LED industry in general and especially automotive, the overarching trend is more efficient LEDs with each new product cycle. As recently as a decade ago, we wondered if LEDs would ever be bright enough to be landing lights. No more.

"When we first started, LED efficiencies were in the range of 60 to 80 lumens per watt," says Dean Wilkinson of AeroLEDs. "Now, 120 to 150 lumens per watt is pretty

Whelen's Parmetheus landing and taxi lamps, top right, are into their second generation and at under $300, are the least expensive LED replacements. Two discrete arrays of LEDs are wired in series to improve durability. Coming from Aveo, lower photo, is the latest big thing: conformal wingtips that integrate position and strobe lights. Look for versions for the Cessna 100 series at AirVenture 2017.

SELECT LED LANDING/RECOGNITION LIGHTS

COMPANY* / PRODUCT	LAMP TYPE	RETAIL PRICE	COMMENTS
AEROLEDS			
SUNSPOT 36HX	Landing or taxi light	$435	PAR 36 lamp, the most popular size. Drop in for GE4509. Has integrated pulse/wig-wag feature.
SUNSPOT 36LX	Landing or taxi light	$339	Drop in for GE4509, among others. Lower current than HX. No pulse or wig-wag.
SUNSPOT 46HX, LX	Landing or taxi light	$639 to $735	PAR 46 versions of Sunspot to replace GE4522, 4577 and others. HX has pulse and wig-wag.
SUNSPOT 36-4596	Landing light	$559	PAR 36 drop-in for 250-watt GE4596.
SUNSPOT 36-4587	Taxi light	$559	PAR 36 drop-in for 250-watt GE4587.
SUNBEAM	Recognition light	$415	Recognition light for Diamond DA40, Columbia, some Cirrus and Grumman models. Features pulse/wig-wag.
AVEO ENGINEERING			
HERCULES 30	Landing or taxi light	$975	Part 36 replacement for GE4509 and others. Standard version can be landing, taxi and/or wig-wag.
HERCULES DROP-IN	Landing or taxi light	$895	Slightly shallower PAR 36 replacement to fit small mounts. No wig-wag. Hercules Drop-In Plus ($995) has pulse and wig-wag functions.
SAMPSON	Landing or taxi light	$1195	PAR 46 version of Hercules.
SAMPSON DROP-IN	Landing or taxi light	$1095	PAR 46 version of Hercules drop-in. Drop-In Plus version ($1495) has pulse and wig-wag function.
CRYSTAL CONFORMA	Wingtip position, strobe, rear position	$2500	Similar to experimental-only ZipTips, these are conformal wingtips that integrate LEDs, initially for Cessna singles. Other models may be planned.
TELEDYNE			
ALPHABEAM PAR 36	Landing and taxi light	$275	An early LED product. Basic PAR 36 with no other functions. Company didn't respond to queries about improvements.
ALPHABEAM II PAR 46	Landing light	$896	Follow-on product to PAR 36 light. Teledyne says it's aimed at commercial aircraft.
WHELEN ENGINEERING			
PAR36 PLUS	Landing and taxi light	$227.95	Basic PAR 36 replacement for popular landing light sizes.
PAR46 PLUS	Landing light only	$293.95	PAR 46 replacement for landing lights.

**** This chart provides a general overview of aviation LEDs approved for certified aircraft. Not all products are listed. Check the company websites for more detailed information. In future coverage, we'll examine navigation and position lights.***

common. So there's been a doubling of efficiency in the last eight years, probably. In the next eight years, you're probably going to see another doubling," he adds. Is this going to go on forever, to the point where a landing light can run on an AA battery? Probably not. "There is an upper limit. I think 200 lumens per watt is about it. Six hundred lumens per watt is 100 percent efficiency and that's not really possible," Wilkinson explains.

Not that what we've got is too shabby now. Our tests show that even the last generation of LEDs easily outshone standard GE incandescents. Color temperatures closer to daylight also means they create more contrast to illuminate details on runways and taxiways. Newer LEDs are either brighter or the same brightness at lower current draws. This changes the product development map.

"If you get the current down for the same light, or keep the current and get a lot more light, you've got room to play," Wilkinson says. As a result, look for more products that leverage the advantages of LEDs.

One of these comes from Aveo, a company that positions itself upmarket and has facilities in Florida, eastern Europe and India. The company's LED line covers a range of FAR Part 23 applications plus lighting for commercial air transport aircraft. Its latest offering, set to appear at AirVenture as we go to press this month, is called the Crystal Conforma. It's a composite wingtip structure for 100-series Cessnas that incorporates nav, strobe and rear position lights in a single unit.

These will retail for about $2500 for the pair. They're actually the certified version of a product called ZipTips for some experimental aircraft that also add landing lights to the mix. Understandably, gaining approvals for that under Part 23 is challenging, but we suspect Aveo will get to it eventually, given the attraction of a fully integrated solution. For the time being, as shown in the chart at left, Aveo has a full line of landing/taxi light replacements for many certified aircraft. Although we're not examining position/nav lights in detail in this article, Aveo also has a line of those.

OEM VS. LEGACY

Given the low volume of new aircraft, we would peg the market driver for LEDs as the legacy fleet. Not necessarily, says AeroLEDs' Wilkinson. The company does a fair amount of OEM business and recently became a supplier to Textron/Beechcraft and Pilatus. Wilkinson says these companies have switched to LEDs because—in both cases—subjective testing by company engineering and test pilots found them to be superior, even though the measured light output doesn't necessarily equal claimed output for incandescents. What's driving the legacy market? Probably an even mix of per-

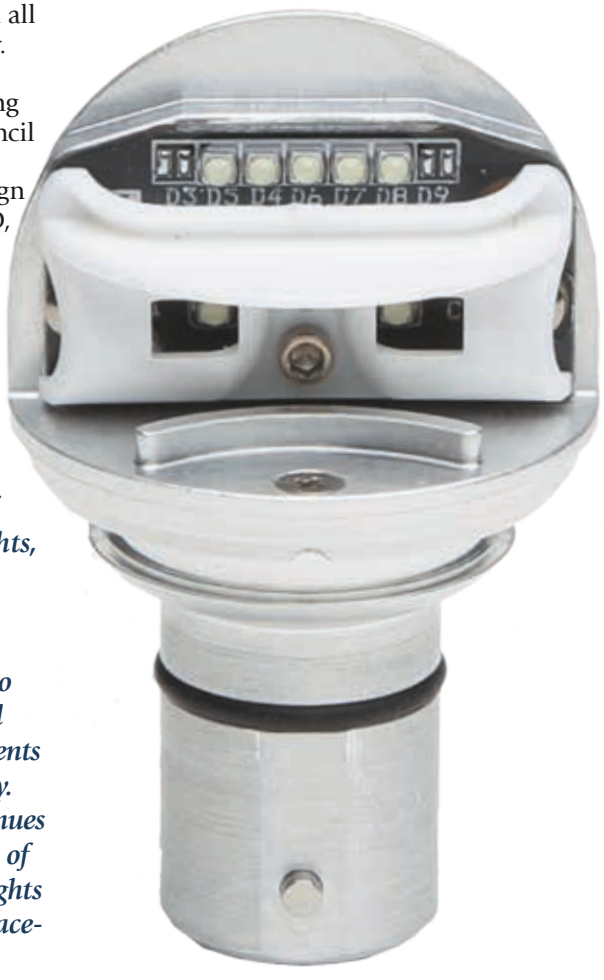
formance, durability and gadget lust. Wilkinson says there's price sensitivity in the legacy market, but it's hard to imagine that anyone shopping the web for a $10 GE4509 would suddenly be swayed by a $435 LED equivalent. Where owners find value, say the manufacturers, are in two areas. One, the lamps can realistically be considered lifetime purchases and since they can be turned on and left on, there's a payoff in conspicuity. Adding to that is that most of the bulbs include a pulse or wig-wag feature that's relatively easy to wire and activate. Then again, not everyone wants that.

"Our lights originally had a great deal of customization and flexibility in beam widths, wig-wag, taxi array, landing array…and a 50 percent intensity feature for helicopters operating in dust or snow," says Aveo's Rick Lindstrom. "We found that people were saying, 'Wait a minute. I don't want that. All I want is a light with two terminals that I can swap out,'" Lindstrom says. The company's $895 Hercules Drop-In meets that brief. AeroLEDs has similar offerings, with the $339 Sunspot 36LX representing the lowest rung on the product ladder.

As the product chart shows, the market is highly stratified by price, with Aveo in the top tier, AeroLEDs occupying a broad middle with a diverse product line, and Whelan and Teledyne at the bottom with sub-$300 offerings that don't have wig-wag, pulsing or intensity controls. For those companies—at least Whelan—product revision has consisted of upgrading when the next generation of LEDs appear. "As a general rule of thumb, we'll maintain a design for five to six years. We're also at the mercy of the manufacturers of LEDs because aviation is a very small user of LEDs," says Jeff Argersinger, Whelen's director of aviation sales.

LED replacements are brighter, cooler and consume less power than the incandescent bulbs they replace. But they do so at the expense of larger size, mainly due to a heat sink on the back of the lamp. Aveo's solution to this is its Hercules 30 Drop-In, right. It's slightly shallower than the standard version and thus will fit in more restricted mounting rings.

Whelan, he says, buys some 65 million LEDs a year across its high-volume product lines in vehicle lighting, so it has a good feel for what improvements are coming. Cree Inc. is the dominant supplier of LED components and manufacturers try to keep abreast of what it's about to introduce. But, as with all things in aviation, it's not that easy. "We can design optics for a certain size LED and now Cree comes along with an LED that's the size of a pencil eraser. Now our optics don't work with that. So now we need to design new optics. But if it's a smaller LED, maybe we can use more and get more intensity and maybe run them at a lower current. You can maintain that sweet spot so you're not over-driving them," Argersinger says. And that's exactly how

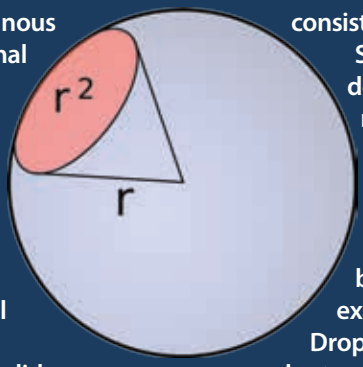


One emerging trend is increasing availability of drop-in position lights, such as Whelen's Chroma model at right. These are designed to meet TSO and FAA requirements for chromaticity. AeroLEDs continues to expand its line of landing and taxi lights with the PAR 36 replacement for the GE4596, left.

BRIGHTNESS EXPLAINED (SORT OF)

Compared to realistically evaluating specs on light output, nailing Jell-O to the ceiling is relatively easy. That's because there appears to be no agreed-upon method of comparing light output from aircraft lamps of any sort. In the end, as Dean Wilkinson of AeroLEDs told us, a subjective judgment is as good as it gets.

First, a short essay on the differences between candela, lumens and lux. After a fashion, they're all measurements of light energy, but like sound, light energy varies with distance from the source and it can be shaped and focused so angles matter, too. A candela—it's the same as candlepower—is a measurement of luminous intensity. It's directional and monochromatic. So a candela is the luminous intensity from a source of 1/683 watt per steradian. If you don't know what a steradian is, don't feel bad. It's the standard international unit of solid angular measurement and allows light to be measured consistently in angular, three-dimensional space. A steradian is a cone shape that emanates from a sphere, the center of which is the light source.



A light source that uniformly illuminates one candela across one steradian is one lumen. That ought to clear things up, right? Don't forget lux and it's not the hotel in Las Vegas, either. A lux is equal to one lumen per square meter. The last time we measured landing light output (see *Aviation Consumer*, May 2015), we used a lux meter because that's what we had available. Measuring candela would have been better, but was beyond our meager abilities. However, if everything is measured in lux, there's at least some consistent basis for comparison.

Unfortunately, a buyer perusing the websites looking for equivalent consistency might not find it. That's especially true when comparing LEDs to GE bulbs.

For example, the stalwart GE4509—the most common landing light—has a nominal rating of 110,000 candela. But it's not necessarily clear how this was or is measured and two LED manufacturers told us they're hard pressed to see 80,000 cd out of this bulb. And that degrades as the filament heats and sags out of the most efficient center part of the reflector.

When testing incandescent bulbs with a lux meter, we saw significant output variations between incandescent sources, even though we were careful to place the sensor consistently.

So what to make of candela claims by the LED manufacturers? In our view, not too much, because we don't know if the measurements are done consistently by the companies. For example, for its Hercules Drop-In PAR 36, Aveo gives a color temperature, but no candela output. For its equivalent PAR 36, AeroLEDs gives 50,000 candela for the landing lens and 15,000 for the wider taxi lens. For its Parmetheus Plus, Whelan promises 60,000 cd for the landing light and 15,000 for the taxi version.

Does that mean the Whelan is the brightest? AeroLEDs and Aveo might argue the point and we might, too. As we've noted, color temperature matters. A lot. The warmer the temperature in degrees Kelvin, the closer the light is to daylight and the better it illuminates fine detail such as runway stripes and markings. In our experience, all the LEDs are better at this than traditional incandescents, no matter what their claimed brightness might be.

For this report, we weren't able to assemble all the products for an informal light range test and subjective evaluation. We'll do that in a future article.

Whelan got to the Parmetheus Plus, which is 40 percent brighter than what it replaces.

AeroLEDs has done essentially the same with its ever-expanding lines. The newest models are brighter than ever and offer drop-in for GE's 4596, 4587, 4580 and 4554 bulbs. On its website, AeroLEDs has a long list of approvals and applications covering just about every mainstream landing light. Like Aveo and Whelen, it has approved navigation and position lights, which we'll cover in a future issue.

BUY OR NOT?

Although we're seeing new products and improved products for the same applications, the buying calculus remains the same, in our view. Despite a glut of LED manufacturing capacity, prices of aviation-related lighting aren't likely to decrease much, if at all. We suspect the current three-tier price structure will endure for the foreseeable future.

As we've said before, the two best reasons to buy an LED landing light are conspicuity and freedom from frequent replacement. The lights can be left on without fear of failure. (Bulb life is claimed between 30,000 and 50,000 hours and we're not hearing complaints about premature failures.) We're less convinced that LED position lights are as cost effective because the incandescent versions don't fail very often and the LED replacements are still expensive. We'll take a look at that in a future report.

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www.whelan.com

SiriusXM Weather: WSI Cancels InFlight

WSI says its InFlight data service has reached life's end. This orphans several receivers and leaves Garmin as the dominant supplier of SiriusXM weather receivers.

by Larry Anglisano

If you own an Avidyne MLB700 or WSI AV300-series satellite weather receiver, you might look for a replacement. At the end of 2017, WSI—now branded The Weather Company, an IBM Business—is pulling the plug on its InFlight cockpit weather service that it delivers by SiriusXM satellites. Avidyne said it isn't offering a replacement receiver because there's more demand for ADS-B systems.

Is this the beginning of the end for subscription-based broadcast satellite weather as many predicted? The short answer is no. It might actually be gaining more traction, with Garmin and SiriusXM leading the charge.

ForeFlight recently added SXM weather to its Mobile app through SiriusXM's own SXAR-1 portable receiver and Garmin is close to releasing a new SXM receiver for tablets, for the aera 660 GPS and for the G3X avionics suite. Garmin also updated its existing certified and portable receivers so they're compatible with SiriusXM's latest broadcast signal.

On the data side, Baron Weather Service, a longtime provider of the XM WX Satellite Weather, says it's committed long term to the market. It continues to provide the data for legacy receivers, while focusing on newer two-way broadcast technology to fix bandwidth limitations.

WSI: PEAKS AND VALLEYS

This isn't the first time WSI decommissioned weather receivers. In the early 2000s, it had its own datalink service provided by the twin beam Mobile Satellite Ventures system and sold the experimental AV100 receiver for EFBs and the certified AV200 for the UPS-AT MX20 MFD. Later—through reverse engineering—the AV200 worked with Garmin's GNS530/430, but Garmin declared it an unofficial interface. The back-door serial data interface was ultimately killed when Garmin upgraded the GNS navigators to WAAS.

Third-party compatibility aside, WSI couldn't resolve technical problems it ran into with its own satellite technology. There were coverage issues and buyers who spent upward of $5000 for a WSI installation were eventually left with proverbial paperweights.

But WSI soldiered on, signing on with Sirius Satellite Radio as the pipeline provider for the new AV300 receiver. Avidyne joined in with its own version, the MLB700.

Despite the change in satellite delivery, WSI InFlight continued to stream the same weather products for which the company earned respect, including WSI's proprietary NOWrad radar. NOWrad is a mosaic of the U.S. Doppler network that's been fine-tuned by WSI meteorologists for a more realistic depiction of precipitation. We've appreciated the high-quality graphics and reliability of the data.

While WSI regrouped, Garmin was setting a brisk pace. It took the market by storm with the GPSMAP396 portable GPS, which had the puck-shaped GXM30 XM antenna/receiver. Garmin has since built at least four more portable models, including the current aera series and two generations of the GDL69 permanent-mount XM receiver.

The WSI AV300, bottom, and the Avidyne MLB700, top, will stop receiving weather data at the end of 2017. Avidyne's receiver will still receive SiriusXM entertainment channels. That's the controller shown next to the receiver.

MULTIPLE BROADCASTS

The confusing part of the broadcast datalink weather market is there are several data transmissions, all handled by SiriusXM. In part, they differ by the way weather products are bundled and the vintage of the receiver. It's a handful to keep straight and if the hardware isn't confusing enough, some receivers work with WSI's weather and some with Baron's XM WX. Here's why.

SELECT WSI/SXM WEATHER INTERFACES IN PLAY

The Garmin GDL69A-SXM replaces the legacy GDL69A for Garmin GTN retrofit displays and the G1000. It works with the GNS530W/430W, too, but not with non-WAAS units. For them, the legacy GDL69A still works, via Baron data.

On Garmin's portable side, the current GXM42 works with the aera 510/560, aera796 and GPSMAP696. The original GXM30/40 receivers will still work with GPS396/496 portables, via Baron data. A solution for the aera660 is due any day.

SiriusXM Aviation's SXAR-1 works with ForeFlight Mobile and WSI's Pilotbrief Optima for iPads. The device also receives SiriusXM entertainment channels and connects to Bluetooth headsets. It's sold through Sporty's and SiriusXM.

Before the XM and Sirius merger, there were already two streams of weather data. XM (with Baron data) occupied 2332.5 to 2345 MHz and Sirius (with WSI InFlight data) was on 2320 to 2332.5 MHz.

The merge created SiriusXM (SXM), both satellite systems remained in service and a third data stream was eventually added to support what is now SiriusXM Aviation. The latest service works with a newer generation of receivers, including the portable SXAR-1—a product launched by SiriusXM Aviation in partnership with WSI—for interface with WSI's Pilotbrief Optima app for iPad.

The subscription chart on page 15 lists the weather products that are in the current SXM Aviation stream. While full-featured, it's a double-edged sword, in our view. For example, there's more bundled data in the entry-level $34.99 per-month Pilot Express than with the $34.99 per-month XM WX Aviator LT (powered by Baron Weather), but you'll have to upgrade the receiver to take advantage of the new packages.

HARDWARE TO SUPPORT

The Weather Company's SXM weather service isn't going away—only InFlight is. As the sidebar on this page shows, there are a variety of portable and permanent-mount receivers (and display interfaces), including SiriusXM's own SXAR-1. We think this product was given a new lease on life when ForeFlight included the interface.

When we first looked at the SXAR-1 (January 2015 *Aviation Consumer*) it was a good performer, but we thought WSI's Pilotbrief Optima app was lacking compared to ForeFlight, Garmin Pilot and others that have a full-up nav interface and we predicted buyers would pass on it. ForeFlight ultimately

SIRIUSXM AVIATION SERVICE LEVELS (LATEST-GEN RECEIVERS, WSI DATA)				
PACKAGE CONTENTS	Pilot Express $34.99 month	Pilot Preferred $54.99 month	Pilot Pro $99.99 month	SiriusXM Pilot for ForeFlight app $39.99
NEXRAD radar	✔	✔	✔	✔
NEXRAD storm cell attributes	✔	✔	✔	✔
Radar coverage/site status	✔	✔	✔	✔
Lightning cloud-to-cloud, cloud-to-ground	✔	✔	✔	✔
Temporary flight restrictions (TFRs)	✔	✔	✔	✔
Winds aloft (including graphical depiction)	✔	✔	✔	✔
AIRMETs/SIGMETs/PIREPs	✔	✔	✔	✔
Temperatures aloft	✔	✔	✔	✔
Standard forecast winds	0 hours	0-24 hours	0-48 hours	
High resolution forecast winds	0 hours	0-3 hours	0-24 hours	0 hours
METARs, TAFs CONUS	✔	✔	✔	✔
METARs, TAFs non-CONUS		✔	✔	✔
Tropical storm tracks	✔	✔	✔	
Cloud top imaging		✔	✔	✔
Surface visibility forecast		0-1 hours	0-3 hours	
Graphical turbulence guidance			✔	
Freezing level/forecasting time		0-1 hours	0-3 hours	
Icing NOWcast			✔	
Convective outlook			✔	
SiriusXM Radio programming	Optional	Optional	Optional	Optional

showed WSI how it's done.

We looked (more favorably) at the SXAR-1/ForeFlight interface in the January 2017 *Aviation Consumer.* SiriusXM even added a ForeFlight-specific subscription package, which is $39.99 per month—a few bucks more than Pilot Express.

As for customers facing the InFlight shutdown on December 31, 2017, The Weather Company's Matthew Taylor reasoned that the SXAR-1 portable solution would be embraced by owners with soon-to-be-orphaned Avidyne and WSI receivers because so many pilots fly with iPads. We're not so sure about that, given the deep integration of the MLB700 on Avidyne displays, which includes the IFD-series navigators, the EX-series MFDs and the R9 retrofit flight deck.

Not everyone is sold on viewing weather data on a tablet, especially when they've been accustomed to using it on a big-screen panel display.

For those pilots, the HeadsUp Technologies XMD76 is compatible with Avidyne displays, but not with the newer SiriusXM Aviation subscription service. This system is common in Avidyne Entegra-equipped Cirrus models and receives Baron data. The swap will require a new antenna, too.

The option for Avidyne IFD540/440 owners is to buy a Garmin GDL69. The GDL69A-SXM has a list price of $4475 and the GDL69-SXM (no entertainment capability) is $3875. The retiring MLB700 will still receive SiriusXM entertainment programming.

WHOSE DECISION?

Acknowledging that it's unfortunate for owners of orphaned receivers, The Weather Company says cutting InFlight is a financial decision, plus the inability to further advance the system. It might be argued that it's making a reasonable business decision in trimming some fat by shutting down the aging InFlight, while retaining only one data feed. Frankly, we wondered how long it would keep the two systems going.

On the other hand, there has been speculation whether SiriusXM was behind the decision in an effort to more tightly control its broadcast service. After all, the third-party receivers are licensed by SiriusXM. We asked SiriusXM's VP of Aviation Dave Wasby for comment and he referred us to The Weather Company, but added: "At SiriusXM, we have strong partnerships with both The Weather Company and Baron as providers of our weather data." Of course we already knew that, but we still don't know how long SiriusXM will keep streaming Baron's data to the herds of legacy receivers. There are a lot of first-generation Garmin GDL69 and GXM40 receivers in service. Orphaning them—especially the GDL69—would be met with sizable consumer pushback.

As some have already pointed out, Garmin holding the lion's share of SiriusXM-licensed receivers might seem to threaten lively competition, but it can also be argued that Garmin is doing what Garmin does, and that's aggressively pursuing market demand by pumping out the latest hardware. The Weather Company told us there are no restrictions—anyone can join the SXM market with a working receiver.

It's hard to predict how Garmin's pending next-gen SiriusXM receiver will sell in the flooded market of subscription-free ADS-B receivers, but if it could do both SXM and ADS-B, it might set a new benchmark for portable weather receivers. We'll do a full report when it's ready for prime time.

AIRCRAFT OWNERSHIP

Warbird Ownership: Respect Required

Stepping into the major league of general aviation requires big money and a commitment to undergoing effective and regular training.

by Rick Durden

Warbird ownership: "It's not for the faint of heart, but there's nothing like it," according to warbird owner and airshow pilot Stan Musick. While it takes cubic money to acquire and operate big-time warbirds—WWII fighter, bombers and transports and post-war jets—the path toward owning and safely operating an airplane in the major league of general aviation is the same for those armed with bags of money or simply determination: You've got to spend quality time in the minor leagues first.

We'll go into the overall considerations of owning and operating warbirds and then focus on a few examples.

GETTING STARTED

As we were researching this article experienced warbird pilots passed along numerous stories of wrecked machines and injured or dead pilots with a common theme: A wealthy pilot of limited experience, large ego and questionable judgment bought himself a fighter. Due to his hubris, and unwillingness to take more than minimal training, he proceeded to get himself into a jam and took the wrong actions trying to extricate himself.

We were told again and again by experienced warbird pilots that the way to get into warbird ownership is to first do extensive homework into the type of airplane you're interested in while getting to know those who fly them: Go to airshows and talk with warbird pilots, get on warbird owner forums on the internet and let your interest be known as well as your willingness to listen, and do such things as joining the North American Trainer Association (www.flynata.org) and attending the National Warbird Operator Conference (www.nwoc.aero). Beth Jenkins, instructor in the Commemorative Air Force's (CAF) B-25 "Devil Dog," recommended joining the air museum (we'll use "museum" expansively to include any nonprofit group that operates a warbird) or CAF wing that operates the warbird that interests you and show up for meetings and work sessions. Volunteer to swing wrenches on the airplanes so that you get an intimate introduction to the airplane and its systems.

One warbird owner, who declined to let us use his name, said that it's also important to get to know the warbird pilots because those who want to own warbirds often also want to fly formation with others and fly in airshows—and it's important to figure out which pilots you consider good enough to fly formation with.

IT'S TIME TO BUY

In the warbird world, "No Damage History" has no meaning because each airplane probably has one and will almost certainly have been rebuilt or refurbished—the airplanes were built to last six weeks in combat, not 70 years—so the question is the quality of the work. In addition, there is usually a tradeoff between functionality and originality. If

The "Cadillac" of the fighters, the P-51D, above. The challenging to fly AT-6, below, is the stepping stone into WWII fighters.

originality is your goal, there are airplanes out there that match the way they came out of the factory door (but with better paint). However, those who fly warbirds regularly have recognized that the original panels were not terribly user friendly and have made changes to take advantage of new technology—and probably increase the level of safety.

You have to make a decision as to how close the airplane is to what you ultimately want, how much you're willing to pay for it as is (we learned that there is often a big difference between advertised warbird prices and actual sale prices) and what you're willing to pay to get it to the condition you desire.

You may decide to join a CAF wing or a museum under conditions through which you can fly one or more of the warbirds. That usually involves a buy-in under an agreement through which you can fly the airplane so long as you comply with training terms, requirements to put in certain numbers of hours as a volunteer and to be prepared to pick up a share of the tab when something big breaks.

For most used airplanes, the condition of the engine(s) is a major driver in the selling price. We were told that with warbirds it's slightly less important, even though the Merlin engine that powers the Mustang and Spitfire is only good for something between 300 and 700 hours between overhauls and an overhaul costs north of $150,000. The big radials are much cheaper to overhaul than hot-water 12s—an overhaul of a 2100-HP R-2800 used in the Corsair, Hellcat, Tigercat, Bearcat and Martin B-26 can be had for $90,000.

We'll take a brief look at a sample of some of the more popular warbirds on the market or in flying museums.

AT-6/SNJ/HARVARD

Every service in the U.S. and most of its WWII allies used the AT-6 (AT – Advanced Trainer) as the final step in the training process before putting pilots into fighters, bombers and transports. It is now *the* transition airplane into the warbird world because it is not forgiving of student mistakes and is at least slightly more difficult to fly than all of the WWII U.S. fighters—with little stall warning, vicious roll-off if the ball is not centered during the stall and an eagerness to burn through at least 2000 feet without hesitation should a pilot inadvertently spin it.

That being said, despite looking fat, slow and sluggish, the T-6 has lightning-quick handling, decent control harmony and does, as Stan Musick put it, "great old-man's aerobatics." It is a tremendously fun airplane to fly, has what may be the best aircraft engine ever made, the 600-HP Pratt & Whitney R-1340 (figure $45,000 for overhaul) and there are a lot of them out there so you can find people to fly with.

Fuel burn is 30 to 40 GPH. Owners tell us that maintenance costs run slightly less than on their Bonanzas and that they experience very few unscheduled maintenance issues. Prices for a decent, flyable airplane start at $125,000, with good ones going for as low as $150,000.

Inadvertent—and usually fatal—stalls in the traffic pattern have been the bane of private ownership of T-6s since WWII—as has been low level aerobatics. It may be a trainer, but it has to be flown with a great respect for the fact that it will bite. When we checked out in the T-6 we took to heart the admonition of Randy Sohn, then the chief check airman for the CAF: "The P-51 is a great trainer for the T-6."

P-51 MUSTANG

Mustang prices start above $1.5 million for a flyable one. It enjoys a good reputation for easy and reasonably priced airframe maintenance, with parts readily available—most are standard AN components. The North American maintenance manuals are clear and straightforward.

The engine is another matter. The original Mustang (the British gave the airplane its name) had an Allison engine, but its high-altitude performance was anemic. A switch was made to the Rolls-Royce Merlin—which was eventually built in the U.S. by Packard and Continental.

Despite U.S. manufacture, the engine hardware is British standard—you'll need tools. There are numerous little mods that help make the Merlin more easily maintainable, such as installing a full-flow oil filter, a preoiler and "Merlin fingers"—which replace the chrome pad on the rocker arm that flakes away and damages the cam, with a piece of tungsten. Merlin engines and parts are readily available, they are just expensive. The engine demands regular maintenance by the numbers, with inspections of varying complexity every 25 and 50 hours of operation.

The P-51 has a deserved reputation as being a delight to fly, but with wicked stall behavior (virtually no warning and violent roll-off) and requiring care to avoid uncontrollable left roll when flying slowly and adding power. It is not as light on the controls as the T-6 and has a higher stick-force-per-g curve than the other fighters. It demands major

TRAINING, CERTIFICATION AND INSURANCE

Not surprisingly, when you're about to fly an airplane with more than enough torque and P-factor to roll you inverted in a heartbeat, malicious stall behavior and the ability to blow through the 250-KIAS-under-10,000-foot speed limit and laugh, the FAA and insurers are going to have something to say about it.

For single-seat fighters, the only flight training available that we found was in some P-51s modified with dual controls and that are owned by individuals (or companies) that give dual in them as part of their business, such as Stallion 51 (www.stallion51.com) in Florida, and within the Commemorative Air Force (CAF). There are private organizations and museums that give dual in the DC-3—we did not find any training available outside of museums for other transports and any of the bombers.

If you want to fly as PIC in a turbojet-powered aircraft or a piston pounder that has a gross weight of more than 12,500 pounds—and has a U.S. type certificate—you have to obtain a type rating. In the warbird world that means only the DC-3/C-47 and B-25. The process involves taking instruction from an appropriately rated instructor, getting signed off for the checkride—which is given by an approved examiner—and passing the oral and practical test. The practical test is to ATP standards no matter what pilot rating the applicant holds. Once you have a type rating, you must pass an annual proficiency check that meets the requirements of FAR Part 61.58. Interestingly, because of a quirk in the regs and the specifics of the DC-3's type certificate, the annual proficiency check requirement does not apply to the DC-3.

Because virtually no warbirds were issued civilian type certificates (almost all now hold experimental category certificates), the FAA procedure for certification to fly those aircraft is set out in FAA Order 8900.1—specifically, Volume 5, Chapter 9, Section 2. The goal of the training required and authorization to fly the airplanes, according to the FAA, is to "ensure for the pilots flying these aircraft a level of safety and proficiency similar to what is available for an aircraft with a type rating." The aircraft affected are all jets as well as piston-powered airplanes that have more than 800 horsepower and a Vne greater than 250 knots—which covers virtually all WWII fighters and most of the bombers.

To obtain the required "Experimental Aircraft Authorization," a pilot must take instruction for the type of aircraft involved from an instructor who has received authorization from the FAA and then take a checkride that is essentially identical to a type-rating checkride—although, for a single-seat fighter, the examiner is going to watch from the ground. The checkride consists of an oral and practical section and is to ATP standards.

The pilot rating and experience requirements that must be met before applying for an Experimental Aircraft Authorization are set out in Order 8900.1. They start with holding a private pilot certificate, a third-class medical and 500 hours of PIC time and go up from there depending on the type of aircraft involved.

Once a pilot has passed the checkride for an Experimental Aircraft Authorization, she gets a new pilot certificate with the aircraft type printed on the back—just like a type rating. However, unlike a type rating, there is no requirement for an annual checkride to continue flying as PIC. The insurance brokers we spoke with said that none of the companies with which they work require an annual checkride for coverage, but all give a substantial discount on the annual premium if the pilot does complete a recognized recurrent training program.

Interestingly, because the C, D and K models of the P-51 are licensed in the limited and not experimental category, FAA Order 8900.1 does not apply to them. Accordingly, the FAA does not require a pilot seeking to buy and fly one to have more than complex, high-performance and tailwheel endorsements. It does not mandate any training or a checkride. Everyone is aware of the hole in the regs, the FAA has not taken steps to fix it and, according to insurance brokers, the real method of assuring training in those hotrods is insurance requirements.

We were told by brokers that they do not have trouble placing hull and liability insurance for warbirds if the pilot has significant T-6 experience prior to stepping into a fighter (200 hours was the number most frequently mentioned—including a back-seat checkout because the airplane is completely blind forward from that seat) and type-specific training; however, the cost will be entirely dependent on the level of the pilot's experience in type. They reported no problem initially obtaining liability limits of $2 million, with higher limits available later.

Finally, we note that when EAA ran the warbird pilot examination program, it kept the number of approved warbird examiners under 10 nationally—and they were able to handle all of the checkrides. Some years ago the FAA took over the program and increased the number of examiners substantially. Now most training programs and museums have "captive" examiners. While that is common in the smaller general aviation world—flight schools generally have DPEs on staff or nearby—we have never liked it because of the concern for pressure on examiners to lower their standards. We've seen it happen. It means an increased accident risk when substandard pilots get ratings. When it involves a private pilot in a Katana, that risk has generally been felt to be acceptable. However, when it comes to multimillion-dollar warbirds and the financial pressure that can be applied by those who have the wherewithal to own those machines, we have a level of discomfort with schools and museums having captive examiners. We've seen too many big egos connected with big money and marginal pilot skills in the warbird world. The check and balance has historically been examiners who are ruthlessly independent—we are concerned that it has been eroded.

The Yankee Air Force's C-47 on final, above. Czech L-39 jet trainer, below, is increasingly popular as an affordable warbird.

rudder inputs (and rudder trim use) with power and speed changes—a great deal of right rudder when slow, with high power and standing on the left rudder in a dive. Figure on a fuel burn of 80 gallons for the first hour of flight and then 60 GPH in cruise. We were advised to plan on $100,000 per year for operating costs, including fuel, maintenance, insurance, hangar and engine and prop reserve, if the airplane is flown 50-60 hours.

CHANCE-VOUGHT CORSAIR

Defining "cool" when it comes to piston fighters, the Corsair went through a number of iterations during its production history. Originally equipped with an updraft carburetor version of the Pratt & Whitney R-2800, which was subject to engine fires, most have been converted to the downdraft carb version used on transport aircraft.

Owners told us to expect an engine life of 1300-2000 hours if flown regularly. One Corsair owner who was not willing to have his name published also said that, unlike a Merlin, the R-2800 gives a great deal of warning when its health starts deteriorating—it leaks and burns more oil, smokes and becomes hard to start.

As with most WWII airplanes, the airframe was built to be maintained by kids just off the farm, with some exceptions—one is a complicated hydraulic system that got more complex as the airplane evolved. The final versions had hydraulically boosted controls and even a hydraulically actuated canopy. Nevertheless, owners told us that the system rarely causes problems so long as the hoses are changed periodically. One told us that he had hydraulic ills that were only solved with replacing the 62 lines—which hadn't been done in over 20 years. Airframe sheet metal work is expensive due to the compound curves involved and the use of spot welding rather than rivets.

We were told that annuals run between $6000 and $35,000. One owner compared his overall yearly operating costs to those of a Cessna 421.

There are no dual-control Corsairs, so most pilots move into one either from other fighters or a few hundred hours in a T-6. Control forces are astonishingly light for what is a massive airplane. It "does not fly like a T-6," we were advised; it's easier and much better flying. However, as one pilot told us—where the T-6 will roll steeply after an uncoordinated stall, the Corsair will roll past the vertical.

The airplane has a reputation for excellent handling (except in a stall) to the extent that one owner said that, "If you can figure out how to start it, you can probably fly it." Where no tailwheel fighter has great three-point visibility, the later Corsairs are better than most as the cockpit and seating position were revised forward and upward to improve the airplane's ability to operate from aircraft carriers.

Plan on a fuel burn of 100-110 gallons for the first hour, then 80 GPH after that.

DOUGLAS C-47/DC-3

From a pilot's standpoint, the C-47/DC-3 is mostly a delightfully docile, honest-flying airplane with some of the best ground manners of any tailwheel bird. There are exceptions lurking in corners of the flight envelope: Three point landings are dangerously unpredictable and can damage the airframe and, because it is a swept-wing airplane, taking one into a full stall may cause you to exceed your adventure quotient for the month as it rolls off and potentially spins. The airplane is also unforgiving to the pilot who does not know its systems. The Hamilton Standard propeller feathering and unfeathering system has a failure mode that can lead to loss of the airplane.

While there is no maximum operating speed for the landing gear, raising and lowering it involves moving two floor-mounted levers in the correct sequence or risking jamming the gear in some intermediate position. In addition, the airspeed and power settings must be monitored carefully so that the props are never "driving" the engines during descent—the reverse loading will cause bearing failure.

A few years ago you couldn't give away a DC-3 with passenger seats. Now, with museums and individuals desiring DC-3s/C-47s for excursion machines or personal airplanes, our survey indicated they command prices in excess of $300,000 as compared to $150,000 for a freighter.

Because C-47s did and still do spend time parked outside, corrosion can be an issue, but it tends to be limited to a few areas such as the plates over the fuel tanks and the wing/nacelle attach area.

If considering a purchase, look over the hat section on the tailwheel support—a blown three-point landing can damage it and repair

Hydraulically actuated main gear in the Corsair turns 90 degrees during retraction, above. CAF's B-25 "Devil Dog," below. Flat-spot a tire on landing? That'll be $4000 for a new one.

involves expensive sheet metal work. The symptom of damage is that the airplane won't taxi straight.

There were three types of brakes installed on the C-47. According to longtime owner and operator Bob Steenbock, all are satisfactory. The "truck" brakes are the least expensive, but heat up and fade, so avoid short fields; the expander tube type are effective but parts may be hard to get; while most expensive, the Goodyears are the best.

Adding to the cost of maintenance on the airplane is its size, requiring appropriate equipment to gain access to the portions that need attention.

DC-3s/C-47s were equipped with both Wright and Pratt & Whitney engines, with the 1,200-HP Pratt & Whitney R-1830 now almost uniformly the engine of choice. Overhauls currently start at $28,000, depending on the condition of the engine to be overhauled. While there aren't any new parts being made—everything is being overhauled—there doesn't seem to be a shortage, although we heard some questions about crankshaft availability.

THE JETS

Over the last 30 years the idea of private ownership of a jet warbird went from "Are you nuts?" to almost routine. Not long after the Iron Curtain fluttered into history, Soviet-bloc trainers and fighters began following the money to the U.S. It's not unusual to see a MiG at an airport with a long runway and the Czechoslovakian Aero Vodochody L-39 Albatross two-seat trainer has become ubiquitous and even has its own racing event at Reno.

Thus far the eye-watering price tag increases that hit the piston warbirds in the early 1980s haven't reached the jets—perhaps because of the cost of feeding them Jet A. An L-39 in good condition can be had for $250,000 if you're ready to supply it with 150 gallons of fuel per hour. Larry Salganek of Jetwarbird Training Center in Santa Fe, New Mexico (www.jetwarbird.com) told us that its performance and handling are predictable (by the 1960s stability and control was understood), with few bad habits other than the slow spool-up time common to older jet engines. For pilots with some high-performance or jet experience, he advises that a transition can be made into the jet—including checkride—in five to nine hours.

YouTube See a video on P-51 Mustang ownership at http://tinyurl.com/u7r3ydf

Salganek said that annual operational costs include $15,000 for insurance, $6000 to $20,000 for maintenance and a reserve for the 1000-hour engine TBO ($150,000 for overhaul) and the APU ($30,000 overhaul). He told us that the L-39 has the lowest unscheduled maintenance cost for any warbird he's ever flown.

When asked, Salganek said that for a sea-level home base for the airplane, he'd recommend a minimum runway length of 4000 feet.

We inquired about the fighter end of the jet warbird spectrum and were told that MiG-15s are the most readily available. Salganek went on to say that it is an entirely different animal from the trainers. Bluntly put, it's a 1947, swept-wing airplane that reflects the technology of the time: Handling is not good—it is not docile and it has a number of control issues that require intimate knowledge of the airplane—it likes long runways and its first-generation turbojet sucks down fuel at a rate of 300 GPH. However, on the bright side, you can buy an engine for $15,000 and there are plenty available.

CONCLUSION

They're big, they're fast and the rush you get flying one is like nothing else in aviation. Nevertheless, warbirds are products of an earlier time of aeronautical knowledge and their systems design and handling quirks and vices are simply unknown in modern airplanes. Accordingly, they can bring a modern pilot who shows up with big ego, big cash and a lack of respect to grief in a hurry.

We think that stepping into the world of warbird ownership must be done with patience, humility and a willingness to learn everything possible about the airplane, its systems and handling. Otherwise, the chances are that if you wreck one, it will be the airplane that is mourned, not you.

Smart Anemometers: WeatherFlow a Top Pick

We prefer the WeatherFlow WindMeter smartphone anemometer over the Vaavud Sleipnir, but both devices can be improved with updated connectors.

by Larry Anglisano

I reviewed Vaavud's first-gen Mjolnir smartphone anemometer a few years ago and discovered its shortcomings, yet appreciated its utility on the water and land. I used it for seaplane flying on remote lakes where local wind reports weren't available, and to compare aging ATIS recordings on the home field. The disappointment was a lack of wind direction display.

That's why I was anxious to try Vaavud's newer Sleipnir, which has new measuring blades and a wind direction utility. Pleased with the company's home weather station gear, I also tried the WeatherFlow WindMeter. It turned out to be the favorite.

CONNECTOR ISSUES

First, the Vaavud Sleipnir. Distributed by Sporty's, marine outlets and weather equipment suppliers, it sells for $59.95 and is one of several portable anemometers from Denmark-based Vaavud. I tried it with my current Apple iPhone 7, which doesn't have a 3.5-mm audio jack for plugging the device in. While it's still compatible with the phone, you'll need to use the Apple Lightning/3.5-mm jack adapter.

An older iPhone, an iPad or an Android device is better matched because the anemometer plugs directly into the 3.5-mm jack, while an attachment clip secures it upright. Simply one-hand the phone into the wind and view the data.

Part of the problem is that the Lightning adapter's pigtail is too short to clip the anemometer on the phone (especially with a fat case on it), so you have to hold the phone in one hand and the anemometer in the other—stressing the flopping cable.

I preferred the early model's measuring blades. Inspired by more expensive professional anemometers that often have a three-cup design, the original Mjolnir (still in the product line) uses two rotating measuring cups with magnets built in the hub. The flatter blades made it easier to stash.

Weighing 14 grams, the Sleipnir seems almost as durable and compact, but it uses two curved rotating blades and an internal optical recording sensor, rather than magnets. The specs say the omnidirectional meter records 44,100 measurements per second.

The anemometer isn't sophisticated enough to measure wind direction on it its own, but instead uses the smartphone's compass, accelerometer and GPS. Plus, it's up to the user to position the anemometer into the wind for more accurate computations, and the device needs to sample the wind for at least 30 seconds.

While full featured, I think the Vaavud smartphone app is more than many pilots might use. It has a social media sharing feature and shows measurements taken from other Vaavud users, which you access from a worldwide map. Pilots might primarily use the data page, which has configurable units (MPH, knots, KM/H, M/S) and displays current wind speed, maximum speed and wind direction using a vector arrow and text stamp (SW, for example).

For each measurement, a gust value is calculated, which tells you how much the wind is varying. The weather savvy know this as turbulence intensity. Even I figured out that a low value (less than 10 percent) means the wind is pretty much blowing steady.

The Vaavad Sleipnir in the lower photo is plugged into the audio jack of an iPhone 5. At the top, the WeatherFlow WindMeter is plugged into an iPhone 7, using the Apple Lightning adapter cable. It comes with a stiffener to hold it upright. The Vaavud doesn't.

The Sleipnir comes with a soft storage case and the app is free. Contact www.sportys.com and www.vaavud.com.

WEATHERFLOW

The $39.95 WindMeter from commercial weather station maker WeatherFlow seems to have similar sampling accuracy, but it uses a turbine blade encased in a rubber shell, giving it a more rugged feel than the Vaavud. Compatible with Apple and Android devices, it uses the company's Wind and Weather app (and iWindSurf, SailFlow and a few other specialty apps) for data display. But, it too requires an Apple Lightning adapter for iPhone 7 smartphones. The saving grace is the current model smartly comes with a stiffener to keep the anemometer anchored vertically, but it really needs a cleaner Lightning plug option, in my view.

The WeatherFlow device and app measures wind speed (average and gusts), direction (true and magnetic) and the app gives you the option to name or trash each sampling. After it takes the measurement, the app automatically creates an onsite report, which summarizes wind direction, average speed and peak gust. From there, you can edit a description and save it to the sampling log, plus you can send it as an SMS or email message. You can also view the data on a map (linked on a new webpage), using the View On Map command, where the wind data is overlaid with a vector arrow. For seaplane ops, this turned out to be a good utility for reading crosswinds on groups of lakes. Contact www.weatherflow.com.

A WIN BY APP, DESIGN

John Zimmerman at Sporty's told me smartphone anemometers are niche products, but are gaining traction as they get better. My Sleipnir failed out of the box and I couldn't talk or email with Vaavud for technical help. Luckily, distributor Sporty's nails customer service and helped sort it out.

WeatherFlow, however, got back to me in a few hours to answer a technical question. For that, I'd buy a WeatherFlow product over a Vaavud.

What really sealed the deal is the WindMeter's rugged housing, lower price, Lightning adapter stiffener and my preference for the utilitarian Wind and Weather app.

Metal in the Oil Filter: Benign To Catastrophic

With few exceptions, an oil filter should be free of metal contaminants. Identifying the metal by type can help determine what part of the engine it came from.

Staff report

In addition to oil lab analysis, we've always recommended cutting open the spin-on filter for physical analysis. If the engine is shedding certain metals, you could spot them in the filter, especially ones that have trap magnets.

Curtail the troubleshooting effort and cost by tracing the metal fragments to the right part of the engine. Here's a rough rundown of metals that end up in the filter, and their identifiable characteristics.

ALUMINUM

The most common metal that shows up in the filter is aluminum and that makes sense because a large portion of the engine—the crankcase, piston and cylinder heads to name a few—is aluminum. When a piston ring or valve guide breaks you'll likely see aluminum. If there's any good news, aluminum is an easy metal to identify. It's silver and shiny, non-magnetic and hard. Try and crush it with your fingernail and it won't deform.

A possible problem for Lycoming engines is a failed piston pin plug. You might find a bunch of thin aluminum flakes in the filter. Some engine pros refer to it as ivory snowflakes of death.

If you find very fine aluminum filings, you may be looking at a broken piston ring that's chewing away at the ring land. If you're finding aluminum filings that are coarse and salt-like, the failure is likely creating a grinding—maybe a loose valve guide in the head or a broken valve spring is rubbing against the guide well. If you find large chunks of aluminum that flow out with the oil, retrieve them from the catch bucket and bring them to a trusted shop for identification. Then hang on to them—they make interesting conversation at house parties.

STEEL AND IRON

These are perhaps the second most common metals in the engine. Get out your magnet because that's the

If you do your own oil changes, invest in a decent oil filter cutter. You may spot metal that needs immediate identification.

stone-simple way to distinguish them from aluminum. But the simple part ends there.

If traces of iron show up in an oil lab analysis report there might not be a problem. Consider how long the engine has been sitting. Rusty cylinder walls might spike the iron count, but visible evidence of iron and steel is another matter and needs to be looked at immediately. If it were ours, the engine would be grounded.

It's possible that iron bits trapped in the filter is cam related. Grab the magnet—iron filings from the cam or cam followers are generally dark in color and latch on to the end of the magnet. A failed cam might shed fine steel that's almost undetectable in the filter.

That's why we like the ring magnet in the Tempest oil filter, made by Aero Accessories. The magnet is there to possibly catch fine particles of steel that might pass through the 40-micron filtering paper.

In the beginning stages of cam failure, though, the cam might shed fine iron filings that are nearly impossible to notice. This symptom is more prominent in Lycoming engines, we're told. In a Continental you might find fine ground-up steel (it's extremely shiny), mixed in with some bronze. This is from the rocker shaft grinding on the rocker bushing. It does a real number—once off the engine, the rocker shaft looks like someone hit it with 50 grit sandpaper.

Broken piston rings may show up as small, dull-colored iron bits. But, you'll also find bits of aluminum because the trashed ring is also damaging the ring land by scouring it.

Engine been sitting a bit too long? Ground-up steel in the filter could be from cylinder rust. When the engine finally runs, the surface rust comes off and gets flushed with the oil. This should be a one-shot deal, until the next time it sits too long.

BRONZE

Gold flakes in the filter may be from any of the many bronze bushings throughout the engine. You generally don't find bronze shavings. But if you do, checking the oil suction screen is essential. On Continental engines, you may find some long (up to two inches in some cases) bronze hair-like metal trapped in the filter or screen. It's a good bet this is from the starter adapter spring rubbing on the gear. If you access the oil suction screen and find larger semicircular bits of bronze, it could be from connecting rod bushings that have worked out of the rod end and are breaking off in chunks.

In Lycomings, bronze nuggets could be the tach drive bushing on the back end of the cam. The tach's T-shaped drive pin is supposed to ride in a groove in the bushing, but that groove can wear over time as the lube dries up. Initially, it may make tiny bronze flakes that increase in size and number.

Best to drop the sump and check the suction screen. If there is no other obvious source, it's time to pull the accessory case and inspect the tach drive bushing.

TIN: MAJOR DANGER

The trouble with tin is it's easy to confuse with aluminum. In a lab report, high levels of tin (and lead) might be from the babbitt on the connecting rod bearings, which is the primary place lead and tin is used in the engine.

If one side of the metal flake is copper in color and the other side is silver, you're looking at a hunk of babbitt, or bearing metal. This is the inlay of the bearing itself and is a sign of major distress. Pinch it—unlike aluminum, it's soft and pliable.

Tin that shows up in an oil analysis is one of those things that may mean nothing or everything, depending on engine age. With a new engine you may get a high reading for a short while, but watch out if it happens with an engine that's well past break-in. If the bearing journals start to get wiped, catastrophic failure is almost a sure thing.

CHROMIUM, MAGNESIUM

Chrome in the filter is rare and usually easily isolated to the engine's top end. Still, it might not be easily distinguishable from aluminum. Both are non-magnetic and can appear as a whitish color in the filter. But chrome is always flat and flaky.

A thorough oil lab analysis should supplement filter inspection, not replace it.

One test is to drop it in diluted sodium hydroxide, or drain cleaner. The pieces will dissolve if they're aluminum. Possible sources of chrome are piston rings (the outer edges being chrome plated), exhaust valve stems (on Continentals) or cylinder barrels, when the cylinders are chromed.

Magnesium is more likely to appear in an oil analysis and probably not in the filter because so little is used. Magnesium particles look much like aluminum, but are flammable and won't react to sodium hydroxide.

We've heard there's a correlation between Bendix 1200 series magneto bearing failure and magnesium presence. That's because a failed mag bearing may scrape the mag case enough to make particles large enough to end up in the filter. Some Lycoming engines had magnesium oil sumps.

ISOLATION IS RARE

You might find two or more different metals in the filter because one failed part may take out another—or several. You might even find non-metals in there. Carbon deposits look like coffee grounds and are usually caused by excessive blow-by.

Intended as a general guide and as a point of reference before committing to a major teardown inspection, we didn't list all possible failure points here. That's nearly impossible.

Last, we think creating an oil lab analysis trend spreadsheet is a good supplement and backstop to visually inspecting the filter. We'll look at ways to create one in an upcoming report.

Cheetahs and Tigers

Which four-place Grumman you choose might depend on the need for speed, climb and payload.

Photo courtesy American Yankee Association

The Grumman Cheetah and bigger-engined Tiger may be overlooked by some buyers searching the crowded under-$50K used airplane market. In fact, among entry-level Cessna and Piper models, the AA-5A Cheetah could very well be a used market leader.

With a sporty slide-back canopy, snappy handling and reasonable cruise speed for its fuel-sipping 150-HP powerplant, a Cheetah works for training, traveling and for tooling around the local area. On the other hand, the 180-HP AA-5B Tiger might be the better of the two cats when more climb performance and load-hauling is needed.

Here's a side-by-side comparison of both models—including a detailed accident analysis—to help narrow the buying decision.

HISTORY

The Cheetah and Tiger basic design traces back to the 1960s and the two-seat AA-1 Yankee. The brainchild of Jim Bede, the Yankee featured revolutionary construction, aluminum-honeycomb sandwich fuselage panels and rivetless bonded skins. The fuel tanks were housed within a tubular wing spar. While the intentions were good in marketing the Yankee as a trainer, the airplane proved to be a bit too hot for students to handle.

In 1972, American Aviation decided to introduce a 150-HP, four-place version of the AA-1 and called it the Traveler. While the Traveler shared the family genes of the AA-1, it was really an all-new airplane, significantly larger and boasted new systems. It also had more traditional fuel tanks. Gone were those grossly inaccurate sight-gauge fuel quantity gauges that held avgas inside of the cabin.

Owners generally boast of low operating costs and excellent dispatch records.

The Traveler was a different airplane that tried to compete with complex aircraft such as the Cessna 177 Cardinal and Piper's PA28R-series Arrow with little success.

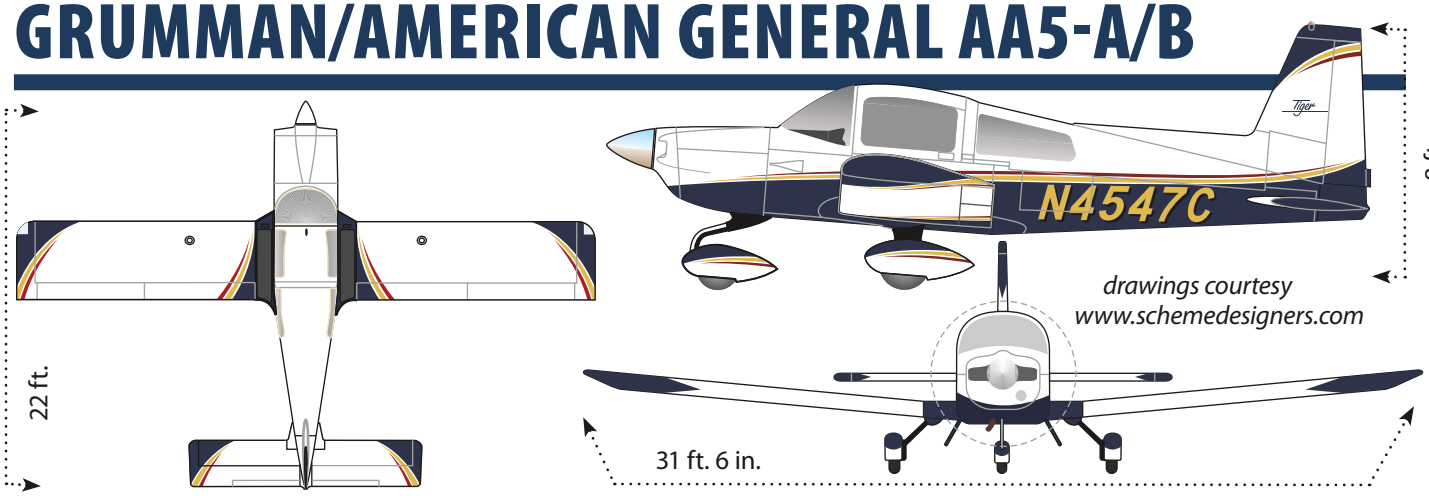
Still, the market wanted more performance than the Traveler could deliver. Then Grumman (with deep pockets) stepped in and involved the famous Roy LoPresti to work his aerodynamic magic on the design. The result was the AA-5B Tiger. Introduced in 1975, the Tiger had bigger fuel tanks, a different elevator, a more efficient cowling and most notably, a beefier 180-HP Lycoming O-360-A4K engine.

In 1976, these airframe improvements were applied to the existing Traveler, which became the AA-5A Cheetah, but it retained the 150-HP Lycoming O-320-E2G engine. Essentially, the Cheetah and Tiger are the same aircraft with different engines.

Production came to a halt in

A Cheetah and Tiger, main photo, share the same airframe design, but a Tiger will get you to the destination airport more quickly thanks to more horsepower.

GRUMMAN/AMERICAN GENERAL AA5-A/B

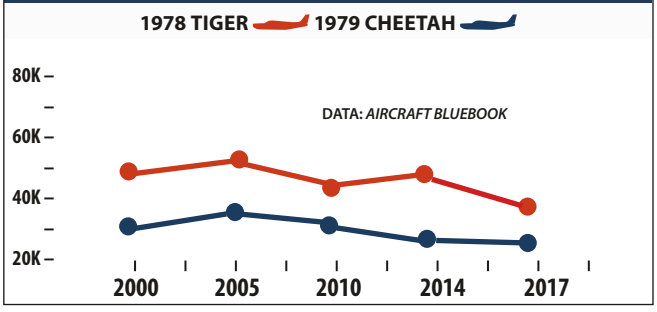


drawings courtesy
www.schemedesigners.com

CHEETAH/TIGER SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1976 AA-5A CHEETAH	LYC. 150-HP O-320-E2G	2000	$20,000	38/51	800 LBS	128 KTS	±$29,000
1975 AA-5B TIGER	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	±$35,000
1977 AA-5A CHEETAH	LYC. 150-HP O-320-E2G	2000	$21,000	51	950 LBS	135-140 KTS	±$31,000
1977 AA-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	±$39,000
1978 AA-5A CHEETAH	LYC. 150-HP O-320-E2G	2000	$21,000	51	950 LBS	135-140 KTS	±$32,000
1979 AA-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	±$43,000
1990 AG-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	±$60,000
1991 AG-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	±$65,000
1992 AG-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	±$70,000
1993 AG-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	950 LBS	135-140 KTS	±$75,000
2002 TIGER AG-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	900 LBS	135-140 KTS	±$90,000
2003 TIGER AG-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	900 LBS	135-140 KTS	±$100,000
2004 TIGER AG-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	900 LBS	135-140 KTS	±$110,000
2005 TIGER AG-5B	LYC. 180-HP O-360-A4K	2000	$21,000	51	900 LBS	135-140 KTS	±$120,000

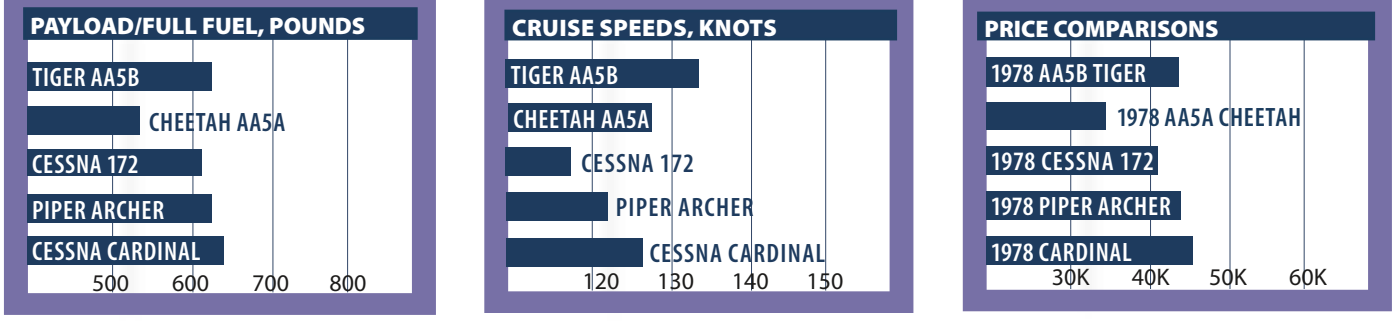
RESALE VALUES



SELECT RECENT ADs

AD 2006-12-07	ECI CYLINDER ASSEMBLIES
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



As owner Peter Kuhns proves in the top photo, it's easy to look cool in a Cheetah with its fighter-like sliding canopy. It also means the cabin, bottom, will get wet on rainy ramps.

1979 after Gulfstream bought the line and the new owners concentrated on bizjets. That turned out to be a good plan given the big general aviation slide that occurred the following year. American General bought the designs in the late 1980s, and the first AG-5Bs, incorporating a few design improvements, were 1990 models. American General folded in 1994 and the parts inventories and rights were sold to FletchAir.

Original production for the AA-5B Tiger was 1323 airplanes, while 900 AA-5A Cheetahs were built. American General built around 150 AG-5Bs before it folded.

There was also the Martinsburg, West Virginia-based Tiger Aircraft that was established in 1999 to return the Tiger to production. It built roughly 50 AG-5B models (complete with Garmin G1000 integrated avionics and leather interior) before going bankrupt in 2007. The assets were acquired by True Flight Aerospace (www.trueflightaerospace.com), which is advertising that it's currently working on a fuel-injected (Lycoming IO-360) version of the AG-5B Tiger.

SPEEDSTERS

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 180-HP Tiger is the fastest of the line, since the 150-HP Cheetah is generally 12 knots slower, while the Traveler is slower yet.

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.

Owners tell us the stock Cheetah, with 30 fewer horsepower, can be a dog in hot-weather climbs. The Yankee is worse. Later 160-HP versions of the Warrior, with speed pants, can just about run with a Cheetah.

Cheetah owner Duffy Fainer told us that with the high-compression STC (which raises the horsepower from 150 to 160), PowerFlow exhaust and Sensenich propeller, a tweaked Cheetah can maintain the same rate of climb as a stock Tiger. "Once in cruise, the Tiger will pull away, but for formation purposes, the two airplanes are well matched," he said.

HAULING AND 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 essentially makes it a two-place airplane. But loading might not be a huge issue anyway since the Cheetah lacks any remarkable baggage space. But, fold-down rear seats can create a decent cargo compartment for snowboards, golf clubs and other stuff when you aren't carrying people. Otherwise, any heavy items you can load in 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.

As for going places, the Tiger's 51-gallon fuel capacity yields about four hours of endurance with reserve—a pretty good fit for the aircraft. Owners tell us that 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-gallon capacity 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.

Speaking of comfort, we wouldn't exactly call the Cheetah or Tiger luxurious. These airplanes are relatively stark with no-frills dwellings, but for many, this adds to some of the appeal.

As for handling, proud owners are spot on when they say Cheetahs and Tigers are the sports car of the skies. The feel is light and responsive with somewhat touchy controls, which really makes it an autopilot airplane for hard IFR.

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

Just don't push these airplanes into a parking spot without a towbar attached—you'll risk damaging the nosewheel. Oh, and chock the mains and not the nosewheel.

The takeoff run 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 castering nosewheel, but there isn't really much to it.

Landing is a reasonably easy affair in a Cheetah and Tiger (the Yankee, on the other hand, sinks like a flying manhole cover when the power is pulled off). Owners will say their Cheetahs and Tigers float and adding insult to injury, coming in with extra speed is a setup for the classic runway overrun.

But, do it right and you're rewarded with a squeaker, helped by the nose strut shock absorber, which was added in the 1978 model year.

A single radio stack works for basic IFR avionics in a Cheetah, top. Panels in later Tigers look slightly more modern, middle. Garmin's G1000 was standard in the last of Tiger Aircraft's AG-5Bs, bottom.

ERGOS, SYSTEMS

The sliding canopy adds to the Grumman's sporty cockpit and sports-car-like appeal. The price to be paid is a semi-awkward ingress. Pop the seat cushion off its pan to spare wear and tear of the upholstery. You'll get wet entering and exiting in the rain, but are rewarded with excellent ventilation on hot days during taxi (and in flight).

Once inside, 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.

Keep a hammer in the aircraft to smash your way out if you crash because that showoff canopy can bend or warp to the point of not sliding open. Also, consider protecting the two pieces of the canopy lock to keep it from getting smashed.

The Cheetah has the 150-HP Lycoming O-320 under the cowling, top, while the Tiger has the 180-HP O-360, bottom. Both are easy to access with the split cowling on or off.

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 Cheetah and Tiger drivers 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. That can bite you if you aren't careful.

While there were few if any major design changes during the aircraft's production run, the 1977 model year brought improved soundproofing and a windshield that was upgraded to quarter-inch thickness and also had better sealing. In 1978, the seats were upgraded for a needed boost in comfort.

Several owners told us they upgraded to Oregon Aero cushions for even better comfort. But you might also have to deal with some aesthetic issues on these old airplanes.

There's a good chance the used Cheetah or Tiger you're considering will have some interior and instrument panel cracks because there's a lot of plastic trim. As with any airplane, the best investment you can make to preserve the interior (and exterior) from UV and heat damage is a good cabin cover.

MAINTAINING THEM

In general, the Cheetah and Tiger are simple airplanes that lack hydraulic systems and retractable landing gear. But you won't get any free passes when it comes to maintenance just because these are little airplanes. Sadly, more than one shop told us some Grumman owners don't take maintenance seriously enough. As a result, one shop actually refuses to work on Grummans. Don't be one of those owners, but do understand some design issues that could cause problems.

We've always thought the Cheetah and Tiger should have cowl flaps because the tightly cowled engine can run hot. That means you'll want to maintain the engine baffling and think hard about installing a graphic engine monitor, in our view. Air Mods (www.airmodsnw.com) 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.

While probably not an airframe issue these days, worth mentioning is that 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. This included Tigers through serial number 125. While there were no wrecks that we know about, at least one delamination occurred on a Tiger in flight.

The Cheetah/Tiger castering 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 are the requirements.(Not many shops have the manual and readers tell us that improperly performed maintenance on used airplanes for sale is common.)

You might thank Grummans for the current trend toward castering nosewheels (yes, like on a Cirrus) 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 100-hour inspection of the ailerons and one 200-hour inspection of the McCauley prop hub for cracks. The AD is a good argument for a highly recommended Sensenich propeller upgrade, which eliminates an annoying RPM restric-

Duffy Fainer sent us this Cheetah/Tiger formation action cam shot. His Cheetah has the high-compression STC, Sensenich prop and PowerFlow exhaust.

tion between 1850 and 2250 RPM in descending flight—right at the usual instrument approach speed.

One potentially onerous AD cropped up in 1998: AD 98-2-8 calls for inspection of the hollow crankshaft 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.

SUPPORT, MODS

Grumman owners enjoy one of the best and perhaps the most enthusiastic owners groups around, the American Yankee Association (www.aya.org). It has an excellent newsletter 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. There's also The Grumman Gang (www.grumman.net). We're grateful for the help both organizations gave us for this report.

Owners attest that the Cheetah and Tiger are well supported. FletchAir Inc. (800-329-4647 and www.fletchair.com) has long specialized in Grummans. David Fletcher, president of FletchAir, has grown up with the Grumman family of aircraft and has been a stocking Grumman dealer since 1974. When American General folded, FletchAir acquired the parts inventories and manufacturing rights. FletchAir is known worldwide as the single largest manufacturer and distributor of parts for American General, Grumman-American and Gulfstream-American models.

If you want to turn a Cheetah or Traveler into a Tiger, Air Mods NW has a 180-HP conversion. The company can also mod Travelers and Cheetahs for 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 also has a split-nose 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 AG Tiger already has a split nosebowl, as do the newer Tigers that came from Tiger Aircraft.

Other mods of note: Approach Aviation (www.approachaviation.com) has a ram air induction kit, PowerFlow (www.powerflowsystems.com) has a tuned exhaust system, plus there is AuCountry Aviation (www.aucountry.com) and LoPresti Aviation (www.loprestiaviation.com) with cowling mods.

Yankee Aviation (www.yankee-aviation.com) in Hamilton, Ohio, is a small shop specializing in Grumman

CHEETAH AND TIGER WRECKS: ENGINE TROUBLES

We had originally planned to take 50 of the most recent Cheetah and Tiger accidents, combine them and call the result the AA-5 Hit Parade. But, since the airplanes are just different enough, we decided to compile stats from a full 100 accidents for each. They're shown in the charts below; we'll look at the AA-5B Tiger first—its data is in the box on the left.

The big news for the Tiger is an almost complete absence of fuel-related mishaps. A grand total of one pilot mismanaged his fuel—he didn't change tanks during his entire flight, even after running the one he was using dry. It's the lowest rate of fuel-related accidents we've seen for any airplane.

The low number for runway loss of control accidents—eight—was somewhat masked by the surprisingly high number of go-around crashes—11. All of the blown go-arounds came after what was about to be an RLOC event. Adding the two together to get 19 events nevertheless indicates that the Tiger has better than average runway handling.

With 30 more horsepower than a Cheetah, we expected to see fewer Tiger go-around accidents—we didn't, and we're scratching our heads. We also expected to see fewer accidents that involved hitting obstructions on takeoff—we did, there were none. More power is not a guarantee that an airplane will climb: Six pilots stalled their airplanes after takeoff and crashed.

Even with more power, density altitude has to be respected in the Tiger. There were five crashes involving pilots who couldn't outclimb rising terrain under high and/or hot conditions.

Virtually all of the 13 engine stoppages were because of failure to do maintenance or doing it improperly.

We were impressed by the chutzpah if not the skill of a pilot who figured it would be fine to buy and immediately fly a Tiger that had been sitting for three years. The bad news was that there was a reason the airplane hadn't been flown—the engine was in immediate need of serious work and it quit about 20 minutes into the flight. The good news was that the pilot was at altitude over an airport with a nice, long runway. The worse news was that he couldn't hit it. He touched down, on airport property, perpendicular to the runway, on rough ground and tore up his new-to-him Tiger.

Six pilots started takeoff rolls and decided to abort, couldn't get stopped and hit things off the end of the runway. That number seemed high to us, but we could not find out whether five of the six pilots had not calculated takeoff distance or there was something wrong with the airplane that caused it to not accelerate as expected. The sixth one had forgotten to remove the control lock and hadn't done a control check. She figured things out when she couldn't raise the nose during the takeoff roll. It was only after she made a valiant, but unsuccessful, attempt to remove the control lock that she aborted the takeoff and went whistling off the end of the runway.

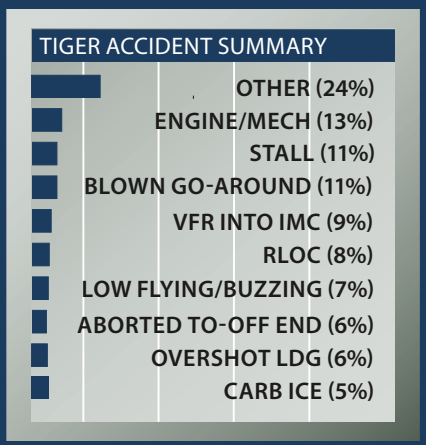
As for the Cheetah, our examination of the 100 most recent wrecks did not turn up any glaring issues—there were no signs of these lower-powered models lying in wait to bite owners. The biggest single item was engine stoppages in flight. Of the 14, three were blamed on carb ice and 10 were for reasons unknown. The remainder involved either component failures due to lack of maintenance or improper maintenance.

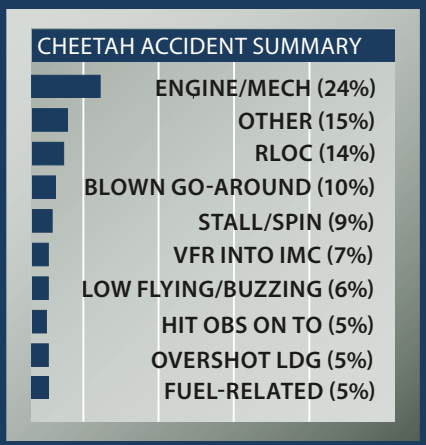
We're always interested in the rate of runway loss of control (RLOC) accidents when we do our accident review. With 14, plus 10 blown go-arounds from potential RLOCs, the Cheetah fell into what we consider to be a very low rate of unpleasant runway adventures. We credit the effective flight controls for playing a part in the good news.

While the little Grumman has a slippery airframe and will float a long ways on landing if a pilot tacks on extra speed on the approach, we counted only five overshot landing events, about average for four-place airplanes. With 45 degrees of flap travel, their drag can correct for a certain amount of sloppy pilot technique if they are used on landing.

Three of the nine stall/spin accidents were over-gross takeoffs and departure stalls. Density altitude has to be respected in a Cheetah.

There were plenty of accidents involving questionable pilot decision making. Seven pilots crashed after trying to fly VFR in IMC. Six totaled their airplanes as a result of low flying or buzzing. One owner, not a mechanic, changed the vacuum pump in his Cheetah. Despite the engine hemorrhaging oil on two flights and onlookers urging him to have a mechanic look at things, he launched on a third. The oil-starved engine quit shortly after takeoff. The pilot did not survive the forced landing.





maintenance and its owners, Roscoe and Luann, are Grumman owners and A&P/IAs who trained with Air-Mods NW and FletchAir.

OWNER FEEDBACK

My first airplane was a Grumman Traveler, a 1973 AA5, that I owned for five years (1991 to 1996) and flew for 3000 hours. I so loved that plane and flying that I left working for the Naval Research Laboratory and started my own aviation business using that Traveler (after adding two camera ports—one thermal, one visual—to do aerial surveying). This is the plane that found the original Wright Brothers hangar on Huffman Prairie (now part of Wright Patterson Air Force Base). Videos of that work are on the Grumman Pilots YouTube channel. I currently own two Cheetahs and they're great planes.

The Grumman Pilots Association is the largest international Grumman association (1000 members and growing) and is committed to supporting the entire fleet through the website www.grummanpilotsassociation.com. There is a YouTube channel featuring maintenance videos on how to properly care for the line. This organization also has Wrench and Elbow-Bending weekends held around the country to teach owners and their mechanics the details of how to properly care for these unique birds. I also own (after spending 11 years finding it) the AA-2—known as the Patriot—which is a the four-seat prototype that led to the Traveler.

Roscoe Rosche
www.yankee-aviation.com

I own a 1979 AA-5A with a rebuilt 160-HP O-320 engine and Sensenich 61-inch prop. The plane has a Power-Flow muffler and 1800 hours on the airframe. The airframe has a gross weight of 2200 pounds an empty weight of 1450 pounds. The useful load with full fuel works out to a rather anemic 450 pounds, considering it carries a whopping 51 gallons.

My AA-5A is equipped for basic IFR. Insurance for me as a 400-hour VFR pilot for a $70,000 hull value is $1000 per year. I perform owner-assisted annuals every year, which can vary between $650 to $950.

The cockpit is slightly tight, but the amazing visibility makes it bright and comfortable. Cruise speed at 7500 feet ranges (depending on thriftiness) from 7.8 GPH at 105 knots to around 10.5 GPH at 125 knots. On landing, I shoot for an approach speed of 70 knots on short final.

I'm relatively new to flying, but I believe the Cheetah (and its older sibling the Traveler) is the lowest-cost, most-fun-to-fly, four-seat airplane in existence. Transitioning from a 172 to a Cheetah was a major eye-opener (the visibility and docile characteristics are a shock to Cessna graduates), requiring a few hours with an instructor to get the hang of it. The plane flies like a jet fighter, has a low instrument panel and leans so far forward in cruise you're sure something's not right.

Without hesitation I tell new pilots the Cheetah is the ultimate first airplane because it's inexpensive to purchase, inexpensive to maintain and inexpensive to fly. Additionally, the Cheetah is faster than the type-certified O-320-powered competition, has a sliding canopy for cool-factor and is pleasant in cruise flight. I suggest looking for a model that has the high-compression upgrade with the Sensenich propeller, or simply plan on upgrading to it.

The major downside to a Cheetah is the long, hard decision regarding getting a Cheetah or what some call a real airplane like the Tiger. Cheetahs can arguably go fast, but Tigers are just plain fast. Minor baked-in Cheetah squawks include an anemic useful load (not so for the Traveler) and a weak nosewheel—requiring proper and careful landings. Be extra suspicious of grass operations.

Prebuy musts include valve-wobble test (Cheetah engines run hot), nosegear torque tube rust and pitting, spar corrosion and leaky fuel tanks. The AA5-series canopy really deserves a hangar and not a tie-down, so put one on your wish list.

Parts are still easy to come by and Grumman mechanics who specialize in the type are out there. The American Yankee Association is a great organization and at its fly-ins actually fly their airplanes, unlike other groups.

The incredible fun of flying the Cheetah and its incredible range with long-range tanks makes this plane the perfect one for new pilots who want a moderately fast, true cross-country, fuel-sipping bird. Basically you're getting the reliability and simplicity of a 172 with 10-plus knots better cruise speed on a miserly fuel flow. Oh yeah, and Grummans have way more ramp appeal.

Pete Kuhns
Shelbyville, Indiana

I have owned the same 1979 Gulfstream American AA-5A Cheetah for the past 25 years and have found it to be an outstanding and economical aircraft for me and my family. The slide-back canopy, sleek aerodynamic lines and bonded surfaces (no rivets) make you realize from first sight that you are not going to be flying an old Cessna or Piper. Due to the canopy and lower instrument panel, it's a good choice for smaller pilots who sometimes can't see over the Cessna 172 instrument panel.

It flies like it looks and is tightly coupled and light on the controls because of the superior aerodynamics courtesy of Mr. LoPresti, plus it can walk away from the 150- and 160-HP Cessna 172s and Piper Cherokees that it competed with.

My aircraft has been modified to a high-compression version, which raised the horsepower to 160 from 150. I consistently fly at a reliable 127 knots true airspeed at 7000 feet at 2600 RPM. Every Cessna 172 or Cherokee 140 I fly with is quickly left in the dust by a good 10 to 15 knots. It was this way even before I did the upgrades.

Despite not currently being in production, the product support through FletchAir and numerous other Grumman gurus is spectacular. In 25 years, I have never not been able to find a needed part with a phone call or two. The Cheetah and Tiger are simple, easily maintained aircraft designed to be pilot and mechanic friendly. The only head scratcher was why the Grumman American folks did not split the nosebowl so that you could take the whole cowl off without removing the propeller. Fortunately, aftermarket STCs took care of that problem and I think the split nosebowl is an absolute must-have for any Cheetah owner. The Lycoming 0-320 E2G has been bulletproof.

I have modified my aircraft with

The Aviation Consumer

TIGER/CHEETAH

(continued from page 31)

the 160-HP upgrade, the Sensenich prop, PowerFlow exhaust, split nosebowl and new avionics with ADS-B In/Out. There are lots of great mods that can be purchased through FletchAir or shops that keep the Grumman line going strong.

The Grumman Gang is a worldwide network of owners who share their experiences and questions via the internet. It is very active and on most days has 10 to 15 messages from the users. I think the American Yankee Association is one of the best type clubs in existence. It's great for technical issues and many social and camaraderie opportunities for fellow Grumman enthusiasts.

Any Grumman American pilot can tell you that getting caught on the ramp in a rainstorm can "dampen" the enthusiasm. The slide-back canopy is an absolute blast to fly or taxi around with (plus it offers incredible ventilation on hot days), but can be a real bummer when trying to enter or exit the aircraft during a gully washer. You can count on both you and your seats getting wet. The canopy seals are notorious for leaking, but can be easily fixed by using a canopy cover—which you should have anyway.

All that speed that the bonded wing gives you in cruise also comes with a slight penalty in that the Cheetah is not a great short-field or climbing airplane. My 172 friends can outclimb me any day of the week, but I quickly overtake them and speed past in cruise. It is a trade-off.

The Sensenich propeller, high-compression engine mod and PowerFlow exhaust have greatly helped the problem. I currently operate the Cheetah from my home field of Prescott, Arizona, which is 5000 feet with density altitudes of 8000-plus on fairly hot days, with my wife and 16-year-old son on board. It can be a slow climber on high and hot days, but manageable. Of course, the ultimate remedy might be the Tiger—essentially the same airplane but with a 180-HP engine.

The Cheetah is arguably the fastest and most economical plane in its class. If you are looking for performance, styling and unmatched fun, the Cheetah may be a perfect fit. It was my third airplane and I never thought I would own any airplane for over 25 years, but I have never crossed paths with any airplane that I could afford that offers the performance, great looks, utility and ease of maintenance that the Cheetah has given, so I have never traded up. It was the best aviation decision I ever made. Before you buy a Skyhawk or Cherokee, give the Cheetah a serious look.

Ken Nebrig
via email

Don Metz sent the lower photo (courtesy of the American Yankee Association) of a 1979 Gulfstream American Cheetah running with a 1978 Grumman Tiger.

FEEDBACK WANTED

PITTS SPECIAL

It's time for a fresh look at the market for the Pitts Special aerobat in the Used Aircraft Guide for an upcoming issue of *Aviation Consumer*. We want to know what it's like to own these aircraft, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your Pitts to appear in the magazine, send us any photographs **(full-size, high-resolution please)** you'd like to share to the email below. We welcome information on mods, operating expenses or any other comments. Send correspondence by September 1, 2017, to:

Aviation Consumer
Email at:
ConsumerEditor@hotmail.com