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The Aviation Consumer

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FRIENDS DON'T LET FRIENDS FLY ELECTRIC GLIDERS

I wouldn't exactly say this overheard tongue-in-cheek comment was the common thread from this year's Soaring Society of America's (SSA) national convention in South Carolina this past February, but it's proof that hardcore sailplane enthusiasts are barely lukewarm to the idea of electrically powered gliders. Talking with showgoers, I drew parallels with the skepticism of evolving electric technology in the powered aircraft market. Still, aside from Stemme's Rotax-powered touring motorglider and a healthy variety of two-stroke powered models displayed on the convention floor, electric sailplanes were, naturally, head-turners. But in learning more about the technology, there were plenty of head-shakes.

The biggest crowds gathered around the kit-built single-seat Alisport Silent 2 Electro. Italian manufacturer Alisport isn't new to aviation and actually has three divisions: sailplanes, STOL aircraft, plus propellers and accessories.

The company's Silent 2 Electro glider is a self-launching competition model—part of the reason for controversy and skepticism. More on that in a minute. If you aren't familiar with glider ops, it simply means you don't need a tow plane to launch it. Instead, a composite and aerodynamically clean (folding) nose-mounted propeller driven by an LZ Design brushless electric DC motor can launch the sailplane to a maximum altitude of 5000 feet, although most pilots will climb to a lesser altitude to reserve power, unaffected by density altitude, of course.

The 220-kW motor (it and the propeller spin at 4500 RPM) is powered by two lithium batteries with a combined capacity of 4.3 kWh, weighing roughly 37 pounds. Remove the batteries when you're finished flying and take them home for a five-hour recharge, though top-off time will vary with the state of depletion and the available output voltage. The batteries are positioned as close to the ship's center of gravity as possible. The photo above shows location and access. The other photo is the system's master controller. Think of it as an electronic power control/throttle, with a simple rotary knob that drives a variable potentiometer. This allows the operator to increase or decrease power and RPM, while monitoring available endurance and battery voltage/current. The glider uses an 8-Ah engine battery, which is charged via a flywheel generator to power cockpit electronics (sparingly), including soaring computers and a comm radio.

A company rep told me the Silent sailplane was initially developed for gliderports in Europe that have noise restrictions and are only allowed to winch and launch. But that's not the driving reason many sailplane buyers will consider electric technology, which also includes sailplanes with front electric sustainer systems. Like the FES (front electric self-launcher) in the Silent 2 sailplane, the idea of an electric sustaining system is to bring another level of safety and convenience to soaring missions during times of weak thermal activity. Simple: Run out of lift, start the motor and climb. But it's not a solve-all.

My friend and winning sailplane competitor Al Simmons echoed thoughts of other experienced sailplane competitors I talked with. His experience proves that it isn't uncommon to fall short of your planned destination by 100 miles or more. Fully charged batteries in the Silent 2 will last for 15 minutes in a sustained full-power climb, and roughly one hour in cruise flight. For pilots like Simmons, that endurance isn't convincing enough for serious soaring missions. For them, gas-powered engines—including two-stroke models—for motorgliders win, while it's baby steps for the electrics, just like it is in other markets. —*Larry Anglisano*

SEAPLANE TRAINING

Larry Anglisano's report on Jack Brown's Seaplane Base (March 2016 *Aviation Consumer*) was spot on. I got my SES (single-engine sea) rating there in 2006 and based on the article, it appears that not much has changed since then, except for the price. It was $899 when I took it.

Larry is absolutely right in saying that if you don't have any experience in a Piper Cub or similar tailwheel airplane, the five hours of dual instruction the school includes in the price is generally not a reality for course completion. Plus, the additional time can increase the price quickly and substantially.

For others taking the course who have time to gain additional experience, one excellent way to have fun and learn about flying the J3 Cub is to go to Preston Aviation Tailwheel School over at the terminal building at Winter Haven Airport, located next to the seaplane base. I believe Tim Preston is one of the best tailwheel instructors you will find. The school uses an award-winning Cub (plus a Stearman) for instruction.

After a few hours with Preston, you should be comfortable enough in the Cub to make the transition to Brown's Cubs on floats with relative ease, while possibly earning a tailwheel endorsement at the same time.

Kudos to Larry and *Aviation Consumer* for an excellent report.

Paul Taeksian
Cape Cod, Massachusetts

I read with interest your coverage of seaplane transition training in your last issue, since I'm planning on earning my rating to transition to the Glastar amphib I'm building.

The deal breaker for me is that Brown's operation won't allow you to rent one of its Cubs after you earn the rating. That's mind-boggling to me, since the owner of the school has apparently found you proficient to exercise the privileges of your SES rating after the checkride.

As the useful follow-up sidebar you included in your article proves, finding seaplanes for solo rental isn't easy, but they do exist. For non-owners who want to keep working on critical skills that can quickly decay if they don't keep practicing them, seaplane rental could be the only option. Thanks for your excellent magazine.

Thomas Gibson
via email

When asked why it doesn't rent its seaplanes for solo flying, Brown's told us its insurance policy won't allow it.

KSN770 COUNTERPOINT

I received my March 2016 *Aviation Consumer* and went right to the article on the BendixKing KSN770, since we had seriously considered it for our Cessna 210 in December 2014.

I was surprised how gently *Aviation Consumer* treated a product that has been promised for years, has been offered for sale since 2014, yet has so many major shortcomings. As a lifelong King equipment user (with an all-King panel) I hoped to be purchasing the long-awaited KSN770. That didn't happen.

In the end, I'm now a Garmin customer, having installed the GTN750 navigator. The KSN770, at about $20,000 installed, is intended for aircraft making cross-country flights. Yet it does not have integrated weather capability. This is a major capability shortcoming that was not mentioned in the sales literature, and it came out when we specifically asked the BendixKing representative. ADS-B In capability is a big deal. We love it on our GTN750.

BendixKing's Roger Dykeman told *Aviation Consumer* the company plans to complete the ADS-B In interface at some point, but couldn't say when that would be. That doesn't sound like a commitment to the product. It's worth noting that BendixKing's trade-in allowances are capped.

Timothy Brady
Easton, Connecticut

We said in the headline that the KSN770 doesn't have ADS-B weather or wireless capability, which for some is a tradeoff for the thousands of dollars in cost savings over Garmin and Avidyne navigators.

The KSN770 does have integrated weather capability through an optional XM Weather receiver, ship's weather radar and Stormscope spherics receiver, although we completely agree that lack of ADS-B can be a deal breaker for many.

As for BendixKing's commitment to the product, we're told the KSN770 is currently in the TSO process to gain ADS-B In capability. According to BendixKing, Garmin's GTN navigators earned the TSO before a separate TSO was required for ADS-B data display.

NARCO AVIONICS SUPPORT

I wish you guys would write another report on servicing old avionics. It seems there are many in service that need repair. I have a Narco MK12D in my Comanche that I use for backup, but I can't find a shop that has a display assembly. Any ideas?

Kent Elliott
Savannah, Georgia

We'll put a report on our coverage list. As for your MK12D, your only option may be to find a used unit for parts.

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Garmin's New ADS-B: All-In-One Transponders

Garmin's GTX345 transponder has wireless output, built-in WAAS GPS and brings long-awaited ADS-B weather and traffic display to some G1000 systems.

by Larry Anglisano

As our refreshed ADS-B buyer's guide on page 7 proves, there is no shortage of ADS-B In and Out solutions. But, what has been missing is a certified WAAS-equipped ADS-B system packaged in a rack-mounted transponder that works with OEM glass panels, retrofit displays, portable GPS and tablet computers. That's a void Garmin plans to fill with its next-generation wireless ADS-B transponders—the GTX335 and GTX345.

Several years ago when it was looking like FAA-mandated ADS-B equipage was a sure thing, buyers logically envisioned an easy path to compliance with a transponder. That came early on with Garmin's upgradable GTX330. But it was only a partial solution. It outputted ADS-B, but couldn't receive the free FIS-B weather everyone wants. It also required a pricey WAAS GPS input (which meant a $10,000-plus GNS navigator upgrade) to complete the ADS-B output data. That didn't help owners of lesser, non-WAAS-equipped aircraft. Let's have a look at Garmin's latest GTX.

FAMILIAR FACE

The new transponders are based on a design Garmin has been using for years, beginning with the Mode A/C digital GTX327 transponder. If you have the GTX327 or the later GTX330, you'll be hard-pressed to tell any difference between them and the new GTX335/GTX345 models. The new ones retain a flight timer and pressure altitude readout.

Garmin offers the new ADS-B transponder in several versions; the most basic is the entry-level GTX335 ES without GPS. At $2995, it has 1090ES extended squitter ADS-B Out, but no ADS-B In. If you think this entry-level model sounds a lot like Garmin's previous GTX330ES, you are correct. Garmin says there is little if any significant difference between the two, other than the GTX335 having a lower price—nearly $1000 less.

While the GTX330ES will be replaced by the GTX335, Garmin made it clear that it can support the GTX330ES series for years to come. That makes sense, since the new models are based on the existing GTX330-series platform.

The GTX335 is available with internal WAAS GPS as an option, which meets the ADS-B mandate standard for a position source and increases the price to $3795. This means you won't have to install a panel-mounted GPS to drive the transponder. The shop will have to

CHECKLIST

- Transponder-based In/Out interface cuts down on installation effort and cost.
- Bluetooth interface with Garmin portable GPS and ForeFlight caters to the market's lower end.
- FIS-B weather overlay not available for some G1000 suites, for lack of OEM approval.

The Bluetooth-equipped GTX345, bottom, outputs ADS-B traffic and weather data to Garmin's aera796 portable GPS, left, and the newly announced aera660 portable. It also works with ForeFlight Mobile and Garmin Pilot tablet apps for iOS and Android.

install a GPS antenna, of course, and the transponder will need a traditional L-band antenna system like any transponder.

The $4995 GTX345 series kicks the interface potential up to a higher level with a dual-band ADS-B In receiver. Dual bands mean the transponder can receive ADS-B data on both 978 and 1090 MHz frequencies. Like the GTX335, the GTX345 is a 1090ES unit, making it a player for higher altitudes where 1090ES is required. The flagship GTX345 with internal WAAS GPS is $5795.

BLUETOOTH ENABLED

A major difference between the GTX345 and lower-end GTX335 is the internal wireless Bluetooth transceiver, which follows the footsteps of Garmin's remote-mounted Flight Stream wireless hub. Using Garmin's Connext Bluetooth link, the GTX345 streams ADS-B traffic and FIS-B weather data to the aera795/796 portable GPS, iOS and Android tablets running the Garmin Pilot navigation app, in addition to the ForeFlight Mobile app for iPad.

The data interface trickles down from the Flight Stream two-way data transfer protocol (it's only a one-way communication stream between the transponder and tablet app) and it enables the transfer of pressure altitude data, ADS-B messaging, plus FIS-B weather and ADS-B traffic overlay. You'll need to have ForeFlight Mobile version 7.20 or higher for the interface to work, while the ADS-B In data interface isn't limited to portable equipment.

Through a wired interface, the GTX345 sends both ADS-B weather and traffic to the GTN750 and GTN650 navigators, and to the GNS530W and GNS430W WAAS navigators.

As with the older GTX33-series remote transponder, the GTX345 is available in a remote LRU version, the GTX345-R. This enables the GTN750 to display and provide tuning of transponder squawk codes and mode functions, eliminating the need for a panel control head.

But don't expect the same functionality with all displays. For example, the GTN750 and GTN650 can display up to 60 ADS-B airborne and ground traffic targets in true ADS-B symbology. As for FIS-B weather, the GTN750 will display regional and CONUS NEXRAD, METARs, TAFs, PIREPs, winds and temperature aloft, AIRMETs, SIGMETs, TFRs and NOTAMs. That's pretty much a full-boat ADS-B interface. There is also Garmin's TargetTrend function—advanced traffic awareness that portrays the traffic on-screen in real and future time.

That's the GTX345 in the panel of a Cessna 152, top, streaming ADS-B data to an iPad. The other end of the spectrum is the G1000 integrated avionics suite, middle. The GTX345-R remote ADS-B LRU, bottom, handles ADS-B Out and In, and displays it on some G1000s, but not in Diamond's DA40NG/42.

The GNS530W and GNS430W interface is somewhat limited. For example, these displays will only support eight airborne traffic targets displayed in TIS-A symbology. As for FIS-B weather, you'll see regional and CONUS NEXRAD, METARs and TAFs. Additionally, you won't be able to control the remote GTX345-R.

The GTX345 will also work with Garmin's stand-alone GMX200 MFD, displaying up to 60 traffic targets, plus regional NEXRAD, TAFs and METARs. It will also work with the long-discontinued MX20, but out experience is the unit just doesn't have the processing horsepower to deal with weather graphics—potentially shutting down or freezing up when you need it the most.

Garmin says an interface with the G600/G500 PFD is planned for a future release, displaying all of the traffic and weather products that the GTN navigators are capable of.

G1000 INTERFACE

ADS-B In capability has been a nagging shortcoming of Garmin's G1000 integrated avionics suite, and the

GARMIN'S NEW PORTABLE GPS

On the heels of its wireless ADS-B transponder release, Garmin also announced the new aera660 aviation portable GPS.

The latest $849 aera isn't a clean-sheet design and closely resembles the company's nuvi automotive navigator. The device has a 5-inch capacitive touchscreen, a 5.5 by 3.4 by .8 inch chassis and weighs 8.64 ounces with the battery installed. For a general idea of its stature, compare it with Apple's 6.22 by 3.06 by .28 inch iPhone 6 Plus—which has a slightly larger 5.5-inch display.

A look at the tech specs reveals that the aera's rechargeable lithium-ion battery has relatively short endurance—up to four hours. You can increase the life to around six hours if you run the display down to 5 percent backlight intensity, which is night mode. You'll certainly want to feed it external voltage with the included USB cable. There is reason for all the power draw. It has wireless connectivity with the GTN touchscreen navigators and Garmin's standalone comm radios.

The new aera660 is also being marketed for use as a primary display in the GTX345 transponder and GDL39 portable ADS-B interface, connecting with these devices either through a Bluetooth or wired connection. The aera is a full-up navigator and EFIS display equipped with a GPS/GLONASS receiver and Garmin's 3D Vision and charting and meets Class 1 and Class 2 EFB (electronic flight bag) requirements. For the helicopter crowd, it has Garmin's built-in WireAware wire-strike awareness system.

We'll see how the aera compares to comparably sized smartphones in a future issue of *Aviation Consumer*.

GTX345 finally enables the capability. The GTX345-R can take the place of the existing remote GTX transponder in select G1000 systems.

For most G1000s, the $5795 GTX345-R with internal GPS is used—requiring another antenna. It would be easier to use the existing G1000 WAAS LRU to drive the transponder, but it requires OEM approval. The GTX345-R can display FIS-B weather and ADS-B traffic on some G1000 systems, including non-WAAS suites in Cessna 172, 182, 206, 208 Caravan and 350/400 Corvalis singles. It's also fully compatible with G1000-equipped Piper models, including the Meridian turboprop.

Display of GTX345-R ADS-B traffic on any G1000 requires GDU software version 7.10 and GIA63 version 5.31 or later. For FIS-B weather display, any G1000 suite requires GDU software version 12.00 and GIA63 version 6.20 or later. Check with your G1000 service center on upgrade costs and OEM approval status of the software. Some aren't approved yet, including the Diamond DA40NG and DA42. The Hawker Beechcraft G58, G36 and some G1000 Mooney models aren't approved, either.

COMPETITION, NEW ALTITUDE ENCODER

Garmin isn't alone with a transponder-based total ADS-B solution. Appareo is working on its Stratux ESG GPS-equipped model, but the new GTX series is certified and available now. Another model that's in the works is the $3500 Sandia Aerospace STX360 Sentinel. Sandia says it will be available in a remote LRU for interfacing with EFIS displays.

Unlike the Garmin and Appareo 1090ES solutions, it won't be a player in high-flying aircraft since it outputs ADS-B on 978 MHz. While it also receives ADS-B In on 978 MHz, it won't display NEXRAD graphics on its LCD display (only METARs) and it doesn't have an internal WAAS GPS receiver. It does have a wireless transceiver for outputting FIS-B and ADS-B traffic to a tablet, but Sandia hasn't announced app compatibility. Sandia says it's on track for certification later this year.

Garmin's new altitude encoder, left, is roughly the size of a quarter and mounts to the transponder mounting rack.

In our estimation, that leaves L-3 Aviation, with its Lynx NGT9000 multi-function transponder, the closest certified competitor to the GTX345. We covered the NGT9000—which starts at $6800—in the April 2015 issue of *Aviation Consumer* and liked its scalability, bright RGB touch display and intuitive feature set. It doesn't have an internal wireless transceiver, so you'll have to purchase an optional module to stream the data to tablets running the WingX Pro navigation app. The flagship NGT9000D+, which has diversity, internal WAAS GPS, plus an internal TAS traffic processor, has an eye-popping price tag of nearly $12,000.

Garmin has also introduced its next-generation Mode C altitude encoder, simply called the Garmin Altitude Encoder. At $279, it's the smallest digitizer we've seen to date and cuts down on installation effort because it mounts directly to the GTX345/335 mounting tray. Garmin says the encoder has a proprietary data code that works directly with the GTX335/345 transponders. You still need Mode C altitude encoding in a full-up ADS-B interface.

While manufacturers like Sandia Aerospace (which previously supplied Garmin with its SAE-series digitizer) have conveniently integrated the encoder into the transponder, there is a downside: The static system has to be recertified if the transponder is removed and reinstalled.

No doubt, buyers who recently invested in Garmin's GDL88 remote ADS-B solution are shaking heads at Garmin's new transponder technology, which promises an easier, cheaper and cleaner installation. But, that's the cost of early adoption in a rapidly changing ADS-B market.

MANDATE-COMPLIANT, PANEL ADS-B PRODUCTS

PRODUCT	ADS-B SPECS	DISPLAY INTERFACES	PRICE	COMMENTS
APPAREO				
STRATUS ESG	1090ES ADS-B TRANSPONDER	N/A	$3490	Has internal WAAS GPS, interfaces with Stratus portable
ASPEN AVIONICS				
ATX100	978 UAT OUT, 978 UAT IN	EVOLUTION MFD	$2645	Requires external GPS
ATX100G	978 UAT OUT, 978 UAT IN	EVOLUTION MFD	$3495	Has internal WAAS GPS, ADS-B In and Out
AVIDYNE				
AXP340	1090ES ADS-B TRANPONDER	N/A	$3995	Partial plug-and-play with some existing BendixKing KT76A/C, KT78A transponders, requires WAAS GPS input
MLB100	978 UAT IN	IFD540/IFD440	$2495	Compatible with Avidyne's IFD540 navigator
BENDIXKING				
KT74	1090ES ADS-B TRANSPONDER	N/A	$2999	Partial plug-and-play with KT76A/C, KT78A transponders, requires WAAS GPS input
KGX130	978 UAT IN	IOS TABLET MFD TRAFFIC ONLY	$1489	ADS-B In only, for use with 1090ES transponder
KGX150	978 UAT OUT, 978 UAT IN	IOS TABLET MFD TRAFFIC ONLY	$4069	Has internal WAAS GPS.
KGX150	978 UAT OUT, UAT IN	IOS TABLET MFD TRAFFIC ONLY	$3489	Version without internal WAAS GPS
FREEFLIGHT SYSTEMS				
FDL-978-TX	978 UAT OUT	N/A	$2995	Has Diversity, includes control head
FDL-978-XVR	978 UAT OUT, 978 UAT IN	IOS, ANDROID MFD TRAFFIC	$3695	Has Diversity, includes control head and WiFi module
FDL-978-XVR	978 UAT OUT, 978 UAT IN	IOS TABLET MFD TRAFFIC	$4495	Internal WAAS GPS, includes WiFi module for tablet use
FDL-978-TX/L	978 UAT OUT	N/A	$1995	Lite version, no ARINC card, upgradeable to ADS-B In
FDL-1090-TX	1090ES ADS-B TRANSPONDER	N/A	$4495	Remote control head/processor design, requires WAAS GPS input
GARMIN				
GTX335	1090ES ADS-B TRANSPONDER	N/A	$3295	Internal WAAS $3795
GTX345	1090ES ADS-B TRANSPONDER	GTN/GNS/G1000/TAB	$4995	Internal WAAS $5795, GTX345-R LRU priced the same
GDL84	978 UAT OUT, DUAL-BAND IN	IOS, ANDROID TABLETS	$3995*	Standalone ADS-B Out and In, wireless Bluetooth connectivity with Flight Stream 110/210. Requires Garmin Pilot, ForeFlight tablet app. *$4495 with Flight Stream 210 (built-in AHRS)
GDL88	978 UAT OUT, DUAL-BAND IN	GNS530W/430W GTN750/650 G600/500 *IOS/ANDROID	$3995	Requires WAAS GPS input, tablet interface requires Flight Stream wireless Bluetooth module, Garmin Pilot or ForeFlight app
GDL88-W	978 UAT, DUAL-BAND IN	GNS530W/430W GTN750/650 G600/500 *IOS/ANDROID	$5143	Has built-in WAAS GPS receiver, tablet tablet interface requires Flight Stream wireless Bluetooth, Garmin Pilot or ForeFlight app
GDL88-D	978 UAT, DUAL-BAND IN	GNS530W/430W G600/500 GTN750/650 *IOS/ANDROID	$4495	Diversity model (requires top and bottom antenna installation), requires WAAS GPS input, tablet interface requires Flight Stream wireless Bluetooth module, ForeFlight or Garmin Pilot app
GDL88-WD	978 UAT, DUAL-BAND IN	GNS530W/430W GTN750/650 G600/500 *IOS/ANDROID	$5643	Has built-in WAAS GPS receiver, Diversity (requires top and bottom antenna installation), tablet tablet interface requires Flight Stream wireless Bluetooth module, ForeFlight or Garmin Pilot app
L-3 AVIATION LYNX				
NGT-9000D+	1090ES ADS-B TRANSPONDER DUAL-BAND ADS-B IN	SELF-CONTAINED, GARMIN MX20	$11,933	Rack-mounted, internal WAAS, TAS, Diversity, displays traffic on any display that accepts Skywatch data
NGT-9000D	1090ES ADS-B TRANSPONDER DUAL-BAND ADS-B IN	SELF-CONTAINED, GARMIN MX20	$8133	Has Diversity, but no internal TAS

MANDATE-COMPLIANT, PANEL ADS-B PRODUCTS (CONTINUED)

PRODUCT	ADS-B SPECS	INTERFACES	PRICE	COMMENTS
NGT-9000+	1090ES ADS-B TRANSPONDER DUAL-BAND ADS-B IN	SELF-CONTAINED, GARMIN MX20	$9200	Has internal TAS, but no Diversity
NGT-9000	1090ES ADS-B TRANSPONDER DUAL-BAND ADS-B IN	SELF-CONTAINED, GARMIN MX20	$6800	No Diversity, no internal TAS
NGT-2500	978 UAT OUT, 978 UAT IN	MX20, TABLET	$3467	iOS, Android tablet interface requires $270 optional WiFi module, $1223 control panel may be required
NGT-2000	978 UAT OUT, 978 UAT IN	TABLET	$3200	Requires $270 WiFi module, built-in WAAS GPS, could require $1223 optional control panel
NGT-1000	978 UAT OUT	N/A	$2132	Basic mandate-compliance, built-in WAAS GPS, could require control panel installation
NAVWORX				
ADS600	978 UAT IN	Garmin MX20, GMX200 *GNS430/530/G500/600	$1199	*Garmin display interface will overlay traffic only. $2399 version with internal GPS can interface to 1090ES transponders
ADS600-B	978 UAT IN, 978 UAT OUT	Garmin MX20, GMX200 *GNS430/530/G500/600	$2399	Has non-certified built-in WAAS GPS for aircraft that don't need to comply with ADS-B mandate
ADS600-BG	978 UAT IN, 978 UAT OUT	Garmin MX20, GMX200 *GNS430/530/G500/600	$3499	Built-in mandate-compliant WAAS GPS, complete with antennas and installation hardware
SANDIA AEROSPACE				
STX360	978 UAT IN/OUT	INTERNAL	TBD	Mode A/C transponder with integral ADS-B In/Out
TRIG AVIONICS				
TT31	1090ES TRANSPONDER	N/A	$2568	Requires external WAAS GPS input, KT76A/C replacement
TT22	1090ES TRANSPONDER	N/A	$2595	Remote control head and processor

NON-CERTIFIED PORTABLE ADS-B PRODUCTS

PRODUCT	PRICE	SIZE	ADS-B SPECS	BATTERY LIFE	MAJOR APPS SUPPORTED	COMMENTS
DUAL XGPS170	$549	4.3 X 2.7 X 0.8	978 MHZ	5 HOURS	WINGX PRO, FLTPLAN.COM, SEATTLE AVIONICS FLYQ, ADVENTURE PILOT IFLY	Convenient chassis design with nonskid base
SAGETECH CLARITY	$1150	2.5 X 2.5 X 1.5	978 MHZ 1090 MHZ	6 TO 8 HOURS	WINGX, ADVENTURE PILOT IFLY, GLOBAL NAV SOURCE, IPAD EFB, SKYVISION EXTREME	ADS-B only; no AHRS, dual band
SAGETECH CLARITY SV	$1400	2.5 X 2.5 X 1.5	978 MHZ 1090 MHZ	6 TO 8 HOURS	WINGX, ADVENTURE PILOT IFLY, GLOBAL NAV SOURCE, IPAD EFB, SKYVISION EXTREME	Top overall performer for GPS, ADS-B and EFIS; smallest physical size; runs HOT
ILEVIL AW	$1395	4 X 2.5 X 1.0	978 MHZ	5 HOURS	WINGX, FLYQ, ADVENTURE PILOT, AHRS UTILITY, XAVION, AVNAV EFB, AVARE	Can be be hardwired, pressure transducer interface for airspeed/altitude
ILEVIL 2SW	$1195	4 X 2.5 X 1.0	978 MHZ	5 HOURS	WINGX, FLYQ, ADVENTURE PILOT IFLY, AHRS UTILITY, XAVION, AVNAV EFB, AVARE	Good performer, solar charging, now has dual frequency ADS-B
STRATUS II	$899	6 X 2.6 X 1.25	978 MHZ 1090 MHZ	8 HOURS	FOREFLIGHT ONLY	Good overall value; runs coolest; requires toggling to separate app to use EFIS
STRATUS I	$499	5.75 X 4.25 X 1.0	978 MHZ	8 HOURS	FOREFLIGHT ONLY	First-generation model, no AHRS, single-band receiver
GARMIN GDL39	$599 $699 W/ BATTERY	3.5 X 1.9 X 6.0	978 MHZ 1090MHZ	4 HOURS	GARMIN PILOT FOR IOS AND FOR ANDROID, GARMIN GPS396/496/696/AERA500 VIA CABLE, GARMIN 796	Bulky footprint, especially with optional battery installed
GARMIN GDL39 3D	$849 $899 W/ BATTERY	3.5 X 1.9 X 6.0	978 MHZ 1090 MHZ	4 HOURS	GARMIN PILOT FOR IOS AND FOR ANDROID, GARMIN GPS396/496/696/AERA500 VIA CABLE, GARMIN 796	Has AHRS output for driving Garmin Pilot attitude and synthetic vision display
SKYVISION SALUS-3 978UAT/1090ES	$1099	8.0 X 3.0 X 2.0	978 MHZ 1090ES	EXTERNAL VOLTAGE	XTREME VISION, WINGX PRO, SKYRADAR, ADVENTURE PILOT, XAVION	First portable solution attempting to meet ADS-B mandate certification
STRATUX	FROM $100	VARIES WITH CASE OPTION	978 MHZ 1090ES	EXTERNAL VOLTAGE	FOREFLIGHT, WINGX, FLYQ, OTHERS	Assemble your own receiver and play the ADS-B data on a variety of apps

Speedbrake Mods: Questionable For Some

Precise Flight SpeedBrakes and PowerPac Spoilers can more than double descent rates without power chops or Vne busts. Consider your mission, engine and skills.

by Larry Anglisano

Some OEMs include speedbrakes as standard or as an option on new aircraft, and they've been available for years as STC'd retrofit systems. Fitting speedbrakes in the aftermarket may seem like a complicated project, and while it's a major modification, the installation is easier than you might think—as easy as cutting holes (rectangles, actually) in metal wings can be, that is.

In this article we'll look at the two and only aftermarket speedbrake systems, the installation, real-world use and the cost.

SPOILERS OR SPEEDBRAKES?

Technically, speedbrakes are spoilers because they spoil the airflow over the wing. Confusing the matter is Precise Flight's product— the electric SpeedBrake 2000 system.

There is also the PowerPac Spoilers system from Spoilers Inc. It offers a number of STC'd kits for twin-engine aircraft retrofits, including twin-Cessna models, the Beech Baron and Duke, the Piper Aerostar, plus the Piper Malibu/Mirage singles.

Whether you call either spoilers or speedbrakes, the marketing push for each comes down to, well, coming down—fast—without an engine-shocking power reduction.

Considered a third dimension of flight control, wing lift spoilers make for easier speed reductions to gear extension speed, combat ATC slam-dunk descents, plus extend high-altitude efficiency closer to the runway.

PowerPac's STC allows for spoiler deployment and retraction in icing conditions, while Precise Flight's SpeedBrakes aren't approved for use in visible ice.

Both products have been around for years, resulting in engineering improvements that contribute to better failsafe capability while also taming installation complexity.

CHECKLIST

- ⊕ Precise Flight SpeedBrakes are relatively easy to install, with experience.
- ⊕ PowerPac hydraulic spoilers are engineered with failsafe in mind.
- ~ We don't think either makes sense for slower aircraft. STCs are limited to high-performance models.

HYDRAULIC VS ELECTRIC

PowerPac represents its spoilers as the "jet-type" design, similar to the plate-like spoilers on big airplanes. PowerPac says these are designed to reduce lift, rather than merely increasing drag.

The PowerPac Spoilers for twins, lead photo, and the Precise Flight SpeedBrake 2000 system, bottom, are both considered spoilers because they do just that—they spoil the wing's airflow.

SPOILERS: AVIATION'S DELETE KEY

The first time I flew a sailplane was also the first time I used spoilers/speedbrakes. Deploying them, I rapidly discovered that they allowed an astonishing capability to fine-tune my approach path and nail the touchdown to within a few feet of the desired point. I immediately wondered where these wonderful things had been all my life. I later learned that they'd preceded me by some years, having been around since 1920, when de Havilland tested them (but rejected their use) on its D.H. 16 airliner.

I've used speedbrakes on early 20-series Learjets, Citations, a few piston singles—including the Cessna P210—and piston twins. My experience has been uniformly positive. All of the types that I've used—with the exception of those on the Lears—generate no pitch change with deployment. Most simply cause a linear increase in drag, with some accompanying rumble, allowing rapid deceleration, descent or both. You can come out of the sky like a dropped sewer cover, then close them and you're instantly flying again. Deploying them on touchdown means more weight on the wheels immediately and higher drag for more rapid deceleration—two huge pluses when dealing with a nasty crosswind on rollout.

For those who subscribe to the shock-cooling hypothesis, speedbrakes allow a rapid descent without a major power reduction. I especially like them when I want to keep the speed down during a descent in turbulence as well as those times when ATC keeps you high, setting up a slam-dunk approach. Unlike extending flaps to increase drag—which reduces the structural strength of the wing—deploying spoilers does not affect the flight loads the wing can endure, which provides a certain level of comfort when trying to keep the speed down in serious turbulence.

Over the years I've to come to think of spoilers as an excellent tool for dealing with descents in turbulence, controllers who keep me high as the airport disappears under the nose and as aviation's delete key when I screw up and am too high and/or too fast on final. Deploy. Fix the problem. Stow. I wish more airplanes had them.

—Rick Durden

PowerPac spoilers are hydraulic, and all retrofit kits (except the one for the Aerostar) employ an electric-hydraulic pump (called the PowerPac) to supply hydraulic pressure for deployment/retraction. The kit for the Aerostar consists of a manifold that directs hydraulic pressure from the airplane's own system to the spoiler system actuators.

When deployed, they extend upward into the slipstream at a 60-degree angle, spoiling a portion of the lift being generated by the wing, while at the same time creating drag. When retracted, they stow flat in the top surface of the wing.

For an added layer of failsafe, the system uses limit switches on each drive servo motor to close off the flow of hydraulic pressure. This triggers a logic signal to the panel-mounted status annunciators for each spoiler. The spoilers are deployed and retracted with a single push-button switch, which applies power to the hydraulic pump.

During electrical failure, the solenoid valve opens, sending hydraulic fluid back to the reservoir, while the aerodynamic pressure and return springs on each plate immediately retract the spoilers into the wings. You can initiate a manual hydraulic dump by pushing the switch twice.

Spoilers Inc. says its target performance for the product is an increase in descent rate of between 50 and 100 percent of what it would be without them. The spoiler plates are designed to minimizing rumbling and drastic changes in pitch.

As part of the STC process, the spoilers were stall tested with all possible combinations of gear position, flap position and CG range, proving no adverse change in stall characteristics and no substantial increase in stall speeds when deployed.

The spoilers are made of aluminum alloy, weigh 20 pounds when installed and are fully deployed within four seconds.

As for installation, Spoilers Inc. suggests upward of 45 hours of shop labor for the aircraft on its STC. Add at least seven hours to that if your shop has never installed them. Installation time can increase by 20 hours if the aircraft is STOL-equipped. List pricing of the hardware ranges from $7000 to $9500, depending on the kit.

PRECISE FLIGHT

The SpeedBrake system was Precise

Flight's first product. Originally offered in 1980, its current SpeedBrake 2000 system is standard equipment on new Mooney, Beech, Piper and Cessna Corvalis models, while a similar kit is offered to the aftermarket through STC retrofit. The SpeedBrake 2000 is also provided from aftermarket modifier Knots2U.

The aluminum system is electrically driven and operates quite differently than the PowerPac Spoilers. It uses no hydraulics, cables or pulleys and the blades stow flush with the surface of the wing when retracted. Precise Flight says its SpeedBrakes can double the descent rate, while reducing airspeed by an average of 20 knots. SpeedBrakes are deployable up to the aircraft Vne and have no overall speed restrictions.

The scissor-like aluminum blade cartridges are attached inside each wing using stiffeners, doubler plates (which strengthen the cutout areas) and retaining brackets. Precise Flight provides bare-ended wiring harnesses, which terminate in a central bay location and connect to the ALC (asymmetric logic control box). The logic inside the ALC ensures that both brakes deploy at the same time, while a panel-mounted on/off actuator switch and status annunciator panel is used for primary control.

Operation is straightforward. According to the flight manual supplement for the Beechcraft Bonanza series, expedited descents are accomplished by setting 2400 RPM and approximately 16 to 18 inches MP, followed by SpeedBrake deployment. In the landing pattern, the FMS states to fly a high base and final leg, extend the wing flaps and then deploy the SpeedBrakes. You can use the SpeedBrakes intermittently to modulate the glidepath.

Precise Flight says that experienced installers can retrofit the SpeedBrake system in roughly 25 hours, but the average installation time is more like 35 hours.

The typical price of the kit is around $5000. For fiberglass aircraft (only the Columbia 300 is approved for retrofit), a prefabricated fiberglass pocket is grafted into each wing for housing the SpeedBrake cartridge.

Precise Flight says you might be able to earn FAA field approval for aircraft not covered by the STC, but you should expect the process to be extensive and costly.

That's the PowerPac Spoiler system command switch and warning annunciator, top photo. The Precise Flight SpeedBrake 2000 cartridges are asymmetrically deployed. That's one on a Mooney Ovation2, bottom.

WORTH THE INVESTMENT?

As Rick Durden describes in the sidebar on page 10, there are some compelling operational benefits to speedbrake retrofits—perhaps more compelling for finicky high-output engines.

RAM Aircraft is one engine builder that advocates the use of PowerPac Spoilers to help combat engine shock cooling, particularly for RAM-modded Cessna twins. Given the nature of the installation, we think selecting an experienced shop—or at least one with expertise in sheet metal work—is imperative. RAM is one of them.

But for lesser aircraft (we're talking about Archers and Skylanes, to name a couple), we don't think attempting a field approval for installation is worth the chase. But if you fly a high-performance piston in regions where slam-dunk approaches are the norm rather than the exception, or are concerned with chilling the engine while throttled back in a last-minute descent, we think either product is worth considering.

You might also consider passenger comfort and airframe stress. Speedbrakes and spoilers can avoid the drama of uncomfortable nose-down descents, while allowing for a slower ride while descending through turbulence.

Last, we disagree with those who say speedbrakes are a substitute for STOL mods. Good speed control on final is what efficient and shorter landings are made of, and speedbrakes and spoilers can help get you set up for it before hitting the traffic pattern.

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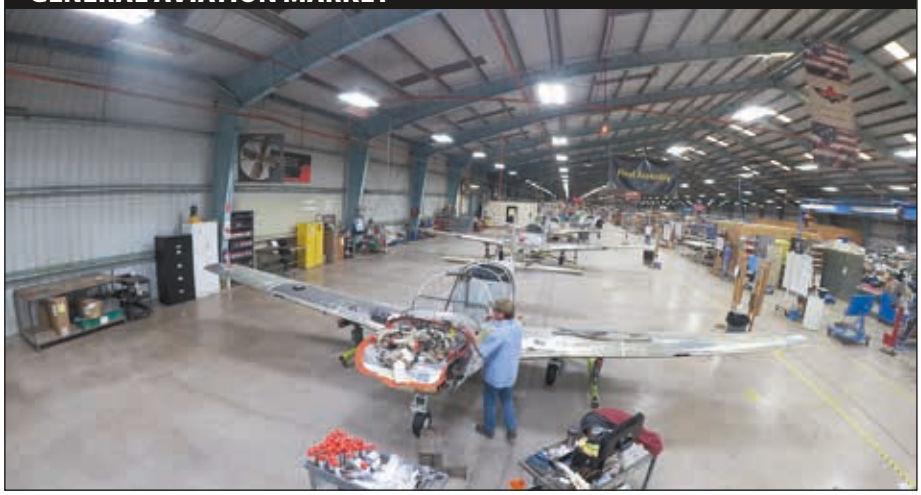


Mooney's new assembly line, left, was in the final stages of tweaking in mid-February. The plant can produce two airplanes a month, but that rate is readily expandable.

Mooney Reset: Cutting Build Costs

Legacy models are hobbled by high build-hour requirements. Investments at Kerrville aim to cut production time by as much as half.

by Paul Bertorelli

Even if the likes of a Cirrus or Lancair hadn't come along, builders of metal airplanes like the Mooney M20 series were headed for a box. As volume diminished, the airplanes remained as complex as ever to build, with thousands of hand operations and individual parts. Economy of scale had evaporated.

Now, with an infusion of Chinese capital, Mooney's Kerrville, Texas, factory is confronting this challenge the only way it can, with a fundamental rethink of the production process and carefully focused injection of investment in digital and automated manufacturing, essentially mirroring what Lycoming has done to remain competitive. We covered this in detail in the February 2015 issue of *Aviation Consumer*.

Yet Mooney's circumstance isn't parallel to Lycoming's because even as it struggles to retool its legacy products, it will soon introduce clean-sheet airplanes—the M10 series—specifically designed to be fast and efficient to build. We were told on a recent visit to Kerrville that the new airplanes are likely to be built partially or entirely in the Texas plant, with an eventual assembly operation in China.

REVITALIZING THE M20

The sidebar on page 14 summarizes Mooney's two new M20-based derivatives, the M20V Acclaim Ultra and the M20U Ovation Ultra. While neither of these could be considered true clean-sheet designs, they do represent substantial improvements on the previous M20 models. But the real story is how Mooney hopes to make massive efficiency gains in the way the airplanes are built. As these airplanes near the $800,000 mark, Mooney clearly doesn't have much more headroom to raise prices, so sustainable profits will likely accrue from reducing both the time and cost of building them.

We toured the plant with Rob Dutton, who's Mooney's recently hired chief manufacturing officer. He comes to the job from a long career in aerospace, mostly on the commercial and transport side. We first visited the Kerrville plant 20 years—and two owners—ago and the changes have been dramatic. The assembly line has been drastically shortened with fewer stations and, as has every other company in aerospace, Mooney has embraced the lean, *kanban*-style of manufacturing that stresses low inventories and data tracking of everything from small fasteners to the man hours required to build major structures like wings and fuselages.

Physically, the place is still recognizable, but barely. The cavernous assembly hangars, once dark caves, are now brightly lit with modern LED lighting, fresh wiring and paint. During our visit over two days, the ancient back shops were still a work in progress, with old office modules being ripped out in favor of modern replacements.

Production equipment remains a mix of the old and new, but what new stuff we did see improves both productivity and quality to the extent that Mooney is also doing what Lycoming is doing: bringing many jobs they used to outsource back in-house. The company is also using its production capacity to build parts and structures for other aerospace companies, something it has done before.

SELECTIVE COMPOSITE

Mooneys have always had bits of plastic for fairings and interiors, but the new M20U/V aircraft will have a major composite component in a new cabin shell with composite doors. Dutton says this does two things: It makes for better-fitting, quieter doors and shaves assembly time. Mooney had originally planned to outsource the doors, but when an analysis showed they could be built in-house for a quarter of the price, the doors came back in. The

One of the most labor-intensive and complex components of the M20 is the single-piece wing, right. A new heat-treating facility, middle left, and increased use of CNC equipment, middle right, have increased both output and quality. Mooney has transitioned to a fully digital parts tracking and storage system, lower photo.

shell itself is made by a vendor for now, but it might be manufactured in the Mooney shops, too, especially once the M10 production gets started.

"The new composite shell takes the place of a lot of sheet metal parts and also the fasteners that put those sheet metal parts together," Dutton says. "And you have to remember when you're hand-building an airplane like this, you have to do a little bit of trimming, a little bit of adjustment to make them fit. The composite shell will bring a static size and shape and won't need any adjustment. We can just put the shell over the roll cage, make it fit and fair, and tie it down," he adds.

Before that happens, assemblers will have much better access to the fuselage frame to fit wiring, plumbing and control circuitry. As for the roll cage, the individual 4130 steel tubes are now CNC cut and welded in a jig that assures consistent shape and dimension. That tube cutting is done by a vendor, but that too may eventually come back into the factory.

As for the shell, it's a major reducer of build hours. "It's a big savings in labor, both in assembly and piece parts. When you rivet, you need two people and we've eliminated some of that. And you don't have to buy that shell until later down the assembly line and you don't have to install it until later," Dutton says. That means avionics and systems can be installed, literally, before the roof goes on.

Does this mean aircraft builds are approaching automotive quality and repetitive accuracy? "I wouldn't say it's approaching automotive quality, but it's pretty good for aerospace manufacturing," Dutton explains.

MOVING FORWARD

Dutton says the wider use of CNC equipment will inevitably produce a more accurate airframe, better fits and higher quality, but there are limits to that when building an old-school airframe like the M20. "Moving forward on a new airplane like the M10, the design of the parts is all being done in a CAD system, so the tolerances on that airplane will be a lot tighter," Dutton says. "That airplane will go together a lot more toward the automotive model," he adds.

Interestingly, as the new CAD-CAM technology integrates with the existing factory in Kerrville, there may be further efficiency and quality gains for the M20. "If we have to do any redesign or improvements on the M20, I'm sure we'll use that same technology. We have used some CAD on the M20, but a lot of it is still on old two-dimensional drawings," says Dutton.

Because it has so many discrete parts—many of them cut and shaped aluminum—a large number of hours are devoted to simply handling the parts necessary to build larger aluminum structures. And that aluminum has to be heat treated before and after the various shaping operations. "Our core capability here is sheet metal fabrication and forming; brake forming, hydroforming, roll forming. We would not be able to do that as efficiently as we do today without a heat-treat process," Dutton says. At one time, Mooney had a salt-bath heat-treat system, but that was removed when the company went into hibernation in 2009. When the company returned to production, parts had to be sent out for heat treating. That required shipping parts back packed in dry ice to retain the treatment. If it sounds inefficient, it was. "It was a logistical nightmare and an extreme expense," Dutton says. Now, with a nearly million-dollar investment, the

RETOOLING THE M20

Just as the factory itself confronted daunting economics, so too did the aging M20 design face a difficult design challenge. What could be done to improve the old welded-tube, metal-skin basic design? Mooney's solution was both surprising and creative.

Would-be buyers and owners have always complained about the lack of a pilot's-side door, so the new M20V Acclaim Ultra has one. This was made possible by replacing the original aluminum skin around the cabin with a single-piece composite shell, as shown below.

To ease ingress and egress, the two composite doors are wider, making access to the rear seats less of a contortion. Mooney COO Tom Bowen also says the doors will fit much better, making for a quieter cabin. While they were at it, the company completely redesigned the interior with new, ergonomically shaped seats, composite interior panels and a reworked instrument panel design. The new airplanes—the second is the normally aspirated M20U Ovation Ultra—will retain the Garmin G1000 suite and GFC 700 autopilot. Bowen says the new airplanes have a newly redesigned wiring harness that's lighter and has fewer connectors.

The Acclaim Ultra will retain the Continental TSIO-550G, with 280 HP and a TBO of 2200 hours. Bowen told us final weights haven't been determined yet, but the typical useful load is expected to be about the same as the current Acclaim model of 1000 pounds. Max takeoff weight for the airplane will be 3368 pounds. Standard fuel capacity is 89 gallons with a 100-gallon long-range option.

It appears that the Acclaim will retain its title as the fastest four-place piston single, with a claimed maximum cruising speed of 242 knots, but a typical cruise of 225 knots. Cheap it ain't. Equipped price is expected to be $769,000.

company has its own heat-treat facility and can take in work from other companies while also smoothing the production process. Further, with the new heat-treat process, the parts distort less, requiring less remedial work to obtain acceptable fits.

HALF THE HOURS?

During our factory walkabout, we asked Dutton how many build hours he thought could be taken out of the typical M20 airframe. This remains an unknown, but reducing the hours by half seems possible.

"I'm sure the composite shell and the doors are just one thing that's going on now. But take the wire harness. You'd think a wire harness is a wire harness, but if you remove wires and a dozen connectors, the part is easer to build and takes less time to install," Dutton says.

Although the investment in both the Kerrville shops and the company's Chino, California, facility has been considerable, there's room to make more. But it will require sales volume to justify it. "We have a list of investments we want to make. One of the next we plan to make is a new CNC machine for the machine shop. That will really increase our output capability in the machine shop," Dutton explains. As far as further automation, we asked if a factory like Mooney's would ever see the kind of robotics found in the typical automotive plant. "I can't see that happening in this facility. I don't see that kind of investment giving a payback in any kind of short term," Dutton says.

Volume-wise, the factory is capable of about two aircraft per month, but with little addition to overhead other than some additional labor, it could expand that considerably, something it will need to do to get back to break even. What remains to be seen is if Mooney will find sales to justify such expansion. When the M10 is integrated into Kerrville, the venerable factory will become *sui generis* for GA manufacturing.

Operational Blunders: Protecting Yourself

You've just damaged an airplane and probably violated at least one of the FARs. All is not lost. Here's what to do to assure the best possible outcome.

by Rick Durden

The day had started out so well. You flew out to meet with a client and wrapped up a big sale. On the way home you got some time in the clag and shot an approach to your non-towered home field. You broke out well above minimums and easily spotted the runway. But then, somehow, you didn't handle the crosswind during rollout and went swerving off the runway into the grass. To make matters worse, just before you got the airplane stopped the nose gear hit a hidden storm-drain cover and collapsed.

You shut everything down and crawled out, pretty disgusted with yourself. Looking at the bent prop and nose damage, you remember that Part 830 of the NTSB regulations defines a reportable aircraft accident. This clearly isn't enough damage to qualify, so you know you don't have to report this to any federal agency. You know you have good insurance, so you'll call your agent first thing and you'll talk with the FBO about getting the airplane moved into your hangar where it will be protected from the elements until repairs can get started.

About then people start showing up, asking if you're OK. Two of them show you FAA identification—they're inspectors who were at the airport restaurant and saw the whole thing. They, very politely, say they'd like to talk with you about what happened at some point—and they'll want to see your logbook and the airplane's logs.

Three days later you meet with them, talk about the incident and they look through the logs and your certificates. All of your stuff is in order—flight review, medical, instrument currency. Your airplane has a current annual, but, whoops, somehow you'd let the transponder and pitot-static checks lapse—you're in violation of FAR 91.411 and 91.413.

How can this happen? Can the FAA step in and inspect you and your airplane after an event that didn't even qualify as a reportable accident? What can you do to protect yourself from winding up with a violation? Will your insurance company pay if you violated a reg?

We'll answer all of these questions and take an in-depth look at the more common operational blunders pilots make, how the FAA responds, how to avoid bringing yourself to the FAA's attention, what protection you can have in place should you bring yourself to the FAA's attention and whether your insurance company is going to try to deny a claim if you bust a reg and have an accident.

WHICH BLUNDERS?

The FAA was tasked by the Federal Aviation Act of 1958 to, among other things, scrutinize aviation for the purpose of safety. An FAA inspector has the authority to ask pilots and aircraft owners to produce their certificates and logbooks for inspection. Most often that comes about during a ramp check (although it's unusual for the inspector to ask to look at logbooks), and it is normal any time there is an accident or an incident that comes to the attention of the FAA.

If you have an accident and report it to the NTSB (by regulation, that's the agency to which aircraft accidents are to be reported), the NTSB then tells the FAA. Almost invariably an FAA inspector is assigned to get involved with the investigation. That inspector will ask to see all certificates and logbooks. Under the regs, the pilot and owner must make them available for review.

That means that you shouldn't rush to call the NTSB if you have a fender-bender event with your airplane—and that includes a gear-up landing. If the event doesn't meet the definition of an accident under Part 830 of the NTSB regs, there is absolutely no requirement to report it to the NTSB. The definition of an accident includes fairly severe damage—and gear-up landings almost never generate enough damage to be a reportable accident. In fact, the definition appears to have been created with an eye to not saddling the NTSB with investigating gear-up accidents. They don't want to hear about those; they're already plenty busy.

AFTER THE DUST SETTLES

The unthinkable has just happened—you've damaged an airplane. The good news is that the airplane has stopped and you are conscious and able to move. Here's a checklist for what to do next:

• Shut off the fuel, master switch and mags.

• Get everyone out of the airplane and move away from it. While post-crash fires are common only in movies, there is always a risk. Unless you have a severely injured passenger who, in your best judgment, shouldn't be moved, get everyone clear of the aircraft.

• Attend to the injured. If you can make a cellphone (or radio) call for emergency services, do it and get them on their way; otherwise, start first aid.

• Take a deep breath and assess the situation. If you are in the wilderness, start thinking about survival, signaling and rescue.

• Secure the aircraft. Protect it from further damage. Resist having it moved by well-meaning individuals until you've spoken to your insurance agent.

• If you have time, take pictures of the scene with your cellphone.

•Call your insurance agent and aviation attorney.

• If people start arriving, limit your conversation to taking care of your passengers and securing the airplane. If someone starts questioning you about the event beyond those two topics, politely, but assertively, decline to discuss it then and there and get contact information for that person. You do not and *should not* discuss what happened with authorities until you have had time to collect yourself and find out the extent of your injuries—that's usually at least 24 hours. Think PTSD—you have damaged an airplane, a big-time traumatic event for a pilot.

• NTSB regulations require immediate notification of an accident. However, you can't notify until you know that what has just happened meets the NTSB definition of accident. If you determine that the extent of the damage or injuries meet the definition, then notify the NTSB—not the FAA.

• As soon as you can, get yourself and your passengers to a safe, secure location where you can sort out what to do next with a minimum of interference and do what your insurance agent and aviation attorney recommend.

Unfortunately, if someone does get excited and call the NTSB (or FAA) after you clip a runway light, you can't stop the inspector who is assigned to your incident from demanding your certificates and logbooks by pointing out the event wasn't a reportable accident—you're in the crosshairs. So, think before you make a phone call.

The most common way to come to the FAA's attention is via the most common, non-fatal accident for general aviation airplanes—runway loss of control (RLOC). If you lose it in a crosswind, scratch the airplane and someone tells the FAA, you get to produce certificates and logbooks and have an FAA inspector ask you a lot of questions.

The second most common way to invite unwanted attention from the FAA is to make a mistake when ATC is involved—not follow a clearance, bust an altitude or enter Class B airspace without a clearance. Neck and neck with those blunders is inadvertently flying into a TFR.

A close third is to do something stupid with an airplane where people can see (and photograph) you. Coming up rapidly on the outside for ways of generating FAA attention is making a video of yourself doing something stupid with an aircraft and posting it on social media. The biggie on these is low flying/buzz jobs/scud running. Everyone has a cellphone camera. Not everyone thinks a low-flying airplane is cool—and a certain percentage of the population sees a low-flying airplane and thinks, "terrorist attack." We're serious; some people become terrified.

If you do a buzz job and someone complains to the FAA, the FAA is required to investigate. If there is a photo or video that helps identify your airplane, the FAA's workload in proving a violation against you drops off dramatically. The FAA can, and will, subpoena the data from any GPS device in your airplane and use it against you in a violation action.

If you are one who feels the need to fly low, we suggest you do it where there are very few people who might see you.

We are aware of situations where pilots had decided to continue flying after their medicals had expired or they'd lost their medicals and were turned in because someone who knew about it got mad at them and called the FAA. Compliance with the FARs is almost entirely on the honor system—reduced to its essence, the FAA trusts you to do the right things when you fly. When a pilot violates that trust intentionally, the FAA will come down hard. Based on our experience and conversations with aviation attorneys and FAA inspectors, flying without a medical and falsifying logbooks are two effective ways to have the FAA lower the boom on yourself.

VIOLATIONS AND CATCHES

Under the Pilot's Bill of Rights law, the FAA has to tell you when it is investigating you for a possible violation of an FAR. While you are required to present your certificates and logbooks, you do not have to speak with the FAA or provide a written statement—and if you do so, anything you say or write can be used against you in a violation action.

We strongly recommend that

following any sort of an accident or incident, or if you receive notice that the FAA is investigating you, that you speak with an aviation attorney before you talk with the FAA.

The overriding element in deciding whether you should talk to the FAA if there is a risk that you were in violation of a regulation is whether that talk will help or hurt you. You must decide, as objectively as possible, if talking to the FAA can improve things for you.

In the past, the answer was often no, as the FAA often had the goods on you from radar data of an altitude bust, ATC tape of you not complying with a clearance or a photo of you flying under a bridge and smiling for the camera.

As of last summer evaluating the "can I make this better" question changed for what we think is the better. The FAA changed its policy on pilot enforcement—it wants more matters resolved at the FSDO level, not elevated to an enforcement action to be handled by FAA lawyers. FAA Order 8000.373, issued June 26, 2015, sets out the new FAA policy of having well-intentioned pilots who inadvertently violate a regulation go through retraining and education rather than nailing them with a violation and suspension of their certificates. That, of course, doesn't apply to the pilot who intentionally flew under the bridge after saying something along the lines of "Y'all watch this."

We think that is great. For some years the FAA has gradually been encouraging FSDO inspectors to have pilots who made an honest mistake go through retraining to help prevent future mistakes. We think that where it's been applied it's worked. We're glad to see that it is now official FAA policy.

The catch is that in order to take advantage of the policy, the pilot has to talk with the FAA during the investigation. He or she has to discuss what happened so the FAA inspector can determine if the pilot made a mistake or meant to violate a reg and whether the pilot has a constructive attitude toward safe operations.

That means that if you don't talk and the inspector thinks you violated a reg, it's likely the matter is going to get kicked upstairs to the attorneys for an enforcement action. Therefore, not talking can hurt you. If you do talk, the inspector has the choice of resolving the whole thing by sitting down and talking with you about how to avoid it in the future, having you take some dual to make sure your skills and judgment are up to snuff or elevating it to an enforcement action. Your demeanor and attitude can and will affect the inspector's decision.

We think the new policy means that if you think you made an honest mistake—and your attorney objectively agrees with you—it's probably better to talk with the FAA inspector during an investigation. If you buzzed a crowded beach, telling the inspector that you're sorry and won't do it again won't help you and is an admission that you were the one flying the airplane.

AN INCIDENT IS TRAUMATIC

A huge caution from us—do not talk with the FAA inspector the day of your incident/accident or right away upon receiving the letter telling you that you're being investigated.

Whether you realize it or not, your adrenaline level is spraying out of your ears and you are not going to be entirely rational or put your best foot forward in the conversation.

Following the most minor paint-scrape airplane incident, even the coolest pilot in the world is going to be mortified that he or she dinged an airplane—that pilot would rather have totaled the family car—it's a huge point of pride.

For the next 24 hours, if you ask that pilot the sum of two plus two, she or he is likely to say, "Thursday," and not have a clue that the answer makes no sense.

That's enough damage to be reportable, top, but if it was incurred taxiing to the fuel pump it doesn't meet the NTSB's definition of an accident, and there's no reason to report it to any federal agency. Maintenance flight tests, bottom, increase risk and another level off regulatory complexity should you crash.

That means that if an inspector approaches you following an incident or accident and wants to talk with you, politely say that you will talk in the next day or so, but not today. Some inspectors come across with the bad-cop routine and claim that you have to talk. You don't. Get the inspector's phone number and professionally and politely repeat that you will call in the next day or so.

For an investigation letter from the FAA, call your aviation attorney and, with him or her, make a decision

TEST FLIGHT WRECKS

In the bad old days of aircraft maintenance, it wasn't uncommon for shop personnel to fly customer aircraft as part of troubleshooting and final testing. Now insurance and liability issues generally quash the idea. The hangar keepers liability insurance policy shops carry might only cover ground ops. This often results in the shop technician flying shotgun with the aircraft owner on a test flight. I have some grey hairs from years of doing just that and will forever remember one maintenance flight that went bad: Engine failure forced a landing in a cornfield, destroying the aircraft.

Crashing on a maintenance flight can be muddy because a third party (the shop) is involved. If that shop is an FAA repair station, it might have specific flight-testing guidelines and procedures written in its ops specs, which govern the conditions under which the flight is conducted. The flight can likely only be made in VFR conditions and without passengers—a common-sense practice after major maintenance

Since I'm here to write about it, I obviously survived the ordeal but walked away with a sour taste of how some FSDOs handle post-crash investigations. Since I transmitted a mayday call before the ditching, authorities—including FAA inspectors—were on the scene almost before I was. The fast crash response was great—the behavior of the inspectors wasn't. The lead inspector inexplicably demanded that the aircraft owner climb into the inverted wreckage (buried in corn stalks and loaded with fuel) to retrieve the aircraft paperwork. And then the questions began.

Pilots are vulnerable in the hours after the drama of a crash. They need time to sort it all out. It is positively the worst time to talk with officials and it's often where serious trouble begins. That's because changing your story in the days after the initial interview reflects on your credibility—and your credibility is being scrutinized. It's best to say as little as possible until you can make an accurate and truthful statement. If news reporters arrive on the scene as they did after my put-down, they'll try to get in your face for a statement. If the reporter has limited aviation knowledge, you'll be trying to correct inaccurate reporting forever. Even the airport manager from the airport from which we departed showed up to ask questions, even though we were 10 miles from the airfield. My response to him included something about riding in on a horse.

The next day I was contacted by no fewer than four different investigators from the FAA and NTSB—all trying to poke holes in the aircraft owner's statement. As a technician, I was still considered a passenger, despite holding a pilot certificate. Part of the investigation was to determine what each person was doing during the emergency. Aside from snugging my seat belt, making the mayday call, hawk-eying the airspeed and opening the cabin door prior to touchdown, I was busy contemplating whether I might go to a heaven or a hell.

One regulatory lesson to learn about flying an aircraft right after maintenance is to be certain the shop has issued a maintenance release. If it hasn't, the aircraft is technically unairworthy and you, the PIC, are responsible.

A team of investigators showed up at the shop asking for the maintenance release and a full report of the work that was accomplished.

Pilots have been killed by retrieving aircraft from shops after hours, assuming it was airworthy when in fact it was not.

A signed maintenance release is proof that the aircraft is officially airworthy, although after the thing has been all over the hangar floor, you're a test pilot. Bottom line: A crash will add layers of regulatory complexity to the investigation.

—Larry Anglisano

about talking to the FAA, but don't make the call to the FAA for at least 24 hours.

Almost invariably, if you talk to the FAA the day of the incident, you will say something that doesn't make sense, is completely inaccurate or both. Later, you'll be faced with trying to correct your comment and the FAA may accuse you of making inconsistent statements—and lying to a federal official is a felony. Martha Stewart didn't go to the slam for cooking the company books; she went for lying to investigators.

If the FAA asks for a written statement, discuss it with your lawyer, keep it short and to the point (pilots have a tendency to get themselves into trouble by saying too much) and then review and revise it with your lawyer before sending it in. You want it to be 100 percent accurate and you want to express it well.

PRESS

You couldn't get the gear down despite everything. You made a beautiful gear-up landing. No one was scratched—and we don't know of anyone hurt in a gear-up landing of a civilian airplane since WWII so long as the pilot kept the engine running at least until very short final. However, the press was alerted, ran live coverage of breaking news of aircraft occupants in mortal danger and your miracle landing and now wants to interview you.

Our recommendation is to politely decline or just make yourself unavailable. Trust us, you will not come across as the coolest pilot ever—your hair will be messed up from your headset, it's impossible to answer stupid questions quickly and concisely and the reporter will decide which parts of the video get shown on the news. You will not only look like a dolt, there's a chance you'll say something the FAA can latch on to and investigate beyond a simple mechanically induced gear-up event.

NASA/ASRS FORM

Any time you think you may have violated a regulation or if you have an incident in which you damage an airplane, file an Accident Safety Reporting System (ASRS) report with NASA (http://asrs.arc.nasa.gov) immediately. There is absolutely no downside to doing so. The FAA can-

Before you make that cool low pass, remember that even in a sparsely populated area, you have to be 500 feet from people and structures. Are you sure nobody will take a picture and file a complaint with the FAA?

not find out who filed it from NASA. You do not implicate yourself if the FAA investigates the event. If you are found to have committed a violation—so long as it wasn't on purpose and didn't involve what the NTSB defines as an accident—when you show the FAA that you filed an ASRS report within 10 days of the event, you will not be subjected to the penalty associated with the violation.

The ASRS report is one of the best protections available to a pilot who inadvertently violates a regulation.

INSURANCE

In the example at the beginning of the article you were flying IFR apparently in violation of two FARs, but they had nothing to do with why you damaged your airplane. Can your insurance company deny coverage because of the violation? No—with almost no exceptions.

While pilots often claim that aircraft insurance companies do everything they can to keep from paying claims, the reality is just the opposite. We talked with Jon Doolittle, principal of Sutton James aviation insurance brokers, about denials of coverage. When we brought up the subject, he expressed surprise, as he said it is something that is rarely seen in the aviation world. He told us that he cannot recall a single denial of coverage of a claim within his agency in the last decade.

Doolittle explained that violation of an FAR is almost never grounds for denial of coverage. Unless the violation was causally related to the accident, an insurance company would have a hard time convincing a court that it didn't have to pay a claim under its policy. Also, it's expensive for an insurance company to litigate a denial of coverage claim.

According to Doolittle, his experience has been that even where an insurer can rightfully deny a claim—such as where the pilot had lied about his time or ratings on his application, or the airplane was way out of annual—the company will usually pay the claim and then never insure the pilot again.

The bottom line is twofold: If you crash and it turns out you violated a reg somewhere in the process, your insurer is almost certainly going to pay the claim; but if you do something that affects whether the insurer would cover you in the first place, such as lie on the application or don't bother to have your airplane annualed or renew your medical, the chances of a coverage denial do go up.

PROTECTIVE MEASURES

What can you do in advance to protect yourself from the unpleasant things discussed above?

Enroll in the AOPA Pilot Protection Plan. The $39 annual fee for the basic service includes unlimited consultation with Legal Service Plan staff and a specified list of number of hours of representation by an aviation attorney who is on the LSP list of attorneys. The $99 Plus Level plan provides coverage geared toward professional pilots.

As far as we're concerned, the Pilot Protection Plan is inexpensive insurance for pilots for legal and medical issues. We do note that you can't enroll after you've had your incident or notification of investigation and expect coverage—just as you can't buy insurance after an accident and expect coverage.

Take regular, frequent dual, especially on crosswind landings. It sounds very basic and it is—recurrent training dramatically reduces your accident risk. The data we've seen indicates that staying current in the FAA WINGS program dramatically reduces a pilot's risk of being involved in an accident. Professional pilots fly frequently, yet they take recurrent training—it's a major part of the reason their accident rate is low.

Learn about crash survival and the equipment you should have with your for survival. We recommend the nonprofit foundation Equipped to Survive (www.equipped.org) for further information.

Don't do anything dumb. Make sure you check for TFRs before every flight.

Tempted to make a low pass down the runway at a fly-in so the 40 or 50 people standing on the ramp can see how cool you are? Avoid temptation. The FAA has said that group of people makes the ramp a congested area—if you are not taking off or landing, you've got to be 2000 feet away horizontally and 1000 feet above them. One of them may not like what you've just done and make a call to the FAA to complain. Suddenly you're being investigated for violation of the minimum altitude regulations.

CONCLUSION

Inadvertently violating a reg doesn't mean your insurance isn't going to pay if you have an accident or that you're going to get a violation. However, protect yourself by joining AOPA's Pilot Protection Plan and taking regular recurrent training.

If something does bring you to the FAA's attention, resist the temptation to talk to anyone about the incident until you have spoken to an attorney and had time to focus your thoughts.

DIY Maintenance: Tools, Manuals, Smarts

Doing preventive maintenance chores yourself can save money and build confidence, but consider working with a shop or mechanic as a backstop.

by Larry Anglisano

For some, the fun part of owning an aircraft is the time spent alone with it in the hangar. That eventually leads to wrenching it.

Before you get too deep in the cowling, you should evaluate your technical skills, understand the regulations and inventory the proper tooling. In this article, I'll outline the regulations and some of the maintenance items the FAA allows you to perform on your certified aircraft (for more freedom, consider an experimental, plus an A&P rating).

GOT TOOLS?

In the 1980s movie *Fast Times at Ridgemont High*, Sean Penn's character Jeff Spicoli proclaimed that since his father has an awesome set of tools, he could fix anything. And while you may posses many of those same tools in your T-hangar, the FAA doesn't quite see it that way when it comes to aircraft maintenance.

Aside from prescribing the maintenance items it considers to be minor and preventive in nature, plus allowing the replacement of parts that don't require complex disassembly, FAR 43.13 also requires the use of specialized tools and test equipment. How do you find out which tools you need? An FAA-approved maintenance manual is the best source. I think it's foolish to tackle many of the tasks allowed without having an appropriate manual available for reference. On the shop level, if you don't have the manual or tools, you aren't approved to work on it. And even if you have the tools, consider that torque wrenches, meters and tensiometers, to name a few, generally require outside calibration. If you have access to service manuals and literature, they should be the latest revision and applicable to the aircraft you're working on.

A repairman troubleshoots with calibrated instruments and tools, which is a good lead for do-it-yourselfers to follow.

FAR 43.13 uses interesting language when it comes to the quality of your work, basically saying you can't worsen the condition and consider it to be airworthy. That closes the door to unapproved major modifications or any alterations that deviate from a type design or original parts specification. That will have to be signed off as a major modification on an FAA 337 form, and only repair stations and IAs can approve them.

FAR 43.3 section (g) says the same rules apply to holders of sport pilot certificates when working on LSAs.

CAN'T TOUCH THAT

The gentle side of the FAA actually promotes owner-performed preventive maintenance—to save money and increase safety—in its AC 20-106 advisory circular and posts a document on its website www.faa.gov—*Maintenance Aspects of Owning Your Own Aircraft*. It covers best maintenance practices, while referencing the FARs as the final ruling. Remember, advisory circulars are advisory in nature, not must-do regulation.

As for rules, the FAA uses specific language in part 43.3 when allowing for minor and preventive maintenance. For starters, those not holding a mechanic certificate, a repairman certificate or operating under an FAA repair station can't perform alterations or rebuilding. But you can perform preventive maintenance tasks and the list is extensive. The chart on page 22 is only part of what's allowed.

To perform the tasks (and to sign it off in the aircraft maintenance records), the FAA says you need to posses a valid Part 61-issued pilot certificate and may only perform preventive maintenance on an aircraft owned or operated by you—the

certificate holder with the ID number you'll record in the logs as proof.

It can be argued that you can't wrench your friend's aircraft if you aren't an owner or operator. Additionally, want to moonlight and perform preventive maintenance at the local airfield on aircraft you don't own or fly? I wouldn't do that.

Teaming with a mechanic offers more leverage. For repair actions not considered preventive, FAR 43 says in part that a person working under the supervision of a mechanic or repairman certificate holder may perform the maintenance, preventive maintenance and alteration that his supervisor is authorized perform. The caveat here is the repairman or mechanic has to personally observe you doing the work and be readily available for consultation. This is otherwise known as owner-assisted inspections. Smaller shops may allow it, but larger ones likely will not.

Of course, non-mechanics are not authorized to approve work accomplished by others. That means if your buddy changes your tire while you aren't present, you can't legally sign off the task in the maintenance logbook, and neither can he.

HOW MINOR IS MINOR?

Let's look at some of the tasks the FAA says are fair game for a non-mechanic to accomplish, understanding that you still might not be competent to complete the task to the standard the maintenance manual prescribes. I'll start with oil changes.

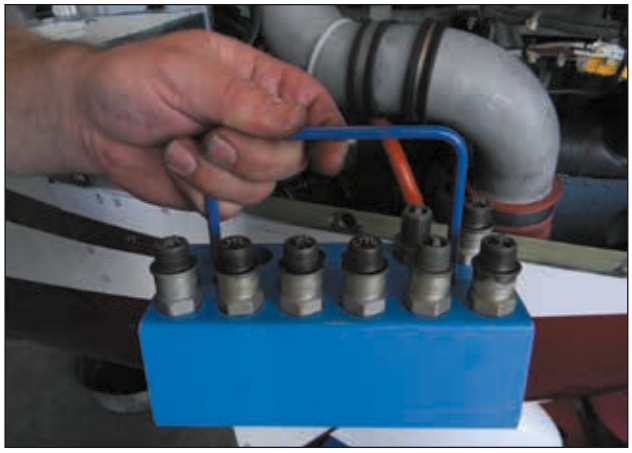
Just like changing the oil on your vehicle, you'll get dirty changing your aircraft oil and filter, but that's where the similarities end.

Depending on the aircraft, you might have to remove and reinstall the cowling to gain access to the drain plug and oil filter. While this isn't difficult work, you might be messing with cowl flap hardware, which if not correctly rigged, won't operate properly once the cowling is reinstalled.

Once you properly torque the new oil filter to the engine, it's time to perfect your safety wiring technique. It's not just a matter of twisting the wire until it's snug. The diameter of the safety wire and the number of twists you make is critical.

When we research the NTSB accident records for our used aircraft reports each month, we inevitably find instances of engine failures because someone didn't properly wire the oil filter (or didn't attach the safety wire at all) and it vibrated loose—dumping all the oil from the engine. Again, it's not difficult work, but you need to know proper technique.

The FAA says you can swap out tires, but do you have the proper tools to separate a tire rim? You'll also have to support the aircraft on jacks, top. Spark plug cleaning and swap-outs, middle, may seem easy, but do you know how to test them? Changing your aircraft oil and filter, bottom, isn't quite like changing it in your vehicle.



Once the old filter is off, you'll have to inspect it for particle contamination, while also correctly obtaining an oil sample for an accurate analysis.

The regulations say you can service your own landing gear struts, but botching that chore can ultimately cost you lots of money. Consider that the Oleo struts commonly used on main landing gear assemblies are serviced with a high-pressure air or nitrogen source. Get a little too aggressive with refilling them and you can destroy the strut.

Moving inside the cabin, the FAA says you can repair upholstery and decorative furnishings—and many aging aircraft can really use it. But,

SELECT FAA-APPROVED DIY ITEMS

- ✔ Remove, install and repair landing gear tires.
- ✔ Service landing gear wheel bearings.
- ✔ Service landing gear shock struts (add oil and air).
- ✔ Replace landing and position light bulbs and lenses.
- ✔ Replace seat belts.
- ✔ Replace and service batteries.
- ✔ Replace or clean spark plugs and set plug gap.
- ✔ Replenish hydraulic fluid in service reservoirs.
- ✔ Replace defective safety wire or cotter keys.
- ✔ Clean and replace inlet air filter.
- ✔ Remove and reinstall self-contained panel-mounted avionics.

don't fall into the trap of using unapproved components. I remember one owner who did a wonderful job of replacing the seat upholstery and sidewalls in his Piper Comanche, compliments of the shop that specializes in custom boat interiors. The components were waterproof—but not fire retardant—and in violation of the FARs, which specifically address fire-retardant qualities. He ended up tearing it all out and installing an approved aircraft interior.

On the topic of fabric, you can make simple patches to the skin of fabric aircraft as long as it doesn't require rib stitching or the removal of structural components or control surfaces. Even so, fabric repair is specialized work and an acquired skill.

DO THE VISUAL

Don't underestimate the value of visually inspecting (not disassembling) the systems you aren't approved to work on. A sharp eye between annual inspections can save money and keep ahead of breakdowns.

Do you look at the magnetos? They're generally a 100-hour or yearly inspection item, but some deserve more attention. Trouble can be easy to spot: oil seeping from the casing. Plus, the housing might break free from the engine. I remember finding a pressurized mag hanging loose inside the cowling of a Centurion. That same aircraft had an obvious hairline crack at the base of the turbocharger. A smart pilot would agree to a further inspection, but this owner pilot was convinced that a cracked turbo was a deferrable item. I refused to fly that aircraft and his IA refused to sign it off. He flew it away.

You can legally remove and replace a self-contained panel-mounted avionics component, but breaking a contact pin on a connector can be a costly blunder. Some jobs are best left for the pros.

While you're inspecting the exhaust and turbo, eyeball the flexible induction hoses and the fittings at the turbo inlet oil lines. You don't want the hose to get ingested by the turbo and it does happen.

Keeping the engine bay clean will help you spot oil leaks early. Just because the engine isn't spewing oil on the hangar floor doesn't mean it isn't leaking, unless the engine is round—in which case it's always leaking.

Some oil may be blow-by from breather assemblies or from the engine spitting out overfill, but you'll need to follow the leak to the source to know for sure.

Oil isn't the only leaking fluid that drips. Inspect fuel injector lines and clamps and put a wrench on the securing nuts on the spider to each injector. See any leakage? Raw fuel pouring around the injector manifold is what inflight fires are made of.

AVIONICS WORK

Just because you successfully built a Heathkit project in high school (I failed) doesn't make you an avionics technician, which often requires a repairman rating.

Still, the FAA limits do-it-yourselfers to what used to be basic avionics tasks, like removing and reinstalling a radio that's self-contained in the radio stack. As simple as it may seem, you can screw this up.

Generally, radios are secured to the mounting trays or sleeves using lockdown cams, which are often accessed with a hex wrench from a hole in the radio bezel. Stick a blunt tool in the wrong bezel hole and you might trash a display photocell.

Plus, getting an avionics component out of the panel isn't always the difficult part, but getting it back in might be, especially when the radios are tightly racked. It if doesn't seat into the connector (or you break a

A&P RATINGS: WAYS YOU MIGHT EARN ONE

Now that you're comfortable with wrenching the easy stuff on your engine and airframe, thoughts may turn to earning an A&P (airframe and powerplant rating). Unlike the process of earning a new pilot rating, it's not quite as easy as taking a course, an exam and going home with ticket in hand ready to rebuild your own aircraft.

The FAA requires a minimum of 18 months of practical experience working with either powerplants or airframes, or 30 months of practical experience working on both at the same time. As an alternative, you must successfully graduate from an FAA-approved aviation maintenance technician school. The curriculum offered by most schools is 12 to 24 months in length.

As for on-the-job practical training, you would have to be employed by an FAA repair station or an FBO and work under the supervision of a certified mechanic. You'll have to provide the FAA pay receipts, a logbook entry endorsed by a supervisor mechanic and other proof you worked at the facility for the required time. The FAA also recognizes some prior military occupational specialties for work credit.

With proof of training presented to a FSDO (flight standards district office), the next step is to pass a written exam, an oral test and a practical test, which is issued by an FAA-designated mechanical examiner. The testing covers 43 technical subjects and you must pass all the tests within a 24-month period.

Now with a fresh A&P rating in your wallet, you can legally perform annual maintenance items, but the inspection and sign-off has to be done by an IA (inspection authorization) rating holder. To be eligible for the IA rating, you must hold an A&P rating for a three-year period before applying to take additional knowledge testing and have been actively engaged in aircraft maintenance for the two-year period prior to applying for testing. If that sounds time-consuming, it is and it doesn't always work for the working aircraft owner.

It did work for Mooney owner Robert McGuire, who earned an A&P and an IA rating to care for his aircraft, logging experience working part-time at a shop. But even after proving his qualifications and keeping his IA current—with the authority to accomplish and sign off on his own maintenance and mods—McGuire recognizes the need to partner with qualified technicians.

"It's always a good idea to have another set of qualified eyes when inspecting your own aircraft," he said. He also realizes that his area of expertise is limited to the Mooney models he's owned and worked on over the years, and defers engine rebuilding and other specialized tasks to expert shops.

"If my engine needs to be rebuilt, I'm going to pull it off the aircraft and send it out. I don't have the specialized tools to do it myself," McGuire said.

And that's the takeaway for earning your own repair certificates. Like exercising the rights of any other rating, you'll need to be realistic and set your own personal minimums.

contact pin in the process), you'll have intermittencies—or the system may not work at all. You'll be paying for a teardown and wiring repair.

Owner-performed software modifications are questionable because they'll likely require a change to the previously approved flight manual supplement. The process might require reprogramming and calibrations.

Unless you have a current manual, you'll be messing with data that can take down the entire system architecture. Service centers are trained on maintaining OEM glass like the Garmin G1000 and Avidyne Entegra and they should do the updates.

BUTTON IT UP

But before you do, secure a good relationship with a competent A&P mechanic or repair station and let them know what you've done. Their guidance can be a backstop for your repair actions.

Be respectful and mindful that the shop is a business, with lots of overhead and regulations to deal with. If you ask to borrow its tools and shop floor space, you might be turned away, but don't take it personally. At some shops, insurance policies prohibit non-employees on the maintenance floor.

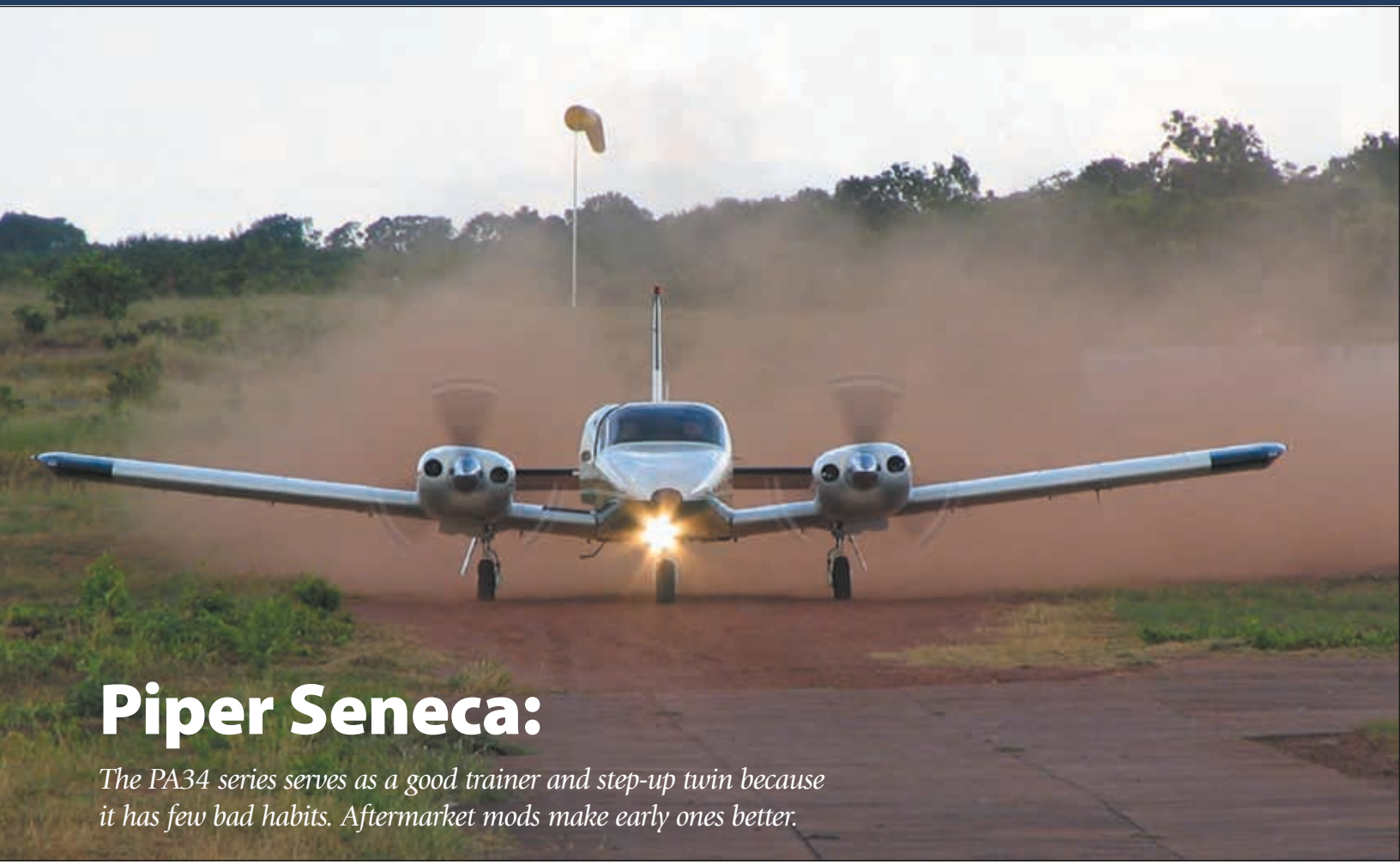
All is not lost. Good shops will recognize you are a paying customer because as the sidebar above explains, you'll still need a shop to sign off annual inspections and major modifications, even if you decide to earn your A&P rating.

Years ago there was a guy at the local airfield who was convinced every maintenance shop and FAA inspector was out to screw him and every other aircraft owner. He once remarked that annual inspections are a scam.

While he wasn't an A&P technician, everyone presumed he did his own maintenance, using his inventory of new and used parts. As most of us expected, he eventually flew himself to a smoking hole after the critical engine on his twin failed during takeoff.

While this exaggerates even the extreme consequences of do-it-yourself preventive maintenance, be realistic about your wrenching abilities and know when to bring the aircraft to trained professionals.

Replacing batteries is on the FAA's list of preventive maintenance items, but it's worth having a shop properly service it before you install it.



Piper Seneca:

The PA34 series serves as a good trainer and step-up twin because it has few bad habits. Aftermarket mods make early ones better.

As we have reported in previous used aircraft articles, used piston twins are generally good deals in the current sales market. The Beech Baron, Travel Air, Piper Aztec and even the Beech Duke are all examples. On the other hand, for various reasons, the market for new piston twins remains relatively flat, and there are few models for the taking. Piper builds two of them, the Seminole and the Seneca. Both have endured for various reasons, although neither is made in much volume these days.

It's easy to see why the Seneca has endured. Arguably, it does nothing extraordinarily well—it's not exceptionally fast or a joy to fly, nor will it turn heads on the ramp—but it does a lot well enough.

But one can be affordable to buy and maintain (earlier ones, anyway), carries a good load and flies without any nasty habits. There are plenty of used examples on the market and the Seneca remains popular as a multi-engine trainer, but it's not the sort of airplane anyone who learned in will want to immediately ditch in favor of something sexier.

In our view, the Seneca is an entirely reasonable airplane. That, more than anything, may explain why it endures in Piper's line, although the latest Seneca V is far more complex than the original Seneca I. The Seneca V is one of only five twins still in production—the others being the Baron, Piper's own Seminole, the Diamond Twin Star, plus the Tecnam P2006T.

Later Senecas are decent haulers and loading one is about as easy as it gets.

MODEL HISTORY

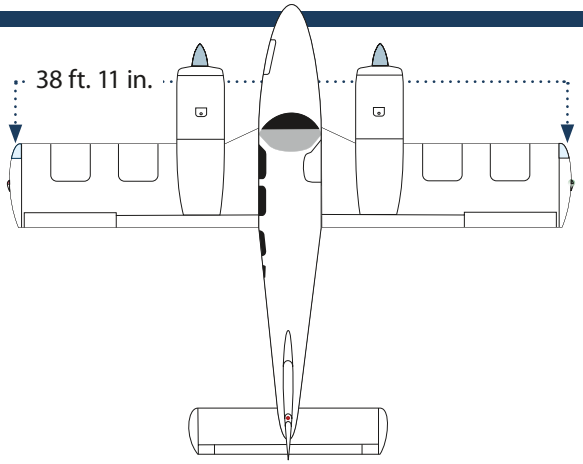
All modern manufacturers are known for so-called "parts bin" engineering—stretching the parts and pieces of one model into another, something that makes perfect sense. But few have been as good at it as Piper has.

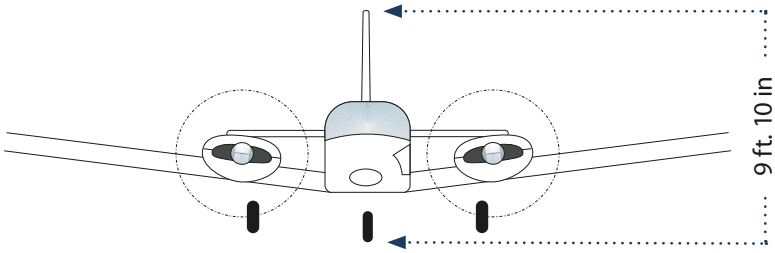
The Cherokee line began with the Cherokee Six, the Saratoga and the Seneca. Saw off the wings of a Seneca and a Cherokee Six and you couldn't tell the two apart. The Seneca first appeared in 1971, when GA was still a growing industry and there was actually headroom for new twins. At the time, the Aztec—a good seller for Piper—and the Comanche were growing long in the tooth and Piper needed something new.

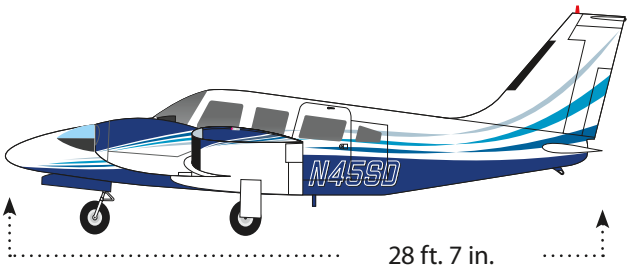
The Seneca started out with counter-rotating Lycoming IO-360C1E6 engines producing 200 HP each

As the Seneca in the main photo demonstrates, the aircraft offers decent short-field performance. Counter-rotating propellers make an engine failure manageable.

PIPER PA-34 SENECA





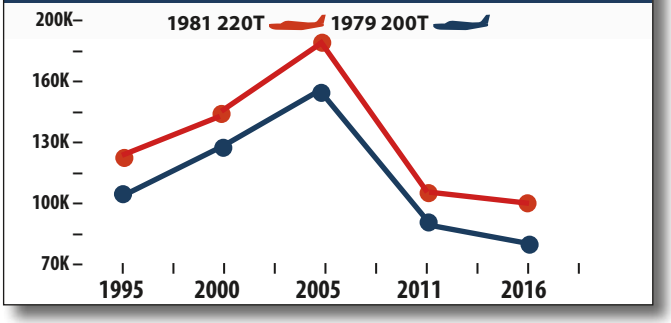


Drawings courtesy www.schemedesigners.com

SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1972-1974 PA-34-200 SENECA I	200-HP-LYC. IO-360-C1E6	2000	$28,000	100	1414 LBS	163 KTS	±$42,000
1975-1980 PA-34-200T SENECA II	200-HP-CONT. TSIO-360-E	1400	$35,000	93	1340 LBS	177 KTS	±$66,000
1981-1990 PA-34-220T SENECA III	220-HP-CONT. TSIO-360-KB	1800	$37,000	93/123	1800 LBS	178 KTS	±$140,000
1991-1993 PA-34-220T SENECA III	220-HP-CONT. TSIO-360-KB	1800	$37,000	93/123	1800 LBS	178 KTS	±$200,000
1994-1996 PA-34-220T SENECA IV	220-HP-CONT. TSIO-360-KB	1800	$37,000	123	1800 LBS	178 KTS	±$225,000
1997-2007 PA-34-220T SENECA V	220-HP-CONT. L/TSIO-360-RB	1800	$45,000	122	1350 LBS	178 KTS	±$400,000
2008-2010 PA-34-220T SENECA V	220-HP-CONT. L/TSIO-360-RB	1800	$45,000	122	1350 LBS	178 KTS	±$600,000
2011-2014 PA-34 220T SENECA V	220-HP-CONT. L/TSIO-360-RB	1800	$45,000	122	1376 LBS	197 KTS	±$865,000

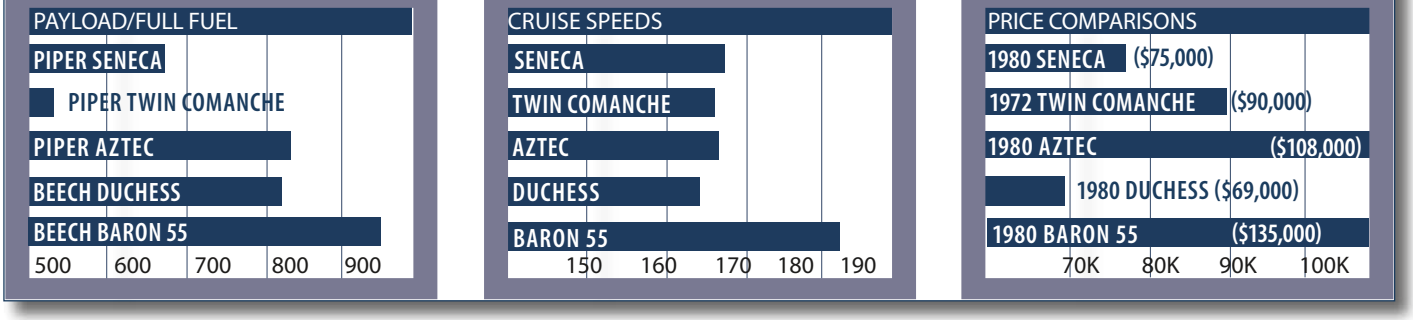
RESALE VALUES



SELECT RECENT ADs

AD 10-15-10	CONTROL WHEEL SHAFT INSPECTION, REPLACEMENT
AD 05-15-10	COMBUSTION HEATER INSPECTION
AD 2005-13-16	NOSE LANDING GEAR BOLT
AD 97-01-01	MAIN GEAR SIDEBRACE
AD 94-13-11	MAIN LANDING GEAR TRUNION

SELECT MODEL COMPARISONS



A new Seneca V, top, easily exceeds$1 million. The mid-2000s Seneca V came standard with Avidyne Entegra integrated glass, plus Garmin navigators, middle, but upgrades for older models are endless. Jonathan Baldwin equipped his Seneca I with a three-screen Aspen suite with synthetic vision, bottom.

(think of a Piper Arrow, times two) and at its introduction, it cost about the same as the Twin Comanche C/R model, but had larger engines, a higher gross weight and a roomier cabin with a rear door that the so-called Twinkie lacked. In other words, it was close to cabin-class comfort for about $63,000 equipped.

Both the Seneca and the Twin Comanche were built in 1972, but when Tropical Storm Agnes pushed the Susquehanna River into Piper's Lock Haven works, the Twin Comanche drowned with it and the Seneca was moved to Piper's new Florida operation.

Piper built 360 Senecas that year, a good start in the twin market where the competition was the Cessna Skymaster, which sold poorly in 1972. In three years, Piper sold 933 Seneca Is, dramatically outdoing the Aztec and Comanche.

Part of this was due, no doubt, to Piper's decision to modernize the airframe. It dumped the Comanche's Byzantine plumbing, favoring a fuel system with only three positions: on, off and crossfeed. Since the airplane had counter-rotating props, there was no worry about critical engines, either.

The Seneca was based on the wildly successful PA-32 series with a long and wide cabin, true seating for six, a big aft door on the left and a cockpit door on the right. Since passengers might not like climbing over wings, this design proved a favorite among charter operators and for owners with big families. It still does. And despite its boxy shape, Piper applied some styling touches to make the aircraft fairly attractive. Early interiors, apart from that unfortunate velour upholstery, were also a step up from early efforts. The modern Seneca V has dropped one of the seats in favor of an optional entertainment/refreshment center. Add air conditioning, nice cabin lighting, leather and all of the other high-end amenities current buyers expect and it's obvious the Seneca has come a long way—and with an even longer price tag.

The original Seneca I was a good start, but it was lacking, too. Pitch stability wasn't the best and the controls were on the heavy side—Bonanza and Baron pilots wouldn't like it much. The airplane also had noticeable Dutch roll in turbulence, which would tax the stomachs of the backseat passengers.

There were design and production issues, too, that led to a lot of ADs. Re-

cords indicate that the original Seneca is subject to close to 50 ADs, counting the shotgun ADs that apply to many other airplanes, a dubious record.

To its credit, Piper didn't sit still. It corrected the Seneca's handling and noise/vibration shortcomings. The ailerons were changed to a modified Frise design and made larger. The engine mounts were changed and soundproofing was added. Piper also changed some of the weights to give pilots the option of carrying more weight or more fuel. Gross weight was increased from 4000 to 4200 pounds. The increase carried with it a price, of course.

Single-engine performance at the higher gross weight was marginal, at best. Single-engine rate of climb sank from 230 FPM to 190 FPM and single-engine ceiling from 5200 feet to 3650 feet. Piper also introduced a new limitation: a zero-fuel weight of 4000 pounds, meaning that any weight over 4000 pounds had to be in fuel, not payload.

SENECA II

With a strong if not a hot seller on its hands, Piper continued to improve the Seneca with the PA-34-200T Seneca II. More changes were made to the control system to improve handling. The aileron/rudder interconnect was removed and with it went some control heaviness.

The rudder gained an anti-servo tab and the stabilator was changed with the addition of a bobweight. The ailerons were increased in span and balanced for lighter effort. This time, the changes worked and no major alterations were made after that.

But the big performance change for the Seneca II came in the powerplants, with the four-banger Lycs giving way to six-cylinder turbocharged Continental TSIO-360-E engines with fixed wastegates.

Rated at the same 200 HP at sea level, they produced 215 HP at 12,000 feet. Flying high and fast is nice, of course, but twin drivers worry more about high-altitude engine-out performance. Here, the Seneca II was a different beast entirely.

Single-engine climb rate improved to 235 FPM and single-engine ceiling more than tripled to 13,400 feet. Initial recommended TBO was the same 1400 hours. In 1977, this was increased to 1800 hours and owners report that with careful operation and maintenance, this is realistic. Still, most owners recognize that maintaining the Seneca I's original Lycoming IO-360 powerplants might be an easier and cheaper affair.

That's the utilitarian rear cabin of a Seneca I, top photo. When later Seneca models hit the shop floor, middle, expect higher costs to maintain the turbocharged Continental engines. The Lycomings on a Seneca I, bottom, are cheaper.

The airplane got a higher gross weight, too, increasing by 370 pounds to 4570 pounds. However, the zero-fuel weight stayed at 4000 pounds, so the benefit was a mixed blessing. And another limiting weight was introduced: a maximum landing weight of 4342 pounds. Once again, pilots were given more flexibility and more ways

Passengers appreciate the convenient rear cabin door, top photo, even if it's a long step in and out. Andy Jones' Seneca II, bottom, has 220-HP intercooled engines with three-blade props. He sees 175 knots on 25 GPH.

to get into trouble if the loading limits weren't obeyed.

With the improved controls and engines, the Seneca II also got optional extended-range fuel tanks that increased usable fuel from 93 to 123 gallons. The campaign against noise and vibration continued with the addition of a three-blade prop option, which weighed 46 more pounds.

The popular club seating option was also introduced, as was a Janitrol heater and optional fan to move heated or ambient air through the cabin. In later years, some system changes and options were added, such as a priming system to make engine start easier, more powerful brakes, modifications to the instrument panel, plus air conditioning. In 1980, a built-in oxygen system was offered.

SENECA III AND BEYOND

By the late 1970s, with sales still strong, Piper began overhauling its entire model line, introducing the tapered wings, and had a fling with T-tails in Arrows and Lances.

The 1981 Seneca III was supposed to have the same T-tail and tapered wing as the Lance, but Piper found that the flying qualities weren't as good as the company had hoped. The configuration was left unchanged. There were still significant changes to the Seneca III, however. A different variant of the Continentals was used, with 220 HP each. These engines had a higher RPM limit (2800 versus 2575 RPM). This, combined with fuel scheduling, resulted in maximum power of 220 HP, albeit time-limited to only five minutes.

Continuous rated power was still 200 HP. Single-engine rate of climb improved marginally to 240 FPM and all-engine rate of climb went from 1340 to 1400 FPM. However, most other performance figures, such as runway required, declined somewhat due to a further increase in allowable weights, the unavoidable bugaboo of every manufacturer.

The new weight limits were made possible by a reinforced structure. This time, the zero-fuel and landing weights were raised as well. Maximum takeoff weight was now 4750 pounds, zero-fuel weight 4470 pounds and max landing weight 4513 pounds. The pneumatic system (for air-driven instruments and optional de-ice system power) was changed from a pressure to a vacuum system in 1981. According to Piper, this improved mean time between pump failures from an average of 400 hours to more than 700 hours. Owners say that in the field, the pressure pumps last about the same as vacuum pumps.

Other changes to the Seneca III included a new and more modern instrument panel, a one-piece windshield and a switch to electric flaps. We've always been fans of manual flaps: They're simple, positive and hard to break. The move to electric flaps was required because of a change to larger flaps, which resulted in high actuation forces.

Amazingly, the Seneca never went out of production, even during Piper's troubled times in the late 1980s and early 1990s. Admittedly, production was down to a trickle (four were built in 1992, for example), but it stayed on the price lists. And it's still there today.

As part of Piper's transformation into New Piper, the Seneca was revamped yet again, being redubbed the Seneca IV and later, the Seneca V. Relatively few design changes were made, the most notable being new cowlings that result in higher speeds. Also, the interiors have been markedly improved in recent models, while

Garmin's G1000 integrated avionics fill the instrument panel—completely full.

The Seneca's wide cabin allows for a wide instrument panel, of course. This means the aircraft is fitted with the three-screen version of Garmin's G1000 glass avionics suite. This includes dual primary flight displays (PFDs) for both the pilot and copilot, plus a large multi-function display (MFD) in the center. The Seneca V also has Garmin's integrated GFC700 flight control system and electronic engine instrumentation.

Along with these improvements come much higher prices: When the Seneca IV was introduced in 1994, it sold for about $425,000. A new Seneca V easy flirts with $1 million-plus, making a run at the G58 Baron.

PERFORMANCE

All of the Senecas offer fairly good short-field performance and sea-level fields of 3000 feet or so are no problem as long as both engines are turning. As noted above, however, later versions are better once airborne. Of all the light twins, the Seneca is among the most benign in the runway environment.

It's not a fast airplane, however. The normally aspirated early models cruise in the 160- to 170-knot range at 65 percent and 10,000 feet. Limiting speeds are low: 129 to 130 knots for gear extension; 138, 121 and 107 knots for 10-, 25- and 40-degrees flaps, respectively.

One owner we spoke to highly recommends that speedbrakes be fitted. The turbocharged models are, of course, quite a bit faster, especially when taken high. Owners report cruise speeds in the 180-knot or faster range in the high teens and low flight levels on typical fuel flows of 24 to 28 GPH.

The later Senecas are decent haulers. Loading the Seneca is about as easy as it gets. The fuselage is low to the ground, allowing rear passengers to climb on board easily, and the rear seats are easy to remove. The two baggage compartments have weight limits of 100 pounds apiece. The generous CG range permits flexibility in seat selection and the later models were equipped with a clever visual slide-rule type CG computer, which makes loading a snap.

Owners tells us that early Senecas have useful loads in the 1200- to 1300-pound range while the Seneca II averages closer to 1500 pounds, with its higher gross weight of 4570 pounds. The latest iteration, the Seneca V, has regressed due to higher empty weight, with useful loads in the 1300- to 1400-pound range. That's the case with many new aircraft, the result of weight-gaining creature comforts. It's a trade-off.

CABIN AND COMFORT

With its four-foot-wide cabin, adequate seating for all but the biggest of six people and ample windows, the Seneca is long on comfort in comparison to most other piston-powered airplanes in this class. Although the club seating often yields a tangle of legs in the rear cabin, it's still appreciated by passengers, according to owners who have contacted us. Given its payload, the Seneca is a good five-person airplane with some baggage or a four-person airplane with a lot of baggage, stowed in either the nose compartment or behind the rear seats in the cabin.

Flight visibility from the cabin is adequate, but not exceptional. The big windows are nice but up front, the large engine nacelles extend forward of the wing leading edge, blocking horizontal and downward visibility.

This, coupled with the wide-chord wing, makes spotting traffic below the airplane difficult. Heating and ventilation are typical Piper, with overhead and floor vents that provide enough air in most circumstances. Seats are also typical Piper, which is to say reasonably comfortable but with a tendency to sag and wear with use. Most owners recommend overhauling them.

MODIFICATIONS

Senecas, beginning with the II, came with fixed wastegate turbochargers. These are relatively simple and inexpensive to manufacture, but at the cost of efficiency as well as longevity and a tendency to overboost due to sensitive throttle response. Owners say a must-have mod is to fit the engines with Merlyn automatic upper deck air controllers. We've heard good reports about these mods and other owners tell us intercoolers can also help. (Contact www.merlyn-products.com or 509-838-7500.)

SENECA CRASHES: BOTCHED LANDINGS

Reviewing the last 100 Seneca accidents brought three things to mind:

1. The airplane is a capable cross-country machine and pilots accordingly get into trouble with weather when they insist on going;

2. For a long time the Seneca was the most popular multi-engine trainer and it suffered grievously from ham-handed students and CFIs playing stupid tricks on students or simply not paying attention; and

3. With the advent of lighter twins, the Seneca fell out of favor as a trainer and its accident rate has plummeted in the last few years.

We did notice that pilots had difficulty landing Senecas, especially if they bounced the landing—19 accidents were due to hard or bounced landings that progressed to the point of airframe damage.

Once on the runway, the PA34, with its wide gear, proved reasonably easy to control as there were only 12 runway loss of control (RLOC) events. However, too much speed on final is not a good thing in any airplane, Senecas included—eight pilots went whistling off the end of the runway they'd chosen.

There were four botched go-arounds—two of those were attempted with an engine shut down, and one of those was in an airplane that was 160 pounds over gross *at the time the go-around was attempted*. Piston twins have lousy enough single-engine climb performance; handicapping them with extra weight borders on suicidal.

There were only six gear-up events—and half of those involved collapse of a gear leg due to a mechanical issue that had not been addressed. Those numbers were less than we expected when compared to other light twins, so we think the Seneca gear system has withstood the test of time and maintenance malpractice.

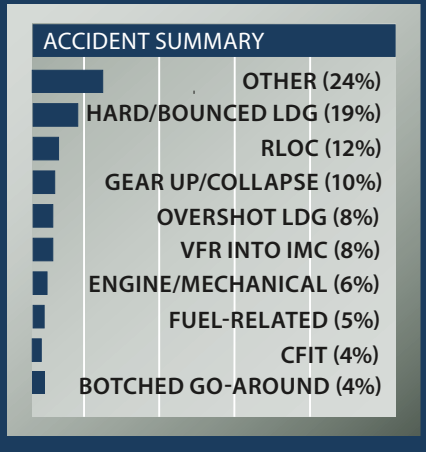
Two over-enthusiastic pilots snapped the gear handle to the up position during the takeoff roll and successfully lowered the airplane to the runway.

The rate of engine/mechanical problems was lower than we expected to see. All were due to maintenance not performed. Two pilots lost prop blades due to long-existing fatigue cracks. One pilot declined to have a bad fuel servo fixed and had the mechanic button up the airplane. That engine quit at 50 feet and the pilot proved he wasn't up to speed on single-engine ops and promptly stuck the airplane into the dirt.

There were eight VFR into IMC crashes clearly connected with pilots who were determined to go somewhere despite the weather. All either hit rising terrain or spiraled in. Four instrument pilots went the wrong way on missed approaches and hit terrain.

One of the best examples of students catching instructors flat-footed was the student who, when the CFI said "go around," promptly firewalled just one throttle. The CFI wasn't fast enough to correct the problem before a wingtip hit the ground.

One owner landed hard enough to damage the airplane. He didn't report the accident for two months, until he needed a ferry permit and had to fess up.



Due to the low speed restrictions, speedbrakes are a good investment, particularly in heavy traffic areas. Precise Flight makes a set for $4995. Contact: 800-547-2558. For Seneca I owners who want turbocharging, the old Rajay is found on used models, but no longer installed.

Seneca II and III owners can improve their turbos with Turboplus intercoolers in kit form. Contact www.turboplus.com or 888-514-4514. Although the takeoff and landing numbers on the Seneca are decent, owners who want better performance can invest in Sierra Industries' R/STOL kit. Call for pricing and expect a long lead time. Contact: 888-835-9377 or www.sijet.com for more information.

Hartzell Propeller had an aggressive program to install three-blade propellers on the Seneca II and III. The STCs can replace either two-blade Hartzell or three-blade McCauley propellers. The three-blades offer better takeoff and initial climb and also eliminate the RPM/MP restriction applicable to the two-blade propellers. Contact Hartzell at www.hartzellprop.com or 937-778-4200. Although the props are still available, the deals may not be. Check with Hartzell to find out.

The Piper Owner Society supports Seneca buying and ownership and is a good general resource for Pipers of all sorts. Contact 800-313-0582 or www.piperowner.org. Another group is the Piper Flyer Association at www.piperflyer.org.

OWNER COMMENTS

I own a 1983 Seneca III that I bought used in 1985 and have been flying it for 30 years. I added two aftermarket devices that are proven great value. One is TurboPlus intercoolers and the other is Precise Flight speedbrakes.

The intercoolers have been completely maintenance-free, but last year I noted increasing discrepancy of the throttle positions starting about 8000 feet, and becoming quite pronounced in the mid teens. A test at a critical altitude using the shop manual showed a significant

loss of manifold pressure on the left engine. For a while, I suspected the turbocharger, so I had it de-coked, but found no improvement. Then I thought maybe the intercooler might be leaking internally and allowing some compressed air to bleed off. However, no leaks were found. Finally, I took my expert A&P up for a test flight. He carefully monitored all engine parameters and determined that the high RPM fuel flows were way out of adjustment. He readjusted the fuel pressures for both engines and now everything is fine. Worth noting to other owners is that the intercoolers were not the culprit. Plus, engine performance charts have to be corrected for the drop in temperature that the intercoolers provide.

The great advantage of intercoolers is increased engine output at lower fuel flows, while keeping CHTs well within operating limits.

In fact, the engines run so cool I have learned to keep one oil winterization plate on each engine year-round, adding a second plate for the winter. Otherwise, the oil temps do not get high enough in routine use to boil off condensed water in the crankcase.

The speedbrakes were initially a hybrid electric/hydraulic system, which created problems with rigging and leaks. However, Precise Flight changed them over to all-electric years ago and they have been problem-free ever since. Their great advantage is to allow quicker descents (as ATC so often requests) without shock-cooling the engines. The only maintenance item is assuring that the drains are not clogged or elevated above the bottom of the box. Otherwise, a little bit of water will settle in the boxes and then freeze in flight—preventing extension of the brakes.

The intercoolers and speedbrakes together have been wonderful for engine life. In the first life of both engines, I never touched the top end of either engine. It was the crankshaft bearings that required overhaul. Now well into the second life of both engines—nearly 15 years, but only about 1000 hours—I have replaced only one cylinder on one engine due to low compression. I highly recommend both these mods for the Seneca. Aside from GPS and satellite weather system upgrades, I would call them the two best things I did for my Seneca in 30 years.

Phil Steeves, N8467X
via email

I moved up from a Piper Cherokee Six-300. I was looking for something with similar efficiency and load-carrying capability and the Seneca, properly equipped, fit that bill for my family of five and our dog.

I think we have all heard and read the conversations about the additional security (or lack thereof) of twin-engine operations. Clearly all pilots, especially of twins, will want to maintain currency. While the Seneca is a step up from a fixed-gear single, it was an easier transition than I expected.

The benefits of the counter-rotating engines make single-engine operations and Vmc demonstrations (practiced or real) a much more manageable event—even for pilots who aren't practicing these scenarios as often as they should. From a safety point of view, operating a well-equipped twin in regular IMC is a huge benefit over a well-equipped single. I believe the extra alternator and engine provide a lot of options.

While my Seneca has several upgrades (220-HP intercooled engines and three-blade props), it performs right at where the revised operating specifications say it should. I can typically operate the engines at 9.5-10 GPH per side, with 165-knot groundspeeds at 10,000 to 12,000 feet. If I push the power up a bit, I can get 175 knots at 25 to 26 GPH at the same altitudes. I usually plan for 21 GPH total and 165 knots. That enables an easy five-hour endurance, with a little more than required IFR reserves.

From a hauling standpoint, the Seneca is no slouch. As it is currently configured, I can fill the tanks, all five seats plus baggage and never really have to be concerned. Most of the late 1970 to mid 1980 models have very respectable useful loads—typically in the high 1400s to low 1600s, depending on engines and installed equipment.

The cabin for crew and passengers is plenty spacious, but the club seating is best for smaller passen-

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The Aviation Consumer

PIPER SENECA

(continued from page 31)

gers because the leg-tangle can be a bit awkward for four full-sized adults. Entrance and exit is very easy through the large copilot and pilot-side passenger door. The additional baggage door and nose compartment make for adequate stowage for all but the heaviest of packers.

There are plenty of upgrades and STCs available for all model-year Senecas. The wide instrument panel is a great platform for a wide variety of avionics upgrades. Plus, since the Seneca is still in production, parts are readily available

Many have said that the Piper Seneca is not really great at anything in particular. If you want speed in a similar sized twin, consider the Cessna Turbo 310R. If you want to haul a huge load, maybe consider a Piper Aztec. But, if you want something in the middle, the Seneca seems to be well-placed among light twins.

Andy Jones
via email

My 1973 Seneca I is a capable six-place piston twin, although it's not incredibly fast. It averages around 145 to 150 knots, but it has a roomy cabin that's comfortable even on long flights. It's also stable in flight and easy to fly—aided by the counter-rotating props.

The only thing that takes getting used to when transitioning to it from a single-engine airplane is the amount of back pressure required in the landing flare.

The big drawback in the Seneca is the lack of single-engine climb performance, as it loses about 90 percent during an engine-out situation. This is due to the the empty weight CG being near the forward limit. You can help by having passengers and and cargo in the rear of the airplane.

The only drawback to the cabin is in the middle seats, as they are right behind the pilot seats and don't provide much legroom until the front seats are moved forward.

Both cargo compartments (nose and cabin) provide ample room, and with 100-pound limits, both provide good flexibility for loading luggage.

I do recommend filling the aft luggage area first, as it helps maintain the CG limits and is fairly accessible in flight.

I usually plan on maximum endurance flights of around three hours, which still allows for 1.5 hours of fuel reserve. I plan on 20 to 24 GPH for fuel expenditures.

I have found the wide instrument panel to be very upgradable, both for flight instruments and panel avionics. My airplane has a three-screen Aspen PFD/MFD suite, S-Tec 55X autopilot, Garmin GTN touchscreen navigators, a satelite weather receiver, ADS-B system, plus digital engine monitors and fuel computers.

The only drawback to all of these upgrades is relying on ample electrical power. Each engine has a 60-amp alternator, which is more than capable of producing the power for all the avionics, but an alternator failure requires load-shedding. Fortunately, the Aspen displays have backup batteries.

As with any airplane, as long as preventive maintenance is kept up with, the annual maintenance cost can be controlled, but like any twin, there is basically two of everything. My experience is that the Lycoming IO-360 engines are excellent, worry-free engines. Quality overhauls can be pricey, but thanks to a 2000-hour TBO and thorough preventive maintenance, this cost can be spread out over a long period.

Overall, my Seneca I has been a great family airplane that I am always praising. I would only improve on two things: more horsepower from the engines—which will help the single-engine performance—and more alternator output to keep up with the increased electrical demands of a panel full of avionics.

Jonathan Baldwin
via email

FEEDBACK WANTED

AC CITABRIA

For the July 2016 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the American Champion Citabria and Decathlon. We want to know what it's like to own these aerobatic aircraft, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your airplane to appear in the magazine, send us any photographs **(full-size, high-resolution please)** you'd like to share to the email below. We welcome information on mods, support organizations or any other comments. Send correspondence on the Citabria and Decathlon by May 1, 2016, to:

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