

The Aviation Consumer®

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FIRST WORD**CIRRUS JET STEP-UPS: SKILLS ASSESSMENT, TYPE RATING**

The big announcement last month from Cirrus is that it achieved FAA certification for its Vision personal jet. With a couple of deliveries expected by the end of 2016—and perhaps as many as 50 or so for 2017—you can bet all eyes at the Cirrus flight ops department will keep a close watch on early adopters. Just how these Williams FJ33-5A turboprop-equipped singles will fare in the hands of jet-world newbies is anyone's guess, but I asked Matt Bergwall at Cirrus what the training department is doing before the sales department hands over the keys to proud new Vision jet jockeys. After all, Cirrus learned some hard lessons in safety when it delivered its speedy piston-powered SR models nearly 17 years ago. According to Bergwall, planning for the piston-to-turbine transition actually started before the Vision was designed.



That's because from the very beginning, the Vision was designed specifically as a step-up aircraft for the Cirrus SR series owner-pilot demographic.

For example, slide into the Vision cockpit and the positioning of the throttle is similar to where it is in the SR22, as are the rocker switches for the batteries and generators. Although the Vision is equipped with Garmin's G3000 integrated avionics, which Cirrus calls Perspective Touch, pilots familiar with the G1000 Perspective used in later-model SR aircraft should have a relatively easy avionics transition. While the Vision cruises at speeds north of 300 knots, Cirrus said it has climb and slow-speed handling characteristics similar to the SR22. But despite Cirrus giving its existing customers a head start, I can tell by talking with Bergwall that it isn't attempting to oversimplify the Vision Jet transition. Cirrus—and the insurance companies that will cover new Vision pilots—knows that turbine-world step-ups present new challenges far beyond learning more advanced systems. The Vision cockpit isn't the place to brush up on basic skills.

While the aircraft isn't equipped for RVSM altitudes, it has a 28,000-foot service ceiling, so some transitioning (and aging) pilots will be faced with the additional workload of high-altitude ops, different descent planning and simply having to stay ahead of the aircraft, where things happen faster than they do in a piston single. These aspects are covered, in part, in the Cirrus Approach in-house type rating program—which kicks into high gear well before a new owner might even think about flying the jet home. This includes a general skills analysis by a Cirrus instructor, perhaps a year before taking delivery. "If we can conduct a skills assessment flight with the customer while they're current, we'll have a better idea of what that pilot needs in terms of training to successfully fly the Vision," Bergwall told me. There may be exemptions to the assessment process, including some professional pilots who currently operate turbine airplanes. They'll still be required to take the Cirrus Approach type rating course and may complete it in roughly seven days, while an amateur may take considerably longer. Think in terms of proficiency-based—as opposed to time-based—training.

At this point, Cirrus doesn't have plans to outsource the training. It's currently setting up the Vision Center in Knoxville, Tennessee, where sales, delivery and training will take place. The transition includes a Perspective Touch course, which focuses on the Garmin avionics. A good portion of the Vision type rating training will be conducted in full-motion simulators, while early buyers will train in a production Vision that's entirely dedicated for customer training. Cirrus wants every Vision customer to be type rated in the Vision before taking delivery because logically, that separates the anxiety of training from the stress and excitement of the purchase and delivery. There is also a mentoring period, where Cirrus instructors will accompany a new owner on his or her normal missions.

Cirrus has 600-plus delivery positions reserved for the \$1.96 million jet, which has a CAPS airframe parachute and seating for five adults. Look for a full review of the Cirrus Vision Jet in a future issue of *Aviation Consumer*.—Larry Anglisano

ADS-B TRANSPONDERS

Your article on ADS-B transponders (November 2016 *Aviation Consumer*) suggests you can save \$500 by wiring in your existing Stratus portable ADS-B receiver to the new Stratus ESG transponder, instead of buying the new 2i receiver. This is true only if you don't wire it in, but continue to use it standalone.

I just had NexAir Avionics in Massachusetts install the Stratus ESGi transponder system in my Ercoupe and I chose the package with the 2i because the savings without it is only \$350. That is because the interface cable set costs \$150, but it's included with the ESGi bundle. I figured I could sell my existing Stratus 2 for more than \$350 (you proclaimed it a good used market deal in a separate article) and come out ahead.

I am happy with the install, although I wish Appareo offered an option for a shorter interface cable. I flew the required test in Boston's controlled airspace and received a PAPR with zero errors. The FAA followed up with a message saying "the check is in the mail."

David Abrams
via email

Thank you for the recent detailed article on ADS-B transponders. It seems *Aviation Consumer* is the only publication that can help us confused buyers make sense of this changing market. I'm an aging pilot and not sure I'll be flying long after the 2020 mandate hits, but still need to equip my Cessna 206 for ADS-B.

My question: Should I upgrade on the cheap and only install ADS-B Out (Garmin's entry-level GTX335, perhaps), or will most prospective buyers want an airplane with both ADS-B In and Out?

Richard Clarke
via email

That's a good question, but a tough call for your situation. We think any

ADS-B Out installation is shortchanged without ADS-B In capability, but as we've suggested, the ADS-B buying decision depends partly on the user's preferred tablet app interface.



Get a quote for both the GTX335 and GTX345 and decide if the price delta makes sense. It might, especially if you plan to fly the airplane for a while.

I greatly appreciated your recent article on all of the new ADS-B transponders. Having installed an L-3 NGT-9000 this past September, and with 30 hours of flying with it, I want to point out some advantages to this system that you missed.

First, the NGT's Wi-Fi is compatible with a wide variety of tablet computer applications. The other products are limited to one or two apps.

Additionally, the NGT-9000's integral dual color display provides increased flexibility. With all of the other ADS-B solutions, if you scroll out on the screen to look at the weather, you lose fidelity on traffic targets near your position. If you scroll in close to view traffic, you lose the weather picture around you. With the L-3, you can leave the traffic display set for anywhere from .5 to 40 miles while displaying weather across the country, either on your tablet or on the right side of the L-3 display. No other box gives you that kind of flexibility.

While the screen is not large, the resolution is high enough and the screen is bright enough to be seen in any cockpit lighting.

Alan Williams
via email

MOONEY DESIGN 101

I have enjoyed and benefited from *Aviation Consumer* for 25 years, so you would think I would know the answer to this question that came up after reading about the Mooney 201 in your December 2016 Used Aircraft Guide. What do you mean when you say the aircraft has a semi-monocoque

rear fuselage mated to a steel tube cabin?

P. Douglas Daniels, Jr.
Howell, Michigan

You aren't the only reader to ask this question, Doug. The idea behind a hybrid semi-monocoque construction is increased structural strength. Instead of a single shell (monocoque)—or full skeleton—semi-monocoque construction uses a partial skeleton to reinforce the airframe's skin in critical areas, but the skin supports most of the aerodynamic load, further reinforced by internal bulkheads, bracing or stringers. The design isn't just for Mooneys—Boeing's 787 Dreamliner has a semi-monocoque airframe, too.

We made a typo in the Mooney report. The last year for the 201 (Allegro) was 1998, not 2008.

UPSET TRAINING

Your December 2016 article on upset training probably minimized both the fun factor and the real cost. I took training right after getting my private pilot certificate. I told the instructor I just wanted to practice upsets and spins—nothing more complicated—but he cajoled me into doing some simple acro. I ended up buying a Pitts.

Mark Hauswald
via email

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CHECKLIST

- + Both the Dynon D10A and Garmin G5 have rich feature sets...
- ~ ...but buyers really want approved EHSI nav and autopilot capability. Who will be the first?
- + We give the G5 a slight ease-of-installation advantage for external GPS input and chassis size.

Budget EFIS Shootout: Dynon Versus Garmin

Priced below \$3000, Dynon's D10A and Garmin's G5 are approved for Part 23 aircraft, but you still need backup instruments and neither has nav functions.

by Larry Anglisano

The FAA turned a regulatory corner last year when it gave the green light to replace spinning attitude gyros (and vacuum systems) with TSO'd standalone solid-state electronic attitude instruments. It wasn't long before Dynon—partnering with the Experimental Aircraft Association (EAA)—announced an AML-STC to retrofit its experimental D10A EFIS into lower-end Part 23 aircraft. As expected, Garmin competitively and swiftly earned a more extensive AML-STC for its experimental G5 EFIS just a few months later.

AVIONICS FLIGHT TEST

The D10A and G5 have similar form, function and pricing, which confuses the buying decision. They both sport decent color displays that mimic primary flight displays (PFDs) and they're designed for an easy retrofit. Plus, they are both priced under \$3000. In this article, we put the two instruments side-by-side for a look at their differences and limitations.

THEN AND NOW

The instrument retrofit market has

changed considerably in the last year (we covered digital attitude indicators in the December 2015 issue of *Aviation Consumer*). At the time, Sandia Aerospace finally emerged from the trenches of TSO certification with its SAI-340 Quattro backup attitude indicator. This was perfectly timed around the FAA's policy statement allowing for electronic attitude instruments for installation as primary systems.

At \$3600 (not counting install), we thought Sandia ruled the roost because it was priced considerably less than L-3's \$6000 ESI-500 Genesis, which was really a mini-EFIS intended as a backup for larger primary glass PFDs.

BendixKing also announced the KI300, an electronic replacement for its aging and maintenance-intensive analog KI-256 flight director gyro. It was supposed to have a \$5000 starting price, but BendixKing still hasn't brought it to market and has remained mostly silent on the product's progress.

But Garmin and Dynon didn't have to start from scratch. Each company already had low-cost EFIS

displays aimed exclusively for the experimental aircraft market. Rather than dealing with the lengthy process and high cost of earning TSO certification, Dynon (partnering with EAA, the D10A's STC holder) and Garmin lobbied installation approval through an STC. The STC governs how the instruments are installed, which means any deviation to the approved AML-STC installation manuals will require additional certification via FAA field approval.

Garmin says the electronics in the G5 meet the DO-334 performance requirements needed for TSO on its certified AHRS systems, although the instrument doesn't have a TSO.

BACKUPS GOTTA STAY

While the D10A and G5 are essentially mini-EFIS systems—plenty capable to serve as primary one-and-only flight displays just as they are in experimental aircraft—the STC for each requires the use of supporting backup instruments.

The FAA issued each STC for the sole purpose of replacing the attitude gyro even though both instruments bring far more functionality to the table. These other functions—including airspeed, altimetry and track data, to name a few—are secondary and supplemental only. Moreover, there is no autopilot interface or nav/GPS course guidance displayed.

Garmin's STC'd G5 for Part 23 aircraft installed in a Cessna 172 panel (top photo) is a de-featured version of the G5 that's sold for experimental aircraft.

With its wide bezel, Dynon's D10A, top, could be a tight squeeze in some panels, requiring metal work. Both systems are plumbed for pitot and static air input, but Garmin's shallow chassis, bottom photo, saves space behind the panel. The arrows point to each display's onboard backup battery.

But what if you wanted to buy a pair of G5s or D10As and place them side-by-side in the panel and ditch the airspeed and altimeter instruments? You know, build your own low-cost glass panel. You can't do it because the AML-STC doesn't allow it—the instruments aren't TSO'd. Dynon's STC requires a panel placard reminding you that non-attitude indications are not for reference in flight. Silly, but those are the rules. Garmin told us the G5 can't even be used to legally back up its certified G500/600 primary flight display or a G1000.

Each STC specifically prescribes where the instrument is located on the panel. When installing the D10A, Dynon's instructions say you must maintain the six-pack orientation of the existing primary flight instruments. In other words, you can't rearrange them, plus the D10A must be placed where the previous round-gauge attitude gyro was installed.

Garmin's G5, on the other hand, is approved as a replacement for either the attitude indicator or the turn coordinator (not both), so it can be placed in either position.

As for the AML (approved model list), Dynon came out of the gate with limited applications in the first revision of the STC. Remember, EAA's intent in securing the STC was to make the instrument accessible to buyers with lower-end aircraft. This includes Cessna 150/152/172/175/177/182 and Piper PA24/28/32/38 models.

According to the STC, the aircraft must, per the original type certificate, have been equipped with a pneumatically driven attitude indicator at time of manufacture to be eligible. As with any STC, the installation has to be signed off by an A&P with Inspection Authorization (or an



FAA repair station) and requires the filing of a Form 337.

Garmin's G5 AML is far more comprehensive, encompassing 562 aircraft models, which Garmin says it plans to expand.

DISPLAY, FORM FACTOR

The STC'd version of Dynon's EFIS-D10A trickles down from the D10A it has been selling for nearly 10 years, while Garmin's G5 was released just last year. Put the two side-by-side and the advancements in display technology are evident.

We wouldn't exactly label the D10A's 3.8-inch diagonal color LCD display as being outdated, but it doesn't have the vibrancy of Garmin's newer G5, in our opinion.

At 3.5 diagonal inches, the G5's QVGA color LCD display is slightly smaller. It has a display resolution of 320 by 240 pixels. Check that against the D10A's 320 by 240 pixel, 450-nit LCD display. Same pixel count—but we give the G5's QVGA the edge in viewing quality.



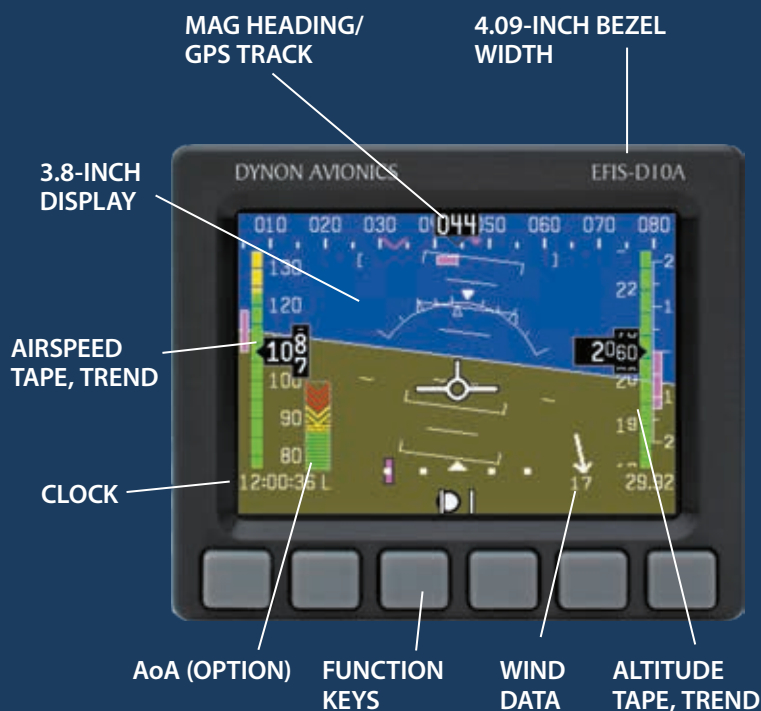
Both the D10A and G5 require a pitot and static source inputted directly to fittings on the rear of the instrument's chassis. We give Garmin's G5 a slight installation advantage because of its shallow footprint—measuring only 2.6 inches deep. The D10A's chassis is every bit of 7 inches

GARMIN G5 AND DYNON EFIS-D10A COMPARED



DIMENSIONS: 3.4 by 3.6 by 3.6 inches

BASE PRICE: \$2149, STC is included



DIMENSIONS: 4.09 by 3.39 by 7.64 inches

BASE PRICE: \$2725, with \$100 STC

deep, plus the harness (fabricated by Dynon) extends an additional few inches. Panel depth isn't the only consideration. Since the D10A is 4.09 inches wide, some Cessna 172 retrofits require the installation of a new subpanel to support a slightly wider spacing between the airspeed and altimeter instruments.

The D10A can be mounted in a standard configuration (with an external bezel) or flush mounted, using an optional flush-mount bracket.

The Garmin G5's bezel is 3.4 inches wide and 3.6 inches high—allowing for plenty of space between the other instruments. We like that the G5 can be removed and reinstalled from the front of the instrument panel—no need to access the back of it.

The D10A and G5 share a straightforward electrical installation and both require GPS position for backing up the attitude solution. We think Garmin has the advantage here because the D5 accepts input from the

GNS430W/530W (legacy non-WAAS navigators won't work) and the current GTN750/650 navigators via serial bus. The other option is using the GPS engine that's built into the unit, but that requires a dedicated antenna, increasing install effort and cost.

Dynon's D10A connects with the external GPS251 GPS receiver/antenna, which is powered by the D10A with a supplied four-wire harness with a DB9 connector.

STANDARDS AND OPTIONS

In addition to displaying attitude, altitude, airspeed and turn rate/inclinometer, the D10A has a bus voltage display, G meter, timers and a clock. Also included is the internal backup battery, which has an endurance of two hours.

We think the optional EDC-D10A remote magnetometer is worth purchasing and gives the D10A an advantage over the Garmin. The EDC input replaces GPS ground

track with a magnetic heading tape at the top of the display. But, expect a sizable installation effort to get this right. While the EDC can be installed pretty much anywhere in the aircraft, magnetometers don't work well when corrupted with electrical interference.

Garmin has a remote magnetometer interface with the G5 version for experimentals, but doesn't offer it with the STC'd version. We heard rumors of a future EHSI interface, which we would embrace. The G5 doesn't have an angle of attack function, either, but the D10A does.

When connected with the company's AoA probe, the data logically displays next to the airspeed data. We found Dynon's AoA to be a good performer with an easy calibration procedure. The probe has two static air pressure ports—one on the face, which is insensitive to the angle of attack—and another located on an angled surface of the probe, just

Experimental applications unleash the full potential of these budget EFIS displays, including an electronic HSI navigation display shown on Dynon's D100. Navigation and autopilot interfaces are not approved in the Garmin or Dynon/EAA STC.

under the pitot port. The software uses the difference between these two pressures to calculate the AoA. There is also an optional temperature probe, for OAT, density altitude and true airspeed display.

As for user feature set, Garmin keeps the menu structure shallow and only displays the G5 data in a single PFD format. A rotary knob is used to access the main menu and to set the baro and altitude alerter. The capacity status of the backup battery is shown in the upper left corner of the display. The ground track tape has a reference marker for minding a desired track, but remember, this isn't magnetic heading.

Attitude information is displayed over a virtual blue sky and brown ground with a white horizon line, which is also part of the pitch scale. Pitch markings are spaced at 2.5-degree intervals and a yellow symbolic aircraft corresponds to the current pitch attitude. A slip/skid indicator is positioned at the bottom of the display, along with a magenta turn rate trend vector. Missing on the STC'd G5, but standard on the version for experimental aircraft, is a flight director command bar presentation because autopilot input is excluded from the STC.

The G5 has programmable V-speed references. When airspeed is present, the V-speeds are displayed at their respective locations to the right of the airspeed scale. The airspeed

trend vector is displayed as a magenta line to the right of the tape. The end of the trend vector corresponds to the predicted airspeed in six seconds if the current rate of acceleration is maintained. If the trend vector crosses Vne, the text of the current airspeed readout changes to yellow.

The G5's altitude alerting feature is logical. When passing within 1000 and again at 200 feet of a selected altitude, the set value flashes for five seconds. Bust the altitude by 200 feet and the selected altitude data box changes to yellow text against a black background. We think an audio output would make the interface better. Dynon's D10A has an output for connecting to an audio system for altitude and AoA alerts.

The D10A's bezel has six buttons for data entry and for accessing its menu system. The onscreen menu consists of two rows of grey text boxes denoting the currently displayed menu. There is also a lower row containing six more labels that denote the function of the button below it. We like that many of the primary onscreen elements shift up, so critical data isn't obscured by the menu when it's active.

Each page has a dedicated menu, which may have options for hopping to another menu or adjusting parameters like the baro, setting the timer and adjusting the



display backlighting.

The D10A's horizon line, pitch and roll indicators are presented much like the G5's. Bounded by blue at the top and brown at the bottom in traditional gyro-based artificial horizon fashion, the horizon line stays parallel to the earth's horizon line regardless of the aircraft's attitude. The parallel lines above and below the horizon line are the pitch indicator lines, with each line indicating 5 degrees of pitch. The end of each 10-degree pitch indicator line has a hooked barb that points toward the horizon line.

The roll scale has tic marks at 10, 20, 30, 45, 60 and 90 degrees of roll. The stationary roll indicator has an internal arrow that moves to stay perpendicular to the horizon, while a moving roll indicator rotates the scale about a stationary internal arrow, which points to the current roll angle on the scale. Again, this follows the display of most mechanical attitude instrument presentations.

The time clock (which can be set for local and Zulu time) is displayed in the lower left-hand corner of the screen, below the airspeed tape. When a count-down or count-up timer is enabled, it is displayed in place of the clock until the timer is stopped. With the optional OAT probe, a winds aloft arrow and wind speed is displayed on the lower corner of the display. In light winds, the arrow remains on the screen, but the speed value goes away.

The slip/skid ball works much like it does on a mechanical instrument. It is a visual representation of lateral acceleration. It's simple: If the ball is within the two vertical lines, you are in coordinated flight.



Garmin's STC allows for more flexible mounting locations. It can replace the turn coordinator or the attitude gyro, but not both.

DYNON D100: SUPERBRIGHT WIDE

The reality of using either the Dynon D10A or Garmin G5 in the real world is this: While the STC says the airspeed and altimeter tapes are intended for supplemental use (that's why you gotta keep the backup instruments, right?) your eyeballs will be fixed to the screen for primary everything. As good as we think these displays are (with Garmin having the modern advantage), each instrument is jampacked with bits of data that can be a struggle for aging eyes. That's where Dynon's Superbright widescreen EFIS-D100 comes in.

With a 7-inch diagonal color LCD screen and a front bezel that measures 6.95 inches wide, the D100



easily dwarfs the D10A and Garmin G5. Moreover, the D100 is blanketed by EAA's AML-STC, enabling it to be installed and used the same way as the smaller D10A. The same limitations apply—no autopilot or navigation interface is approved. The D100 has a G meter, timers, a voltmeter and accepts inputs from optional AoA and magnetic heading sensors. It also has a splitscreen.

Mounting the D100 requires cutting a 6.78 by 4.75 inch rectangular cutout on the surface of the panel, which will obviously displace the required backup instruments, so you'll need to plan on sizable panel work.

The D100 instrument has a starting price of \$2740 and buyers must purchase the STC from the EAA for \$100.

Noticeably missing on both the D10A and G5 is synthetic vision. We think buyers will want it. Buyers may also want a built-in checklist feature and the D10A has it. You may define up to 25 checklists and each checklist/data panel can contain up to 14 lines of text and 40 characters per line. The checklists must be built and loaded through a serial port using Dynon's Excel-based checklist creator programmer. The Garmin G5 doesn't have a checklist function, but it does have a bezel-mounted micro USB port for loading software updates.

GOOD PERFORMERS

We flew with both the G5 (an experimental version, which has the same internal sensors as the STC'd version), and the D10A. Both were solid performers. When the FAA issued the STC, this is rightfully what

it cared about the most (and how the instruments interface with the pilot during a sensor failure).

We did light aerobatics with the D10A and it never flagged its data. The attitude presentation is generated from algorithms using multiple sensors and is not reliant on any single external system. A G meter shows the current, maximum and minimum acceleration.

Dynon says the instrument can provide an accurate attitude—even in the event of airspeed loss (due to icing or other blockage)—because of its redundant GPS assist function. In normal operation, the instrument uses airspeed to aid with attitude accuracy. If there's trouble with the airspeed reference, the GPS ground-speed substitutes.

You'll know when the airspeed input is lost because a magenta "GPS assist" message appears on the horizon display. A loss of GPS and airspeed data results in a "crosscheck attitude" message. That means using those backup flight instruments that the STC says need to stay in the panel. It's still a lot of redundancy.

Consider Aspen's Evolution PFD where an iced/blocked pitot tube will red-flag most of the displayed data.

The G5 calculates attitude using built-in inertial sensors. The instrument also uses GPS and airspeed data to tighten up the accuracy of the attitude information. The G5 should come up valid within one minute of initial power up. If the G5 senses that the attitude solution is valid, but not yet within the internal accuracy limits, an "aligning" message is displayed. The displayed attitude information is still accurate and usable while this indication is shown. The G5 can align itself while taxiing and during level flight. If the G5 inertial sensors fail, an "attitude fail" message is displayed, while the onscreen data is flagged with a red X.

We didn't do them, but Garmin says the G5 is capable of handling extremely dynamic maneuvers, including aerobatics and air racing.

WHAT'S THE BOTTOM LINE?

First, the Garmin G5. It has a list price of \$2149 with the backup battery, installation kit and approval to use the STC. If you need an external GPS antenna, the price jumps to \$2499. But that's more than twice the cost of the G5 for experimental applications. We asked Garmin why and they told us the additional cost comes from the STC certification process.

Dynon's D10A is generally purchased in the "EAA sales kit" and has a base price of \$2625, including the instrument and the backup battery. The GPS251 GPS receiver/antenna module is \$295, the unheated AoA/pitot sensor is \$200, the EDC-D10A remote heading magnetometer is \$100, the OAT probe is \$65 and if you want the instrument mounted flush in the panel, Dynon sells a \$20 mounting bracket. You'll need to purchase the STC directly from the EAA for an additional \$100.

The larger D100, which is covered by the STC, is sold standalone for \$2740. Add the backup battery, the GPS receiver/antenna and the other optional sensors listed above and the price soars to around \$3400, not counting a big installation.

For features, we think the Dynon D10A wins, especially for the ability to connect a heading sensor. But for cost, installation ease, display quality and backup battery life, we prefer the G5. Still, neither has what we really want—nav and autopilot functions.

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Portable Oxygen: Mountain High is Tops

Pulse oximeters reveal that most of us should use supplemental oxygen. There are lots of choices, but we think Mountain High is the most sophisticated.

by Rick Durden

The widespread availability, and use, of inexpensive pulse oximeters opened the eyes of many in the aviation community to what the aeromedical folks have been telling us for years: The FARs on oxygen give a false sense of security to pilots. Pilots who are in full compliance with the regs are often oxygen-deprived to a level that adversely affects their ability to operate the airplane. The good news is that there are a number of reasonably priced, high-quality portable oxygen systems to help protect yourself against hypoxia and make your flights safer and more comfortable.

BREATHING 101

Oxygen makes up some 21 percent of air. Every pilot knows that as you gain altitude, the air molecules get farther apart so it's increasingly difficult to convince oxygen to pass through the human lung and join with hemoglobin to oxygenate the bloodstream. As the blood's oxygen saturation level drops, it leads to hypoxia, an evil, wicked, mean and nasty condition. It causes, among other things, deterioration of mental and physical functions as well as loss of vision. All the while, it neatly obstructs the pilot's ability to recognize its onset because its most powerful symptom is euphoria—"Everything is great!" For a frightening example of the effects of hypoxia, there's a recording of a hypoxic Learjet crew talking at <http://tinyurl.com/lqj64bb>.

In our opinion, a number of otherwise unexplained general aviation accidents were due to the effects of hypoxia causing either loss of control or diminished capacity to the point the pilot could not follow an instrument approach chart and flew into terrain. In researching this article, every aeromedical professional we spoke with emphasized the fact that the effects of hypoxia become pronounced at lower altitudes than most pilots realize, often because the reduction in mental and physical functioning are covered up by the profound feeling that all is going well.

In addition, the usual day-to-day events we deal with such as stress and fatigue exacerbate hypoxia. Another fact of life is that as we age we become hypoxic at progressively lower altitudes.

A pilot can legally climb to 14,000 feet and fly there for 30 minutes without supplemental oxygen although at the very best, his or her blood oxygen saturation will be 88 percent, and more likely closer to 83 percent. Dr. Bruce Chien of Peoria, Illinois, told us that most hospitals will not

accept an "informed consent" from a patient who has a saturation level below 90 percent. That got our attention.

We strongly recommend that any pilot who flies above 6000 feet MSL with any regularity own and use a pulse oximeter. We also recommend that he or she give serious consideration to purchasing and using a portable oxygen system.

Yes, we know, for many of us pilots the thought is that what we don't know won't scare us. But, now that we know, we should be at least concerned and—good news—there's a large selection of supplemental oxygen systems that aren't terribly expensive. We'll talk about what's in a system, what systems are on the market and pass along the prices we found

OXYGEN

All oxygen produced in the U.S. is made through a complex process called liquefaction. Simplified, air is compressed and cooled to such an extreme state it becomes a liquid. The component gases are boiled off, leaving only very nearly pure liquid oxygen. Oxygen is oxygen. Ever since liquefaction became the sole process



Mountain High Oxygen Systems' XCP-4p, four-place, portable system with regulator, top, flow meters, bottom, and carrying case, center and left.

OXYGEN USE REGULATIONS: OUTDATED, CONFUSING

The Federal Aviation Regulations concerning supplemental oxygen use in flight—Part 91.211—were put in place in 1963. They have never been updated to apply what has been learned about the effects of oxygen deprivation on the human body. In doing the research for this article every doctor we spoke with told us that requirements for oxygen use under 91.211 are inadequate and the false sense of security they provide pilots has undoubtedly cost a number of lives. Dr. Brent Blue of Jackson, Wyoming, an *Aviation Consumer* contributor, put it bluntly: “Oxygen is underutilized on a wholesale basis.”

The nearly 54-year-old regulation appears to have been a political compromise. The aeromedical community knew that supplemental oxygen was needed for many pilots, especially those who smoked, at altitudes as low as 6000 feet MSL. However, the alphabet groups didn’t want a regulation that would require pilots to lug around heavy steel oxygen tanks—they’re made of aluminum or composite materials now and are much lighter—and have to pay for oxygen fills if they could avoid it. Accordingly, they pressed for the highest minimum usage altitudes they could get from the FAA.

As a result of the pushback from industry, FAR 91.211 allows a pilot to fly as high as 14,000 feet for 30 minutes without supplemental oxygen. Apparently, the idea was to allow pilots to fly completely across the country—climbing briefly to clear the highest mountain passes—without having to carry supplemental oxygen. We think that’s nuts.

A workable pulse oximeter can be purchased for under \$30. We think every pilot who flies above 6000 feet should have one in his or her flight bag. The recommendations we received from multiple aeromedical sources regarding supplemental oxygen use were simple: When sitting down at home, breathing normally, use a pulse oximeter to determine your resting blood oxygenation level. For most people it will be around 96 percent. When you’re flying, check your oxygenation level regularly—once it has dropped five points, supplemental oxygen is recommended—when it has dropped 10 points, supple-



mental oxygen is required, in our opinion.

For years, pilots have assumed they were doing great when flying in circumstances where they needed supplemental oxygen. That’s because the first symptom of hypoxia is elation.

Don’t believe you need supplemental oxygen? The best way to see how much it benefits you is to make a night flight at 8000 feet. Once set up in cruise, take a few breaths of oxygen and see how much brighter the lights get and how much more clearly you can see. That’s because the retina is one of your body’s most sensitive organs to low oxygen levels.

Finally, there is a great deal of literature—and even some FAA publications—that says you can’t use an oxygen cannula above 17,999 feet; you have to use a

mask. However, there is no FAR to that effect. FAR 23.1447 is often quoted for the mask requirement, but it applies to aircraft certification—not flight operations. It applies to built-in oxygen systems in aircraft and the required components in those systems, not how they’re used.

Nevertheless, once you get above 18,000 feet, your time of useful consciousness (TUC) without supplemental oxygen

gets distressingly short. What matters is your blood oxygen saturation. Whether you are using a mask or cannula, it needs to be monitored and you should be aware of the potential shortcomings of each delivery device. If you’re using a cannula and have a lingering verbal exchange with ATC—perhaps a clearance reroute—you may be breathing through your mouth and, according to Mountain High Oxygen’s general manager Brad Stankey, you run the risk of hypoxia. If you’re using a mask and take it off to eat a sandwich, there’s a risk, according to Dr. Brent Blue, that you’ll become hypoxic and won’t put it back on.

We agree that a mask is increasingly necessary at altitudes above 18,000 feet—and strongly recommend its use—however, no matter what you use, what’s most important is continuing to make sure the oxygen is getting into your bloodstream.

of producing it, there has been no difference between aviation, medical and industrial oxygen—which means that the least expensive place to purchase it is at your local welding shop. Oxygen used for aviation is not some magical, drier form of the gas even though requirements in

FAR Part 135 for “aviator’s breathing oxygen” prescribe some testing in the supply chain. There are no such requirements for Part 91 operations.

PORTABLE SYSTEMS

A portable system truly is—you can carry a four-place system in a bag. It

consists of an oxygen bottle, a regulator that reduces the pressure of the compressed oxygen from the 1800 to 2100 PSI range (depending on the bottle) to a usable range, some sort of flow control device, tubing and either an oxygen mask, standard cannula or a type of conserving

SELECT 20-22 CUBIC-FOOT PORTABLE OXYGEN SYSTEMS COMPARED

SUPPLIER	FLOW METER?	MASK OR CANNULA?	TWO-PLACE PRICE	FOUR-PLACE PRICE
Aeromedix	2-place basic uses single regulator for flow control; 2- and 4-place advanced uses individual flow meters	Oxymizer cannulas and 1 mask	Basic - \$495; with flow meter - \$625	\$730
Aerox	Individual flow meters	Oxymizer cannulas and 1 mask	\$632	\$823
Delta Air-King	2-place basic uses single regulator; 2- and 4- place advanced uses individual flow meters	Regular cannulas and 1 mask	Basic - \$435; advanced - \$525; with Oxymizer cannulas - \$575	\$625; with Oxymizer cannulas - \$675
Mountain High	Individual flow meters	Conserving cannulas and 1 mask	\$875	\$1070
Precise Flight	Individual flow meters	Same number of masks as cannulas	\$860	\$960
Skyox	Pilot controls flow for all users	Oxymizer cannulas and 1 mask	\$563	\$633

cannula of which the Oxymizer is most common. A conserving cannula rebreathes a portion of the oxygen via a bladder in a plastic mustache device or pendant arrangement. The normal rule of thumb used for planning oxygen use per person is two liters per minute or 120 liters per hour for either a cannula or mask. A conserving cannula cuts that rate at least in half.

We found standard cannulas for under \$10 and Oxymizer conserving cannulas for under \$40. Basic oxygen masks were advertised for as low as \$11. However, if you want a mask with a microphone in it, so you don't have to shove the mask out of the way to talk with ATC, plan on at least \$450.

FLOW

There are two general methods for regulating oxygen flow in portable systems: The continuous flow method uses a regulator set at a constant flow rate that is a compromise. It's good for up to about FL250, but more than enough at lower altitudes. Most portable systems include a flow meter to slow the flow at lower altitudes. An altitude adjustable system

has a control on the regulator or flow meter that allows the user to set the flow to what is appropriate for the altitude of the airplane.

No matter which flow method is used, there should be an indicator in each user's line to show if there is oxygen flowing to the user. Most use green to show flow and red to show no flow—caused by anything from an empty bottle, the regulator turned off to a kink in the oxygen line.

BOTTLES

Our survey of purveyors of portable oxygen systems showed that bottles are available in a wide range of weights, sizes and capacities. To narrow it down for the chart above, we looked at 20-22 cubic foot bottles because they provide enough oxygen

for an extended round trip without refilling and aren't so big they require a major effort getting them in and out of the airplane. In our conversations with suppliers we found that every single one was enthusiastic about talking oxygen systems—at a level that surprised us, and we talk to a lot of product manufacturers.

We strongly recommend that when you consider a system, call and talk with the supplier about your needs and flight profiles so that you can tailor the system—especially the bottle size—to your needs.

We found that regulators came in different flavors in terms of number of outlets and ability to adjust oxygen flow for the number of users on the system.

The flow meters offered for the



Clockwise from lower right: Delta Air-King basic portable system, mustache-style Oxymizer cannula, pulse oximeter registering 96 percent blood oxygen saturation and Mountain High Oxygen Systems' Electronic Demand System pulse-demand flow regulator.

OXYGEN CANNULA ON YOUR HEADSET

There are a few challenges involved with using a cannula for your oxygen supply. Figuring out how to wear one the first time can become low comedy. Digression—the preferred method is for the splitter to go under your chin, the two tubes are tucked behind your ears and the cannula is tucked into your nose, with the tab on the opposite side of the nasal tubes pointing downward. The slider at the splitter is moved upward toward your neck to tighten the assembly, but not so tight that it's uncomfortable. The alternate method is to place the nasal tubes in your nose, tab down, and run the tubes along either side of your head, above your ears. The slider at the splitter is tightened behind your head.

Putting on a cannula while wearing a headset means removing the headset and then juggling the cord and the cannula tubes while hoping you don't miss an important call from ATC.

There has to be a better way.

Some years ago Mountain High Oxygen Systems came up with an oxygen cannula that can be mounted on a headset. It recently released an upgraded version, the E-Z Breathe II Boom Cannula. Having wrestled conventional cannulas for years, we decided to give it a try.

The installation instructions, both text and video on the website, are clear and complete.

The boom is mounted to a headset earcup—it can mount from the left or right—via a ball mount attached with an adhesive foam pad. The boom has a thumb friction screw to keep it firmly positioned on the ball mount.

The (non-conserving) cannula

itself has copper wires embedded in it that allow it to be twisted as needed—it slides in and out as well—to fit the wearer's face. We found the cannula easy to adjust, although a mirror proved handy to get it right the first time. On a conventional cannula we're used to tightening the slider so the nasal tube section is firmly against our face—it took a bit to adjust to the nasal tubes not

being held tightly against the base of our nose, but we found we liked not having cannula tubes strapped against our head.

We also liked being able to rotate the cannula boom up out of the way—it didn't interfere with the boom

mic. That meant we could get everything set up for oxygen use prior to takeoff with the cannula boom rotated up.

Once it was time to go on oxygen, it was only a matter of rotating the boom down and inserting the nasal tubes—no pulling off the headset and wrapping cannula tubes around our ears.

On descending below oxygen altitudes, it's only a matter of shutting off the oxygen and rotating the cannula boom out of the way. You don't have to either pull off your headset or decide to leave the cannula in place until landing.

We stow our headset in a small case between flights, and found it was easy to remove the E-Z Breathe II from the ball mount and store it, still attached to the oxygen supply tube, with our oxygen gear.

For \$99 from Mountain High, we think the E-Z Breathe II Boom Cannula is worth it for anyone who uses oxygen regularly. The kit includes a spare cannula and adhesive foam mounting pad.



systems we surveyed are a rotameter-type design—they're sometimes called floating-ball meters. Most are made up of a clear plastic or acrylic (preferred) tube with unmeasured oxygen from the regulator entering one end and a metered flow to the cannula/mask coming out the other. The flow is adjusted using a thumb-screw needle valve that suspends a ball in the plastic column of the flow meter corresponding to a scale calibrated in altitude on the side of the column.

Carrying cases are offered as standard with some systems; for others they are an extra-cost option. Depending on where you intend to put the bottle, a carrying case may or may not be worth the money. Some users told us that they put the bottle in a seat back, and save money by using a fabric sack they had around home to carry the system around.

In our survey, we priced two- and four-place systems. As we did so, we noted that some suppliers recognize that a number of users only need oxygen for the pilot and one passenger and then only for short periods of time, so they offer some very basic two-place systems at attractively low prices.

•**Mountain High.** We consider Mountain High to have one of the most sophisticated systems on the market. We particularly like the regulator it offers; it has four ports with snap-in connectors that all exit the top facing in the same direction. It easily allows for from one to four users. An owner who buys the system for just two users can easily expand it by simply purchasing tubing, flow meters and cannulas.

Mountain High also offers a pulse demand oxygen system (referred to as Electronic Delivery System) that will plug into virtually any portable oxygen system. It replaces the flow meter and reduces wasted oxygen by sending a measured pulse of oxygen to the individual user when he or she breathes in. The data published on Mountain High's website shows that using a minimizing cannula cuts oxygen use by more than half—the Electronic Delivery System (EDS) reduces that by another 30 percent.

At 15,000 feet its 22.8 cubic foot tank provides 6.3 hours of oxygen for a single user with a mask or cannula, 14.8 hours with a minimizer

Standard oxygen masks are inexpensive—plan on \$10 to \$20. However, if you want one with a microphone, right, plan on spending north of \$450.

cannula and 19.2 hours with a mini-mizer and EDS.

- **SkyOx.** SkyOx keeps the cost of its units down by not providing individual flow meters for each user. A single flow valve adjusts the flow of oxygen so that it is the same for each user. While we prefer individual flow meters as oxygen use is not one-size-fits-all, we do like that the flow does not have to be adjusted when a new user plugs in to the system. Each SkyOx system comes with Oxymizer cannulas and one mask.

- **Precise Flight.** One of the innovators in the general aviation oxygen field, Precise Flight not only offers a range of packages for portable oxygen systems, it has also developed the mechanical (no batteries required) X3 Demand Conserver. It supplies oxygen when the user demands it—breathes—and the company claims it will increase oxygen duration at least 300 percent. The price is \$799 for a unit that can be used by one or two users.

Precise Flight is the only supplier we found that provides the same number of masks as it does cannulas with its systems. It is also the only supplier we found that has a flow meter that can be used for regular cannulas and masks as well as oxygen-conserving cannulas—its A-5 variable area flow meter.

- **Aeromedix.** Aeromedix offers a basic, two-place system with Oxymizer cannulas for a rock-bottom price of \$495. It uses a simple splitter to provide oxygen to two people—there is no individual flow control. Adding its proprietary flow control meters ups the price to \$625.

- **Delta Air-King.** At \$435 for its most basic two-place system, Delta Air-King was the lowest price portable system we found. It has no flow meters and includes only standard cannulas and one mask—nevertheless, it delivers oxygen where and when it's needed and can be upgraded easily. Moving up to Oxymizer cannulas and individual flow meters won't break the bank.



Delta Air-King also offers two different oxygen headsets—the EZ-Arm headset. Neither is a headset that has earphones and a mic; each is a headset in the sense that it has a clear headband that goes over the user's head and has a boom that curves around the front of the user's face, supporting either a nasal cannula or oxygen diffuser. The price is \$25 for either version. It appeared to us that it would interfere with a traditional earmuff headset, although would probably be usable with an in-ear style headset.

- **Aerox.** We like that Aerox includes individual flow meters in all of its systems, including its basic two-place unit. It also has a wide variety of oxygen bottles, making it easy to fine-tune the system to the

user. The regulators are equipped with push-pull connectors that simplify plugging in or removing users and straightening out tangled oxygen tubes. Unfortunately, we found the website to be surprisingly short on details of its systems.

CONCLUSION

We were impressed by the number of suppliers, the extent of the selection and quality of the systems available. We recommend that if you regularly fly above 6000 feet, that you explore purchasing and using a portable oxygen system. Dr. Brent Blue told us that pilots who have been flying above 6,000 feet should at least have oxygen available for 10 minutes prior to landing or shooting an instrument approach. We think that's wise.

CONTACTS...

Aerox
207-637-2331
www.aerox.com

Aeromedix
888-362-7123
www.aeromedix.com

Delta Air-King
866-737-7247
www.deltaoxygen.com

Mountain High
800-468-8185
www.mhoxigen.com

Precise Flight
800-547-2558
www.preciseflight.com

Sky Ox
800-253-0800
www.skyox.com

Tecnam Astore: An LSA, But Barely

That's because its performance, avionics and options make it rival certified aircraft in everything but price.

by Paul Bertorelli

Let's drive the final stake through the heart of this idea: Light sport airplanes would sell better if they were cheaper. And to pound the stake firmly home, we'll use the airplane we're reviewing in this report, the Tecnam Astore, as the hammer.

When the Astore was rolled out at the European Aero show in 2013, we didn't pay much attention to either the price or the market intent. It looked like just another LSA in a swarm of LSAs. But while we weren't looking, the Astore has become a best seller, at least for Tecnam, if not in the larger universe of light sport airplanes. Right out of the gate, the

Astore—
which

means Goshawk in Italian—was to be pitched to the upper tier of the light sport spectrum and it sure enough is, with upscale avionics and an interior as luxe as buyers might wish.

If there's any surprise to this, it's that many Astore buyers are step-down owners, ditching their Cirri, Barons and Mooneys for something that's sporty, with respectable speed, but a heck of a lot cheaper to own.

CERTIFIED AIRPLANES

Tecnam is somewhat unique in the world of light sport aircraft, in that it's a company that produces a line of certified, standard-category aircraft, but that also has a light sport line. It's been in business since 1948. The company's Capua, Italy, factory built 191 airplanes in 2015, nearly half of which were certified

CHECKLIST



Tecnam doesn't pretend this is a minimalist airplane. It's top tier.



Avionics, including ESP-capable autopilot, equal certified aircraft.



The Astore pushes the weight limits for a legal LSA.

aircraft. It will soon certify a new Lycoming-powered twin for the air taxi market, the 2012 Traveller.

The Astore fits into this mix as part of a remodeled line of light sport aircraft. Because Tecnam markets in a world with a patchwork of light aircraft approval rules, its product line is complex. But the company has in mind two offerings in both the high- and low-wing categories and at two price points.

In the low-wing category, the P2002 Sierra is the entry-level offering while the Astore represents the upper tier. For the high wings, the P92 Eaglet occupies the low-price point, while the P2008 is the luxury model. Tecnam builds other variants for countries with different weight and approval rules.

Indeed, even the Astore isn't sold



everywhere. While it meets U.S. light sport standards, it's not available in Canada because it's too heavy for the Canadian Advanced Ultralight rules, which have a 1232-pound weight limit, compared to the U.S. 600 kg or 1320-pound limit.

While we're discussing weight, the Astore has a lot of it. Under U.S. rules, the minimum payload for a two-place light sport aircraft is determined by a formula that includes horsepower. For a 100-HP airplane, the minimum is 430 pounds, meaning the maximum empty weight is 890 pounds. The Astore we flew was at least one pound over this, but it gains a 7.5-pound credit for having the 115-HP Rotax 914.

Still, with two 200-pounders aboard, the Astore has a bare 30 pounds remaining for fuel or about five gallons. Weight can be shaved by eliminating equipment, but buyers simply don't do that. We suspect they ignore the 1320-pound limit.

"We make no apologies for the higher weight," Tecnam's director of sales, Shannon Yeager, told us. "This airplane is just built to a higher standard," he adds. That means it has more structure than the typical LSA clipped to a minimum and uses much of the same hardware and fixtures used in the company's certified aircraft.

OPTIONS, OPTIONS

Given the options list, Tecnam doesn't even pretend that the Astore is a minimalist airplane intended to compete on price. It presents more as a luxury sport sedan that a would-be buyer can customize with a dizzying range of choices. For engines, there are three options: the Rotax 912ULS and 912 iS, both at 100 HP and the 115-HP turbocharged 914. Since the 914 became available about a year after the airplane appeared, it's the overwhelming choice of buyers, Yeager says.

There are custom paint jobs and three levels of interior trim, including seats that slide fore and aft—a relative rarity in LSAs—and headrests that pivot to allow access to the baggage compartment. Another nice big-airplane touch is an LED courtesy lamp in the baggage compartment, which has an exterior door and a capacity of 77 pounds.

Avionics options are generous and rival anything being offered in certi-

fied aircraft, but at a fraction of the cost. The base offering is a European VFR option that includes just basic gauges, but Yeager says he doesn't allow these into the U.S. to protect the secondary market.

The minimal option for U.S. buyers is a six-pack with a Garmin 796, a GTR 200 comm, a GTX 327 transponder and an audio panel. With the 100-HP 912ULS option, that package retails for \$173,420. A Dynon Skyview SV1000 retails for \$180,320 and a Garmin G3X suite sells for \$181,470.

The 912 iS engine adds another \$9,142 and the 914 adds \$23,690. Since buyers tilt toward premium packages, including the engine, the typical invoice on an Astore is just north of \$200,000. Also, don't let it escape notice that the price Delta between the lowest- and highest-priced avionics packages is only \$8000. No surprise most buyers pick the premium package. Yeager says this gives the airplanes more appeal on resale, which he stresses is a concern for Tecnam.

ERGOS, CABIN

One thing we found appealing about the Astore is its flat cabin floor. Ingress is from the front of the wing and once aboard, you can easily walk across to the other side inside the cabin. The canopy, when fully open, doesn't obstruct this and there's no forward pedestal to intervene. The sliding seats are readily adjustable and will accommodate pilots taller than six feet plus.

The Astore's premium avionics package, top photo, is the Garmin G3X touch. Newer versions lose the steam gauges in favor of dual ADAHRS. Interiors include leather seats that slide for adjustment, middle. Exterior door accesses 77-pound capacity baggage area, bottom photo.



The step over the cabin sidewalls isn't too daunting, but you'll need to grip the forward cockpit rail to ease the butt drop into the seat. The Astore could do with a dedicated handle for this, in our view.

The sliding canopy works well and has three locks, one in the center and



The 115-HP Rotax 912, left, is the most popular engine option. Castering nosewheel is protected by a beefy oleo strut inside the engine compartment.



two on each side. It can be opened for taxi, but not in flight and hasn't been tested for inadvertent opening while airborne. Whether it would depart the aircraft is an unknown, so securing it before takeoff is a must. The Astore can be equipped with toe or hand brakes, but for U.S. models, toe brakes are the only option. These make for precise ground handling, albeit we found them a little grabby.

There's no nosewheel steering, just a castering wheel. Tecnam is clearly aware that LSAs have developed a reputation for having tender feet and they've addressed this in two ways. First, the nosegear has a beefy oleo-pneumatic strut to protect the firewall against damage from a hard landing and the mains are spring aluminum hinged and mounted in rawhide liners to absorb hard bumps.

The Astore has a big-airplane look and feel inside, with a robust, curved stick to clear the feet and high-quality

switchgear and controls throughout. The throttle is mounted on a shallow pedestal on the floor, which also houses an accessory power socket and the fuel switch valve. It has two positions to two 14.5 gallon tanks; no both. Rotax engines have return fuel lines and switching the tank also switches the return to the same tank, eliminating the overflow risk of pumping the return into a full tank.

Despite the large canopy, visibility from inside the cockpit is so-so; it's good out the sides but is partially blocked forward by the canopy rail. With a little contortion, reaching stuff in the baggage compartment is possible, if it's not positioned too far back. Tecnam tended to ventilation with large eyeball vents in the panel that spew gales of air without howling, which was a problem in the P2008.

The Astore we flew was equipped with the Garmin G3X package and two backup steam gauges—an altimeter and ASI—between the two screens. Yeager said the newest Astores eliminate this in favor of dual ADAHRS for the G3X, a level of redundancy heretofore found in expensive certified aircraft. That the G3X has a full-featured autopilot with envelope protection adds to the sense that it's a sophisticated, high-performance cruiser in the guise of an LSA.

PERFORMANCE

And what kind of performance? With the 914, the Astore is a 120-knot airplane on 4.5 to 5 GPH. If U.S. rules allowed the constant speed prop that European rules do, it would cruise at 130 knots on the same fuel. The model we flew had a ground-adjustable Sensenich prop set for climb, which it did at a brisk 1200 FPM initially. It gives up 200 feet of that if the prop is set for cruise, but it gains a few knots in level flight. We saw about 118 knots TAS at 3000 feet.

Because Tecnam's heritage is certified aircraft, the company's LSAs can be relied upon to fly like certified air-

planes and the Astore does. Its control forces are pleasant without the hair-trigger lightness we find in so many LSAs. Trim is all electric and there's a bendable rudder tab for yaw trim. In slow flight, the Astore has a predictable phugoid recovery when displaced from a trimmed airspeed, but we found this less so at higher speeds, where it was sluggish to recover from a hands-off pitch-down displacement.


When flaps are deployed—electric, continuously positionable Fowler types—only minor trim adjustment (or none) is necessary. The published full-flap stall speed is 38 knots and the stall announces itself with an unmistakable burble before evolving into a mild parachute mode. For landings, we used approach speeds in the mid-50-knot range, but we suspect more familiarly with the airplane would make 49 knots practical. That's 1.3 Vso.

CONCLUSION

We like the Astore not so much for what it is, but what it represents: an LSA taken to the edge of what's possible in performance and capability. Might as well say it: Given the avionics, autopilot and performance, the Astore is a mini Cirrus at less than a third the price and the fuel flow. Yes, it is weight limited. And yes, we're tired of giving hollow lip service to observing the arbitrary 1320-pound LSA limit, which is long overdue to be eliminated or raised.

Tecnam points out that the Astore, in its present form, could be a certified airplane and would have a gross weight considerably above 1320 pounds, as it would if placed into the experimental category. It would require no additional structure or modifications. We think owners probably realize this and not to encourage ignoring regulations, but we can't get too exercised about flying at the higher weights.

The fact that Tecnam finds many buyers of the Astore are stepping down from capable, expensive airplanes for reasons other than medical loss tells us that buyers see value in a \$200,000-plus LSA. We can't recall anyone ever suggesting the market would go this way, but it clearly has.

 See a video reviews of the Astore at <http://tinyurl.com/j95ht2a>

CONTACT...

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Totes For Gadgets: Sporty's, MyGoFlight Top

Who needs a bulky full-size flight bag to carry a tablet computer and small electronics? We tried several space-saving alternatives that are built to last.

by Larry Anglisano

It used to be that the perfect flight bag had to accommodate several thick binders of paper charts, heavy headsets, a bulky portable GPS, oversized flashlights and anything else you could squeeze into it. It's different now.

These days, we strut to the airfield armed with a tablet computer loaded with electronic charts, plus a handful of other small gadgets that might get lost in the bottom of a large flight bag. The solution? Downsize the bag, and there are plenty of aviation-specific solutions for doing so.

Partly for my own amusement, but mostly with your budget money in mind, I collected several totes that won't hog valuable cabin space, but are smartly designed to tame the clutter of modern gadgetry. Here's the summary.

WELCOME TO MY WORLD

Unlike Joe Pilot, I've never been a guy for flight bags. Instead, I cram my flying stuff into a large backpack that serves double duty for hiking and motorcycling. The problem with that is small items get lost in the bottom and are difficult to retrieve while flying. That's where these aviation-purposed totes shine. It's all about dedicated compartments.

For most flying missions and before leaving the house or office, I pack: a Bose A20 headset, an iPad Mini and the Flight Outfitters fold-down kneeboard for housing it, an

Yes, all that stuff fits in each bag, except the smaller MyGoFlight PLC Lite because it doesn't have side pockets. The PLC Sport does.

iPhone 7 smartphone, my wallet, two action cameras with mounts, extra batteries and charging cables all housed in a soft storage bag, sunglasses, a Smith & Wesson Captain's flashlight, a pulse oximeter, a Garmin GDL39 portable ADS-B receiver (or lately, the SXAR-1 SiriusXM receiver), a ball cap, a bottle of water, packaged snacks (granola bars, usually), a bottle of pain reliever, a bottle of hand sanitizer and for long hauls, a magazine or two. When it's cold, I'll bring a warm hat, gloves and a neck warmer. I don't carry my portable radio, but I should.

To be fair, I probably carry more space-eating camera gear than other pilots because a lot of my missions are for shooting photos and video. If

that sounds like a lot of stuff to pack into a medium-size tote, it really is. When I'm packed, there is no room for much of anything else.

To keep this trial contained, I limited it to six totes (there are plenty more), so if one works well for you, I want to hear about it. I consulted with a couple of mail order suppliers, including Sporty's and Pilot Mall, plus fellow pilots, to get a feel for what bags in this size class are the most popular sellers.

SPORTY'S HP IPAD BAG

The HP iPad Bag is part of Sporty's new Flight Gear HP collection, which also includes an update of the





The MyGoFlight PLC Sport, left, has padded tablet pockets and convenient see-through mesh pockets. The Sporty's iPad Bag, right, has a cable feed-through system for charging the tablet. It also has dedicated pockets for a flashlight and a water bottle. The Brightline FLEX system at bottom of the page enables you to build your bag.

popular full-size Captain's model. Realizing that pilots don't carry the stuff they used to, the new bags are 30 percent lighter than the previous Flight Gear models, but are stronger, have reinforced handles and come with a three-year warranty. If you own any vintage Flight Gear bags (I still have the original from the 1980s), you likely recognize the excellent build quality.

The \$69.95 iPad Bag, which measures 12 inches wide by 7.5 inches deep and 13 inches high, focuses on organization and of course, housing an iPad and its accessories. The main compartment measures 11 by 9 by 5 inches and has a headset hangar. This feature alone makes the bag my favorite of the group. I generally keep

my Bose A20 in its carry case, but the iPad Bag offers enough protection so it doesn't get crushed. There are two internal mesh zipper pockets, two mesh side pockets, four AA battery pockets and four webbing loops for fastening stuff with carabiner clips.

The outside has a transceiver pocket, phone pocket, chart pockets (good for my magazines), flashlight and fuel tester pockets, plus a water bottle holder. On the inside, a padded tablet pocket is large enough for a full-size iPad and accommodated my foldable kneeboard. There is even a charging cord pass-thru (for connecting a power supply/charger) from the main compartment to the iPad pocket.

Sporty's offers optional custom embroidery and accessory pockets called Gear Mods, which are modular storage compartments that can be moved from one bag to another. Contact www.sportys.com.

MYGOFLIGHT PLC BAGS

I own MyGoFlight's flagship PLC Pro flight bag, which doubles as a backpack, and it has survived serious abuse (I backed over it with my truck one dark morning). Plus, it is one of the few smaller bags that can accommodate my 15-inch MacBook computer. The other thing that impressed me was the build quality and in particular, the strength of the zipper system. Pack any bag beyond its capacity and there's a chance you'll break a zipper, but not on the PLC. That's why I was anxious to try the company's \$139.99 PLC Sport bag, which is essentially a scaled down version of the Pro.

The PLC Sport measures 14 inches high by 13 inches wide and 6 inches deep. It has two main compartments

(instead of three compartments on the Pro) and is large enough to carry one headset, a full-size tablet computer and a portable transceiver. One of the padded pockets can accommodate a 13-inch laptop computer, although I was able to squeeze in my iPad Mini and a small MacBook.

The main compartment easily accommodated my Bose headset, but I was sold on the headset hangar feature in the Sporty's bag. One feature I like about the PLC Pro is the see-through mesh pockets and the Sport has them, too. This makes it easy to locate stuff you need quickly, like sunglasses, a wallet and keys, for example. The quick access pocket at the top of the bag proved convenient for storing snacks, hand sanitizer and a bottle of pain reliever—all stuff you don't want to be fishing for on the inside of the bag while flying.

I was able to easily fit all of my gear into the PLC Sport, with the exception of the action camera mounts. Since I don't carry a transceiver, I used the deep radio storage pocket for storing my ADS-B receiver, pulse oximeter and two actions cameras. Three other side pockets provide storage for batteries and small electronics, while the main front compartment has plenty of storage for pens, business cards and even a smartphone.

Missing on the PLC Sport is an external water bottle holder—a capability that's important to me. Actually, the transceiver pocket can hold a water bottle, but not both. Speaking of water, the exterior of all the PLC bags are made from sailcloth, making the bags water resistant.

Measuring 14 inches high by 11 inches wide and 6 inches deep, the \$99.99 PLC Lite is the smallest in the series and while it can accommodate

one headset, a full-size tablet and a 13-inch laptop computer, it only has two main compartments. Unlike the PLC Sport, the Lite doesn't have the side pockets or the quick-access pocket. It was a deal breaker for me, but if you only carry a headset, a tablet and small accessories, it should work. MyGoFlight says the Lite is a starter flight bag and that's an accurate description.

MyGoFlight offers optional embroidery and the LugLoc luggage locator system (\$85) for all of its bags. Contact www.mygoflight.com.

FLIGHT OUTFITTERS

Ohio-based Flight Outfitters was founded in 2014, but got its start making high-end bags for the law enforcement, firefighting and EMS industries. What impresses me the most about Flight Outfitters is the dedication to improving its products, which includes sending product samples to industry professionals, accompanied by a comment/feedback card. Its customer service folks are friendly and easy to talk with—that means a lot.

Two bags caught my eye: the \$99.95 Lift, a bag resembling the Sporty's iPad Bag—and the \$79.95 Thrust, which is a sling pack design.

The Thrust turned out to be more accommodating than it appears on the outside, which measures 22 inches high by 11 inches wide by 6.5 inches deep. The bag has a carry handle and also includes a single padded shoulder strap that can be adjusted for use on either shoulder.

One side pouch can hold a water bottle (or transceiver) and the other can hold a fuel tester or small flashlight. The bag's main storage capacity is in four internal pockets, which are lined with MA1-inspired bright orange fleece—the largest pocket measuring 17 inches high by 10.5 inches wide by 1.5 inches deep. That's plenty of room for a mid-size laptop computer and full-size tablet—I was able to store my iPad Mini with the kneeboard and a small MacBook inside.

The second largest pocket is 12.5 inches high and 10.5 inches deep, which is large enough to house two headsets, or in my case, one headset



The Flight Outfitters Lift bag, upper left, has a braided wire reinforced handle and enough space for a headset, tablet and transceiver. The Thrust, top, is a cavernous sling bag that could work better if it had two straps.

and all of my camera gear—including the action cam mounts. Another 11-inch pocket is large enough to hold my ADS-B receiver, gloves, hat and wallet. A small zippered pouch at the top of the midsection of the bag worked well for holding keys, pens and a couple of granola bars.

The Thrust also has four internal mesh organizers for housing cables, charging cords and spare batteries, although the bag has a AA battery holder in one of the compartments.

While it has a custom molded padded back, I think the Thrust could be better if you can wear it like a traditional backpack. I'm not a fan of sling packs, especially when fully loaded.

The \$99.95 Lift measures 12 inches high by 10.5 inches wide by 9 inches deep and has three main pockets. If you still carry paper charts, the bag has a quick-access chart pocket on the front that I found useful for storing a magazine. There is also a water bottle or transceiver holder, plus a side pocket designed for a small flashlight.

Don't plan on storing a laptop computer inside of the Lift; it's designed to carry a tablet computer and I was able to squeeze in the iPad Mini, plus the kneeboard. Like the Thrust, the Lift's pockets are lined with orange fleece, which makes items easy to spot even in a dimly lit cabin. The bag also has four internal mesh organizers, a key clip, plus elastic loops for storing batteries. Contact www.flightoutfitters.com.

SATURATED MARKET

As I mentioned earlier, there are

more available options for carrying your stuff and the flight bag roundup article in the February 2015 issue of *Aviation Consumer* is worth a read.

During my trials, I went flying with a friend who invested big—over \$200—in the Brightline Bags (www.brightlinebags.com) FLEX. The FLEX is versatile because it allows you to select specific compartments for the stuff you need to carry for a given mission. For instance, for a basic mission you may only need to pack a headset, a flashlight and other small stuff. The system is designed to Velcro or zip certain compartments together to customize your own bag.

Flight bags are such personal items that one size won't fit all, so it's tough to say which one will work best for you. Of the smaller totes I tried, both the Sporty's HP iPad Bag and the MyGoFlight PLC Sport worked the best for the stuff I carry. Moreover, my experience living with the larger MyGoFlight PLC Pro for a couple of years—plus the smart features in the Sporty's bag—made it easier to declare them as the winners.

You Tube See a video review of flight totes at <http://tinyurl.com/j95ht2a>

More ForeFlight WX: SiriusXM's SXAR-1

If free ADS-B weather isn't enough, you can now play SiriusXM satellite broadcast weather on the popular ForeFlight tablet app for 40 bucks per month.

by Larry Anglisano

Just when we thought subscription-based SiriusXM satellite broadcast weather data was totally eclipsed by free ADS-B, a new SXM interface surfaces from ForeFlight. More interesting is that ForeFlight is the exclusive app for interfacing the Appareo Stratus portable ADS-B weather and traffic receiver.

In a market saturated with ADS-B gear, will the market tolerate another glareshield-mounted portable weather receiver and the monthly subscription that tags along? ForeFlight believes it will—partnering with SiriusXM with an interface for SXM's SXAR-1 receiver. We've been flying with the setup for a few months. Here's an overview.

SAVED FROM EXTINCTION

That's possibly what ForeFlight has done with this interface. SiriusXM

launched its SXAR-1 aviation receiver a couple of years ago with its partnership with WSI and the Pilotbrief Optima iPad app, a not-so-popular program that supports WSI's own weather data that's delivered by SiriusXM. We tried the interface and were impressed with the weather graphics and overall feature set, but felt that a third-party app interface and more navigation features could make it better. ForeFlight is a logical fit, in our estimation.

At 5.0 by 2.7 by 1.2 inches, the SXAR-1 receiver is roughly the size of a fat smartphone and weighs roughly one pound. It has a nonskid base for resting on the glareshield and is powered by a USB-rechargeable battery. We've seen endurance as high as seven hours between charges. What

CHECKLIST



The SXAR-1 weather data overlays on ForeFlight just like FIS-B weather does.



But, SiriusXM will work on the ground, while FIS-B generally only works in the air.



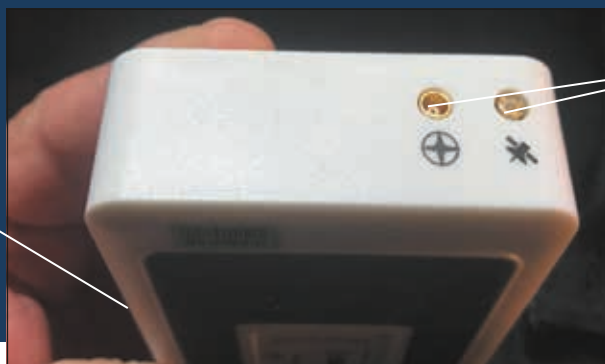
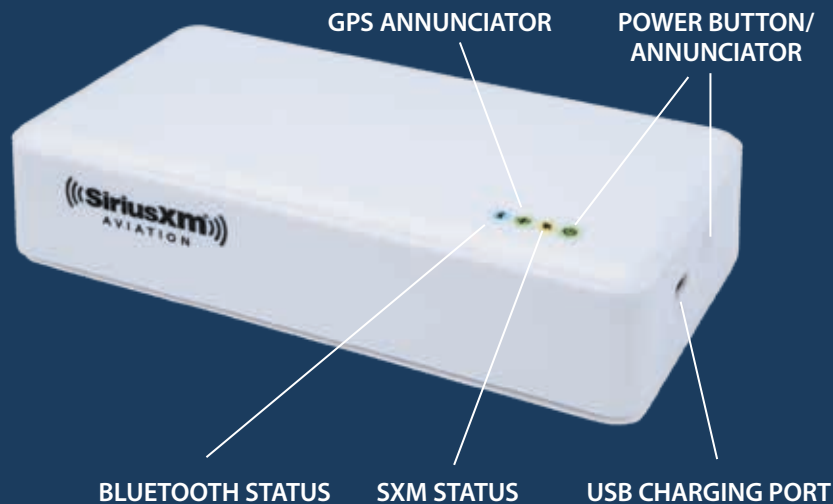
For lighter missions, free ADS-B data still wins over SXM's \$40 monthly fee.

that means is you generally won't have to string a power cable over the glareshield for shorter trips. It works with iPad 2 and later tablets via Bluetooth. There are inputs for optional external GPS (ForeFlight Mobile can display GPS information from the receiver) and SXM antennas, but we never needed to use them—even when the device was stashed in a backpack. The SXAR-1 receiver



The SXAR-1, left photo, has reliable SiriusXM reception, plus wireless Bluetooth connectivity with current iPads running ForeFlight 8.1 or greater.

SXAR-1: WHAT'S IN THE BOX



SIRIUSXM FOR FOREFLIGHT
STANDARD WEATHER PRODUCTS \$39.99 MONTHLY FEE
High resolution composite (NEXRAD) radar
High resolution base reflectivity radar
NEXRAD storm cell attributes
Lightning (cloud-to-cloud, cloud-to-ground)
Temporary flight restrictions
Graphical winds/temps aloft
AIRMETs/SIGMETs/AIREPs/PIREPs
METARs/TAFs

will only connect to one tablet or smartphone at a time.

Controls are limited to a power button and power cable input on the side of the case, plus four status annunciators on the top of the case. These show the status of power, satellite reception and Bluetooth connectivity. ForeFlight controls the brightness of the status lights for managing battery power and preserving night vision.

FOREFLIGHT 8.1 OR LATER

That's what you'll need to play the SXAR-1's received weather data, or at least part of what SiriusXM Aviation is broadcasting. The chart in the sidebar above lists compatible weather products—a new Pilot package developed for the ForeFlight app that's priced at \$39.99 per month. ForeFlight says that more weather products—and potentially an entertainment interface—are coming.

Since the SXAR-1 connects with ForeFlight via Bluetooth, and the

Stratus ADS-B receiver connects with Wi-Fi, you can interface both receivers at the same time, but not weather from both. The drill is to use the SXAR-1 for weather and the Stratus for ADS-B traffic, GPS, pressure altitude data and AHRS flight instrument data. ForeFlight says you can also connect Garmin's GTX345 Bluetooth ADS-B transponder while the SXAR-1 is connected (for ADS-B traffic display), but we didn't try it.

As has always been the case, SiriusXM satellite broadcast offers more weather data than ADS-B FIS-B. This includes cloud tops, cloud-to-cloud/cloud-to-ground lightning data and storm tracks with greater coverage (it will work on the ground) and tighter radar display resolution outside of the 250 nautical mile range. There are some coverage differences, too.

SiriusXM enables display of TAF data in the CONUS, Alaska, Canada, Mexico, the Caribbean and Hawaii,

while ADS-B displays TAFs within 250 to 500 nautical miles. ADS-B limits winds and temperature aloft within 500 to 1000 nautical miles. What you won't get with SiriusXM data is NOTAMs. With ADS-B, you'll see them within 100 nautical miles, plus special use airspace status within 250 to 500 nautical miles.

MORE TO COME

The SXAR-1/ForeFlight satellite weather interface won't be the only portable SXM choice. Garmin is close to releasing a new portable SiriusXM receiver of its own, which will advance the interface of its Aera 660 portable GPS navigator. It works with Garmin's GDL39, GDL88 and GTX345 ADS-B equipment, but not with the company's existing GXM42 receiver.

The SXAR-1 (sold through Sporty's and SiriusXM Aviation) is \$499 and SiriusXM is currently offering a \$200 rebate. Contact www.foreflight.com and www.siriusxm.com.

Action Cam Mounts: NFlight, MyPilot Excel

We found the best of these accessories to be exceptionally well designed and executed. You can find a mount for any application.

by Paul Bertorelli

When action cams became popular for aviation five years ago, mounting them inside or outside the cockpit was a challenge unmet. Not anymore. The sports cam aftermarket has devised dozens of ways to mount cameras just about anywhere.

We gathered up a gaggle of these mounts and put them to the test. While some are better than others, we found there's a competent mount for every purpose.

OUTSIDE MOUNTS

While duct or gaffer tape will fasten a camera to a strut, surely there must be a better way? And yes, there is. One is the **WingItMounts WIMGP-01** (\$119 from www.wingitmounts.com). The WingIt is hogged from a billet of aluminum and fits around the strut of Cessna 100-series



airplanes and other aircraft with similar struts. We found it will also fit on the trailing edge of 200-series Cessna struts, too. While easy to install, the WingIt's weak point is limited camera rotation in the longitudinal plane. You can fix that with an **SP Gadgets Swivel Arm mount**, which adapts to both the WingIt and the camera. (\$9.99 from Amazon.)

But a better choice, in our view, comes from **MyPilot Pro**. These mounts use an ingenious overcenter lock similar to a bicycle wheel quick lock to clamp the mount into a wing or tail tiedown ring. Quick and secure, the version that features a RAM arm (\$69.95 from www.mypilotpro.com) would be our first choice. For \$54.95, the company has a mount with just the standard GoPro bracket.

NFlightCam has a line of high-quality GoPro accessories including a pair of mounts that attach with the typical number 6, 8 or 10 screw used for inspection plates and other aircraft exterior hardware and trim. The kit has a cylindrical billet that screws to the aircraft surface, then the mount clamps to that.

Two versions are available, one with a RAM-type arm (\$79.99) and another with a stainless steel ball-and-socket arrangement (\$59.99). Note that the adjustable arm is not a RAM part, but is similar in design. We found these mounts to be exceptionally well made and secure on the aircraft. Contact www.nflightcam.com.

Worthy of mention is another product from RAM called the Tough Claw. It's intended as a large-tube clamp-type mount, but will function on small struts and other external structure. It worked well both inside

and outside the Cub. Prices range from \$33.49 to \$72.49, depending on size. See www.rammount.com

CABIN MOUNTS

Cabin and cockpit camera mounts generally rely on suction cups and our top pick, the **Joby mount**, has the best one we've used. It will stick like discarded gum to curved windshields or flat cabin glass with a single quarter



NavWorx ADS-B: Non-Compliance AD

Buyers are blindsided by the first proposed airworthiness directive against an ADS-B system. Worse is the FAA's deauthorization of NavWorx's production approval.

Staff report



Joby mount



RAM suction mount

twist of the locking ring. The fully flexible Gorilla arm is fitted with a standard 1/4-20 tripod fitting. It retails for \$29.95 from www.joby.com.

We found two also rans, one from RAM and another from MyPilot Pro. The RAM mount's suction cup isn't quite as easy to use or as strong as the Joby, but it works with all of RAM's accessories. The cup itself costs \$15.95 from various sources. You'll need the socket arms and camera adapter to fill out the system.

MyPilot Pro's suction mount consists of a three flexible suction cups and a center RAM mount to accept a ball accessory of any kind. It works best on flat surfaces, but will accommodate a mildly concave curved windshield. The so-called Spider Mount is available for \$49.95 from www.mypilotpro.com.

With the GoPro Hero 5 hitting the market this fall, NFlightCam is out with its own \$149.99 aviation bundle for that camera. We weren't able to obtain one for a review, but we'll examine it when it's available. Meanwhile, see our video for more complete information on camera mounts.

YouTube See a video review of cam mounts at <http://tinyurl.com/j95ht2a>

Just when some owners thought equipping for the ADS-B mandate was behind them, it has become more complicated. That's because in October 2016, the FAA issued an unapproved parts notification that affects certain ADS600-B systems (pictured below) manufactured by Rollett, Texas-based NavWorx. These are remote-mounted universal access transceivers (UATs) that were previously sold as mandate-compliant solutions for the upcoming 2020 ADS-B mandate.

As of early November 2016, sources estimated that roughly 800 U.S.-registered aircraft would be affected by what has become a proposed airworthiness directive for ADS600-B systems carrying part numbers 200-0012 and 200-0013, plus ADS-600-EXP systems with part number 200-8013. The proposed AD would prohibit installing the devices in a U.S.-registered aircraft, plus require removing any that are already installed.

The unapproved parts notification and subsequent proposed AD centers around the WAAS GPS engine used in the transceivers, which according to the FAA, are not certified per the governing TSO C-154c specification. In a statement made in its notice of proposed rulemaking, the FAA said that an unapproved software revision—which altered the system integrity level (SIL)—rendered the units non-compliant with the TSO and could communicate unreliable posi-

tion data to ATC and other aircraft.

The trouble for NavWorx surfaced when ADS600-B owners were denied payment of the FAA's \$500 ADS-B install rebate because the program only applies to FAA-approved and mandate-compliant systems.

In a statement on the company's website, NavWorx president Bill Moffitt said the AD may be rescinded or modified later in December 2016. One solution is to modify affected transceivers with the approved GPS engine used in 200-0112 and 200-0113-part numbered devices.

However, the situation gets worse. As we go to press, the FAA issued an emergency order suspending the company's authorization to manufacture the units because, according to the FAA, NavWorx has "declined on repeated occasions to allow FAA personnel to conduct required inspections."



AVIDYNE'S INVOLVEMENT

If you bought an Avidyne system—the SkyTrax100 ADS-B In receiver made by NavWorx—you can rest easy. Since it doesn't transmit any ADS-B Out data, it isn't affected by the proposed AD.

We've heard from readers who can't get through to NavWorx via phone or email, but we made contact with Bill Moffitt who assured us the company is working diligently on a solution.

We'll provide updates to this story on our Facebook page at <http://tinyurl.com/zkky79x>.

Piper Arrow

It's not great at any one thing, but it works well for training and regional travel.



At one time, a normally aspirated 200-HP Piper Arrow was our go-to aircraft for travel around the Northeast and occasional hauls from Connecticut to the Carolinas. While the Arrow lacked the excitement of a Mooney 201, it was stone simple to fly, had reasonable operating costs and most important to our mission—it delivered good dispatch reliability.

Those are compelling traits long recognized by flight schools who swear by them as relatively economical complex trainers. Plus, owners report happy relationships with the Arrow's combination of useful load and range. Through longevity and numbers, it may have replaced the Bonanza as the ubiquitous retractable single.

Since it's little more than a retractable Cherokee, the Arrow is a logical step-up airplane for pilots accustomed to Piper's fixed-gear four-seaters. Moving from one cockpit to the other, everything will be reasonably familiar, from gauge placement to systems to handling and procedures. That's no accident, of course: Offering a full line of airplanes was the basic marketing model for all of the

major manufacturers in the 1960s and 1970s. As they started out in two-seat trainers, pilots were encouraged to step up into similar four-place, fixed-gear models, then to retractables from the same bloodline.

While the market has changed, the Arrow soldiers on. It's a relatively ubiquitous airplane, available in many flavors ranging from the original, relatively sedate 180-HP version

to three pioneering designers, John Thorpe, Karl Bergey and Fred Weick, who were charged with developing an airplane that would compete with the Cessna 172. Introduced in 1962 as the Cherokee 150 and 160, the PA-28 gave Piper a badly needed shot in the arm in the low-end market. Cessna had a runaway success on its hands with the 172, and Piper's competition—the Tri-Pacer—was downright dowdy by comparison.

The original Cherokee did well, and was soon joined by the 180 and 235, giving Piper a strong lineup of fixed-gear singles meeting many missions. Since all Cherokees share the same basic airframe, the company was also able to realize some manufacturing economies.

By the mid-1960s, Piper began considering the PA-28 as a candidate to compete in the light four-place re-

The marketplace has declared the Arrow the runaway winner in terms of non-adjusted appreciation.

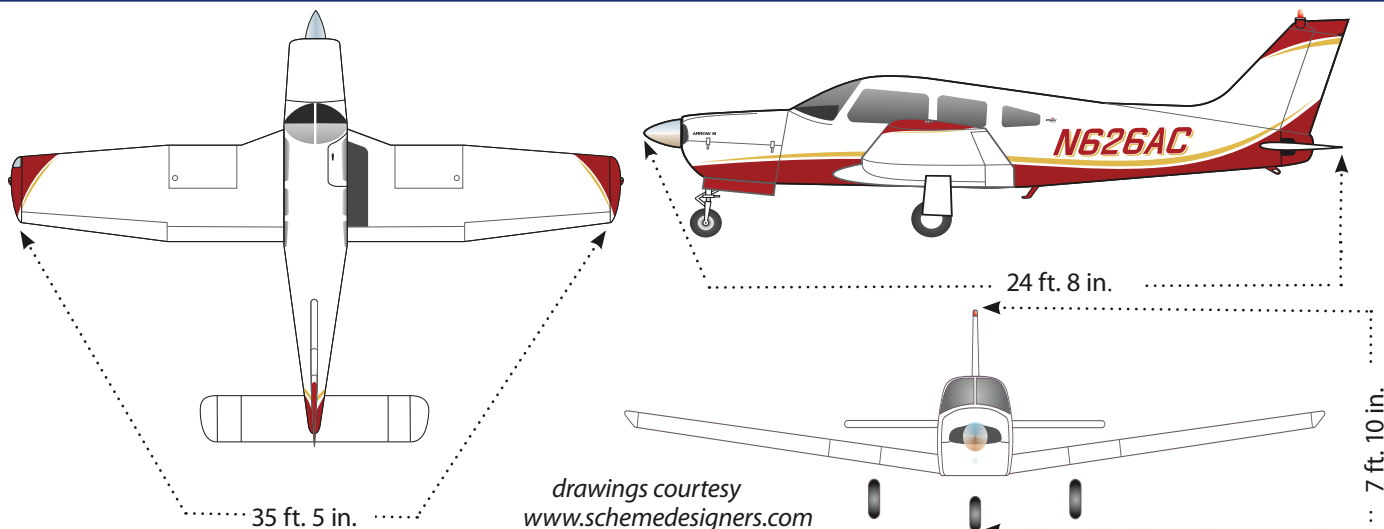
with its short, stubby wings to a fire-breathing, T-tailed, turbocharged version perhaps best known for heat-management and runway-hogging issues. Even Piper has a bad day. A few quirks aside, though, some version or vintage of the Piper Arrow may be the right airplane at the right time for a prospective owner.

HISTORY OF THE LINE

The original PA-28 owes its existence

Newer Arrows like the one in main photo have Aircraft Bluebook values that flirt with \$400,000. Models from the 1970s are in the \$60,000 price range.

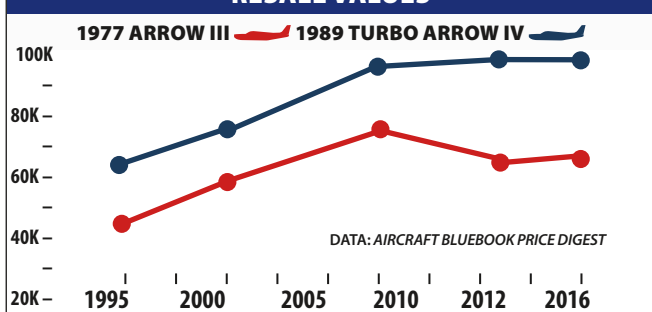
PIPER ARROW SERIES



PIPER ARROW SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1968 PIPER ARROW (180 HP)	LYCOMING IO-360-B1E	2000	\$25,000	50	1120 LBS	141 KTS	±\$41,000
1969 PIPER ARROW (200 HP)	LYCOMING IO-360-C1C	2000	\$27,000	50	1141 LBS	144 KTS	±\$43,000
1972 PIPER ARROW II	LYCOMING IO-360-C1C	2000	\$27,000	50	1127 LBS	143 KTS	±\$50,000
1977 PIPER ARROW III	LYCOMING IO-360-C1C6	2000	\$27,000	72	1113 LBS	138 KTS	±\$62,000
1977 PIPER TURBO ARROW III	TCM TSIO-360-F OR FB	1800	\$40,000	72	1208 LBS	172 KTS	±\$64,000
1980 PIPER ARROW IV	LYCOMING IO-360-C1C6	2000	\$27,000	72	1113 LBS	138 KTS	±\$69,000
1980 PIPER TURBO ARROW IV	TCM TSIO-360-FB	1800	\$40,000	72	1208 LBS	172 KTS	±\$74,000
1989 PIPER TURBO ARROW	TCM TSIO-360-FB	1800	\$40,000	72	1208 LBS	172 KTS	±\$108,000
2002 PIPER ARROW	LYCOMING IO-360-C1C6	2000	\$27,000	72	1113 LBS	138 KTS	±\$145,000
2012 PIPER ARROW	LYCOMING IO-360-C1C6	2000	\$27,000	72	1112 LBS	138 KTS	±\$350,000

RESALE VALUES

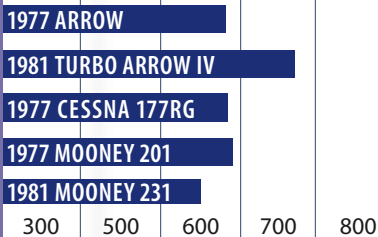


SELECT RECENT ADS

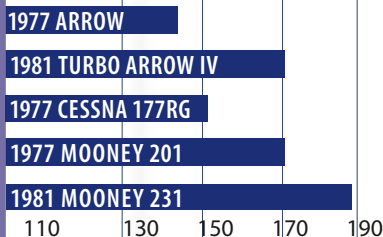
- AD 2010-15-10** CONTROL WHEEL SHAFT INSPECTION FOR EXCESSIVE WEAR
- AD 2006-20-09** REPLACE CERTAIN CRANKSHAFTS IN LYCOMING -360 ENGINES
- AD 2006-18-15** REPETITIVE HARTZELL PROPELLER HUB EDDY CURRENT INSPECTIONS
- AD 97-26-17** REPLACE NON-VAR CRANKSHAFTS IN TURBO ARROW ENGINES
- AD 97-01-01** REPETITIVELY INSPECT MAIN GEAR SIDEBRACE STUDS FOR CRACKS

SELECT MODEL COMPARISONS

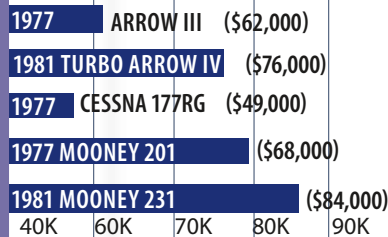
PAYLOAD/FULL FUEL



CRUISE SPEEDS



PRICE COMPARISONS





Older Arrows will have a variety of retrofit avionics, top, while Avidyne's Entegra glass PFD/MFD and Garmin's GNS430 navigators appeared in 2004, just like in the Archer, bottom.

tractable market, then dominated by Mooney with Beech's least expensive retractable—the Debonair—costing a third again as much as a Mooney. Cessna had no comparable airplane at all, and Piper's Comanche would go out of production in the mid-1970s.

Piper folded the gear on its Cherokee 180 and in 1967 unveiled the first Arrow. It was every bit a Cherokee, from the fat, constant-chord Hershey Bar wing to the stabilator. The base price was \$16,900, some \$1350 less than the Mooney M20C Mark 21 (according to the Aircraft Bluebook Price Digest). However, the average equipped price of an Arrow, as delivered, was actually about \$2000 more than the Mooney. A Cherokee 180 from the same year

had a base price of a mere \$12,900.

The PA-28R-180 came with a constant-speed prop turned by a Lycoming IO-360-B1E engine. The new retractable gear was electro-mechanical (compared to Mooney's distinctive manual "Johnson bar" arrangement), and

had a unique feature designed to enhance safety: an auto-extension mechanism that would lower the gear if the airplane slowed below a certain airspeed. More on the Arrow's gear system in a moment.

The original Arrow compared well with the Mooney in some departments, such as roominess and cost, but fell short in terms of speed. Cruise was pegged at 141 knots, compared to 158 for the Mooney. Still, the Arrow was considerably faster than the carbureted, fixed-gear, fixed-prop (but otherwise identical) Cherokee 180.

After two years and sales of almost 1100 airplanes, Piper came out with a 200-HP version of the Arrow. An extra \$500 bought pilots a Lycoming IO-360-C1C engine, a few knots and a 100-pound boost in gross weight, though that was eaten into by a 79-pound increase in empty weight. The -C1C engine was more costly in other ways, too—it had a 1200-hour TBO, compared to 2000 for the 180. That short TBO has since been lengthened by fitting new exhaust valves, and it's highly unlikely that any of the 1200-hour

mills remain. The 200's TBO is now also 2000 hours.

The 200-HP Arrow was sufficiently more popular than the 180 that the latter was dropped in 1971. Starting with the 1972 model year, the airplane was redesignated the Arrow II. Its fuselage was stretched five inches, providing more rear-seat room; its wingspan increased 26 inches by widening the Hershey Bar design and the stabilator's span increased. This allowed 50 pounds more gross weight, and the addition of the long-awaited manual gear-extension override. Thanks to larger bearing dowels, the old 1200-hour TBO was boosted to 1400 hours. The next year marked the development of a redesigned camshaft and another TBO increase—to 1600 hours.

In the mid-1970s, Piper revamped its line of metal singles (leaving the Super Cub alone), starting with the bottom of the PA-28 line. Beginning in 1975, the airplane that had been the Cherokee 140 became the Warrior, sporting a new, semi-tapered wing of higher aspect ratio than the familiar Hershey Bar and a 150-HP engine. This new wing found its way onto the Arrow in 1977, creating the Arrow III. In that same year, Piper made a turbocharged version of the Arrow. More on this variant in a moment.

The new wing improved performance somewhat, most notably in terms of glide. It also gave pilots a healthy 24-gallon increase in fuel capacity.

The Arrow III lasted only two model years. In 1979, Piper made a controversial design decision, opting to follow the T-tail design fad. This was dubbed "Arrow IV." Predictably, performance suffered. Like many T-tail airplanes, the Arrow IV flies differently than Arrows with conventional tail feathers. The T-tail, depending on airspeed, is either very effective or far less effective than a conventional tail (which isn't as prone to abrupt transitions between different flying regimes). This occurs because the stabilator sits up out of the propwash, and so is less effective at low airspeeds. Many pilots complain that the Arrow IV has squirrely low-speed performance, with a tendency to over-rotate on takeoff. Others, who don't try to fly the Arrow IV like the earlier models,

look more favorably upon the T-tail. Regardless, some who have flown both report the T-tailed version also demands more attention to pitch trim when changing airspeeds.

During the general aviation slump of the late 1980s and early 1990s, Arrow production was spotty: The normally aspirated Arrow IV wasn't built for model years 1983 through 1987; only the Turbo Arrow IV was available. For model years 1988, 1989 and 1990, conventional-tail, normally aspirated Arrows were made alongside T-tailed turbo models. The last three Turbo Arrow IVs were 1990 models; subsequent Arrows through current production all have conventional tails and lack turbos. No Arrows of any flavor carry 1991 or 1993 model designations; this was the time when Piper was on the rocks, searching for a buyer. One Arrow is labeled as a 1994 model.

Piper emerged from bankruptcy in 1995 as New Piper, a moniker dropped in 2006. Today's version—known simply as the "Arrow," without any Roman numerals—is essentially an Arrow III, arguably the best of the bunch. The 2012 model's base price is \$414,900, which includes a Garmin G500 avionics suite, but no autopilot.

MARKETPLACE

When the Arrow was introduced, its only real competition came from Mooney's early M20s. Other manufacturers soon realized the viability of the market segment, however, and it wasn't long before other competitors appeared. Beech's offering was the rather lackluster (though roomy) Sierra, while Cessna weighed in first with the Cardinal RG, then the Cutlass RG. Rockwell got into the small retractable business with the Commander 112, and Mooney upped the ante with the landmark 201.

The average equipped prices of these airplanes when new in 1977 (the first year all of them were offered at once) ran as follows: Arrow III: \$50,320, Cessna Cardinal RG: \$50,095, Rockwell Commander 112: \$61,295, Beech Sierra: \$53,594 and Mooney 201: \$57,420.

The marketplace has declared the Arrow the runaway winner in terms of non-adjusted appreciation: That same 1977 airplane has increased in value by 21 percent. The Mooney is



T-tails and turbos, pictured here, might demand more attention on the takeoff roll than normally aspirated and traditional-tailed Arrows.



second, up a little over 18 percent. The big loser is the Sierra, which has lost considerable value. It's worth noting the used marketplace doesn't like the T-tailed Arrow much, either: A 1979 PA-28RT-201 has not yet recovered its new average equipped price, while a 1978 Arrow III is worth about 10 percent more than its new cost.

The Mooney runs away from the rest in speed and efficiency, which have great value. This is food for thought, since the Arrow is no faster than, say, a Grumman/AGAC Tiger, an airplane that delivers this performance on 20 less horsepower with a fixed-pitch prop and fixed landing gear. It costs about 15 to 20 percent less to buy, and less to maintain.

PERFORMANCE/HANDLING

The 200-HP Arrow is an unremarkable performer; the 180-HP version is even less remarkable. Cruise

speeds range from 130 (180-HP) to 143 knots (normally aspirated 200-HP T-tail) and as high as 170 knots for a turbocharged version flown in the teens. The normally aspirated Arrows generally burn 9 to 12 GPH, while the turbocharged versions drink about 14 GPH when pushed. A Cessna Cardinal RG, Cutlass RG or Grumman Tiger will go as fast, while burning less fuel. And a Mooney 201, on the same fuel, goes the fastest. Still, the Arrow has a roomier interior than all but the Cardinal, and its useful load is the greatest: 1200 pounds.

The first two Arrows had somewhat limited range, thanks to their 48-gallon fuel capacity. Beginning with the taper-wing Arrow III, 72-gallon fuel tanks eliminated that problem. Taper-wing Arrow owners report as much as 6.5 hours' endur-

ARROW ACCIDENTS: ENGINE/MECH

Piper's Cherokee Arrow series airplanes established a reputation early on as "Just the facts, Ma'am" plain vanilla airplanes that were reliable and easy to fly. Our review of the 100 most recent Arrow accidents didn't give us any reason to argue with that rep. We came away believing that Arrows seldom let their humans down—their humans more often let them down.

Tied with "other" (more about that in a moment) for the most common initiator of Arrow prangs was the pigeonhole topic of "engine/mechanical." The vast majority of those events were due to maintenance malpractice, most commonly improper cylinder installation or repairs to the fuel or oil system. Three owners decided to install oil quick drains on airplanes on which the installation wasn't approved. They each found out why on the subsequent flight. The nosegear hit and opened the quick drain, leading—not long after—to oil starvation and engine seizure.

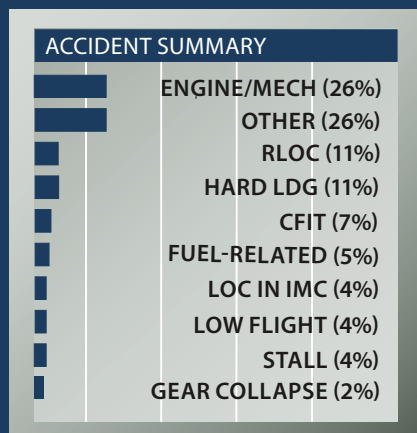
There were only 11 runway loss of control (RLOC) accidents on takeoff or landing (mostly landing), a tribute to well-designed landing gear and the Arrow's overall good manners on the ground. However, there were also 11 hard landing events. Two were reported only sometime after the fact—the damage was discovered on a later preflight. In both cases it was impossible to determine who had been flying the airplane when the damage was incurred. ("I swear, it wasn't me!")

We also noted only one gear-up landing to a stop, perhaps a record for retractable gear airplanes and a tribute to the automatic gear extension system on many Arrows. One pilot reported that as he touched down he suffered a prop strike and the airplane seemed to be handling strangely, so he pulled up—only to then hit so hard he drove the right main gear through the top of the wing. The investigator noted that, because of the gear geom-

etry, it's impossible to have a prop strike with the gear down—yet the runway and prop showed definite evidence the two had become intimate. It was determined that the pilot had not been completely forthcoming in his description of the event—he'd actually forgotten the gear, pulled up when the prop hit the runway, extended the gear and then performed the hard landing.

The automatic gear extension system was a player in two high density altitude takeoff accidents. Neither pilot understood that the system would keep the gear down until it sensed enough airspeed—which wasn't reached. Neither knew that the solution is to use the override feature on the system and get the gear up so the airplane will accelerate and climb. One pilot landed on the rising terrain ahead of him; the other thought the engine wasn't making power so he slid the mixture control to rich—and then it really wouldn't make power at that altitude. He damaged the airplane in the subsequent forced landing.

We considered the majority of the 26 "other" accidents to fall in the category of stupid pilot tricks, including such things as retracting the gear on rollout, trying to take off on runways too short for the weight of the airplane and conditions, VFR into IMC, doing aerobatics until the airplane breaks up in flight and starting at high RPM and not knowing how to use the brakes.



ance, while Arrow II owners sometimes wish for larger tanks.

The Arrow handles much like any PA-28, which is to say it's fairly benign. Stalls are a non-event. The wing loading is lower than higher-performance retractables like the Bonanza/Debonair and Mooney, which means a less solid ride in turbulence and at lower speeds. However, that's also a benefit during landing. Owners report few vices.

Climb performance is competent, but unremarkable. The Arrow is not a STOL airplane, but it doesn't eat up runway, either. During letdowns, the Arrow's gear serves as an effective speedbrake. The gear extension limit is close to the cruise speed (which really says more about the cruise speed than it does about the gear), so descents aren't the problem they are in slick airplanes like the Mooney.

INTERIOR

The Arrow's interior is quite comfortable. Piper deserves mention for its seat design in later aircraft, which have a crashworthy S-tube design meant to progressively collapse and absorb energy during an impact. This same basic design is used in the JAARS bush-plane seat. Piper also gets crashworthiness kudos for installing a thickly padded glareshield.

Heating and ventilation are both quite good, unlike some other airplanes in the class, with lots of overhead and floor vents. Egress is not the best; we don't like the single cabin door, especially when compared to the double-doored Cardinal RG, Cutlass RG, Commander 112 and the Beech Sierra. Further, the double-latch system can confuse passengers, particularly in an emergency: Be sure to brief them.

Piper chose long ago to put the engine gauges near the power controls, which makes a certain amount of sense except when setting and monitoring power on takeoff. We'd rather see the gauges up in the pilot's line of sight where they're hard to miss.

GEAR, TURBO TROUBLES

The Arrow's automatic landing gear extension system was intended as a safety feature; Piper touted the Arrow as the perfect airplane for pilots transitioning to retractables. Many

pilots and insurance underwriters embraced the “foolproof” gear system, with some insurers even assigning lower rates. Alas, the system isn’t perfect, and didn’t prevent landing gear-related mishaps in the Arrow.

Also the Arrow’s automatic gear extension system is a good example of how safety features can spawn new hazards even while eliminating old ones. In high-power, low-air-speed configurations, the system could either delay retraction or lower the gear at an unwanted time.

Then there are Arrow pilots who lose their engines and decide to ditch with the gear up. Unfortunately, some forget to override the automatic extension system. The gear pops out seconds before splash-down—sending the Arrow head over heels. Savvy Arrow pilots learned early on to “pin”—override—the system to keep the gear retracted when doing any sort of max-performance work.

There is a second pitot tube, located on the left side of the cabin, for the automatic gear system. If it is equipped with pitot heat, it should be checked along with the primary pitot tube before flight, as more than one pilot making a high-speed, IFR descent through a thin stratus layer has had the gear suddenly extend because that second pitot froze over.

There were enough “misunderstandings” by mid-1987 that Piper, then owned by Lear-Siegler, ordered the system deactivated because of concern over liability suits. It sold kits to do so, and told customers it wouldn’t provide parts to repair the existing system. Piper sold 1400 kits.

A year later—then owned by M. Stuart Millar—the company withdrew its deactivation order, provided that pilots “take the necessary actions to assure that any pilots flying these aircraft are fully advised of the system and its proper operation.” In part, Piper was responding to the complaints of irate owners who believed the system worked often enough to be desirable.

When Piper hung a 200-HP turbocharged Continental TSIO-360-F onto an Arrow III in 1977, the combination looked like a perfect match: the world’s premier economy retractable single and a powerplant promising high-tech performance at low-tech prices.

The extra money—the average 1977 Turbo Arrow III went out the door costing around \$4600 more than its non-turbo’d sibling—boosted book max cruise speed from 149 KTAS to a whopping 177 at altitude. A new cowling rounded out the deal and announced to the ramp rats your bird was turbocharged.

Soon, however, the engine began earning a reputation as tricky to operate and prone to self-destruction. It didn’t help much when, in 1979, Piper combined its T-tail airframe with the turbo’d engine, even if the powerplant got a different suffix and much-needed TBO extension (from 1400 to 1800 hours).

The result was a handful on the runway: The T-tail’s tendency to encourage overrotation, coupled with the engine’s need for attention on the takeoff roll, meant a busy time, especially on high-elevation fields. On the good side: The engine’s fixed wastegate introduced legions of pilots to the term “bootstrapping.” For pilots transitioning from a normally aspirated Arrow, it was too tempting to run the throttle to its stop early in the takeoff roll, just as one would with the non-turbo’d version.

Do that with the Turbo Arrow, though, and you’d get a red “overboost” light very soon, often followed by your mechanic’s bill for the subsequent inspection. Instead, the favored technique was to run up the MAP to no more than 30 or so inches early in the takeoff roll, then forget about it while monitoring the other engine gauges and keeping the centerline straddled.

When workload permitted—or runway length demanded—and after the system spooled itself up to around 35 inches, a gentle nudge to the throttle gave around 39 or 40 inches, and then the engine likely would boost itself the rest of the way to its 41 inches of manifold pressure limit and off you went.

Alas, the engine wasn’t as bulletproof as Continental intended or Piper hoped. One five-year print-out of FAA Accident and Incident Reports for the Turbo Arrow disclosed no fewer than 54 instances of powerplant failures. Furthermore, the engine stoppages weren’t the result of typical pilot errors such as fuel mismanagement, fuel exhaustion, etc. They occurred from failed



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The Arrow's rear cabin is the same size as the one in the Warrior and Archer. At roughly 42 inches wide, it's not cavernous.

connecting rods or rod bolts, broken crankshafts and damaged pistons.

Things got so bad that the National Transportation Safety Board in 1985 called for an airworthiness design review of the engine, citing a litany of component failures. Then-FAA Administrator Donald Engen rejected the request.

These days, things have calmed way down with the Turbo Arrow. A recent check of Service Difficulty Reports (SDRs) going back into the 1990s did not uncover any real trends with the Turbo Arrow's engine, airframe or appliances.

BETTER: TURBO MODS

One of the reasons for the Turbo Arrow's recent reliability may be the aftermarket mods available. Two are significant: intercoolers and an automatic wastegate. Turboplus (www.turboplus.com) and Airflow Systems (www.airflow-systems.com) offer intercoolers.

At 12,000 feet, the Turbo Arrow has a fairly low critical altitude—the max altitude at which the engine will develop its rated horsepower. Owners say they get a higher critical altitude with the intercoolers, along with lower operating temperatures.

Meanwhile, in an effort to prevent bootstrapping on the Turbo Arrow and other aircraft with the TSIO-360 engine, Merlyn Products (www.merlynproducts.com) has taken an even more dramatic step and come up with an automatic upper deck controller that looks like the answer to a prayer for Turbo Arrow owners. It increases the critical altitude by 5500 feet while boosting cruise climb and speed slightly, and lowering CHT and oil temperatures significantly.

The ostensibly nifty benefits of this system are much lower turbo speeds, lower engine RPM settings at all altitudes and generally allowing lower engine operating temperatures.

CLUBS, MORE MODS

A variety of mods are available for PA-28Rs, from the usual flap and gap seals (Knots-2U, www.knots2u.com) to shoulder harnesses (B.A.S. Inc., www.basinc-aeromod.com) to the high-spiff-factor LoPresti (www.loprestiaeromod.com) cowling. Speedbrakes can be had from Precise Flight (www.preciseflight.com), though the Arrow doesn't really need them.

As with any personal airplane, we strongly recommend joining a type club. Their expertise can save real money when tracking down common problems. Arrow owners have two excellent organizations from which to choose: the Cherokee Pilots Association (www.piperowner.com) and the Piper Owner Society (www.piperowner.org).

(www.piperowner.org).

OWNER COMMENTS

When I was looking to step up from my Cherokee 140 back in 2004, I thought the Arrow would be the ultimate transition. It looked to have reasonable performance, good handling and might be relatively inexpensive to maintain. It just so happened that a friend had one and invited me to fly along on a cross-country trip to the Midwest and back to Connecticut. This opportunity allowed me to fly and see firsthand how well this airplane performed. Needless to say, I was hooked.

A search for an Arrow proved challenging as I was looking for a turnkey aircraft that had pristine paint, a low-time engine and solid avionics. My search finally revealed a 1979 Piper Arrow IV. I had no experience with the T-tails, but heard rumors that the aircraft required extra handling to fly. I decided to fly it with the owner's CFII and put it through the paces. I learned that most of the T-tail rumors are simply that—rumors.

My Arrow IV came nicely equipped because the previous owner did a complete refurbishment on the aircraft in 2001. It had custom paint, a high-end leather interior and a full Garmin suite of avionics coupled to an S-TEC 55X autopilot. There was little not to like. Better yet, the owner replaced the old engine with a factory remanufactured engine, which had 380 hours on it when I picked up the aircraft.

Fast-forward to 2016 and I have over 1200 hours on the engine and all has been good. The Lycoming IO-360 is fairly bulletproof. I use CamGuard additive and Phillips 20-50 oil blend to reduce potential corrosion. I had one sticky valve that had to be lapped, but that has been it.

Over the years I have kept up with upgrades including changing the exterior landing lights to HIDs, updating avionics by adding a Sandel SN3308 EHSI, a Garmin 796 GPS, the VoiceFlight system and most recently, trading out the transponder for a Garmin GTX345 all-in-one transponder for ADS-B compliance. Since the aircraft is hangared, the paint and interior are still like new. This has also reduced the potential for exterior corrosion—a big concern.

Twelve years of ownership has proved interesting, with a few major surprises. I went through three landing gear pumps over the first five years of ownership. These were clearly substandard pumps and all has been good since. The aircraft is also equipped with the Piper Aire air conditioning. The headache with the system is that it utilizes a thin alternator belt, which has to be monitored. Any slight bit of wearing or twisting requires immediate replacement. I had two sudden belt failures over the last 12 years and it's a major hassle because the prop needs to be pulled to change the belt. Luckily, I have a good A&P who knows how to install, adjust and properly align the belt. Last, the idiotic AD for mandatory crankshaft replacement was completed at a \$13,000 expense to me.

I average around 50 to 60 hours of flying time per year, flying up and down the East Coast. Annual inspections are around \$2300. Insurance costs have remained around \$1700 for a \$125,000 hull value and \$1 million smooth policy. I'm a 2200-hour instrument pilot. The total cost to keep the Arrow flying a year is around \$9000, including insurance, engine reserves, hangar lease, annuals, upgrades and navigation databases. This is before any fuel costs.

Typical groundspeeds are 139 to 142 knots while sipping 8 to 9 GPH at altitude. I tend to run lean of peak EGT when able, while monitoring the temperatures on the engine analyzer.

Overall, the aircraft meets my mission needs and is a solid performer with decent speeds.

A. Elwood
via email

I have a 1969 PA28R-200 Arrow. Its original baby-blue paint has held up well since the aircraft has been hangared for most of its life. It currently has 3400 hours on the airframe and 1400 hours since its first engine overhaul.

I've upgraded the avionics with an S-TEC autopilot with digital steering, altitude hold and trim command, plus the autopilot is interfaced with a Garmin GNS530W. I also have a Garmin GDL88 ADS-B system with Flight Stream 210 for wireless data interface to my iPad. There is also a

Garmin GPSMap396 with XM satellite weather that sits in a Air Gizmo dock mount, a PS Engineering PMA450 audio system, plus a Sandia SAI-340 electronic attitude indicator. I monitor the engine and fuel burn with a JP Instruments EDM700 and a FS450 fuel computer.

Maintenance issues are few, with the most expensive being propeller and governor replacement a few years ago. Oil consumption is approximately one quart per 8 to 10 hours. I have a good handle on fuel burn thanks to the FS450, which averages 8.7 GPH at my normal cruise altitude of 12,500 (I live in Colorado).

True airspeed has consistently been 140 knots over the 15 years I have owned the Arrow, while the average cost for annual inspections has been about \$2100.

Jim Torley
via email

I've enjoyed my 1973 200-HP Arrow II with air conditioning since early 2001 and plan to keep it many more years. It is a good all-purpose airplane, from the \$100 barbeque, to frequent 200-NM runs to the beach, to the occasional 500- to 1000-NM trip to Canada and the Bahamas.

With 48 gallons of usable fuel (burning 9 to 11 GPH), I flight plan for 450-NM IFR legs, unless I anticipate dodging thunderstorms. It trues out at 169 MPH.

My airplane came with LoPresti wheel covers that offer a speed increase, plus they are cheap. What would be moderate turbulence in my old Skyhawk is light turbulence in the Arrow, determined when I flew the Skyhawk to a buddy's airport several times and then climbed into his Arrow for comparison.

The big and expensive problem areas are air conditioning and landing gear. Everything else is trivial and relatively cheap. I leaned toward the Arrow after I lost my Skyhawk to hail damage because of its range and air conditioning (it's one of the few lower-end planes with air conditioning).

A friend with a Cirrus gave me grief on a flyout because she beat me by seven minutes after departing from the same airport. I reminded her that hadn't I dropped the air conditioning condenser into the

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USED ARROW

(continued from page 31)

slipstream, I'd fly 8 knots faster. She never ribbed me about speed again.

The biggest—and unsafe—problem with air conditioning in single-engine Pipers before about 2001 is that Piper shrank the alternator belt from 5/8 inches to 3/8 inches in order to make space for the compressor belt. This isn't sufficient. Even after following Piper's service bulletin to precisely align the pulleys, I still shredded alternator belts every 10 to 15 flight hours—not fun in night IMC. If the belt is twisted, it probably will shred and depart the aircraft on the next flight.

The solution, short of modifying the plane to change to 5/8 inch pulleys, brackets and belt or suffer 95- to 100-degree summers without air conditioning here in the South, is to spend north of \$4000 on parts and about eight hours of your mechanic's time to replace the pulleys, alternator mounting bracket and a belt to modify it to the standards Piper used in 2001 and models beyond.

Piper will sell a modification kit for \$500 to \$700 more, but I obtained a parts list and searched for the cheapest vendor for each. Seven years later the alternator belt is fine. It was well worth the cost and effort.

The nosegear trunion suffered a metal fatigue failure in 2008, horizontally cracking through about half of it, resulting in collapse when I attempted takeoff from a sand and dirt runway due to the nosewheel twisting 90 degrees to the right when turning onto the runway. This caused

an abrupt engine stoppage when the prop stuck in the ground. AIG insurance was wonderful.

A friend's Arrow suffered a similar main nosegear failure. I suggest to carefully inspect the gear. Recently, the nosegear didn't come down on the first attempt. I swapped the landing gear status lamps, recycled the gear and it was down and locked.

My mechanic found the gear indicator adjustments set at maximum travel, suggesting that we might even get a green indication when the gear is not actually down and locked. He completely disassembled the gear and found many worn bushings and such needing replacement. This apparently had never been done in its 43 years. He recommends this procedure every 10 to 15 years, so be aware of it when evaluating an Arrow for purchase.

Another concern is corrosion around the throttle pushrod where it enters the guide tube in the engine compartment. I discovered this when I was unable to advance the throttle from idle when attempting an engine start in Canada.

I'm lucky I didn't pull it to idle on my previous night IFR flight. When I returned home, I had the throttle, mixture and prop cables replaced.

Last, being fuel-injected, the Arrow can be difficult to start when the engine is hot, especially after quick-turn refueling in the summer. An FAA- and PMA-approved Slick Start magneto booster system (the Slick Start integrates solid-state electronics with conventional ignition hardware to deliver optimum spark energy for improved engine starting) greatly

FEEDBACK WANTED

PIPER NAVAJO



For the April 2017 issue of *Aviation Consumer*, our Used Aircraft Guide will be on the Piper Navajo cabin-class piston twin. We want to know what it's like to own these aircraft, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your 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, operating expenses or any other comments. Send correspondence on the Piper Navajo by February 1, 2017, to:

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helped, but it's not a cure-all. As a rule, if the engine doesn't fire in two start attempts, proceed to a flooded start procedure.

I think my Arrow has suffered far more mechanical problems than most. Still, I recommend the airplane, but suggest having a competent mechanic who is familiar with the Arrow spend the time needed to maintain it properly.

Bob Toxen
Atlanta, Georgia

