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FIRST WORD**GARMIN'S NEW DISPLAYS: A TEST IN PRICE TOLERANCE**

No matter how you feel about Garmin's market domination, you can't argue that the company maintains the poll position by enthusiastically pumping out a steady stream of fresh products almost on a monthly basis. But Garmin also knows how to get the most mileage from its major systems and the G600/500 retrofit PFD/MFD was getting stale.

So when Garmin's director of aftermarket sales, Jim Alpiser, introduced the company's TXi series next-generation retrofit cockpit displays this past October, there was an obvious and genuine enthusiasm in his delivery. Rightful-

ly so. These new TXi displays are a big deal. They pave a new road for Garmin for the next 10 years, replacing the aging G600/G500—the company's first certified retrofit PFD released nearly nine years ago. The flagship TXi line isn't a tweaked version of the old hardware and software, and it wasn't born from other existing products; it's a ground-up redesign. Smartly, and unlike the G500 and G600, the new TXi hardware closely resembles the GTN750/650 navigators and finally has a touchscreen interface, has optional engine monitoring, is available in multiple sizes and configurations and is compatible with G600/500 wiring.

Based on the presentation and a close look at the interface potential (I haven't flown with the TXi yet—that's in the works for an upcoming full report)—from a design standpoint I think the TXi line is positioned to be one of Garmin's best-executed aviation products since the GNS430. But there's one potential show-stealing elephant in the room, in my estimation: the price.

There have been rumors about a new display line from Garmin for some time and with high expectations. Moreover, the recent trend of cheaper displays (and autopilots) that trickle down from the experimental and LSA world had the market assuming Garmin would sell its new displays at, well, experimental prices. It got a taste of that with the G5 EFIS and GFC500 autopilot—two products with roots deep in the LSA and experimental market, but with an STC for installation in certified airplanes. The G5 is under \$5000 and the GFC500 under \$10,000.

My eyes and ears told me the market was expecting these new displays to be a derivative of the experimental GX3 Touch, but with a wide-reaching AML-STC. Not so. The TXi line is fully FAA-certified to a high standard. In fact, the new G700 TXi variant that's intended for Part 23 applications (that's the jet market) supports Level A software—the highest certification standard. My sense is the TXi's certification effort (which commenced long before the FAA relaxed equipment standards for displays and autopilots) has a lot to do with its selling price. The entry-level G500 TXi system with a 7-inch display has a list price of \$12,000 and options (including the \$4000 engine display system) quickly drive the price northbound. The 10-inch display you see in the Baron pictured above starts at \$15,000. I may be wrong, but I suspect some buyers expected pricing that's at least one-third of this. I asked Alpiser why Garmin didn't bring a lower-priced solution to market, as Dynon is doing with its experimental SkyView. While he didn't dismiss the idea of such a product down the road, he suggested buyers will accept the price for a higher level of confidence in the TXi's design standards.

I'm not so sure, but I agree with Alpiser who pointed out there's no comparing the TXi's design characteristics with non-certified products when it comes to materials, electrical shielding, lightning testing and a lot of other stuff that tags along with a stringent certification process. As Alpiser put it, "In avionics product development, the last 5 percent of effort to achieve the highest certification level is what costs the most money." Many customers will moan and pay these costs, of course, and an aggressive dealer network will push the product hard, but the real test for Garmin will be the TXi's sales volume in a shrinking retrofit market just getting used to lower prices and rising competition.—Larry Anglisano



CIRRUS VISION JET TRAINING

Kudos to your coverage of the Cirrus Vision Jet in the October 2017 issue of *Aviation Consumer*. Out of all the magazines that covered it, I thought you guys were the most thorough.

One thing you didn't mention was the cost for insurance. I'm a 3000-hour piston pilot currently flying a pressurized Baron and my insurance agent wasn't sure I could get coverage without doing the Cirrus training. Is it a prerequisite, as far as you know?



Thanks for your hard work and for delivering a useful publication month after month.

Ramone Correia
via email

We appreciate your words, Ramone. As we mentioned in the article, you'll need a type rating to fly the SF50 Vision Jet and for now the only place to earn it is at Cirrus.

As for insurance, as long as you have the SF50 type rating and have a current policy with your Baron, our sources tell us you'd have no problem getting coverage. Still, we couldn't guess at what price.

BOSE HEADSET BUGABOO

My guess is that many pilots like me are over 40 years of age (I'm 62) and may not be completely familiar with newer wireless Bluetooth technology and its limitations.

After a radio failure on a recent flight, I tried to pair my newer Bose A20 Bluetooth headset with my new Samsung Galaxy S8 smartphone I bought to replace my aging iPhone 4, which would connect to my A20. The local ATC tower has a recorded phone line where they can issue control instructions in a pinch.

However, my phone did not recognize the Bose A20 headset as an available device or add it to the Bluetooth list—at a time when I needed it the most.

I called Bose and learned that the Bluetooth module fills up with only a few device connections and can't

recognize a new device until you clear out the old device signatures. This clearing process is buried deep in the A20 owner's manual, but I think it's poorly explained. There is no reference to filling up the Bluetooth pairing queue—which is the reason for the clearing process in the first place.

To clear the queue, you simultaneously hold the Bluetooth button and the minus volume control for 7 seconds. After doing that, my Samsung smartphone paired flawlessly.

I thought a note in *Aviation Consumer* may help some other pilots in the future when pairing a Bose and perhaps even other Bluetooth headsets.

Bob Reed
via email

THE \$60K SLIDE

After reading the landing gear mishap article in the October 2017 *Aviation Consumer* I was disappointed in your lack of understanding of the Piper Comanche landing gear system. Since the Comanche was the only Piper model used for comparison in your article, I assume that is what you were referring to when you wrote that "airplanes that use electric/hydraulic systems seem to be the most susceptible to gear extension failures. That would be Cessna and Piper and larger twins."

Please be advised that the Piper Comanche landing gear uses an electric motor driving cables to retract and extend the landing gear. No hydraulic fluid is involved, except for the brakes.

I did enjoy the article and thought it was very informative. I have flown for the U.S. Air Force as well as the airlines and have never made fun of anyone who had the misfortune to land sans wheels. I still fly my 1961 Comanche and a 1944 SNJ, and I'll be 80 years of age next year. When I retire from flying I hope to be able to say that I always landed on the wheels. Keep the shiny side up.

Marty Case
via email

We know enough about that old Comanche's landing gear system to suggest following the maintenance manual to the letter. While it isn't a complicated system, it's a source of trouble when neglected or maintained by techs who aren't familiar with the problem areas. For starters, this includes replacing the bungees on a regular basis and ensuring that every bushing in the system has no play. As for those cables, there should be a slight amount of pressure on the over-center arms that hold the gear in the full down-and-locked position. This prevents the arms from moving up and out of the downlock position. If not, it's a \$60K slide waiting to happen.

SHOP LABOR RATES

You guys should do a story on shop labor rates. I recently got some avionics quotes and it was difficult to figure out what was being charged. Turns out it was around \$90 per hour.

Steve Brechtel
via email

You didn't say which region you're shopping, but \$90 per hour for specialty work like avionics seems a bit low. For typical pistons and light turbines, \$100 to as much as \$150 per hour seems to be the current typical labor rate. Flat-rate package pricing is actually in your favor as long as you have a written contract.

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Portable SXM Receivers: Separated By Apps

For Garmin Pilot, the twin receiver GDL52 has SXM, ADS-B weather and traffic, plus attitude data. For ForeFlight, the utilitarian SXAR-1 is a solid performer.

by Larry Anglisano

It wasn't long ago that subscription-based satellite broadcast weather systems lost traction in a market flooded with ADS-B weather receivers. WSI is canceling its InFlight data service at the end of this year and Aviodyne discontinued the MLB700 Sirius weather receiver. This leaves Garmin as the dominant supplier of SiriusXM (SXM) weather receivers.

While SXM's longevity is anyone's guess, Garmin finally brought the anticipated GDL51 and GDL52 to the market this past summer. There's also the SiriusXM Aviation SXAR-1 (which is sold by Sporty's and directly from SiriusXM), plus the WR-10BT WxWorx receiver that's sold by Baron Weather.

In this article we'll take a look at how they compare in performance, portability and display compatibility.

SXM VERSUS XM

For a refresher on the history of XM-delivered satellite weather, we

suggest reading the SiriusXM analysis article in the August 2017 issue of *Aviation Consumer*. In a nutshell, the confusing part of the satellite datalink weather market is multiple broadcasts by SiriusXM, plus the different bundles of weather products for vintage and current receivers. We re-ran the current SXM subscription chart for quick reference on page 6.

For the purposes of this receiver hardware article (we'll cover three standalone receivers), consider that Garmin's new GDL51/GDL52 and the SXAR-1 for ForeFlight receive the latest SiriusXM Aviation data, while the Baron WxWorx receiver works with the older data stream known as XM WX.

Additionally, SiriusXM entertainment programming is available with both data streams. Worth mention-

CHECKLIST

-  The GDL51 and SXAR-1 are well matched in performance and portability.
-  The GDL52 does ADS-B traffic, SXM weather and attitude in one device.
-  The WxWorx WR-10BT/Mobile Link is a good performer, but it has dated, wired hardware.

ing is that vintage receivers including Garmin's GPSMap396/496 and earlier aera 500-series portable GPS systems still work with the older XM WX data stream. The same is true for the first-gen Garmin GDL69 and also the HeadsUp Technologies XMD76 permanent-mount receivers.

GARMIN GDL51 AND GDL52

Some buyers balked when Garmin released the aera660 portable GPS without a satellite weather interface. Logically, an SXM receiver interface was expected because a handful of previous Garmin portables (going back several generations, starting with the GPS396) were so equipped, including the current production aera796. It uses the wired GXM42 remote SXM antenna/receiver that plugs in via USB.

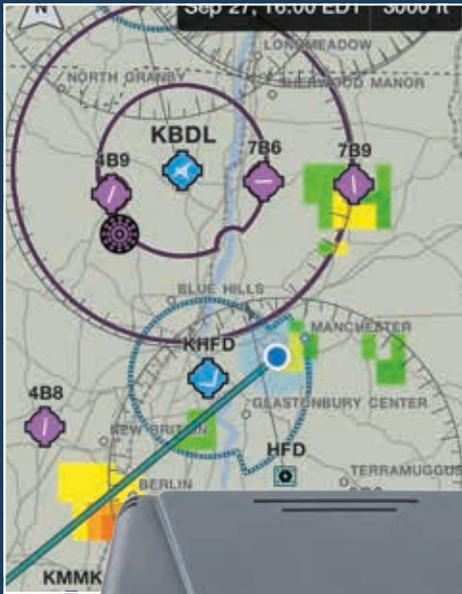
But given the aera660's wireless feature set (it connects via Bluetooth with Garmin's GDL39-series ADS-B receiver and other accessories), a wired SXM interface would seem out of place. Plus, who wants wires these days? Not us. The solution is the GDL51 portable SiriusXM weather and music receiver.

Priced at \$699, the GDL51 is one of several versions of the device. Considered entry-level, the GDL51 has a built-in WAAS GPS for sending position, speed and backup attitude data to the 660 and 796 portables

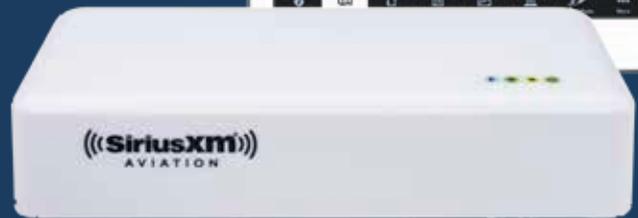
The Garmin GDL51, left inset photo, is designed to sit on top of the glareshield. It has Bluetooth connectivity with tablets and smartphones running the Garmin Pilot app and the aera660 portable GPS shown in the main photo.



GARMIN PILOT OR FOREFLIGHT MOBILE?



Before deciding on a receiver, consider your tablet app of choice. To the left, Garmin's GDL51 works only with the Pilot app for both Apple and Android. To the right, the SiriusXM Aviation SXAR-1 works with ForeFlight (shown) and the WSI Pilotbrief. Baron's WxWorx WR-10BT, middle, works with Garmin Pilot and ForeFlight.



and to the Garmin Pilot tablet and smartphone app, which has SVX synthetic vision and a full set of electronic flight instruments.

The \$1199 GDL52 is a step up and includes an integral dual-channel ADS-B In traffic and weather receiver, in addition to the SXM weather and entertainment receiver, plus WAAS GPS. Both models interface with tablets, smartphones and select Garmin portable GPS navigators via Garmin's Connex Bluetooth.

At first blush, the devices resemble a small digital alarm clock and at 4.9 by 1.3 by 3.4 inches, they are the right size for stashing on top of the glareshield. Weighing .75 pounds, the receivers have an anti-slip mat on the bottom of the case to keep them from moving around. Still, since the unsecured receivers can be dangerous projectiles in a crash or even in turbulence, we think the \$25 base mounting bracket is a good investment. Garmin also sells a \$50 mounting bracket with suction cup for hanging the device from a win-

dow—again, not the best in a crash situation, but better than not being secured.

The GDL runs on a lithium-ion battery that Garmin says should last for around seven hours on a full charge. Based on our use, that's about right, although like most cockpit portable electronics we suggest plugging it in using the supplied Micro-B USB cable. The GDL has a battery saver feature that turns the unit off when external power is removed and when it senses that the groundspeed is less than 20 knots, there's no GPS fix and when there is no Connex wireless connection.

We wonder when the heck Garmin will standardize the power cables for

its portables because if you're like us, the goal is to reduce the number of cables you have to bring along and not add to the mess. We have a few Garmin VIRB action cameras that use a Mini-B cable for charging and the D2 Titanium aviator watch that uses a charging cradle. We favor Mini-B for everything.

The controls on the GDL51 and GDL52 are minimal and limited to a power button on the left side of the case. There is also an input for an optional SXM antenna, but in our trials the GDL51 had flawless reception without it. Whether on top of the glareshield in a Mooney or even sitting on the seat, we never lost the signal. The mounting plate can be used to mount the GDL outside of the cockpit, but in remote locations you might have to use external antennas.

The right side of the case has an input for an external GPS antenna and an audio output port for piping SXM entertainment into a headset that doesn't have Bluetooth, for ex-

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

ample. A power/data port is used for hardwired connections with aircraft power and Garmin's portable GPS when using the optional power/data interface cable. A wired connection substantially expands the interface. For example, if you had two mobile devices running Garmin Pilot and connected to the GDL51/52, you could hardwire two more devices to the GDL and stream data to all four simultaneously.

The front of the GDL case houses a smart battery life annunciator. It turns red when the device is charging and flashes if there's a fault. When the battery is less than 20 percent of its capacity, the light is orange and it's green when there is power

applied or the battery level is greater than 20 percent.

The Connex (Bluetooth) annunciator is blue when there is an active Bluetooth connection and flashes when the pairing list on the host device is cleared. When the internal GPS receiver is locked on, the GPS annunciator is green and off when there's no signal. The SXM annunciator works the same way.

You connect the GDL to the Garmin Pilot app (after successful Bluetooth pairing with the phone or tablet) by accessing the Connex tab in the app and selecting SiriusXM. From there you can see signal quality for both weather and audio datalink, plus the availability of SiriusXM weather products. The GDL receives all of the products as shown in the chart above, and the Garmin Pilot app and

aera660 have a full display interface.

The dual-channel ADS-B receiver in the GDL52 is similar in capabilities to Garmin's GDL39 series receivers. The device queues both ADS-B and SXM weather while it's turned off or in sleep mode and automatically updates when the connected display comes back on.

As for ADS-B traffic display, the GDL52 uses Garmin's TargetTrend and TerminalTraffic technology—a feature that's standard on current-production panel-mount displays. In a nutshell, rather than showing traffic in a fixed snapshot, TargetTrend is velocity-based and uses relative motion to help you better determine which traffic threats are a priority.

The GDL52 isn't yet available as we go to press, so we didn't fly with it. Garmin says it should begin shipping early next year. Worth mentioning is the remote version of the GDL51/52, designated as the GDL51R and GDL52R. These are remote-box solutions for connecting to Garmin's G3X Touch integrated avionics system for LSA and experimental aircraft. The remote version supports up to two wired displays and two Connex Bluetooth connec-



The Garmin GDL51R, left, is a remote version that wires up to the G3X Touch displays and also has Bluetooth for connecting to portables.

tions (a tablet and a portable GPS, for example).

The GDL51R/52R uses a 15-pin serial connector for power and data, plus it requires external antennas for GPS and SXM.

The remote versions are priced the same as the standard ones and there's currently a \$200 SiriusXM rebate for all models when signing on with a data subscription.

SIRIUSXM SXAR-1

SiriusXM Aviation released the SXAR-1 portable receiver a couple of years ago with a partnership with WSI and the Pilotbrief Optima for iPad app. We think the app stifled the SXAR-1's growth given its lack of popularity, plus it lacked the utility app users were accustomed to with other full-featured navigation apps.

But an interface with the hugely popular ForeFlight app gave the SXAR-1 a new lease on life. The device is slightly smaller than Garmin's GDL51/52 and 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 that runs for roughly seven hours—the same as the Garmin.

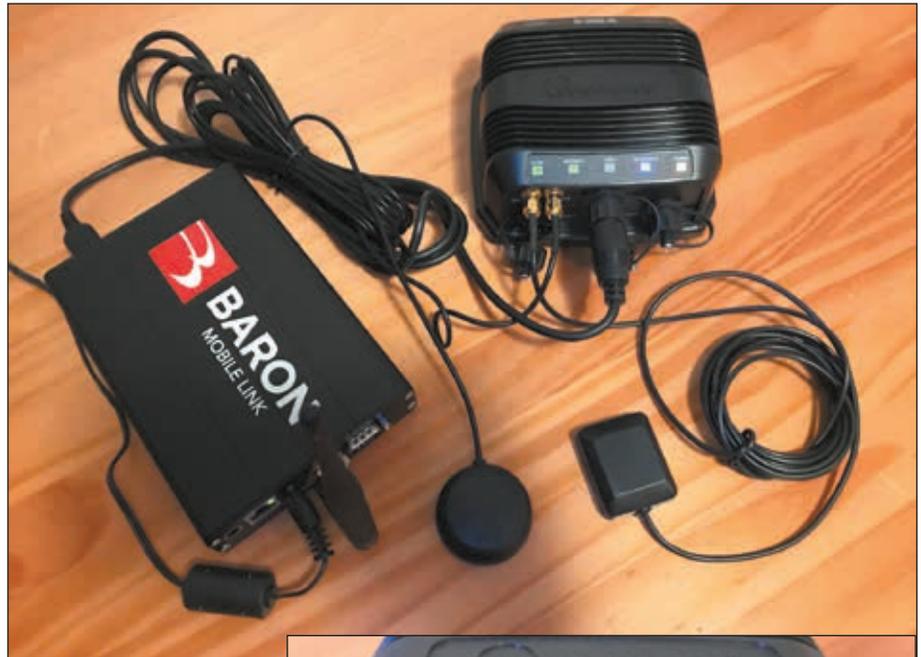
It's equipped, but we didn't need to use the ports for external SXM and GPS antennas. The SXAR-1 even worked well when stashed in our flight bag on the back seat. The device couldn't get simpler and the controls are refreshingly few. There's a power button, plus four status annunciators on the top of the case. They show the status of power, satellite reception and Bluetooth connectivity. We really like that the ForeFlight app controls the brightness of the SXAR-1's annunciators for preserving night vision.

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800-800-1020
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WxWorx
251-881-8811
www.wxworx.com



That's the Baron WxWorx setup on our test bench, top photo. Compared to the Garmin GDL51/52 and SXM's SXAR-1, it's not exactly portable with all those wires. The WR-10BT receiver, bottom, has a rugged chassis and connectors.



If you already connect an ADS-B receiver to ForeFlight, you'll still be able to use the SXAR-1 because it connects to the app through Bluetooth and the Stratus connects via Wi-Fi. You won't, however, be able to display weather data from both at the same time. Since SXM weather radar is higher resolution than ADS-B FIS-B radar (plus there are more weather products, including cloud tops and better lightning data), our suggestion is to use SXM for weather and the Stratus for ADS-B traffic, AHRS flight instruments, GPS position and pressure altitude.

Since Garmin's GTX345 ADS-B transponder is compatible with ForeFlight, you can use it (for traffic) and the SXAR-1 (for weather) at the same time.

As you see in the weather product chart on page 6, SiriusXM developed a new weather package for ForeFlight and the SXAR-1. New to the ForeFlight interface is SiriusXM radio streaming. If you have a Bluetooth headset, you can wirelessly stream the audio while tuning the channels through the ForeFlight app. But, you won't be able to receive audio alerts from the ForeFlight app while connected to the SXAR-1 for music.

Sporty's (www.sportys.com) sells the SXAR-1 for \$699 and SiriusXM is offering a \$200 rebate, for a final cost of \$499. The SiriusXM Aviation subscription is \$39.99 per month.

WXWORX WR-10BT

Huntsville, Alabama-based Baron Weather was the first provider of weather data for XM Satellite Radio through its WxWorx division. Providing weather hardware and software



Unlike the Garmin and SXM receivers, the WxWorx receiver can stream data to a PC and EFB. That's the WxWorx on Wings program in the screenshot at the top. The Mobile Link, bottom, creates a wireless network for displaying weather on multiple devices.

for aviation, ground and marine markets, Baron coexists with The Weather Company (previously WSI) streaming its data over the SiriusXM broadcast on 2332.5 and 2345 MHz. Baron provides the data for first-generation weather receivers including the Garmin GDL69 and vintage portable GPS units including the GPS396/496. The stream also works with the HeadsUp Technologies XMD76 series receiver. WxWorx provided its own receivers over the years and the third-generation portable is the WR-10BT weather data receiver.

The WR-10BT has an advantage over the other portable datalink receivers because it can stream data to a wider variety of displays, including

PCs, MFDs and also mobile devices over a wired, Bluetooth or Wi-Fi connection. More on that.

Measuring 2.25 by 5.25 by 5.25 inches and weighing 1.3 pounds, the WR-10BT is larger than the Garmin GDL51/52 and the SiriusXM SXAR-1. The polycarbonate/ABS enclosure is designed for unsecured surface mounting (we wouldn't do that given its bulk) and WxWorx has an optional mounting bracket kit. The receiver works with XM Satellite Radio with an active audio subscription.

Equipped with an internal WAAS GPS receiver for weather display position accuracy, the WR-10BT has four connection types, including USB, wireless Bluetooth, RS232 serial and also 10/100 BaseT Ethernet. Additionally, the device requires separate antenna inputs for both XM and GPS. The WR-10BT doesn't have a built-in battery, so external voltage is required either through a DC power accessory, an AC socket or through a connection with the Mobile Link wireless transmitter, which sends input voltage to the receiver over the data port. The WR-10BT can also be powered by USB, but you'll need the specific WxWorx USB cable for connecting to the device's power port, which is a round screw-in keyed connector.

We think the device's five input connectors (including the two SMA antenna ports) are rugged, but unlike familiar Mini/Micro-B USB connectors, the ones on the WR-10BT aren't what most users have in the drawer.

There are five status annunciators on the upper portion of the case that show valid XM audio signal, weather data signal, GPS antenna signal, Bluetooth connection and power input. In our trials, the WR-10BT acquired both GPS and XM signals quickly and reception was solid. We tried the system with the Garmin Pilot app, but it's compatible with a variety of third-party apps including ForeFlight, GlobalNavSource EFB and WingX Pro. That's a good thing. We couldn't believe it worked with Garmin.

The WR-10BT (yes, BT stands for Bluetooth) can connect to a portable device through Bluetooth, but the WxWorx external Mobile Link Wi-Fi device is the preferred method of connecting smartphones and tablets.

The portable antenna-equipped Mobile Link device is 4.4 by 6.4 by 1.2 inches, weighs 0.4 pounds and requires power input plus a USB connection to the WR-10BT receiver. With all of this hardware to mount in the space-challenged Mooney, plus all of the required wiring harnesses, we just can't see the system competing with the other totally portable solutions.

But, you could do a semi-portable installation (the Mobile Link network has a 98-foot reception range) and for those who fly with a PC, the WxWorx on Wings software is full-featured with decent radar graphics, winds aloft data, echo tops and lightning data, to name a few features. The program has a unique feature called AutoTrak, which uses the GPS position from the WR-10BT receiver to monitor the country for severe weather activity. You can also overlay TFRs, airports, nav aids and your own GPS position on the map.

A WX10-BT/Mobile Link bundle is \$1125. XM WX data subscriptions for the WxWorx system start at \$34.99 per month (Aviator LT) with high-resolution Nexrad radar, TFRs, METARs and TAFs being the primary products. The Aviator subscription (\$54.99) offers Canadian radar, lightning, AIRMETs, SIGMETS, freezing levels and echo tops, to name a few products. Go to the subscription page on www.wxworx.com for a full list.

IT COMES DOWN TO APPS

We give Garmin's GDL52 an edge over SiriusXM's SXAR-1 simply because it combines an ADS-B receiver and an SXM receiver. We think there's a certain utility there for Garmin Pilot users who need better radar resolution than FIS-B provides, plus weather that works reliably on the ground, and also want to see enhanced ADS-B traffic. For ForeFlight users, the SXAR-1 is worthy, but it doesn't do traffic. Selecting the base GDL51 or the SXAR-1 will come down to whether you use ForeFlight or Garmin Pilot.

As for the WxWorx system, we like that it works with multiple third-party apps, PCs and has Wi-Fi, but we think it's time for a hardware refresh.

AEPC Service Program: Fixed Fee MX for Pistons

Born in the jet world, the AEPC Piston Engine Service Program isn't an extended warranty. Instead, it follows the power-by-the-hour approach to reserves.

by Larry Anglisano

A company called AeroEngine Protection Corp. has been aggressively marketing a range of scheduled and unscheduled maintenance programs for piston engines. While the concept is new in the piston aircraft market, similar programs have been the norm in the jet aircraft world for years, and aircraft OEMs, used aircraft dealers, engine overhaulers and fleet operators are signing on with AEPC's programs for pistons in impressive numbers. *Aircraft Bluebook* has even recognized the program when publishing typical resale costs.

For this article, we took a closer look at AEPC's programs to see just how it works. Here's a rundown.

POWER-BY-THE-HOUR

That phrase is a Rolls-Royce trademark invented way back in 1962 to support the grenade-like Viper engine on the de Havilland/Hawker Siddeley 125 business jet. Because of the unreliable nature of the engine, the idea was to build confidence by offering a complete engine and accessory replacement and service program offered for a fixed cost per flying hour. The concept was eventually copied by others, making its way to a wide variety of turboprop and turboprop applications.

In 1989, AEPC's founder, Ron Zilberbrand, started Jet Support Services Inc. (JSSI), which went on to

The engine doesn't have to be new to get on a PESP program. The 1400-hour Lycoming on the Cardinal pictured here is fair game as long as it passes a stringent initial inspection.

become one of the largest independent providers of hourly-cost maintenance programs for turbine engines, before selling the company in 2008. Believing there's a need for programs in the piston market, he recently launched AEPC.

In the turbine aircraft world, the first question that comes up during a jet's resale is whether or not the aircraft is on a maintenance program, which includes programs for engines, airframes, landing gear, avionics and even APUs so the entire aircraft can be operated on a fixed-rate basis. AEPC deals strictly with programs for piston engines—no airframe or avionics coverage—but that will likely expand as it works with OEMs and fleet operators.

Zilberbrand realizes that unlike in the jet world, operators of typical



CHECKLIST



This concept has been the gold standard in the jet world.



The piston market is recognizing an increased resale value of programmed aircraft.



If you fly a low-end aircraft less than 50 hours per year, a buy-in likely isn't for you.

private piston-powered aircraft don't have a chief pilot and a director of maintenance to look after the aircraft. One of Zilberbrand's goals is to instill a discipline in piston aircraft owners that simply doesn't exist to the extent it does in the jet world. We agree that the mindset needs to change. A lot of owners simply aren't prepared for major unscheduled maintenance. AEPC doesn't claim to lower your maintenance costs.

PISTON ENGINE SERVICE PROGRAMS

An important aspect to remember is that AEPC isn't offering a warranty program or insurance—far from it. Zilberbrand reinforces that none of these programs should be considered a warranty. That's because the technical definition of a warranty is a guarantee made by the manufac-

PISTON ENGINE SERVICE PROGRAM FEATURES

INCLUDED PROGRAM FEATURES	PESP	PESP PLUS	PESP CARE
Coverage for engine components, includes 100 percent of parts and labor	✓	✓	✓
Eligible for open enrollment any time during engine's life	✓	✓	✓
Loaner engine components offered when available and applicable	✓	✓	✓
Loaner engine accessories offered when available and applicable	✓	✓	✓
Ground freight charges included with component replacement effort	✓	✓	✓
Loss of use reimbursement for components covered	✓	✓	✓
Trip interruption reimbursement for components covered	✓	✓	✓
Renewable agreement	✓	✓	✓
Agreement duration of three years minimum	✓	✓	✓
Coverage for engine accessories, which includes 100 percent of parts and labor		✓	✓
Contract agreement required for a minimum of five years			✓
Coverage for scheduled service (annual inspection and overhauls)			✓
Fixed budget for scheduled service			✓
Fixed budget for unscheduled service	✓	✓	✓

turer of a product that it will operate as it was intended for set amount of time after you acquire it. Moreover, AEPC doesn't maintain anything. While it does have on-staff advisors who work with the aircraft owners to help troubleshoot problems and coordinate FAA-approved shops and mechanics, you are free to bring your aircraft to any qualified facility of your choice. The chart above is a quick reference guide for standard benefits under a given service plan.

In summary, there are three segments to this family of engine programs (contracts) termed PESP, for Piston Engine Service Program. AEPC says one of the benefits of signing on to even the most basic maintenance program is minimizing the risk of pricey unscheduled service (think real-money stuff like all new cylinders), while stabilizing the overall scheduled service budget. Unless you are seriously structured about putting money aside for all maintenance events—and some owners are not—this could lessen the blow. There might be payback when you sell the aircraft because all maintenance programs are transferable upon the sale or trade of a covered aircraft in good standing. Plus, it shows a buyer you were serious about maintaining the engine. Our research shows the industry is indeed putting a premium on aircraft that are programmed, like it is

in the jet world. *Aircraft Bluebook* says to add \$65,000 to a used SR22 with an AEPC program in place.

There are three programs for buy-in, starting with unscheduled coverage only for engine components (PESP), unscheduled coverage for engine components and also its accessories (PESP Plus) and a program that covers engine components, accessories, plus annual inspections and engine overhauls (PESP Care).

Let's consider an existing second-generation Cirrus SR22 with a mid-time engine. You're new to the aircraft and concerned about the engine unexpectedly needing a top overhaul and other unscheduled work. Maybe it eats a cylinder or two—not uncommon. Lurking in the back of your mind is the day your shop tells you it's time for an overhaul. Under the base PESP program, what's covered is the unscheduled failure of major engine components. This includes the case, crankshaft, camshaft, lifters, cylinders, intake valves, rocker arms, rod bearings, intake springs, exhaust valves, rings, gasket sets, tappets and even an oil pump housing. For the Continental IO-550 series in the Cirrus, the PESP program also covers the exhaust system components.

"Using the age-old jet program philosophy, by paying by the hour what you're doing is ultimately zero-timing the engine by prepaying for scheduled engine maintenance and

along with that comes scheduled maintenance," Zilberbrand told us. If you sell the airplane, the program can stay in place as long as someone keeps paying the hourly rate. These rates vary by aircraft, but for the Cirrus SR22, the enrollment fee for the base PESP program is \$7725, which covers unscheduled component replacement for 600 hours of flight time, or for three years and up to 200 flight hours per year.

The PESP Plus (for a \$13,334 enrollment fee) is a similar program, but it also includes accessory replacement. Sticking with the Cirrus SR22 as an example, what's covered here is components like the starter, the starter adapter, magnetos, engine fuel pump and both alternators.

The flagship program is the PESP Care. The Cirrus has a \$7725 enrollment fee and uses a fixed budget formula for scheduled and unscheduled service. You have to sign on to PESP Care through a five-year renewable agreement, as opposed to three years for the PESP Plus program. For the Cirrus on a PESP Care program, you pay \$63.04 per hour for 100 percent coverage of parts and labor, for both scheduled (100 hour/annual inspections, mag replacement and overhauls) and unscheduled service, including removal and replacement of the engine and shipping. You'll pay \$22.95 up front for each hour already flown off the engine.

You don't pay the hourly rate in advance. Instead, pay as you fly. On a monthly basis you'll go to the company's website and log in to enter the ending time and starting flight times for the month flown to determine how much you need to pay into the program. Pretty simple—if you flew 10 hours for the month, simply multiply it by the \$63.04 hourly rate and mail AEPC a check for \$630.04.

That money goes into a reserve account for future maintenance. AEPC pays the shop directly. If you're over 30 days late with payment, you can get hit with an 18 percent fee per monthly invoice and dropped from the program.

GETTING STARTED

The program covers a wide variety of Lycoming and Continental engines. To qualify for the program, the aircraft engine must undergo an initial inspection at an FAA-approved shop or by a certificated A&P of your choice. This is called a pre-enrollment engine review, which is assigned to a legal contract. One of the first things that is verified is the engine serial number (on a warm engine), which must match the aircraft logbooks. The inspection is fairly involved.

It includes a ground run to warm the engine for a differential compression check. If it's a Continental engine, a master orifice reading is obtained before the compression check. During the ground run, the engine idle speed and oil pressure is recorded, as is the RPM drop of each magneto. The engine is uncowed and inspected for oil leaks, a mag timing check is accomplished and the engine case and cylinders are inspected for cracks in prone locations and around spark plug bosses.

The inspection also includes an oil change, where the oil filter is cut open and inspected for metal and other contaminants, and an oil sample is sent to Blackstone Labs for analysis. AEPC says it may also request a cylinder borescope inspection and possibly a valve guide

Cylinder replacement, among other major engine components, top photo, is included in the base PESP program, while the PESP Care is the flagship hourly rate program that reserves for inspections and overhauls at the shop of your choice, including the factory, bottom.



inspection, depending on the overall condition of the engine and the compression check readings.

AEPC requires that you send the engine and flight data that's recorded by an onboard trend monitoring system, if equipped. Also, you'll have to do your part in protecting the engine during storage. In the contract, deal-breaking abuse specifically includes exposing the airframe or engine to the damaging effects of corrosion. Under the contract, Illinois is the state of governing law.

We didn't see any red flags in the agreement, but we did spot a statement that said replacement components will not necessarily be new unless specifically approved by AEPC. Additionally, the coverage of some troubleshooting efforts is capped at two hours. All non-consumable components removed from the aircraft become the property of AEPC.

Under the unscheduled service contract, there's an AOG benefit that pays you \$100 per day (up to five business days) if a covered component isn't available after six days.

THIS ISN'T FOR EVERYONE

"The owner who needs this program the most might be the one who flies a \$30,000 aircraft less than 50 hours per year, but he's probably not going to pay 15 percent of the aircraft's value for PESP Care," Zilberbrand admits. AEPC has no problem with



old aircraft with high-time engines because it's looking at it carefully during the pre-enrollment inspection. What we're getting at is if you try to enroll knowing the engine needs a top overhaul, so will AEPC.

During our research we learned that some large respected aircraft dealers and high-volume engine overhaulers are adopting AEPC programs as standard. Poplar Grove Air-motive includes an AEPC program with 700 hours of coverage on every engine it sends out the door.

OEMs are getting on board, too. American Champion is delivering its new models with a program attached, AEPC is working with Piper to program the Malibu/Matrix and Seneca and Zilberbrand hinted at plans for new Cirrus models. We'll revisit the program in a year to see how it's going. If you have experience with it, we want to hear about it.

CONTACT...

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Remote Heat Switching: Wemo Smart Plugs Win

Control your engine heater remotely with cellphone-activated switching from FST or SwitchBox. When Wi-Fi is available, Wemo Smart Plugs are a bargain.

by Rick Durden

Someone just flipped the switch and shut off summer. Aircraft owners who live in the temperate climes are preparing their machines for the demands of winter. Unless those owners have been living under a rock, they know that part of that preparation involves figuring out a way to start the engine when the frost is on the pumpkin because they know that firing it up in very cold weather, without some form of preheat, can do a lot of damage to the engine.

We're going to talk first about why preheating an engine is important and the concerns about engine corrosion due to moisture that can accumulate in the engine due to improper preheating with an electrical

engine heater. Then we'll look at the products available to remotely switch heaters on and off if a pilot doesn't want to leave the heater plugged in full time and have to drive out to the airport to plug it in prior to a flight. The bottom line? We like the remote switches sold by SwitchBox Control, FST LLC and Belkin—and their prices.

YA GOTTA PREHEAT

In their service instructions—SIL 03-1 for Continental and Lycoming's number 1505—the engine manufacturers make it clear that their engines should be preheated when the OAT falls below 20 degrees F. We can't resist pulling Continental's chain because its letter refers to wind chill



CHECKLIST

-  For around \$50, Wi-Fi-based Wemo Smart Plugs are convenient and cheap.
-  Cellphone-linked units can switch two independent lines.
-  Repeatedly turning the heat on without flying can lead to corrosion.

factor, which is irrelevant to OAT and metal objects—and think it's time they correct that error.

PLUGGED IN CONTINUALLY?

The question that we hear is whether leaving an electric engine heater plugged in continually will cause corrosion in the engine. While we will be doing an in-depth piece on engine heaters in a future article, the simple answer is that if the heater keeps the temperature of the entire engine above the dew point there will be no place for the moisture in the engine to condense—and potentially cause corrosion.

We believe that a heater manufacturer should be able to provide data to demonstrate to a prospective buyer that it will keep the overall engine temperature above the dew point in prolonged use—if it will.

The downside to using a heater for only a few hours prior to an intended flight is that if you don't fly and have to shut the heater off you have just created conditions conducive to water vapor condensing in the engine. While a few times probably isn't a big deal, doing so repeatedly starts pushing the level of risk up there.

In addition, we do not recommend using a timer that turns your heater on and off if you aren't going to go flying at the end of each cycle.

While researching this article we spoke with a number of mechan-

An electric engine heater is an ideal way to get the engine ready for a cold-weather start. What are your options for turning it on and off if you don't want to leave it plugged in all winter?

The SwitchBox controls two independent lines with up to 1800 watts and 15 amps.

ics who referred to seeing water when first starting to drain the oil during winter oil changes on heater-equipped customer aircraft, corrosion in various locations of the engines as well as looking through a borescope and seeing liquid water inside cylinders.

If you are not able to ensure your heater will keep the entire engine above dew point, we recommend turning on the heater the number of hours prior to your flight recommended by the manufacturer.

The good news is that there are good remote switching devices on the market and most will run two separate electrical lines—something that is handy if you are also running a cabin and/or avionics heater, which may draw more power than the engine heater, and you want to turn them on and off separately.

SWITCHBOX CONTROL

Two versions of the 4G SwitchBox from SwitchBox Control are offered: the \$349.99 SwitchBox and the \$364.99 SwitchBox with LED plugs (they light up to show the circuit is active). The units are otherwise identical, with two independent outlets able to handle 120 volts, 15 amps and 1800 watts. Each comes with an activated T-Mobile account with \$3 credit that expires after 30 days when a \$10 credit must be added by the user.

The unit has a custom timer that can be programmed for up to 18 hours. The user establishes a security list of telephone numbers from which it will accept calls. Calls to the unit are free and do not subtract from the balance in the cellphone account. Texts from the unit cost 10 cents for T-Mobile, 20 cents for AT&T. The manufacturer's instruction manual indicates the unit can be operated for \$30 per year in cellphone fees.

According to SwitchBox Control, the preferred method of operation is via the free app for iPhone, iPad or Android device. The website provides a video explaining the operation of the apps. There is also an app for any



device with internet access. The unit may be activated via a phone call—the call goes to voicemail and power line 1 activates. Calling the unit again will cause outlet 1 to turn off. When using a text message, the user enters a code to turn on either outlet 1 or outlet 2; however, the unit can be programmed via text message to turn on both outlets via text message. When the unit is turned on or off via text message, the unit replies with a text confirming the action has taken place. Signal strength to the unit may also be monitored via text messaging or the app.

There is a 10-foot remote antenna available for \$20 to get the best cellphone reception. The signal quality should be checked with the hangar door closed. The SwitchBox comes with a 12-month warranty and 30-day money-back guarantee.

SwitchBox Control still offers a 2G version of the SwitchBox with the same features as the 4G version. Prices are \$299.99 for the unit and \$314.99 for the unit with LED plugs. According to the website, the 4G device has 30-40 percent better cell reception than the 2G model. As SwitchBox only pairs with T-Mobile service, we note that while T-Mobile has said it will continue 2G service until 2020, it also appears that it is suspending it in some areas already. Because of the upcoming phase out of 2G service, we do not recommend buying a 2G unit.

We contacted former astronaut Jay



Apt who has been using his SwitchBox since 2012 to ask him how it had been working over the last five years. He told us that he'd had no trouble with it, but that he'd found it was simpler to operate the device with text messages rather than the app.

When we spoke with him in early September he said that the preheater season had started where he lives in western Pennsylvania and he had just added \$20 to his T-Mobile account, which should run his SwitchBox for the season. We note that not keeping the account current can result in losing the cellphone number and a hassle in obtaining a new sim card and re-establishing service.

Dr. Apt said that he was glad to have the antenna extension as cellphone reception varied within his hangar. He also said that the cord from the SwitchBox to the wall plug is fairly short so he tie-wrapped the unit to a spot adjacent to the power plug in the hangar.

FST LLC

Offering three remote switching



units, FST differentiates them primarily by the switching capacity.

The basic unit, U-Phone-iT 4G, is marketed through Aircraft Spruce for \$292 and has two independently controlled 120 VAC outlets with a 10-amp overall capacity. It can be controlled by a telephone call, text message or iPhone (no Android) app provided with the unit. For security, you select the phone numbers from which the device will accept calls as well as set a password. The call or text turns the selected line on or off or activates a programmed cycle—it can be remotely programmed.

Max switching power of the U-Phone-iT 4G is 1000 watts and 10 amps. The device monitors cellphone strength at its location—a remote antenna is available for \$48.50. It sends automatic notifications of power outages and restoration and it can be

interrogated as to status, responding by text message.

The box itself is made of ABS plastic with dimensions of 4.75 by 5 by 8.5 inches and weighs 2.5 pounds. It has a carrying handle and non-marring feet. Neon lamps illuminate to show when the outlets are active.

The U-Phone-iT 4G comes with a 12-month warranty and 80 days of paid AT&T cell service. FST says that the user-managed cell service costs as little as \$4 per month.

For \$375, FST's Regal Pro has all of features of the U-Phone-iT 4G and a maximum switching power of 1700 watts, a 15-amp capacity and a clock-based activation program that can turn on its outlets at a specific time of day and leave them on for periods selected by the owner.

Contained in an aluminum case, the dimensions of the Regal Pro are 5.4 by 6 by 10 inches. It weighs 3.2 pounds.

At \$395, the top-of-the-line Regal Pro-Max 4G has a 20-amp capacity and one outlet with a 2400-watt capacity and the second with a 1400-watt capacity. FST says that it will handle the highest-power aircraft engine heaters on the market and that it can service two single-engine or two twin-engine aircraft simultaneously and separately.

The Regal Pro-Max has an aluminum case with dimensions of 5.4 by 6 by 10 inches and weighs 5 pounds. The operating temperature range for all of the FST devices is -10 to 120 degrees F, which may not be adequate for the coldest sections of the country.

FST offers a cell management subscription service that will make sure your switch's service continues to operate for \$80 per year.

BELKIN

If your hangar has decent Wi-Fi

FST's line, left, includes the Regal Pro-Max, U-Phone-iT 4G and Regal Pro. Belkin's Smart Plugs, below left, require a Wi-Fi connection but are attractively priced.

reception, there are a series of Wemo "Smart Plugs" available from Belkin. While they are advertised for household use, they will handle 1800 watts and 15 amps.

Prices range from \$29.99 to \$49.99. Each is controlled by an app for Android and iOS operating systems—and they monitor the energy use of the heater plugged into the unit. If the user wants to control a second power line, it's just a matter of buying another Smart Plug and programming it.

CONCLUSION

We like both the SwitchBox Control and FST LLC lines of remote switches, but lean toward the FST entry-level box because it is the cheapest on the cellphone-controlled market for those whose heaters don't draw more than 10 amps and 1000 watts. However, if you want to use an app to control the heater and have an Android device, it's a SwitchBox Controls unit only. We like that both manufacturers' units can be interrogated as to their status.

We're learning that an increasing number of owners have Wi-Fi service in their hangars. In that case, we think the under-\$50 Wemo Smart Plugs are the way to go.

CONTACTS

Belkin
800-223-5546
www.belkin.com

FST LLC
262-412-7580
www.fstllc.com

SwitchBox Control
No phone number provided
www.switchboxcontrol.com



AIRCRAFT OWNERSHIP

Rescue Buys: Think Salvage Value

Getting a slumbering aircraft back in the air means accepting that you'll go over budget on repairs and restoration. Type organizations are a good starting point.

by Peter Kuhns

At nearly every airport you'll find aircraft that haven't flown in years. Some are hidden in private hangars, some are stashed in the corners of maintenance shop hangars and some are ramp derelicts that are begging for rescue from the harsh elements. Is it worth getting involved with these neglected birds given the number of airworthy ones on the current market? The short answer is maybe, but only with the right approach and a healthy dose of realism. Hint: Seldom is there a great deal.

For this field report, we talked with owners who have endured the realities of rescuing a neglected aircraft and describe why it might and might not be worth the effort and investment risk.

STORAGE MATTERS

While it's more common to find aircraft that haven't moved in years sitting on outdoor tiedowns, you might stumble upon some hidden gems. Like classic car barn finds, it's all about the preservation. Done right,

long-term storage in a dry environment helps preserve the airframe and avionics, but even when impeccably preserved, don't think you can fly the airplane out without careful inspection. Legally, you'll need a ferry permit. See the November 2016 *Aviation Consumer* on the permit process.

"If it's hangared in a dry environment, you'll still need to borescope the engine," advises Robert McGuire, an A&P/IA with Mooney expertise. In the Mooney world, McGuire cautioned that it seldom makes sense to think you'll save money with hangar rescues because you'll likely spend up to \$60,000 for even an older one with aging avionics. In general, he thinks you'll end up spending tens of thousands of dollars to update the panel and maybe as much for airframe work only to find the engine needs to be rebuilt. "I'd say no, don't do it," he told us.

Accident reports may drive his counterpoint home. A Beechcraft Sierra that sat for 12 years on a ramp

Just because it's hangared doesn't mean it's preserved. The Grumman Lynx in the main photo is covered with bird droppings and might also be infested with mice. It also looks to have surface rust.

in Utah was recently purchased from an eBay listing. Two weeks later it departed, presumably for the first time (based on ATC communications), crashed a quarter mile from the departure end of the runway onto a city street and hit a car before catching fire. Thankfully no one was hurt and while the NTSB hasn't released its final report (the preliminary is at tinyurl.com/ybvm8m5l), the chatter in Beech type club communities prior to the sale was ripe with the unfortunate history of this airplane (none of which appeared in the eBay listing). There were some warnings of rotted fuel lines. But it isn't all grim in the world of aircraft rescues. We heard plenty of success stories during our research.

IT CAN BE DONE

No matter how upside down and jaded you become as a new owner of a neglected aircraft, there do seem to be some worthwhile takeaways from those who have succeeded in rescuing forlorn birds.

"It can be done. We did it 15 years ago with a Grumman Tiger," says John Sjaardema, of Excel-Air Services in Rensselaer, Indiana. The shop bought the Tiger sight unseen in Arizona after the aircraft hadn't flown in 15 years. Sjaardema concedes he didn't make much money on the airplane—maybe \$5000 profit—but it kept his staff busy during a slow winter. "Yes, we rescued it, but would I do it again today? For a Tiger, maybe, but I wouldn't attempt that kind of restoration on a lower-end Traveler or AA-1, for example, because we'd never recoup the costs," he told us. That's the common thread we heard from nearly every expert we spoke with because for the most part, the serious restoration effort (and the expense) that's often required of rescue aircraft might only make sense for planes with decent market value.

But aside from inherent value, perhaps the aircraft you have your eye on is uniquely configured. Sometimes it's a pretty good score as it was



The rescue attempt of the Beech Sierra in the top photo didn't end nearly as well as Tommy Kreuter's vintage Beech Bonanza, middle, which—

other than needing a battery—turned out to be squawk-free after sitting in a hangar for 14 years. Consider investing in cylinder borescoping, bottom, on any engine that's been sitting—indoors or out.



Yan Aero. Lindauer—an A&P with IA—did what every buyer should and asked the broker for the aircraft and engine logbooks, plus detailed photos of the aircraft.

"We shot the broker a low-ball offer that wouldn't end up killing us financially if there

were surprises later on, and the seller accepted it," Lindauer told us. He ended up having the airplane ferried to his location so he could perform the annual inspection, which ended up costing \$2000. The father and son team ended up with a decent four-seat retract with only 400 hours on the engine for around \$40,000. That's rare, though.

WHAT SHOULD YOU PAY?

Paying the right price for a rescue aircraft is definitely part of the equation. And for some planes, that price might be—or might need to be—zero.

Larry Crowl managed to rescue a 1975 Cessna 177RG Cardinal, but only because it was given to him. The asking price wasn't due to penny-pinching neglect. Crowl's friend bought the Cardinal in 2003 and then he went through a string of serious health issues, which kept him and the airplane grounded for 10 years.

"I told him I'd love to buy the airplane and convinced him not to part it out. He said he'd give it to me on one condition: I send the engine to a reputable shop for rebuild, so that's what I did," Crowl told us. It wasn't all roses, however. The Cardinal sat for two years outside and required the re-skinning of the tail because of bird infestation.

Crowl's advice to the hopeful: "You have to find a trusted mechanic to join you in any aircraft rescue process, and add nearly 15 percent more than you'd like to spend on restoring it," he said. You'll also need patience because as Crowl noted, there will be times that you need a replacement part and it won't be readily available.

Of course, the flip side of an amazingly low acquisition price (as in free) is paying full price. Why in the world would you do that? In some cases, the forgotten plane that sits rotting in a hangar or a tiedown might be the only plane you can fly. That was the case for Brian Estes, who rescued a 1978 Cardinal RG five years ago.

The mostly all-original airplane sat (hangared) for three years and Estes told the seller he would pay the asking price if he would fly the airplane to Estes' own mechanic for an inspection.

"I bought it and completely rebuilt it, including the interior, engine, avionics and paint. It's essentially a new plane," said Estes. But why so much love after paying full price for something that's been sitting for so long and needed so much work? "I'm paralyzed from the legs down and the Cardinal RG is the only airplane I can fly independently due to its enormous doors and high wing," he told us.

THERE'S SOME LUCK INVOLVED

How seminal is luck in this process? "I was definitely lucky," says Tommy Kreuter, about his 1947 Bonanza he rescued from 14 years of slumber. Kreuter had just earned his private pilot's certificate in 2010 and the wife of his father's business associate

for Curt Lindauer. But you have to be smart about it.

"My son was trying to finish the training for his private pilot's certificate and asked if I wanted to get back into flying (after a 13-year hiatus) and partner in an airplane. Our budget was small and requirements were light, so we searched and searched," Lindauer told us. Finally a 1975 Beech B24R Sierra that had a landing gear incident popped up on an internet search. The airplane had flown very little following the prop and engine overhaul, which was performed by the respected Penn

TYPE CLUBS: WORTH IT FOR TECH DATA

The aviation equivalent of free actually exists and it's called the type club. The low cost of joining one for full benefits, including access to technical resources—often around \$50—could be your best investment before even embarking on a rescue project. How is this possible? Longtime pilots of a certain aircraft type—many of them A&Ps—know a thing or two about their planes and generally love to share experience and knowledge. The internet makes for easy access. In addition, type clubs have prebuy inspection lists that uncover relatively obscure things to look for during an inspection. And no, some critical ones aren't always covered in an airworthiness directive or service bulletin.

As one example, some late-model Grumman Tigers (this is the AG-5B) have dissimilar metal corrosion rearing its ugly head through blistering rivets around the middle of the wing flaps. The metal strap that holds the flap was made of steel and the flap is made of aluminum. Over the years the two dissimilar metals react and start to corrode the flap. You would think there is a service bulletin or even an AD for this, but there isn't. However, this issue does appear on the pre-inspection checklist avail-

able from the Grumman type club.

Another bacon-saving benefit to type clubs is the enduring relationships these clubs have with mechanics who specialize in the type. Not only might these shops be higher



caliber (not always the cheapest, however), many are partners with the type club members. This means many are welcoming to owner-assisted annual inspections, they might host events at type club

conventions and (time permitting) actively participate, answering questions from members on the type club web forums. Type organizations can also be a good source for training.

The American Bonanza Society offers its Beechcraft Pilot Proficiency Program (BPPP) free to all ABS members, although complimentary temporary memberships must be converted to a paid membership to participate. The BPPP has one of the better online training centers we've seen. For instance, the BPPP initial course focuses on aircraft systems and techniques for proper engine operation. The systems, procedures and techniques course consists of 13 go-at-your-own-pace training modules and includes short quizzes at the end of a module. Two of the programs that focus on fuel systems and engine failures have versions dedicated to certain models, including the Baron/Travel Air and Bonanza/Debonair. You can expand the online training to real-world flight instruction. ABS also offers type-specific training for experienced A&P mechanics in its ABS Maintenance Academy.

Last, use caution while using free type-club internet forums. They can be good resources for getting answers to lots of questions, but some technical content can be dated.

was selling a hangar. The gentleman had dementia and thought he was still flying, but actually hadn't flown in 14 years.

"I went to see what was in the hangar and in the back under a

tarp was a 1947 Bonanza. I bought the hangar and then had the plane ferried 60 miles to my mechanic. It turns out the airplane was squawk free and after sitting all that time there were no rat's nests and no

ADs. It just needed a new battery and a double oil change," Kreuter told us. It's an interesting story. The engine had been overhauled in 1968 and received chrome cylinders. In addition, the remote oil tank check valve failed, allowing oil to flood the case, essentially pickling it. This Bonanza was owned by the same pilot since 1952 and lived in the same hangar all that time.

We asked Kreuter if he would rescue another plane, even though the next time he might not be so lucky. "Yeah, now that I know what to look for. It's all random though and you really can't be looking for a particular type," he said.

THE TAKEAWAYS

What are the takeaways from these successful rescues? Partner with an A&P if you aren't one because you'll be relying on him or her a lot. Type

continued on page 32

TIPS FOR RESCUE BUYERS

- ✓ Start by joining a type club and get an inspection checklist.
- ✓ Consider the hidden damage caused by outdoor storage.
- ✓ Lobby the help of a mechanic experienced with the model.
- ✓ Plan on borescopic imaging of engine cylinders.
- ✓ Don't think about flying the aircraft without a detailed inspection.
- ✓ Plan on going over budget on restoration projects.
- ✓ Some neglected aircraft aren't even worth salvage value.
- ✓ Neglected complex models might not be worth chasing.

Hot Starting: Science and Art

Hot starting problems can be minimized by monitoring ignition system health and controlling vapor in fuel lines. Aftermarket devices can help.

by Rick Durden

It's long been recognized that an effective way of starting a fight in a bar catering to pilots is to innocently ask about procedures for hot starting big-bore Lycoming or Continental engines and then step back. The chairs will start flying.

That's about what happened when we started the research for this piece. We heard it all. Being either foolish or fearless, we immersed ourselves in the subject to see if we could come up with information as to why hot starting is a problem, find recommen-

dations for maintenance and operating technique that can minimize the problem and see if there are aftermarket devices that can help. We did, we did and there are.

THE PROBLEM

Hot starting difficulties for piston-engine general aviation airplanes tend to be limited to fuel-injected engines that do not have some sort of computer-controlled ignition and/or fuel injection system. That means almost all higher-horsepower engines.

The classic "it won't run" situation occurs on a warm or hot day, some 15-45 minutes after landing. The pilot tries to start the engine. It will catch, run briefly and then quit. Further attempts may or may not result in the engine firing at all. If it does, it will usually only run a few seconds before reciprocation ceases.

The underlying reason is that the fuel lines downstream of the fuel control unit through the distributor valve and to the individual cylinders are positioned so that they absorb the heat after engine shutdown. The fuel in the lines vaporizes—so liquid fuel is not getting to the fuel injector nozzles and the cylinder doesn't get the appropriate fuel mixture for ignition. The problem is made worse by unresolved maintenance issues in the ignition system.

IGNITION

Hot start issues boil down to two: inadequately robust spark from the ignition system and fuel vapor that prevents liquid fuel from reaching the injector nozzles.

According to Mike Busch, founder of Savvy Aircraft Maintenance Management, during a hot start, the mags, impulse coupling(s), ignition wiring harness and spark plugs have to be in good condition to generate adequate spark because the fuel mixture in the cylinders may be less than ideal.

Busch told us that while the magneto manufacturers' recommended 500-hour interval for inspection and replacement of components as needed (IRAN) is not required for a Part 91 operator, he strongly recommends it. We agree. In our May 2016 issue, we looked at magnetos in detail and found that within 500 hours of operation it's not unusual for plastic components to wear or fail and for carbon tracking to induce arcing, throwing off mag timing and/or internal E-gap timing, leading to hard starting issues.

As would be expected, dirty or improperly gapped spark plugs will cause hard starting in general.

Another cause of weak spark is high resistance in the spark plugs. Each plug has a resistor that reduces

While this is one way of dealing with hot starting issues, we don't recommend it.



On most fuel-injected engines such as this Continental IO-550, the fuel lines (curving silver tubes) to the cylinders run directly over the top of the engine itself—in the ideal location to become heat soaked following shutdown.

the voltage from the magneto to an appropriate value for the spark that ignites the fuel/air mixture. Normal resistance for a new plug is 1000 to 2000 ohms. Plug manufacturers state that resistance may climb in service. The question is how much is too much. Tempest publishes guidelines recommending replacement once resistance exceeds 5000 ohms. Our research did not elicit consistent recommendations on the subject. Nevertheless, it's our opinion that if you're having starting issues, check plug resistance and replace any that are showing a level above 5000 ohms.

Many Continental engines are equipped with a "shower of sparks" system to multiply the number of sparks from each plug per activation of a magneto's impulse coupling. The system has been around since the Ford Model T because it works. A vibrator switch triggers a rapid firing sequence that causes there to be nine to 12 sparks from the impulse coupling rather than one—creating a longer spark sequence that helps ease hot (and cold) starting.

We have gotten good feedback from users on Champion's SlickStart, an aftermarket ignition enhancer that can be thought of as a computerized approach to the shower of sparks concept. The \$829 box was designed for Slick magnetos, but versions are available for some Bendix mags. It creates a long, powerful voltage for low-speed starting, increasing the length of the starter sequence and increasing the electrical energy to the plugs by up to 340 times that of an impulse-coupled spark.

FUEL VAPOR

The more common cause of hot starting woes is that following shutdown the heat of the engine rises and is trapped right where the fuel lines to the cylinders live. The fuel vaporizes, blocking the flow of liquid fuel to the



injector nozzles. The sour spot for a hot start attempt is 15 to 45 minutes after engine shutdown. George Braly and his team at General Aviation Modifications Inc. (GAMI) instrumented some airplanes with big-bore, fuel-injected Continental engines to track post-shutdown temperatures in the cowl. What they found was that in addition to vaporizing the fuel in the lines above the engine itself, much of the residual heat was concentrated in the engine-driven fuel pump. The fuel vaporizes in it and the pump won't pump.

During a starting attempt, the pilot runs the boost (primer) pump to prime the engine and then hits the starter. The engine starts on the fuel from the primer, uses it up and quits because all the cylinders then receive nothing but vapor.

There are a number of prophylactic steps that can be taken, including heat shielding the fuel lines, which—according to Mike Busch—pays big dividends. In addition, on airplanes with an oil access door on top of the cowl, opening it after shutdown allows much of the heat that would be trapped above the engine to escape. If the airplane has cowl flaps, parking it facing downwind, with the cowl flaps open, helps drive the heat out of the front of the cowl.

The solution for fuel-vapor induced hot starting problems is to get rid of the vapor in the engine-driven fuel pump and the fuel lines above the engine. Our research indicated this can be accomplished by following what is in most POHs for the airplanes, that

Lycomings hot start more easily than Continentals—their fuel injection systems are not the same—and that there is an aftermarket product that looks promising.

iStart (www.istartair.com) is a computerized priming assist system with a secondary fuel injection system that samples the engine temperature and injects the appropriate amount of fuel for priming, cranking and starting. The additional plumbing is independent of portions of the engine's fuel system. It's only used for starting (not in flight) and cannot operate when the engine is running.

During start, the mixture control is left at idle cutoff while iStart adjusts the fuel delivery through its fuel lines. Once the engine is running, you advance the mixture control and set the throttle for 1000 RPM. Once 10 seconds have elapsed and RPM has stabilized, iStart shuts down.

The price is \$995 plus specific fuel lines and fittings for the type aircraft (it's STC'd on Beech singles and the Bellanca Viking thus far)—installation is estimated at a day. iStart has proven popular on experimental aircraft over the past six years. STCs are expected for Cessna singles followed by Piper and Diamond aircraft.

TECHNIQUE

We think we've heard every hot starting technique known to pilots including "go to McDonald's, get a burger and by the time you get back it'll start right up."

We do not recommend the technique of intentionally flooding the



iStart adds additional fuel lines (red hoses) through a computer-controlled secondary fuel injector (black cylinder between red hoses in center of photo), left. The SlickStart module usually mounts on the firewall and connects with the impulse-coupled magneto(s), lower left.



engine by running the boost pump with the throttle wide open and the mixture rich and then attempting a start with the mixture at idle cutoff while moving the throttle slowly until the correct mixture is reached, and enriching the mixture when the engine fires.

Intentionally flooding the engine means running fuel onto the ground under the engine—creating a very real fire risk. When the engine is overprimed, it's not unusual to get a long gout of flame out of the exhaust stack when the engine fires. It usually, but not always, wraps upwards around the cowling and happens so fast that the pilot doesn't notice it during daylight hours. That can—and has—ignited a puddle of fuel under the engine.

We recommend following the aircraft manufacturer's technique in the POH. For most Continental engines it involves what Mike Busch refers to as a forced purge. That starts with pulling the mixture to idle cutoff,

advancing the throttle to the stop and running the boost pump on high for a minimum of 45 seconds. With the mixture at idle cutoff, no fuel will get past the fuel control unit—unless it is improperly adjusted, a problem in its own right. Relatively cool fuel from the wing tank is circulated through the lines, to the FCU, driving the hot fuel back to the fuel tank and cooling down the fuel lines upstream of the FCU. The only hot fuel is between it and the cylinders.

Once the boost pump is shut off, the mixture is set at full rich, the throttle for slightly over 1200 RPM and the boost pump used briefly to prime the engine. Immediately engage the starter. The engine may turn several blades before firing. Be ready with the boost pump when it fires as the engine is likely to quit once the small amount of vapor in the lines between the FCU and cylinders gets to the injector nozzles. If the engine stumbles or quits, turn the boost pump to high until it starts running again. It may be necessary to do that a second or third time. Once the RPM settles down—it may take 30 seconds—slowly reduce power to the desired idle RPM.

For Lycoming engines the solution is similar. Do the forced purge. Then go to full rich and prime the engine with the boost pump for two to four seconds. Pull the mixture to idle cutoff and set the throttle about one inch above idle. Engage the starter. When the engine fires, slide the mixture to rich over a few seconds and

be ready with the boost pump if the engine stumbles or quits.

STARTERS

In researching this article we heard from an Aerostar owner who said he'd solved his hot start problems by replacing the slow-turning factory starters on his engines with much faster turning Sky-Tec starters.

Of course, that got our attention, so we followed up and learned that while a faster turn rate is beneficial because there is prop momentum carrying the crankshaft through uneven cylinder firing, there is a point of diminishing returns. Magneto impulse couplings disengage at an RPM as low as 180 and Sky-Tec's starters will turn up at about 120-140 RPM—so there's not a lot of room for improvement. A faster turning starter may help, but it's not a panacea.

We also learned that one of the unsung victims of difficult hot starting is starters. Virtually every aircraft starter has a cranking limitation and cool down requirement. The rule of thumb is that for every 30 seconds of cranking, the starter must cool down for 90 seconds.

CONCLUSION

Hot starting challenges can be minimized by assuring that all components of the ignition system are in good operating order and following a starting technique that recognizes and deals with fuel vapor in the fuel lines above the engine. We also like the available aftermarket products SlickStart for spark enhancement and iStart to meter the fuel appropriately during the start sequence.

We also urge pilots to remember that if a hot start attempt is not going well, they may be frying an expensive starter. Maybe it is time to go to McDonald's and let things cool off.

Garmin VIRB 360: VR for Aviation

The 360 is easy to use and produces in-camera stitched footage. But at \$800, it's a niche product that doesn't beat the VIRB Ultra 30.

by Paul Bertorelli

If point-of-view or action cams are as common as iPads in the modern cockpit, buyers may be getting a little bored with the ordinary flat footage they produce. Enter the 360 camera, a gadget that literally has eyes in the back of its head. The 360 market hasn't exactly exploded, but there are a half dozen to pick from, with more on the way.

What do they do? They produce footage commonly called VR or virtual reality. This allows the viewer to use a cursor to scroll around the imagery 360 degrees horizontally and, depending the camera, up to 360 degrees vertically. It's supposed to be like actually being there but, trust us, you'd rather be there than sitting in your den scrolling around a YouTube video.

For this review, we're examining the Garmin VIRB 360 simply because Garmin is an aviation company so, not surprisingly, its camera works with aviation accessories like Blue-



tooth headsets. And since Garmin is primarily a GPS company, the tracking features built into the VIRB 360 are well suited for aviation and for any kind of action sports.

TWO INTO ONE

The VIRB 360 follows the VIRB Ultra 30 we reviewed in the November 2016 issue of *Aviation Consumer*. It's also a bit of throwback to the previous VIRB series, the VIRB XE and it has similar form factor. In fact, physically, the 360 looks like a pair of XEs sawed in half and melded back together, even though it's a new platform.

The 360 has wide-angle lenses on the front and the back and these are protected by a removable (and replaceable) plastic cover. And that's a good thing, because those lenses are right out there and no matter how careful you are, you'll scratch them.

While most action cams use the GoPro standard finger-type mount as part of the case, the 360 is self-contained in its own case and the mounts are two snap-on accessories, one for the GoPro style and the other a standard 1/4-20 mount. This is a plus because it's thus easy to mount the camera on a tripod and—bonus—the camera is shipped with a small handle that opens up into a miniature tripod. That's one less piece you have to carry and if there's any downside to POV cameras, it's all the junk you have to carry to mount and support them.

Speaking of support, this camera

CHECKLIST



The VIRB 360 is easy to use, but works best with the wireless app.



While 360 footage is sharp, we don't think it beats flat cameras.



Good as it is, at \$800, it's hard to justify this camera as a first purchase POV.

ain't a cheap date. You'll need a high-capacity Micro SD card and although Garmin says a 32GB will work, we would recommend a 128GB U3 card, which will cost about \$60. A small card will fill up pretty quickly.

The card snaps into a slot in a panel that has the USB/charging port and a video output port for viewing the camera's output. Once fully charged, battery life is good. We attached the camera in the cockpit of the B-29 Doc at AirVenture last July and it ran continuously for about 90 minutes, with battery and card space to spare. Battery storage time appears to be excellent. We left the camera unused for two months and the battery was still at about half capacity.

OLD SCHOOL INTERFACE

While the VIRB Ultra 30 sports a touchscreen control interface that's effortless to use, the 360 reverts back to the old button-and-menu design. We're not fans, although there are so few settings that it's not excruciating to use. It's just slow. To avoid that, we recommend controlling the camera with the free wireless app Garmin offers.

We've found wireless apps for cameras to be notoriously unreliable and frustratingly tender. Both the Garmin and GoPro apps tend to lose connections with the camera when you least expect it and when the camera is where you can't get at it, like on a

The VIRB 360, left, is shipped with a handle that opens up into a small tripod. The slider on the side of the camera turns on the recording function even if the camera isn't powered up.



If the camera mount isn't stable, vibration and shake can be eliminated by stabilizing the footage with VIRB Edit.

is where you can't get at it, like on a wing mount. The VIRB app seems the better of the two, but it's far from bulletproof.

The app allows you to easily set things like photo mode, timers, exposure compensation and two things unique to 360 cameras: Stitch distance and lens control. If the 360 has one killer feature, it's that it stitches the footage inside the camera rather than requiring post production work to do this. Stitching combines the two images into a seamless whole. You can select a near or far distance stitch, depending on what you're shooting. When the footage is played, you'll barely notice the stitch line.

The camera also allows you to set 360 mode or use the front or rear lens only or shoot RAW footage on both and then stitch it yourself or use it as you please. RAW footage will appear as extreme wide angle from either lens. Selecting either the front or the rear lens will yield flat footage similar to other POV cameras. The 360 has a range of resolution and frame choices, but isn't as flexible as the VIRB Ultra 30. For stitched footage, it's up to 4K or 3840 by 2160 at 30 frames. For unstitched images, the camera will yield 5.7K (2880 square) and it will shoot traditional flat footage at 1080 and up to 120 FPS.

SHOOTING

This is where the app comes in

GOPRO 6, FUSION 360

As the world of action cams gets more competitive, at press time GoPro announced a follow-on product to the GoPro 5 introduced a year ago. The GoPro 6's main claim is that it shoots 4K footage at 60 frames per second, making razor sharp slow-motion footage possible with action cams.

Thanks to a new processor, it can also shoot 240 FPS in 1080p, which ought to yield impressive slo-mo in much better resolution than the GoPro 5 can do. GoPro also claims the GoPro 6 has improved image stabilization, perhaps comparable to that found in the VIRB 360. Retail for the GoPro 6 is \$499, while the 5 remains on sale for \$399. Also announced in late September was the long-rumored Fusion VR, a 360-degree camera to



compete with others already on the market. At \$599, the Fusion has a similar featureset as the VIRB 360. We're gonna guess Garmin will drop the price on the 360 to match. Watch for it.

handy. The 360 has no viewer, so to aim the shots, the apps playback function is helpful. On the other hand, the lens views are so wide that if you point the camera in the general direction, you'll get usable footage.

As with all of the VIRBs, the 360 has a sliding switch on the side of the camera to activate the record function. This works whether the camera is powered up or not, a feature we find indispensable. For audio input, the camera will pair with Bluetooth headsets, but it will not accept a hardwired external microphone, as will the other VIRB models.

It does have four onboard mics which produce what Garmin calls spatial audio. In other words, the audio is picked up from multiple directions. None of this helps with in-cockpit recording, however, if that's your thing.

When positioning the camera, it helps to think ahead about what the camera will see in the 360-degree sphere. If you had it on the glareshield looking forward, it will see over the nose and the rear lens will see you in the cockpit. The viewer has the choice of scrolling around to see either view.

Video streamers such as YouTube and Vimeo now process the 360 metadata necessary to make the footage viewable in 360. You don't have to process or edit it in any special way.

However...combining it with traditional flat footage is difficult at best. We combined 360 footage with flat footage from the VIRB Ultra 30 in Adobe's Premier Pro and found the combination unworkable. As we go to press this month, Garmin has just announced an upgrade to its free editing program, VIRB Edit, that it says allows combining the two types of footage. We haven't had time to try the feature so we'll report on it later. In our view, being able to combine the footage is a must because most of us won't shoot everything in 360.

Another powerful feature the VIRB 360 has is post-production stabilization. Using the gyro data contained in the footage, VIRB edit can remove shake and wobble from footage producing gimble-like smoothness. Even if you don't shoot much 360, having that capability can turn average footage in extraordinary footage.

BUY IT?

In our view, at \$799 (\$749 discounted), the VIRB 360 is too expensive to be other than a specialty camera for limited kinds of shooting. If you already have an action cam or two and have money to burn for another one, the 360 may be the best, easiest-to-use choice for aviation purposes. The in-camera stitching works well and reduces the hassle factor of using it. Still, the 360 is just not a must-have.

NavWorx ADS600-B 2.0: Resolving The FAA's AD

NavWorx has a second-generation version of the AD-stricken ADS600-B transceiver, plus an upgrade path for existing grounded systems.

by Larry Anglisano

As we reported in the January 2017 *Aviation Consumer*, the model ADS600-B ADS-B In/Out transceiver from NavWorx was hit with an AD (airworthiness directive) and an unapproved parts notification that forced owners to have their systems removed, and shops and distributors to shelve the products in their inventory. Affecting nearly 600 systems in the field, it was the first ADS-B product hit with an AD.

If you own one of these ADS600-B/EXP-series systems (part numbers 200-0012, 200-0013 and 200-8013), NavWorx has a solution with the second-gen ADS600-B 2.0 product. But as we go to press, the new 2.0 transceiver isn't approved for installation in certified aircraft.

NEW GPS REQUIRED

The good news is that existing ADS600-B systems might not forever remain proverbial paperweights. To recap, the FAA AD (link to it at tinyurl.com/ydgbopxm) for these first-gen systems centers around the transceiver's internal WAAS GPS receiver, which the agency determined wasn't certified per the governing TSO C-154c specification. Moreover, it declared that NavWorx made an unapproved software revision to some units (altering the system integrity level, or SIL) that could communicate unreliable position data to other aircraft and to ADS-B radar.

With pressure from AOPA and consumers to further explain its claims, the FAA said in the AD that it is concerned with the transceiver's SiRF IV GPS receiver's integrity—rather than its accuracy—because it doesn't have fault detection and

exclusion capability. According to the AD, this is significant in the event of "signal-in-space error or satellite signal failure." Incorrectly reporting its own position by 0.2 nautical miles or more can result in incorrect ATC separation instructions and traffic advisories. Incidentally, 0.2 nautical miles is the minimum integrity containment radius around the aircraft's reported position that's required in FAR 91.227 ADS-B position reporting criteria.

Worth mentioning is that there have been no reported cases of a collision or safety incident resulting from an incorrect ADS-B transmission from ADS600-B-equipped aircraft. And, flight tests have been made with the system resulting in satisfactory ADS-B performance monitor reports from the FAA.

Real-world technical matters aside, the FAA refused to process all of the \$500 rebate reservations submitted by ADS600-B customers and issued a strong warning saying in part that "you may be subject to civil or criminal penalties for any knowing and willful misrepresentation in the reservation request, or in any other matter or representation related to the reservation," in an email correspondence sent to some customers. The agency did go on to say it would extend the rebate reservation for those who plan to buy a qualifying system. The replacement system can be other brands (there are plenty of

other options), the current NavWorx ADS600-B 2.0 or even older systems that have been upgraded to 2.0 status. By the time you read this, the Sept. 17, 2017, deadline for submitting a new rebate reservation will have passed.

The NavWorx upgrade won't come without a cost, which will depend on the serial number of the ADS600-B/EX product. NavWorx told us that basically any system sold prior to 2016 will cost \$500 to upgrade to an ADS600-B 2.0 version and the upgrade for ones that were sold during 2016 are priced at \$399. The transceiver will need to go back to NavWorx and a replacement WAAS receiver will be installed.

Dallas Avionics is the primary NavWorx sales distributor and has a procedure in place for sending systems in for upgrade. NavWorx CEO Bill Moffitt told us new ADS600-B 2.0 systems aren't yet approved for installation in certified aircraft because the FAA hasn't issued a TSO or approved the STC manual. Moffitt said the company has applied for a global AMOC (alternate method of compliance) for the AD and the ADS600-B 2.0 uses the same proven WAAS GPS module that has been flying in over 1000 experimental aircraft.

Contact the company at www.navworx.com and 888-628-9679.

The \$2020 NavWorx ADS600-B 2.0 UAT transceiver shown below is plug-and-play with first-gen transceivers hit with the AD and has internal Wi-Fi for connecting with multiple displays.



Pitts Special

These competition-worthy aerobats demand pilot proficiency and skill. Thorough inspections are a must.



If you're looking for an airborne toy, something to both challenge and perfect your skills, you've come to the right place in a Pitts. Straight up, if you're looking for a one- or two-seat cruiser, we suggest looking elsewhere.

The used Pitts market can be daunting. Many different variants have evolved over the years, including factory-built and experimental versions, but there remain two main types: a single-seater and a two-holer.

Today, you can buy a new, factory-built machine from certificate holder Aviat Aircraft, or get the plans and components for a single-seat version (S1-C or S1-SS) from Steen Aero Lab. We'll concentrate mainly on the certificated Pitts Special for this market overview article, but we'll also touch on experimentals.

HISTORY LESSON

Until the advent of the Pitts Special, aerobatics was a horizontal affair, even in the hairy-chested, fuel-sucking, 450-HP Boeings and Wacos.

Practitioners pirouetted under the stern God of Energy Management—gravity and drag meant vertical maneuvers were brief events.

A small, clean biplane taking advantage of progressively more powerful—and lighter—opposed engines being developed took akro through the roof.

First flown in 1944 (or 1945—sources vary) as a single-seat homebuilt with only a 55-HP engine, the type has developed into today's highly refined and FAA-certified, two-seat, 300-HP aerial hot rod used for advanced training and—at least in lower categories—competitive aerobatics and racing.

Dominant in aerobatic competition during the 1960s and 1970s, the Pitts Special eventually ceded that position to more modern monoplane designs from Extra and Sukhoi. Even Pitts himself saw the monoplane light: Before his death in 2005 at age 89, he designed but never built the Model 13, an enclosed coupe. But the basic biplane design of the Special remains popular as a recre-

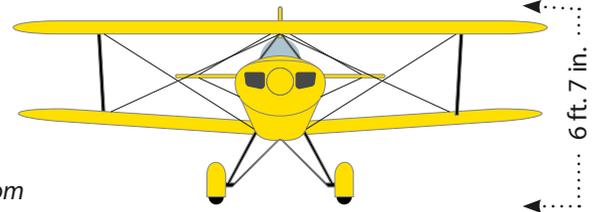
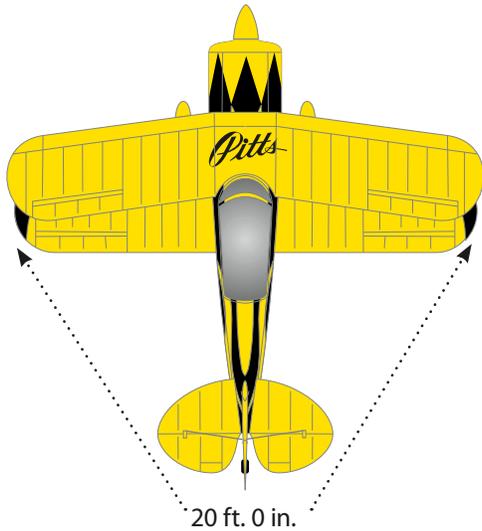
CHECKLIST	
	For serious aerobatics, the Pitts is a good choice that shouldn't break the bank.
	As airplanes go, a Pitts has simple systems. Owners report good factory and field support.
	Bring your A-game when flying a Pitts. Runway wrecks rule the accident reports.

ational and aerobatic training aircraft, and still can be seen strutting its stuff at airshows, fly-ins, pancake breakfasts and in private hangars throughout the world.

It's not for every pilot, of course. Its small stature, dictated by the need to keep things light and strong,

That's reader Chris Schaich throwing around his 1969 Pitts S-1C (rebuilt in 1980) in the lead photo. He says that overall, learning to fly a Pitts will make you a better pilot.

PITTS SPECIAL



drawings courtesy
www.schemedesigners.com

PITTS SPECIAL MODEL HISTORY (CERTIFICATED)

MODEL	ENGINE	TBO	OVERHAUL	FUEL	MAXIMUM WEIGHT	V _A	V _{NE}
S-1S	180-HP LYCOMING IO-360-B4A	2000	\$28,500	20	1150 LBS	134 KCAS	176 KCAS
S-1T	200-HP LYCOMING AEIO-360-A1D/E	1400	\$29,000	20	1150 LBS	134 KCAS	176 KCAS
S-2	180 HP LYCOMING IO-360-B4A	2000	\$28,500	24	1500 LBS	134 KCAS	176 KCAS
S-2A	200-HP LYCOMING AEIO-360-A1A/E	1400	\$29,000	24	1575 LBS	134 KCAS	176 KCAS
S-2S	260-HP LYCOMING AEIO-540-D4A5	1400	\$38,700	35	1575 LBS	134 KCAS	176 KCAS
S-2B	260-HP LYCOMING AEIO-540-D4A5	1400	\$38,700	29	1700 LBS	134 KCAS	184 KCAS
S-2C	260-HP LYCOMING AEIO-540-D4A5	1400	\$38,700	29	1700 LBS	134 KCAS	184 KCAS

means a short fuselage and stubby, relatively highly loaded wings when compared to most other personal airplanes. All of this results in an airplane responsive to the slightest control input, whether on or off a runway.

The S-1 (single-seat) and S-2 (tandem seating for two) Pitts Special is the brainchild of Curtis Pitts, a designer and cropduster, who envisioned the airplane as the first one specifically designed for aerobatics, according to the International Council of Air Shows Foundation. From the start, Pitts focused on keeping his creation small and light, something distinctly at odds with the much larger, radial-engined biplanes then popular.

By keeping things smaller than the norm, Pitts could incorporate a relatively underpowered flat engine and still obtain excellent performance.

Despite the Special's enduring popularity, Pitts also designed several monoplane types. But the biplane design—affording double the

aileron capability in most variants—offered the greatest strength and lift in a smaller package.

EARLY CHAMPIONSHIPS

The first Pitts Special to achieve notoriety was L'il Stinker, flown by aerobatics legend Betty Skelton to three consecutive U.S. Female Aerobatic Championships in 1948, 1949 and 1950. At the time, all Pitts Specials were built by Pitts. It wasn't until 1960 that plans were offered.

The first Pitts Special one could build in a garage or hangar was the S-1C, characteristics of which included a flat-bottom wing, bungee-landing gear, two ailerons and a single seat. It was powered by pretty much anything its builder wanted to hang on the front, from 85-HP Continentals to 200-HP Lycomings. According to Steen Aero Lab, which also markets S-1 plans and components, the S-1C is the "benchmark" version.

"Nearly all homebuilt S-1s used S-1C plans for the fuselage and tail,

with supplemental wing plan options," according to the company.

Soon, variants began coming out of Pitts' shop, with differences mainly resulting from tinkering with horsepower, fixed or constant-speed props, and flat-bottom or symmetrical wings. Homebuilders also incorporated their own changes, resulting in a wide range of versions—and disagreements between aficionados as to which is which.

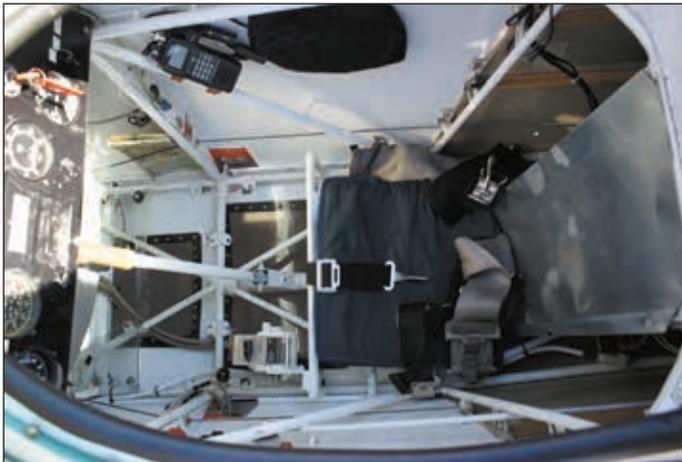
These include the S-1D (S-1C with a slightly stretched fuselage and four ailerons), S-1E (a homebuilt), the S-1S (commonly known as the "roundwing" Pitts, it was certified in 1973 and features symmetrical airfoils, four ailerons and a different upper-wing design enabling it to stall first) and the follow-on S-1SS.

FOLLOW-ON DESIGNS

One result of Pitts' refusal to leave well enough alone was the S-1-11B, or Model 11, also known as the Super Stinker. Still a single-seater, it featured a 300-plus-HP Lycom-



The instrument panel in a Pitts is utilitarian, with radios mounted low or on the side of the cockpit, top photo. No floor, bottom, means anything dropped disappears and can potentially jam the controls.



rons and a symmetrical airfoil. The prototype S-2 had a 180-HP engine; production airplanes, designated the S-2A, came with 200 HP. Soon, the S-2B came on the scene, with 260 HP and featuring improved ailerons and rudder. It was followed by the current

ing, four ailerons and a symmetrical airfoil (better for inverted flight than the flat-bottom version), and was available as either a factory-, plans- or kit-built airplane.

The S-1T, a certificated, production version of the S1-S, replaced the S-1S in 1981, according to Steen Aero Lab. It came with a 200-HP Lycoming, constant-speed prop and redesigned ailerons.

The S-1T, according to the Aviat website (www.aviataircraft.com), is available for manufacture on demand. Aviat reiterates that the S-1T is regularly used in all competition categories in both national and world aerobatic contests.

NEED TWO SEATS?

Meanwhile, a two-seat Pitts model was developed. It sported four aile-

production model, the S-2C, tweaked by Aviat VP of Engineering and long-time aerobatic pilot Ed Saurenmann to make inside and outside aerobatic handling more symmetrical, increase cruise speed and improve handling on landing.

Of all the models and variants developed over the years, many remain available. For example, Aviat Aircraft's website shows that it currently offers plans for the S-1S for \$250. The S-2C is in production and as we noted, it will build the S-1T on demand. Aviat also provides parts support for versions no longer in production.

Despite the S-1/S-2's popularity, additional Pitts versions were developed. The Model 12, the last design built and flown by Curtis Pitts, was a slightly larger two-seat biplane spe-

cifically designed to use the Russian Vedeneyev M14P/PF radial engine of 360-400 HP. Plans are available from the current owner of the rights to the airplane, Jim Kimball Enterprises (www.jimkimballenterprises.com).

Finally, Steen Aero Lab (www.steenaro.com) has been developing the Pitts Model 14 for some years. It was one of Curtis Pitts' last designs and is billed by Steen Aero Lab as "a leading-edge two-place aerobatic biplane." Like the Model 12, it's designed around the 400-HP Vedeneyev M14PF nine-cylinder radial. The company has a Model 14 project log posted on its webpage and it's an interesting read.

HANDLING

A Pitts is about as small as a biplane can be and still carry two people, fuel and a large engine. Some owners, however, point out that filling both seats creates weight-and-balance problems, especially if you intend to do aerobatics. And, cripes, who the heck wouldn't?

Both basic models are exceedingly clean and, to put it frankly, go like hell. It's hard to believe that a few years ago these were considered at or near the top in world competition, but are now being used for primary training for those moving up.

The controls are well harmonized. For one who came up in acro flying an Aerobat or Citabria, the overwhelming feeling is it's only necessary to *think* about a maneuver to fly it. Most of those pilots badly overcontrol a Pitts the first time out. For one accustomed to running out of speed in the vertical almost instantaneously in a Citabria, the Pitts is a revelation.

But for all the delights it brings once airborne, visibility on landing is awful and the airplane is just plain hard to land compared to a Citabria or Extra. We've seen too many NTSB statements for Pitts landing accidents that bluntly say that the probable

cause was “the failure of the pilot to maintain directional control during the landing rollout.” Go to the accident sidebar on page 28 and you’ll see what we mean.

Of course, this should surprise no one: Just take a look at the short fuselage, small tailwheel and relatively narrow main gear. Then decide how you’ll see the runway in front of the airplane when it’s in the three-point position. It’s essential to get a good checkout before you fly the airplane home, or you run a significant risk of tearing it up on your first couple of landings. It’s also essential to leave at home any tricycle-gear habits and remember to perform S-turns while taxiing.

Anyone moving up to a Pitts also should become proficient in performing forward slips because it is an effective method of keeping the runway clearly in sight on final approach. And, although the S-2C’s published “clean” VS1 stall speed is a seemingly benign 56 knots, it’s a few knots higher than the VS0 “dirty” stall speed of high-performance singles such as the Bonanza and Cessna Centurion.

Is the Pitts a handful? Those who have fallen in love with it emphatically say, “No!” Pitts guru Budd Davisson, for one, says he can teach anyone to land a Pitts. “The Pitts Special’s reputation for being a handful on the ground is grossly exaggerated,” he adds. Davisson offers a transition course for aspiring Pitts pilots, estimating around 8-10 hours stick time for someone with a tailwheel endorsement, but admits the time required can “vary all over the block and is impossible to predict.” We get it.

MAINTENANCE/INSPECTION

With fixed conventional landing gear and refreshingly few avionics or instruments, a typical Pitts Special is about as simple as airplanes get. The airframes are fabric-covered steel tubing, with a plywood torque box joining the wing spars.

In addition to the standard aerobatic airplane prepurchase checklist, look for slop in the control system. It often just requires an adjustment but bearings can be worn out. Any Pitts flown regularly for aerobatics should be inspected frequently. Make sure the inspection holes have been



That’s Raymond Nickels’ 1986 S2-B over the desert in the top photo. Behind-the-head storage is all a Pitts has so travel light. Once you remove a lot of fasteners, the airframe and engine are accessible for thorough inspections.



cut in the underside of the wings, indicating someone is looking at the structure.

Once the wings are bolted together, the upper and lower wings form a rigid unit, so an impact to the lower wing may result in damage to the upper. It’s essential to inspect each wing. Look to see if the spinner and nose bowl line up. If not, the bushings on the engine mounts are worn and are allowing the engine to sag. While this is initially cosmetic, it can result in the alternator being pushed into the nose bowl and the exhaust hitting the front of the firewall as well as crushing the air box.

According to Budd Davisson, “There’s an easy way to tell if a Pitts



has been subjected to extremely hard aerobatics outside of its design envelope. The most highly stressed part of the airplane is the anti-drag wire inside the top wing in the first bay outboard of the center section. The back ends of those wires go through the rear spar and come out inside the fabric area either side of the handhold behind the rear spar.

PITTS WRECKS: RLOC, COLLISIONS, FUEL

We admit it up front: Going through the 100 most recent accidents of Pitts Specials was unlike reviewing accidents of any other type of airplane. With its reputation as a tough airplane to control on landing, we expected nearly half of the accidents to involve runway loss of control (RLOC)—there were 30. That's exactly what we saw for the Citabria/Dectahlon series—the poster children for good-handling tailwheel airplanes. By comparison, the RLOC rate for the Cessna 185 in our last review was 52, for the Super Cub, 40.

What got our attention was the number of fuel-related accidents—12; the number of collisions—eight in the air and six on the ground; and structural failures in flight—four.

Most of the Pitts series have limited fuel capacity—they were designed as aerobatic masters, not traveling machines. Their pilots know this; however, every one of the twelve who had a fuel-related engine stoppage simply ran his airplane out of gas. Most didn't bother to check the quantity prior to takeoff, a few got confused in their record-keeping regarding flight time since refueling and one landed at an airport without fuel (it was in the NOTAM) and tried unsuccessfully to make it to the next airport. We wonder about the dynamic between the pilot fueling his Pitts and his helper at the pump who was asked to call out when it read 14 gallons. The helper confused 1.4 and 14.

The FAA has expressed its concern about pilots running airplanes out of fuel—we think Pitts pilots should be hyper-alert to the subject.

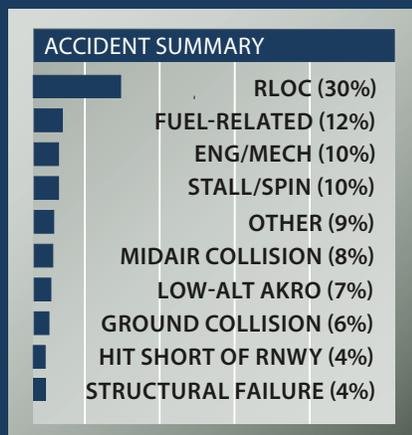
Visibility from a Pitts is best described as lousy. That is reflected in the six on-ground and eight in-air collisions involving the marque. Nevertheless, we have no sympathy for the impatient Pitts pilot who saw the Cherokee ahead of him in the hangar alley and rather than make

a radio call to ask him to provide more clearance, decided to barge through the space between the Cherokee's wing and a hangar. The Pitts didn't fit.

Most of the midair events were in the traffic pattern—often within moments of landing. The Pitts pilots apparently were aware of visibility issues as the NTSB reports indicate they were making position reports while the other airplanes were not. We felt the pain of the Pitts pilot who was looking so hard for another airplane giving position reports in the pattern that he hit a tree on short final.

Four pilots tore up their biplanes stalling at low altitude, mostly on landing. Seven decided to engage in low-altitude aerobatics and tied the record for low-altitude flying. Six pilots spun into the ground after starting with what appeared to be plenty of altitude. Investigations indicated that half were over gross weight and out of CG aft.

There were four structural failure events, only one of which was fatal—a pilot who had bragged of his disregard for airspeed and G-load limits. A pilot who was teaching himself aerobatics put his left lower wing into a neighbor's tree. He repaired the torn fabric with duct tape. On the next flight he proved that duct tape can't fix stupid when the left lower wing structure failed and most of it departed the airplane. To our astonishment, the pilot was able to land the airplane.



If the airplane has been flown too hard, chances are there will be damage where the wire's nut sits on top of the block that's glued to the rear face of the rear spar (just inboard of the root rib)."

The engine and prop might demand some extra inspection time, especially if your mechanic isn't familiar with an aerobatic engine installation. Many Pitts may come with a smoke generator, another oddity for the average mechanic.

Of course, the covering on any fabric airplane should be considered suspect, especially if the example hasn't been hangared. Any ownership budget should set aside some dollars to recover the airplane at the appropriate time.

Finally, and while we're not aware of any systemic corrosion issues with the steel tubing in a Pitts, the prudent purchaser is always on the lookout for related issues.

PRICING/MODIFICATIONS

The *Aircraft Bluebook* doesn't track the Pitts Special, so we searched the old standby, *Trade-A-Plane*, as well as some aircraft sales websites. We were surprised at how few Pitts were on the market. Want an \$11,000 S-1C project airplane with an IO-360 B1B engine that last flew in 2003? There's one on Barnstormers.com. On the other end of the spectrum, there's a pretty nice-looking 1993 S-2B in Germany listed for \$115,000 U.S. dollars. It even has a ferry fuel tank and factory smoke system.

As a pure sport airplane, Pitts modifications are usually designed to improve some aspect of the type's handling or maintenance. Items like clear, Lexan floor panels, smoke generators, Haigh locking tailwheels (admired by new Pitts pilots, less so by old sticks) and spring steel gear (to replace the older bungee-cord design) are popular mods. Other add-ons or replacements, depending on the aircraft's age, include inverted fuel and oil, electrical systems, Ceconite fabric coverings, seat-bottom parachutes and new, five-point harnesses.

TYPE CLUBS/SUPPORT

We're not aware of a type club devoted to the Pitts Special, unless you count the various national and international organizations devoted to aerobatics. While not type clubs



A recommended landing technique for the Pitts is to hold the airplane in a forward slip, so the runway can be clearly seen on final. The airplane is so responsive that the slip can be maintained until well into the flare—the airplane is then straightened out, just before touchdown.

per se, they are populated with pilots who have flown—and may still fly—the Pitts and have a thing or two to share. There is a Pitts Special Facebook page with nearly 6000 members. We do recommend joining the International Aerobatic Club for information and support on Pitts—its members were extremely helpful in providing information for this article, as were some of our valued readers. The local Experimental Aircraft Association chapter may be another great resource, especially for a kit- or plans-built example.

The ultimate aficionado, however, is the aforementioned Budd Davisson, whose website (www.airbum.com) includes substantial resources for the pilot merely wanting to learn more about Mr. Pitts' Specials or needing detailed information on which one to choose and how to fly it.

OWNER COMMENTS

I bought my 1986 S-2B in 1998 while

living in Michigan. The aircraft had about 350 hours on it at the time, and I am the third owner. I paid \$77,000 for it. Since then, I have flown the airplane 650 hours and have done at least 15 owner-assisted annual inspections.

I wanted a high-performance two-place factory-built aerobatic airplane at a reasonable price, and at that time the S-2B was really the only choice. The S-2A is somewhat underpowered (keep in mind that even with 270 HP, the S-2B is a study in parasite drag) and a new S-2C would have been more than twice the price. I have done some aerobatic competition at the Sportsman level, but mostly I just go out and have fun one hour at a time. I also enjoy giving rides to friends and introducing my pilot buddies to spins and aerobatics.

I have flown between Nevada and the Midwest three times, but obviously this is not a cross-country aircraft. The cockpit is cramped and



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Good forward visibility isn't exactly a Pitts' strong point. Keep landing it without breaking it and you're doing fine. In the end, you buy a Pitts for the inverted view while in the air, bottom photo.

after 90 minutes of sitting on a parachute you want to either land or bail out. Planning is important—there better be fuel at your destination—and you're going to want a hangar for overnight storage.

My insurance carrier wanted 15 hours of dual instruction before issuing coverage, which I got from the late Bill Thomas in Florida. Previous tailwheel experience was nearly useless in transitioning to the Pitts, but with good instruction the "ruder dance" starts to come naturally. There is, of course, no forward vis-

ibility on the ground with the tail down for taxi, initial take-off roll and landing.

I'm blind in one eye, so if I can do it, anyone can with practice and instruction (of course, I avoid narrow runways and even moderate crosswinds). When asked, I tell people that I always try to remember that anytime I'm within 50 feet of the ground the airplane wants to kill me. This concentrates the mind, which is far more important than skill level. A moment of complacency and you will end up in the weeds.

Insurance runs about \$2000-\$2500 for \$1 million in liability and \$100,000 for the aircraft. In 19 years I've had two claims, one when a canopy latch failed (that's when

you find out why there is a \$3500 deductible on the canopy), and one for wingtip damage after a bounced landing. I took the airplane to the factory for repair. If you've flown a Pitts for nearly 700 hours, chances are you've bent it at least once.

Maintenance has been straightforward, but having an A&P with knowledge and understanding of the aircraft for both prebuy and regular maintenance is essential. If you are considering a mid-1980s factory-built airplane that has original fabric, call the factory and ask if it is among those that had questionable cotton fabric. If so, you'll probably be able to put your finger right through it. My airplane was completely rebuilt by the factory in 2003. At the time, I believe that was about \$32,000. They did a great job, made several modifications and took care of the wing attach point AD.

Factory support has always been fantastic and, all things considered, parts prices seem quite reasonable. I strongly suggest you take the aircraft to the factory for an annual every few years—they will find and fix things even the best A&P will miss. The AEIO-540 is pretty bulletproof. After 1000 hours mine was showing signs of cylinder scoring (probably from well over 1000 starts, not to mention rapidly going from full power to idle and back again during aerobatics), so I preemptively had an overhaul done by Barret Precision Engines in Tulsa, Oklahoma. The overhaul was about \$40,000 and Barret is one of very few shops I would trust with an aerobatic engine.

A big downside to a factory-built Pitts is that doing a proper annual inspection is a nightmare. Doing it right requires removing well over 500 screws to take the airplane apart from the rear cockpit forward. This is tedious and somewhat complicated, but after the first couple of times it starts to go smoothly and a little faster. To save a couple days labor at typical A&P rates, I take everything apart and then bring in my mechanic for the inspections, adjustments and any procedures. After cleaning everything I put it back together and get a final sign-off from my A&P. Depending on how much time I have, this can take weeks or even months, but this is an airplane that requires



A 1974 S-2A. The first S-2As had an open front cockpit that could be covered with an Art Scholl ATC cover to make the airplane single-place. Later, the design went to a canopy that covered both cockpits but acquired a reputation for expensively departing the airplane if not carefully latched.

a very close look every year. I have seen many factory-built airplanes that obviously have not been properly inspected in years. I hate to think about what might be hiding under those unremoved panels.

Including parts and labor, annual inspections have been consistently under \$1000. I change the oil and filter every 25 hours. I budget \$200 per hour plus fuel, and over the course of nearly 20 years that seems to have worked out about right. Two things I did immediately upon purchasing the airplane were install a fuel totalizer (the sight gauge is completely useless) and a full electronic engine analyzer. The engine is over half the aircraft value, so running it with a single CHT reading is simply insane. It paid for itself almost immediately when the engine developed an exhaust gasket leak.

I can't speak for the homebuilt Pitts community, but I have really enjoyed my long ownership of a factory-built S-2B. Let's face it—this is an expensive toy with little or no practical use, and it probably would have been cheaper to rent one than to own one, even for nearly 700 hours of flying. It is, however, gangs of fun and probably considerably cheaper to buy and operate than a similar or higher-performance facto-

ry-built monoplane. Besides, a red biplane is just very cool, and one with two-place capability lets you share the fun. If this is your first aerobatic airplane, get proper instruction and don't be an idiot with the airplane. The most impressive thing I do in my airplane is come back alive, and I won't let myself or anyone else talk me out of that philosophy.

For proficiency, I do three landings at the end of every flight, and I try to fly four or more times every month. Based on the current market, I would suspect that a well-maintained S-2B with a low-time engine can be had for \$80,000 to \$100,000. A well-maintained and properly repaired Pitts is more important than it having no damage history. Of course, a hangar is essential.

I would strongly advise that the first annual inspection after purchase be done at the factory—you'll be amazed at what they find.

Raymond Nickels
Boulder City, Nevada

I own a Pitts S-1C, built in 1969 and then rebuilt in 1980. It has a Lycoming IO-360 with 11-1 pistons. The Pitts is a most remarkable aircraft, but demands absolute attention when flying it. To quote the well-

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RESCUE BUYS

(continued from page 17)

clubs are a gold mine of help prior to a purchase, particularly the prebuy checklists available to members. And of course there's opportunity to ask questions online about the condition of the plane prior to purchase—particularly how much it will cost to fix X, Y and Z. A running theme on successful rescues seems to be only consider planes that have been hangared 100 percent of the time and walk away from the varmints.

If you must have the plane that's melted into the ramp, don't even consider flying it—or hiring a ferry pilot to fly it—until it has been given an extensive annual inspection.

And probably most important (for your sanity) negotiate the price correctly. Think salvage value because some planes aren't worth the aluminum they're made of, no matter how unique or rare.

This is one area where you can't compromise, considering you likely don't know the condition of the plane beyond what you can see. Chances are good everything will need a thorough analysis, which by itself can cost thousands.

Mike Cagle, who has restored several Bonanzas, says the price has to be right. And to make sure it is, you really need to do a thorough prebuy with an independent mechanic.

"I should have done a much better prebuy on my current plane. I was still able to buy it below market value, but had I known how questionable a lot of the logbook entries were, I would have offered even less. I was rushing

and didn't do a good one. I regret that," he admitted.

Contributor Peter Kuhns is a Grumman Cheetah owner looking for something a little faster with a little better useful load, but not necessarily a rescue project.

PITTS SPECIAL

(continued from page 31)

known Pitts instructor, Budd Davison, "It puts your habits, good and bad, under a magnifying glass." The plane has a bad rap as being twitchy, but it only does what it is told to do by the pilot at the stick. Flown well, it is a dream. Fly it poorly and things might not end well. Anyone getting into a Pitts—regardless of tailwheel time—should seek a competent Pitts instructor. Even if it's been a few years since you last flew one, get current first.

Consider that the insurance company might ask if you received Pitts training and from who, plus you'll want to fly it frequently enough to stay proficient—and safe. I prefer to land in the three-point configuration almost exclusively and rarely have I had a situation that required a wheel landing. The plane seems to like three-points the best.

For operating costs, starting with insurance, with hull coverage at \$40,000 and \$1 million in liability I pay \$600 per year, and that's with another aircraft on the policy. I believe when I first purchased the aircraft the insurance was \$1100 with \$30,000 in hull insurance.

Fuel burn is about 10 GPH with a 200-HP IO-360 in cruise flight, going 160 knots. Conditional inspections run \$600 to \$1800 depending on

FEEDBACK WANTED

PIPER AZTEC



It's time for a look at the light twin market in an upcoming Used Aircraft Guide in *Aviation Consumer* and we'll start with the Piper Aztec. 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 Aztec to appear in the magazine, send us any photographs (full-size, high-resolution please) you'd like to share to the email below. We welcome information on mods, operating expenses or any other comments. Send correspondence by December 1, 2017, to:

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how many squawks are discovered. Sometimes it can be done in one day with about 10 hours of labor. Until I had to recover my wings, the usual maintenance items included oil changes, brakes and tires. When the wings came off to replace the 28-year-old fabric, things got expensive. The wing ribs needed some attention from years of hard use. In the end it cost about \$35,000 to recover and fix all the minor wood work needed in the wings.

These airplanes need to be inside, so budget for a hangar. In my area hangars rent for \$250 to \$500 per month for the smaller ones.

Overall, learning to fly a Pitts will make you a better pilot. "If you have the means, I highly recommend picking one up," to quote movie character Ferris Bueller.

Chris Schaich
via email