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The Aviation Consumer®

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The Aviation Consumer

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BIOMETRIC AVIONICS: NOT THERE YET

On the heels of the suspected decompression and hypoxia-related TBM900 crash that took the life of Larry Glazer, the president of the TBM Owners and Pilots Association, and his wife Jane Glazer, a non-pilot physician asked if there are onboard systems that monitor the health of a pilot's body during flight. That got me thinking. With all of the available avionics integration, why not include body health monitoring in the interface? You know, important stuff like blood pressure, heart rate, pulse and of course oxygen saturation levels.

That's partially what the Guardian Avionics Aero455 panel-mounted pulse oximeter system does. But the device isn't a full-time, set-it-and-forget-it monitor. In other words, you have to voluntarily stick a finger in the thing to get a reading. That simple task could be too much for even a mildly hypoxic pilot to remember. A review of the Guardian integrated pulse oximeter/CO level system follows on page 20 of this issue.

Because I deal with the effects of hypoxia at low altitudes (I'm a non-smoking athlete), I curiously interviewed a handful of clinical professionals on the subject of full-time inflight hypoxia monitoring. While some are pilots and some are not, all agreed that it's important to begin monitoring oxygen saturation levels early in flight, and at low altitudes—lower than you might expect. I'll skip the yawning lecture about the dangerous effects of hypoxia, but it's worth mentioning a few tidbits that we tend to forget.

Dr. Bob Dodenhoff, our resident AME, reminded me that some people with COPD (chronic obstructive pulmonary disease) are hypoxic at sea level. Moreover, heavy smokers may not have hypoxic symptoms at the surface, but can develop symptoms at much lower altitudes than non-smokers. Dodenhoff stressed that there is no absolute level where hypoxia can not develop.

Another clinician pointed out that in a perfect world, the pilot would be connected to a pulse oxi from the start to the end of flight. The device would—without any pilot intervention—continuously monitor and alert the pilot to either descend to a lower altitude or begin using supplementary oxygen. Unfortunately, that device doesn't exist because as far as I know, there is no other practical way to accurately measure arterial oxygen saturation than with fingertip oximetry, which uses a light emitter with red and infrared LEDs that shine through the fingertip—an area with generally good blood flow.

As you know, wearing an oximeter on your finger during the entire flight just isn't practical, especially in the age of touchscreen. Even the Masimo iSp02 pulse oximeter iPad interface requires a wired connection between the finger sensor and tablet. Alternatively, the goal should be to recognize your own hypoxic symptoms while you're alert enough to do something about it.

Personally, I know I'm becoming hypoxic (and I'm ready for it at around 10,500 feet) when my breathing initially increases, which also triggers a mild panic attack that escalates as I watch the altimeter climb. While I'm able to overcome the psychological effects of the symptoms as I adjust to the altitude, my performance continues to worsen. I have trouble reading back frequency changes, my attention span decreases and I'm as euphoric as I am after drinking numerous cocktails.

That's why I hope for a more advanced biometric integration that would automatically alert me of a generalized hypoxic state before my performance does. This would require a tiny, untethered arterial sensor that won't affect dexterity, comfort and can wirelessly transmit real-time data to a display, while also providing audible warnings. Until that device exists, the Guardian panel oximeter is as integrated as biometric avionics can be. —*Larry Anglisano*

ASPEN'S RED X UPDATE

I have a single-screen Aspen Avionics EFD1000Pro installed in my Piper Arrow since July of 2012 and it is amazing. Unfortunately, I learned that if the system loses pitot input (if it's clogged, for example), you completely lose most all critical data, even non-pitot-sourced data. This results in a black screen with two red Xs covering the upper and lower halves. This means no attitude, airspeed, altitude, heading, HSI or GPS overlay from an external navigator, like a Garmin GNS530 or 430. If the pitot resolution shows less than 30 knots and the GPS speed is indicating greater than 50 knots, all of the PFD data blanks out.

What really surprises me is that Aspen still hasn't programmed the unit to be able to retain data and display capability that are unaffected by the pitot failure. I can see no reason that my GPS navigational overlay (and weather overlay) needs to disappear during a pitot input failure.

I understand that GPS data can take the place of pitot data if the units are programmed to use it. I do hope that they correct this soon and utilize the quality GPS data that I and most others are streaming to the Aspen units at all times. For Aspen to make its entire critical display system dependent on a single pitot and not fashion a backup that appropriately utilizes GPS data is nuts.

John Rooks
via email

Aspen's Perri Coyne responds: "The EFD1000 AHRS solution is derived from gyro and accelerometer inputs, and stabilized with magnetometer and air data. These inputs are fed into a Kalman filter, which uses the various sensor data to derive a stabilized attitude output. While other low-cost AHRS for light aircraft rely upon GPS ground speed as a corrector, we chose pitot rather than a GPS to allow our system to be installed without requiring a GPS input. With the loss of pitot input, the attitude solution would be degraded, so the attitude is flagged as invalid and the pilot should refer to backup instrumentation. This is the reason the backup airspeed, attitude and altimeter instruments are required.

We are evaluating other attitude solutions that will reduce or eliminate the need for pitot pressure. If there is no hardware change required, we will make this available to our existing customers as we have done with other enhancements."

PORTABLE RADIO TECH

Thanks for another great article on handheld transceivers in your October 2014 issue. I wonder if you might consider adding another criteria to your bench tests.

Several years back I bought the model SP-200 from Sporty's. Unfortunately, I discovered that I couldn't get within 100 feet of my FBO without the AWOS bleeding over all comm frequencies. As always, Sporty's stood by its products and swapped the radio with an ICOM IC-A6 without even charging me for shipping. I can't rule out the possibility that what I experienced was just a fluke with that one radio, but I'm much more leery of the frequency bleedover now. I thought you might want to consider that in future tests.

Bob Simmons
Xenia, Ohio

Frequency splash could either be a selectivity issue (depending on how narrowly-designed the band width is for each frequency) or another issue called spurious response, which is the receiver's ability to reject harmonics. You didn't specify if the AWOS frequency was close to the one you were monitoring (not physically close, but its location in the frequency band relative to the desired frequency). If AWOS was at 126.450 MHz and the tower was 126.600 MHz, it would be a selectivity issue. If AWOS was 118.000 and the other was 136.000, it would be a spurious response.

ANGRY 'SUMBITCH

I have no political party affiliation, but my wife says I'm a member of the "angry 'sumbitch" party. The FAA frustrates me with its fossilized bureaucracy. For decades, automobiles had electronic ignition, anti-lock brakes and airbags with proven safety, yet because of the FAA's bureaucratic, lethargic, red-tape-strangled processes, there are few options for safety enhancements on my TB20, such as vortex generators or air bags.

In your October 2014 issue, you reported on Dynon's Touch that's only available for experimental and LSAs. It is an oxymoron that FAA promulgates general aviation safety, yet obstructs the availability of enhancements that would save pilot lives. New airframes have many of these safety enhancements, but in this economy, I doubt the average owner can afford a $500,000 plane.

Art Watanabe
Liberty Lake, Washington

We're honored the Dynon Skyview Touch article brought out the best in you, Art. With any luck, the proposed changes to Part 23 will someday bring affordable safety solutions to certified aircraft.

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BendixKing Redux: No Killer Products Yet

BendixKing says its revised line of third-party products is the first step in gaining market traction. So far, it hasn't touched Garmin's spot at the top.

CHECKLIST

- Third-party products wearing the BendixKing name are high quality.
- BendixKing is leveraging technology from its jet market for GA cockpits.
- Missing are products that easily and cheaply replace legacy King avionics.

by Larry Anglisano

It's been nearly three years since BendixKing announced its commitment to revitalize the brand name that once stood for quality, value and industry-leading innovation. At the time, the announcement hinted there would be a repeat of an era when King Radio was king of the avionics market.

We knew that would be a tall order since it had to engineer, certify and pitch a fresh product line that could compete with market-dominant and a highly innovative Garmin. Perhaps more challenging was winning back the loyal customers it lost after almost 15 years of silence. And the biggest challenge of all was convincing a scorned dealer network that the company had the steam to hold its own in the shrinking market. For years, the BendixKing dealer network watched as parent company Honeywell focused on the high-end business jet and commercial transport market, nearly abandoning the lower end of the market.

With a diverse product line that includes an audio panel, transponder, angle of attack system, several ADS-B options and the newly certified KSN770 GPS navigator—plus some legacy products that are built to order—BendixKing is back in the general aviation market. But many of its new products are sourced from other manufacturers, hardly representing the engineering know-how and innovation that loyal BendixKing customers might expect. But while there are some homegrown products that originate from Honeywell's EPIC jet avionics, the new affordable and innovative products the company promised a few years ago aren't here yet. Here's a look at some of the products that do exist and what shops are saying about them.

TRUST FACTOR

Just last month BendixKing announced that its president, Kevin Gould, was "moving on to other opportunities." Gould, the former president of Piper Aircraft, took over the BendixKing division in 2012 and can be credited with adding new products to the lineup through partnerships with FreeFlight Systems, Trig Avionics and Aspen Avionics.

When Gould took the helm, he recognized the immediate need to reengage the dealer network with personal shop visits and by reinstating the dealer advisory council, a way for shops to work directly with BendixKing while offering suggestions for a fresh product line.

"The trust factor is something we have to earn back. We need to prove this to our dealers and to our customers through our actions. In the near term, that's going to be

Clockwise from top left, the KGX150 ADS-B receiver from FreeFlight Systems, the KLR10 AoA from Alpha Systems and the KT74 ADS-B transponder from Trig Avionics all wear the BendixKing name.

an uphill battle," Gould told *Aviation Consumer* in an interview last year. At the time, the company was struggling to gain certification of its KSN770 navigator.

Since then, BendixKing has maintained a sizable presence at major trade shows, unveiling a new line of products that's hardly dethroned Garmin and its long list of new products, including the FlightStream wireless tablet-to-panel interface. BendixKing recently discontinued its WingMan tablet app after a cold reception in the market.

Since promotion is greatly dependant on the dealer network, we wanted to find out if trust in the BendixKing brand name has yet been established with authorized distributors, so we asked some. The short answer is no.

As one shop reported, "We've sold over $1 million in Garmin in one year. In that same year, we've had perhaps 10 requests for BendixKing proposals," Not surprisingly, none of the shops we spoke with would go on the record. Our sense is they value the dealership for sourcing service parts for repairing legacy radios, something negative input could jeopardize, perhaps even violating dealer agreements.

"I want to see BendixKing come back strong because they once had a strong product line and frankly, Garmin needs brisk competition and customers want alternatives. But slapping your name on other brands hints at an identity crisis," said another shop manager.

Those were precisely the points we mentioned to Roger Dykeman, BendixKing's VP of marketing and product management, a company veteran with a strong technical background with legacy BendixKing avionics. Dykeman recognizes that putting the BendixKing name on third-party products isn't a long-term solution. He hinted this is a short-term approach to rebuilding the brand.

"We're changing the course of a very large ship and that takes time. When Gould was the president, we looked at ways to positively affect the market in the short term while we turn the company in a better direction for the longer haul. That meant putting our name on products that might benefit from BendixKing brand identity, while offering a more extensive support and distribution network," he said. These products include the FreeFlight Rangr series ADS-B transceivers (relabeled the KGX130 and KGX150), a top pick in our recent ADS-B roundup article (September 2014 *Aviation Consumer*), the Trig Avionics-designed KT74 ADS-B transponder and the Alpha Systems AoA, sold as the KLR10.

The AeroVue retrofit flight deck reinforces parent company Honeywell's commitment to the light jet and turboprop market, upper photo. Shops report good parts supply and technical support for legacy King avionics, bottom. This makes BendixKing dealerships a valuable resource for shops and consumers.

Dykeman told us there will be announcements of homegrown BendixKing products coming in the early first quarter of next year.

"In parallel with branding partnership products, we've been developing our own products. It simply takes time to get those products going. Even basic navcomm radios can't be rolled out in a short period of time, given the level of FAA certification effort that's required," he noted.

And BendixKing is well familiar with the delays that tag along with product certification. The KSN770 navigator was snagged in certification for well over a year, and was awarded certification this past August. The shops we spoke with note that compared to Garmin's GTN navigators, interest in the KSN770 has been weak. On the other hand, many shops we spoke with noted that interest in Avidyne's IFD540 navigator has also been weak. That system was also delayed because of certification issues.

Developing new products wasn't made any easier when the company moved its operation from Olathe, Kansas, to Albuquerque, New Mexico. This meant hiring a new engineering staff, rather than transplanting existing talent to the new facility. It's worth noting that some key BendixKing employees moved over to Garmin.

VERSUS GARMIN

BendixKing's current full-stack retrofit products include the PS-Engineering-designed KMA30 audio panel, the KSN770 navigator and KT74 transponder. What buyers might not realize is the lineup still includes legacy products, including the KX155

Need a navcomm replacement? BendixKing will still build you a legacy KX155 with internal glideslope receiver, upper left, for $5317. It set the navcomm standard until Garmin came out with the smart $4500 GNC255A, lower. It has a built-in frequency database, RS232 interconnect with Garmin navigators and frequency monitoring.

navcomm, KCS55A mechanical HSI system, the KR87 ADF (sold primarily to other countries) and even the KI825 electronic HSI—a product that originally had a lukewarm reception, but is now being embraced by the military, we're told. Dykeman also told us that many of the legacy products are built to order, with various lead times.

There's also the KFC225 autopilot, a system that has STC for twin Cessna, Piper Malibu and Beech Baron and Bonanza applications. Unlike Garmin that only has a retrofit autopilot for the LSA and experimental market, BendixKing's KFC225 is an STC-approved system for use with both the Aspen Evolution and the Garmin G500/600 retrofit PFD systems.

AEROVUE, AEROWAVE

A major new product that trickles down from Honeywell's transport category market is the new AeroVue IFD (integrated flight deck), introduced at AirVenture 2014. BendixKing says the AeroVue model represents the future of BendixKing, which in part includes repackaging successful higher-end products and features from the business jet avionics market and applying them to smaller general aviation cockpits.

On the outside, AeruVue has a striking resemblance to the Honeywell Apex Edge integrated avionics

KSN770: CERTIFIED, BUT FOR WHAT NICHE?

We'll attempt to answer that in a bit. First, a history refresher. When buyers were looking for a modern alternative to the Garmin GNS530 somewhere around 2008, all eyes were on the BendixKing KSN770. The brochures made it look like the retrofit navigator that would put the sleeping BendixKing back on track and a jogging Garmin sprinting to the engineering lab. The system was everything the market was calling for—airways, VGA display, touchscreen, radar overlay, plus the rugged hardware that BendixKing was known for. Unfortunately, it was years in the making and the market didn't sit still.

Now that the $13,995 KSN770 (and the $12,995 KSN765, a version without comm or raw nav function) is certified, consumers have moved on to the Garmin GTN series navigators, tablet computers and most recently, Avidyne's IFD540 slide-in replacement for the GNS530W—none of which existed when the KSN770 was first pitched. That's not to say the KSN770 isn't capable. It brings a long list of functions, including a hybrid touch interface, excellent graphics, a logical user interface and most importantly, good interface capability with core legacy products in the BendixKing line. This includes the RDR2000-series weather radar and KGP560 TAWS-B, in addition to a variety of traffic systems, plus the L-3 Stormscope. It's also compatible with the KGX130 ADS-B transceiver for use as an approved WAAS position source. It won't, however, display ADS-B FIS-B weather or FIS-B traffic data—a major shortcoming that's being addressed.

We can't help but compare the KSN to the KMD540-series MFD that was part of the BendixKing IHAS (integrated hazard awareness system) because of its bezel and control design, plus the open architecture that plays with nearly all of the remote sensors used in a full-up IHAS interface. It's even marketed as a "safety display," essentially the second-gen KMD540. The IHAS 5000 and IHAS 8000 (with weather radar) was focused at higher-end piston twins and even light turboprops, although some single-engine Cessna pistons had the IHAS as standard. Some of those packages still exist and generally include a KLN94 or even older KLN89 GPS. While it's not a slide-in, interfacing the KSN with an existing IHAS package could be easier (and cheaper) than rewiring the interface for a Garmin GTN750. It also uses less panel space. There's also the RDR2000 weather radar interface, a non-player on a Garmin GTN750, but nearly plug-and-play with the KSN770.

Whether the KSN770 will appeal to existing IHAS owners is anyone's guess, but if BendixKing can get shops to embrace it, or even mention it as a viable option, IHAS-replacement could be its niche market.

There are still plenty of King Silver Crown radio stacks that need replacement, top. The BendixKing stack (KMA30, KSN770 and KT74) might turn more heads if it could plug and play with vintage King radios. The $21,800 KI825 EHSI will play with a KCS55A compass system.

system used on the Pilatus PC12NG turboprop, and has roots in the high-end Epic system, but it's designed around retrofit projects where it will replace all of the round gauges in older King Air twins.

The AeroVue uses three 12-inch displays (two primary flight displays and one multifunction display) that are controlled with hard keys and knobs rather than with a touch-screen interface. There is an optional cursor control user interface that's integral to programming the integrated navigator, but we think buyers might expect a hybrid touch interface like Garmin's G5000 jet-focused integrated cockpit.

AeroVue has an integrated flight control/autopilot system, flight management system, Honeywell's SmartView synthetic vision, electronic charts, ADS-B output, ship's weather radar and optional EGPWS (enhanced ground proximity warning system). AeroVue has an advanced graphics solution, including overlay of ship radar on the electronic HSI. This is an advanced feature set that Honeywell has nearly perfected in jets, and in our view can benefit smaller cockpits.

The initial retrofit STC for the AeroVue is on the Beechcraft King Air 200/B200 turboprops and is expected to have a fly-away price of around $250,000. The King Air full-panel retrofit market is currently dominated by Garmin, with its G1000 STC that's roughly $350,000 installed. We asked BendixKing's Dykeman if the AeroVue could be a player in piston singles. After all, Garmin's aging G1000 never did fill a vacant integrated cockpit retrofit market. "It is certainly our intent to expand AeroVue and its derivatives," he told us.

Another new product is the AeroWave 100 inflight satellite internet and messaging system. The AeroWave can provide connectivity speeds up to 200 Kbps (3G speeds) with a remote processor, satellite antenna and owner-provided cabin modem.

At $19,995 the system is one of the least expensive cabin internet systems on the market, and usage is charged by the hour, rather than by the amount of data that's used. The target market for the AeroWave is owner and corporate-flown single and twin turboprops and light jets.

TV AEROVUE VIDEO

AVweb
www.avweb.com

INDUSTRIAL WAR

Dykeman said that parent company Honeywell is being supportive in the effort to rejuvenate the BendixKing name, despite its prior commitment to serving higher-end markets.

BendixKing's longevity likely depends on it. As one shop owner put it,"It's industrial war going on in the avionics market right now. The way you win a war is to have more firepower than the other guy and to bring heavy-duty power. That's what Garmin has and it influences a shop when recommending a product line to buyers."

Finally, one shop manager echoed our thoughts on a way for the new BendixKing to gain market traction.

"There's a viable market for upgrading the later-generation Silver Crown radios in late 1990s to early 2000s vintage Cessna singles. If BendixKing could come out with an affordable line of radios to modernize those panels, and ones with even older digital Silver Crown like the KX155, then they would really have something."

Contact www.bendixking.com, 855-250-7027.

Aircraft Brakes: Assuring You'll Stop

Modern aircraft brakes are reliable, effective and inexpensive to keep up, if common sense preventive maintenance is performed.

by Rick Durden

We stand on them, we ride them, we ignore them—and yet, fortunately, they rarely let us down. However, as good as brakes have become, their enemies are still neglect and corrosion, which can lead to that horrible feeling of "nobody's home" when you rock forward with your toes—followed shortly by the sounds of bending metal.

We'll go through how modern general aviation aircraft disk brakes function, what you should know about their care and feeding, who makes most of them and what your options are if you're flying an older airplane with brakes that are either not very good, or adequate—but you can't get parts.

BRAKES 101

Stopping general aviation airplanes has come a long way from the days when a pilot simply closed the throttle, pulled back hard on the stick to drive the tail skid into the turf and hoped.

Main gear wheel brakes went through numerous iterations including drums, expander tubes and, best of all, hydraulic disks. The Cleveland line of wheels and brakes became the gold standard for general aviation several decades ago. It was bought out by Parker Aerospace, which kept the Cleveland name alive, and now accounts for about 80 percent of the wheels and brakes installed on general aviation airplanes.

Life further improved for general aviation pilots when manufacturers decided that the individual wheel brakes would be actuated by pedals above the respective rudder bar rather than one-inch-square postage stamps pressed with the pilot's heel. A pilot's toes proved to be better able to modulate pedal pressure, not to mention simply hitting the pedal at all.

In a typical general aviation airplane—and somewhat simplified—pressing on the toe brake moves a mechanical linkage connected to the master cylinder and pushes a piston inside the master cylinder to increase pressure on the hydraulic fluid stored inside the sealed cylinder. The fluid pressure increase is transmitted through lines to the brake assembly on the landing gear wheel.

When the pilot removes pressure from the toe brake, a spring pushes the piston back to the full off position, which allows the fluid that was pushed into the brake assembly to be pulled back toward the master cylinder. A compensating mechanism in the master cylinder also helps assure that any excess fluid goes to the right place—the fluid reservoir—so that the brake doesn't drag or, worse, lock up. While it all sounds simple in theory, getting brakes to apply linearly with force applied and then release when force is removed—and do so consistently—has driven engineers and aircraft owners to tears.

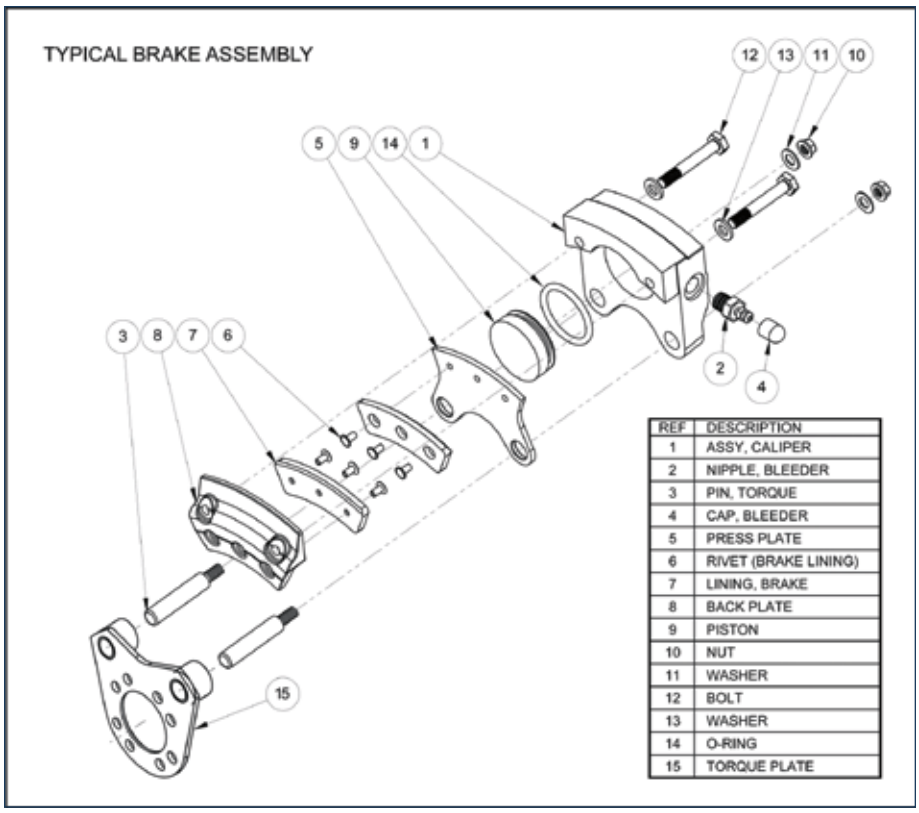
Most general aviation airplanes have single-disk brakes—heavier air-

Parker/Cleveland 6.00 x 6 wheels and brakes, left photo.

CHECKLIST

- Disk brakes will reliably stop your aircraft in just over 10 seconds.
- Brake pads cost about $20 and should be changed before worn to .10 inch.
- Worn-out pads mean metal-on-metal wear and expensive fixes.

Exploded drawing of a typical general aviation disk brake assembly, courtesy of Grove Aircraft.



REF	DESCRIPTION
1	ASSY, CALIPER
2	NIPPLE, BLEEDER
3	PIN, TORQUE
4	CAP, BLEEDER
5	PRESS PLATE
6	RIVET (BRAKE LINING)
7	LINING, BRAKE
8	BACK PLATE
9	PISTON
10	NUT
11	WASHER
12	BOLT
13	WASHER
14	O-RING
15	TORQUE PLATE

planes use multiple-disk systems. In a single-disk system, the brake works by applying friction to both sides of a rotating disk that is attached to the main landing gear wheel. The idea is to convert kinetic energy to heat.

Steel has proven to be the best all-around metal for absorbing heat for maximum braking. There is a brake lining (or pad or puck) in the caliper/brake housing, positioned on either side of the brake disk. The inboard brake lining is stationary—riveted to the back plate of the brake housing.

The caliper also contains a piston or pistons in cylinders, which are used to move the outboard brake linings. Hydraulic pressure from the brake master cylinder enters the brake cylinder and forces the piston toward the disk, pushing the brake lining on that side of the caliper against the disk. The disk is free to move laterally, so it is pressed against the inboard brake lining by the outboard brake lining, creating the friction required for braking.

When pressure on the brake pedal is removed and the spring in the master cylinder pushes the piston in the master cylinder back to the off position, hydraulic pressure against the brake piston is removed and a return spring or springs move the brake piston back to the off position so the brake doesn't drag.

SELF ADJUSTING

There is a self-adjusting mechanism and pin in the brake cylinder, so that as the brake linings wear, the piston travel is adjusted so that the same travel of the piston is always required to apply the brake.

Air in the brake lines will compress, which does anything from making brakes "spongy" and braking action unpredictable, to not work at all. A bleeder valve is installed on the brake housing so that air can be bled from the system.

Brake linings are either organic—originally asbestos, but now usually Kevlar impregnated with various metals—or metallic. Organic linings are used for lighter weight airplanes. It's easy to tell which is which—organic linings have holes in them for the rivets that mount them on the calipers, metallic do not, and they are mounted to a metal backing plate with pins.

Because of concerns with corrosion of steel brake disks—corrosion pitting speeds the wear of brake linings and reduces braking effectiveness—different metals have been tried. Stainless steel is used as well, but it has only half the ability to absorb heat as steel. It's not uncommon for brake disks to be chromed to fight corrosion, but the chrome eventually wears through and the exposure returns. At least one supplier offers a nickel-plating of the disk, but it degrades brake effectiveness, so it is removed from the portion of the disk swiped by the brake linings after the plating process.

CERTIFICATION

Certification of braking systems involves a calculation as to the heat energy that has to be created to stop the airplane in slightly over 10 seconds. Testing then involves putting the system designed from those calculations on a dynamometer test stand and demonstrating that the system can make the required 10- to 12-second stop 100 times (the brakes are allowed to cool after each stop), while changing brake pads no more than once.

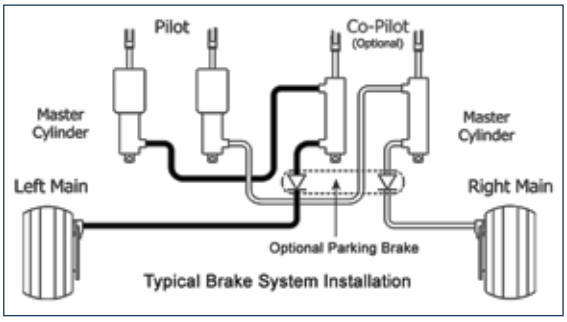
In terms of the energy required to make a 10- to 12-second stop, Grove Aircraft owner Robbie Grove guided us through a calculator on the company's website that showed that for a Cessna 210 touching down at a weight of 3500 pounds and starting to apply the brakes at 55 knots, each brake would have to absorb over 243,000 foot-pounds of kinetic energy.

According to Grove, nosewheel airplanes without nosewheel steering must have brakes that have 50 percent more capacity than those with nosewheel steering—although that is still lighter than a nosewheel steering mechanism.

HEAT

Retained heat is the enemy of brakes—the brakes have to create heat, but they have to shed it. As the lining heats up, it loses its effectiveness. For modern disk brakes, that's usually not a problem as even hard braking to slow to taxi speed will still allow plenty of brake effectiveness when taxiing in—unless the pilot is one of those who taxis at

That's the Parker/Cleveland brake system training equipment, left. Typical general aviation brake system drawing courtesy of Grove Aircraft, bottom.



Typical Brake System Installation

1300 RPM while riding the brakes. However, heat can be a problem for nosewheel airplanes that don't have nosewheel steering at airports where it's necessary to taxi a long way when there is a crosswind.

CARE AND FEEDING

The brake system can correct for small fluid leaks through a compensating port in the master cylinder. It will route brake fluid in from the reservoir—so long as the fluid lasts. That means that a part of the pilot's preflight should be to check for leaks in the parts of the brake lines that can be seen as well as for any drips or puddles underneath the brake assemblies. Scott Utz, president of Arapahoe Aero on Denver's Centennial Airport, told us that if there is any fluid noticed, the brakes should be checked and any repairs made before the next flight. It's pretty simple: If the brake runs out of fluid, it's not going to work.

Vern Rodgers, Tech Support Manager at Parker Wheel and Brake Division (Cleveland), told us that the brake problems he sees most often come about because owners are reluctant to pay attention to their brakes—they too often wait for something serious to show up, such as a leak or complete failure. It's much cheaper to replace worn brake pads than to have to do repairs and component replacement because the pads wore out and metal-on-metal wear wrecked the disk and parts of the caliper.

Brake pads generally run $18 to $20 for an airplane the size of a Cessna 172. Two are needed per brake and replacement takes about 30 minutes a side, according to Scott Utz.

NO WEAR INDICATORS

There are no wear indicators for brake pads. Minimum thickness for brake pads is generally 0.100 inch—however, the service manual for the particular type of brake is definitive. Once the linings are worn below limits, there will be metal-to-metal contact between either the steel rivets of organic linings or the metal backing plate and pins of metallic lines and the brake disk. (Grove Aircraft brakes use brass rivets that will not damage steel brake disks.) The steel-to-steel contact will rapidly start to erode the disk. While linings are $20 each, a disk is $100 to $120 for something the size of a Cessna 172—it's foolish to tear up a disk because of a delay in replacing linings.

In addition, the brake piston is designed for used with a brake pad that is within tolerances. Once the pad is worn below tolerances, the piston will extend too far, potentially leading to a brake fluid leak. Worse, its O-ring may come out of the caliper, which will result in a massive brake fluid leak and early brake failure.

Scott Utz told us that when his company gets a call to come get an airplane that has had a brake failure, almost invariably examination shows that the brake linings were "gone" and the piston had come so far out of the caliper that the brake fluid was lost.

CHECK WEAR AT OIL CHANGE

Utz recommended checking the brake lining thickness at each oil change—it's one of the courtesy inspections his company does for its customers. Otherwise, the brake pad thickness is only checked at the annual inspection—which he does not consider to be frequently enough. He also said that Parker produces a key fob with a quick reference tool that allows assuring that a brake lining is thicker than 0.100 inch.

Vern Rodgers of Parker/Cleveland emphasized that one of the best ways to make brakes last is to use them. As with airplanes generally, lack of use is simply not good—especially when it comes to the risk of corrosion, which will attack all metallic brake system components.

In addition, non-use allows the glaze on the brake pads to break down. When brake linings are replaced, there is a conditioning process required—which the shop should do. It involves hard stops from a fast taxi. It imparts the glaze to the linings that is important to good braking action. When the glaze breaks brake effectiveness is reduced.

There is no hard and fast rule on how long linings and disks will last, although it should be more than a few hundred hours. A great deal depends on conditions in which the airplane is operated, or not operated, and whether the pilot rides the brakes while taxiing.

Rodgers told us that brake hoses should be replaced every 10 years and other components inspected regularly for condition.

Grove also recommended replacing the O-ring any time the caliper is off of the brake, as they are inexpensive and will wear out, causing leaks and brake failure.

UPGRADES

Owners of older airplanes that have mechanical disk brakes, hydraulic disk brakes, mechanical drum brakes, hydraulic drum brakes, expander tube brakes or brakes manufactured by companies such as McCauley that either no longer exist or were bought out (and the new owner quit supporting the line) have been finding it more and more difficult to get parts for their brakes. Fortunately, the situation is starting to improve as suppliers expand their product lines to provide modern disk brakes for older airplanes.

The McCauley line was purchased by Parker, but is no longer supported. Parker offers kits to convert McCauley wheels and brakes (most brake conversions require doing both the wheel and brake) to Parker/Cleveland—they start at about $2000.

Grove Aircraft makes wheels and brakes that will fit many older aircraft—it recently obtained an STC for the Super Cub series to convert them to their hydraulic disk brakes. Robbie Grove told us that the company has been very successful in working with owners and the FAA to get field approvals for many classic and antique airplanes that were built in such small numbers that obtaining an STC is not financially viable.

While field approvals are reportedly notoriously hard to get, Grove said that his company keeps an extensive file of approvals that have been received, which has helped greatly when a new FSDO is approached for an approval. In addition, the company is seeking STCs for brake conversions for many of the classic airplanes manufactured in the 1940s and 1950s.

A relatively new entrant into the field is Airframes Alaska, which offers PMA-replacement wheels and brakes, Cleveland wheels and brakes, as well as its own line of wheels and brakes. Currently, they have direct replacement parts and subassemblies for the Cessna 180, 185 and 206 series as well as Piper PA12, 14 and 18s.

We spoke with Israel Payton in customer support, who told us that Airframes Alaska will also sell individual components in circumstances where they might only be available in kits from other suppliers.

CONCLUSION

Modern disk brakes are effective and reliable, and should provide years of solid service—if the owner is willing to do routine preventive maintenance. That means regularly checking brake pad wear and replacing the pads before they reach the wear tolerance, as well as watching for evidence of corrosion.

Each preflight inspection should include a check for any leaks—if any are found, the brake should be inspected and repaired prior to flight. Oh, and don't ride the brakes when taxiing.

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MAKE YOUR BRAKES LAST

After talking with brake manufacturers and maintenance technicians about their experiences with aircraft brakes over a combined total of more than 100 years, we distilled that experience down to a list of simple things pilots and owners can do to get the most out of their brakes while saving money.

Include the brakes on the preflight—even if they're covered by wheel pants, look at the condition of the visible parts and check for corrosion, cracks and frayed hoses.

Any drip or puddle under a brake is a red flag—don't fly the airplane until a maintenance technician looks it over. Otherwise you're begging for a brake failure—and Murphy's Law as applied to aviation means it will happen at absolutely the worst time.

Use the brakes. It helps fight corrosion, the bane of brakes. Also, the glaze that was built up on the brake pads during initial conditioning is renewed through use. Non-use allows the glaze to degrade, reducing brake effectiveness.

Check brake pad thickness at least as frequently as at each oil change. Replace them when they approach wear limits—it's much cheaper than fixing the damage that will occur to the disk if you let them wear out.

When taxiing, don't ride the brakes—stay completely off them unless you need to decelerate.

Pull the throttle to idle before applying the brakes.

When turning or taxiing crosswind, put the rudder to the stop before applying the brake—you may not need the brake.

Before landing, assure your toes are low on the pedals—think, "Heels on the floor."

Groppo Trail: Italy's Affordable LSA

It's a modernized version of the Cub idea. Minimal panel choices tamp the price down.

by Paul Bertorelli

AIRCRAFT FLIGHT TRIAL

Somewhere between conception and execution of the light sport aircraft idea, the notion of simple and inexpensive got tossed overboard. Typical LSAs are lavishly equipped at prices in the $130,000 range. Yet at least a couple of companies persist with offerings below that price, including the Italian-built Groppo Trail, which surfaced again this year at AirVenture.

It's not entirely new to the U.S., having appeared *sotto voce* last year, but with no marketing push. Now the model has been picked up by Steve Bensinger's Lone Palm Aero for another run at the U.S. market, offering an experimental amateur-built version and ELSA and SLSA models.

With a background in European microlight manufacture dating to 1982, Groppo appears to be applying that kind of technology to the Trail, which will sell in a U.S.-equivalent LSA version for $79,900 with steam gauges and $82,900 with a minimal glass panel from MGL, a South African company. Options like floats and tri-gear may drive that base up, but it starts well under the $100,000 mark.

NO FRILLS

How do they do that, when everyone else is selling LSAs for $30,000 to $50,000 more? In our view, there's no mystery to this. The Trail is simply a minimalist airplane. While it has some intriguing features, Groppo and Bensinger have resisted the urge to tart the Trail up with more elaborate features than it needs to fulfill its basic purpose as a day VFR fun flyer meant to be, if not cheap, affordable.

First impression of the airplane is that its design brief is built on the Cub idea, although it's not exactly a Cub clone. It's a tandem two-seater with conventional strutted wings and simple, lightweight construction.

The cabin is a welded cage of 4130 square-section chromoly tubing which, à la Mooney, provides some crashworthiness. Aft of the cabin section, the airframe is conventional stressed-skin riveted aluminum construction over ribs. We noticed that many of those rivets are pop rivets, which simplifies construction.

The wings are conventional aluminum skin over ribs, with fuel stored in molded nylon tanks in the wing roots. Capacity for U.S. models will be 26 gallons between the two sides, almost doubling the 15 gallons Euro versions carry, since these airplanes typically aren't used for distance flying in Europe. Also to the European design mode, the wings fold, the idea being that this enhances affordability, saving the thrifty owner the expense of a tiedown or even a shared hangar. Europeans have many more affordable garages than they do hangars on airports. Trailering is more common there than in the U.S. and Bensinger isn't sure how North American owners will adapt to it.

"We're leaving it up to the buyer at this point. Because the tail doesn't fold yet, it's still a bit tricky to trailer," Bensinger said. Groppo is working on a folding tail design which, if it works as intended, will reduce the width of the folded airplane to the width of the gear—5 ft. 7 in. That will easily fit into one bay of a two-car garage.

"Once we come up with a good tail fold system, we'll probably come up with a trailer that can be sold with it. It's still very doable to take it back

CHECKLIST

- For well under $100,000, the Trail is a departure from expensive LSAs.
- Quick-fold wings, tundra tires and a belly pod are nice options.
- U.S. delivery and production haven't been worked out as of press time.

and forth and stick it in your garage at home, " Bensinger told us.

QUICK FOLD

He demonstrated the wing-fold process, which takes one person about five minutes, with no tools required. The aileron push-tubes disconnect and there's a threaded pin to fasten each wing into the spar carry through. Fuel lines remain attached. The wings rotate to the vertical (chordwise) and pivot toward the back, where a fixture secures them for towing.

Those fixtures will likely be options for the Trail, as will floats, a full control set for the rear seat, a belly pod luggage compartment and the parts to convert to tri-gear, which requires a few hours of work. There's no accounting for taste, but in our view, the airplane would be considerably less appealing as a tri-gear airplane. It just looks right as a taildragger and why not leave it at that? There's also a tow hook add-on for glider tugging, another Euro-inspired option.

Panelwise, the Trail is likely to remain austere to meet its sub-$100,000 price point. As currently priced with steam gauges, it has just a single MGL V6 radio/intercom and a Sandia STX-165 transponder. For $3000 more or $82,900, you get the MGL Avionics Xtreme EMS EFIS and engine monitor pair, plus an iPad mini with ForeFlight for navigation.

The panel space may be tight, but the weight isn't. The Trail version we flew had a claimed empty weight of 720 pounds, which is light by LSA standards, yielding a useful load of 580 pounds. (The Trail gross-weight limit is 1300 pounds, not the LSA standard of 1320 pounds.)

That's two 200-pounders, full fuel and an overnight bag. Not that there's really space to carry much. There's a Cub-style breadbox behind the rear seat. Considering the Trail's generous useful load, the belly pod idea makes sense. That could turn it into a respectable outback airplane to rival the Kitfox. We won't be surprised if EAB builders opt for the turbocharged 914 Rotax just for that reason, should it become an option.

ERGONOMICS, FLIGHT TRIAL

As a tandem, the Trail's cabin area isn't exactly commodious, but it's certainly wider and more comfortable than a J-3 Cub. Soloing is from the front seat, but to enter the rear, the front seat pivots forward. That's helpful, but the door opening has an angled corner member that squats right in the middle of the ingress path. Bensinger says that will be eliminated in future models and that's a good idea.

Once inside, visibility from the rear cockpit is typical tandem; acceptable, but not great. The windshield doesn't have the usual downtubes so the view from the front is quite panoramic for a taildragger. During taxi, the view from the front is unobstructed, so no need for S-turns. Even from the back, it's not bad and a cut above legacy taildraggers.

The Trail will have a full swiveling Matco tailwheel and Matco toebrakes—they're optional for the rear seat—so ground handling is sure footed and precise, just as all modern LSA taildraggers seem to be. With a big rudder and strongish brakes, even a club-footed pilot will have margin against losing it in a groundloop.

Bounces, however, are another matter. We wouldn't expect an airplane in this price class to be oleo-equipped and the Trail isn't—just spring-aluminum legs bolted to the fuselage externally. There's no traditional box structure for the gear. Any spring gear will give as good as it gets, so a wheelie with a too-high descent rate will yield a nice bounce. Timing is everything. So is airspeed.

In flying the airplane, Bensinger had suggested a speed of 70 MPH indicated on long final, but we didn't sense that the airplane was comfortable there. It seemed to naturally settle into about 60 MPH and 55 over the threshold yielded a nice, bounce-free three pointer. Wheelies will take practice, but that's true of any taildragger, perhaps with the exception of the

Interior, top photos, is relatively spacious; front seat tilts forward for ingress. Panel space, below, is tight, but adequate.

For trailering home, the Trail's wings can be folded by one person in about five minutes.

Great Lakes biplane we reviewed in the September 2014 issue. It has oleos with sufficient stroke to soak up the most embarrassing touchdowns.

The Trail version we flew had a two-blade wood prop that Bensinger described as over-pitched for the airplane. Perhaps so, but with two aboard, the Trail still managed a respectable climb and got itself to a 1000-foot pattern altitude by the mid downwind. For takeoff, the tail comes up easily and the airplane flies when it's ready, without the need to tug it off the runway. Again, this is typical LSA performance. But then we've come to expect this from airplanes that are all about the same size, have similar wing sections and not only the same power, but the same engine, the 100-HP Rotax 912 ULS.

One thing Groppo may have paid more attention to is control forces and harmony. In some LSAs we've flown, the stick has zero breakout feel and light, almost dangerously so, control forces, especially in pitch. Groppo seems to have positioned the control pivot points to give the airplane a just-right, slightly heavier feel in roll and pitch.

It feels like a larger airplane and we think that's a good thing. Too-light control forces invite over control, uncommanded excursions and PIOs on landing and takeoff. The Czech Sport Cruiser is notorious for this, in our estimation. Cruise speed? No surprise, just like every other airplane with the same power: about 100 MPH on 4.5 to 5 GPH. This will vary up or down by as the company sorts through the prop choices available for the engine.

And speaking of engines, there may be choices there, too. In Europe, the Trail is flown with the 80-HP Rotax 912 UL, but there's also a Jabiru 2200 and Sauer option. U.S. models will likely get the 912 ULS and eventually the new 912 iS. "It's just a matter of putting it on the airplane and running it through the ASTM process. I don't see why not," Bensinger explained.

What we would most like to see is the 912 iS Sport engine. With its improved induction, it offers more midrange torque for shorter takeoffs and climbs. The Trail is no slouch with its cruise prop, but it's always better to have more climb rate than less and to use less runway rather than more.

CONCLUSIONS

The Trail is, in the end, another contender among many. Its performance is respectable if not exceptional, but then that sentence can be attached to any of a dozen other similar light sport aircraft. It's very much in the Cub tradition and, in our view, is best left as a taildragger and flown like the Cub it mimics. Why fuss with the aesthetics?

The Trail's strong point is price and value. If it hews to that $82,000 price point, it will invoice as much as $30,000 or more under other Cub clone offerings, which makes it a lot of airplane for the money. Having said that, the LSA market seems to have defied expectations that droves of buyers would respond to simple, low-cost airframes. What they seem to want are simple airplanes festooned with every glass gadget available. We'll see if Groppo can carve out a niche of buyers who really do want what the LSA concept originally promised.

WHO ARE THESE GUYS?

Groppo is among a slew of European microlight manufacturers who've been plying the market since the early 1980s, long before the U.S. light sport rule was even a thought. Steve Bensinger told us that nearly 100 Trails (or variants) have been built for the European market, where they are called Trials.

Bensinger comes to the Trail with experience marketing another LSA line, which he has since dropped. The U.S. marketing effort can best be described as work in progress. Bensinger says Groppo plans to ship not complete airplanes but boxed kits for assembly in the U.S. That means Bensinger and other dealers Groppo may bring on will have to find a U.S. production facility which, as of press time, had not been finalized.

Our advice is that before committing to a purchase contract, a buyer should query about the status of the production arrangement and gain a clear understanding of delivery promises and warranty support on the aircraft and engine.

Bensinger told us EAB kits can be delivered in a matter of a couple of weeks, but SLSA versions may require up to four months for delivery of completed aircraft.

CONTACTS

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Redbird Xwind Sim: Conquering Crosswinds

Using the Redbird Xwind Simulator, Crosswind Concepts, Ltd. has developed an inexpensive, effective crosswind training course.

by Rick Durden

CHECKLIST

- ⊕ Focused solely on crosswind training, the Redbird Sim is effective.
- ⊕ The simulator handles much like a real airplane in a gusty crosswind.
- ~ At $28,000, the simulator may not be affordable as a single-focus trainer.

There aren't any magic bullets for eliminating general aviation accidents—but I've just run across a dedicated, reasonably priced simulator training program that has a lot of potential for reducing the most common type of GA accident, runway loss of control (RLOC).

For some reason, pilots and owners are not very good at responding appropriately when given hard data on risks. Case in point: RLOC. The crash data for the last two years of *Used Aircraft Guides* in this magazine shows that 23.6 percent of the wrecks for nosewheel airplanes and 53.2 percent for tailwheel airplanes were RLOC events. The numbers are probably higher because many RLOC prangs don't meet the damage or injury threshold (which is pretty high) to be a reportable.

The most effective way to prevent an RLOC crash is to take recurrent training—yet if there's one thing a general aviation pilot won't spend a dime on if he can help it, it's recurrent training. However, there's a high probability that same training-resistant pilot has already shelled out a couple thousand bucks for a traffic alerting device even though midair collisions account for less than one percent of accidents.

There have been all sorts of attempts to cut down the RLOC accident rate over the years, yet nothing has worked. Pilots seem to stubbornly insist on their right to ignore an obvious risk and go on wrecking airplanes.

CROSSWIND CONCEPTS, LTD.

About two months ago, I was introduced to a company called Crosswind Concepts, Ltd. at a local pilot safety meeting. Manager Taylor Albrecht gave a brief talk about a crosswind training simulator the company was using. My experience with flight simulators for crosswind training had been that they were OK, not great—even the newest.

I went into my simulator session with low expectations. I came out impressed. Short review: The Redbird Xwind simulator combined with the straight-forward "hour of ground instruction, hour in the box" training program by Crosswind Concepts, Ltd., should dramatically increase a pilot's ability to evaluate and handle a gusty crosswind through approach, landing and rollout.

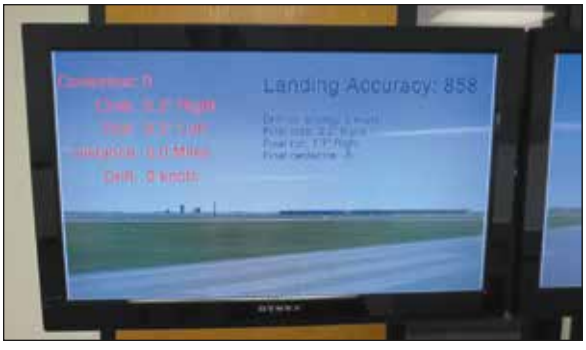
In addition, it provides an objective measurement of a pilot's ability to land in a crosswind, scoring the approach, landing and rollout in their entirety and displaying the degree of yaw, amount of sideload and distance from centerline on touchdown. In my opinion, the objective data helps a pilot establish personal minimums for crosswinds far better than the current pass/fail system where after a landing you can either use the airplane again or you can't.

THE SIMULATOR

Taylor Albrecht explained that the initial crosswind simulator was developed by Brad Whitsitt of Indianapolis. As it evolved, Whitsitt teamed with Redbird Flight Simulations to create the current version. It consists of an open cockpit with

Crosswind Concepts, Ltd. manager, Taylor Albrecht demonstrates a wing-low slip to landing in the Redbird Xwind Simulator.

Open cockpit, with just the essentials for teaching crosswinds, the sim rolls and yaws and translates left and right on rails, above left. After rollout, a score and details of the touchdown are posted, below left.



yoke and rudder pedals. The cockpit moves left and right on rails as the pilot induces yaw—or doesn't correct for wind drift—and rolls left and right at angles that are pretty close to the real thing when slipping for a landing in a crosswind. There is no pitch control—it's not needed.

Three screens in front of the pilot present a convincing runway display. In the initial training mode (which a pilot can conduct without an instructor present, thus paying only for simulator time), the runway is endless, so the pilot can practice holding the airplane directly above the runway. He can internalize the idea of keeping the nose straight down the runway while correcting drift with bank and developing the muscle memory involved with making a wing-low landing in a crosswind.

In evaluation mode (an instructor must be present to run the sim), the computer sets the airplane up on final. The pilot then flies the sim all the way through the landing, seeking to touch down on the upwind gear, and hold it there with increasing aileron deflection during rollout as the airplane comes to a stop. The evaluation then appears on the screen.

In the Xwind Simulator, there are no distractions; it's pure focus on crosswind landings. It continues as many times as the pilot wishes.

IN THE BOX

I was told to start out by treating the simulator as an amusement park ride—to explore the controls while making coordinated turns as well as side and forward slips. The computer screens were off.

Once the screens were turned on and I could see the runway, I relied on two stripes on top of the panel to determine whether I was yawing—and there was a constant readout of yaw on the left screen.

I found that the simulator was nicely sensitive in yaw; with a little experimenting, it would point the airplane very accurately and fairly quickly return it to a desired spot when displaced by turbulence or a gust.

The ailerons had a slight delay between cause and effect, and then reacted more than linearly. I felt that it was an attempt to duplicate the level of responsiveness of the ailerons when the airplane is slowed to approach speed. If so, I think the designers and tweakers got it very nearly right.

For me, confidence built rapidly as I flew it in a side slip above the runway centerline, dealing with crosswinds, gusts and turbulence of various magnitudes. The controls were effective enough to put the airplane where I wanted it; all I had to do was practice to get the modulation right.

EVALUATION MODE

Albrecht then put the sim into evaluation mode and I started making landings—there was positive transfer from the flying over the runway exercise, making switching over to landing straightforward.

I liked that on rollout, it was necessary to progressively increase aileron deflection into the wind. If full aileron is not eventually used, the computer will dramatically pick up the upwind wing and cause the airplane to swerve. The steering feel changes as well; it simulates how the rudders behave as nosewheel steering becomes effective.

After coming to a stop, the computer scores the the full approach, landing and rollout, with 1000 being perfect. It also shows yaw, side load and distance in feet from centerline on touchdown.

Having the instructor make changes in the wind and turbulence variables during the approach required me to continuously evaluate what I had to do to keep the airplane where I wanted it and whether I was going to continue the approach or make a go-around.

I liked that the sim also showed the need for a pilot to make a correction as soon as the airplane wasn't precisely where desired—don't wait, act. My reaction was that this will be an effective tool for tailwheel pilots where delay in making a correction often means a groundloop.

THE TRAINING PROGRAM

Albrecht explained that the company

was formed to provide effective stick and rudder crosswind training. It has two locations in the Denver area, with a simulator at Rocky Mountain Metro and Centennial Airports. Its training program has evolved into an hour of ground school and an hour in the simulator. Called Maximum Demonstrated Crosswind, the cost is $225. It is tailored for the customer's level of experience and has proven to be effective enough that more time isn't generally needed. Albrecht also organizes competitions within FBOs and is putting together some between pilots at different airports. The simulator costs just under $28,000.

POINT YOUR NOSE

The course starts with the concept of "Point your nose with your toes" for lining up the airplane—because the instructors have seen too much negative transfer from driving an automobile. It emphasizes aeronautical decision making and how to quickly evaluate a crosswind.

Crosswind Concepts, Ltd. has teamed with a large FBO—it requires its pre-solo students go through the MDC course. According to Albrecht, the FBO has seen the frequency of tire replacements drop as a result. Instructors who have canceled a lesson due to winds have sent their students through the MDC course so they can see what that flight would have been like.

The Xwind Simulator does not qualify as a simulator in which a pilot can log the time, which may be causing some resistance from student pilots. In addition, with the extraordinarily high flying time requirements under the new ATP rules, instructors who want to fly for the airlines are under pressure to fly every moment they can, and some are reluctant to put their students into a simulator because the instructor cannot log the time.

Albrecht is aggressively marketing the program and the sim as an effective teaching tool that instructors who want their students to be the best pilots possible should use. He is also reaching out to the FAA. Already at least one pilot who tore up an airplane in a crosswind and had to go through FAA-mandated remedial training has gone through the MDC course to comply.

Avemco Insurance likes the program—it's giving pilots who complete the MDC course a five percent discount on their insurance.

CONCLUSION

In my view, this is a training device and program that can do a great deal to improve a pilot's understanding of and ability to handle crosswinds in two hours.

For $225, it seems to me to be an inexpensive way to reduce the rate of the highest risk accident we face in general aviation, RLOC.

CONTACTS

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REAL WORLD VERSUS THE SIMULATOR

In the main article, I expressed what turned out to be a strongly positive evaluation of the "highly focused Redbird Xwind Simulator."

That being the case, how does the simulator behave in comparison with a real airplane in a gusting crosswind?

The simulator approaches at a set speed, and has roll response that is just sloppy enough that it mimics an airplane similar to a Cessna 172 or Cherokee Warrior fairly well, although the rudder may be slightly more responsive but have slightly less travel than on a 172.

Because the speed on approach is set, the pilot experiences a stabilized approach, with consistent control responsiveness/effectiveness—that's important.

In a real airplane, the pilot can increase the speed on approach, improving the control effectiveness. That gives immediate gratification, but will almost invariably present an expensive bill—the airplane has a lot of extra energy to manage and it will float before touching down. That means the pilot is suddenly dealing with constantly diminishing control effectiveness. It may be that at as the airplane decelerates to what should have been the approach speed, it will turn out that the crosswind is too strong for capability of the airplane.

In addition, the pilot is likely to force the airplane onto the ground at well above stall speed and then relax because it's a nosewheel machine—and not put in full aileron deflection into the wind, which is needed to pin the upwind wheel and have good rolling control.

In a real airplane, the pilot learns bad habits with speed control and control use on rollout—and gets away with them. Usually.

In the sim, speed control is set, so the pilot learns a stabilized approach and how to deal with slightly mushy controls all the way down final. The pilot can accurately determine if the crosswind is within their and the airplane's capabilities.

The sim may be slightly less responsive than a real airplane, but that is a good thing—I found myself putting the controls to the stops from time to time. The willingness to do so is essential in making a successful landing in a strong crosswind.

On rollout, the sim punished failure to progressively roll in full aileron deflection—much more so than a real airplane.

Overall, the sim is just a little more demanding to fly than a real airplane—making it a good learning tool.

Cheap Flight Timers: No Frills Functionality

Inexpensive kitchen timers have long held a place in our flight bags. At around 12 bucks, the TDM TM30 offers the most utility for basic cockpit use.

by Frank Bowlin

Given today's avionics and RNAV approaches, do you really need a timer? Truth is, many of the devices in our panels and on our portable gadgets already have a timer built in. Using that timer, however, can be a challenge as the sequence of commands to access it in the Garmin G1000, for instance, might not be something you're going to always remember or find sufficiently convenient. So, we think a dedicated, standalone timer is still useful. Sure, you could use the timer function in your smartphone, on the Pebble Smart watch or the one in Garmin's D2 pilot watch, but we think timers are best placed within the instrument scan.

Still, would you actually use the thing? Yes. You'd still use it to time fuel tanks, power reductions on descent when concerned about shock cooling, maybe for timing a turbo cool-down after landing and, yes, on the occasional non-RNAV approach.

Frustrated by the ever cheapening of household electronic gadgets, we mounted a search to see if any simple household timers were still made with 10 direct-entry buttons. The good news is that they are. The bad news is that they're a bit difficult to find.

First, you're unlikely to find them at your local Target or Walmart. It took us a concerted search on the web to find one. We purchased four for evaluation. These are the West Bend 40005 ($15.67 from Wayfair.com), the General Instruments TI239 (MSRP is $24.95, but commonly priced around $40 on Amazon) and two from Component Design Northwest (CDN), the TM23-S ($19.51 from Wayfair.com) and the TM30 ($11.99 from Wayfair.com).

Each offers direct entry with 0-9 buttons and can count up or count down by seconds. Some count only up to minutes, while some go to hours. All but the West Bend have a nice overrun feature on the countdown timer. With the overrun feature, when the timer reaches zero, it starts counting up. This way, if you're timing a hold, for instance, and you want a two-minute leg, you'll know that the leg actually took two minutes and nine seconds.

Surprisingly, we found we still liked the older Timex models, but some may be tough to source, except maybe on eBay. They have a good combination of size, ease of use, display and alarm tone and volume. Oh, and we won't be reporting battery life for this roundup. If they're anything like that old Timex, the battery life is measured in decades. That Timex is still working fine with a AAA battery dated to expire in March 2004. Of course, the TI239 using a button battery probably won't last so long.

WEST BEND 40005

This is a basic timer. It operates quite simply and doesn't have the over-

Whether it's cooking a turkey or timing holds, these cheap, non-aviation timers get the job done, left photo. Clockwise from top, the CDN TM30, CDN TM23-S, Westbend 40005, Timex and the General Tools and Instruments TI239.

CHECKLIST

- Models with direct-entry buttons work best for cockpit timing chores.
- Many models have audible alarms to get your attention.
- Aviation models from ASA and Sporty's lack direct-entry 0-9 keys.

run feature. Like most of the timers, from zero it counts up when you push start. Or, from zero you can enter a time and push start and it'll count down. With a few variations, this is the standard way these timers operate.

It has a six-digit display. The display is large, with the hours and minutes about 5/8 inch tall, but the seconds are shorter at a little over 5/16 inch. This size difference caused us to overlook the seconds on one occasion—quickly glancing at zero minutes, we thought the timer had elapsed when there were seconds remaining.

When the timer reaches zero, the alarm beeps repeatedly, four beeps at a time, over and over.

The back has a bulge for the AAA battery and a spring loaded clip that you could use to clip it on your shirt. The clip has a magnet on it as well as a bale that falls to hold the clip open to act as a kick stand.

Our only real gripe is the alarm. That beep is more like a chirp. It's quite high pitched. It is loud, though, and somewhat penetrating. But with aging ears and a loud cockpit, it might be difficult to hear. With the display remaining static when it reaches zero, you could miss the end of the timed event.

COCKPIT-PURPOSED

Worth mentioning are two popular timers targeted specifically for cockpit use, including the $50 ASA Flight Timer. The ASA has no shortage of features, including three simultaneous timer functions, audible and visual alarms, a stopwatch and a digital notepad. There's even a dedicated approach timer mode for storing up to 12 approach times.

The $27 Flight Timer from Sporty's is more basic and has useful flashing LEDs to announce timer expiration and two independent count up and countdown timers, each with a unique alarm. We have the Sporty's model and found that battery life isn't great, especially since we don't use it much.

Are the features on these aviation-purposed timers more than many pilots will use? We think so. We also think the ASA's push-twist setting mode can be cumbersome, especially when one-handing the timer in turbulence. For that reason, we give our kitchen timers the edge, thanks to their direct-entry feature set and low cost. After all, it's only a timer.

GENERAL TOOLS, CDN

The General Tools and Instruments TI239 is the smallest of the timers, although it hosts a good-sized display with four digits for minutes and seconds. Operation is standard for the basic functions.

The overrun feature on this timer operates in a unique way. When the count down timer reaches zero, it begins a continuous beeping and the display counts up. It doesn't flash. When you now push the stop/reset button, the beeping stops and the display stops and shows the sum of the original time you set, plus the overrun.

Say you were timing that hold leg from two minutes, but you went 15 seconds over. The display is now set to 2:15, showing you the total time since you started timing. At this point, you'd expect to be able to count down from that 2:15, but you can't. Pushing start does nothing. If you push stop/reset, the display reverts to the original time from which you can count down. Of course, if you push stop/reset again, it zeroes the timer.

The back of the timer is smooth except for the clip that's like the one on the West Bend, with the magnet and the bale that makes the clip into a kick stand. It takes a button battery. It's alarm chirps like the one in the West Bend.

The display on the CDN model TM30 might be the best of the batch, in our view. It's about the same size as the West Bend, but it seems bolder and has somewhat higher contrast. The display has five digits, providing a single digit for hours. Another nice feature of this display is that when the timer expires and the alarm starts beeping, the display flashes. We like that for cockpit use—if you miss the beeping, the flashing display might get your attention. Finally, the display also has the word TIMER and an up and down arrow to show whether the timer is counting up or down.

The overrun on the TM30 doesn't capture the overtime. When it counts down to zero, it starts counting up like the other overrun features. However, when you do press stop, the overtime vanishes and is replaced by the original countdown value. To us, this is probably the most awkward of the overrun implementations. The alarm is lower pitched than the others. It's still a clear beep, but not nearly so high that we'd call it a chirp. This one is probably the most likely to audibly get your attention in the cockpit. But, if it doesn't, this timer is the only one to feature a vibrator. There's a switch on the back allowing you to select the beeper or a vibrator.

The TM30 has a clip on the back similar to the other timer clips, with a magnet on it and a bale to hold it open as a kick stand. However, there's also a little hinged loop at the top of the clip that you open for the option of hanging the timer on a hook.

Just about everything on the CDN model TM23-S is different than the others. It's the only one to offer a clock, which can be set for 12-hour or 24-hour format. The six-digit display is of similar large size to the other CDN and the West Bend, but the clear cover over the display seems more highly reflective. We often struggled to clearly view the display. Like the TM30, the display flashes when the timer expires.

This timer is physically the largest, but still not overly so. It takes a AAA

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The Aero455 oximeter lives in a metal enclosure that fits a 2-inch instrument cutout, main photo. It works with a variety of displays, including JP Instruments engine monitors, inset.

Life Guardian Aero455: Panel-Ox, CO Minder

We're not convinced a panel-mounted oximeter offers sizable utility, but we like the Aero455's ability to monitor carbon monoxide and cabin altitude.

by Larry Anglisano

The Guardian Aero455 panel oximeter might not have been invented if company founder Ash Vij didn't find himself crossing the Rockies in his Cessna 206 without a pulse oximeter. He knew the status of his oxygen supply, but was pretty interested to know his blood saturation. Vij is convinced that his panel oximeter is the cure-all for misplaced portables.

Many features in the $999 Aero 455 were born from the Aero452 CO detector, with an added RS232 databus, older Bluetooth technology and a cabin pressure sensor and alerter system. The device made its debut in the Cessna Corvalis TTx, where it interfaces with Garmin's G2000 integrated avionics. It's also FAA-approved for retrofit.

FORM FACTOR

The oximeter is mounted in a metal housing that measures 2.5 by 2.5-inch chassis has a round bezel for mounting in a 2-inch instrument cutout. To ensure accurate readings of the CO sensor, the device has an inlet fan to draw in cabin air.

Optimally, the device should be located in an area that both the pilot and copilot can finger it, but that might require cutting the panel if an instrument hole isn't available.

The Aero455 measures blood oxygen saturation levels (SP02) between 70 and 100 percent and measurement is taken like any other finger oximeter. Simply stick your finger in the sensor and hold it there for about 10 seconds while the device shines light through the blood vessels of the fingertip. Compatible displays will indicate the measured SP02 and heart rate.

The system is compatible with the company's Aero55, a $300 device that can function as a dedicated display (and has an amber CO warning annunciator and LCD CO level readout). It too requires a 2-inch panel cutout.

For monitoring passengers, the system comes standard with integral Bluetooth and interfaces with the Nonin Onyx 9560 wireless pulse oximeter, a clinical/industrial portable model that's sold by Guardian as the Aero901 for a hefty $450. The unit isn't compatible with the high energy or so-called Smart Bluetooth-equipped NoninConnect model. It's priced at $219 and is targeted at aviation and sports use.

While the Guardian outputs to a display on dual channels (one for the panel-mounted oximeter and one for the Bluetooth-received oximeter data) Guardian says that most displays will only show one reading at a time due to the limited screen space. Without Bluetooth Smart, the Aero455 is limited to connecting with one sensor at a time.

Compatible certified and experi-

The Aero455's low-energy Bluetooth won't connect with the newer Bluetooth Smart NoninConnect sports and aviation oximeter, left, but works with the pricey clinical Onyx 9560, right.

MASIMO ISP02: DATA-RICH, BUT TETHERED

Well known in clinical settings for its line of noninvasive patient monitoring equipment, Masimo, Incorporated offers the $145 iSp02 tablet-driven pulse oximeter. Intended for extreme sports and aviation use, the iSp02 measures blood oxygenation, pulse rate and perfusion index, and presents the data in a free tablet app that's compatible with iOS and Android.

The finger sensor attaches to a 30-inch cable that plugs into the tablet—an obvious drawback for extreme sports and cockpit use, in our view, compared with the new Nonin Bluetooth NoninConnect portable. The interface cable is barely long enough to reach a tablet that's placed on the copilot seat. For panel-mounted tablets that sit in an AirGizmos dock mount, the device is nearly unusable without creative wire routing.

Logistics aside, the iSp02 has a healthy amount of usable features—far more than the Guardian panel oximeter—and its data is presented in a simple, logical way that's easy to decipher at a glance thanks to large onscreen characters and a simple layout (we evaluated the product on an iPad mini in the cabin of a Cirrus).

The main screen has three main data fields for displaying the numerical value of current blood oxygenation (percentage of Sp02), the current pulse rate in beats per minute and the arterial pulse signal strength, known as the perfusion index. A low perfusion value indicates poor blood flow to the finger. Masimo says that unlike most other pulse oximeter, the iSp02 can accurately measure in low perfusion conditions. For a clinical-like experience, it has an audio mode that beeps in time with measurements, but we couldn't hear it while wearing a headset.

The application displays arterial pulsations in a graphical waveform, with signal IQ indicator lines that show the assessment of the confidence in the displayed Sp02 value. Logically, a higher vertical line indicates higher confidence in the measurement. It also has a history screen with trend data to include three separate times: Beginning of the trend, midpoint and the time of the last data point within the trend. The trend data can be emailed and displayed in any .csv file spreadsheet.

Masimo hinted at a new version of the iSp02 coming in the near future, but wouldn't tell us about it. If it has Bluetooth Smart connectivity, we think it would step the already worthy product up several notches. Until then, the wireless convenience of the app-driven NoninConnect model has it beat.

mental displays include the Garmin G3X and G3X Touch, G1000, G2000 and G900, the Grand Rapids Sports, Horizon HX-series, Advanced Flight Systems PFD and the Electronics International MVP-50 and CGR-30 series engine monitors. It also works on the JP Instruments EDM730/830 and EDM900/960 primary display color monitors. Guardian advises to check with each manufacturer at the time of installation to be sure the current software is compatible.

As for installation, the Aero455 connects with third-party displays primarily through an RS232 serial interface. Guardian told us installation times will vary depending on the existing wiring and required panel work, but expect a basic installation to take roughly one day.

CABIN ALTITUDE NAG

The Aero455 has an integral carbon monoxide detector that measures the presence of CO between 20-999 PPM (parts per million). The system can be wired to a remote annunciator light for CO warnings.

The alarm level is calibrated to provide a visual alert within five minutes or less whenever the carbon monoxide level reaches 50 PPM or greater. The warning time is shortened at higher levels of CO concentrations and becomes instant should the carbon monoxide level reach 400 PPM or greater. Additionally, there is a headphone audio output that reminds you to periodically check SP02 based on the cabin altitude.

The built-in pressure compensation sensor detects cabin altitude changes up to 25,000 feet and signals to the remote annunciator and headphones when the cabin altitude climbs above 10,000, 12,500 and 14,000 feet. The idea here is to monitor potential cabin pressurization failures and to remind you to stick your finger in the panel oximeter.

The detector should be returned to Guardian at the end of its five-year service life for replacement and calibration of the CO sensor to maintain airworthiness of the unit. The main reason for replacement of the sensor is the degradation of the sensor and

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CONTACTS

Guardian Avionics
480-707-3490
www.guardianavionics.com

Masimo, Inc.
800-326-4890
www.masimo.com

Nonin Medical, Inc.
800-356-8874
www.nonin.com

Bad Elf GPS Pro+: Barometer, GLONASS

Elf's multipurpose WAAS/GLONASS receiver excels at datalogging and has altitude display. We like its versatility, but not its incompatibility with Android.

by Larry Anglisano

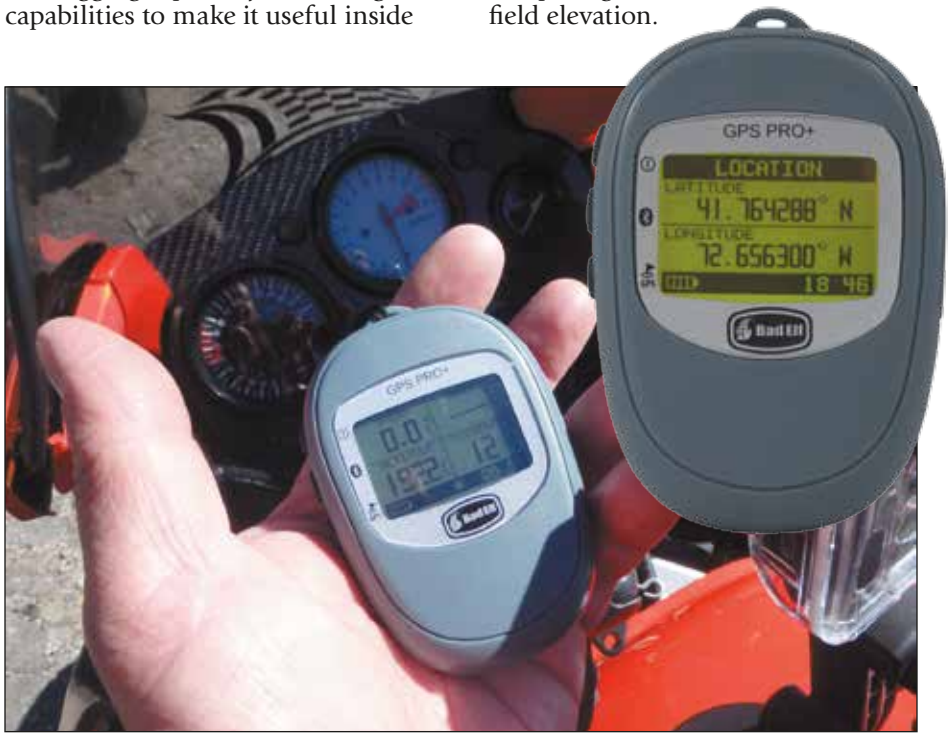
Navigation apps require reliable GPS position input for georeferencing, which is the ownship data that's displayed on electronic charts and maps. The built-in GPS on many tablets might not be reliable enough without cell phone tower assist, especially in the cabin at higher altitudes. That's why a wireless GPS receiver remains an integral component for cockpit tablet use.

On the other hand, WAAS-equipped portable ADS-B receivers fill that need, leaving a dwindling market for standalone receivers like the new $300 Bad Elf GPS Pro+.

Still, we think the new Elf receiver with its integral WAAS and GLONASS engines, barometer and datalogging capability has enough capabilities to make it useful inside and outside the cockpit. It's also a solid performer, with impressive battery life, five-device Bluetooth connectivity and fast satellite lock-on.

The new Pro+ shares the same housing and basic control set as the original Pro model, which remains in the Elf lineup and is priced at $200. But the 66-channel Pro+ has both WAAS GPS and GLONASS (that's Russian satellites) receivers, which help the device come up and ready for navigation in well under 20 seconds, based on our trials.

The new Pro+ also has built-in temperature and barometer sensors for displaying altitude (it won't display temperature), which we found accurate to within a few feet when comparing the altitude resolution to field elevation.



What really impressed us was the Elf's battery life—nearly 30 hours. The unit is also easy to use without having to reference a manual, thanks to minimal keys and a shallow menu.

The left side of the 3.0 x 2.4 x 0.7-inch housing (which can be worn around the neck with an included lanyard) has three buttons for power, Bluetooth and GPS functions. The backlit LCD display performs well in sunlight and logically displays at-a-glance data including speed, heading, altitude, satellite receiver accuracy, battery life and clock time.

MISSION VERSATILITY

If you engage in outdoor activities, the ELF's datalogging capability might be a useful tool. It can log up to 200 hours of trip data in its internal memory and can then be accessed directly from a Mac, PC or managed in the Bad Elf tablet app.

For instance, we took the device on a multi-day motorcycle road trip, where it was useful for recording position on roads that we wanted to find again. We also used it during standup paddleboarding outings, where it precisely logged distance paddled, position and speed. The logger is easy to operate. Simply hold the GPS button for a few seconds to turn the logging on and the device will record your position every second. Once data logging is complete, you can use the Bad Elf utility app to save, map and share the log with others via email or send to Google Maps. In the aircraft, the logger might be used for training flights.

The device is compatible with a wide variety of tablet apps, including ForeFlight Mobile, WingX Pro7, Jeppesen Mobile FD and Reader Plates, to name a few. It also works with non-aviation apps for cycling, agriculture and equestrian activities.

There's one shortcoming: The device isn't compatible with aviation apps for Android, a market that's gaining popularity. Elf's founder John Cunningham said that could change with demand.

Contact www.bad-elf.com.

Aside from its excellent performance, the GPS Pro+ proved to be a good datalogger for non-aviation missions, left.

LONG-TERM EVALUATION

Cirrus Fuel Sender Mod: G1/G2-Challenged

While owners of third-gen and newer Cirrus models report good performance, the CIES digital fuel senders failed the long-term test in our G1 testbed.

by Larry Anglisano

Last winter we reported on the CIES digital fuel sender retrofit for earlier Cirrus models. To recap, the modification is intended to better the accuracy of the original analog float-type fuel quantity senders used in first and second generation SR20 and SR22 aircraft.

The retrofit includes replacing all four of the existing fuel sensors with the CIES digital magnetoresistive sensors, in addition to replacing the stock analog fuel quantity gauge with the FL202G digital control head made by Aerospace Logic. It's a so-called "smart gauge" that indicates fuel quantity both numerically and graphically, in addition to warning of fuel imbalance situations, should you forget to switch tanks.

Our evaluation was based on the retrofit of a 2002 first-generation SR22. The installation cost $5200 and the plane was down for approximately one week.

As we reported in the March 2014 issue of *Aviation Consumer*, we found the system worked as advertised, with an approximate discrepancy of around 1.7 gallons total. But over the course of approximately six months, the system became grossly inaccurate, sometimes off by 15 gallons or more, while often displaying accurately when the aircraft was on the ground. CIES arranged for replacement of all the components and a complete recalibration of the system, but there was little if any improvement in performance. Recently, owners of other modified earlier-gen Cirrus models have reported similar problems, while some report favorable performance. What's going on?

CIES president and system designer Scott Philben is wondering the same thing, although he's aware of anomalies. "Cirrus G1 and G2 applications are a mixed bag for us. These aircraft are unique because they have two fuel senders in each wing, including one that's installed in a small collector tank. This makes proper calibration difficult," he said. That collector tank is a walled, semi-section of the tank on the far inboard section of the wing. It holds approximately 2 gallons of fuel. The collector is supposed to house non-sloshing fuel, since it's always full. It's assumed that Cirrus mounted the sender in the collector tank to measure the last remaining amount of fuel so the gauge shows zero when there's no fuel remaining. Philiben says there's a slight measuring dead zone—and inaccuracy—that's inherent with G1 and G2 models, but G3 and later aircraft have revised sender mounting locations. (CIES provides the sender kit to Cirrus Aircraft and fuel gauge accuracy as displayed on the Garmin Perspective avionics is known to be highly accurate.)

The CIES STC is limited to using the existing fuel sender mounting locations, and modifying the fuel tank structure to mount the senders in a better location would simply make the installation cost-prohibitive.

CIES is evaluating a Cirrus wing and fuel tank in hopes of gaining better performance. It's also exploring the possibility of a power supply issue that's causing gross inaccuracies in some applications, including the one we've been flying with.

Until then, CIES has stopped shipping retrofit kits and the system is being removed from our evaluation aircraft. CIES has also agreed to refund the cost of the install. We'll continue to report on any changes in status as they unfold. CIES said that Cirrus wants to offer the mod for earlier models.

Although the gauge shows 63 gallons, the tanks have 74 gallons of fuel. It triggered a fuel imbalance warning, right photo.

Model 35 Bonanza

Arguably the most recognizable light airplane ever produced, the Beechcraft 35-series V-tail Bonanza delivers on utility, efficiency and timeless good looks.

If Piper put general aviation on the map with the J-3 Cub, Beechcraft made it possible to actually go places on that map, thanks to the incomparable Bonanza.

With antecedents dating to 1947, the venerable V-tail remained in continuous production until 1982, something no other model can claim.

The Bonanza's unique combination of good looks, cabin comfort, high performance and good load carrying capability earned it a loyal following that continues yet today.

Indeed, some owners say the early models are among the best values on the used aircraft market, but we urge a dollop of caution. Unless those 50- and 60-year-old airframes have been well maintained, they can be, in the words of one owner, a money pit.

But the good news is that there are plenty of upgraded Bonanzas to pick from and owners are rabidly loyal to these airplanes. Although not cheap to operate, they aren't unreasonable, either. Parts and support remain easily available, although owners concede parts can be expensive.

Anyone who has stepped into a V-tail Bonanza from another model is impressed with how well it handles.

The V-tails suffered a bad rep thanks to a series of breakups during the 1980s, but these airplanes have been subjected to a Beech-developed tail beef-up kit that has all but eliminated the breakup issue.

MODEL HISTORY

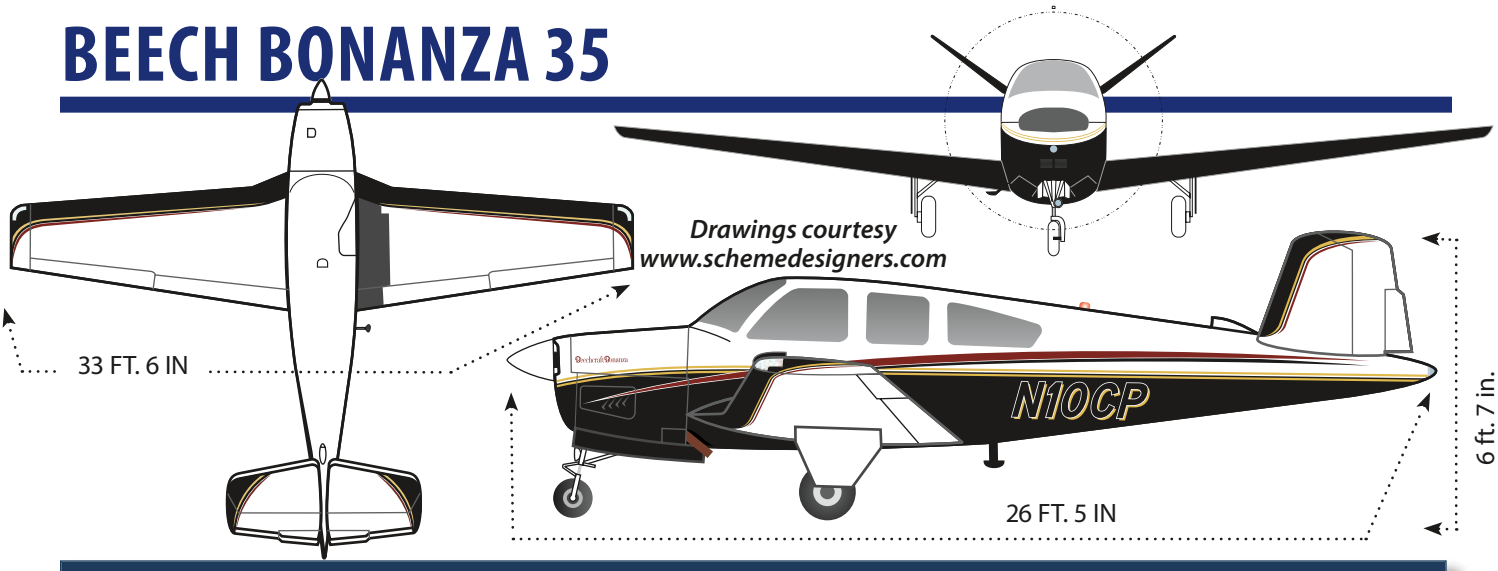
The first V-tail Bonanzas were so ingeniously conceived that it appears they sprang from the mind of designer Ralph Harmon and others full-blown in the dim past of 1945. At the outset, the airplane was like nothing else on the market: fast and slick and great looking. The basic format was retained for decades through fine-tuning, strengthening and bigger engine iterations, yielding a plethora of model designations and no shortage of mods.

In keeping with Beechcraft's reputation for excellence, the early Bo's got the benefit of wind tunnel testing and study to find ways to boost speed and increase safety, something not commonly done in the 1940s. This shows in the details, such as fully retractable tricycle gear, with no projecting bumps or humps as on some other aircraft and extensive use of flush-riveting. A unique fuselage design incorporates a sled-like keel arrangement and box structure to increase crashworthiness.

This structure extends into the

That's Al Boyce's 1959 K35 Bonanza (with some slick photo work by Tom Reid) climbing out in the Bahamas, main photo.

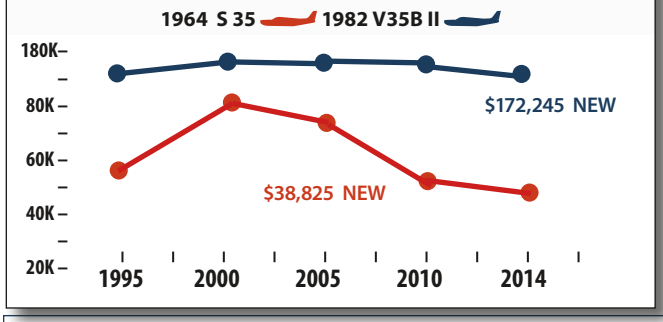
BEECH BONANZA 35



SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL	CRUISE	TYPICAL RETAIL
1947-1949 BONANZA 35	CONT. 185-HP E-185	1500	$30,000	39/60	1092 LBS	150 KTS	±$18,000
1949-1950 A,B 35	CONT. 185/196 HP E-185B	1500	$30,000	39/60	1075	148	±$20,000
1951-1953 C,D 35	CONT. 205 HP E-185-11	1500	$30,000	39/60	1050	152	±$23,000
1954-1956 E,F,G 35	CONT. 225 HP E-225-8	1500	$30,000	39/60	1053	160	±$32,000
1957-1960 H,J,K,M 35	CONT. 240/250 HP O-470	1500	$30,000	49/70	1118	170	±$41,000
1961-1963 N, P 35	CONT. 260 HP IO-470-N	1500	$30,000	50/80	1270	170	±$46,000
1964-1965 S 35	CONT. 285 HP IO-520-B/BA	1700	$30,000	50/80	1385	178	±$54,000
1966-1967 V 35	CONT. 285 HP IO-520-B/BA	1700	$30,000	50/120	1485	177	±$59,000
1966-1967 V 35-TC	CONT. 285 HP IO-TSIO 520-D	1400	$30,000	50/120	1450	195	±$64,000
1968-1969 V 35 A	CONT. 285 HP IO-520-B/BA	1700	$30,000	44/74	1440	177	±65,000
1968-1969 V 35 A-TC	CONT. 285 HP IO-TSIO 520-D	1400	$30,000	50/120	1373	200	±$73,000
1970-1976 V 35 B	CONT. 285 HP IO-520-B/BA	1700	$30,000	74	1450	172	±$89,000
1977-1982 V 35 B	CONT. 285 HP IO-520-B/BA	1700	$30,000	74	1450	172	±$115,000

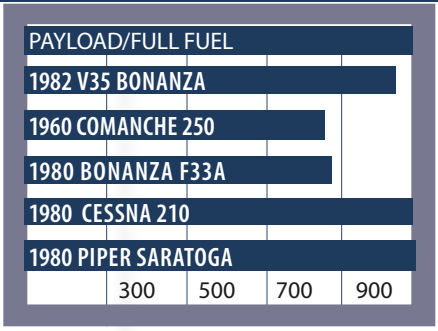
RESALE VALUES

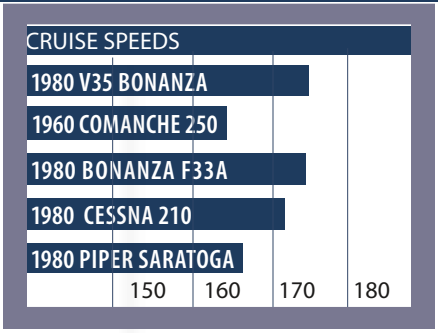


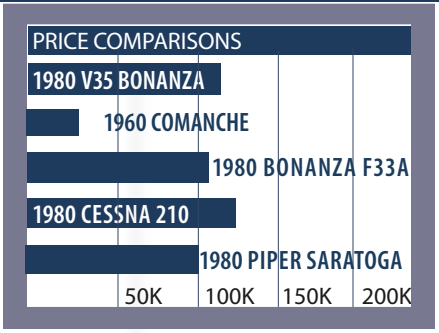
SELECT RECENT ADs

AD 97-06-11	RUDDERVATOR CONTROL ASSEMBLY
AD 94-20-04R2	TAIL MODIFICATION (REVISED)
AD-76-05-05	STABILIZER ATTACH FITTING
AD 75-15-08	ENGINE LUBRICATION
AD 72-11-02	ENGINE FUEL INTERRUPTION

SELECT MODEL COMPARISONS







Paul Damiano's IO-550-powered N35, left photos, has enough avionics and fuel range to fly nonstop from northern New Hampshire to Daytona Beach, Florida. The Osborne tip tanks add an additional 40 gallons of fuel, for a total of 120 gallons, including the mains. "That's why I don't need a Baron," Damiano says.

engine compartment, with the motor mounted on keel extensions, making it easy to access for most maintenance operations. Huge side windows were hinged at the top with quick release openings at the bottom to allow easy escape in an emergency, a side benefit enjoyed by rear-seat passengers.

STRAIGHT 35

The first so-called "straight 35" model Bonanza had a 165-HP Continental engine that produced an amazing 175 MPH at cruise speed. These models are among the cheapest Bonanzas on the market these days, but we would counsel potential buyers to be cautious.

Unlike later models, the straight 35 lacks a shear web in the main wing spar—a design strategy undertaken to save weight. And although Beech offered a 35R wing strengthening conversion in 1951, there weren't many takers for the expensive mod, priced at $6000.

Beech offered a number of wing mods and there was an aftermarket mod called the Jourdan-Flannagan mod.

Some advise avoiding these, but if you're considering one, the American Bonanza Society believes they can be operated safely if you do your homework. That means a careful prebuy inspection and a checkout that emphasizes operating limitations.

With the succeeding A35, Beech made important strengthening improvements, added a new wing carrythrough structure and thicker wing skins and fuselage stringers. They beefed up the fuselage bulkhead at the tail attachment. On the B35, a slight power boost during takeoff of 11 HP was engineered through slightly higher RPM.

With the C35, major changes were made to the stabilizer. The chord was increased by 14.4 percent and the dihedral increased slightly in an attempt to reduce yawing. The chord increase was made by simply extending the leading edge, but leaving the front spar where it was.

This created a greater overhang forward of the spar that would figure in tail-twisting during in-flight breakups and would later be secured by a bracket after a big FAA/Beech investigation into the breakup problem.

With the E35, buyers had the option of a 225-HP Continental engine. Also, aileron trim was added for the first time and back-seat passengers got a couple inches more leg room. The magnesium flaps were replaced with aluminum ones. In the G35, the wing was beefed up once again. And gear extension speed went up from 125 to 140 MPH, the first in a series of speed boosts that would make the landing gear an effective speed brake.

MODERN BONANZAS

The H-model represents what Larry Ball in his book, *The Incomparable Bonanzas,* calls the beginning of a second generation of Bonanzas. The airplane got a bigger 240-HP powerplant which, for the first time in the line, offered identical takeoff and max continuous horsepower. This was the first wet sump design for the Bonanzas, allowing oil to be carried internally rather than in a separate oil tank, thus simplifying the plumbing somewhat. Additional strengthening was also added to tail, fuselage and wings.

The major change on the J35 was a switch to a 250-HP fuel-injected engine. On the K35, the standard fuel capacity was boosted from 40 to 50 gallons, which with the 20-gallon aux tanks gave 70 gallons and moved the airplane up into the serious cross-country machine it is today. Also, an optional fifth jump seat was offered, allowing more chances to load aft of the weight-and-balance envelope. Throw it away is our advice and many owners seem to agree.

Elongated, curved rear side windows were added to the N35. Horsepower went up to 260 and fuel capacity rose to 80 gallons, while the number of fuel tanks was reduced to

two. This was done by offering optional 40-gallon tanks in place of the standard 25-gallon tanks. Along with "full-time" fuel quantity gauges provided to both tanks, fuel management was simplified, a good safety feature.

The addition of new, long leading-edge fuel tanks displaced wing landing lights, which in turn were moved to the nose and nose gear strut, where they remain in modern designs. Landing light bulb replacement is thus among the easiest of all GA models. Pilots concerned with tracking troublesome magnesium components might also note the ailerons were converted to aluminum, thus easing repairs and repainting somewhat.

On the used market, the P35 is one of the best values, perhaps because it got a completely redesigned instrument panel, with the famous "piano keyboard" switch arrangement of the early models abandoned in favor of conventional switches, albeit not always located in the best places along the lower panel eyebrow. The P-model saw a higher landing gear extension speed, up from 140 to 165 MPH. Although the P-model was a large step forward, Beech had even bigger ideas.

The S35 Bonanza got a 285-HP powerplant and a longer cabin with a new aft window shape like that found on Barons. The aft bulkhead was moved back 19 inches and although this made for a comfy cabin, it planted the seed of what has become a chronic complaint among Bonanza owners: aft CG. To address that in the S-model, Beech added a 25-pound lead weight to the nose for balance.

Theoretically, the S-model was a six seater. But not really. It's just not practical to stuff passengers back there, unless they're lightweight kids. The larger baggage compartment door is a nice plus, however. Visibility out front improved with the V35 model as a one-piece windshield was made standard. And on the V35A that followed, a bigger, swept windshield was added that allowed more space behind the instrument panel for maintenance.

A V35TC turbocharged model was added to the line for the first time, also. Normal gear-down speed went from 165 to 175 MPH. The big safety improvement on the V35Bs was the addition of anti-slosh fuel cells to prevent inadvertent unporting during slips, skids and turning takeoffs, a shortcoming that had caused mishaps.

The way it used to be, top right photo. That's the panel in Marty Noonan's 1950 B-35. Before there was a throwover yoke, there were dual yokes. Note the classic piano key switches on the lower panel. Lower photo shows Noonan's newer ride, a 1970 V35B with tip tanks that boost gross weight to 3600 pounds, up from 3400 pounds.

Some models carry placards advising of minimum takeoff fuel, but many have anti-slosh baffles to address this.

PERFORMANCE

Bonanzas are famous for their speed and justifiably so. With the largish engines and relatively low drag, owners report cruise in the 150- to 175-knot range, depending on engine power. The real eye opener with regard to raw speed is the conversion to an IO-550, which a number of owners have done.

That speed comes at a price, however. Like Mooneys and other high-performance airplanes, the Bonanza is slick and will build speed quickly in a dive or an upset; thus it requires attention from the pilot in instrument conditions or potentially moderate turbulence. Bo pilots are wisely taught the desperation tactic of lowering the gear to arrest an out-of-control dive or unusual attitude.

Anyone who has stepped into a Bonanza from another model is immediately impressed with how well the V-tail (and straight tails) handle. The controls are silky smooth and light with nearly perfect harmony between aileron and pitch pressure. However, the stick-forces-per-G are also light, which means that the ham-fisted pilot has less margin in turbulent air. Even with the tail mods, the airframe can still be bent.

As with any high-performance airplanes, landings require good speed control. Although they can be done power off, most pilots seem to fly the approach with just a bit of throttle to improve ruddervator response and avoid sink fests. Consistent, smooth touchdowns are achievable but, more to the point, really screwing up a landing in a Bonanza is hard to do. It doesn't have the Mooney's vicious porpoise or the Saratoga's tendency to plop.

What it does have is the famous Bonanza tail waggle in turbulence, which is bound to make backseaters with tender stomachs somewhat queasy. Oddly, many believe the tail waggle is unique to the V-tail, but the straight-tail 33s have it too. Some owners ignore it; some say a yaw damper is required equipment.

WEIGHT AND BALANCE

Apart from the tail waggle, passengers give Bonanzas high marks. For one thing, there's plenty of shoulder and head room; the interior feels more like a 1950s Chevy than the cramped interior of the typical high-performance single. The front seats are relatively upright and comfortable, but lack much forward and rearward adjustment. Leg room is adequate in both front and rear seats. By GA standards, the giant windows give unmatched airiness and visibility, es-

If you can't afford an IO-550 conversion, the next best choice is the IO-520, found in the S-model forward. For the power, it's one of the most economical GA engines available.

pecially out the rear side windows and forward through the windshield.

When carrying passengers, Bonanza pilots learn to brief them carefully on closing the cabin door. Most pilots do it themselves, for if not properly secured, the door is almost certain to pop open on rotation. It's not an aerodynamic hazard to further flight, but can be dangerously distracting.

The aircraft's loading Achilles' heel is its relatively narrow weight-and-balance envelope, a peccadillo owners bitch about. Even without big-butted passengers, it's easy to load aft of the rear CG, a potentially nasty situation in any airplane, but doubly so in one with controls as light as those on the Bonanza.

And on later models, as fuel burns out of the leading edge wing tanks, the center of gravity shifts farther to the rear, aggravating the situation. V-tail Bonanzas have generally stricter rear CG limits than the straight-tail models, which means that the same load will put you a lot closer to the aft limit in a V-tail.

MAINTENANCE

Buyers should be alert to three main problem areas: Damaged control cables, rods, fittings, malfunctioning, out-of-order landing gear components and corrosion. The landing gear and corrosion problems can be especially expensive to repair.

There's also the tail inspection that's required by Beech Aircraft Corp. as part of the tail-brace installation.

Obviously, the tail fix will have been completed more than 20 years ago, but that doesn't mean corrosion will stop. The airplane should be inspected carefully. Proper rudder-vator balance has always been a critical matter on the V-tail Bonanzas to prevent flutter or vibration, which can contribute to severe structural damage and even inflight break-ups.

We found at least four of these incidents in our recent scan of accidents. The balance margin is so narrow that unbalance could—and has—resulted from repainting the ruddervators without rebalancing afterwards. Most shops know all about this, but some still make the error anyway.

Corrosion is often encountered with magnesium components like the ruddervators and on some Bonanzas, the flaps and ailerons. But check other components as well, as the Bonanza fleet ages. Some corrosion may have been well hidden. The 35 series is not exactly slammed with ADs, but a prospective buyer should check the list carefully, especially the tail fix AD.

MODS, OWNER GROUP

A lot of mods are available for Bonanzas, from STOL kits (Sierra, www.sijet.com) to engine swaps (D'Shannon Aviation's IO-550, www.beryldshannon.com), to speed brakes (Precise Flight, www.preciseflight.com) to TKS anti-ice systems from CAV Aerospace at www.weepingwings.com.

D'Shannon also offers vortex generators, which are a worthwhile investment. Speaking of things worthy, The American Bonanza Society (www.bonanza.org) provides a good-looking four-color magazine, plus lots of technical advice. It sponsors pilot training and maintenance clinics around the country through its affiliated Bonanza Pilot Proficiency Program.

We would consider membership in this group a must for Bonanza owners, but especially any owner new to the airplane. Contact P.O. Box 12888, Wichita, KS 67277, 316-945-1700 or www.bonanza.org.

OWNER FEEDBACK

I've owned my 1979 V35B Bonanza for 22 years, having flown it nearly 2600 hours throughout the United States, Canada and the Bahamas. I am the second owner and purchased the plane in 1992. The Bonanza's capabilities—in terms of comfort, handling and mission—have more than exceeded my expectations. Over the years I have looked at replacing it with an A36, a Cirrus SR22 and a Beech Baron, but I found after analyzing the investment, operating cost, speed and capability that the V35B was always the best fit for my overall mission.

When I did look at upgrading to a Baron, my mechanic showed me the maintenance bills of a friend's 1979 BE55 and it was clear that cost of operation would triple for the sake of a few knots. As my missions are generally during the daytime and not over mountains or water, I decided to pass on the Baron.

Mods to my airplane include the Mike Smith gap seals, yaw skeg and tail bulkhead, plus D'Shannon IO550B engine conversion and baffles, in addition to GAMIjectors.

Rich of peak, I true out at 180 knots with a fuel burn of 17 to 18 GPH. While at lean of peak, I typically see 172 knots with a fuel burn of 11 to 12 GPH.

I upgraded to a new AirTex interior that was installed in 2010. At the same time, I had all the glass replaced with thicker glass and UV protection. Accomplished by LP Aero Plastics, Inc., the mod has made the cabin cooler and quieter.

The Bonanza makes an excellent IFR platform. My Garmin GMX200 MFD and Garmin GNS480 GPS makes an ideal combination, along with a Garmin GDL69 for XM datalink weather and entertainment. I am struggling with what to do about ADS-B compliance. I like my current setup so much I will probably update my GTX 330 mode S to an ES for ADS-B out only.

Garmin has assured me that a one-time software update is in the works for the GNS480 to make it a WAAS-compatible (and mandate-compliant) position source for driving the GTX330ES.

One thing that makes owning a Bonanza great is the support of the America Bonanza Society (ABS). This type group actively supports Bonanza, Debonair, Baron and Travel Air operators through its technical advi-

sory services and efforts to minimize the impact of ADs. Through the ABS air safety foundation it promotes pilot safety with the Bonanza Pilot Proficiency Program (BPPP), which provides both online and classroom training, as well as flight training with specifically type-trained instructors.

The ABS Maintenance Academy conducts training seminars for mechanics in the proper techniques of maintaining the Bonanza, thus insuring that there is a cadre of qualified service technicians to maintain the fleet into the future.

With regard to maintenance, I think it's important to have the aircraft maintained by a shop that is knowledgeable in Bonanzas and Barons. I use George Barker Aviation in New Smyrna, Florida, whose principal—Curtis Boulware—is an ABS Technical Advisor.

Operating costs average about $20,000 per year and based on an average of 100 hours a year or $200 per flight hour, excluding an engine and propeller reserve. Annuals on my V35B have averaged roughly $2100 for the past three years, with additional maintenance items averaging $2000 to $3000. Insurance is $1900 for $1 million smooth and for a $150,000 hull value.

Joe Palazzi
via email

The following thoughts come from my 37 years owning a 1959 K35 Bonanza. lnitial selection of the

For average-size adults, the 49-inch-wide Bonanza cabin is a reasonably spacious dwelling. Joe Palazzi's V35B sports a new Artex interior, top photo.

Bonanza over competing singles is a natural if you like quality design and construction, nimble flight controls, good traffic watch (with the low wing) and of course, go-fast performance. The cabin is a roomy 49 inches wide and seats four, but is better considered a three place if you fill up the fuel tanks. The CG shifts aft with fuel burn, so you need to figure out what the CG will be during the later parts of a flight.

The 35 Bonanza has a number of different fuel configurations and like most things aviation, fuel tank management requires attention. The K35 has two 25-gallon mains and two 10-gallon aux tanks. I added two 15-gallon tip tanks for range and comfort because the aircraft's tendency to fishtail in turbulence is somewhat diminished thanks to the good-looking canted tanks. If longer range is on your list, it will go from San Diego, California, to Wichita, Kansas, nonstop with IFR reserves. The basic airframe is quite sturdy and designed to utility category standards. The landing gear can take punishment, but must be maintained to specs by a mechanic that's familiar with Beechcraft models.

The K35 is a consistent 160-knot TAS performer, burning 13.5 GPH.

BENT BONANZAS: JUDGMENT, ENGINES

After reviewing the 100 most recent Model 35 accidents, we couldn't help but wonder about the demographics of the owners. The majority of the events fell into the "other" category and generally reflected lousy judgment on the part of the pilot, especially when the 17 fuel-related accidents are added to the pot. On top of that, 10 of the fatally injured pilots had been taking FAA-proscribed medications that may have impaired their ability to fly an airplane.

Fifteen of the 17 fuel-related accidents involved running a tank dry and not getting a restart—most of the time the pilot didn't even follow the restart checklist. The other two pilots tried to fly further than the available fuel aboard would allow.

There was no question about impairment of the pilot who not only was taking proscribed medications, but had several drinks prior to departure. On an IFR flight plan, he climbed steadily for several minutes before pitching the airplane over into a dive so steep that the airplane broke up prior to ground impact.

With the Bonanza 35-series history of in-flight breakups and the fixes applied to the airframe, we were pleased to find that, while there were three in-flight breakups, none were attributed to any issue with the airframe. In addition to the impaired pilot referenced above, there was a non-instrument-rated pilot who lost control in IMC and broke the airplane in a spiral dive and one who decided to descend, VFR, at well above Vne.

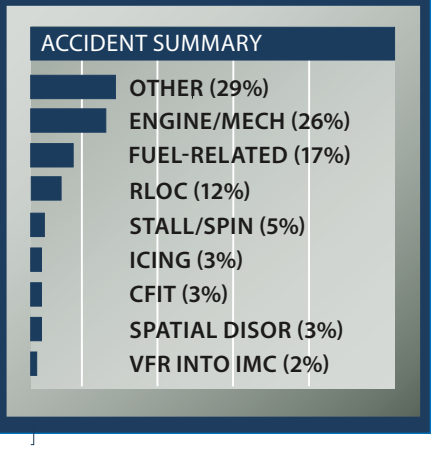
There were two airframe overload events—bent, not broken. One pilot was staring at his GPS as the airplane entered a diving spiral; he overloaded the structure during a hasty recovery. Another pilot experienced either buzz or flutter serious enough to damage the structure while flying above Va in turbulence.

Of the 26 engine power loss events, investigators couldn't figure out why in 12 of them. In the remaining 14, almost all were due to either improper or lack of maintenance.

The wide-track landing gear of the Bonanza has a deserved reputation for helping make its ground handling among the best in general aviation. That was reflected in a low rate of runway loss of control (RLOC) accidents, 12 percent.

The bad judgment runner-up in our survey was the owner who landed in a hay field after the door popped open on takeoff. He closed the door, then tried to take off downwind from the hay field. He hit a hedgerow and tore the airplane up in a drainage ditch. The airplane hadn't had an annual for years—but then he hadn't had a medical or flight review for years, either. He told investigators that he just kept on flying.

A Bonanza pilot on an IFR clearance, in IMC, told the controller he "had an oil pressure problem." The controller started to vector him for an instrument approach at a nearby airport. During vectors, the controller inquired about the oil pressure problem. The pilot responded, "Oil pressure zero, cylinders cold." He did not declare an emergency or admit the engine had failed. Despite being high enough to have reached the airport when the engine quit, the pilot never disclosed the situation to the controller, who continued vectoring the airplane for an approach. The less-than-loquacious pilot died in the crash.



The best way to operate it is at 75 percent power or full throttle at altitude and 75 degrees rich of peak.

You buy a Bonanza to go fast. Descent planning is essential because the airframe is slick and comes downhill with a lot of airspeed to manage. The gear is a great speedbrake, but can't be used above 140 MPH. The stock 250 HP lO-470-C engine rewards those who do not yank the power off to descend. This engine is less susceptible to the case cracking problems experienced by its 520 and 550 big brothers. The generator or alternator is belt driven, which avoids the gear driven problems found in the bigger displacement models..

Annuals might run around $3000 on a well-maintained and cared for airframe. As with any airframe, that figure can mushroom if one lets things slide. As an ATP, insuring the hull for $75,000 and $1 million, $100,000 limit liability, the annual insurance bill wanders around either side of the $1400 mark.

Parts availability is good even for the older models, but they will be pricey. There are too many STC-approved modifications to entertain, but look for the speed slope windshield, opening side window vents, tip tanks, shoulder harnesses and Cleveland wheels and brakes as popular additions. You'll also want to consider the age of fuel cells, wing bolts, gear and flap motor overhauls and any landing gear work as you shop the market.

Probably one of the greatest aspects of Bonanza ownership is the support available through membership in the American Bonanza Society. The ABS has a great team of technical advisors at your disposal, a fine safety foundation and a slick monthly newsletter with lots of good information on maintenance and operation. The service clinics (inspections) put on all around the country have got to be the best value in aviation and (if they can be coordinated) could be used as a great prebuy lookover. If not, ask if the Bonanza you are looking at has been through one recently.

The BPPP (Bonanza pilot proficiency program) offers a weekend of Bonanza ground and flight training with some seasoned pros instructing. Your insurance company will be im-

pressed. The ABS annual convention and Oshkosh tent gatherings are also a great source of learning all things Bonanza. You might even want to join a 100 Bonanza formation fly-in to OSH and camp under your wing.

All V-tails got the tails beefed up to one degree or another by a mandatory AD back in the 1980s. There are a number of other not terribly onerous ADs depending on the model, so a careful prebuy inspection performed by a savvy Bonanza mechanic is a must. Most Bonanza owners take pride in their ride and that will be reflected in the asking price. Beware of a bargain.

Al Boyce
Coronado, California

Ever since I was a teenager learning to fly, I have admired the V-tail Bonanza. When I could finally afford to own one (more than 30 years ago) I bought a 1963 P-model that was equipped with an IO-470N engine and 80-gallon fuel tanks.

I was attracted to the aircraft not only because of its appearance, but also for its comfort for up to four people, its ruggedness and its relatively high speed. I added an STC allowing a 100-pound gross weight increase, resulting in an aircraft that could carry four people and full fuel, but no baggage—or baggage and either less fuel or fewer people. It was very flexible. Since the rear seats are easily removable, they were often taken out to make room for cargo The low wing loading and rugged gear allowed me to operate from grass strips as well as paved runways.

I installed GAMijectors and attempted to run lean of peak, but the IO-470 did not run well in that mode, so I was forced to run rich of peak. With a full load, the plane would cruise at 150 knots on 12.5 to 13.5 GPH. When my engine reached 1500 hours roughly 12 years ago, I installed a new IO-470. Continental had changed something in the design because this engine ran fine at lean of peak and I could easily fly at 150 knots on 11.5 GPH in the 5000- to 8000-foot altitude band, where the airplane performs the best.

Several years ago I moved to a low-time 1977 V35B Bonanza with an IO-520 engine and the same 80 gallons of fuel. This gave me a large baggage door, better soundproofing, better lighting and a smoother powerplant. With GAMI fuel injectors, this engine runs fine at lean of peak.

The Beech-developed tail reinforcement mod stifled the plane's "doctor-killing" reputation. It's rare to find a V-tail without a beef-up.

The airplane has a gross weight that's 200 pounds greater than the P-model, but the empty weight is also up by that amount, so I still have the same 1000 pounds of useful load. Even though I am effectively carrying the weight of an added passenger, the plane performs a bit more efficiently. I flight plan 150 knots on 11.2 GPH. Of course I can bump that all the way up to 170 knots, but the airplane is noisier and burns about 17-18 GPH. To get this performance, I have to run rich of peak.

At that conservative 150-knot cruise setting, I have well over six hours of range. I do a fair amount of IFR flying and like to do 600-mile legs. At the lower power setting I can do that and have sufficient IFR reserves. I could add tip tanks and push the speed up, as many have, but payload would be degraded.

One last item that may be of interest. The empty CG of the P-model was well forward and I had a lot of loading flexibility. In the V35B, the empty CG is much further aft. Also, since the gross weight is higher, the full-load CG range is smaller so loading is much more critical. With four people, even with partial fuel, a modest amount of baggage can cause an out-of-range CG. Since I seldom have two rear seat passengers, I usually can add needed baggage without a problem, but need to check the CG carefully as I consume fuel.

Bill Foley
via email

The Aviation Consumer

Flight Timers

(continued from page 19)

battery. The back is smooth, with a magnet and a fold-out loop that's a kick stand or could possibly be hung on a hook. The alarm is similar to the other chirps, but it often seemed more muted and softer, possibly from the way we were holding it. Nonetheless, it's quite likely that you could miss the beeping of an expired timer.

In addition to the clock, this timer is also the only one with simultaneous count-up and count-down timers—both can be running at the same time, much like the aviation-purposed timers. Unfortunately, this necessitates a rather more complex operating logic. If you want to view the clock, you push the clock button. If you want the count-down timer, you push the timer button. The count up-timer has a count-up button. These are in addition to start/stop and clear buttons. The display has annunciators for timer and count down that flash when these independent functions are operating, so you can see what it's doing.

When you stop the timer during the overrun, it freezes the display with the overtime showing. Push start/stop again and it simply resets the timer to the original value, which you can again time with another push of the start/stop button.

We love the TM23-S for the features. We don't love the highly reflective display and the excruciating small legends on the 0-9 buttons. If you're past 45 years old, you're unlikely to be able to read these in anything but the brightest light without wearing your cheater-glasses. Also, the more complex operating logic, while not difficult, did induce operator errors. For these reasons, we're not sure this timer should have a place in a cockpit.

WHICH ONE?

We liked some features on each of these, but we also found gripes about each as well. In the final analysis, though, we'd probably pick the CDN TM30 as the best set of compromises. Its display is clear and sharp, the alarm beeper is most likely to be practical in a cockpit and the vibrate option is a clear plus. About the only thing we truly didn't like is the operation of the overrun failing to capture the overtime, which isn't a deal breaker for us.

You might argue that you no longer need traditional timers like these, and we'd agree, but with caveats. Bottom line, though, is that there are still many events that should be timed, and these little household timers are useful, convenient and best of all, cheap.

Contributor Frank Bowlin is the editor of sister publication IFR Magazine.

Panel Oximeter

(continued from page 21)

dirt accumulation over the years. It's returned within five days and comes with a fresh 12-month warranty for a flat fee of $150.

Aircraft manufacturers are beginning to recognize at least some benefit to offering the Aero455 as standard or optional equipment. It will soon be available in the Piper Matrix, and Guardian hinted at a total Bluetooth interface that's in the works for new Cirrus models.

Guardian is currently taking preorders for the FMS650, a connected cockpit product that has integral USB chargers, CO detection, plus Smart and traditional Bluetooth transceivers that send engine and GPS data to tablet apps, including the WingX Pro7, Garmin Pilot and ForeFlight, to name a few, in addition to its own Pilot FMS app.

We'll have a look at the FMS650 when it's available, but at first blush it promises to have a more modern biometric feature set, better Bluetooth connectivity and more efficient monitoring and display capability than the Aero455. It doesn't, however, have a built-in oximeter for those times when your portable is not to be found.

FEEDBACK WANTED

BEECH MODEL 19/23

For the February 2015 issue of *Aviation Consumer,* our Used Aircraft Guide will be on the Beechcraft Sport, Sundowner and Musketeer trainers. We want to know what it's like to own these planes, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your airplane to appear in the magazine, send us any photographs you'd care to share. We accept digital photos e-mailed to the address below. We welcome information on mods, support organizations or any other comments. Please send correspondence on the Beech 19/23 by December 1, 2014, to:

Aviation Consumer
e-mail at:
ConsumerEditor@hotmail.com