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The Aviation Consumer

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FLEET-WIDE COMPLIMENTARY CIRRUS TRAINING

In the early 2000s Cirrus learned that equipping an airplane with a parachute and gee-whiz avionics doesn't necessarily make it safe. As was proven more recently, favorable accident stats come from focused training. But as one Cirrus sales pro put it, it's the Wild West when it comes to the market of used SR20s and SR22s because some buyers either get the wrong training or in some cases, no transition training at all. A get-in-and-go approach doesn't work well in a Cirrus.

While no fault of the company, it's an ugly day for the Cirrus brand when the new owner of a used SR22 makes the evening news after balling one up, as was the case not far from my home field this past spring. The second-gen SR22 wasn't in the owner's hands for more than a couple of weeks before it ended up in a fireball on the other side of the airport fence after several unstable attempts at landing in benign visual conditions. Ivy McIver at Cirrus told me these kinds of mishaps are why the company decided to offer complimentary transition training to Cirrus buyers new to the aircraft—no matter its age or where it was sourced.

The program is called Cirrus Embark and it's an add-on to the company's existing Cirrus Approach training program. Part of the goal is to address the operational differences in stepping up to a Cirrus from other aircraft models. What's bold about the Embark program—aside from Cirrus eating the cost—is that the invitation is open to new owners of any Cirrus (including all partners in a shared ownership arrangement) no matter where they bought the aircraft. It could be one sourced from a used aircraft dealer or from an individual.

To qualify for the program, owners must have at least a private pilot certificate and must enroll in the program within 30 days of purchasing the aircraft, plus the training must be completed within 60 days of program enrollment. The aircraft must also be in airworthy condition and the training must be accomplished in the customer's own Cirrus. The program includes one-on-one Cirrus transition training with an authorized Cirrus training provider, which is tailored to the pilot's previous experience. So if you are stepping out of a Cherokee, for example, the Embark training will focus partly on the differences in the two airplanes.

By now Cirrus knows just what it takes to transition pilots to the SR22 and entry-level SR20. The Cirrus Transition training course focuses on mastering aircraft control, engine management, integrated avionics and emergency situations. Completing the course generally satisfies many insurance company requirements and covers the initial checkout procedure for pilots new to the Cirrus.

Once enrolled in the program, a Cirrus flight training advisor contacts the customer to discuss specific training needs and connects them with a Cirrus standardized instructor pilot (CSIP) or Cirrus training center (CTC). Up to three days of training is included, plus the program also includes a one-year membership to COPA, the Cirrus owner/pilot association. The Embark program will cost Cirrus some money, but maybe not as much as the lawsuits that might come from existing airplanes getting into the hands of poorly trained new owners.

ICON'S RECORDED REALITY CHECK

Speaking of unfortunate wrecks, I recently sat down with Icon Aircraft's CEO, Kirk Hawkins, who told me the NTSB is close to releasing its final report on the crash of the company's A5 LSA. Last May the crash killed Icon's chief engineer, Jon Karkow, and senior engineer Cagri Sever. The investigation moved along much quicker than others because all Icons are equipped with a flight data recorder that logs a trail of data points, ranging from aircraft configuration to position and altitude for all stages of each flight. While some have objected to this equipage requirement, it has utility. Based on the data logged from the crash, Hawkins suggested the A5 itself will be cleared as the cause, but I think it will be a reminder that the joy of water flying comes with higher risks.—*Larry Anglisano*

FORGOTTEN DAVID CLARK

I read Larry Anglisano's First Word commentary about the shrinking ANR headset market in the August 2017 *Aviation Consumer* and was surprised that the $895 David Clark DC One-X, launched in March 2016, was not mentioned among the others in the premium headset category.

In developing this headset, it was certainly our intention to target the premium ANR headset market and the success of this product, as well as the response from the pilot community, confirms that we hit the mark.

The One-X has features not found in other top-tier aviation headsets currently on the market. These include hybrid active noise reduction, a 50-hour battery life, the temperature-managed Outlast headpad material, a nighttime dark mode that disables the set's LED lighting, a folding compact design that weighs 12.3 ounces, plus the set has TSO approval.

I think the product has established itself as a formidable competitor in the premium ANR headset market.

Mark Gardell
David Clark

The company's $695 Pro-X model was mentioned in that commentary as a credible player in the premium ANR market and we think it has an advantage with a lower price point.

We found David Clark's flagship One-X to be mostly a good performer—but with slightly stronger clamping forces than the Pro-X—when we reviewed it in the May 2016 Aviation Consumer.

I can solve the Bose versus Lightspeed debate, but you'll have to spend some money: Buy one of each. Some passengers in the back seat of my Mooney seem to like one over the other, which is right in line with Anglisano's advice: You have to try these things before buying them because your choice is usually based more on personal fit than the company that makes them.

Bill Sealing
via email

AVIDYNE AND GARMIN

In the SiriusXM Weather article in the August 2017 *Aviation Consumer* you suggest that the legacy Garmin GDL69 receiver would be compatible with the Avidyne IFD540 navigator. Does that mean the current-production GDL69SXM receiver is also compatible with the IFD540?

John Housel
Memphis, Tennessee

The plug-and-play Avidyne IFD540 and smaller IFD440 are compatible with the legacy Garmin GDL69 receiver, but not with the newer GDL69SXM series. According to Avidyne's Tom Harper, Garmin changed up the RS232 serial data stream output with the GDL-69SXM.

Your only choice could be to look for a legacy GDL69(A) on the used market. We found some.

SPOT TRACKER BEEFS

I love having you guys in my Rolodex when stuff like this happens. Last year at Oshkosh, the rep from Spot sold me two tracking devices based on a generous rebate program and a referral discount to offset next year's annual fee. I bought in because I thought it was a great idea to put one of these in each of my airplanes so anyone interested could see where the airplane was.

The deal: Buy a Spot Trace for $99.00, sign up for a year and then if you buy another Spot Trace, they would knock 20 percent off the next year's renewal, at $99.00 per year. If you refer five people, the ad says you get a year for free. Not so fast. I got an email from Spot saying that they were going to charge $14.99 for satellite upgrades and raise the renewal fee to $149 per year. Spot pulled the rug out from under anyone who bought more than one device—or referred a friend—by raising the price well above any discount promised. I called multiple times to object, but everyone on the other end of the phone was unsympathetic and powerless to do anything.

I still get my discount, but raising the price 65 percent in one year erases the promised discount—which is why I bought the thing in the first place. It seems like a bait-and-switch rip-off. It's not the money as much as the principle that annoys me and I bet other Spot users are too.

Tom Reid
via email

We asked Globalstar (Spot is a wholly owned subsidiarity of the company) to comment on this. According to Erica Kelt in the company's public relations area, there was indeed an untimely price increase ("the first since 2007," she said) to cover network and infrastructure improvements and upgrades.

CORRECTION

In the Editor's Choice article in the July 2017 *Aviation Consumer* we stated the incorrect distributor contact for the CO Experts model 2016 CO detector. Aeromedix sells it and a variety of aviation medical, emergency and survival products. Contact www.aeromedix.com, 307-732-2642.

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Garmin's New Autopilots: Flawless Performers

Garmin counters the competition with two new retrofit autopilots. For now, STC approvals are limited, but both fly with the same precision as the high-end GFC700.

by Larry Anglisano

CHECKLIST

- If you're impressed with the GFC700, these retrofit systems won't disappoint.
- The servos are designed for an easier installation and increased reliability.
- The AML-STCs are limited to the Cessna 172 and Beech Bonanza/Baron.

While all eyes were on TruTrak and Trio this past year (both were knee-deep in earning STCs for experimental autopilots), Garmin was quietly working on its own retrofit autopilot. Actually, the company already had two: the one that's integrated within the G3X experimental avionics suite, plus the impressive GFC700 that's built into the G1000 and G3000 integrated avionics.

The technology in these systems ultimately trickled down to two retrofit autopilots—the entry-level GFC500 and higher-end, clean-sheet GFC600—both of which currently have limited STCs for aftermarket retrofit, but more are in the works. We recently flew with both of them during a visit to Garmin's flight ops in Olathe, Kansas. Here's a flight report.

GFC500

Most of the GFC500's components have been flying in a variety of experimental and LSA models. In these applications, the G3X Touch and G5 EFIS—which Garmin got STC'd in response to Dynon's approved D10A—are the primary displays in the autopilot interface. We called it early on that the G5 would be integral to an STC'd autopilot and it finally is.

Garmin was dinged for releasing the STC'd version of the G5 without an autopilot interface, and it put some buyers on the fence impatiently waiting for third-party autopilot compatibility and with any luck, an approved autopilot. Garmin announced both at AirVenture last month.

Indeed, the GFC500 autopilot has a rich data interface with the G5. The instrument also channels in pitch and roll reference to the GMC507 electromechanical mode controller, which sports controls that are just the right size, even in turbulence. Like the hardware in higher-end Garmin autopilots, the GMC507 controller has intuitive ergos—the way an autopilot control head has to be. The two knobs you use the most—heading command and altitude select—are located on each side of the front bezel, while a thumb wheel that adjusts the aircraft's pitch, airspeed and vertical speed is located near the center.

The G5 also serves as the autopilot's mode annunciator and for inputting flying commands like altitude changes and setting vertical speed and indicated airspeed holds. The system also has a flight director, so the magenta-colored command bars are placed over the G5's attitude display.

Not all interfaces will be equipped with it, but the GFC500 supports an electric trim servo for automatic trimming. Without it, the system has trim prompting. When the system senses the controls are out of trim, it prompts you to hand-trim the old-fashioned way. The trim prompter warnings are difficult to miss—they pop up in bold inside of a text in a box that's on the G5's attitude display.

But getting the computing and input gains just right is only half the battle in engineering an autopilot that should fly the airplane better than a human. The GSA28 servos (roll, pitch, trim and yaw) are the components that do the heavy lifting. When we flew it this past July, Garmin's Cessna 172M STC airplane wasn't equipped with the autotrim (or yaw damper)

In the GFC500 system, the GMC507 control head, shown in the upper left, pairs with the G5 flight instrument for pitch and roll pickoff and autopilot annunciation. The GFC600 system's controller shown at the bottom has built-in flight data sensors and works with third-party EFIS and analog instruments.

The GSA28 and higher-end GSA87 shown to the right use similar drive technology, but the one used with the TSO-standardized GFC600 has an environmentally rugged chassis. That's the controller in the middle photo and optional GI285 remote mode annunciator at the bottom. Both performed well when splashed with sunlight.

and we don't think the airframe needs either. Trim it yourself and save on the installation and component costs.

The GSA28 "smart" servos have earned Garmin sizable respect in the experimental market. They use brushless DC motors and don't have a mechanical clutch and shear pin arrangement for slipping the controls during pilot override. Instead, there's a geartrain and internal engagement clutch that allows for backdriving the motor. In the Skyhawk, we were able to slip the servos with one finger both in cruise and in approach configurations.

The other benefit that was noticeable to us, compared to vintage S-TEC-equipped models we've flown, is the servos induce no noticeable control friction while hand flying. That's because the engagement clutch decouples from the servo motor when the autopilot is off.

On a side note, autopilots fly only as good as the aircraft is rigged. Good installers will know to check the aircraft's control cable tensions and overall health. Ask if yours needs rigging and be prepared to pay some shop labor to get the control cables and pulleys in shape. The investment is worth it, from our experience.

ENVELOPE PROTECTION AND NAV COUPLING

There's plenty of it built in and the GFC507 controller has a get-me-out-of-this LVL (level) button. Jab it and the autopilot levels the wings. We got aggressive with it in the Skyhawk, rolling the wings way over and pitching the nose down, but a push of the LVL button straightened things out in short order. Be ready to reduce the power before attempting a save when at cruise airspeeds, especially when the nose is down, because there's at least some delay before the vertical speed returns to zero.

Also standard is Garmin's ESP, for electronic stability and protection. Like in Garmin's GFC700 system, ESP works in the background and is independent of the autopilot's mode controller.

For example, if preprogrammed airspeed, attitude and bank angles are exceeded (based on the aircraft's flight envelope), the system inputs light control force in an attempt to nudge the controls back. In the Skyhawk, we thought the ESP prompts could have been more pronounced, although Garmin says the forces get stronger the farther the aircraft strays from the set limits. And should you miss them and things really get out of hand, the autopilot engages with the flight director command bars in the level mode.

We like that ESP can be easily turned on or off. Think about it: You don't want ESP engaging while you're intentionally throwing the airplane around, like when practicing unusual attitude recovery and stalls. The ESP is turned on or off from a shallow menu in the G5 display.

The GFC500 has full lateral and vertical approach capture and tracking, plus VNAV (vertical nav) for flying vertical flight plan profiles. It's activated with a dedicated VNAV button on the GFC507 controller.

Interfacing with a GPS navigator, including Garmin's GTN-series touch systems, requires the GAD29 navigation adapter, which is wired in-line with the G5 flight instrument. It's also required when connecting the autopilot to the GNS430W/530W GPS units. The adapter isn't required with Garmin's GNC255 navcomm radio; it's wired direct without the

G5 TO GET THIRD-PARTY INTERFACES

There's a wider market for Garmin's G5 electronic directional instrument than Garmin's new GFC500 autopilot. What buyers really want is G5 compatibility with legacy autopilots. This is S-TEC, BendixKing, Century/Piper and ARC Cessna systems. Garmin says it's working on an amendment to the G5's STC to make it so. It will require the GAD29B adapter, which will allow for heading command and nav tracking, plus roll steering when connected to the GNS430W/530W and GTN navigators. Garmin didn't give a date for the approval.

converter. The GAD29 is priced at $499 and installation might take a couple of hours.

Garmin says the initial STC for the GFC500 (in the Cessna 172) is expected to be completed in the last quarter of 2017, with an STC for the Cessna 182 and Piper PA-28 series to follow.

The system has a base price of $6995 for the two-axis configuration and doesn't include the G5 attitude and G5 directional instruments. The primary attitude indicator is $2149 and the G5 heading indicator is $2449. Add all that up and the system comes in at around $12,000, without installation. It goes up from there with major options. If you want the pitch trim kit, it's an additional $2100, including the installation kit, plus the yaw damper is $1500.

HIGHER-END GFC600

Unlike the budget-based GFC500, the flagship retrofit GFC600 is a clean-sheet autopilot that Garmin built to TSO standards. The focus isn't entry-level aircraft, but instead high-performance piston singles and twins. As we go to press, Garmin has received an FAA STC for the system in the Beech A36 Bonanza and B55 Baron. For this report, we flew with the GFC600 in Garmin's Bonanza.

Interestingly, the attitude-based GFC600 was designed as a stand-alone system, although it works with Garmin's G500/600 PFD, plus third-party retrofit EFIS systems including the Aspen Evolution. Garmin also lists compatibility with mechanical HSI systems, including the venerable BendixKing KCS55A and Century NSD360A. It also works with Sandel's SN3500/4500 EHSI, plus it can play with some mechanical directional gyros that have a heading bug.

The backbone of the system is the GMC605 mode controller, which is designed for mounting in the radio stack. The controller is unique in the world of autopilots because it contains internal flight data sensors that calculate the aircraft's attitude and doesn't rely on an external attitude source. Still, the system requires airspeed and baro-corrected altitude input, which it can source from an external air data computer (including the one used with Garmin's G500/600 PFD). Garmin offers a small air data module for interfaces where an air data computer isn't available, but we think a large number of installations will include the G500/600.

Baro-corrected altitude input is a big plus for any autopilot. With your current autopilot, how many times have you been given a fresh altimeter setting and had to rejigger the altitude hold so it matches? With baro-corrected altitude input, the autopilot synchronizes with small changes in altitude that result from an updated altimeter setting.

The GMC605 provides autopilot and flight director mode selection buttons and a thumb wheel for adjustment of the pitch, airspeed and vertical speed references. Mode annunciation is via a backlit monochrome LCD display that we found was a good performer in bright sun, although in the Bonanza it was mounted at the very bottom of the radio stack—we'd want it up top.

For some installations where the autopilot controller is placed outside of the pilot's field of view (and when there is no PFD to display the autopilot modes), the GI285 annunciator panel is used. This is a high-quality panel with excellent sunlight readability and better yet, its footprint is similar to the mode annunciator used on the vintage King KFC200 autopilot—an aged system with sizable potential for replacement with the GFC600, in our view.

The GFC600 uses the beefier GSA87 servos, which are nearly identical in mechanical design to the GSA28 servos used in the GFC500, but have a chassis build that's more tolerant of harsh conditions.

DISPLAYS AND ERGOS

Garmin wisely included third-party PFDs and HSIs in the GFC600 interface, in addition to its own G500/600. The GDU620 (that's the display used in the G500/600 system) shows the autopilot's mode annunciation and alerts, plus it displays flight director command bars. It's also used for altitude preselect and heading command, plus the ESP circuitry uses the display for bank limit reference.

Since the command bars can be displayed when the autopilot is flying or not, hollow magenta bars indicate that the pilot is following the cues, and solid bars are shown when the autopilot is doing the flying.

When an Aspen Evolution PFD is used, it too displays the command bars, plus it controls the heading command and provides full nav coupling, including GPS steering.

We found that the GMC605 controller has good ergonomics and the onscreen data is spread out in a logical manner. For example, the left side of the bezel houses three

color LEDs located adjacent to the AP (autopilot engage), FD (flight director on/off) and YD (yaw damper on/off) buttons, so there's never any guessing which is engaged. They illuminate in green when active. Disconnect the yaw damper (and the autopilot, for that matter) and the LED for each mode will flash yellow in return. Red is used to indicate an abnormal disconnect or failure condition. There is also an audio panel interface for aural alerting.

The left side of the main LCD screen shows lateral flight director modes, the center portion of the display provides vertical modes and references and the right side of the display serves as a message area for autopilot status and alerts. Active modes and references are depicted in large letters along the upper portion of the display, with armed modes in a smaller font along the lower portion. The message area can display up to four messages simultaneously.

The GI285 remote annunciator is smarter yet and can illuminate in multiple colors, plus it has flashing annunciations when there's something that requires immediate attention. The active autopilot modes are depicted in green and armed modes are in white. Yellow is used to indicate when an active mode is dropped automatically by the autopilot. We like that the pitch trim annunciation is displayed in yellow during a trim failure (or when a mis-trim has occurred) because gone unnoticed, trim failures can be a killer, especially in aircraft with heavier control forces.

RIGHT ON THE MONEY

That's what we remarked when flying with the GFC600 in the Bonanza. The system was well suited for the aircraft's relatively heavy controls, yet responsive handling. Slow speed, high speed and approach speed—the GFC600 flew the aircraft like it was on rails—just as we're accustomed to with the integrated GFC700.

Particularly impressive was the precision with which the system flew GPS RNAV approaches in the moderately bumpy Kansas air. You know, one of those bounce-around days where your hands are inches from the yoke as you backstop the autopilot. And should you need to step in, the system has control wheel steering. Pressing the external CWS button disengages the pitch and roll servos so you can position the airplane where you want it. Release the button and the servos engage. You can also override the servos by hand, of course.

There's a considerable amount of envelope protection, with plenty of visual and aural clues to get your attention. Like the GFC500, the GFC600 has a Level mode, plus the ESP is always working in the background.

There's also sizable automation when the system is connected with a GTN750 or 650 navigator, including a coupled go-around mode when executing a missed approach. You have to load the missed approach procedure in the navigator, but the autopilot is smart enough to pitch the command bars for the appropriate climb attitude for flying the missed, while also activating the missed approach procedure in the GTN. This saves you the extra button pushing. The lower-end GFC500 has the same function, but both systems require an external go-around button.

YouTube See a video on Garmin's autopilots at http://tinyurl.com/y82qxr9n

Get too slow and the GFC500 steps in with visual and aural warnings, plus it adds servo force to help keep the nose down. Simple yoke-mounted switches include autopilot disconnect and pitch trim control, when equipped.

MODERATE PRICE

The GFC600 has a starting price of $19,995, and $23,995 with electric pitch trim. Garmin said it's currently evaluating more aircraft models to add to the limited AML-STC. In our estimation, it might be tough to decide which airframes might be appropriate for the lower-priced GFC500—a system that's no slouch when it comes to performance.

Last, Garmin has competition and not just TruTrak and Trio. Both Genesys Aerosystems (S-TEC) and BendixKing announced fresh models, but neither have an STC yet. Based on our trials, they'll need to work hard if they want to compete with Garmin's impressive-performing autopilots and the aggressive dealer network that will push them.

Pulse Oximeters: Too Cheap to Ignore

Prices on these safety gadgets have plunged to the point that there's no excuse not to have one. At the high end, we like the Nonin products, but the cheap ones will suffice.

by Rick Durden

Our monthly perusal of NTSB accident data reveals a smattering of accidents caused by hypoxia and many more that could be. We simply lack the data to know for sure, but now that you can buy a pulse oximeter for the price of a good lunch, there's really no reason you can't monitor your own blood oxygen saturation on flights where it's warranted.

As we're reporting in this article, the range and price of pulse oximeters has expanded during the past decade and with some costing as little as $13, we're not sure how much cheaper these things can get. It wasn't always that way, however. As recently as a decade ago, medical-grade oximeters sold for almost $700 or more than twice what the equivalent products sell for today.

The argument for these devices is compelling. If you fly much above 6000 feet, you'll be less oxygenated than you would be at sea level. But how much less? Traditionally, pilots have been taught to self-diagnose their own hypoxic symptoms, which is fine as far it goes. But an easy-to-use oximeter takes the guesswork out of it and some are cheap enough to stick in the seat pockets of a multi-seat airplane.

For this article we looked at a cross section of what is available, evaluating them at various altitudes from 8650 to 17,500 feet.

Our conclusion? It's like Alice's Restaurant—you can get anything you want, at almost any level of complexity, at price points from under $20 to several hundred dollars, and all of them work. Plus, if you are a serious athlete, you can use the oximeter you fly with to enhance your training regimen. It's a question of deciding what you want.

That's a Masimo MightySat, the four-in-one wireless pulse oximeter that is also a personal health monitor.

CHECKLIST

- Prices are so low that there is no reason not to own a pulse oximeter.
- Even the cheapest pulse oximeter is "good enough."
- Highest end unit provides information for fitness training use.

INTERNAL WORKINGS

Inside the little box we clip onto a fingertip, a beam of red and infrared light passes through a pulsating capillary bed and a sensor measures the amount of red and infrared light emerging from the tissues. Oxygenated blood absorbs light at 660 nm (red light), whereas deoxygenated blood absorbs light preferentially at 905 nm (infrared).

Each manufacturer uses a proprietary algorithm to collect data from pulsatile arterial blood and ignore local noise from the tissues. The relative absorption of light is processed according to what is known as Beer-Lambert's law and a qualitative measurement of the user's percentage of oxygen saturation (SpO_2) is derived.

Manufacturers warn that it's necessary to keep one's finger stationary during measurement. We found that even in moderate levels of turbulence, all of the pulse oximeters we tried worked just fine. The use of nail polish or wearing of artificial fingernails can degrade the accuracy of, or completely defeat, a pulse oximeter.

While some pilots subscribe to the "what I don't know won't hurt me" school of aviation, ignorance of one's level of blood oxygenation can put a pilot into a world of hurt (see

Pulse oximeter display orientations vary, from left: Masimo MightySat, Nonin 9590, FaceLake FL400 and Acc U Rate CMS 500DL, top. Nonin GO2, bottom. Photos were taken at a field elevation of 8650 feet.

sidebar on page 14). Here's a sample of what's available on the market.

FACELAKE FL400

At $12.95 through Amazon, the FaceLake FL400 Pulse Oximeter came with a lanyard and a protective carrying case. Because this unit has a protruding power switch and we just toss our pulse oximeter into our flight bag, we think some protection against switching the unit on inadvertently is a good thing. Two AAA batteries were included.

The user manual said that the manual was written in accordance with directives for medical devices, but did not make clear that the unit itself does not meet the standards for medical devices.

The unidirectional LED display is oriented away from the user so to read it, the hand must be palm up and the finger with the oximeter on it pointed at the user. Time for the SpO_2 readout to display was 7.5 seconds.

The FL400 SpO_2 readout was always within one percentage point of the medically certified unit we used as the baseline for our readings.

Fumbling with the unit outside the airplane, we dropped it on the concrete ramp. We picked it up and checked on it—it worked. It did make us think that we should have attached the lanyard that came with it and we wouldn't want to drop it more than once or twice.

ACC U RATE

We purchased the Acc U Rate CMS 500DL Fingertip Pulse Oximeter for $18.95 through Amazon. It came with two AAA batteries, a lanyard and silicone protective cover. The surprisingly detailed user manual makes it clear that the product is not for anyone who need SpO_2 and pulse rate measurements for a medical condition.

The unidirectional LED display is oriented toward the user with the user's hand pointed away from the user. In our use, the display began indicating blood oxygen saturation at 12 seconds, with the heart rate showing up slightly sooner. The display could be read reasonably well in bright sunlight in the cockpit. The unit powers off automatically after 16 seconds of nonuse. The only way to get a warranty for the CMS 500DL that we could find was to follow the instructions to register one's purchase with the manufacturer—which resulted in the issuance of a one-year warranty.

The unit's readings were within two percentage points of the medical unit we used as a baseline. We bought one of these units three years ago. It lasted two years before giving up the ghost. For an inexpensive unit, it's our opinion that its accuracy is sufficient for monitoring blood oxygen saturation inflight. While it is not a medical unit, it is better than having nothing at all although it is not as accurate as the cheaper FL400 and doesn't have a storage case.

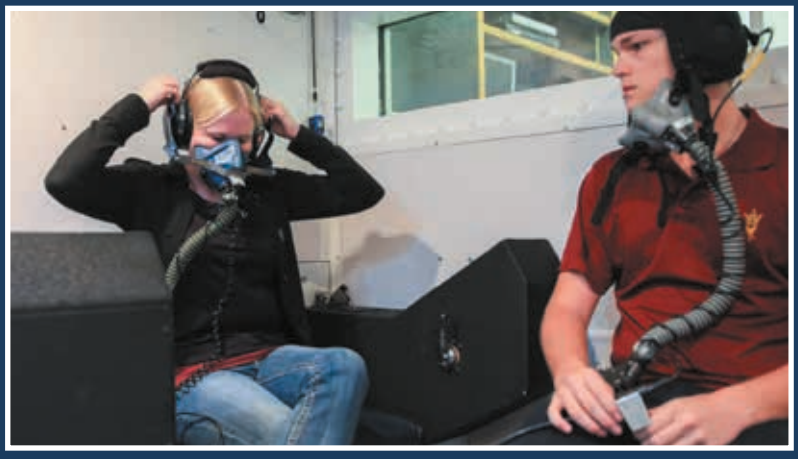
NONIN GO2

Nonin is one of the few American makers of pulse oximeters, which pushes up the price a bit. For $89.00 from aeromedix.com, the Nonin

OXYGENATING THE BRAIN

Telling a pilot that a shortage of oxygen to the brain causes hypoxia is akin to telling Noah about the Flood. Pilots learned about that way back in baby pilot school. Plus, they're tough—they can't be tripped up by some little molecule.

The problem is that hypoxia is one of the most conniving, trickiest and nastiest enemies a healthy human body faces because it simultaneously causes progressively—and eventually profound—cognitive impairment while being utterly charming as it convinces the brain that all is not just well, but absolutely splendid.



That's the hypobaric (altitude) chamber at Arizona State University in use at right. Unless you've been in a hypobaric chamber and/or watched someone in one, at altitude without supplemental oxygen, it's nearly impossible to understand at a gut level just how hypoxia will cause a pilot to do amazingly foolish things—or do nothing—while being personally convinced he's doing smart stuff very well. The euphoria caused by hypoxia generally causes the victim to be unable to recognize its onset.

To help understand, we suggest listening to the terrifying exchange between ATC and a hypoxic Learjet crew at: https://tinyurl.com/ycxfm9pc.

FAR 91.211 sets out the rules for the use of supplemental oxygen. Not only were they promulgated before pulse oximetry existed, they ignored what was known in the medical community about hypoxia at the time. The FAA did not publish its justification for its supplemental oxygen regulation that we can find. Our informal research pointed toward the rationale that because supplemental oxygen equipment at the time was heavy and expensive, there was a push to persuade the FAA to allow a pilot to be able to fly across the U.S., including some of the highest mountains, without having to carry oxygen. Accordingly, a pilot can legally climb to 14,000 feet and fly there for 30 minutes without supplemental oxygen, although her or his oxygen saturation will be between 83 and 88 percent. We recognize that the regs have to be one size fits all when it comes to pilots; however, pilots have this disconcerting tendency to be individuals when it comes to their susceptibility to hypoxia. Our ability to oxygenate our blood effectively varies with age, health, sex, time of day, level of fatigue—to name a few of the variables.

For what passes as a "normal" person—in good health and a nonsmoker—blood oxygen saturation ranges between 95 and 100 percent at sea level. For reference, without oxygen, the range for that same person at 20,000 feet is 70 to 75 percent. For further reference, Dr. Bruce Chien of Peoria, Illinois, pointed out to us that most hospitals will not accept an "informed consent" from a patient who has a blood oxygen saturation of below 90 percent. You might want to look back at the previous paragraph regarding the saturation range for a pilot at 14,000 feet.

We rely on guidelines published by Dr. Brent Blue (a contributor to *Aviation Consumer)* regarding supplemental oxygen use to avoid cognitive and physical impairment. They call for use of oxygen when a person's blood oxygen saturation drops 10 percentage points below what it is at the person's home altitude. Blue also states that a pilot is likely to suffer less fatigue in flight if supplemental oxygen is started when the percentage is five points below what it is at home.

It is our strong recommendation that following Dr. Blue's guidelines regarding blood oxygen saturation in making decisions as to altitudes at which to fly and/or the use of supplemental oxygen, rather than relying on FAR 91.211, will substantially reduce the risk of a pilot becoming involved in an accident caused, at least in part, by the effects of hypoxia.

GO_2 is targeted at active people and pilots who want to know their blood oxygen saturation.

The most streamlined of the units we reviewed, the GO_2 comes with a two-year warranty and a lanyard but no carrying case. The unit is more robust in construction than the lower-priced ones we reviewed and, because it turns on automatically when a finger is inserted—no power switch to inadvertently bump—there's no need for a carrying case. It uses one AAA battery, which was included. Battery installation was the most challenging of all of the units we reviewed.

The unit displayed SpO_2 in nine seconds after a finger was inserted. It shut off automatically 10 seconds after the finger was withdrawn. The unidirectional LED display is oriented toward the user when the finger is pointed away. The SpO_2 readout matched the medical unit we used for this review. There is a bar measure that shows pulse strength in addition to heart rate.

NONIN 9590 ONYX VANTAGE

At $225.00 from aeromedix.com,

SELECT PULSE OXIMETERS COMPARED

MODEL	PRICE	TIME TO START UP	WARRANTY	COMMENTS
FACELAKE FL400	$12.95	7.5 SECONDS	1 YEAR	Adequate, in our opinion, to provide enough information to avoid hypoxia inflight.
ACC U RATE CMS 500DL	$18.95	12 SECONDS	1 YEAR WITH REGISTRATION	No carrying case so power switch may be bumped in a flight bag degrading battery life.
NONIN GO2	$89.00	9 SECONDS	2 YEARS	Robust unit from an American manufacturer that also makes medical-quality pulse oximeters.
NONIN 9590 ONYX VANTAGE	$225.00	7.5 SECONDS	4 YEARS	Heavy duty (drop tested), medically certified unit that we used as the baseline for SpO2 accuracy.
MASIMO MIGHTYSAT	$299.00	7.5 SECONDS	4 YEARS	Biometric device providing the most information of all units; data can be transmitted to a tablet for trend monitoring.

the Nonin 9590 Onyx Vantage is a medical product that is designed for the rough treatment a pilot can give it in service. The Aeromedix website has a video of drop testing the unit, showing that it continued to function accurately after being dropped from waist height 50 times.

Because it is medically certified, it is the unit we used as the baseline for SpO2 levels for this review. It's a serious unit; unlike the other units reviewed that have brief, paper user manuals, the 9590's user manual is on a CD even though using it is as easy as its little brother, the Nonin GO2.

The 9590 Onyx Vantage turns on when a finger is inserted, so there is no concern about battery depletion from bumping the power switch in a flight bag. The display showed SpO2 in 7.5 seconds after a finger was inserted. It shut off 10 seconds after the finger was removed. To read the unidirectional display, the finger must be pointed at the user.

MASIMO MIGHTYSAT

Available through the Apple store for $299.00 (down from $399.00 two years ago) the Masimo Mighty Sat MPH-9900 is, in our opinion, the most advanced biometric device available to pilots. Masimo, with Nonin, is the other American big dog in the medical pulse oximeter world. While not certified as a medical device, the MightySat uses technology from the higher-end clinical instruments. It also boasts the ability to obtain accurate readings in undesirable conditions such as chilly fingers in a cold cockpit.

The largest of the oximeters we reviewed, the MightySat also provides the most data on the directionally adjustable display and links the data to your iPhone or iPad for use with Masimo's Personal Health app. SpO2 data is displayed in 7.5 seconds of the device activating when a finger is inserted. It shuts off within five seconds of the finger being withdrawn.

Powered by two AAA batteries, battery life is advertised at 30 hours. Its SpO2 readings matched the Nonin medical unit we used as a baseline.

Where this unit also shines is in the data presented beyond SpO2 and heart rate—it shows perfusion index (PI), respiratory rate and pleth variability index. The display is clear and easy to read in bright sunlight

PI is the ratio of pulsatile blood flow to the nonpulsatile blood flow—a lower value means lower blood flow. Each person establishes her or his own baseline over time during flying and physical activity.

Pleth variability index is used to evaluate a patient's fluid status—used for pilots to monitor their hydration. If the value is high, dehydration is a concern as it affects cognition.

Respiration rate (which Masimo calls RRp) in breaths per minute is a tool used by athletes who want to quantify their breathing and by pilots as an indicator of hypoxia—symptoms include rapid breathing and rapid heart rate.

There is a small touchpad below the display used to access the main menu to make changes to the display and Bluetooth functions.

For a pilot who wants real-time and trend monitoring regarding his or her physical condition while flying as well as in physical activity, the MightySat should fit the bill. We do recommend using the provided lanyard and carrying case as we wouldn't want to drop it.

CONCLUSION

In aviation or even in consumer electronics, we don't often see a twenty-fold price spread between the lowest and highest priced products. But as you can see from the chart here, that's definitely the case with oximeters. So does spending more get you more? It clearly does, but that's not the same as needing the product to do more. In basic function, simply measuring SpO2, even the cheapest of these devices gets the job done.

We definitely consider the bottom end products—the FaceLake FL400 and the Acc U Rate—good enough. Even if you replaced them every year or two, at $20, who cares? They aren't so critical that a failure during flight would endanger the outcome.

If you want more capability and plan to use your oximeter for sports training, the Nonin 9590 and especially the Masimo MightySat are definitely worth considering.

The 9590 is a medical-grade instrument and is robustly built, if that's a concern. And at even at $225, it's really not an expensive gadget as airplane stuff goes. Although we performed no durability tests, our view is that is just looks and feels more robust than the cheaper oximeters. We invite comments from readers who may have long-term experience.

The MightySat is the one to buy if you don't mind the $299 price and you want to pair it with a smartphone or tablet to track your biometric data, especially for fitness training. Serious athletes may use it a lot more for that than for flying.

Dynon Goes Certified: Skyview Meet Skyhawk

Dynon's new certified line promises affordable competition against Garmin and Aspen. Expanded STC/AMLs are planned.

by Paul Bertorelli

Amongst the bumper crop of avionics at AirVenture was the surprise announcement from Dynon that its heretofore experimental-only Skyview HDX glass suite will be available for certified aircraft. Dynon is launching an entire product line called Dynon Certified to support the equipment.

Not surprisingly, Dynon caught a lot of attention at the show with an installation in a Cessna 172 that ridded the panel of a pile of steam gauges—and a vacuum pump—in favor of a full-up glass panel suite that includes a PFD/MFD combination in a single screen, ADS-B In and Out, Dynon's in-house autopilot and a full set of engine gauges.

As of early August, Dynon had announced the STCs, but said they didn't expect approvals until later in the year, with installations following shortly thereafter.

D10A FOLLOW

Dynon's Mike Schofield said the company considered the Skyview product a direct follow-on to its groundbreaking approvals for the D10A EFIS announced at Sun 'n Fun 2016. Those approvals were part of a joint project with EAA called the Accessible Safety STC. Initially, these covered the Cessna 172 and Piper PA-28 line, but it was later expanded to cover most of the Cessna 100 and 200 series, the Piper PA-32 line and Beech and Mooney singles.

"The first two airplanes that will get STC'd are the Cessna 172 and the Beechcraft Baron and those two are the ones we're doing all the engineering design work with," Schofield said. "After that, we'll be going for a broad AML and we still have a lot to learn on how to do that quickly and effectively," he added.

However, along with EAA's help, Dynon expanded the STC list for the D10A rapidly and Schofield said owners can rely on it as a template for what's coming with the Skyview STC/AML project.

TOUCH AND KNOBS

The Skyview HDX is Dynon's latest iteration of glass originally developed for the experimental and light sport markets. The 10.32-inch (total width) display is designed to incorporate a full primary flight display and can be split to show a PFD on one side and a multi-function moving map on the other.

It's mostly self-contained in a package that's 3.1 inches deep, so fitting it into all but the tightest panels should be doable without heroic modifications to the panel, although dispensing with steam gauges will

At AirVenture, Dynon showed its flagship Skyview HDX installed in a Cessna Skyhawk, left. Other approvals are supposed to follow soon.

CHECKLIST

- ⊕ Dynon's Skyview HDX is the most complete retrofit package to date.
- ⊕ At low- to mid-$20s, installed, complete with autopilot, it's affordable.
- ~ Dynon will have to scramble to build a competitive dealer and support network.

likely require a new subpanel, at least.

Screen resolution is 1280 by 800 pixels, according to Dynon's spec sheet. The display has a 37-pin and 9-pin connector for main wiring harnesses and interfaces and also features USB connectors. It also has onboard wireless capability.

Early versions of the Dynon EFIS products were knob controlled, but as the systems evolved, Dynon developed a dual-control approach—both touchscreen and knobs for navigation and commands.

That means most functions can be done with either touch or knobs. That directly addresses user worries about using touchscreens in turbulence, where punching the right screen icon can be difficult and punching the wrong one can require stressful backtracking.

The HDX control set has two knobs at the lower corners of the bottom bezel with eight keys for various functions that change with context. These are labeled along the bottom edge of the display. While the HDX can be paired as two displays, it can also provide full function in just one.

As shown in the accompanying video, the typical configuration is likely to be a primary flight display on the left and a multi-function/moving map on the right. The PFD has the usual suspects, but it can also be configured to show virtual steam gauges rather than what has become the traditional HSI and tape view. The display is loaded with information, including true airspeed, density altitude, outside air temperature, wind and, lately, an angle-of-attack indicator.

The engine instruments, which will vary by aircraft, are placed along the bottom edge of the display and in addition to the required power instruments and temperatures, fuel quantity is also displayed. There's also voltage and amp info and visual flap and trim-state indicators. A unique addition is a percentage-power indicator and a leaning function. That may be attractive to owners who have no or just basic engine monitoring equipment.

The autopilot is controlled through a virtual panel or a dedicated hard panel and offers altitude hold, vertical speed and altitude preselect. A separate virtual subpanel controls the Mode-S transponder Dynon supplies for ADS-B Out.

All of these functions, by the way, are touch enabled, as is control and navigation around the moving

WHITHER THE G3X?

AirVenture 2017 was all about juxtapositions. The high-profile one was two flying B-29s side-by-side on the ramp and flying in formation. A more subtle variety was Dynon's announcement that the Skyview would be available for certified aircraft juxtaposed with CubCrafters' announcement that Garmin's G3X Touch would be in its Part 23-certified XCub.

The XCub is selling well and CubCrafters had intended that it would have a sophisticated glass panel of some sort. But the airplane is approved for day and night VFR and may never be approved for IFR, thus the non-certified G3X made sense.

So if it's approved for an OEM airplane, why not retrofits for legacy airplanes, competing with Dynon and Aspen? We asked Garmin and got this noncommittal answer: "Garmin continues to interact with the FAA on products we can STC and bring to the certified aircraft market, leveraging both new and existing products in our portfolio." Let us translate: That's corporate speak for "we're thinking about it, but haven't decided yet."

And since it's not a flat out no, we're taking it as a probably. Like it or not, in our view, Garmin will be forced into competing in the legacy market with the G3X. Even if it has new products in the pipeline intended for certified airplanes, the company won't want to give any ground in the legacy segment. We shall see.

Dynon's package includes autopilot servos, far left, and engine instruments with power and leaning indicators, below.

map. (The knobs are handy for subselections in major functions, such as scrolling through comm frequencies or selecting weather reporting points.) The HDX offers the option of building flight plans in the MFD or in whatever navigator happens to be feeding it.

COMPLETE PACKAGE

What may be the Skyview's strongest selling point is that it's a complete package that includes the display itself, plus Dynon's autopilot servos controlled through the virtual panel or dedicated hardware. ADS-B In and Out are also included, using a 1090 remote transponder.

"We expect the package will vary, but what we have in the Cessna 172 is basically everything—the flight instruments, the engine instruments, ADS-B In and Out, the autopilot. What we do expect is that there will be people who have already done their ADS-B for 2020 or they have an engine monitor that they already like. And so just like homebuilders can, there will be different options that people will have," Schofield told us during an interview at AirVenture. The package also includes a D10A EFIS to serve as a backup, thus eliminating the need for a vacuum pump or mechanical instrumentation.

While it has its own autopilot system, the HDX won't offer support for third-party autopilots, at least initially. Nor will it provide an interface with digital comm radios. Dynon has its own comm radio suite; however, these aren't approved for IFR.

Similarly, the HDX is equipped with an onboard GPS, but again, it's not approved for IFR navigation, so installs will require a third-party navigator. Schofield said the HDX will integrate with Avidyne's IFD series and Garmin's GNS and GTN lines. Dynon's radios may be approved for IFR in the future, Schofield said. Other interfaces may also be added. With current interfaces, the system can resolve HSI/CDI indications, show aircraft position on the moving map and display stored flight plans, including approaches with fixes depicted.

HOW MUCH?

The installed cost of the certified Skyview HDX will vary by aircraft application because some owners won't necessarily want or need all of the features offered. Schofield said the AirVenture Skyhawk test bed had a full package and amounted to about $16,000 in hardware. "We estimate that fully installed, the system will be in the low- to mid-20s price range," he said.

Without the extensive marketing and support network that competitors like Garmin and Avidyne enjoy, Dynon says it's considering taking on at least some installations itself, although that program hasn't been developed yet. Schofield said the company will have more to say about it once the STCs are in place. For now, we'll be watching for those. For a complete review of the Skyview architecture, see the October 2014 issue of *Aviation Consumer.* For more, see www.dynonavionics.com.

YouTube See a video review of the Skyview at http://tinyurl.com/j95ht2a

AIRCRAFT MAINTENANCE

Lycoming Rod SB: How Large a Problem?

Lycoming says about 1300 factory engines are affected, plus an unknown number of field overhauls. Inspections are onerous.

by Paul Bertorelli

As we go to press in early August, Lycoming, field shops and owners were struggling to clarify a service bulletin that requires inspection and possible replacement of connecting rod bushings in hundreds of Lycoming engines. The mandatory service bulletin—SB632—was announced on July 17, just ahead of AirVenture. Two weeks later, shops tell us they are still fielding calls from worried owners trying to understand the scope of the bushing issue.

According to Lycoming, the problem came to light after a number of engine failures—Lycoming isn't saying how many—were traced to small-end connecting rod bushings that allow too much side-to-side play between the rod and piston, causing rapid wear and catastrophic damage. Further, fields shops were returning bushings shipped through the normal supply chain to Lycoming because they fit incorrectly. Two shops we spoke to—Penn Yan Aero and G&N Aircraft—reported partial or catastrophic failures in engines they had overhauled.

TEN-HOUR LIMIT

The SB has urgency, requiring owners of all engines overhauled during the affected period to have them reviewed for use of suspect bushings and to potentially be inspected within the next 10 flight hours. The bushings in question were supplied by Lycoming and shipped from the factory between Nov. 18, 2015, and Nov. 15, 2016. In addition, a number of rod/bushing assemblies shipped during periods between Jan. 4, 2016 and Feb. 2, 2017, are also subject to the SB.

Although potentially thousands of engines are impacted, as of late July, Lycoming had identified about 1300 factory engines that may require inspection and/or bushing and rod replacement. In an interview at AirVenture in late July, Lycoming general manager Michael Kraft said the 20-page service bulletin, which lists everything Lycoming builds, may overstate the breadth of the problem.

Kraft said the factory engines are defined by serial number range and not necessarily all those are affected, but a subset. "If you had your engine manufactured or overhauled outside [of the factory], we encourage people to contact the service provider and find out if the bushings were used. These are bulk parts and the service provider should have records if they used bushings from the affected lots," Kraft explained. The first step

Lycoming connecting rods, right, with special tool for testing the fit of the small-end bushing. Lower photo from SB632 describes how it's used to measure interference fit between the bushing's outer diameter and the rod small-end bore.

is a paperwork exercise to identify when the engine was overhauled. If it was done before the earlier 2015 date, the SB has no effect. Also, if you bought a Lycoming engine or overhaul that isn't on the list, you're similarly not affected by the SB.

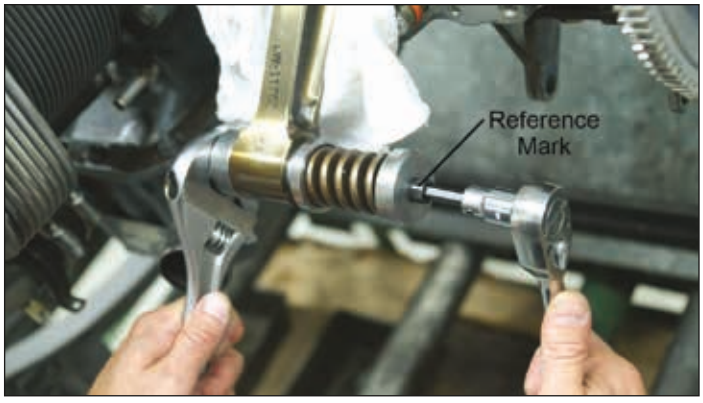
LYCOMING SUPPORT

Lycoming estimates that for those engines that require the bushing inspection, 12 hours of labor will do the job on four-cylinder engines, while 16 will be needed for six-cylinder engines. Lycoming engines on warranty will be covered for parts and labor and, the company said in late July, even engines just past warranty will be supported.

However, Lycoming support for field shops performing the inspection is murkier. Lycoming first said owners should expect warranty performance from the shop that did the overhaul, but when we bluntly asked if Lycoming will or won't give the shops a labor allowance, Kraft said this: "Call your service provider. They obviously have their warranty in terms of what they provided and we also want them to call us so we understand whether they had an affected lot or not," Kraft said. When pressed for a yay or nay on a labor allowance for field shops, Kraft said they should call Lycoming for a determination.

One well-regarded shop in California, Ly-Con Aircraft Engines, told us that it built about 300 engines during the suspect period. Ly-Con's Ken Tunnell said the shop wasn't sure how many would require inspection. As of press time, Lycoming had published a refined version of the bulletin potentially providing some relief from inspection for shops who had the means to verify that rods and bushings were installed to spec.

If an engine has to be opened for inspection, the SB requires that the cylinders be removed and the pistons withdrawn and removed without exposing the rings. This is intended to minimize the need for additional parts and labor hours. Lycoming has developed a special tool (see photo above) to exert calibrated side load on the small-end bushing. If the bushing moves under the load, the rod has to be removed, rebushed and reinstalled. None of the shops we spoke to believed Lycoming's labor allowance was adequate, especially if bushings have to be replaced.



SHOPS UNCERTAIN

The shops we spoke to said Lycoming had always stepped up in supporting such warranty and inspection work in the past, but all were worried that the company was vacillating on the rod bushing bulletin.

"I'm sure my stuff is good, but I have to go back and comply with the inspection requirement," said Ly-Con's Tunnell. "On an issue like this, they've got PMAers out there wanting to take business from them. I've always been under the impression that if I stand behind the OEM, they would stand behind me," Tunnell added. In a follow-up interview, Kraft was still noncommittal on what support Lycoming would provide beyond just replacement parts. But he said any shop should contact Lycoming through normal support channels before billing customers as they proceed with the inspections. All of the shops we spoke to said whether Lycoming pays for the inspections or not, they would honor warranties with customers.

We estimate that about 1000 engines outside the Lycoming factory system might be affected, but it's not yet known how many of those would actually have to be inspected. Kraft said initial inspections revealed that about 10 percent of the opened-up engines had the bad bushings.

For more information on the SB, see www.tinyurl.com/ybbbzq2g and for a podcast by our sister publication, www.avweb.com, see www.tinyurl.com/yb35kdml.

INDUSTRY NEWS

AirVenture Diary: Avionics Galore

New avionics dominated this year's AirVenture at Oshkosh, but there were some signs of life from the new aircraft and the diesel engine markets.

by Larry Anglisano

We'll start with avionics in our annual recap of AirVenture in Oshkosh, Wisconsin, which according to EAA had a record-breaking attendance of 590,000 people. That's up 5 percent over last year.

We knew autopilots would be front and center at the show, but we didn't expect to see six of them, including the two systems from Garmin we covered on page 4.

As promised, TruTrak showed up with an STC for the Vizion autopilot. The STC only covers the Cessna 172 Skyhawk and 177 Cardinal, but TruTrak says it's getting busy with more approvals. Other than Dynon's D10A, third-party EFIS compatibility is lacking, for now, which could put the brakes on for some buyers looking for a complete interface. TruTrak's Andrew Barker told us to expect more announcements for third-party compatibility soon, which in our view has to include Garmin's G5 flight instrument. It's become the dominant low-cost EFIS solution for the market's lower end.

The STC Group (an outside company established to work on certifications) announced it was awarded an STC for the experimental Trio Pro Pilot autopilot for the Cessna 172, 175 and 182 models. The Cessna Cardinal and Piper Cherokee will be next, the company said. Both the TruTrak and Trio systems are priced below $10,000 and various versions of installation kits are available, depending on aircraft configuration and whether it currently has an autopilot.

Icon came to AirVenture with news that it plans to deliver 200 of its A5 LSA amphibs in 2018. So far it's delivered six aircraft.

The other shockers came from BendixKing (see the sidebar on page 17) and Genesys Aerosystems, who both announced new autopilots. Genesys is working on the clean-sheet S-TEC 3100 digital autopilot, says it expects STC certification in early 2018 and is targeting the Cessna 182, 210, Beech Bonanza and Piper Saratoga for initial applications.

No pricing was announced for the 3100, although Jamie Luster from Genesys said the system price will be competitive with other autopilots having similar capabilities. This includes envelope protection, voice annunciations, underspeed and overspeed warnings and a variety of other functions the market expects from a new autopilot.

Is there really a demand for all of these autopilots in the current market? We doubt it, but it's good to have choices and we welcome the competition.

ADS-B SOLUTIONS

We anticipated some action on the ADS-B front and it was there. Garmin was showing its latest GDL82, a mandate-compliant two-piece (transmitter and GPS antenna) remote ADS-B Out system. Priced at $1795, the system

That's more than a wingtip light. It's also a self-contained ADS-B Out solution and uAvionix is working on getting it FAA approved.

BENDIXKING SURPRISES: AUTOPILOT, EFIS, GADGET

Just as the industry all but gave up on BendixKing, it showed up at AirVenture with a handful of new products, including a retrofit autopilot that's designed to replace the company's aging fleet of KFC-series autopilots.

Called the AeroCruze, the KFC230 is focused at replacing the KFC150 and KFC200 autopilots. BendixKing's AeroCruze product manager, Jeff Kaufmann, told us that since nearly 70 percent of an autopilot's installed cost includes the replacement of servos and related hardware, the AeroCruze is designed to retain the existing autopilot servos. In a bold move and as part of an AeroCruze retrofit, BendixKing is offering a two-year warranty on these existing servos as long as the installing shop verifies they are in good working order.

The KFC230 requires a digital attitude source for roll and pitch input, which can come from the company's KI300 electronic flight instrument (more on that in a minute) or from third-party EFIS systems including the Aspen Avionics Evolution and Garmin G500/600. As for the autopilot computer, it's a stack-mounted hybrid controller with color touchscreen, plus it has knobs and buttons. BendixKing is targeting an upgrade price of $10,000 and says it expects to start shipping the product in the middle of 2018.

We've seen the KI300 EFIS before because the company introduced it at AirVenture two years ago, but hasn't delivered it. This year it brought the instrument back in a different form. "We've listened to customer requests for additional features so we reworked the instrument and added airspeed, attitude and slip indications," said Kaufmann. The KI300 is intended to drive third-party attitude-based autopilots, plus the company's own legacy and new AeroCruze systems. The company said it plans to ship the KI300 in September 2017—that's about the time you'll be reading this. Will it deliver?

Last is a new personal tracking, texting and SOS device that's an addition to the company's AeroWave communication product line. Called the AeroWave Text & Track, the handheld device uses the Iridium satellite network. It can send up to 90 characters and receives up to 140 characters of text, interfaces with a smartphone app via Bluetooth, is priced under $500 and is available now.

is a low-flying 978 UAT solution (it doesn't have ADS-B In) that has a built-in WAAS GPS.

Garmin is marketing the GDL82 to the market's lower end, which includes minimally equipped aircraft without WAAS GPS systems, plus buyers who have been reluctant to buy mandate-approved solutions because of complex installations.

Garmin believes the GDL82 has a simpler installation than other systems because the transmitter connects in line with the aircraft's existing transponder and L-band antenna system.

Is this the innovative ADS-B solution the market has been waiting for? We don't really think so and expected this simpler approach to mandate compliance a while ago. As for price, it's budget-based at sub-$2000, but after installation the bottom line will still flirt with $3000.

The real innovator in the ADS-B market was uAvionix. It surprised showgoers with its new SkyBeacon, a smart ADS-B Out system that replaces a navigation light with an LED lamp and a built-in miniature ADS-B transmitter. It also has a self-contained ADS-B blade antenna that's molded into the housing. uAvionix says the system will work with a smartphone app for programming aircraft-specific ADS-B data and although a price hasn't been finalized, it's expected to be around $1400. As for installation, there shouldn't be much to it—perhaps not even enough to involve an avionics shop. The idea is to use the existing lighting wiring (power and ground), fasten the device in place, program it and fly it away. FAA certification hangs in the balance, of course, but we think the agency should see this simple product as an easy way to get more aircraft ADS-B Out-equipped. We'll be watching this one with interest and so should you.

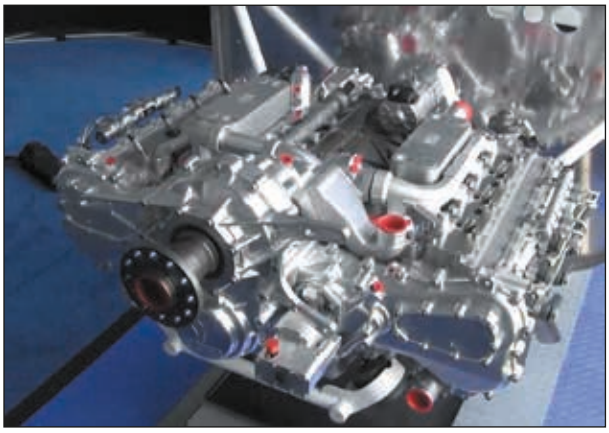
As if there aren't enough portable ADS-B In traffic and weather devices to choose from, ForeFlight brought the new miniature Scout to the show, which was developed in collaboration with uAvionix. The tiny $199 Scout is roughly 3 inches by 1 inch, weighs less than an ounce and uses a micro-USB connector. It works on both 978 and 1090 MHz frequency bands.

The Scout sure looks a lot like the PingBuddy portable device (uAvionix was the creator of that, too) that ForeFlight competitor Seattle Avionics was showing at Sun 'n Fun last spring. Although well-received, the PingBuddy—which was to have an open architecture that could work with a variety of tablet apps—never made it to market. The Scout, unfortunately, has a closed architecture and officially only works with the ForeFlight Mobile app, displaying traffic and weather within the program. We'll get a closer look at the interface in an upcoming portable ADS-B roundup article in *Aviation Consumer*.

ANOTHER SHOT OF DIESELS

If you've written off Jet-A-burning diesel engines for the masses, the technology could actually have a bright future. Continental Motors reported in a press conference that it's seeing more uptake of diesels in the North American flight training market. In an interview with sister publication AVweb.com, Continental's CEO, Rhett Ross, suggested there's sizable demand for an engine with increased efficiency in the training market, even though the initial investment for a diesel upgrade isn't the most economical. The training market isn't the only focus.

Although previously there has



Textron wants to tap the training market with its single-lever, diesel-powered Cessna JT-A Skyhawk shown at the top, while EPS was showing off its 350-HP Graflight V-8 diesel engine (middle image) as a clean-burning, fuel-efficient alternative to traditional high-output Continental engines. Stratos hopes to grab some of the VLJ market from Cirrus with the model 714 single-engine six-place jet, bottom.

been little demand for a high-output retrofit diesel, the company is ready for prime time with its CD-300 V-6 diesel engine, which is fully certified.

Speaking of new certifications, Textron brought its newly certified Turbo JT-A Skyhawk to the show. It's powered by the Continental CD-155, which has a dual-channel FADEC driven by a single power level. The aircraft has a maximum speed of 134 knots, a maximum range of 963 nautical miles, a maximum climb rate of 767 FPM and a 1320-foot takeoff distance. The JT-A Skyhawk has Garmin's new G1000 NXi integrated avionics, a three-blade propeller and an eye-widening price of $435,000. Whether the JT-A will be embraced by the training market remains to be seen.

But it wasn't just Continental diesels in the spotlight. After cooling its heels for a year or so, Engineered Propulsion Systems (EPS) was back at AirVenture and showing off the lightweight horizontally arranged Graflight V-8 diesel engine. Immersed in FAA Part 23 static testing, EPS says it's working on integrating the engine into a Cirrus SR22, although certification testing is in the early stages and the engine will have other uses, including marine and UAV applications.

The 350-HP engine, which has steel pistons and an iron crankcase, is targeted to have a 3000-hour TBO and, according to EPS, an efficiency that can better other diesel engines by 15 percent. At the show, EPS showed us its efficiency data that compared the Graflight to Continental's TSIO-550-E avgas engine. At 75 percent power (262 HP), the Graflight's hourly fuel cost was shown to be $63 per hour, compared to the Continental's $114 per hour cost. EPS said the Graflight is the cleanest engine ever developed for the GA market—cutting CO2 emissions by 30 percent over comparable avgas engines and by 17 percent over competing diesel engines. No price has been set.

AIRCRAFT DEVELOPMENTS

Last summer Piper was celebrating the certification and first delivery of its M600 turboprop single, but at AirVenture this summer it announced that it has grounded the entire fleet of M600s. The trouble began after Piper discovered a single, non-conforming aft wing spar from its supplier, which prompted a mandatory service bulletin. The inspection, which can be done in one day, applies to all 38 M600s in service.

Amidst the hustle and bustle of big military iron at the show's Boeing Plaza, Stratos Aircraft was showing off the model 714 proof of concept personal jet it flew into the show. Using carbon fiber construction, the maximum cruise speed was an advertised 415 knots (at 41,000 feet) and the range is 1526 nautical miles with four people aboard. The prototype we looked at was powered by a Pratt & Whitney Canada JT15D-5, but the company said it likely won't be the engine that's used in the certified aircraft. Swapping out different engines is supposed to be easier because the airframe is assembled with a replaceable steel truss that attaches the tail to the aircraft, making it a modular design. This also makes it possible to tweak the tail section for optimizing performance, as one example.

Is there really a market for another single-engine personal jet? Like Cirrus with its Vision jet, Stratos is targeting owners of turboprop singles looking for more speed and efficiency. We think it will be a long, expensive road to certification for Stratos, which is based in Redmond, Oregon, but the company is prepared to offer the aircraft in kit form as a fallback. It's currently looking for investors,

Finally, the Icon Aircraft tent was jampacked each day as the company flaunted its A5 LSA amphib. It's ready to start selling the tweaked 2018 model and said it hopes to deliver up to 200 aircraft in the coming year, while also building more training and demo centers around the country.

AIRCRAFT PRODUCTION

American Champion: Full-Service Factory

As general aviation manufacturing has slowed, American Champion is meeting the challenge by expanding into refurbs, mods and repair.

by Rick Durden

It all started with a bathtub. In the late 1920s, the cost to rent the airplanes available was a dollar a minute—that's over $14 in current dollars. The over 100-HP radial engines necessary to power the boxkite biplanes weren't cheap to run. Naturally, there were a lot of people trying to come up with an airplane that would be more affordable for the many who lusted to fly.

The first company to successfully cut the cost of flying to something affordable for the middle class was the Aeronautical Corporation of America (Aeronca), an outfit that had money and wanted to build airplanes. It teamed with Jean Roche, a genius engineer employed by the Army's aeronautical research facility in Dayton, Ohio, and who had come up with a single-place airplane that could be paired with a two-cylinder engine that was, wonder of wonders in those days, reasonably reliable.

The Aeronca C-2 rapidly earned the nickname of "Bathtub" because it looked like one; however, it was so inexpensive to build and operate that, despite coming onto the market almost simultaneously with the October 1929 worldwide financial collapse, it sold in volume.

By 1931 Aeronca had widened the C-2 to make it a two-place airplane, which it christened the C-3 Collegian. Advertised as an airplane that could be operated for five cents a mile, the C-3 is credited with starting the first general aviation boom.

In 1936 the "J" series of Cubs from Taylorcraft—later Piper—became the C-3's first serious competitor. With better handling, more room, a little more power and even sporting the same yellow and black paint scheme as the C-3, the new generation singles nearly put Aeronca onto the aeronautical ropes as it struggled to come up with a competitive design before World War II.

In 1944 Aeronca flew its first Model 7 Champion, a two-place, tandem single, which was soloed from the front seat—to compete directly with the Piper J-3 Cub, which was soloed from the rear. Sales of the Model 7 Champ began within months of the end of World War II.

The Model 7 Champ evolved, first with larger engines and later, as the aerobatic Citabria, into a line that included airplanes with and without flaps, a number of engine choices and a brief foray into nosewheel and twin-engine versions—but all have been two-seat, tandem airplanes. An additional line, the 8 series, was added, creating the 8KCAB, a laminar-flow wing, serious aerobatic airplane with a number of engine options, and the 8GCBC Scout, designed to work for its living.

While the airplane line grew, its ownership changed hands a number of times, eventually becoming American Champion Aircraft residing on the airport in Rochester, Wisconsin, a stone's throw from Milwaukee.

With the current, frustratingly stagnant general aviation market for new airplanes, we wanted to see how American Champion was dealing with the challenges, so we went to the factory.

PRODUCT LINE

Not surprisingly, American Champion still builds the Champ—the model 7EC—although now only on special order. Power is a 100-HP Continental O-200 swinging a fixed-pitch wooden Sensenich prop. The Champ is the only airplane in American Champion's product line that falls within the light sport weight and speed limits. Base price is $132,900.

During our visit, company co-owner Jerry Mehlhaff Jr. told us that he thinks the company may have built its last Champ as it's his opinion that BasicMed has probably killed the light sport market.

CITABRIA

The next step up the ladder is the Citabria series, with four models—all aerobatic, all with fixed-pitch props and all with 35 gallons of usable fuel.

The most basic is the 7ECA Citabria Aurora, with a 118-HP Lycoming O-235 up front, a gross weight of 1750 pounds, a 630-pound useful load and a 75 percent power cruise speed of 115 MPH. As with all Citabrias, it is aerobatic with load limits of plus five and minus two Gs. Base price is $149,900.

The 7GCAA Citabria Adventure is priced at $155,500, and has a 160-HP Lycoming O-320 engine and a cruising speed of 124 MPH at 75 percent power. Useful load is 550 pounds, some 80 pounds less than the model 7ECA.

The 7GCBC Citabria, the only version with flaps, now has two engine options: the Explorer model with a 160-HP Lycoming O-320 and the

DECATHLON AILERON HINGE SUPPORT CRACKING RESOLVED

From the days of the C-2, Aeronca ailerons have had a reputation for being heavy and not generating a particularly exciting rate of roll. Not long after the Decathlon was introduced, spades—which look just like their namesake shovel—were attached to the underside of the ailerons to reduce control forces. While they did that, they did not noticeably improve the roll rate.

When American Champion looked at putting a larger engine into the Super Decathlon it was faced with a 39-pound empty weight increase, which—according to Jerry Mehlhaff Jr.—would turn the airplane into a single-place machine. American Champion engineers redesigned portions of the airframe of the Decathlon to accomplish a 50-pound weight reduction in creating the Xtreme. The result was an 11-pound increase in useful load for the Xtreme over the Super even with the heavier, more powerful engine.

Fourteen pounds of the weight loss came from redesigning the ailerons. They received a new cross section that included reshaping the nose, moving the hinge line and making them fatter—the nose bulges above and below the wing, similar to the design of the Pitts Model 12. The new ailerons were also installed on the Super.

An unexpected, according to Mehlhaff, set of results to the aileron design change was much lighter control forces and a roll rate increase from 90 to 120 degrees per second at full deflection.

The combination of the increased roll rate and ability of the Xtreme Decathlon to hold a vertical up line longer because of the power increase meant that it could successfully compete at a higher level in International Aerobatic Club (IAC) competitions. The Super Decathlon is not competitive at the Intermediate level in IAC events—the Xtreme is.

Mehlhaff told us that the stresses imposed on the aileron hinge support area on the Xtremes that were being used for more aggressive maneuvers caused premature wear in the area. One pilot reported a stuck aileron in flight—he was able to free it and land without incident. Postflight inspection revealed cracking around the aileron hinges.

American Champion issued Service Letter 442 with procedures for inspecting the area and began work on a redesign of the affected structure. The SL 442 inspection involves removal of the wingtips, opening inspection covers and removing some fabric.

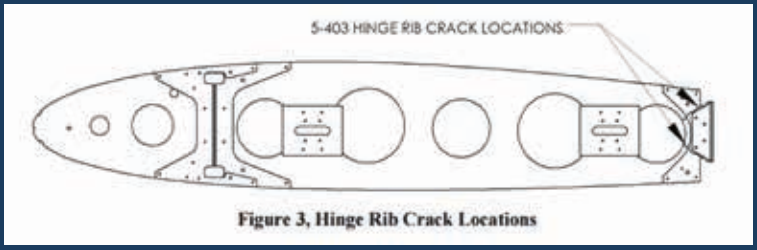


Figure 3, Hinge Rib Crack Locations

In April of this year, the FAA issued an AD mandating the SL 442 inspection prior to further aerobatic flight. Sixty-one airplanes were affected by the AD.

We were at the factory in June and were told that the redesign was complete and the data had been presented to the FAA for final approval.

Mehlhaff said that information from inspections that had taken place confirmed that only a few airplanes showed signs of advanced wear, all were Xtremes and all had been used for high-G aerobatics on a frequent basis.

When we spoke with Mehlhaff at AirVenture, he advised us that the redesign had been approved by the FAA and repairs to affected airplanes were about to start. The company will provide retrofit kits free of charge. He said that all airplanes still under warranty will have the airframe changes made under the warranty. The company will be offering to do the changes for out of warranty airplanes at the factory for well under the company's cost.

High Country Explorer with a 180-HP Lycoming O-360.

The Citabria Explorer has a gross weight of 1800 pounds, useful load of 550 pounds and cruises at 126 MPH at 75 percent power.

The Citabria High Country Explorer has two gross weights—for aerobatics it's 1800 pounds, in the normal category, it's 1950 pounds. Base price for the Explorer is $165,500; for the High Country Explorer, it's $213,900.

DECATHLON

What started out as a re-winged, better Citabria with inverted fuel and oil systems, the 8KCAB Decathlon series evolved from a decent aerobatic trainer capable of outside maneuvers—its load limits are plus six and minus five Gs—into something that will take its pilots well up the line in aerobatic competition for a reasonable price.

There are two versions of the Decathlon: the Super, with a 180-HP Lycoming AEIO-360 engine, and the Xtreme, with a 210-HP Lycoming AEIO-390 engine. Both models have constant-speed, MT composite props and 39 gallons of usable fuel.

Both airplanes have a gross weight of 1950 pounds in the normal category and 1800 in the aerobatic category.

Base price for the Super is $230,000 and $255,000 for the Xtreme. We profiled the Xtreme in the April 2014 issue of *Aviation Consumer.*

SCOUT

What started as the workhorse of the American Champion product line, the 8GCBC Scout, has evolved into what we consider to be one of the best of the backcountry recreational airplanes on the market.

The basic Scout is equipped with a 180-HP Lycoming O-360 engine

and constant-speed, MT prop. Gross weight is 2150 pounds. Useful load varies with the optional equipment installed, which can include huge tundra tires—but figure on about 790 pounds. The airplane is a camel—new Scouts all have 70 gallons of usable fuel, so endurance can be upward of seven hours. With what we feel is a realistic empty weight, 370 pounds can go in the cabin when the airplane is loaded with full fuel.

Cruise speed for the Scout at 75 percent power is 130 MPH. Base price is $246,900.

Pouring another 30 HP into the Scout to create the Denali was akin, in our opinion, to giving a power lifter steroids—without the side effects. Aggressive weight reduction efforts during design of the Denali Scout meant that only 20 pounds of useful load was lost when the heavier engine was hung.

Cruise speed went up to 136 MPH with the power increase. We recently flew a Denali equipped with the optional Hartzell Trailblazer composite prop.

We had been told that it bumped cruise speed by 2 or 3 MPH. During a trip we made of over 1000 NM, true airspeed averaged 142 MPH at 75 percent power. We profiled the Denali in the October 2014 issue of *Aviation Consumer*. Base price is $272,900.

MODERNIZING PRODUCTION

During our visit in June, Jerry Mehlhaff Jr. took us through the three-building factory where we saw that skilled craftsmen and women were still building and refurbishing steel-tube-and-fabric airplanes largely by hand. On first look it seemed as if the production methods hadn't changed since the day the first Champ was shoved out the door.

The reality is much more complex. Manufacturing costs are a constant undertone. Computer-guided laser cutters turn out aluminum wing ribs in less than two minutes rather than the hour it took previously. They were silent by the time we walked through at 9 a.m.—peak period electricity pricing means they run only very early in the morning.

Even though American Champion has been putting dope and fabric on airplanes for decades, it is still refining the process, looking to improve the finished product even further. Most recently it worked with the manufacturer of the glue used in the process to refine the composition to reduce the cure time.

American Champion has fixtures going back to the 1960s, top. Jerry Mehlhaff Jr. in front of partially completed airplanes, above.

A third paint booth has been added so there is enough space so that everything has time to dry in the dust-free environment of the paint booth. That matters when there may be two or more layers of primer and three to five top coats of paint applied to any given surface.

Production has settled down to two new airplanes a month, although Mehlhaff said that the "sweet spot" for the factory is four. That led him to aggressively move into the world of aircraft refurbishment and insurance rebuilds.

With fixtures for wings and fuselages for models going back through the 1960s, a wrecked aircraft can go into its original jigs and fixtures and come out "essentially new except for the data plate."

Owners also bring in older machines for refurbishment, which come out as nearly new airplanes for a fraction of the price. Mehlhaff says he's no longer amazed by some of the mods owners seek. With a Designated Engineering Representative (DER) and Designated Airworthiness Representative (DAR) in-house, getting FAA approval for modifications has proven to be straightforward.

The factory includes an approved repair station so owners bring their airplanes in to have their annual inspections performed by some of the same people who built them.

GOING FORWARD

Mehlhaff said that there will continue to be progressive design changes to the line. The company doesn't do model year changes, it upgrades models when something new is designed, tested and approved. Some changes are big, such as lighter and faster ailerons on the Decathlon and the climb and speed boost provided by the Hartzell Trailblazer prop, but most are more modest such as a better powder coating for the steel fuselage tubing.

Mehlhaff also said that the company is aggressively working to support airplanes in the field—which has worked to keep their values high, which helps with new aircraft sales.

As we finished up our talk at Oshkosh, Mehlhaff said that we should watch for more design changes but wouldn't say what they might be.

Engine Break-in Flights: Know the Power Settings

You get one shot at breaking in a new engine or cylinders. Following manufacturer and overhauler guidelines while using common sense is the recipe for success.

Staff report

At some point you could be faced with flying off a new engine or cylinders. The exact procedures for attempting this sit-up-straight-in-the-seat chore might depend on the engine, the type of cylinders and what the manufacturer recommends. Still, launching for the first time with any new engine must include a solid plan for ground running, power and propeller settings, how far you'll venture from the runway, how high you'll fly and how long you'll conduct the shakedown run.

To help get that plan started, we prepared this basic guide, with a little help from the pros who deliver engines. We'll say up front that this shouldn't be used solely as a guide for every break-in situation.

RUN-IN VERSUS BREAK-IN

They certainly aren't the same. The initial stage of bringing the engine to life is the run-in portion, where the overhauler preferably does this on an instrumented test stand with a club propeller that provides better cooling than a standard prop. While the initial run-in of the engine can be done on the aircraft, it is not the first choice by most engine overhaulers or manufacturers due to the general lack of environmental controls and calibrated instrumentation.

During the run-in, the overhauler goes through a series of RPM and power protocols to make sure the engine is set up properly. This is also where the engine is leak checked and the timing and fuel flow are tweaked to get it ready for the next stage: the break-in flight.

The typical run-in time for a new engine is one or two hours, whereas the break-in occurs during the next 25 to 50 hours by flying it. A technician may or may not join you for the first launch, but it doesn't hurt to ask. Consider this a risky flight and not the time to bring your neighbor for her first one in a small airplane. Don't laugh—we've witnessed the boneheaded decision—on an IFR day.

GROUND OPS

Nearly every engine shop we spoke with cautioned against time spent running on the ground for risk of overheating. Best to do this on a cool day (or the coolest part of the day) and to avoid excessive taxiing at low power settings.

Heat is a huge issue because the new piston rings are in the process of wearing in to the freshly honed cylinder(s), which generates abnormally high friction and heat. Excess heat can glaze or warp cylinder walls or anneal the rings. Don't always count on older CHT gauges as your guide because they may not register quickly. There are delays in registering instant heat excursions as the temperature probe is in the cylinder head, not on the cylinder wall itself.

On the other hand, don't rush off to the centerline without warming and circulating the engine oil. RAM Aircraft in Waco, Texas, suggests not to cycle the propeller, whether for breaking in a new engine or one single cylinder. Others recommend minimal prop cycling. We say use common sense. If the aircraft has been sitting for weeks on a cold-

Whether you're breaking in fresh cylinders or a new engine, it sure helps to have a graphic engine monitor with datalogging capability. Consider installing one while the engine is torn down.

soaked ramp, don't fire it up and go without briefly cycling the prop one time. The last thing you want to discover on initial climb is a problem with the prop governor.

Hopefully the new engine will have been delivered with the proper oil in it (multi-viscosity mineral oil is common), but leftover AeroShell 15-50 in the sump, as an example, isn't the best choice for breaking in new cylinders—or even one of them.

According to RAM, the use of break-in oil and performing break-in procedures should be followed whether replacing one cylinder or six. It specifically mentioned its Nickel cylinders. For direct-drive engines, mineral oil such as SAE 20W-50 Phillips type-M can be used, and for geared engines, RAM prefers that AeroShell straight weight mineral oil is used.

This procedure should be followed for the first 25 hours of operation and can continue to as much as 100 hours, depending on the cylinder bore material used. The oil should be changed as soon as oil consumption stabilizes, but no later than the first 25 hours of operation. At that time, oil should be changed to an ashless dispersant (AD) mineral-based oil. Again, this is what RAM and others we spoke with recommend for most common high-output Continental engines. Talk with your shop about oil and change intervals for break-in.

MINDING POWER SETTINGS

Low-powered engines are more susceptible to poor ring seating than high-powered turbocharged engines, but cylinder wall glazing is a distinct possibility on all. Babying a break-in begs for cylinder glazing. Using lower power settings just doesn't expand the piston rings enough, leaving a film of oil on the cylinder walls. High temps in the combustion chamber oxidize the oil, the rings don't fully seat and the engine ends up with excessive oil consumption for life.

Removing cylinder glaze requires pulling the cylinder and mechanically breaking the glaze. You don't want to go there. The good news is lower-powered engines are the easiest to break in.

Still, it might feel unusual and uncomfortable to be flying around for 30 to 60 minutes with a Lycoming IO-360 at full power with a flat prop and rich mixture, but that's the drill for some break-in instructions.

If it makes you feel better, remember that most flat, non-turbocharged engines were designed to run wide open for their entire life. But for bigger, higher-output Continental engines including the IO-520, IO-550 and TSIO-520, RAM has some recommended power settings for new cylinder break-in.

It says for the first 15 minutes after departing the runway, operate at full power, or no more than 30 inches of manifold pressure for a turbocharged engine with the mixture full rich. Then change RPM between full redline RPM and climb RPM every five minutes. Once cruise altitude is reached, set up 75 percent power and 100 degrees rich of peak.

On a side note, you want to keep an eye on oil temperature and CHT. The general goal for a non-turbo is keeping the CHT under 400 degrees and the oil temperature well below 200, or as your manufacturer/overhauler advises is acceptable. If it's running hot, there could be baffling or temperature probe issues, but we suggest not guessing and landing immediately.

Break in a new engine with known calibrated engine gauges, top. Most replacement engines have been run on a test cell before they're hung on the aircraft. This limits your task to simply dealing with inflight break-in.

For the descent and return to the airport, don't chop the power to idle and glide from altitude. The recommendation is to set 2700 RPM and 23 inches of manifold pressure (1900 RPM and 25 inches on the TSIO engines). Lean to maintain approximately the same EGT as during the cruise period while maintaining a 300- to 500-FPM descent rate to touchdown.

Once back on the ground, you or your mechanic will want to uncowl the engine(s) and perform a leak check and generally look things over. Understand that the new engine might not be fully broken in after the maiden flight and you'll still have to adhere to prescribed power settings for a handful of hours. For cylinders, one break-in flight is all that's needed.

Do it right and with luck you'll be rewarded with a healthy engine that has nicely seated rings and minimal oil consumption.

BREAK-IN FLIGHT OPERATIONAL TIPS

- ✔ Fly during day VFR conditions with minimal passengers.
- ✔ Fly during the coolest period of the day if it's hot.
- ✔ Keep ground running to a minimum; park into the wind.
- ✔ Know and adhere to recommended power settings.
- ✔ Fly within gliding distance of the runway.

Lake Amphibian

If you're ready to step into the world of flying boats, consider a Lake amphibian. Prepare for specialized training, pricey preventive upkeep and serious fun.

Putting a boat hull on an airplane creates a few tradeoffs that prospective buyers should understand. For one thing, it doesn't make for efficient aerodynamics, so don't expect blistering speed and edgy handling. You also wind up with a complex airplane and face the costs of maintaining retractable landing gear and a constant-speed propeller. There are also the expenses of keeping a boat alive and well.

While it's impossible to predict what you'll shell out in preventive and unexpected maintenance, we've talked to enough owners who assert that you should combine the typical costs associated with a complex single and then square the sum to get an accurate number for owning an amphibian. Oh yes, and you get to own an airplane that can sink.

The good news is that Lake Amphibian owners tell us that, almost without exception, they love their airplanes. They happily put up with cruise speeds well below book (we've used book numbers in the graphic on the opposite page—owner feedback says to take them with a healthy helping of salt), the challenges of maintaining an engine set way up in the air and insurance requirements for serious initial and recurrent training. In return, you have the ability to land at some of the most scenic places on the planet—and where no land airplanes can alight.

> ***The airplane shines on the water because its hull is inherently stable and strong, plus its CG is low.***

After seeing some of the photos of Lakes in their natural environment sent in by owners, in addition to our own experiences flying a Renegade, we understand the appeal.

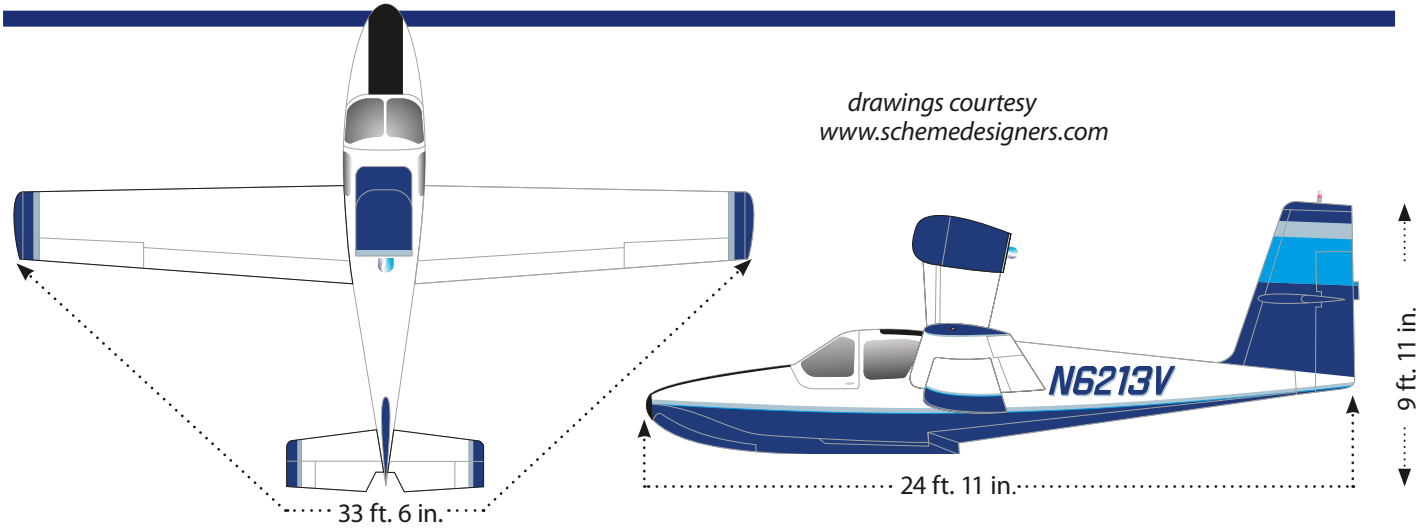
MODEL HISTORY, MARKET

The Lake evolved from a design developed by Grumman, the maker of now classic multi-engine flying boats, as a potential entry in the civilian market after World War II. The company built a prototype but decided not to go any further, letting two of its engineers—Dave Thrust and Herb Lindblad—take the design, which Grumman called the Tadpole, and start building it in 1948 in Sanford, Maine, as the three-seat 150-HP Colonial C-1 Skimmer.

Ten years later, they made it a four-seater with a 180-HP engine and called it the C-2. In 1960, they extended the bow and wings and dubbed it the Lake LA-4. About 250 Skimmers and LA-4s were built before production ended in 1962. There were some company changes that saw the manufacturing side become a separate entity, called Aerofab, from the sales

That's Frank Bell's Renegade 250 beached in the main photo. A previous Buccaneer owner of nine years, he said Lakes are reliable, but only with proactive maintenance.

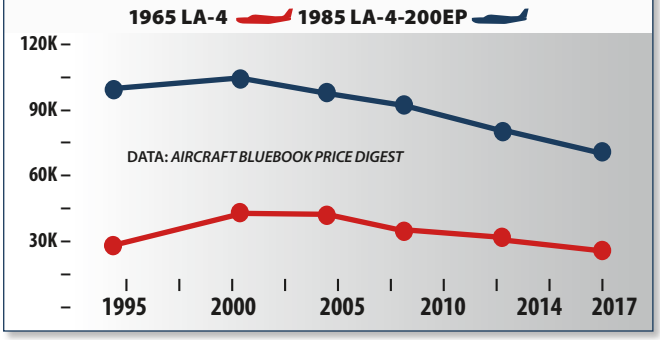
LAKE AMPHIBIAN



LAKE AMPHIBIAN SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
1957 C-1	150-HP LYCOMING O-320-A2A	2000	$20,000	30	700 LBS	117 KTS	±$14,000
1958 C2-IV	180-HP LYCOMING O-360-A1A	2000	$23,000	30	830 LBS	117 KTS	±$19,000
1965 LA-4	180-HP LYCOMING 0-360-A1A	2000	$23,000	40	845 LBS	114 KTS	±$29,000
1979 LA-4-200	200-HP LYCOMING O-360-A1B	2000	$24,000	40/55	1135 LBS	130 KTS	±$62,000
1985 LA-4-200EP	200-HP LYCOMING 0-360-A1B	2000	$24,000	48	1030 LBS	127 KTS	±$91,000
1995 LA-250	250-HP LYCOMING IO-540-CFB5	2000	$30,000	76/90	1290 LBS	122 KTS	± $250,000
1995 LA-270	270-HP LYCOMING TIO-540-AA1AD	1800	$60,000	76/90	1065 LBS	155 KTS	±$265,000
1997 LA-250 SEAFURY	250-HP LYCOMING IO-540-CFB5	2000	$30,000	76/90	1290 LBS	122 KTS	±$345,000
1997 LA-250 TURBO SEAFURY	270-HP LYCOMING TIO-540-AA1AD	1800	$60,000	76/90	1065 LBS	155 KTS	±$365,000

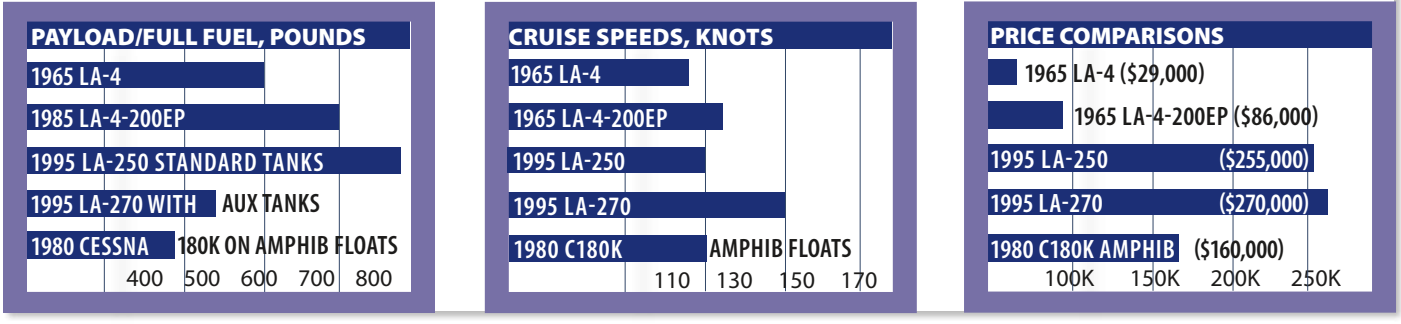
RESALE VALUES



SELECT RECENT ADs

AD 2013-08-14	HORIZONTAL STABILIZER ATTACHMENT FITTING INSPECTION
AD 2002-21-05	INSPECTION OF UPPER AND LOWER WING SPAR DOUBLERS
AD 2000-10-22	WING SPAR REINFORCEMENT KIT INSTALLATION
AD 86-23-05	MODIFICATION OF FUEL SHUTOFF VALVE MOUNTING PLATE
AD 76-12-11	INSPECTION OF FUEL FILTER HOUSING FOR CORROSION

SELECT MODEL COMPARISONS



Ronnie Marrache says his 1984 Lake EP turbo (shown at the top) flies every bit as well as his Mooney 201, except it's 40 knots slower. A Renegade cabin, bottom, isn't exactly cavernous.

and service side, an arrangement that continued until production stopped. The type certificate was acquired by Consolidated Aeronautics (Conaer) in 1963, which moved its corporate headquarters to Texas but kept the factory in Maine.

The Lake Buccaneer (LA-4-200) was born in 1970 when Conaer put a 200-HP fuel-injected Lycoming on the LA-4. Over the years, a few turbo models were made and at least one non-amphibian water-only model.

In 1979, Armand Rivard, an independent Lake distributor, bought the company and moved it to Kissimmee, Florida. He introduced the LA-4-200EP.

To reduce cooling drag and noise, it had a new nacelle and its prop shaft extended five inches farther aft. It also had "batwing" fillets at the wing/fuselage junction to improve low-speed handling by eliminating eddies and turbulence that disrupted prop performance.

Rivard also introduced the Renegade in 1979, a six-seat version with a 250-HP IO-540, a beefed-up structure, a rear cabin door and larger tail. It easily outperforms its predecessors and is even more stable on the water.

Beginning in 1981, the Lakes all got more grease fittings, polychromate primer, an improved canopy and more rust-resistant cabin vents.

A turbo version of the Renegade became available in the late 1980s through an STC, so technically it is a mod done by the factory. Its Lycoming TIO-540 is rated at 270 HP.

In 1991, the company started making the Seafury, a Renegade with lift rings, survival equipment, a custom tool kit, aux power receptacle and stainless steel brake discs, plus extra corrosion-proofing in an extra coat of chromate primer inside and out and a ceramic coating on the steel parts.

Finally, the company developed the Seawolf. It's a Seafury modified for the military as a patrol, reconnaissance and special ops aircraft that has proved popular on the international market.

The company had a hiccup when Armand Rivard decided to try retirement. His son, Bruce, had no interest in taking over the factory so, in 2002, Armand sold his end to a Maryland FBO operator, Wadi Rahim, who called the company Global Amphibians and shut down the Maine factory.

Only two of its veterans moved to a new factory he opened in Florida, according to Bruce Rivard. Things did not work out and before long, his father got the company back. Bruce handled North American sales and service out of New Hampshire (go to www.teamlake.com), including finding good used Lakes and upgrading them for sale with a warranty. Production slowed to special orders only and, in the last few years, stopped.

Prices have a very wide range from $15,000 average retail for a good C-1 Skimmer (a pretty rare find; fewer than 25 were built) to nearly $375,000 for a 1997 LA-270 Turbo Seafury, according to the *Aircraft Bluebook*.

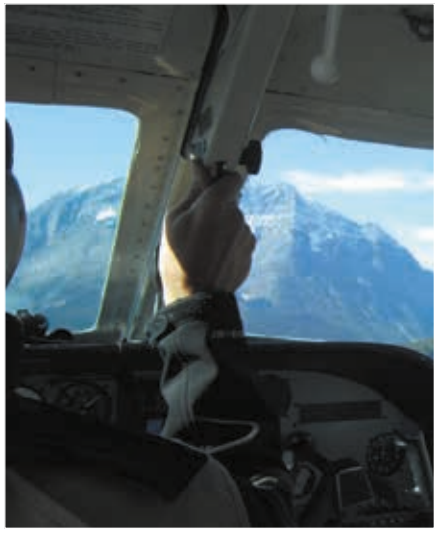
Moreover, prices have been trending slightly down, as they have been for many airplanes, although the EP model has shown some price resiliency. It has been praised as the best compromise among Lakes between cost and performance. The *Bluebook* puts a 1983 LA-4-200EP at $81,000 average retail.

PERFORMANCE, HANDLING

"Instant vacation" is what one owner has called the Lake experience, and Lake fans say there is nothing else short of homebuilts and a couple of exotics (anybody know of a clean Seabee?) that lets them fly as easily into a remote lake or stretch of river as on or off a runway. Of course, Icon aircraft is trying to make these operations a reality for more people with its A5 LSA amphib. Still, as with most machines that float and fly, that flexibility comes at a price in cruise efficiency. For certain the Lake, for its power, does not go fast.

A 200-HP Buccaneer performs on a par with a 150-HP landplane—one owner said that he flight plans his Lake at the same speed he does an older Cessna 172. Owners reported

Lake panels have evolved over the years and accommodate plenty of IFR avionics (top, middle photos). The windshield is steeply raked and the center post has a grab handle, bottom.



that book cruise numbers were not realistic. They reported cruise speeds in the 105- to 115-knot range with fuel consumption of about 10 GPH. A Renegade cruises at about 122 knots and one owner told us he burns 13.5 to 14 GPH. The turbo version shines up high with cruise speeds closer to 150 knots. That's pretty respectable, in our estimation.

The EP does better than the Buccaneer, cruising at about 120 knots. It has hull strakes that improve water handling and allow the hull to break free of the water at a lower speed—45 knots instead of 53 for a Buccaneer (50 knots with a batwing mod).

A Renegade pilot told us the EP is the best of the lot, is almost as fast as the Renegade, has better short-field performance and is more economical. Plus, the 90-gallon EP has a 9- to 10-hour range.

Company specs for the 250-HP Lake list cruise as 132 knots true at 6000 feet with 75-percent power with a 900-FPM best rate of climb at sea level. The turbo version, with its 270 HP, has the same performance except up high, where true airspeed is said to reach 155 knots. The EP's best rate of climb is 980 FPM, according to company specs, and the Buccaneer's rate is optimistically listed as 1200 FPM. An LA-4 with 180 HP is said by the book to climb at 1000 FPM.

Owners have complained that a heavily loaded Buccaneer (it can carry about 1000 pounds) is sluggish during climb. Some call it a two-place airplane with baggage or a four-place airplane with reduced fuel and bags. Lake's 180-HP models should be avoided by buyers looking to carry a lot. At gross weight, climb will be around 500 to 600 FPM and cruise will be about 105 knots, max.

The Lake's tendency to nose down when power is added and to rise when power is reduced because the engine is mounted high above the CG is one of the many reasons that a thorough initial checkout is in order, in our opinion. Owners reported that it's wise to practice low-altitude go arounds because of the nose-down pitch with power—one said, "Cobb the power on a bounced landing, while low and slow, and you're going to break it—probably badly." The high rate of accidents following bounced water landings we saw in the NTSB reports seemed to confirm this owner's concern.

In flight, the airplane is agile by seaplane standards. The ailerons are light but the rudder is a bit heavy, and flying the Lake well requires good rudder skills in the air and on the water. Stalls occur just above 42 knots or so, indicated. Recovery is gentle and predictable.

Having a Lake is not so much about its cross-country flying abilities, which are fine for shorter flights up to 300 miles or so. It is all about getting yourself right into the countryside for whatever fun you have in mind. The airplane shines on the water, owners say, because its hull is inherently stable and strong and its CG is low. Marc Rodstein of the Lake Amphibian Flyers Club says a proficient pilot can make a step-turn takeoff, rising off the water in a circle in case of a tight fit.

On a hot day, it takes precise technique to get a heavily loaded Lake on step for takeoff, especially the older models without hull strakes, available as a mod to reinforce the hull and reduce water drag. They also add more stability in turns.

Nevertheless, the airplane does

LAKE LOSSES: WATER OPERATIONS

In order to find 100 accidents of Lake LA-4 Amphibians we had to search all the way back into the 1980s. As we examined the NTSB reports we came to the conclusion that part of the reason there were relatively few was because there were only just over 1000 built, but also because the accident rate dropped radically after 2008. In fact, we found only four accidents after that year, two of which were overseas.

We credit the drop in the accident rate to type-specific training for the airplane—and to the insurers who mandated it for coverage. With 44 percent of Lake accidents related to water operations—and an additional 5 percent because of unnecessary low flying and inadvertently hitting the water—flying an LA-4 requires respect for its abilities and shortcomings on the water. That means learning to respect the water conditions that place the seaplane at risk—boat wakes, waves of more than a foot and crosswinds—and how to deal with them.

Even more than most other seaplanes, the Lake requires precise pitch control during takeoff and landing. One takeoff mishap involved a pilot determined to accelerate with a nose-low pitch attitude. The nose dug in and the airplane waterlooped, causing serious damage. There were accidents involving step taxiing in which the pilot did not control pitch assertively, the airplane began to porpoise and the pilot failed to take action to damp the oscillations, leading to a nose dive. The same thing happened on more than one landing with either the wrong pitch attitude or a high sink rate.

A number of bounced landings evolved into porpoise events with unhappy endings—one whose nose up and down oscillations got so bad that the airplane made its last impact with the water vertically nose down.

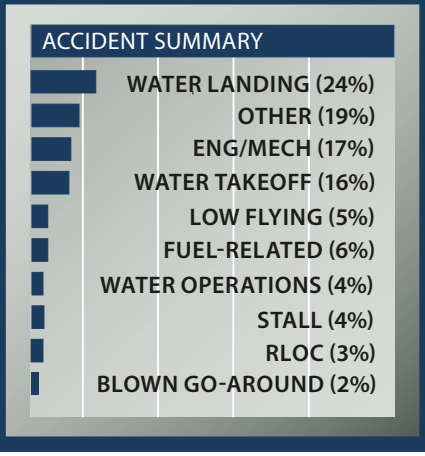
It often takes landplane pilots a period of time before they understand in their aviator souls that a seaplane does not tolerate yaw on a water touchdown. The Lake is no exception—the yaw on touchdown accidents ranged from tearing off sponsons through hull damage to flipping and killing the occupants.

Glassy water is challenging to handle in any seaplane. Until pilots experience it, few believe that it is physically impossible to determine where the surface of the water is until impact. Six LA-4s were torn up (some fatally) in glassy water conditions. One pilot took off and attempted to fly low—he stuck a wing in and cartwheeled. Another claimed he was "practicing reading the water for wind direction"—something that is not done at low altitude—when he slammed into the surface.

There was just one report of a water touchdown with the gear down—and we were relieved to see that it wasn't fatal. Most are. There were only three runway loss of control (RLOC) accidents—superb tribute to the good manners of the airplane on land.

There were six fuel-related accidents, two of which were due to contamination from water that contained rust and pieces of metal.

Seventeen accidents were due to engine stoppage, most because of lack of, or poor, maintenance. You have to climb up on the airplane to actually work on the engine. Looking at it from below doesn't count.



not have a deep-V hull, as does a Seabee, so it does not handle rough water well. In addition, it is a short-bodied flying boat, making it at risk for porpoising. It is a descendant of the Grumman line of flying boats and shorter than the smallest of the marque, the Widgeon, which was not at all tolerant of errors in pitch attitude on landing—many Widgeons were lost to porpoising events.

The Lake accident records are loaded with water mishaps. Catching a sponson in the water landing in a gusty crosswind can cause an upset and a lot of damage. Bad landings or rough water can end with the Lake trying to play submarine. In anything but calm air, docking is a major challenge because the mid-level wing and its sponson may not clear the deck.

On the ground, the Lake pilot needs a knack for steering with differential braking because the plane does not have a steerable nosewheel.

It's absolutely essential—and required for insurance coverage—to get Lake-specific training. The active and, in our opinion, effective Lake Amphibian Flyers Club can provide a list of highly qualified Lake CFIs (not to mention knowledgeable Lake shops, an absolute must for any pre-buy inspection).

Lake Aircraft's Team Lake in Gilford, New Hampshire, offers a one-day introductory ground school that opens the new Lake owner's eyes to what the airplane can do and what to be careful about, not the least of which is the lack of a gear-warning horn and the potential for landing gear up on a runway (not so bad) or gear down on the water (extremely bad). Also note there's no squat switch to prevent a gear collapse on the ground if you accidentally flip up the gear switch. Lake also offers a five-day ground and dual course. Be prepared to work hard.

LOADING, COMFORT

Useful load in real life averages about 800 pounds for a 180-HP Lake without an IFR panel. It's about 950 pounds for the 200-HP version and 1200 pounds for the Renegade.

Lakes tend to be nose heavy, a trait that is aggravated by the fact that the CG moves forward as the airplane is loaded. Marc Rodstein of the Lake club, however, says his

Later-model Lakes are equipped with a cargo door (above), which greatly improved cabin access. It can be retrofitted.

forward CG problem goes away when passengers get in the back of his airplane, making ballast unnecessary. The point is it's not a load-and-go airplane. Having the CG beyond limits for a gross-weight takeoff with a lot of pine trees beyond the beach is asking for trouble.

Only mods and the Renegade airframe have a back seat/cargo hatch, so expect to utter a few expletives when it's time to get in all your fishing and camping gear through one of the two front clamshell doors.

Fuel capacities range from 30 gallons in the Skimmers and 40 gallons in the old LA-4s. The Buccaneer had a 55-gallon option and the Renegade carries 90. There's a mod available for the older Lakes to put fuel in the sponsons, adding 14 gallons total.

There is elbow room up front, a bit less in the back. In older models, the hard seats adjust only fore and aft and the cabin is noisy. The EP model has more foam and customized features, and the Renegade has the nicest interior of all; its price reflects it.

There's no muffler cuff ahead of the firewall to collect heat for the cabin. Through 1973, Lakes used Janitrol gasoline heaters, for which an AD required complete overhauls every two years. Lake switched to Southwind heaters in 1974, but they had only on and off switches so the choice was cook or freeze. Lake went back to improved Janitrols in 1983.

SYSTEMS, MAINTENANCE

For a complex airplane that performs in a tough environment, the Lake has amazingly few ADs.

Hydraulics are used extensively on the Lake, running trim, flaps and gear all through one accumulator, pump and reservoir. All the actuator static and dynamic seals are plain "O" rings and the failure of one will incapacitate the whole system. "You may replenish the supply from your squirt bottle and position the gear,

Getting to the engine requires some effort. Once there the cowling sides open wide (top photo) and the front folds up out of the way (bottom photo).

flaps and trim," an owner told us, "but the flaps and trim will bleed to the trail positions."

All seaplanes leak. It's a fact of life. The hull of the Lake is broken into compartments with drains at the bottom of each—accessible when the airplane is on land. To purge the bilge water when on the water, there is an electric pump located near the step. So long as the airplane is sitting level, owners tell us that it will get rid of most of the water in about five minutes.

The problem comes if the airplane is parked, on its gear, in the water with the tail low, as in the picture at the beginning of this article. The pump will not remove the water in the aft portion of the hull and can lead to an aft CG on takeoff. From owner feedback and a review of accident records, we think this has led to at least one accident. The bilge pump should be run after the airplane is sitting level in the water with the gear up.

A big issue, of course, is corrosion. During the 1960s, the 180-HP Lakes had no zinc chromate treatment and some didn't have alodine. Check for a faint gold tint to the aluminum on the interior structure of any pre-1970s airplane. No tint, no alodine.

The absence of green zinc chromate primer makes the airplane susceptible to corrosion, especially if it flies into saltwater, and a bad case of corrosion can render a Lake worthless. Starting in the 1970s, all Buccaneers were alodined and zinc chromated; starting in 1983, an additional polychromate primer was applied.

Corrosion isn't the only water worry. Lakes take a beating from waves and junk in the water that can lead to dings and dents. Gravel, rocks and sand strip paint and gouge the hull. Watch for it. Also check for internal damage at bulkhead station 97, a stress point for the hull. It was beefed up beginning with 1982 models.

There have been a few complaints about the turbo 270 model. Oil dripping from the crankcase breather tube makes a mess of the tail.

A search of Service Difficulty Reports going back a decade did not yield a lot of them. About a third involved cracks in structural components; there was no distinguishable pattern among the remainder.

Owners were unanimous in telling us that having a prepurchase examination done by a shop that knows the ins and outs of Lakes is essential. One owner passed along his experience of taking his prospective purchase to a shop that had little Lake experience and that gave him a thumbs up on the airplane. He said that he bought the airplane for $80,000 and then spent $200,000 getting all of the undetected problems fixed.

MODS, OWNER GROUP

Bruce Rivard's Lake Aircraft is praised for good service and accessibility. The Lake Amphibian Flyers Club (www.amphibianflyers.com) in Boca Raton, Florida, with about 450 members all over the country and a Canadian affiliate, has a newsletter and holds an annual "Lakeathon" fly-in that was recommended by several owners. The organization's Marc Rodstein came highly regarded as a good source of guidance. He can give you a list of experienced Lake CFIs as well as shops for mods, repairs and inspections. Contact him through the Lake Amphibian Flyers Club.

The website contains an impressive amount of technical data on the Lake, as well as providing a list of recommended shops that know Lakes and their systems. The club can also provide names of instructors qualified to give Lake checkouts.

Popular mods are wing fillets or "batwings" to smooth airflow into the pusher prop and improve low-speed performance. Vortex generators also make for better slow-speed handling. There's a "hydro-booster" kit to fit strakes on the hull to stiffen it and allow for easier water liftoffs. A cargo door is a boon for getting into the back seats and the cargo area. Adding hatch holders is a good idea and turning the sponsons into auxiliary tanks is another option.

OWNER FEEDBACK

I owned a Lake Buccaneer for about six years, and now a Renegade 250 for the last three years. I have had more fun in these airplanes than anything

I've flown in 50 years of military, business and personal flying.

Obviously, they're not great airplanes if you're in a hurry. The Buc is good for about 105 knots and the 250 will do 120 knots on a good day. But we've flown the airplane on multiple trips from North Carolina to Maine, northern Labrador, various destinations in Canada and several trips to Alaska. Low and slow has advantages.

The Renegade is considerably easier to fly, especially on the water, mainly due to an 18-inch longer waterline and a slightly different hull shape. It's also roomier inside and carries quite a bit more gas for longer range—88 gallons—including fuel in the sponsons, wing and main tank. I'd figure 13.5 GPH rich of peak, but this can be brought down to 10 or 10.5 GPH lean of peak at a cost of less than 10 knots. So if you want to visit Lake Faraway and have enough fuel to get back, it can usually be done.

Wing tank fuel transfer is automatic by gravity, so the only fuel management needed is to pump from the sponsons to the main tank when using sponson fuel. The airplane carries 74 gallons without the sponsons, though, which is plenty for most flights. Some Bucs have added wing tanks, for extra range.

Reliability is great, but only if you maintain it proactively, but that can be said for many aircraft. There are several shops around the country that specialize in Lakes and I think it's important to at least do the annual inspection with one of them. There are too many things that a shop new to the type would be likely to overlook. Amphibians Plus in Bartow, Florida (863-534-8025, www.amphibiansplus.com) is in my experience a premier shop and its customer service is superb.

The Lake Amphibian Club (www.lakeamphibclub.com) and associated forum are very active and informative. If there's a question about performance, maintenance, parts or most anything else, someone's got an answer. The website is open to anyone, but you need to join the club to have access to the forum.

Comparing the Renegade to the Buc, you'll find the Renegade is noticeably heavier on the controls, more stable on the water, somewhat faster and handles much better at gross weight. It's been said that the Buc is a sports car and the Renegade is a station wagon.

Coming off the step near the end of the landing run provides an addicting satisfaction.

Any pilot new to the type should absolutely get a checkout from an experienced Lake instructor. Simply having a seaplane rating or experience in a conventional floatplane is not sufficient qualification, in my view. It's not that the plane is difficult to fly (it's not), but it is quite different and there are a number of characteristics to be aware of.

For example, if on takeoff the pilot decides to abort shortly before liftoff and chops the power, he is likely to find himself 10 feet off the water at a very slow speed. Then, adding power just assures a nose-first re-entry and a real bad day.

Insurance is expensive, especially for a low-time pilot. Annuals are expensive too, due to the extra items to inspect and keep in shape.

As a side note, one of the most respected and knowledgeable Lake instructors, Paul Furnee, recently passed away. Paul had over 14,000 hours in Lakes and much of it was in the right seat offering his knowledge to those smart enough to listen. He was chief engineer and test pilot at the factory as the Renegade was being developed and was an amazing fount of knowledge.

Frank Bell
via email

I love your magazine and wanted to offer my experience with my 1984 Lake Amphibian EP Turbo. Some claim the EP moniker was for "extra performance" but it really means extended prop. In these later versions of the 200-series Lake the prop was extended six inches aft, which I'm told reduced the cabin noise as well as allowed for a full cowling around the engine.

I cut my aviation teeth in 152s and 172s and then got my instrument ticket in an Arrow, but I was always fascinated by the Lake. When it came to purchasing my second aircraft I ended up with a Mooney, flew it for 800 hours, but continued to dream of a Lake. I ended up selling the Mooney and while I thought I would never own another airplane, Jim Campbell from the Lake Connection contacted me with information about N87RK.

Although I had a float rating already with a measly 25 hours, I only logged one hour in Lakes from 10 years ago. Most of my pilot friends thought I had lost my mind, saying you just can't dock those things, that I'll spend a fortune on fixing it and that the hydraulic systems are a beast.

Despite all of this friendly advice, I realized my dream and bought N87RK. I will sum it up by saying that while my Mooney was a fun plane to fly, the Lake is designed to be a plane to have fun in.

I use my Lake for a mix of business and pleasure. My home base is KWVL (Waterville, Maine) and I fly to remote clinics for the VA (KRLG) and to the home office in Bedford, Massachusetts, when needed. I also fly to local airports for pilot outreach as part of being an AME.

My wife and I have a small place on Moosehead Lake (near Greenville, Maine) and I am planning to start flying there as well. The Lake flies every bit as well as my Mooney did, except it's 40 knots slower. She is great in IFR and mixes in well both at controlled airports in Boston and remote lakes up north.

I have put just under 140 hours on it since last year. I completed six hours of dual instruction and was able to get a land-only policy from the insurance company (Falcon) and then spent another 19 hours with my Lake instructor going through the official Lake training course. I also spent

The Aviation Consumer

LAKE AMPHIB

(continued from page 31)

15 hours of flying with Professional Instrument Courses doing an IFR refresher in the plane.

Dual instruction from a qualified Lake instructor is a must. There are some quirks. The engine mounted way up top makes the nose respond the opposite of what one would think during power changes.

A thorough prebuy evaluation is also a must, especially if you are looking at a bird that has been in saltwater. I was fortunate to have found a plane that had not only not seen saltwater but also had been cared for. During my first year I had an oil leak between the prop and the crankcase and a hydraulic failure that necessitated putting in a newly fabricated hydraulic accumulator, rebuilding the hydraulic pump and removing and cleaning the hydraulic reservoir. I also had a hydraulic leak at the nosegear and a bent butterfly valve in the turbo.

My annual inspection was $1500 this first year but I had quite a bit of things to do as some of the previous annuals had been suboptimal. I spent another $3000 in parts, but this will likely be a one-time expense.

The avionics in most Lakes are a mixed bag. You can find some that are original with little to no upgrades and others that are all glass. When I bought mine it was a decent IFR panel with steam gauges and a Brittain autopilot. I removed most of the stuff and put in a two-screen Aspen, GNS430W, Lynx ADS-B, Electroair electronic ignition, plus vortex generators.

Insurance was $3500 for the first year, but came down to $2500 when I hit the 100-hour mark. Recurrent training with a Lake instructor is required yearly. There is no open pilot clause on the insurance so everyone must be named and qualified.

With the electronic ignition I can routinely fly at about 10 to 11 GPH (down from 13 GPH before the mod) and with the full 54 gallons (40 in the main and 7 in each sponson) flight plan for four hours with a reserve. The sponson tanks are great for tanking fuel in but just remember that you can't land in the water with fuel in them. I flight plan for 105 to 110 knots and this seems to work out well. The turbo its more for getting off a lake when the density altitude is high. Moosehead lake is at around 1100 feet and in the summer the density altitude can approach 3000 feet or so.

My instructor explained to me that a Lake without power flies like a pregnant brick and he's right. If you lose an engine you are landing soon.

Getting on the step on a hot day in a fully loaded Lake can be a chore and the turbo helps, as it does for boosting climb rates and flying higher to take advantage of winds. There is a price to pay since the turbo weighs 28 pounds. Since the wastegate is manual, this 28 pounds gets to ride with you whether you use the turbo or not, plus you can't be ham-handed with the throttle or you'll damage the engine.

The first thing I did when I got the airplane was remove the two rear seats. The 200 series is a great two-seater with some gear and full fuel in the main tank or a four-placer with limited fuel. I think that it would be very difficult to get a 200-series Lake off the water loaded with four people in the heat of a summer day. Pay attention to the weight and balance — loading can bite you in this airplane. When flying alone I always have at least 10 pounds of lead in the nose.

The Lake brought the fun back to flying for me. Where I saw 10 runways in the Mooney, I see 100 in the Lake. The other day my son and I flew to Moosehead, landed on the north side of Kineo, tied up on Pebble Beach, laced up our hiking boots and climbed the Indian Trail. In a few hours we were back in our hangar. That's what Lake ownership is all about.

Ronnie C. Marrache
via email

FEEDBACK WANTED

CESSNA 120/140

It's time for a fresh look at the Cessna 120/140 taildragger market in an upcoming Used Aircraft Guide in *Aviation Consumer*. We want to know what it's like to own these aircraft, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your Cessna to appear in the magazine, send us any photographs (**full-size, high-resolution please**) you'd like to share to the email below. We welcome information on mods, operating expenses or any other comments. Send correspondence by October 1, 2017, to:

Aviation Consumer
Email at:
ConsumerEditor@hotmail.com