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The Aviation Consumer

EDITOR
Larry Anglisano

SENIOR EDITOR
Rick Durden

EDITORIAL DIRECTOR
Timothy Cole

EDITOR AT LARGE
Paul Bertorelli

SUBSCRIPTION DEPARTMENT
P.O. Box 8535
Big Sandy, TX 75755-8535
800-829-9081
www.aviationconsumer.com/cs

FOR CANADA
Subscription Services
Box 7820 STN Main
London, ON 5W1
Canada

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A CRITICAL EYE ON PRODUCT SUPPORT

When evaluating products, we spend a lot of effort wringing out features and functions, but we don't report enough about the manufacturer's support quality that runs in the background. I'm vowing to change that because getting efficient help when something isn't right can be the difference between loving the brand or telling your neighbors not to buy it. So when I had a Bluetooth connection problem with the Garmin inReach Mini portable satcomm communicator that we cover in this issue, I tried out Garmin's telephone support. It's especially relevant to our review because the inReach products are reasonably new to Garmin after acquiring the tech from DeLorme. Growing and supporting the adopted product line can be tricky because the inReach straddles multiple markets. Needing legit help, I put on my consumer hat and dialed up the 800-800-1020 support line.

In our work, we might not get a realistic taste for the product's support because we often coordinate with a company's marcom department, which might try hard to support our time with a product. In Garmin's case, it sets a high standard for how press relations should be handled. Frankly, we're spoiled by its support effort, and Garmin is plenty smart to know that the success of a product relies partly on how well it works with the media. Avidyne and Aspen also get it right, and so do Seattle Avionics and Airtext. But that doesn't exactly represent the service an end user might get when unboxing a problem.

On initial contact with Garmin, listen closely to the menu of phone extensions for an impressive list of products spread out across multiple markets. There's aviation (portable and panel-mounted gear), wearables (activity trackers and sports watches), automotive (dash cams, navigators and motorcycle electronics), marine (depth finders, plotters, autopilots, radar and VHF gear) and outdoor recreation (digital bow sights, dog containment systems, mapping products, handheld navigators and the inReach satcomm). I'm sure I missed some.

When I selected the extension for inReach support, it took nearly an hour to talk with a pleasant Kansas-based service rep, but it was clear she had limited inReach Mini knowledge. I was one of the first users in the field, and support for the Mini is just ramping up, I'm told.

When I dropped a bomb and told her I was running the device with the Garmin Pilot aviation app and not the Earthmate app, she apologetically handed me off to Garmin's aviation support group, since she knew little about the Pilot app. That was fine by me; I've respected the talent of this team, especially on the dealer support level where deep troubleshooting and engineering is required. But when I called later that afternoon, the system said the wait was over one hour to talk to them. The high-quality inReach products deserve better and customers expect it, which is what I told Garmin's Kyle Grabill, the senior director of Garmin's quality and consumer support, who implemented a new support strategy as a result of my experience with the inReach.

"Because the inReach Mini expands customer use in multiple markets, it increases the need for our team to understand the interfaces with aviation and marine products," he said in part. It's clear that the Mini platform will advance and interface more closely with Garmin's panel avionics. This is logical given Garmin's Connext Flight Stream cabin wireless technology, which also connects with Garmin's D2-series pilot watch and VIRB action cams.

But buyers using the Mini for time-critical flying missions won't stand for hour-plus wait times for support and Grabill gets it. While training inReach support staff (based in Oregon, Kansas and Arizona) on the total Mini ecosystem, he's changed the way inReach-specific calls are routed so you get an inReach specialist every time you request one. "Rather than being a call center, we're going back to basics as a product support team," he told me. —*Larry Anglisano*

BUDGET EFIS

I saw your editorial and video coverage on Aspen's new E5 low-cost EFIS. While I was initially excited, I'm struck at how familiar this seems. The new Aspen Evolution E5 is basically Aspen's 1000 "VFR" model with an approved TruTrak autopilot interface and also an updated processor so that it runs faster. It might be cheaper than the old entry-level display (I don't recall the price) but I don't see the VFR model on Aspen's website anymore.

I don't begrudge Aspen trying to make money as they have a good product. However, I would think that if they really want to dominate the market competition, the E5 should start at $4000 and maybe even $3500. This would put it well below a pair of Garmin G5 instruments (attitude and DG) and make it so attractive that they would fly off the shelves. If this is an uncertified product as claimed, I would think these prices are possible since the cost couldn't have been that much to update the hardware.

Karl Vogelheim
via email

We'll break down Aspen's product line. The Evolution 1000 VFR PFD was priced at $4995. On its website, Aspen has a system comparison guide and currently shows four models. The E5 DUAL EFI is $4995 ($5995 with the ACU required for autopilot interface). It differs from the current $6180 Evolution 1000 Pilot model mainly because it has a VDI (vertical deviation indicator) and LDI (lateral deviation indicator) navigation display for flying approaches. The E5 doesn't have onscreen wind direction and speed data, but the Pilot model does. The Evolution 1000 Pro PFD is $10,995 and the Evolution 1000 Pro Plus PFD is $13,995.

It's not entirely correct to say the new E5 is uncertified. It doesn't have a TSO, but instead an AML-STC for installation.

Thank you for diving deep with the EFIS market survey article in the June 2018 *Aviation Consumer*. I can tell by your tone that you think a certified version of Garmin's G3X Touch EFIS suite is inevitable and I don't think Garmin has a choice. I had considered the new TXi display for my 182, but my shop quoted me over $20,000 with the engine display option. I put the brakes on for now because this airplane is a 1978 model and I'm staring down an engine swap. But, if the G3X Touch were priced sub-$10,000 with engine monitoring, I'd jump on it yesterday.

Floyd Webster
via email

FLIGHT DESIGN

I enjoyed the Flight Design CTLSi flight review in the June 2018 issue of *Aviation Consumer*. What you didn't say is whether the company plans to offer more engine choices now that it's back in production. Doesn't a turbocharged version of the stock Rotax engine make sense? Seems that would give the airplane even more climb authority and I suspect there's a buyer demographic that would embrace it. I operate in the Rockies and have held off buying an LSA (to replace my turbocharged Cessna 210) because I've been watching the Rotax 915 engine with interest. Will it be a player in the Flight Design or any other higher-end LSA?

Stan Woodford
via email

Flight Design didn't comment on future engines for the CTLSi, but we don't think more choices are out of the question, especially as it resurrects the C4 project. That's the four-seat model the company was in the process of certifying before the hiatus. We're watching the product line with interest.

DEFENDING THE GAUGES

First off I would like to say I have read, enjoyed and found value in *Aviation Consumer* for years. Keep up the good work. However, I have to take issue with Larry Anglisano's condescending attitude toward pilots and their aircraft who have conventional gauges. In the May 2018 First Word commentary, Mr. Anglisano spoke of the bad old days of analog equipment. That would be the first century of aviation. From the Wright Flyer to the SR71 are bad old days? Going from a distance of 852 total feet to Mach 3+ are the bad old days because they used analog gauges? Mr. Anglisano you are just plain wrong. This was a wonderful time for aviation and included incredible advancements and innovation all with analog gauges.

With respect to the question of whether glass panels are somehow inherently safer than conventional panels, the jury is still out. I'm seeing more reports of pilots with glass panels crashing in easy IFR situations because they were confused by the complexity of the glass panel. I had a frozen pitot tube flying to work in a RV4 homebuilt with conventional gauges. Obviously they were adequate because I'm alive and writing this letter to you.

Rod Dykhouse
vie email

In that commentary, Anglisano was referring more to the old days of certification, where the rigors placed on analog gear cost buyers too much money. Meanwhile vacuum-driven technology remained unreliable compared to digital instruments.

CONTACT US

Editorial Office
860-614-1987 (EDITORIAL ONLY)
Email: consumereditor@hotmail.com

Subscription Department
P.O. Box 8535
Big Sandy, TX 75755-8535
800-829-9081

Online Customer Service:
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Aircraft Tugs: Electric Power Dominates

For overall reliability and cold-weather ops, we recommend a battery-powered electric tug. For gasoline, the PowerTow 40 EZ is a proven design.

by Rick Durden

It may have been that moment—after our feet had shot upward from the icy ramp while we were trying to pull the Cheetah out of the hangar and we lay there, watching the nosewheel roll toward our nether regions—that we came to like aircraft tugs. We think that an easily maneuverable tug that quickly hooks onto an airplane and can move it without strain reduces the risk not only of injury to the pilot but hangar rash to the airplane.

The good news is that there is a wide selection of tugs on the market that will move airplanes that interest us—6000 pounds or less. The bad news is that the size of the selection can make the right choice challenging.

We'll run through what to consider when making a tug purchase and then outline what's on the market. We'll say up front that if you want the highest level of reliability, live where it gets cold in the winter and have electricity in your hangar, spending the extra money for a battery-powered electric tug makes sense. If you don't mind taking care of the routine maintenance requirements of a gasoline engine and aren't too worried about cold-weather starting, the internal combustion tugs are less expensive to buy.

When it comes time to select the right tug for your airplane, we recommend a conversation with the tug manufacturers to discuss your specific needs. Just because an advertisement says a tug will pull a 4000-pound airplane doesn't mean it will do so up a sloping ramp, over a lip or break in pavement or across sliding door tracks.

Dragger's Nose-Dragger NDE-1 electric tug has two drive wheels and differential to make turning easier.

A tug exists to make an aircraft owner's life easier. If the tug won't easily handle your airplane in the conditions peculiar to your hangar environment—including snow and ice—you are not going to be happy and you risk damaging your airplane in a hangar-rash event. Aircraft tugs are very much "you get what you pay for" products.

We've used tugs powered by gasoline engines as well as corded and cordless electric tugs. As battery technology has steadily improved, we've found ourselves leaning toward battery-powered electric tugs for their convenience and a dislike for dealing with long electrical cords. We've also wished for an electric tug when we couldn't start a gasoline tug on a cold day.

If you have electricity in your hangar, leaving most of the battery-powered tugs plugged in to their smart chargers should ensure no shortage of power, even when you want to move the airplane a few hundred yards to the fuel pump.

BATTERY LIFE

We were told a battery for an electric tug (other than the "power drill" tugs) should last for five to seven years although Terry Railing, proprietor of battery-powered tug maker Aero-Tow, told us that he has customers who reported battery life in excess of 11 years.

Not surprisingly, gasoline-powered tug makers are very sensitive to the need for reliability and ease of starting in cold weather and they have worked like mad to ensure cold starts—but they candidly admitted that they can't make them as reliable in the cold as an electric tug.

Most of the tugs we looked at are actually powered tow bars, so they attach to the nose (or tail) wheel. The wheel itself is the pivot point so most tugs have to be lifted or pulled sideways to make a turn—and care needs to be taken to avoid exceeding nosewheel turn limits. If your

Left to right in upper photo: PowerTow's gasoline-powered 40 EZ, Key EZ and electric ThunderVolt tugs. Aero-Tow's Lil Sherman, below, swivels to keep both driving wheels on the ground when maneuvering.

airplane has nosewheel turn limits, disclose them when you speak with the tug manufacturer. Some tugs have optional casters to ease moving the tug when making a turn. Priceless Aviation Products 701 and 701L and Aero-Tow's Lil Sherman have a swivel arrangement so it's not necessary to lift or slide the tug to turn.

Some tugs lift the nosewheel off of the ground so is not necessary to pull or tilt the tug to make a turn. Those tugs can allow an exceptionally tight turning circle but can potentially side-load the nosegear if mishandled.

Most tug manufacturers will sell you tire chains for winter operation. They sound like a good idea; however, if your hangar floor is relatively smooth concrete, tire chains can turn your tug into a pig on ice—not to mention tearing up the pavement. We lean toward the inexpensive method of handling ice recommended to us by Aero-Tow's Terry Railing: Keep a bag of kitty litter in the hangar and sprinkle it on the ice and snow for instant traction.

Despite advertising, there is no such thing as a "universal" tug. Some come close, but still need adjustments to brackets or bars to fit particular airplanes and some will not work on airplanes with nosewheel pants or on tailwheel airplanes. We repeat our recommendation: Talk to the manufacturer before ordering.

Finally, we were advised by some of the manufacturers that the prices quoted to us will probably ratchet upward significantly if the proposed tariff on steel takes effect.

AERO-TOW

Some years ago Wisconsin-based Aero-Tow (www.aero-tow.com) switched over to purely battery-powered tugs. Owner Terry Railing told us that, because of reliability in operation, sales took off, especially in Alaska and to women. Aero-Tow offers two models that fall into our classification as suitable for under-6000-pound airplanes, the E200 and Lil Sherman. The tugs are described on the website; however, the suggested aircraft weights for each and the prices are not shown. That's because Railing wants to speak with the potential buyer to find out what type of airplane is involved as well as the environment in which the tug will be operating.

Railing also has a policy of selling each tug fully equipped—no options—because his experience has been that dissatisfied customers are the ones who didn't buy enough tug. Each tug comes with the fork assembly and adapter appropriate to the airplane, a battery, charger, electronic speed control and lights.

Because of Railing's experience with customers who had trouble assembling tugs, assembly of the E200 and Lil Sherman involves just installing one bolt. Each tug is built for the customer's airplane. However, should the customer get a different airplane or sell the tug, a call to the factory is all it takes to purchase the correct components for the new airplane—or find out that the tug will work as is.

All Aero-Tow tugs have two driving wheels with a 24-volt electric motor that uses two 12-volt sealed batteries.

The $1500 model E200 (all prices for Aero-Tow were given to us as "ballpark" numbers) weighs 135 pounds, can be configured to tow just about any general aviation airplane—nosewheel or tailwheel—and puts out about one HP. The company describes its capabilities as "equal to the power of one person, struggling, to move the aircraft."

The $3000 Lil Sherman puts out about three HP and has adapters that allow it to tow most general aviation airplanes up to 6000 pounds. It is described as allowing one person to easily move a single or twin. To maximize traction, its frame swivels to keep both driving wheels on the ground during turns.

POWERTOW

In the aircraft tug business for 40 years, with some 30,000 tugs in the field, Northwest Manufacturing (www.powertow.com) seems to be expanding its product line on a regular basis. Long known for its Briggs & Stratton piston-powered tugs capable of burning avgas or mogas, the company has aggressively moved into the electric tug world. As sales manager Gilbert May put it when we spoke with him, "It's the wave of the future. The electric motor puts out more torque, there are fewer parts to break and it's quiet so you can hear when someone yells that you're about to hit a wingtip." Nevertheless, May said that the company wasn't

The Airtug NFE-4 electric tug was designed for Cirrus aircraft.

convinced that it should put an electric tug on the market until it did some testing during an Idaho winter that included keeping the battery in a freezer all night and then subjecting the electric tug to a series of load tests on a bitterly cold morning.

All of the PowerTow tugs have a single driving wheel and will attach to almost any nosewheel aircraft and to Scott tailwheels. With adapters they will work with some other tailwheels; check with the factory. The tug is well balanced and, once disconnected from the airplane, can be rolled with one hand.

The user can affect the tire traction by pushing down on the handle of the tug. We used a PowerTow 40 EZ for eight years to move a Cessna T210 (the tug had been in use for several years before we were involved with it). We noted that the tire tread finally wore down enough that it would slip on a smooth concrete hangar floor; otherwise it worked well to move the airplane on a sloping ramp and in snow and ice. Options available include tire chains and headlights.

Long the most popular of the PowerTow line, the $1899 model 40 EZ puts out 6.75 HP and is advertised as suitable for singles and light twins up to 6000 pounds "depending on conditions."

At $2199, the Key EZ is the 40 EZ with options made standard as well as a key start, 12-volt battery and charger.

With an 8.75-HP engine, the $2799 model 65 EZ is designed to move airplanes up to 7000 pounds. It has a larger frame and longer arms than its smaller siblings and casters to ease movement are standard. In speaking with PowerTow's Gilbert May, he pointed out that he recommends the 65 EZ for light twins with longer noses, such as the Aerostar, because the smaller tugs, with shorter arms, require the user to stoop under the aircraft nose. He said the 65 EZ gets rid of that problem, letting the user stand upright where he or she can more clearly see the wingtips and tail—plus the extra power helps on sloping and contaminated ramps.

The ThunderVolt is PowerTow's first electric tug in its single-wheel line. For $2399, it includes a 12-volt DC motor, battery and battery charger/minder. As with the 40 EZ and Key EZ, it is advertised for airplanes up to 6000 pounds.

PowerTow's website indicates that a ThunderVolt was hooked up to an 8000-pound load and tested on a 10-degree F day. Pushing, it generated 500 pounds of wheel force and 350 pounds when pulling. They were unable to stall the motor; the tire would start to slide first.

DRAGGER

The Dragger (www.dragger.com) series of electric and gasoline tugs are for lighter aircraft on relatively flat ramps and hangars with minimal lips or door tracks. All have two drive wheels and are designed either for nosewheel or tailwheel airplanes—one size does not fit all.

The Nose-Dragger Dragger tugs have a distinct method of attaching to the aircraft—avoiding metal-to-metal contact. The tug is snugged up against the front of the nosewheel and then, by leaning over and moving a lever, a roller is snapped into place against the rear of the nose tire. This effectively cradles the nose tire, although it is not lifted off of the ground. The system accommodates wheel pants so long as there is at least a three-inch clearance from the ground.

If there is a hangar doorsill, lip or tracks, the website calls for you to measure its height. If it is one quarter of an inch or less, Dragger will sell you ramps to deal with the lip. If it is higher than that, the prospective buyer is instructed to call the company.

The $1595 Nose-Dragger Dragger NDG gasoline tug is advertised for aircraft up to 5000 pounds.

The 24-volt electric Nose-Dragger version, model NDE-1, is priced at $2195 and also advertised for aircraft up to 5000 pounds. It includes the battery and smart charger. We like that it has a twist-grip throttle and that its two driving wheels have a differential, making turning easier.

The Tail-Dragger Dragger tugs also have two driving wheels; however, they attach to the airplane by clamping onto the tailwheel and lifting it off of the ground. The operator moves the tug into position parallel to the airplane and adjacent to the port side of the tailwheel. The tug is then collapsed by retracting the caster on the back and then is slid sideways across the ground until the tailwheel is cradled by the midsection of the tug. The aft end of the tug is raised by lifting the handles. The caster extends and locks into position and the tailwheel is supported by the tug. We were impressed by the system.

The company still notes that hangar door sills can be a problem although our review of videos on the company's website caused us to believe that the door sill issue is less of

SELECT TUGS FOR AIRCRAFT UNDER 6000 POUNDS COMPARED

COMPANY, MODEL AND POWER	AIRCRAFT WEIGHT	PRICE	COMMENTS
AERO-TOW E200 (ELECTRIC) AERO-TOW LIL SHERMAN (ELECTRIC)	NOT SPECIFIED UNDER 6000 POUNDS	$1500 $3000	"Equal to the power of one person, struggling, to move an aircraft." Swivel frame keeps both driving wheels on the ground.
POWERTOW 40 EZ (GASOLINE) POWERTOW KEY EZ (GASOLINE) POWERTOW 65 EZ (GASOLINE) POWERTOW THUNDERVOLT (ELECTRIC)	UNDER 6000 POUNDS UNDER 6000 POUNDS UNDER 7000 POUNDS UNDER 6000 POUNDS	$1899 $2199 $2799 $2399	Single wheel, attaches to almost all nosewheel airplanes. Key start version of the 40 EZ. Higher power, larger frame, better for long-nose twins. Electric version of the 40 EZ.
DRAGGER NDG (GASOLINE) DRAGGER NDE-1 (ELECTRIC) DRAGGER TDG-6 (GASOLINE) DRAGGER TDE-1 (ELECTRIC)	UNDER 5000 POUNDS UNDER 5000 POUNDS UNDER 5000 POUNDS UNDER 5000 POUNDS	$1595 $2195 $1595 $2195	Nosewheel airplanes only, hangar doorsills may be a problem. Electric version of the NDG, but with differential for the drive wheels. Tailwheel airplanes only; the tug lifts the tailwheel off of the ground. Electric version of TDG-6, but with differential for the drive wheels.
AIRTUG NFE-4 (ELECTRIC) AIRTUG NFE-6 (ELECTRIC)	UNDER 4000 POUNDS UNDER 6000 POUNDS	$3195 $3795	Designed for Cirrus models; tug lifts nosewheel off the ground. More powerful version of the NFE-4.
PRICELESS 701E (ELECTRIC) PRICELESS 701EL (ELECTRIC)	UNDER 4500 POUNDS UNDER 4500 POUNDS	$2595 $3245	One hour battery life, two-wheel drive, collapses for storage. Longer battery life (90 minutes) version of the 701E, not collapsible.
MINIMAX ELECTRIC DRILL LINE	UNDER 4000 POUNDS	$1400- $1700	Suitable for level surfaces; may have trouble with hangar door lips.
ROBOTOW 28VL (ELECTRIC) ROBOTOW 24SL (ELECTRIC) ROBOTOW MOONEY 28VL (ELECTRIC) ROBOTOW MILLENIUM (ELECTRIC) ROBOTWO LANCAIR 28VL (ELECTRIC)	UNDER 4000 POUNDS UNDER 4000 POUNDS UNDER 4000 POUNDS UNDER 4000 POUNDS UNDER 4000 POUNDS	$1445 $1476 $1492 $1255 $1492	Can move a Cessna 182 about 1000 feet on a charge. Can move a Beech Baron about 600 feet on a charge. Works only on Mooney aircraft. Not a battery unit, comes with 100 feet of electrical cord. Works only on Lancair aircraft.

a problem for the Tail-Dragger tugs.

The gasoline Tail-Dragger Dragger, model TDG-6, is priced at $1595.

The electric Tail-Dragger Dragger, model TDE-1, has the same differential for its two-wheel drive system as the electric Nose-Dragger Dragger. It is priced at $2195. Both versions are rated for airplanes up to 5000 pounds "on a flat surface or a rain grade surface with a grade of no more than 1 to 2 percent."

AIRTUG

Airtug (www.airtug.com) is a sister company to Dragger and offers a line of more powerful tugs capable of moving larger airplanes in more demanding environments.

Naturally, after asserting that the tugs are capable of moving heavier airplanes than the Draggers, we note the exception: The $3195 model NFE-4 is an electric tug specifically designed for Cirrus aircraft and advertised for airplanes of under 4000 pounds.

The tug lifts the nosewheel off of the ground via a clever system in which a U-shaped tow bar is attached to the nosewheel (with or without wheel fairing). A strap is attached to the tow bar and a winch on the handle of the tug is cranked to pull the nosewheel onto a platform on the front of the tug. Another crank raises the platform above the ground.

The 24-volt system moves the airplane via an electric transaxle with differential driving two wheels. Speed is controlled using a thumb throttle. A rear caster balances the unit, so there is no lifting or sliding it sideways when maneuvering an airplane. The system includes two batteries and an onboard smart charger.

At $3795 the NFE-6 is an electric tug rated for airplanes up to 6000 pounds, particularly light twins. It is an electric tug with the same features as the NFE-4 but more power.

PRICELESS AVIATION

Making electric tugs rated for moving airplanes weighing up to 4500 pounds on a flat surface, Priceless Aviation (www.pricelessaviation.com) offers two models that are advertised as optimized for moving aircraft safely in tight areas. Both are 24-volt units and have motors developing 400 watts. Each has a swivel connection between the two-wheel drive unit and tow bar so that the tug does not have to be lifted or tilted to make a turn.

The tow bar has what the company refers to as a universal adapter so that it can attach to any nosewheel airplane without the need of tools, although a buyer does have to identify the type of aircraft to be used—and whether it has wheel pants—when ordering a tug. We spoke with Scott Ake at Priceless and learned that they get calls from aircraft owners who are considering purchasing a used tug and want to know what is involved in setting it up for use on their airplane. Ake told us that it's simply a matter of making sure the new tug owner has the right adapter for the airplane. If a different adapter is required, the price is $125.

The $2595 model 701E uses two 12-volt sealed lead acid batteries with a battery life of approximately one hour. It is collapsible for compact storage.

The model 701EL sells for $3245 and uses two 12-volt sealed dry-cell batteries with an estimated life of 90 minutes when fully charged. It is not collapsible.

Minimax power drill tug on a Cessna 182, above. The Robotow 24SL, below.

Both tugs are capable of handling tailwheel airplanes, although a longer clamp arrangement may be needed. In use, directional control is via a rocker switch and the throttle is lever-operated. Options include chains and ball hitch attachment for moving campers, boats and trailers.

MINIMAX

One of two manufacturers making use of what is effectively an electric drill to power a tow-bar tug, Minimax Aircraft Tug (www.minimax-tugs.com) offers a seemingly endless line of units. Using a 28-volt lithium-ion power system, the tugs are advertised for moving airplanes weighing under 4000 pounds on level surfaces. We note that when moving an airplane with a power-drill tug the aircraft tires must be properly inflated or rolling friction can overpower the tug.

Each tug consists of a power drill at the operator's end, a handle, drive shaft, transmission and attachment to the airplane. The transmission either turns two small "tractor tires" along the ground or a wheel that presses against and turns the nosewheel tire.

On a dry, level surface the nosewheel drive works a little better because of mechanical advantage. If the ramp is contaminated by rain, snow or ice, performance drops off significantly. Both drive systems have some difficulty with sloping ramps and hangar door lips. We saw prices ranging from $1400 to $1700. There are a number of options including spare batteries and traction tape for smooth hangar floors.

ROBOTOW

In business for over 50 years and currently offering battery-powered and corded electric towbars, Robotow (www.robotow.com) units are designed for nosewheel airplanes without wheel pants. All models use a knurled wheel that presses against and drives the nosewheel—it is advertised as non-slip, something important when the tire is wet.

The battery models vary in battery chemistry, size of the battery pack and the operating voltage.

The $1445 28VL uses a 28-volt lithium-ion battery. Robotow says it will move a Cessna 182 1000 feet on a flat ramp on a single charge.

At $1476, the more powerful 24SL has a detachable 24-volt lead acid battery and is advertised as able to move a Beech Baron 600 feet on a flat ramp on one charge.

The Mooney-specific 28VL is priced at $1492 and is the only Robotow model advertised as working on Mooney aircraft.

The fourth model is the $1255 Millennium, a 120-volt corded unit that comes with 100 feet of cord—more than adequate in our experience.

There is also a Lancair-specific 28VL available for $1492.

Each model requires an adapter for the type of airplane to be used—it is included in the price.

CONCLUSION

For flat ramps, no hangar lips and short distances, we think a power drill tug may be satisfactory—although the price may tempt buyers who need more tug to buy one and be dissatisfied.

For owners with electricity in their hangars, other than flat surfaces to navigate and who need cold-weather reliability, we think battery-powered electric is the way to go.

The price of admission for a robust tug, muscular enough to handle a big single or light twin, looks to us to be about $3000.

Where cold starts aren't much of a problem or there's no electricity in the hangar, we think the old standby PowerTow 40 EZ gasoline tug is a reasonably priced workhorse.

AC AIR'S REMOTE-CONTROL TUGS

Chino, California-based AC Air Technology attracted attention at Sun 'n Fun this past spring with its TrackTech remote-control tugs. We took a good look at several models and are impressed with build quality and materials. No, these tugs aren't inexpensive.

First, the tech. AC Air's tugs work with a transmitter/control box (shown in the inset to the right) on the 2.4 GHz radio spectrum. Naturally, there's a concern of interference—and uncommanded control inputs to the tug—but AC Air says its FHSS, for frequency hopping spread spectrum, operates 100 percent interference free. With over 800 tugs in the field, the company says there has never been a signal intercepted or a runaway tug. If the tug loses the signal from the remote, it shuts down.

Choosing the right TrackTech model depends partly on the weight of the airplane. Its lower-end model can tow up to 2500 pounds, while the flagship model can tow 20,000-pound aircraft. AC Air owns a patent on the rubber track technology built into the tug, making it perhaps the only production tug you'll see on tracks. Pricing ranges from $2750 to $10,000.

The general idea of driving a tug remotely is to have the freedom to walk around the aircraft while inching it in to tight spaces without needing a wing walker. Ever have the sickening feeling that follows a hangar crunch? We have, and this technology reduces the risk, but only if you drive it properly. To do that, the remote control needs to be intuitive and simple and based on our use, it is. The lanyard-equipped remote has what's called a Hall effect joystick, which is controlled via sensors rather than with potentiometers. That means longer life and precise control input.

The joystick has forward, back, right and left positions, which move the tug in any of those directions. There's an on/off switch, plus a three-position speed switch for slow, medium and fast. There's also a release button, for releasing the airplane out of the cradle. There's no bending down to strap/unstrap the nosewheel (or tailwheel) from the cradle. It auto-loads and auto-releases. If the tug has optional LED lighting, there's a switch for turning them on or off. The lights (there are two of them mounted to the front of the tug) aren't so much for use as headlights, but instead as a way to spot the tug in the dark. Like the rest of the tug, the lighting is high quality. This factory-installed option is $250.

The second-generation TrackTech T1X2 for non-wheel fairing and fairing-equipped airplanes with a max gross weight of 8000 pounds has a 24-volt rechargeable LiFe P04 lithium-ion battery. Charge time is two hours for continuous 30-minute usage. That's a long time to be moving an airplane—plenty of endurance. It's a strong battery, powering the tug's dual high-torque motors. The battery should last from five to seven years. The electronics, batteries and motors on the TrackTech tugs are easy to get to, housed underneath a hood on the front of the tug.

Weighing 77 pounds, the T1X2 tug has a maximum speed of 160 feet per minute, or roughly 2 MPH. AC Air suggests the T1X2 for towing up steep inclines and challenging hangar door tracks. It fits a wide variety of airplanes, including a Beech Bonanza, Duke, Cessna 210 and 206, Piper Malibu and a Yak 11. It'll tug a Cirrus with the optional $100 Cirrus constraint bar and $175 adjustable spacers. The price: $4950, not including the bar, spacers and freight. There's an option for studded tracks for use in ice and snow. It's an extra $420. AC Air says the standard tracks should last roughly two years with typical use.

The $6750 TrackTech T1.5 can tug airplanes up to 10,000 pounds and with a tire diameter up to 21 inches. Example applications include the Cessna Mustang light jet, Cessna Caravan turboprop single and Socata TBM series. The T1.5 has a Lazy Susan platform. This enables you to rotate the tug underneath of the tire—a safeguard against exceeding the steering limits of the nosewheel. The tire rolls up onto the platform and the weight locks it in place. It won't move until you press the release button on the controller, enabling the platform to rotate 360 degrees underneath the wheel.

AC Air says that much of the typical maintenance (not much more than battery changes, really) can be performed right on site. Other repairs require crating and shipping the tug to AC Air's facilities in California.

The company's website (www.acairtechnology.com) has a good utility for matching the airplane to the correct tug. The tugs work with a wide variety of models. For example, clicking the Mooney M20 tab suggests the $4950 T1X2 model. For a Cessna 172, the $3595 T1V2 will do. If you have wheel pants, you'll need the $65 tire height spacer, which raises the tire up in the cradle.

The tugs have a one-year parts and labor warranty. Contact AC Air Technology at 855-884-7222 .

—Larry Anglisano

PMA450B Audio Panel: Impressive Feature Set

PS Engineering's latest audio control system has a long list of clever, customizable functions. A shallow menu and a function display keep the operation intuitive.

by Larry Anglisano

PS Engineering says the features and functions in its latest PMA450B flagship audio panel are the result of its 33 years concentrating on nothing else but designing aircraft audio controllers. Plus, it listened to what pilots (and installers) want in a modern system and put it all together to not necessarily create a revolutionary panel, but an evolutionary one.

As we've said in previous reviews, Tennessee-based PS Engineering is not one to let its products go stale. This philosophy comes across loud and clear in the PMA450B, an advanced version of its original PMA450. We put the system on our evaluation bench, cranked up the headsets and put it through the paces.

HIGHLY CONFIGURABLE

The PMA450B's OLED (organic light emitting diode) graphics display is integral to operating nearly all of the panel's higher-level functions, including its configurations. With so many advanced functions and customizable settings, we think incorporating a display in the UI is imperative. PS Engineering did a good job of keeping the menu structure shallow and while some users will need to reference the pilot's guide for setting up advanced functions, basic operation is simple.

The panel will come on with the master avionics power, but the small rotary knob serves double duty as a power control (it's a push-in-and-hold switch to eliminate inadvertent power cycles) and pilot/copilot intercom volume. The larger knob is for passenger volume. Green LED bars to the left of the knobs illuminate when you turn the knobs, showing relative volume. The volume controls are linear throughout the range and there was more than enough gain through our Bose A20 headset.

CHECKLIST

- The PMA450B is the most feature-rich audio panel we've used.
- A highly configurable UI caters to a wide variety of users.
- Old wiring and charging system noise will degrade the flawless audio quality. Don't skimp on the install.

Four bezel buttons control comm radio transmit/receive. The bottom row is for transmitting and the top is for listening. There are also dedicated keys for VHF nav radio audio. That's enough to get you flying, but there's a whole lot more.

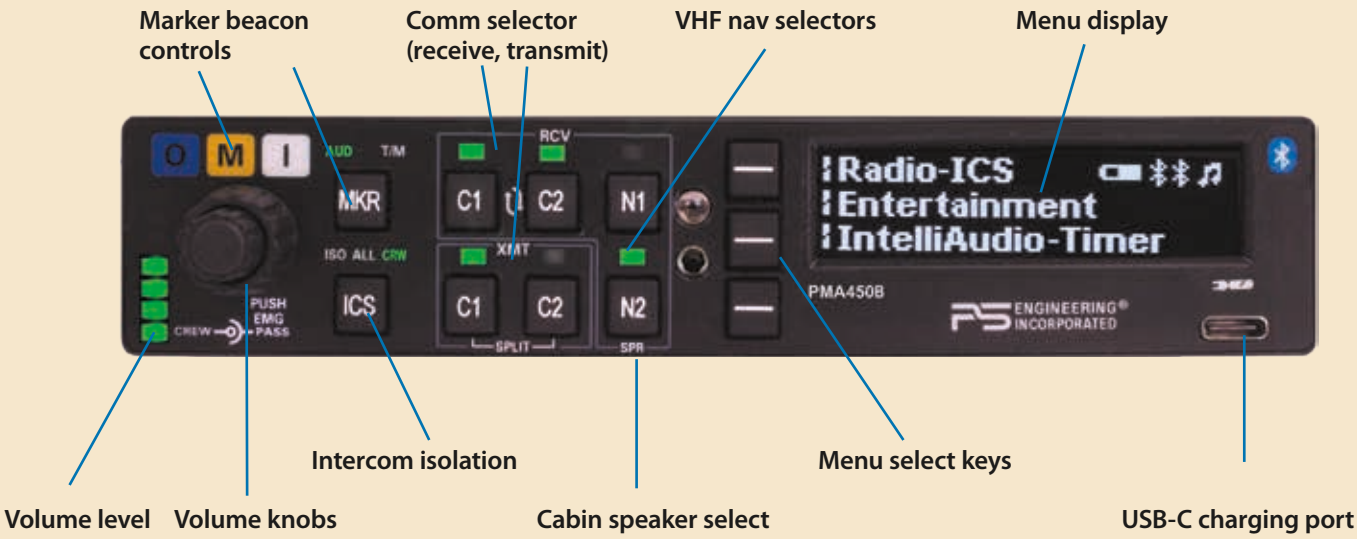
The PMA450B makes it possible for serious amounts of user customization, but before you begin you'll need to understand some basics for working with the PMA450B's menu. In our evaluation we found that the feature set is quite deep and we think some users will be intimidated by it. But understanding some small nuances takes out some of the mystery and finger fumbling.

The OLED display has three line-select buttons to access a variety of functions, including custom configurations. Simply press the line select button to select an item on each menu. When menu hopping, the screen automatically returns to the Home screen after a period of inactivity and the delay time is configurable, from one to 30 seconds. Ten seconds seems to work the best, although you might set the timeout for a longer duration as you learn the system. There's also a display brightness adjustment.

There is an easy clue for recognizing how deep a given menu is. For

The PMA450B eliminates bickering over the selection of inflight music. The panel in the photo is configured so the pilot hears Bluetooth audio source two, the copilot hears a wired music input source and passengers hear Bluetooth source one.

PMA450B BEZEL CONTROLS



example, a small vertical onscreen bar next to a function key (and to the left of the menu item) means that key performs a single function on the menu screen. A split bar indicates that a secondary function is available when you hold the key in for longer than one second. In other words, there are more options hiding in the second level.

The panel has a USB-C charging port on the bezel capable of providing 5 VDC (3 amps of current at 15 watts) to charge smartphones and tablet computers. PS Engineering offers cables to fit a variety of devices.

The six-place intercom in the PMA450B uses PS Engineering's IntelliVox squelch control, which is completely automatic and uses signal processing at each microphone. By sampling voice and ambient noise, the processors open and close the squelch with impressive precision, as long as you keep the microphone against the lips, or close to them.

The intercom has three isolation modes, including all, pilot isolate and crew isolate. But these old-hat functions are what you would expect as standard in any modern audio system.

The panel has many user-adjustable functions in its setup menu. For one, you can rename the switched audio inputs from the default ADF and DME. Since many users don't use this equipment anymore, you can rename/customize the input sources (using up to nine characters) to correspond to audio alerts coming from other equipment, including GPS navigators and traffic alerters, to name a couple.

With a function called Flightmate, the panel has four discrete messages that can be triggered by external systems (engine monitors and landing gear alerts, for example) when they're wired in. On a side note, don't assume your shop will wire these discretes in as standard. It will mean additional effort, but we think it's worth it—especially when the panel is opened and the wiring is accessible. Engine monitors from JP Instruments and Electronics International, to name two, transmit these discrete outputs when wired accordingly.

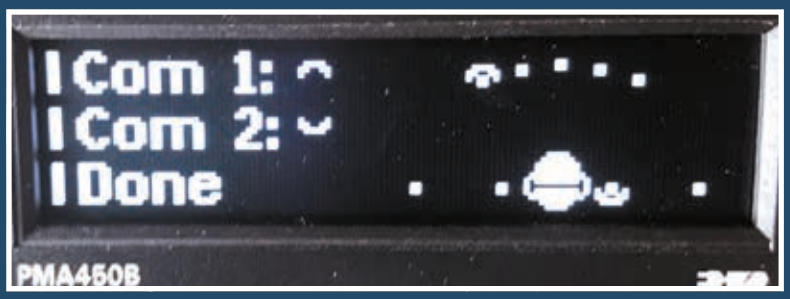
The number one alert is designed for priority and will continue to play until whatever is triggering the condition clears. Alerts two, three and four can be stifled by pressing the Acknowledge soft key. You can record custom alerts in your own voice by speaking them into the microphone. Some examples include "check oil pressure" and "check fuel."

There are other prompts in the upper right portion of the screen that show the status of Bluetooth connection, the connected device's battery status and whether or not a music source is active.

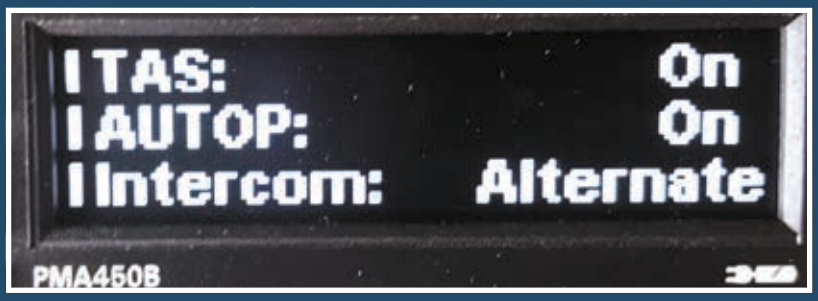
DIMENSIONAL AUDIO

Just like early versions of the PMA450, the current one has PS Engineering's IntelliAudio. The tech is licensed from the U.S. Air Force, which developed the function as an intuitive way to process headphone audio after recognizing its pilots are inundated with multiple audio signals at once.

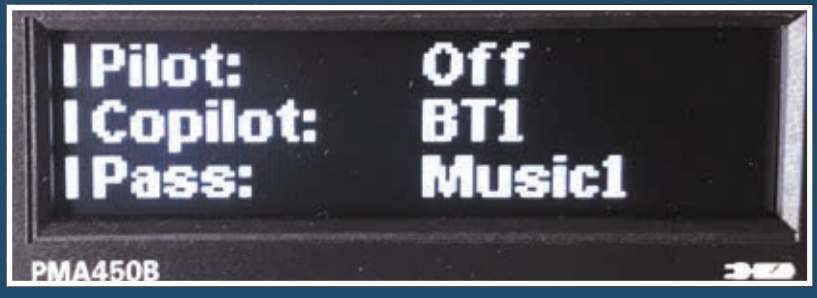
When it's turned on in the PMA450B (accessed from the lowest line select key) comm radio audio signals are digitally processed to appear in different locations in the headset. Maybe you want ATIS or approach control from the second radio positioned at the 3 o'clock position and the primary radio at 9 o'clock. When in Auto mode, IntelliAudio reverts to normal when one of the radios goes quiet, and separation returns when both are active. The HRTF (head related transfer function) allows the user to relocate each comm radio to one of nine defined locations using a simple onscreen graphic that shows where each radio will play. You'll need stereo head-



The screenshot above is one of many spatially processed dimensional sound configurations. Notice that Com 2 is positioned at the 3 o' clock near location, which is directly at the right ear. Com 1 audio is positioned at the 10 o' clock position, above the left ear. These adjustments are made by repeatedly pressing the corresponding Com line keys.



The two switched input sources in the top two line positions were custom edited for TAS traffic and autopilot disconnect. In the Alternate intercom configuration, everyone who is plugged in is active on the intercom, but passengers hear no comm radio chatter. When the comm radio is active, the pilot and copilot won't hear the passengers. Think of this as an automatic Crew mode.



This is the Music Distribution menu, which is set so the pilot hears no music, the copilot is connected with a Bluetooth device (two can connect at once) and the passenger hears audio from a hardwired music source or from a cabin input jack (two can be connected). This isn't just for music. One practical use might be to stream the music from a smartphone and stream audio alerts from an app, via an iPad.

phones for the function to work, and intercom audio cannot be spatially adjusted—a good thing, in our view, for the sake of simplicity. The function can be turned off entirely.

It's important to stress that HRTF doesn't increase the audio volume, but for pilots with hearing impairments, repositioning the audio (there are selectable near and far fields) closer to the ear can help.

While not a function of HRTF, we like the smart comm monitoring mode. This mutes the secondary comm radio audio when the one being used for transmitting has an incoming call. If you're always cranking down the ATIS audio when your primary radio has incoming chatter, this function is for you and us.

BLUETOOTH, RECORDER, TIMERS

The panel has two internal Bluetooth modules (BT1 and BT2) and sizable amounts of smart configuration can be done when connecting. Since the panel can stream data from two independent Bluetooth sources at the same time, one can be used for streaming music and the other can be used for streaming audio out to select action cameras. We'll get to that shortly.

The first thing you'll want to do before setting up your smartphone/tablet and configuring the panel to your liking is unpair all devices to erase them from the panel. The default pass code (PIN) is 0000, but you can change it. Some Bluetooth phones won't pair if a PIN is required, so the panel gives you the option to disable it.

The entertainment input capabilities of the PMA450B are impressive. There are four possible independent music inputs: Bluetooth one, Bluetooth two, music one and music two (these are hardwired inputs either via cabin input jacks or from a remote music source like Garmin's GDL69A SXM receiver). As with other PS Engineering products, these inputs can be configured so the music sources mute with aircraft radio and intercom chatter. This is custom configurable for pilot, copilot and passengers.

The default setting mutes (Mute On) when there's chatter, but you can tell the panel to remember your last preferred mute setting every time you power the system up by turning on the Recall Mute function.

If you fly with non-pilots in the

right seat, PS Engineering takes the interface one step further with the Copilot As Passenger feature. When it's active (it's annunciated as CPX in the upper right corner of the display) and when the Recall ICS function is turned on, the copilot audio station will behave like a passenger seat on the intercom at each power up, unless you turn CPX off. Even the push-to-talk switch is disabled. Think of it as putting the right-seater in a back seat, where some might belong.

The music volume control for crew and passengers is located in the Entertainment menu. While this really isn't difficult to get to, we still wish there was a dedicated volume key on the bezel. When we griped about it, PS Engineering told us there simply wasn't room for another button. We suggest losing the marker beacon select key, or offering a version that doesn't have marker beacons.

The Bluetooth telephone function is hands down the smartest we've seen on any audio panel. Since the panel syncs with the contacts in your phone, when the phone rings an incoming call menu opens that shows who is calling. You answer the call by pressing the line select key on the display and then talk in full duplex.

The PMA450B has an internal audio recorder that stores the last incoming audio from the radio that's selected for transmit. It stores up to eight incoming messages and up to 45 seconds of audio. Only the pilot and copilot hear the playback—passengers don't. Playback is simple: Press and hold the Com receive pushbutton associated with the active transmitter. You can hear all of the stored message or stop it short by holding the Com button for two seconds—handy for verifying assigned headings, frequency changes or for making sure that radio call was for you.

There's also a built-in timer with count down and count up functions, accessed from the bottom line-select key in the main menu. Press the Set button and use the outer rotary knob to select minutes and the inner knob for seconds. The display reverts to normal and as the countdown progresses, the display momentarily shows the remaining time as the interval is divided in half. When there's one minute remaining, the system issues an audible alert of "One Minute," the display counts down the last 10 seconds and a final audible alert says "Time Expired." The count up timer counts to 99 minutes, 99 seconds from the time it's started.

YouTube See a video review of the PMA450B at http://tinyurl.com/j95ht2a

STREAMING TO AN ACTION CAM

PS Streamer is a built-in audio module that streams Bluetooth audio out of the panel. PS Engineering said the interface is compatible with GoPro action cams that have a SENA adapter, plus later-gen Garmin action cameras. To stream Bluetooth from the panel, you configure the second Bluetooth module as an output. Then, set the Bluetooth 2 setting as Streamer and pair it with the camera via the Streamer configuration menu. It takes some button pushes. The Streamer mode is annunciated in the upper right corner of the display using a familiar Bluetooth symbol, but with a flag on it.

Speaking of streaming audio, the PMA450B has a public address mode for talking to passengers over cabin speakers. It's accessed by pressing and holding the N2 (nav) button. This changes the mode from cabin speaker to PA speaker. When the pilot is speaking on the PA, all intercom audio (except for pilot) will be disabled. The pilot hears his PA transmissions in the headset and keys the system with the push-to-talk switch. Through all this, the copilot has full access to the selected comm radios.

If you want to wire in a satellite phone, the PMA450B should be compatible, but you can't answer or hang up the phone through the audio panel. While the panel can accommodate a wired and Bluetooth telephone input, only one can be active at a time. The wired telephone function screen (where you adjust the sidetone and volume) activates when it senses audio from the phone. The menu switches off 25 seconds after the incoming call ends, or when pressing End.

A BIT ABOUT INSTALLATION

Don't underestimate the amount of effort it will take to install the PMA450B, especially when interfacing with engine monitors and other systems. As for audio quality, be prepared to accept that the overall audio quality of any audio system is greatly dependant on many factors—some of which have nothing to do with the avionics system.

If you go into a major installation with charging system-induced and other electrical noise present, don't count on the near-flawless sounding PMA450B to fix it.

In many cases, do count on a call from your installer who wants to do some rewiring. Sometimes a gut job that removes all existing wiring is in order and worth the investment.

TOO MUCH PANEL?

We asked PS Engineering founder Mark Schauer if the features packed into his latest $2595 flagship PMA450B are more than some might want. "Maybe, but that's why we sell the $995 PMA6000B," he chuckled. He's right. PS Engineering covers a wide swath of market with a diverse product line. It's also an OEM, supplying the audio system in the Pilatus PC-12NG turboprop.

As for installation costs, it's not uncommon for many projects to yield sizable invoices, especially when factoring the removal and reinstallation of complex interiors to run new audio jack wiring. A Baron 58 owner reported an installation that topped $7000, while the shop also installed a new GPS navigator and ADS-B transponder.

In our estimation, PS Engineering brand satisfaction is high and its newer panels make for happy passengers. Got an earlier PMA450A? Reader Wally Magathan told us he bought one for his Cirrus to replace the Garmin GMA340 (it's plug-compatible), and the factory recently upgraded the software for free. That added the CPX and the timer functions. "The Copilot As Passenger feature is a welcome refinement because I can I isolate my wife who sits in the right seat so the radio chatter doesn't bother her watching movies on an iPad," he told us.

The PMA450B's nearest competitor is the $2395 Garmin GMA350c, which has Virtual 3-D audio processing, Telligence voice command when it's paired with a GTN750 navigator, plus a feature set that focuses on Bluetooth connectivity, entertainment and audio alerting. We'll see how it compares to the PMA450B in an upcoming review.

Contact www.ps-engineering.com.

Editor's Choice Awards: Cirrus Jet An Easy Win

There's a lot to like about the Cirrus SF50, including its efficiency and easy step-up from an SR22. The uAvionix skyBeacon takes the avionics trophy.

In each July issue of *Aviation Consumer* we pick 12 products, services or companies that were standouts over the editorial year. You know, the best of the best. We don't take our Editor's Choice Gear of the Year awards lightly, but when we handed the keys to Cirrus Jet N52CV back over to Cirrus' Matt Bergwall after flying it halfway across the country (and spending a couple of days on the factory production floor) we knew we had this year's winner.

The Aviation Consumer PRODUCT OF THE YEAR

The SF50 is everything Cirrus said it would be, which is a reasonably easy step-up jet for pilots who have mastered the SR22 piston single. It certainly isn't the fastest or sexiest-looking small jet, but the tradeoff is that buyers get a taste of the jet world at a cost that isn't stupidly expensive. A spacious cabin, well-thought-out Garmin G3000 avionics and pleasant flying characteristics add to the jet's overall appeal.

Typically equipped, a Cirrus Jet will set you back $2.1 million and that isn't chump change, but in our estimation buyers will get one of the best-valued high-end personal aircraft we've flown. Read all about the Cirrus Jet in the October 2017 *Aviation Consumer*.

BEST-DESIGNED ADS-B SYSTEM: UAVIONIX SKYBEACON

At press time, uAvionix says it's on the verge of earning TSO certification for its $1800 skyBeacon ADS-B Out system. The device turned heads last year for its clever wingtip position light design and for a bolt-on installation that can take as little as one hour to install.

The skyBeacon has a built-in mandate-approved WAAS GPS, plus a wireless transmitter for configuration and diagnostics. uAvionix has been selling the skyBeacon for LSA and experimental aircraft and is working on a follow-on product that has a strobe light interface. Visit www.uavionix.com.

BEST PORTABLE TRANSCEIVER: ICOM A25N

The way we see it, everyone should have a portable comm radio in the flight bag for emergency backup. For others, a portable might be the primary radio. The GPS/GLONASS-equipped Icom A25N is the company's latest-gen portable radio that has impressive battery life, a rugged build quality and a solid-performing 6-watt transmitter.

The A25N—which has a VHF navi-

gation receiver—is the first aviation portable with a smartphone app (RS-AERO) interface for building flight plans to export them (via Bluetooth) into the radio for basic navigation. The radio stores plenty of frequencies and has NOAA Weather Radio. The A25N is street-priced around $500. Visit www.icomamerica.com.

BEST NEW ENGINE TECHNOLOGY: ROTAX 915 IS

For pilots who want cutting-edge engine technology, we think the new Rotax 915iS—a derivative of the company's good-performing 914-series engine—qualifies. At 135 HP, the turbocharged Rotax 915iS is the company's most powerful engine that it has certified for production aircraft. With an electronic prop control and automatic leaning, the market for the single-lever 915iS is still somewhat unknown, plus its increased weight over other Rotax offerings could be a challenge for fitting it in some LSAs. Still, we welcome new aircraft engine tech and the Rotax 915iS is the poster child. For more, visit www.rotax.com.

BEST PULSE OXIMETER: MASIMO MIGHTYSAT

When we rounded up pulse oximeters in the September 2017 *Aviation Consumer,* we found that while you don't have to spend big for good quality, the $299 Masimo MightySat provides the most data on a directionally adjustable display, it links to a smartphone running Masimo's Personal Health app and it serves as a useful training tool for athletes. We especially like its pleth variability index, which measures a pilot's hydration status—a concern for cognition. Visit www.masimo.com.

BEST NEW LSA: VASHON RANGER

At $114,500 generously equipped (and $99,500 with a single-screen Dynon display), we wouldn't call the new Vashon Ranger low-priced (mid-priced, perhaps), but with a large, wide cabin, cutting-edge avionics and pleasant flying characteristics, we think the airplane hits a lot of high notes.

Designed by Ken Krueger—the brains behind many Van's RV aircraft designs—the all-metal Ranger is powered by a Continental 0-200D and has a relatively stark interior. Vashon saves money by buying the skins prepainted in white and finishes the airplane with automotive-style vinyl appliques.

When we visited Vashon's Woodinville, Washington, production facility this past spring, we found a level of efficiency that could actually make the LSA profitable without having to jack up the aircraft's price. Imagine that? Visit www.vashonaircraft.com and see its public unveiling at AirVenture Oshkosh this summer.

BEST PORTABLE WX RECEIVER: GARMIN GDL52

We like having options, especially when it comes to weather avoidance. Garmin's GDL52 portable device combines an ADS-B weather and traffic receiver with a SiriusXM satellite weather receiver packaged in one chassis.

Priced at $1199, Garmin's GDL52 is the flagship model in the GDL50 series and has Bluetooth for connecting with Garmin's Pilot tablet app, plus it works with the company's Flight Stream wireless cockpit network. It can also connect with multiple displays with an optional power/data harness, while connecting with two displays over Bluetooth.

If you can live without weather data on the ground (that's where the SiriusXM receiver comes in handy), save the $400 price premium, ditch the monthly SXM subscription fee and go with the ADS-B-only GDL50. Contact www.garmin.com.

BEST PILOT SUNGLASSES LINE: FLYING EYES

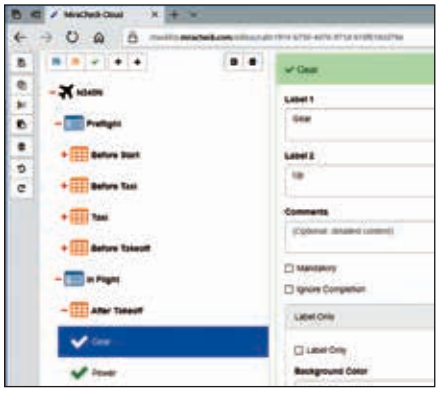
We've been impressed with the quality of Flying Eyes sunglasses ever since the Texas-based company introduced the $169 Hawk convertible model, which has interchangeable temples (including a nylon strap) for a more headset-friendly fit.

Since then, the company has expanded the line with a variety of frame styles that are available with prescription lenses, plus non-prescription bifocals.

In our sunglasses roundup article, we rounded up close to 20 models and the $269 Flying Eyes Kestrel was a favorite among several pilots in our evaluation group because it has classic aviator styling and is available in a 130-mm-wide small frame size for smaller faces.

The Golden Eagle Sport model was also a favorite for durability, comfort and athletic styling. What really sold us on the brand is a generous replacement policy and unmatched support. Check out the line at www.flyingeyesoptics.com.

BEST ELECTRONIC CHECKLIST: MIRACHECK COPILOT



For years our eyes were peeled for the ultimate electronic checklist. While we found some good ones, none of them had the speak/listen capability we hoped for. Finally, we turned up a winner with the MiraCheck. The program runs on iPads and iPhones and there's a somewhat less capable version for Android.

In a nutshell, Mira can read the checklist to you and you can touch the screen to acknowledge. Or, you can configure the app so that she talks and you answer with "Check," or the desired status response.

As in airline flying, we think the challenge/response method of running checklists is the better way and MiraCheck Copilot does it. The Pro version is $49.99 per year, or $129.99 for life. Visit www.miracheck.com.

BEST FLIGHT PLANNING TOOL: ASA CX-3 COMPUTER

If you haven't taken an FAA knowledge exam lately, you might be surprised to learn that tablet computers and smartphones are prohibited items for bringing in to the testing room. FAA Order 8080.6 and AC 60-11 are the guides. But some flight computers including ASA's CX-3 electronic E6-B are fair game.

At $79.95, we think it's worth stashing in any flight bag given the level of flight planning utility it offers. It has a bright display, a night mode and is roughly the size of a large smartphone. ASA did a good job of keeping the rich menu structure shallow and we found it impossible to get lost in any of its menus.

The CX-3 is all about computing complex conversions, and there are 12 categories in all, including speed, distance, duration, temperature, pressure, volume, rate, weight, rate of climb/descent and torque to name a handful. Our favorite tool was the holding pattern utility. That alone could make it worth the investment.

Visit www.asa2fly.com.

BEST DATABASE SOLUTION: BAD ELF WOMBAT

We always thought it would be so much easier to update Jeppesen databases from an iPad or smartphone. Instead, you have to remember to remove the storage card from the avionics (or have a spare card), download the data to your PC or Mac, burn the data to the card and then bring the card or thumb drive back to the airplane. Bad Elf has a solution with the $250 Wombat.

Bad Elf teamed with Jeppesen, which finally launched a mobile version of its JDM utility. With so many of us carrying tablets and smartphones to the cockpit, it only makes sense to be able to download nav data to the device and then use the device to do the upload in the cockpit. That's where the Wombat—a wireless data burner—comes in.

It accepts a variety of storage cards (including the Jeppesen Skybound Reader adapter) and simply talks via Wi-Fi to the tablet or smartphone to transfer the stored Jeppesen nav data onto the inserted card or thumb drive. Sweetening the deal is the built-in battery bank, equipped with USB ports for fast-charging portable devices. Visit www.bad-elf.com.

BEST BALL LOST IN TALL GRASS: BENDIXKING AEROVUE TOUCH

By the time you read this, according to BendixKing's projections it should be close to holding an AML-STC for its AeroVue Touch integrated avionics suite. In our estimation, this product has the makings of a slam-dunk winner. It has a brilliant 10.1-inch color split-screen touch display, synthetic vision, VFR and IFR charts, third-party compatibility, ADS-B interfacing—the list is long. Trouble is, we think it will be a lost ball in the tall grass unless several things happen.

The AeroVue Touch has to be certified on time and it needs the full support of the BendixKing dealer network. Neither will be easy. Plus a huge part of the product's success rides on BendixKing's ability to market it. Remember, the BendixKing brand name took a hit after several seemingly good products were snagged in a lengthy certification process. BendixKing told us it will be different this time.

"BendixKing is benefiting from the FAA's initiative to design aircraft based on performance and safety standards and as a result is currently experiencing a much faster certification process for AeroVue Touch," it said on record. We're watching and ready to report on it. Visit www.bendixking.com.

Antenna Upkeep: Performance, Aesthetics

Swapping old antennas with new ones can add substantial costs to an avionics upgrade, but system performance generally depends on it.

by Larry Anglisano

CHECKLIST

- Replacing old antennas can jumpstart old equipment and improve the plane's appearance.
- There are plenty of OEM replacements that fit the existing mounting holes.
- But don't shortchange the interface. Ask the shop about replacing the signal cable at the same time.

When I worked as avionics tech, it got to the point where I could generally tell how well an aircraft's comm radios work simply by eyeballing the antennas. When an owner complained about VHF nav radio problems, I had visions of a nav antenna coated with corrosion, the result of years collecting water in the vertical tail fairing. When the airplane showed up, my suspicions were usually confirmed.

Truth is, antennas are one of the most neglected accessories on the aircraft. They live hard lives sitting out and flying in all kinds of weather. Plus, belly-mounted antennas collect grease, grime and sustain sizable amounts of heat when in close proximity to exhaust stacks.

Let's take a look at the cost and effort that's required for antenna replacement.

ANTENNAS ARE SYSTEMS

You might not realize it, but antennas are actually major systems that consist of multiple components. Aside from the antenna itself, there's the signal cable, RF connectors on both ends of the cable and in some systems, a coupler or splitter. For this reason, you might get sticker shock when your shop gives you a quote for replacement. Truth is, replacing the antenna might be the easy part of the job, especially if the airframe is opened up for an inspection or for other work.

In many cases, the cabling that attaches the antenna to the radio could be as old as the aircraft and is subject to deterioration and wear from years of vibration, heat and cold. Consider too, that old coaxial cable is likely non-shielded RG58 (or older) and could be the source of interfering noise that's worked its way into your radios and audio system.

That's why many new avionics systems call for low-loss twin-shielded cable. It's worth shotgunning some old cable because newer cabling is fire retardant. The old stuff might not be.

Even though the teardown effort to access the cable (removing the entire interior, including headliner in some cases) can mean days of shop labor, it's a task worth doing. Shortcuts don't count. I've seen shops leave old cabling in place and simply route new cable through the airframe. This can lead to serious troubleshooting tail-chasing as a tech is left scratching his head with one hand and his multimeter in the other wondering why the cable doesn't ring out from one end to the other.

Even if some antennas are in good condition, the shop might have to relocate them so there isn't interference with new systems. The trouble is there is hardly enough room on smaller airframes to accommodate all of the antennas required with new avionics. Let's count them.

Typically there are two comm antennas (one for each radio), one VHF nav antenna that connects to both radios via a splitter, one GPS antenna for each navigator (combined comm/nav/GPS systems like a GNS/GTN or Avidyne IFD navigator still require

The comm antenna on the neglected Mooney in the main image is worn down to the fiberglass. Guess how good its performance will be should that airplane ever fly again.

The V-tail Bonanza in the top photo was upgraded to blade-style navigation antennas to replace the old and draggy so-called flying-V that's on top of the cabin, bottom. These antennas are a set (note the red arrows pointing to each in the top photo). Expect a big invoice for this job—well north of $2000 total. The slight increase in speed may be worth it.

separate comm and nav antennas), transponder antenna, an ADS-B antenna (or two for some systems), marker beacon antenna if still installed, ELT antenna and TAS/TCAS antenna if installed. Got a Stormscope? That requires an antenna, too. While it is possible for two VHF comm radios to share a single antenna through a splitter, this is a rare and expensive interface. If you've lost count, that's a total of 11 antennas all fighting for an interference-free spot on the airframe. It's a wonder some systems even work at all.

Worth noting is that antenna installations on pressurized aircraft could require additional approvals.

TYPICAL REPLACEMENTS

Comm antennas come in different varieties, from an inexpensive metal rod whip design to pricey, high-speed fiberglass models appropriate for turboprops and jets.

A proven and popular design for replacing older Cessna OEM applications is the CI121-series antenna made by veteran antenna manufacturer Comant. This is the fiberglass whip antenna you'll see mounted on top of the fuselage of single-engine Cessna models. Aircraft Spruce lists the CI121 for $188. For the underbelly mount, it's the CI122, sold by Aircraft Spruce for $220. This is a bent-whip antenna with a fiberglass base and metal rod element. Expect a typical invoice of around $1000 for such replacement, including labor.

For replacing original equipment comm antennas on Piper models, antenna maker ITT Corp. offers the DM C70-series antennas. These are staggered on the back of the fuselage and maintain a handsome and stock appearance. The labor costs about the same as the Cessna, but the antennas are nearly twice the price. We saw the common top-mounted DM C70-1/A priced just shy of $400 each. The version that mounts on the bottom of the aircraft (DM C70-4/A) is $450.

Faster aircraft generally require antennas with higher speed ratings. Even when properly installed using doubler plates (this is a stiffener fabricated from sheet metal that attaches between the antenna's base and the surface of the aircraft's skin), an antenna that's not properly rated can come off or worse, damage the skin, requiring a big repair. And as you would expect, antennas with higher speed ratings are more expensive—more than twice the price in some cases.

Navigation antenna replacement won't be cheap, either. Luckily you might only have to replace one. That's because it's common for a single navigational antenna to feed both nav radios in the aircraft through a coaxial splitter. The antenna might be a "whisker"-type dipole antenna or heavy-duty blade set that is a popular replacement for Beech Bonanza models that had the combination comm/

nav antenna housed in the so-called flying-V antenna. It's no surprise that VHF nav antennas live especially tough lives since they're often installed at the top of the vertical tail in a fairing where water collects at the base. Typical failures are the result of excessive corrosion. Once these antennas deteriorate you'll notice decreased nav radio sensitivity and the inability to receive a VOR station from a sizable distance. You might also see scalloping needles on the nav display. This antenna (like all the others) should be inspected during each annual inspection because corrosion might be spotted before it's too late. Basic preventive maintenance will be cheaper than replacement.

Nav dipoles are available in fiberglass and metal, but not all of the mounts are the same so your shop will have to pull the old one off to get the correct replacement. For example, the Comant CI157P dipole antenna that fits a variety of Piper models sells for just under $400. It works for VOR/LOC and glideslope signals.

ADS-B, TRANSPONDER

Complying with the FAA's ADS-B mandate shouldn't require specialty antennas because ADS-B systems use typical L-band transponder antennas. For ADS-B Out via a 1090ES extended squitter transponder, a common blade-style antenna will work just fine. But systems with diversity (which helps eliminate shadowing) require a top and bottom L-Band antenna. UAT systems (which operate on 978 MHz) also use a typical L-Band antenna.

But don't be surprised if the shop wants to replace the existing transponder antenna. Since the antenna lives on the belly, it might be contaminated with oil and grease. I've seen some fiberglass blades melt because they were installed too close to the exhaust flow.

L-Band antennas also come in a rod/ball design, which is just that—a metal rod with a ball at the end. These are generally low performance and aren't nearly as durable as their fiberglass counterparts. Since they're low profile and difficult to see, they're easy to damage when washing the aircraft with a brush. Remind the FBO staff to use caution when washing, regardless of which antenna you have.

The common Comant CI105 transponder/ADS-B blade antenna sells for around $170 and the lower-performing rod antenna is around $75.

SPECIALTY WORK

If you own a fabric-covered aircraft, antenna work can require specialized skill. It also presents some challenges in getting the best performance from a system. That's because the antenna might require the same ground planes as on a metal aircraft.

For fabric aircraft, technicians often fabricate a ground plane using heavy foil tape or other metallic surfaces for a solid bonding of the antenna. Since there might be limited structural space available for mounting antennas on fabric aircraft, the installation of some systems just might not be possible. Composite aircraft present similar challenges, plus you'll need to find a shop that's versed in working with the composite structure.

Advanced Aircraft Electronics (www.advancedaircraft.com) makes a line of antennas designed for composite and fabric aircraft. The company says the antennas have better gain and better impedance matching than some traditional antennas, can be used without a ground plane and can be mounted inside of the aircraft structure rather than to the skin.

Installation is accomplished with adhesive and the antennas have a lifetime guarantee. One antenna works for comm, nav and ELT, although three are required for such an application. Each antenna is $149 and the company sells a transponder antenna for $99. These antennas could require an FAA field approval for installation in certified aircraft, although the company makes a good argument that since these antennas mount inside the structure, don't alter airflow, don't require drilling and are lightweight enough to not affect weight and balance, the installation might be considered a minor alteration. It's up to the shop to decide.

The newer Cub in the top photo has a limited ground plane for antennas on each side of the skylight. Those are replacement all-fiberglass comm antennas on the Piper in the bottom photo.

WRAP IT UP

If you plan to order a new cabin cover and also plan on an avionics upgrade, do the avionics first. Chances are the aircraft will come out of the shop with some new antennas installed in different locations than the old ones.

How do you know if antennas need replacement? Inspect them or ask a tech. If the P-stat coating on fiberglass antennas is worn off and you're noticing deteriorating VHF radio performance, it's probably time to spend some bucks. Having the aircraft painted? Good shops know not to paint antennas, but it's worth reminding them not to. It happens.

Garmin InReach Mini: SOS, SMS, Tracking

Garmin's new palm-sized InReach Mini Iridium satcomm device sacrifices a map, but works with Garmin's Pilot app and the D2 Charlie pilot watch.

by Larry Anglisano

When we looked at Garmin's $499 Iridium-based inReach Explorer+ satellite communicator/tracker in the May 2017 *Aviation Consumer*, we thought it was nearly the right size for use both inside and outside of the cockpit. But we didn't think the extra $100 for the preloaded topo maps and compass was worth it for cockpit use. Many pilots already have plenty of mapping capability on a tablet and on a panel navigator.

Now Garmin has the $349 inReach Mini, a repackaged version of the full-size device that literally fits in the palm of the hand, or comfortably in a shirt pocket. If you can live without onscreen mapping, we think it's the better choice for basic cabin messaging and belt-and-suspender SOS capability.

Recall that the inReach was Garmin's first rebranded DeLorme product after buying the company a couple of years ago.

HOW SMALL?

Like the full-sized inReach communicators, the new Mini works with the subscription-based Iridium satellite network. After unpackaging the device, we marveled at its size.

At 2.04 by 3.90 by 1.0 inches and weighing 3.5 ounces, this thing is tiny. Check that against the Explorer+, which is 2.7 by 6.5 by 1.5 inches and weighs 7.5 ounces. It's a good thing the Mini comes with a carabiner clip (and a spine mount adapter) because if it falls under a seat or in a tight, dark space, finding it could be a challenge. It's durable, though, and fits nicely in the hand.

CHECKLIST

- The Mini interacts nicely with the messaging utility in Garmin Pilot.
- Build quality is good, plus we like the compact design and shallow UI.
- But without using an app interface, the small display and lack of a keypad make texting awkward.

The Mini has a lithium-ion battery with less endurance than its full-size brethren. It will run up to 50 hours at 10-minute tracking intervals with the default two-minute logging. In power save mode, it can run for 20 days and it holds a charge for up to one year when it's powered off. The battery life for the Explorer+ is nearly twice that. The device is charged with a Micro-USB cable.

Even if it had the capability, the device wouldn't work well for onscreen mapping. As you would suspect, the Mini has a tiny display. At .9 by .9 inches and with a 128 by 128 pixel count, we think the monochrome, transflective non-touch screen will be a struggle for aging eyes.

That makes a stronger argument for using the device with a smartphone app. More on that in a minute. You can customize the display's backlighting brightness and also set the length of time before the backlighting turns off.

Unlike the flagship Explorer+, the Mini doesn't have a built-in barometric altimeter or a compass.

FEATURE SET, PERFORMANCE

The inReach Mini has a simple control set with a total of six buttons. Unlike the Explorer+, it has no rocker keys on the face, but function keys on each side of the case. See the graphic on the opposite page. The Iridium satellite antenna is nicely molded into the chassis and

The drawback to the inReach Mini's tiny footprint is a small screen and reduced battery life.

INREACH MINI CONTROL SET

Dimensions: 2.04 x 3.90 x 1.0 inches

the power button lives at the top. Like the full-sized communicators, the Mini has a rugged feel and is designed to survive the elements. The USB charging port is contained under a protective weather cap, plus the device has an IPX7 water rating, which means it's suitable for water splashes, rain and snow. It's not suitable for swimming and the IPX7 water rating doesn't include high-speed water sports. Seaplane flying—a potentially good application for the device in remote areas—is fair game, as long as you don't sink.

The Mini has an SOS key on the right side of the case that's protected by a cap to guard against inadvertent activation. Pull the rubber cap away and you'll have access to the button when you need to dispatch rescue helicopters to your location. While you can edit a custom SOS message, there's a default one that transmits along with your current location.

Once powered up, the Mini acquires a GPS fix and does a handshake with the Iridium satellite network. Once the activation was squared away, the unit locked on quickly. It requires a clear view of the sky to transmit messages and track points over the Iridium network, but it worked well inside the cabin of a high-wing Cessna and in the woods.

When there's a current subscription in place, you can use the Mini as a standalone communicator or connect to it with Garmin's Pilot app via Bluetooth. We'll focus on the aviation-specific Pilot app (we used version 9.0.3), rather than the Earthmate nav app, which comes free with the purchase of an inReach.

You'll find the inReach in the Connext tab of the Pilot app, under Devices. To communicate via text messaging, select the Calls/Msgs tab and up comes a familiar text editor that mimics the SMS messaging app on a smartphone. The utility also merges your phone's contact list. Messaging couldn't get more straightforward.

But don't expect blazing send and receive speeds. On average, we waited nearly 10 minutes total for short messages to send and ultimately appear in the recipient's inbox.

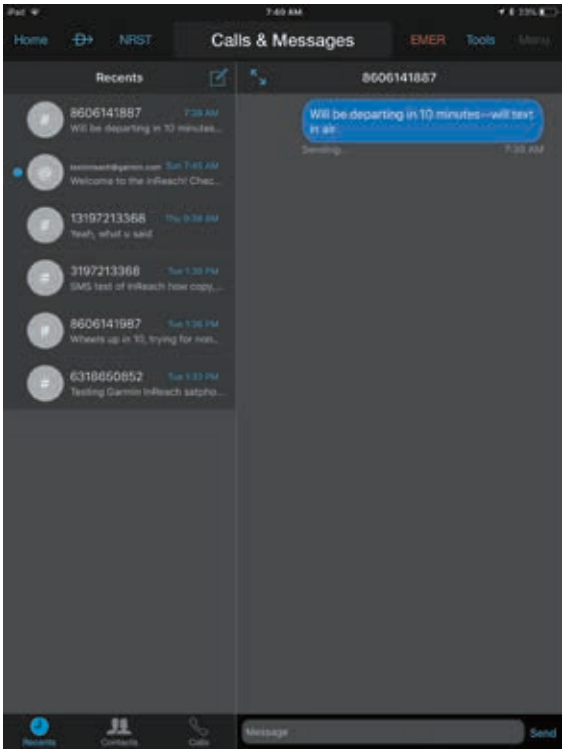
STANDALONE USE

If you aren't communicating through the Garmin Pilot app, the inReach Mini can be used standalone, of course. Typing messages is, well, not exactly efficient given the small screen and lack of a keypad. Then again, you won't be typing your life story with it. Think in terms of on-the-go utility.

Through the MapShare program on www.explore.garmin.com (after creating a personal login), you can edit up to three of your own preset messages to a specific recipient. Then from the Mini's main menu, select Send Preset and choose the message you want and select Send. Maybe you've preset something like "Departing now" or "Pick me up at seaplane dock." In general, you can send all messages to an SMS phone number, an email address or another inReach device. You can also add contacts on the Explore website and sync them to the device.

There's also Quick Messages, which can also be customized, but aren't assigned to a given recipient and are unlimited in number. You set these up under the Quick Text Messages utility on the website.

Free-form messages allow you type



That's the Garmin Pilot messaging utility in the top photo and the Mini's direct messaging UI in the bottom photo.

as you wish directly from the Mini and also from the Garmin D2 Charlie Pilot's watch, plus from some Garmin Forerunner and Fenix-series watches. It connects wirelessly with Garmin's ANT+ technology, which is also used for many other Garmin products. We've been using ANT+ for years on Garmin's cycling sensors and it works well.

When sending messages from the Mini, you scroll through the functions using the up and down keys on the right side of the case. Worth mentioning is that you can combine a Quick text message with custom text at the end of it. Maybe you want to tell your recipient what time you'll be arriving at the seaplane dock, or to be sure to remember the beer.

To type out a new message from scratch, scroll through the menus and select the Write Message option (with the OK key). Typing a message can be slow because you pluck each character (including space and backspace/delete)—one at a time—from a vertically scrolling alphabetical list on the far right side of the display. Once you have your message in place, hit Send and it's off.

You're limited to 160 characters per message. Forget about photos, although you can post a message to social media, including Facebook, Twitter and to your MapShare page.

You can also receive messages, of course, and the device checks for new ones at predefined 10-second intervals. You can customize the time intervals, but the more you update, the more battery life you'll eat. You can manually check for new messages, but the most frequent two-minute interval is only available on the premium subscription plan.

You can set up sounds (and volume level) so the device alerts you when a new message comes in. There's also a ring for sent messages, critical alerts and for when the device powers off.

Worried about how much data you're using? We would keep tabs on it and Data Use is found in the Utilities menu, where you can also reset the counter for a fresh billing cycle.

SENDING OUT AN SOS

Just like Sting and the Police sang about in 1979, you can send out an SOS at any time. Pull away the guard, hold the SOS button and wait for the countdown to send the default message and your position. The distress call is routed to a staffed (24/7) inReach command center. You'll get a confirmation message from the emergency response team and then you'll reply to it, letting them know you are alert enough to communicate. For the first 10 minutes of the rescue sequence, an updated location is sent every 10 minutes when moving and every 30 minutes when stationary. You can also cancel the SOS by holding the button again, transmitting a cancellation request.

We've been asked if the technology is a suitable replacement for ELT technology, including PLBs, but we think it's not for obvious reasons. On the other hand, we think the device has sizable utility for ditching, especially if you're on the move.

That's where the tracking feature comes in. When you start the tracking (simply hit OK from the Tracking menu), the device logs your location and updates it at the specified logging interval. Your track line and track points appear on your MapShare page for others to see.

We skipped the powerful Earthmate app interface in this review because it isn't an aviation app. The inReach doesn't interact with Garmin Pilot aero or topo data and perhaps it should. You could run both apps, but even Garmin agrees switching between them in flight might be confusing.

Since Earthmate runs without an internet connection, you could theoretically use the Mini to navigate to waypoints and locations stored in the device from the MapShare webpage. Maybe you want to land in a remote body of water or strip you've pre-saved.

ANOTHER SUBSCRIPTION

In case you don't have enough data subscriptions, you'll have to pony up $14.95 per month for the basic Safety plan. It includes 10 text messages (that's not many) and 50 cents for each additional text. We think the plan that could make the most sense for aviation use is the $34.95 per-month Recreational plan, which allows 40 texts and unlimited tracking. See all the plans at www.explore.garmin.com.

At press time, we're flying with the new Airtext LT portable Iridium-based cabin comm/messaging system and we'll see how its user interface compares in an upcoming report.

Electroair EIS: Feedback and Questions

Electroair responds to comments and questions about its electronic ignition system from users and prospective buyers.

by Rick Durden

It seems that every time we do an article on electronic ignition system (EIS) our email box fills up with comments—pro and con—and questions. The aftermath to our piece on Electroair's EIS in the May issue was in keeping with tradition.

One owner wrote: "I was one of the early adopters. The system installed on my Mooney Encore was wired through the rotary ignition switch, resulting in unreliable EIS operation. Electroair recognized the wiring error and to their credit, instructed my mechanic on how to bypass the rotary switch and install a dedicated switch for the EIS."

The next issue involved communications: The radio stack was new but weaker signals were scratchy or unreadable. Electroair had a solution: a new ignition harness with better shielding, provided under warranty.

The owner then experienced increasingly frequent engine "burps" during climb, accompanied by loud static in the headset, which eventually precluded use of the radio and intercom. Shutting off the EIS solved the problem, which was traced to arcing on EIS ignition leads. The fix worked for a few flights. When the problem recurred, the owner pulled the EIS and had the mag reinstalled.

Electroair reviewed its records and told us that the emails it exchanged with the owner and shop showed that the original problem was the key switch in the airplane—something Electroair proprietor Mike Kobylik had told us during our interview for the article was a problem with legacy airplanes. Kobylik said that the new ignition wires provided to the Mooney owner—now standard equipment—have a much higher resistance (5700 ohms/foot) and have eliminated radio noise issues.

Kobylik wrote, "I am not sure exactly what was the cause of [Owner's] final problem. Based on what he wrote I would suspect that there was a bad or intermittent connection at one of the spark plugs. For our system, we leave spark wire assembly for the installer in the field. This is because we at the factory have no way of knowing where the coil pack will be installed and therefore cannot make the spark plug wires ahead of time. An instructional video goes through the fabrication process step-by-step (https://tinyurl.com/y96zakfl)."

Another reader, going through an engine overhaul on a Cessna T210, asked a series of questions: "How does Electroair affect the break-in procedure? What role do GAMIjectors play? How is it really going to work and what are the power settings for all the various phases of flight? I was never able to get lean of peak to work with my old engine. It always bootstrapped, especially at higher altitudes."

Kobylik responded: "Break-in procedure and GAMIjectors are not affected by having the Electroair system installed. As a general rule, we encourage the use of GAMIs because they essentially tune the fuel system to the induction system on an individual cylinder basis. In a similar way, the Electroair system is a tuned ignition system—based around manifold pressure.

"Leaning, engine operation, etc.: We expect that with the EIS you will be able to lean the mixture further. We expect CHTs to rise slightly (although one operator reported that his CHTs decreased) and that EGTs will lower slightly. This is because of the more efficient combustion of fuel inside of the cylinder. We do not expect any negative impact on TITs. For turbocharged applications, we do not expect the same fuel savings that you would get from a normally aspirated engine. Since we tune based on MAP, and turbocharged engines are boosted, there is less need for adjusting ignition timing. Having said that however, the electronic ignition does not suffer from changes in altitude like magnetos do. Magnetos suffer from breakdowns at altitude as spark energy tries to move through low-density air inside of a distributor."

Electroair's EIS for a four-cylinder engine.

Cirrus SR22

The second-generation G2 models are a good value in the used SR22 market. Free training sweetens the deal.

The oldest SR22 models date back nearly 18 years, where they sold for just south of $400,000. Today you can buy a cherry, first-gen SR22 for less than half. And while there's little comparison between a G1 and the current SR22T G6, which flirts with $1 million fully loaded, an old Cirrus with updated avionics and a young engine isn't a bad way to get around.

We found plenty of nicely equipped SR22s on the current market to serve a diverse market. Owners stepping up from a Cherokee or Skyhawk, for example, will enjoy a major leap ahead in speed, technology and mission capability. Buyers stepping down from piston twins and even turbines will love the cost savings, while staring down 200-plus knots true in the flight levels in later turbo models.

But don't underestimate maintenance costs—especially when it's turbocharged—and the absolute need for transition and recurrent training. Last year Cirrus made a bold statement with Embark, a complimentary transition/standardization training program for new owners of pre-owned Cirrus aircraft.

BRAND LOYALTY

Since Cirrus Design first morphed from a quirky kit supplier to a full-blown aircraft manufacturer in 1998, it has consistently proven that it got the vision thing right. The entry-level SR20 and flagship SR22 in their various iterations have proven hot sellers and good performers, with unusually loyal customers. This loyalty should pay huge dividends as Cirrus continues to crank out the SF50 personal jet—a logical step up from an SR22.

What explains the brand loyalty? We think there are several reasons. The airplanes perform well and generally deliver on the claim of being manageable to operate for people new to flying. Moreover, mid-production SR22s (G2 and G3 models) offer the right combination of close to cutting-edge equipment and construction methods without becoming so radical or quirky that buyers are put off.

Some of the better buys are the 2002 to 2004 aircraft with Avidyne avionics.

The CAPS (Cirrus Airframe Parachute System), which Cirrus pioneered as a signature marketing feature, is a continuing selling factor. In a poll *Aviation Consumer* conducted shortly after the SR22 appeared, we asked if the parachute was a driver in the purchase decision. Only a third of respondents said it was, but we think that understated the case—and definitely even more so in the current market. We suspect the CAPS has always been a selling point that pushes buyers considering something else into the Cirrus camp. "The parachute is what sells my family on the airplane," is a comment we hear often.

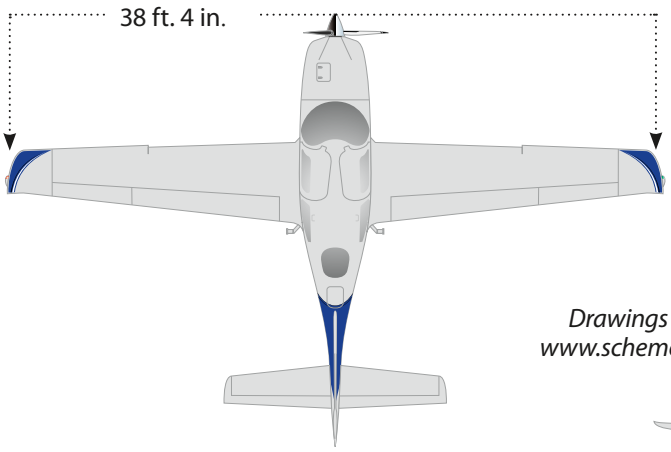
COMPANY HISTORY

Among homebuilders, Cirrus was well-known during the 1990s for its VK30 pusher kit, an innovative composite design that gained some traction, but wasn't a major player in the field. By the mid-1990s, Cirrus principals Alan and Dale Klapmeier developed a new vision, reasoning that the time was right for a high-performance, composite fixed-gear single that anyone could fly.

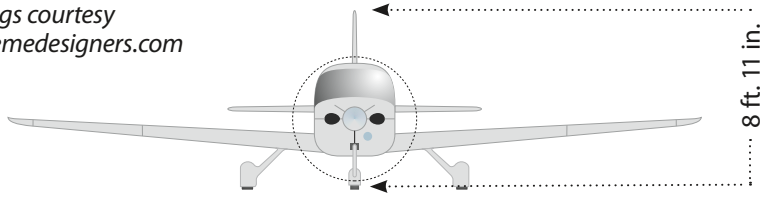
On a variation of Cessna's famed "drive it up and drive it down" campaign of the 1970s, the Klapmeiers launched the company on the premise that it didn't take special DNA to be a pilot. Anyone could do it with the right airplane. And if you got in over

Early generation SR22s like the one flying in the lead photo are priced well under $200,000.

CIRRUS SR22



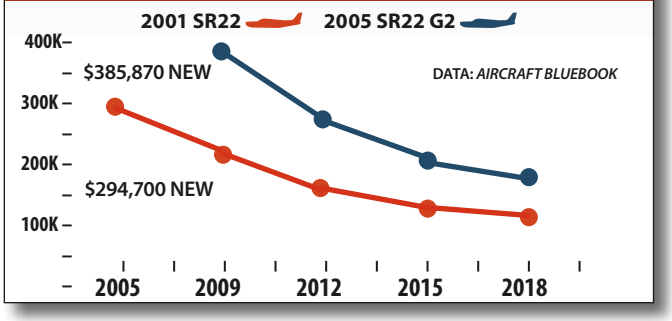
Drawings courtesy
www.schemedesigners.com



SELECT MODEL HISTORY

MODEL YEAR	ENGINE	TBO	OVERHAUL	FUEL	USEFUL LOAD	CRUISE	TYPICAL RETAIL
2001-2002 CIRRUS SR22	CONT. 310-HP IO-550-N	2000	$33,000	81	1150 LBS	180 KTS	±$110,000
2003 CIRRUS SR22	CONT. 310-HP IO-550-N	2000	$33,000	81	1150 LBS	180 KTS	±$130,000
2004-2005 CIRRUS SR22 G2	CONT. 310-HP IO-550-N	2000	$33,000	81	1150 LBS	180 KTS	±$165,000
2006-2007 CIRRUS SR22 TURBO G2	CONT. 310-HP IO-550-N	2000	$33,000	81	1150 LBS	180 KTS	±$250,000
2008 CIRRUS SR22 G2	CONT. 310-HP IO-550-N	2000	$33,000	81	1150 LBS	180 KTS	±$220,000
2009-2010 CIRRUS SR22 G3	CONT. 310-HP IO-550-N	2000	$33,000	92	1150 LBS	180 KTS	±$400,000
2011-2012 CIRRUS SR22T G3	CONT. 310-HP TSIO-550-K	2000	$40,000	92	1150 LBS	180 KTS	±$550,000
2013-2016 CIRRUS SR22 G5	CONT. 310-HP IO-550-N	2000	$33,000	92	1340 LBS	180 KTS	±$600,000

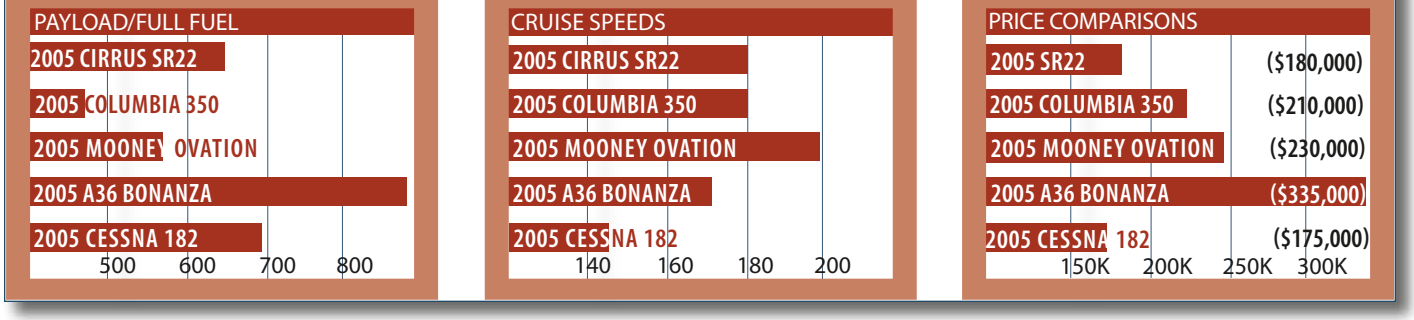
RESALE VALUES



SELECT RECENT ADs

2009-26-01	TKS SYSTEM FITTINGS
2009-05-05	AVIDYNE PFD INSPECTION/MODIFICATION
2008-14-13	DOOR-ROD END REPLACEMENT
2008-03-16	RUDDER, AILERON, AND INTERCONNECT RIGGING
2007-24-13	WINGTIP DRAIN HOLE INSTALLATION
2007-14-03	CIRRUS AIRFRAME PARACHUTE SYSTEM MOD
2006-21-03	BRAKE CALIPER PISTON O-RING SEALS

SELECT MODEL COMPARISONS



The Garmin Perspective avionics suite, top, was first offered in G3 models, replacing the Avidyne Entegra, bottom.

your head, you wouldn't have to die for your mistake; the BRS parachute would pull your fat out of the fire.

The company's first product was the SR20, which appeared in 1999, powered by a 200-HP Continental IO-360ES. At about $197,000 equipped, the airplane was a good buy and proved a strong seller. It also gave buyers their first look at large-screen panel displays, ARNAV's ICDS 2000. By modern standards, this would barely rise to the level of rudimentary, but a decade ago, it was pretty slick, even if the display wasn't as impressive as the Garmin GNS430s that drove it.

Going in, Cirrus knew what Cessna, Piper, Beech and others have always known: If you don't have a follow-on model, your success will be short-lived.

A NEW GAME

Two years later, for the 2001 model year, Cirrus announced the SR22 step-up model and immediately hit pay dirt. Although the SR20 was no slouch, its 150-ish cruise and limited payload left some buyers wanting.

The SR22 scratched that itch. It had a 310-HP Continental IO-500-N, one of Continental's best-ever powerplants, a three-blade prop and more payload, although the basic airframe is largely the same as the SR20.

The IO-550-N brought some improvement to the front end. It's a bit more economical and doesn't have the altitude-compensating fuel pump that can be a maintenance nuisance in the SR20s.

Cirrus pioneered the two-lever control, so the SR22 has a throttle and mixture lever, but no prop control. The RPM is handled by a cable-and-cam arrangement that sets the RPM at either 2700 RPM for takeoff or 2500 RPM for cruise. Most owners seem to like this arrangement, but for those accustomed to three levers, it takes some getting used to. We've learned to love its simplicity.

The SR22 airframe is slightly different than the SR20. The wingtips are 18 inches longer, the rear elevator is larger and the landing gear was moved inboard to give more ground clearance for the prop. Although identical in section to the SR20, the SR22's main spar is substantially beefed up and accommodates more fuel, 81 gallons in the SR22 (92 in later ones, starting with the G3, which has the new wing and a carbon fiber spar). Compare this to the 60 gallons of fuel capacity in the SR20. The SR22's energy-absorbing seats were also modified to account for the airplane's higher weight.

Speaking of weight, the SR22's gross is obviously higher and so is its payload—increased further with the G5 model. When we flew one of the first factory demos in 2001, the aircraft had an 1152-pound useful load or 648 pounds with full fuel on a 3400-pound gross. When the SR22 appeared, Cirrus had just certified a 100-pound upgrade for the SR20, giving it a 3000-pound gross weight with a useful load of about 1030. On equivalent fuel, the SR22 enjoys a 120-pound advantage. Many owners, however, say the SR22 is typically flown with one or two people aboard, full fuel and all the baggage you can stuff inside.

The SR22 will blister along at 170 to 180 knots on about 18 GPH rich of peak. But not many owners run the airplanes that way, given the reality of avgas prices. Throttling back to 65 percent on the lean side gives about 15 GPH and 172 knots. You can easily push that up to 80 percent power on 17 GPH and recover some of the lost speed. This appears to be where most owners operate the SR22. The IO-550 is smooth and perfectly happy in this regime. It will run even leaner for max-range cruise.

The 17 GPH setting yields about four hours of endurance for a still-air range of 700 miles, with reserves. At the max range setting, 1000 miles is doable, as we've proved.

CONSTRUCTION, SYSTEMS

Along with Diamond, Cirrus pioneered high-volume composite construction for light aircraft. When this technology was on the horizon, the aviation press was allowed to believe it would be stronger, lighter and cheaper than metal, even if Cirrus

The SR22 G5 interior is a huge jump in luxury from earlier models. It also has split folding rear seats for easier loading.

didn't exactly say that. Well, it did say stronger and the Cirrus airframe demonstrably meets this claim, according to static structural tests. Cirrus did full-scale crash testing of prototype fuselages at NASA's Langley, Virginia, facility that revealed that even at high impact loads, the composite fuselages remain relatively intact.

The fuselages are laid up in molds in two halves, with the two shells joined and then cured in an autoclave. The wings are similarly constructed and are of a single piece built around and bonded to a massive spar. This forms a strong torsion box that has proved itself well in the rigors of real-world service. But unlike Cessnas and Diamonds, de-winging is a challenge, given the single-piece structure. Control surfaces are conventional riveted aluminum, with a combination of push-pull tubes, cables and bell cranks and a sidestick controller rather than a yoke or center stick. Most of the control circuitry lives under the floorboards, where it's accessible via generous inspection panels.

As with the SR20, trim is entirely electric via a single coolie hat on the side controller—fore and aft for pitch, side-to-side for aileron. Some early SR22s also had electric rudder trim, but that was later deemed unnecessary. Because the pitch trim motor is aggressive, mastering smooth pitch trim changes requires a deft touch to avoid bobbles. We wouldn't mind a slower-turning servo motor or even manual trim with an old-fashioned wheel. But that goes against the grain these days.

That's also true of the SR22's nosegear and main gear system. It has a castering nosewheel and steering is via differential braking, the weight-saving design philosophy that every major manufacturer seems to follow these days. This works well enough in the real world, but has the downside of chewing up brake pads and, in the case of the SR22, leading to several brake-induced fires. This led to an AD requiring periodic O-ring replacement and a brake temperature inspection hole. Some owners say brake wear isn't an issue if you stay off the binders during taxi. As for the castering nosewheel, it makes the airplane a dream to taxi into a parking spot, but a nightmare to hand-push into a hangar.

The wing section and planform is uniquely composed of varying sections, thus the leading edge has the characteristic split on the outer panels. Because the outer panels have a lower angle of incidence, they remain flying while the inner sections have stalled, improving control through the stall and theoretically adding spin resistance. The Cirrus aircraft aren't approved for spins and in place of proving spin recovery, the BRS parachute is provided as the equivalent level of safety.

The fuel system in the SR22 consists of wet cells in each wing. These are plumbed to a single tank switch located on a console between the two pilot seats, which is in plain view and situated near the fuel level gauges. Owners of G1 and G2 models complain of inaccurate fuel gauges, and while there was an aftermarket digital fuel sender and control head upgrade offered by CIES, but it wasn't a good match.

While the fuel is relatively well-protected in the wings, it appears to be not as well-protected as in other aircraft, specifically the Diamond line. Our review of accidents reveals a higher incidence of post-crash fire in the SR22 than in Diamonds.

In keeping with its new-age approach to safety, Cirrus ridded its models of vacuum instrument systems as soon as it could. Although the very early SR20s had vacuum pumps and later became all-electric, SR22s were all-electric right out of the blocks. It has two alternators and two batteries, each electrically isolated from the other and either capable of powering essential electrics. The main alternator is 60 amps, the secondary is 20 amps while the main or starting battery is 10 amp hours. The secondary is composed of two smaller 12-volt batteries connected in series.

As do transport aircraft, the SR22 has more than a single electric bus: two in fact, a main and an essential that, in the event of a battery/alternator failure, will power sufficient avionics to continue the flight. Either can power the essential bus.

On the downside, both alternators are gear driven, one on the front of the engine and one on the rear accessory case. Given the service history of Continental alternators, our druther is to have one belt driven. In any case, we think the all-electric airplane is a significant advance over anything to do with vacuum instruments, which owners have tolerated for years because there was no choice, but that's all changed for those who want out.

The SR20/22 share the same CAPS ballistic parachute but with its 3400-pound gross weight, the SR22 can be up to 500 pounds heavier. That means descent under canopy could be as high as 28 feet per second

The G3 came along in 2007 with a new wing, a carbon fiber spar and more fuel capacity.

compared to the 24 feet per second typical for the SR20. That's a vertical descent of 1680 FPM/19 MPH versus 1440 FPM/16 MPH. Cirrus has said it and we'll say it again: A ride to touchdown under the CAPS canopy won't be something you'll want to repeat, although the vast majority of real-world deployments have yielded no or minor injuries.

MODELS, MAINTENANCE

Buying a used SR22 is not like buying an older Cessna 182 or a Saratoga. That's mainly because you won't see much post-factory equipment variation on Cirrus aircraft. They emerged from the factory fully formed and the panels don't allow many options to mix and match. Some of the early steam gauge airplanes were upgraded to Aspen or Garmin G500s or were converted to Avidyne glass.

The original SR22s had an "A" and "B" option list. The A airplanes, which retailed for $276,600, had a Garmin GNS430/420 combination, an S-TEC System 30 autopilot and a Century NSD-1000 electric HSI. The B airplanes ($294,700 retail) had dual GNS430s, an S-TEC 55 autopilot and a Sandel EHSI. Both options had the ARNAV ICDS-2000 color MFD. The only other option in the early airplanes was a Stormscope and, later, the Skywatch TAS system. At the time, we liked the panel but predicted the ICDS-2000 wouldn't be long for the airplane.

We were right. Within a year the ICDS-2000 was replaced by the Avidyne FlightMax MFD and most of the early aircraft have been converted. By the 2003 model year, SR22s with Avidyne's Entegra PFD/MFD glass cockpits found their way into customer hands. The Avidyne airplanes had GNS430s, a System 55 autopilot and Avidyne's E-max engine monitoring. TKS was available as an option in the earliest SR22s, but it wasn't approved for known icing. That option didn't appear until 2009.

In the 2004 model year, the SR22-G2 emerged, which featured a redesigned cowl, a new prop, a spiffed-up interior, an improved door latch design and a six-point engine mount that addressed vibration issues in the first SR22s. It's a huge improvement.

Early on, Cirrus discovered something unique about its buyers: A substantial number of them would replace a recent model SR22 if a newer model had noticeable improvements. We know of many Cirrus owners who have bought two or three new airplanes in the space of five years or less—even in a softening economy.

Not one to let this opportunity pass by, Cirrus rolled out one of its best sellers ever in the form of the turbonormalized SR22 for the 2007 model year. Cirrus had heard its customers ask for a turbocharged SR22 and Dale Klapmeier once told us the company had considered it from early on. Unfortunately, Cirrus couldn't get its in-house developed turbo to run cool enough, so it never brought the product to market.

To address the demand, it did something unusual: It contracted with Tornado Alley Turbo to install a turbonormalized system under STC. These airplanes proved so popular that for a time, they outsold the normally aspirated version by a margin of two to one. Many owners traded up to the turbo model, the most popular today.

Some of them traded up again a year later when Cirrus announced the G3 model with several improvements, including a redesigned wing with 92 gallons fuel capacity and a carbon fiber spar, the removal of the aileron-rudder interconnect found on earlier models and improved environmental and interior ergos.

Hot on the G3's trail the next year was the Perspective model, a version with the Garmin G1000 EFIS suite adapted specifically to the Cirrus. It has synthetic vision, a flight director and the GFC700 autopilot with (at the time) a unique Level button. Speaking of autopilots, Avidyne's DFC90 retrofit system easily outperforms the rate-based S-TEC 55 series that was standard in G1 through early G3 models. If you've flown both, we're certain you agree.

Even as aircraft sales hit the skids in 2008 and 2009, Cirrus continued to introduce improvements to the SR22. In 2009, it began offering a known-icing package based on the TKS system that had always been available as an uncertified option. In 2010, it finally got its in-house turbo installation sorted out and introduced the 315-HP TSIO-550-K-powered SR22T, to sell alongside the turbonormalized model, which remains in the lineup today.

The latest version is the SR22 G6, replacing the G5 introduced in 2013. The G5 brought a variety of improvements, including optional tricolor paint, a new 3600-pound gross weight, plus a welcomed 50-percent initial flap extension speed of 150 knots, up from 119 knots on older SR22s. With an additional 3.5 degrees of extension, this makes the aircraft much easier to slow on descent. To accommodate the new gross weight increase, Cirrus beefed up the main spar, strengthened the landing gear and added extra layers of composites to the airframe.

Speaking of composites, when composite airframes hit the market, one selling point was that they wouldn't

corrode, parts wouldn't break and they would be cheaper to maintain. This might have proved somewhat true, but whatever savings were lurking in the statistical noise got chewed up in higher avionics costs and, especially, database costs.

It's not that the avionics in the SR22 break more often than other aircraft, but there's more of them and owners report that once off warranty, flat repairs run into big dollars. Recurrent database and datalink weather subscription costs are also something owners of a decade ago didn't spend as much on. You get more with these systems, but you pay more to keep them up, too.

On the plus side, the IO-550 has proved to be a durable and economical engine. We're not seeing many complaints about soft cylinders or premature failures. We don't see a widespread pattern of the engines not making TBO—if treated right.

A scan of the FAA's Service Difficulty Reports revealed some complaints. Door fit and inadvertent opening is a problem in the early models. Cirrus addressed this with a redesign of the latch. Front wheel shimmy can be a problem. In one case, the wheel pant departed the airplane. A few other SDRs dealt with nosegear wear issues. There were also a handful of alternator and starter drive adapter failures. These are common in Continental engines and not unique to the Cirrus.

The SR22 has a total of 14 airworthiness directives, a fair to middling score. None of these are especially onerous or expensive, but some do impact safety, such as 2008-14-13, which requires door hinge replacement to prevent the door from departing the airplane; 2008-06-28, which addresses significant PFD issues; and 2007-14-03, which requires a modification of the CAPS activation system.

And speaking of CAPS, the earliest airplanes are well at the point of needing the 10-year repack/recertification. How much? Plan on about $13,000 all in, if you go with an overhauled unit, but close to $15,000 for a new one. G1 aircraft require costly composite repair and paint work following a repack, but the CAPS is accessed through the baggage area in G2 models and beyond, eliminating the need to break the structure to gain access.

A word on paint work: If the paint is showing its age and you're tempted to upgrade to a more modern scheme that mimics a new Cirrus, you could get into a copyright infringement issue, since Cirrus has copyrighted its modern schemes. Scheme Designer's Craig Barnett—who has dealt with the issue firsthand—told us it's best to check with Cirrus before spraying.

MARKET SCAN

Because of the habit of buyers upgrading with each new model, Cirrus has been a victim of its own success. This became especially obvious in the fall of 2008 and spring of 2009 when a flood of SR22s of various vintages came on the market. At one point, we estimated as many as 200 might have been on the block.

Cirrus eventually divested itself of owning any used inventory, partnering with Ohio-based Lone Mountain Aircraft Sales and Aerista (formerly TAS Aircraft Sales) to carry, manage and resell the used inventory. A used Cirrus with a factory-certified pre-owned status carries a six-month, 100-flight-hour limited factory-backed warranty. But you don't always have to pay the certified pre-owned premium (roughly 10 percent, on average) to get a decent used Cirrus.

In the current market, some of the better buys are the 2002 to 2004 aircraft with Avidyne avionics. *Aircraft Bluebook* lists these for well under $200,000 retail and we don't doubt bargains are out there. The 2001 to 2003 SR22s are even cheaper, with retail prices as low as $110,000. These likely won't be all-glass models—many have steam gauges with an Avidyne MFD. The interiors on these first-generation SR22s were never a high point and many of these older models have tired seats and carpets.

On the other hand, we think a G3 model (2007-2012) is the best compromise in price (over a new one) and modern avionics, with the Garmin G1000 Perspective (2008). Average selling prices, based on our market scan, start at $260,000 for a 2008 and $340,000 for a 2012. For comparison, we spotted several 2013 SR22T-G5 models in the $600,000 range. Big spreads, big differences.

The Cirrus airplanes are exceptionally well-supported in our view, both by the factory and by one of the best owners groups around, the Cir-

CIRRUS CRASHES: LOSS OF CONTROL

Following the introduction of the glass cockpit and integrated autopilot to the SR22, it became one of the first Technically Advanced Airplanes (TAA) in general aviation. Because of strong sales, the SR22 fleet makes up one of the largest sets of TAAs. Our examination of the 100 most recent Cirrus SR22 accidents affirms that while automation has a lot to offer, the reports show that failing to fully understand the equipment is a wreck waiting to happen.

We also came away from our examination of accident reports with a healthy respect for the value of a ballistic parachute—in the Cirrus world that's the Cirrus Airframe Parachute System (CAPS). Put bluntly, we saw lives saved—with virtually no injuries—in circumstances where we were convinced the outcome would have been a fatal crash had the pilot not deployed the CAPS and it worked as advertised. We also looked at a number of crashes involving serious injury and death that, in our opinion, would have been avoided had the pilot activated the CAPS or not delayed too long to do so.

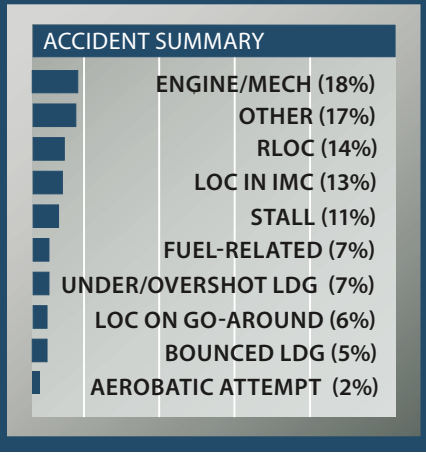
Overall, it is our opinion, based on the 100 accident reports we reviewed, that CAPS deployment saved a number of lives—although we will not try to estimate a precise number. Further, we think there were three fatal accidents because the airplane was equipped with advanced avionics (including an integrated autopilot) and flown in IMC by a pilot who did not correctly understand how to operate the equipment and lost control of the aircraft. In at least one crash, the pilot was so reliant on the autopilot that he was unable to hand-fly the airplane when the autopilot disconnected, lost control and crashed.

Because of the data collection and storage that is an integral part of the SR22 avionics, the quality and quantity of information available to accident investigators is dramatically better than in non-TAA machines. Accidents that previously would have been written off as LOC in IMC for undetermined reasons are now being revealed as, for example, due to a pilot concentrating so hard on fixing an electrical glitch that he allowed the airplane to enter a diving spiral, did not use the autopilot for recovery and failed to use correct control inputs.

There were 18 engine stoppages for mechanical reasons. In two of those the pilot activated the CAPS and there were no injuries. In two there were deaths and serious injuries when the pilot made a forced landing on bad terrain—one pilot said he would only deploy the CAPS during an inflight breakup. In one, the pilot waited until he was 350 feet AGL and realized he couldn't make his desired landing point and pulled. The CAPS did not have time to fully deploy, causing a nose-down impact and serious injuries.

We were disturbed by the number of LOC accidents, both in IMC and due to stalling the airplane in the traffic pattern. We don't think that should be happening and it's a training issue Cirrus continues to address, with notably improved fleet safety. The LOC saves credited to the CAPS were impressive—in one the aircraft had exceeded 170 KIAS and 3.6 Gs prior to deployment.

For an airplane with docile handling, we were surprised by 32 landing-related accidents—perhaps a reflection of lack of stick and rudder training and skills.



rus Owners and Pilots Association at www.cirruspilots.org. For a detailed look at real-world performance numbers on Cirrus aircraft, see www.cirrusreports.com.

OWNER FEEDBACK

I've owned a normally aspirated 2006 SR22 G2 for several years and have put about 600 hours on it so far. The SR22 has an exceptionally wide cabin with doors for both the pilot and copilot. Two doors allowed Cirrus to use an auto-style center console on which to locate the engine controls and flap switch, where they are right at hand with your arm resting on a center cushion that covers a handy storage compartment. The use of a sidestick frees up your unrestricted view of the panel, surprisingly taking no time for a control-wheel pilot to become accustomed to. For some, the crushable honeycomb seats (a crashworthiness safety feature) are too stiff, but my wife and I have not found that to be the case, having no difficulty on many occasions flying over five hours in them. It has effective factory air conditioning, which I found adds significantly to the comfort of flying anywhere in the U.S. when temps are over 80 degrees on the ramp, in hot sunshine or flying at low altitudes in the summer. It's also nice being able to taxi with the doors shut.

The only comparable airplane in my view is the Columbia 350/Corvalis/TTX, a better airframe design in my opinion. But it lacks a CAPS parachute, which initially was no big deal to me. But it made all the difference to my non-pilot wife when we discussed the purchase options. And thinking about it, I realized it's nice to know I don't need to be Bob Hoover to have a chance of surviving an emergency. When would I pull? Perhaps after a buzzard comes through the windshield and into my face, engine failure over big water, forests, mountainous terrain or on dark nights, engine failure into areas of low IMC, engine failure on arrival or departure from airports in built-up areas with your choice of buildings to hit, LOC (loss of control) after severe ice encounter, LOC due to incapacitating medical issue or vertigo and after a midair collision. Now the CAPS seems to me just like automobile seatbelts and airbags: I happily drove as a teenager back when cars did not have them, but I

wouldn't buy an everyday car without them now.

For typical flights at 8000 to 10,000 feet, cruise speeds are 165 to 170 KTAS burning around 13.5 GPH LOP, at 2500 RPM (the minimum RPM the Cirrus power lever permits without sacrificing manifold pressure). For longer range, if headwinds don't keep you down low, the plane climbs to 17,500 feet in 30 minutes with no difficulty, cruising 10 knots slower but burning only 10 GPH at 2500 rpm. With 81 gallons of fuel, that will take you a long way if you can sit that long.

I've upgraded the transponder to the dual-band ADS-B Lynx NGT 9000+ ADS-B system with aural alerting, which replaced the heavy Skywatch traffic processor. I can't recommend this product enough. The PS Engineering PMA450 audio panel is an excellent upgrade from the original Garmin 340. I replaced one Garmin 430 with an IFD440 and the non-WAAS GNS430 with a Garmin 430W. I plan on replacing the S-TEC 55X with a DFC90, a tougher decision because the 55X works fine for me.

Insurance for $1 million smooth has been a steady $2500 per year for an older experienced pilot. Cost of an annual inspection runs about $2500. The cost of fixing what is found in the inspection varies of course, but at least another $1000 to $2000 is to be expected. Compared to some other high-performance singles, it doesn't have the extra cost of retractable gear maintenance and higher insurance premiums, nor the extra costs for corrosion inspection and repairs an aluminum plane can have. But the cost of servicing the parachute every 10 years no doubt offsets most if not all of those savings. The parachutes being reinstalled now in G1s and G2s come with an updated rocket ignition design that is at least $16,000 to complete. Next time doing just the parachute, less igniter, should be much less expensive. Best case is to buy an SR22 in which the prior owner has already paid for the upgrade.

For budget reasons I focused on G1s, G2s and the few early Avidyne G3s when looking to buy. Garmin G1000 G3s and up are in the nosebleed section by comparison. Avidyne's excellent Entegra PFD and MFD panels first appeared in 2002 G1s, but I found my requirement for air conditioning eliminated G1s from consideration. Looking at G2s, I found there were two notable mods during the G2 run: the improved digital electrical system in 2005 starting with serial number 1663, and the redesigned pitot-static system starting in 2006 with serial number 2043. The latter prevents false airspeed and altimeter readings shortly after takeoff into IMC, which can result from rain entering the static ports while on the ramp (there is a service bulletin to retrofit this modification that many affected owners have opted for, but I think it should be an AD).

With full tanks, my fully equipped SR22 GTS G2 payload is only 470 pounds, taking into account the topped-off TKS fluid and my standard gear (extra oil, tow bar, life preservers, headsets, chocks, etc.). That's enough payload for me, my wife and baggage to go from Houston, Texas, to Miami, Florida (950 NM) nonstop, with typical tailwinds. The tanks have tabs at 47 gallons—a typical fueling request line service folks are familiar with—which is enough to take you 400 NM at 165 knots with an hour's reserve. So fueled, the extra payload is enough for two beefy adults, two older kids, plus baggage.

I have found that even flying over the Rockies, turbocharging is not needed in this 310-HP airplane. If the mission requires faster climbs to higher cruise altitudes where turbos can go 190 KTAS at 85 percent power at 18,000 feet, a turbo would be the right decision, if significantly higher fuel flows aren't a factor.

The SR22 has a unique flight control trim system, with stiff springs that provide significant resistance to pitch and roll inputs when hand flying. I find it disappointing for two reasons. First, it takes constant trimming out of the spring forces to prevent wrist and hand fatigue. It's no Bonanza. The solution is heresy to some: Engage the autopilot when at a safe altitude after takeoff and disengage before entering the pattern. The second problem is in the pattern: The springs mask the sloppy control feel in slow flight. The springs are so stiff that even sitting on the ramp there is no need for a control lock. Trim incorrectly and you'll lose.

I used Savvy Aircraft Maintenance for help in reviewing logbooks of SR22s for sale before I made any offers, for advice on shops to use for prebuys and annuals and for general advice on maintenance issues that come up during the year. Savvy has checklists for things like oil changes

CIRRUS EMBARK: TRAINING FOR PRE-OWNED

Last year Cirrus announced it would offer complimentary one-on-one training to pre-owned Cirrus buyers. It's called Cirrus Embark and like the successful Cirrus Approach program, Embark focuses on mastering aircraft control and a variety of other skills you'll need to move into the left seat of a Cirrus. In a nutshell, the Embark program was created by the Cirrus in-house training team and is Cirrus-specific standardized differences and transition training aimed directly at those who purchase pre-owned SR22 and SR20 models—any vintage.

To qualify, you must be the direct owner of a pre-owned Cirrus and it doesn't apply to flying clubs. The training must be conducted in the owner's Cirrus, which has to be in airworthy condition. Direct owners or the owner's designated pilot must enroll in the program within 30 days of aircraft delivery and complete the training within 60 days.

Cirrus says the Embark program is designed for pilots with little or no experience flying a Cirrus and follows a structured lesson flow. Embark isn't intended to accomplish an IPC or a BFR. Up to three days of training are included in the program. Authorized training providers included Cirrus Standardized Instructor Pilots, Cirrus authorized training centers and training center instructors.

Signing up is easy: Go to www.cirrusaircraft.com and click on the Embark link. A simple questionnaire starts the ball rolling.

The Aviation Consumer

USED SR22

(continued from page 31)

that include a few peculiar Cirrus issues mechanics might otherwise miss, and checklists for diagnostic flights that I have found helpful. Download your engine data from the MFD periodically for upload to Savvy's website and they will analyze it.

With proper training, the many safety features and modern avionics systems of the aircraft make the SR22 a remarkably safe, fast and comfortable cross-country airplane. It may not be an airplane to enjoy while hand flying and if your mission requires six seats you need to look elsewhere. Still, the SR22 can take you to distant places in speed, comfort, safety and style.

Wally Magathan
Miami, Florida

I bought my SR22 G2 new in 2005. In 13 years, I've flown it more than 1600 hours. Cirrus has an excellent warranty program that replaced a cracked exhaust manifold and multiple CHT and EGT temperature probes that failed repeatedly in the early years. In 2009, I retrofitted the Avidyne R9 and DFC autopilot. The most important service item in any Cirrus aircraft older than 10 years is the mandatory CAPS repack. This is an expensive 10-year service that costs at least $10,000 to $12,000. My repack done in 2015 required 28.5 hours of labor ($2800) along with $12,000 in parts.

After 12 years, the autopilot roll servo motor needed to be replaced ($1700) and the muffler and heat exchanger were replaced at the same time. The starter failed at about 1500 hours. The magnetos were rebuilt at the most recent annual (2018) and replaced previously at the recommended 500 hours. The aircraft has also required two alternator replacements in the last 13 years. Frequent maintenance items at every annual are the castering nose landing gear and the brakes that overheat without the most careful use. The five most recent annual inspections have averaged $9000.

The Continental IO-550-N engines manufactured between 2003 and 2007 were susceptible to metallurgic issues in the cylinders. In 2011 with 954 total hours on my engine, all six cylinders needed to be replaced due to low compression and oil leaks despite careful leaning and use of the EGT/CHT graphical engine monitor; that bill was greater than $13,000. The engine warranty when new was three years or 1000 hours. Five years later, in 2016, cylinder numbers four and six again required repair by Continental to reground the intake valves and valve seats, while re-honing the cylinder barrels.

Having said all that, the SR22 is remarkably reliable when well-maintained. I have flown from Boston, Massachusetts, to San Francisco, California, and plenty of other places in between. Most of my flights are flown between 8000 and 10,000 feet, and the normally aspirated Continental engine performed very well at 14,500 feet crossing the Rockies.

My SR22 has non-FIKI (flight into known icing) approved TKS weeping wings and tail, along with the slinger ring in the propeller that clears both the prop and the windscreen of ice. I have used it on several occasions to exit icing conditions, and it has performed very well.

Flight planning speed is 168 knots using approximately 14.8 GPH LOP. With over 2200 hours total time and more than 1500 hours in the SR22, my annual insurance rate is less than $3000. Annual recurrent training in the Cirrus Pilot Proficiency Program (CPPP) is a must; it can lower insurance rates (it's mandatory by my carrier), plus the overall SR22 accident rate has declined steadily during the past decade with this program.

Victor Vogel
via email

FEEDBACK WANTED

TWIN COMANCHE

We're preparing a report on the Piper PA-30/39 Twin Comanche in an upcoming Used Aircraft Guide in *Aviation Consumer*. We want to know what it's like to own these twins, how much they cost to operate, maintain and insure and what they're like to fly. If you'd like your airplane to appear in the magazine, send us any photographs (**full-size, high-resolution please**) you'd like to share to the email below. We welcome information on mods, operating expenses or any other comments that can be helpful for buyers considering one. Send correspondence by August 15, 2018, to:

Aviation Consumer
Email at:
ConsumerEditor@hotmail.com