FLIGHT REVIEW

SubSonex

The practical jet age arrives.

BY PAUL DYE

If you say "personal jet" in the lobby of a typical general aviation FBO, images of a Cessna Mustang, Eclipse 500, or maybe the up-and-coming Cirrus Vision will come to most people's minds. Forget those people. Let's talk *really* personal—we're not just general aviation, we're Experimental aviation! How about a single-seat cocoon with one jet engine and an unrestricted view out front—now *that* is personal. And where can you find that formula? In the new SubSonex from Sonex Aircraft, LLC. This single-engine Experimental jet features a reliable, easy-to-install powerplant, and the factory is already shipping ultra-quick-build kits to customers.

The SubSonex began as a dream in the mind of Sonex founder John Monnett—a dream for a personal sport jet that could be flown by someone with average to good pilot talent and skill. The SubSonex JSX-1 flew as a proof of concept airplane several years ago, and astounded the community as the first such design since the BD-5J. Monnett took what he learned from the fixed-gear JSX-1 and refined the design to produce the JSX-2—the current design. An airplane with up to two hours' endurance, it is not just an airshow performance wonder; it is a practical, fun machine that provides enough margin (in fuel, speed, structure, and forgiving flying qualities) that the dream of a true personal jet is now in reach of anyone that can afford to build a mid-level homebuilt. You wouldn't want to make it your only transportation machine, or a "daily driver/do-all" plane—but as a way to unwind in the sky, it would certainly fill the bill.

KITPLANES® was given the opportunity to be the first independent organization to fly the jet for an evaluation, so in April we headed down to Moriarty, New Mexico, the home of test pilot Bob Carlton's Desert Aerospace, to complete the necessary transition training and give the little jet a workout. The training program devised by Carlton and Sonex (and approved by the FAA) is thorough, yet not complicated, and prepares one well for their first flight in the jet (see sidebar on page 21). The airplane flown for the test was the JSX-2 prototype, currently on tour with Carlton flying airshow routines for aviation fans around the country. For a prototype, we were impressed with its fit and finish, and while a few improvements are still in the works, it is representative of what the first customers are building in workshops right now.

Construction

Structurally, the SubSonex appears to have a great deal in common with its

Photos: Paul Dye, Richard VanderMeulen, Paul Bertorelli

The Siren Smell of Kerosene

The personal jet has been a dream of anyone who grew up thinking that airplanes would always be getting faster, flying higher, and going farther—all the while becoming more maneuverable and more capable. Here are a few of the Experimental jet kits that have popped up in the aviation world over the years.

1973—BD-5J: The mother of them all. Jim Bede's BD-5 graced the cover of the October 1971 issue of *Science and Mechanics,* and orders started coming in by the hundreds, then thousands. The jet version was James Bond's escape vehicle in the movie *Octopussy*. Due to build complexity, cost, and a relatively high accident rate, there are only a few BD-5Js flying today.

1992—BD-10: With the BD-5's troubles centering around engine availability issues, Bede chose the ubiquitous General Electric J85 turbine and built the world's first "supersonic" (the plane actually never exceeded Mach 0.83) Experimental around it for his second jet kit. Five aircraft were built—three crashed killing their pilots, and the two remaining are not currently flightworthy.

1999—ViperJet: Originally conceived of as a pusher-prop jet lookalike, driveshaft issues (which also plagued the prop version of the BD-5) led the Hanchette brothers to install a turbojet powerplant. The prototype was underpowered, but a later version had the oomph (and fuel flow). See Doug Rozendaal's PIREP, "ViperJet Redux," in the March 2009 issue of KITPLANES®. The company web site is defunct.

2004—Comp Air Jet: For a mere $1.2 million (and that's 2004 dollars!) you can have your very own business jet. Ron Lueck, president and CEO of Comp Air, says that although they haven't sold any kits, factors like the economic recovery, low fuel prices, and affordable used turbines have prompted more inquiries about this poor man's G650.

—Eric Stewart

ViperJet

SubSonex quickbuild kits under construction in Sonex's Oshkosh facility. Despite the caché of being a jet, the construction is familiar to anyone who has built a Sonex.

piston-powered Sonex brethren. The all-aluminum structure is conventional in every way. Pop rivets are used for primary assemblies, and I saw few cases where solid rivets were used or required. Most of the aluminum panels are flat or have a single curvature—very few compound curves were evident, and if they were, I expect that those parts are preformed by Sonex. The basic box structure includes aluminum angles at the corners, with flat panels such as the side and bottom riveted to those to provide a rigid cocoon.

The outer wing panels are removable for transport (and Sonex offers a trailer that is custom-configured to transport the jet). Since there is no fuel in the wings, putting the airplane together and taking it apart is fairly simple. The fuel tank is poly and sits in the fuselage behind the pilot. The "Y-tail" (two ruddervators and a small rudder that forms the stem of the "Y") appears to be built just the same as the tails on the Waiex and Xenos—proven designs from Sonex. This tail works perfectly for the SubSonex, as the jet exhaust goes right between the panels.

The landing gear on the SubSonex has got to be one of the smallest set of retractable wheels I have ever seen on a human-carrying airplane. Ingeniously designed by John Monnett, the gear features two wheels on each maingear truck and a single wheel on the steerable nosegear. While many (if not most) new tricycle-gear aircraft are electing to go with free-castering nosewheels and differential braking for steering, Monnett decided that a single brake master cylinder was

The Y-tail is the perfect configuration for a single-engine jet. The high thrust line is noticeable, but easily managed.

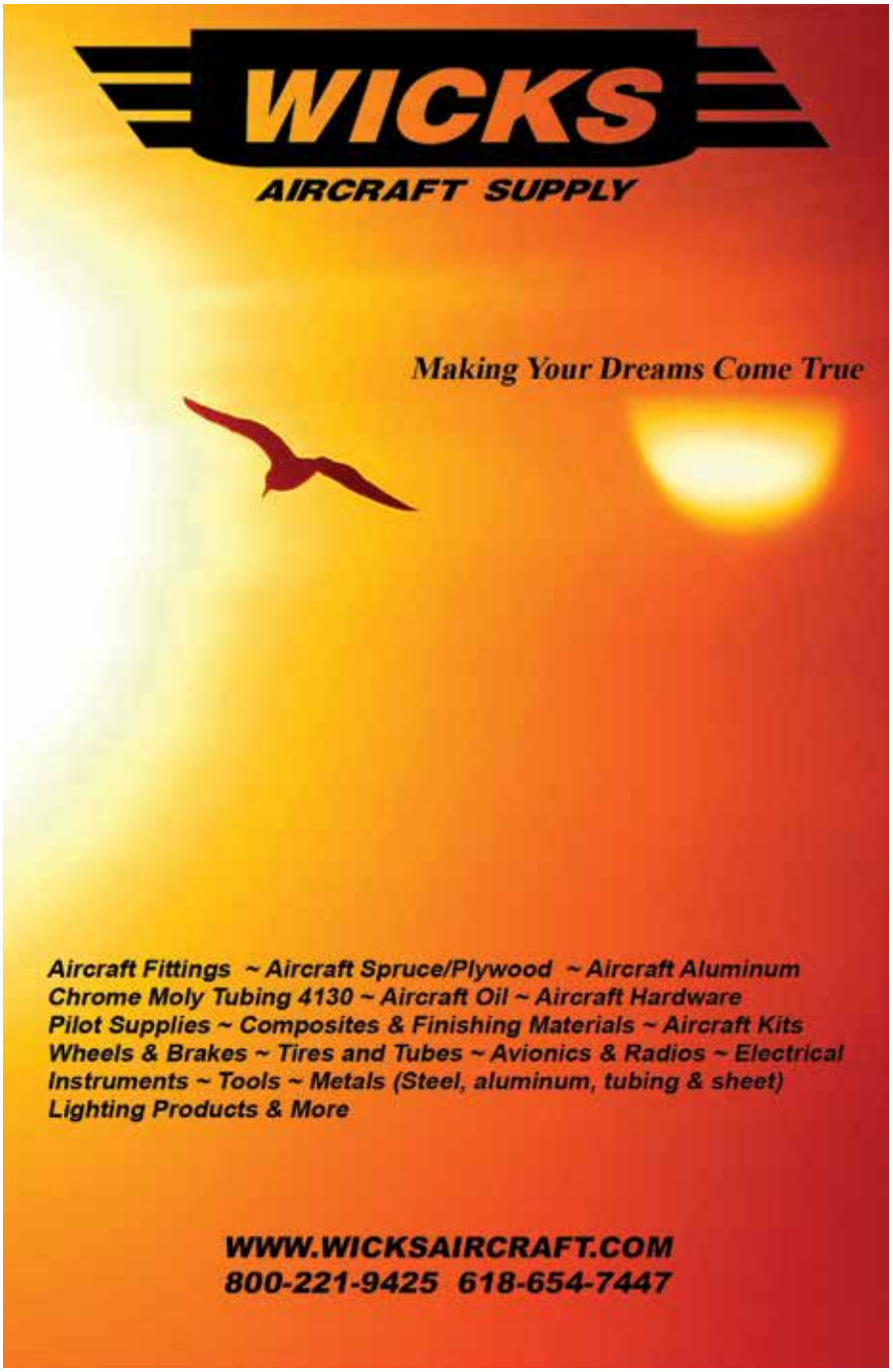
The simple box-like construction might almost make a builder wish there was a *non*-quickbuild option.

lighter than two, and that steering the nosewheel was a lighter alternative. The result is an airplane that steers just fine at all speeds from a slow taxi to the 90+ mph rotation.

The brakes are custom-built into the mainstruts and actuate on disks on one wheel on each side. We understand that a design change to include a brake on the other wheel is in the works; this should increase the available braking capability quite nicely.

The gear is retracted and extended via a pneumatic system that includes an air pump behind the pilot and very small air lines running down to each wheelwell. The gear goes up and down

Two batteries behind the nose cone provide plenty of power for starting.




(Left) The landing gear indicators are LEDs located above the simple toggle switch. (Center) The steerable nosegear is custom built by Sonex and fits the jet perfectly. (Right) The maingear features two tires per side—just like the space shuttle. To improve stopping power, John Monnett has a new design in the works for the brake system.

fairly quickly when the pilot throws the toggle switch on the panel. Three green LEDs indicate that the gear is down and locked, and three red ones indicate that it is retracted. A small pressure gauge located behind the pilot's head indicates the pressure in the system; it is viewable in flight, but not part of the normal scan. It is checked only if the pilot suspects a problem. The LEDs can be a little tough to see in direct sunlight, but you quickly learn to shade the indicator panel with your hand when checking that the gear is down.

A small camera (actually an automotive backup camera) is installed on the underside of the nose, looking backward. The image can be displayed on the EFIS screen if desired to make sure that the gear is actually extended. This is a good backup to the green LEDs, but we never had to use it in flight.

The top-mounted engine is attached structurally with two bolts. This allows for easy maintenance and a simple load path. The canopy is a tip-over and in the current kits is pre-fitted and ready to go—a huge time-saver for most everyone. In the cockpit, plastic side panels close out the mechanisms for controls on each side and make for a comfortable environment for the pilot. The large single-screen MGL EFIS is in

PBS TJ-100 Turbojet Engine

What makes a jet a jet is…well, the jet! The first thing people ask when a new jet aircraft is announced is, "What engine is it using?" The SubSonex became practical with the introduction of the TJ-100 engine from PBS Velká Bíteš of Czechoslovakia. Based on the hot section of a long-time Soviet APU, the TJ-100 is compact (just 24.6 inches long and 10.7 inches in diameter), weighs just 45 pounds, and produces 247 pounds of thrust at full throttle, burning a variety of jet fuels (Jet A-1, JP-5, or JP-8).

So far, the engine has proven reliable in the SubSonex and BonusJet. From a pilot perspective, you do a visual preflight to make sure that the turbine blades are in good shape and the intake area is clean. You check the oil and make sure that the itty-bitty dipstick shows the tiny quantity to be in limits. And then you get in the cockpit and let the Full Authority Digital Engine Control (FADEC) do the rest!

Engine operation is as simple as powering up the computer with the engine power (or master) switch, then taking the Start/Stop switch to Start (in the BonusJet) or advancing the throttle to the start position (in the SubSonex). Verify that the oil pressure is good, the EGT is in limits, and that the engine is stable, and you are ready to go.

Visit *www.desertaerospace.com/turbines.html* for additional information.

—P.D.

Specifications

Thrust:	110 daN (247 lbf)
Length:	625 mm (24.6 in)
Outside diameter:	272 mm (10.7 in)
Total weight:	20.6 kg (45.4 lb)
Electrical power output:	750 W, 28 V
Fuel:	JET A-1, JP-5, JP-8
Specific fuel consumption min:	1.09 kg/daN/h (1.09 L/h)
Oil:	3 cST / 5 cST
Operation Range	
Flight Altitude:	0–8000 m (0–26,000 ft)
Flight Speed:	< Mach 0.8
Start Altitude:	0–4000 m (0–13,000 ft)
Starting Speed:	< Mach 0.4
Operating Temperature:	-30 ~ +50° C (-22 ~ +122° F)

The large handle is for flaps and brakes; the small one on the quadrant is the throttle.

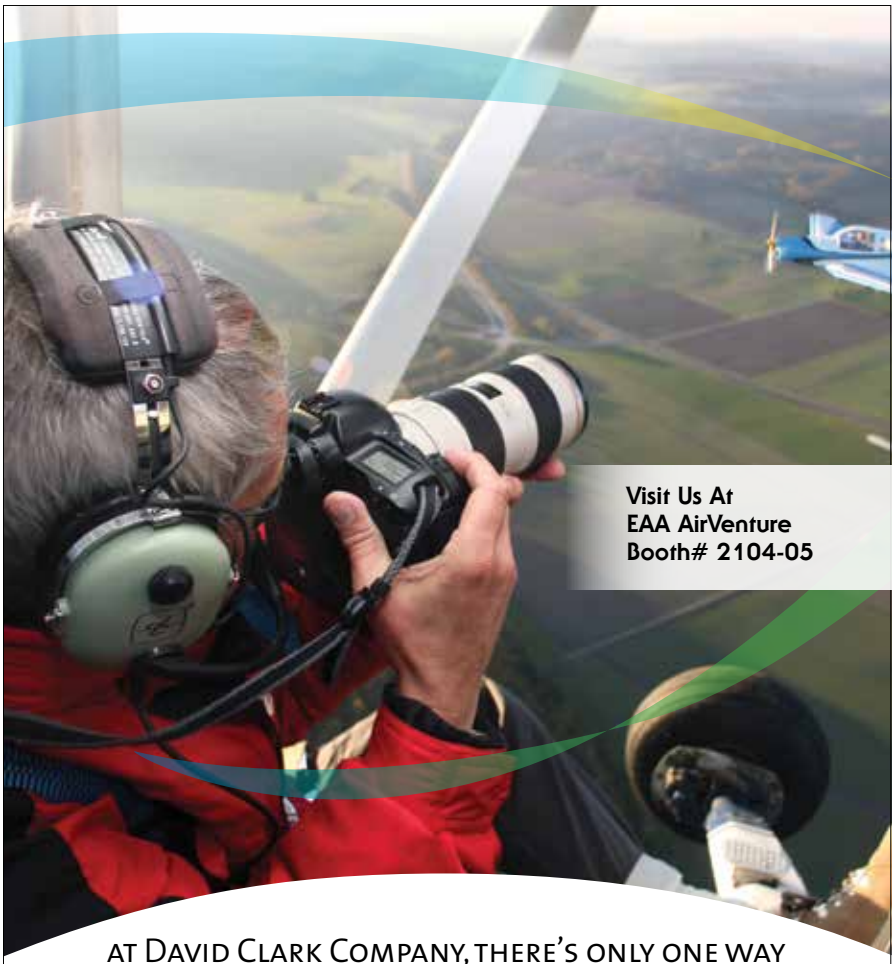
easy reach, and its position is excellent for viewing.

All in all, a builder will find that the SubSonex is conventional and much simpler to build than a typical homebuilt because there are no engine baffles to fit and build, the powerplant systems themselves are so simple as to be mostly hooking up connectors, and the most complex wiring will probably be for avionics—and if you go with the factory setup, that is mostly plug and play as well.

In the Cockpit

The SubSonex cockpit is comfortable for this average-sized human (5 feet 8 inches, 170 pounds). Bob Carlton, the factory test pilot, is three inches taller, and reports not feeling cramped. Comparing it to other single-seat aircraft, I felt it was a little wider than the RV-3 or Onex, and about the same as the newer Panther. Sonex provides plastic side panels in the kit—an unusual luxury item for small homebuilts—and yet these don't intrude on the usable space. You're not going to play handball in the cockpit, but I suspect that most pilots won't feel crowded.

Once you settle yourself in, the first thing you might notice is the lack of a stick between your legs. The SubSonex departs from traditional Sonex designs by having a side-stick controller on the right side. There is a nice rest to stabilize your forearm, and the overall system is quite comfortable.



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On the left side is a hefty handle with detents and a safety latch. Pulling back on the handle increases flap deflection, and pulling all the way back activates the brakes. As with all Sonex designs, there is no differential braking. The safety latch on the handle must be squeezed to move the lever out of the flaps-up position.

While the left hand falls naturally to the combo lever, that's not the throttle. The throttle is actually a fairly small handle on a quadrant mounted up near the canopy sill. This quadrant is the standard controller provided with the PBS TJ-100 turbojet engine, and includes a spring-loaded idle stop. The engine is started by moving the throttle through the spin-up positions, then popping it past flight idle.

The canopy latch is located behind the throttle, and is a little stiff—but this is a good thing because you sure wouldn't want to accidentally release the swing-over canopy in flight. In addition, the latch has a safety pin that is inserted after closing to make sure that it won't be moved accidently.

Moving across the front panel, you'll find remarkably few controls for a turbine aircraft. The landing gear switch and indicator lights are in the upper left of the panel. This switch controls the pneumatic gear. The pilot will occasionally hear the air pump cycle to maintain system pressure. Beneath the gear switch are the master, fuel pump, engine main power, and instrument master switches. The large MGL screen dominates the middle of the panel, and on the right, you find a controller for a cabin heater (not yet installed in this aircraft) and switches for strobes and position lights. A push-to-talk switch sits atop the sidestick.

The SubSonex panel is dominated by a single EFIS screen. Very few switches are required for the rest of the plane's operation. The engine monitoring panel is in the center console.

The center console includes the standard red Sonex trim wheel, the 2 ¼-inch MGL com radio, controls for the oxygen system, and—most importantly—the display module for the engine. This module shows rpm and EGT on vertical light bar displays, as well as status lights for the engine, oil pressure, generator, and the automatic protection system. On the right side of the center console, you'll find a big red T-handle for the Ballistic Recovery 'chute and the Mountain High oxygen system outlet.

Everything you need and nothing that you don't—that's the theme in the SubSonex. It is, after all, a day VFR airplane (at this time), and that simplifies a lot. The FAA is still trying to get its collective heads wrapped around the idea of a jet aircraft that doesn't normally fly IFR, but frankly, this airplane is plenty of fun to have around without trying to burden it that way. In any case, the SubSonex hasn't been used for cross-country flight yet, and until that need arises, the cockpit is perfect for what it does.

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LYCOMING

Sitting in the cockpit, it feels like you can almost reach out and touch the wingtips, but the little cocoon feels quite substantial and compact, not at all flimsy, and ready to go flying!

Flying the SubSonex

The SubSonex is an interesting mix of complexity and simplicity. On the one hand, we all know that jets require careful attention to procedures, precise speed control, and measured responses to off-nominal situations. On the other hand, the SubSonex is started with a single move of the throttle lever, the cockpit has very few switches, and the construction is typical Sonex—simplicity personified. There is nothing truly complicated about the SubSonex. In fact, pilots just figure that there must be a catch because it is a jet. Allow me to let you in on a little secret: If you are reasonably sharp enough to handle anything more complex than a basic trainer, you can probably learn to handle this machine.

Getting into the airplane requires a little help. Because of its size and the placement of the landing gear, it will sit on its tail with no one in the cockpit. While it is OK for it to *sit* on the tailskid, it is not OK for it to *bang* on the skid, so it is important to counterbalance the plane by having someone push down on the nose while the pilot enters. Current operating technique includes three lead-filled shot bags placed in the leg wells to hold the nose down when no one is aboard. These get removed

An Interview With the Monnetts

John and Jeremy Monnett, the father and son team that runs Sonex Aircraft and brought the SubSonex to market, sat down with us to answer a few questions about the latest addition to the already established line of kits coming out of their Oshkosh-based company. Their comments give us a window into the how and why of the SubSonex itself—as well as the obvious joy they get out of making it available to the aviation community.

KITPLANES®: How long have you been thinking about a personal jet project? What was the genesis of the idea?

John: Ever since I saw the BD-5 back in the '70s, I dreamed of having a little jet, knowing full well that at the time, it was not affordable.

Jeremy: I've been attending the airshow at Oshkosh since its earliest days and I was very young. There are a handful of airshow acts that I remember just about every detail. The BD-5 Silver Bullet Team was always a highlight for me as they zoomed past the crowd. I always wondered what it would be like to fly one. This project is 100% my father's idea, and I have been working along with the rest of the team to bring his vision to reality.

KP: From the time you thought of doing a personal jet, did the configuration change in your mind? Or did it turn out to look like your original concept?

John: Actually, Pete Buck and I looked at several configurations for a very light jet as another niche aircraft following the E-Flight electric project. The possible availability of larger model-airplane turbines allowed us to pursue the viability of the project. So, the search was on for an engine that could produce a minimum of 150 pounds of thrust.

KP: Airplanes are frequently designed around an engine; did the design idea go through multiple engine concepts? What were they?

John: I found and bought a Heward engine that promised to deliver the required thrust. We designed and built the single-wheel JSX-1. Unfortunately, the Heward did not have a controller or operating system. Our E-Flight electric team set out to design a controller for the prototype. Heward went out of business…End of story, until I met Bob Carlton at AirVenture. He was flying the PBS engine and steered me in their direction. We received very good cooperation from PBS and purchased a PBS TJ-100 engine.

KP: What do you like about the engine you chose? What features make it a good choice?

John: The PBS is a fully developed engine package. Not only the engine itself, but the controller, instruments, and fuel system components are specific to the package and greatly simplify its installation and operation. It is in production and deliverable.

Jeremy: The PBS TJ-100 engine has done everything the company promised and then some. The fully integrated package of the TJ100 keeps wire runs and harnesses short and simple compared to other hobby engines requiring external ECUs (Engine Control Units).

KP: You first flew the JSX-1 a couple of years ago. What are the design differences between the JSX-1 and JSX-2?

John: JSX-1 was basically a down-and-dirty concept prototype. It was originally fitted with a single mainwheel, which proved to be a bad idea…to say the least. Fitting it with tricycle gear and eventually a retractable nosegear allowed us to evaluate and explore the performance and handling envelope. JSX-2 shares the basic geometry, but has been refined to include a larger cockpit, fully retractable gear, more fuel capacity, rotationally molded fuel tank, and removable external wing panels.

KP: Fitting everything you need to make a flying airplane into a small package is difficult. Did you have to leave anything out of the JSX-2 that you would like to have in there?

John: I did not leave room for a smoke tank, and that has been a challenge for airshow work.

KP: Did the airframe for the JSX-2 evolve from the JSX-1 and the Sonex? Are there any similarities between the Sonex/Waiex/Onex structure and the SubSonex, or is the SubSonex a clean-sheet design?

John: Both JSX-1 and -2 share the same simple construction philosophy as Sonex's other models—a box with a round nose and canopy—but do not share any of the same airframe parts. The geometry is closely related to a scaled Waiex.

Jeremy: In its simple planform, JSX-2 is identical to JSX-1 except for the wider cockpit, which has made for an extremely comfortable cabin for most every sized individual. Our design team learned a great deal about proper V-tail design from the Waiex, and that experience transferred readily to the SubSonex series.

KP: The BRS is something that adds a lot of appeal to many pilots. What was the motivation for including that in the basic aircraft?

John: The BRS was a logical choice for a couple of reasons. It is difficult to bail out of a small aircraft with the cockpit configuration like JSX-2, and parachutes are uncomfortable and take up space. The configuration of the JSX-2 allows a no-nonsense installation near the

After his first flight in the SubSonex, the author (left) is debriefed by test pilot Bob Carlton. First impressions? The jet is fun and not difficult to fly!

when the assistant pushes down for the pilot to enter.

Once I stepped over the cockpit sill and slid my legs in place, it was apparent that the cockpit has ample room for more than just an average-sized human. Fastening the five-point harness was easy, and since the current airplane is used for aerobatic routines at airshows, it is

CG without the hazard typical of low-wing lightweight aircraft of injuring the pilot and passenger when deploying the 'chute.

KP: John, you flew both the JSX-1 and the JSX-2. Can you describe how they are the same and how they differ?

John: Both aircraft fly pretty much the same. I am impressed by how easy and solid they are to fly…much like a Sonex…on steroids!

KP: Both John and Jeremy, describe your first flight in the jet. What were the emotions you felt, this being a long-term goal?

John: As with any new design flight experience, euphoric emotions are shadowed by legitimate concern until proven unfounded. To realize the dream of becoming a jet pilot—even at the age of 70—defies description. I have been spoiled and have little ambition to get behind a spinning propeller again!

Jeremy: I felt comfortable when entering the cockpit…which surprised me. I know the aircraft from the inside out and have watched and studied lots of camera footage of Bob Carlton flying it…there's comfort in familiarity. The BonusJet TST-14 training program was also *huge* in having me ready for what to expect. I felt relief once the wheels left the ground in having a simple and stable aircraft to fly—just like the rest of the Sonex fleet. After landing, I felt extreme pride in my father and the rest of the Sonex Aircraft team and satisfaction in achieving something that no other microjet designer has before: a high-performance aircraft capable of doing fully aerobatic maneuvers and still a lower-time pilot can be comfortable flying it.

KP: Describe some of the design challenges that you faced with the JSX-2. Were there any design goals that you had to give up along the way?

John: The biggest design challenge was designing for a production package that will ensure builders' success.

KP: Does the jet meet your original design goals for speed, payload, and performance? How about handling?

John: Yes!

KP: I understand that you have sold and shipped a number of JSX-2 kits already. Can you tell us how many are on their way to customers?

John: Seven have been delivered to date.

KP: How big of a market do you expect for the SubSonex? At $130,000 for the airframe kit with engine, it is within the financial reach of many who build Experimentals; who do you think might pick this airplane instead of building a similar-priced airplane from another manufacturer?

John: Those who share the dream, understand the mission, have qualifications—and the money—for a toy!

KP: Are you making changes and improvements to the kit? Or do you think you've finalized the configuration?

John: As with all Sonex designs, we are constantly striving to improve the design, its features, and the builder's experience.

Jeremy: I would call the configuration finalized. Keep in mind that JSX-2 is a second-generation aircraft—actually third if you count the major gear change of JSX-1—and had a few minor changes to assemblies to simplify them for the kit market. At this time, no major changes are planned for the kit. The documentation package is quite simple, with many isometric assemblies taking advantage of our 3D design tools and capabilities.

KP: The quickbuild kit looks pretty complete. What is the most challenging part of the build, in your opinion?

John: The quickbuild kit does most all the real challenging tasks, including the canopy.

Jeremy: The Sonex engineering team has been involved with the FAA's National Kit Evaluation Team (NKET) process and worked to maximize the value of the kit and level of completion while staying compliant with the spirit and intent of the Experimental/Amateur-Built aircraft rules.

KP: Is there much fabrication of parts by the builder, like the other Sonex designs, or are most of the pieces formed, and the build is mostly assembly tasks?

Jeremy: The E/A-B SubSonex quickbuild kit is very comparable to the Sonex, Waiex, and Onex quickbuild kits with the wings and fuselage at a high level of completion, and the tail and control surfaces requiring some fabrication and all assembly.

KP: What's Next? Has Sonex Aircraft got any designs warming up in the bullpen behind the jet?

John: I won't go there…We are always working on several concepts, but won't reveal them until they are reality.

Jeremy: I agree about loose lips sinking ships. We are always working on new designs and new concepts and that's what makes our company and design team special. I will say that we do not plan, or desire, to come out with new things that compete with our proven products.

KP: Feel free to expound on anything else you'd like to say!

John: I hope you have as much fun flying SubSonex as I do!

Jeremy: Ditto!

—P.D.

SUBSONEX

Kit Price	$130,000
Estimated completed price	$150,000–$200,000
Estimated build time	300 hours
Number flying (at press time)	1
Powerplant	PBS TJ-100 turbojet

AIRFRAME

Length	16 ft 6 in
Wingspan	18 ft
Wing area	60.0 sq ft
Fuel capacity	40 gal (usable with safe foam)
Maximum gross weight	1000 lb utility, 900 lb aerobatic
Typical empty weight	500 lb
Typical useful load	500 lb utility, 400 lb aerobatic
Load Factor	+4.4/-2.2 G utility, +6/-3 G aerobatic
Seating capacity	1
Cabin width	24 in

PERFORMANCE

Max level speed	265 mph
Cruise speed	240+ mph
Maximum rate of climb	1600 fpm
Stall speed (landing configuration)	58 mph
Stall speed (clean)	64 mph
Takeoff distance	1200 ft
Landing distance	2500 ft
Range (30-min reserve)	480 statute miles

Specifications are manufacturer's estimates and are based on the configuration of the demonstrator aircraft.

equipped with a secondary safety belt which we also fastened—it was there, so why not use it. Once harnessed in, there was plenty of room to swing my head around to see the pneumatic pressure gauge behind my head (which does not need to be monitored routinely). Visibility in all directions except straight back was excellent, and controls fell easily to hand.

The prestart routine involves powering up the MGL EFIS, setting the altimeter, and preparing to record data (if required). One unique step is to bring up a video window to have a look at a nose camera that looks back at all three landing gear—a backup to the gear position lights. Additional preflight tasks include setting the fuel computer with the current quantity, checking the battery voltage, and setting the parking brake for the start. The large combined flap and brake lever on the left side currently has a few pinch points, but I was told that the design has already been changed to allow more room for larger hands.

The start sequence begins when you power up engine electronics and check the display with the lamp test feature. Next comes the fuel pumps and a check to make sure the pressure comes up

The SubSonex Kit–What You Get

The SubSonex JSX-2 is sold as a quickbuild kit with a base price of $130,000. Among the many options is an ultra-quickbuild upgrade, which includes pre-built tail and control surfaces, and pre-installed windshield components. The ultra-quickbuild upgrade can only be used with aircraft licensed in the Experimental Exhibition category. It does not comply with the E/A-B "major portion" rule. For a summary of the differences between the two categories, visit *http://tinyurl.com/qcqtpqu*.

Standard Equipment

- SubSonex E/A-B Quickbuild Kit: Includes pre-built fuselage, wing and pre-installed canopy.
- PBS TJ-100 turbojet engine with all control and monitoring accessories including throttle control, engine monitoring instrument, and pre-wired harnesses.
- BRS full-aircraft parachute recovery system, harnesses, and installation hardware.
- Parts to build and install tail and control surfaces, including cockpit controls, pushrods and cables.
- Parts to trim and install windshield.
- Retractable landing gear, wheels, and brakes including cockpit controls, pre-wired harnesses, and required installation items.
- All fuel system parts and plumbing.
- All fiberglass parts and molded ABS plastic fairings.
- AeroConversions elevator trim system.
- ABS molded cockpit side panels in black.
- Textured nylon upholstery in black or gray.
- All required hardware.

Optional Equipment

- Experimental Exhibition category upgrade with pre-built tail and control surfaces, and pre-installed windshield components: $5,000
- Cabin heat system: $1,500
- Aveo PowerBurst all-in-one wingtip LED light units (includes nav, position, and strobe lights): $479
- Mountain High Oxygen System: $1,680
- Leather upholstery with heated seat in black, gray, or tan: $500
- MGL/SubSonex Instrument Package—includes: MGL iEFIS Explorer package with all sensors, harnesses, and fuel level probe; MGL V6 Com VHF transceiver with harnesses and antenna (controllable by iEFIS unit); Sandia STX 165R remote-mount Mode-C transponder with harnesses and antenna (controlled by iEFIS unit): $8,518
- Triton TC 167 fully-enclosed trailer with side door and modifications for SubSonex Jet (SubSonex kit will be packaged in trailer for delivery): $7,000

—Courtesy of Sonex Aircraft, LLC

above 4.0 psi. The start is accomplished by advancing the throttle from the stop position to the first detent—there you can hear the separator spooling up. After about two seconds, the voltage stabilizes, and you go one more notch to the slow-spin position—you can then hear the compressor beginning to turn. Again, the voltage stabilizes and you go to the high-spin position, then when a few more seconds have elapsed, you depress the flight idle plunger and advance the throttle to the 50% position—ignition kicks off shortly, and the pilot monitors voltage, fuel flow, and EGT to make sure the computer does everything properly.

Procedures call for one to two minutes of engine warmup, and if you have already latched the canopy and are ready to go, you can advance the throttle to break away and begin rolling for the runway. It takes a fair amount of throttle to get rolling—then you want to retard it right away to flight idle to prevent rampant acceleration. Speed is modulated by pulling back on the brake handle. Braking effectiveness is a bit limited on this particular airplane, and Sonex knows this; they are already working on brake modifications, which should make speed control while taxiing much easier.

Once you have completed the start sequence and are rolling toward the runway, you'll find there is remarkably little left to do before takeoff. Check the flight controls one more time, scan for traffic, disable limit monitoring for the engine (to prevent a potential automatic shutdown at a bad time), and as you roll onto the runway, slide the brake/flap handle all the way forward, steering onto the centerline with your feet. Advance the throttle smoothly to about 90%, let it stabilize as the airplane accelerates, advance it to full power, and watch the airspeed climb—quickly!

The tiny wheels are up to the job of supporting this airplane, but as you reach rotation speed of about 90 mph, you might wonder how much more they can take. The answer is plenty, but they get sounding pretty frenetic as you ease

back on the stick. Easing is important to prevent over-rotation, and patience is rewarded with a smooth liftoff and acceleration. The intensifying wheel rumble beneath you is a good cue that it's time to lift off, and as it goes away, an equally good cue to throw the switch to retract the gear. The three green lights go out, the sound of the gear in motion comes and goes, and the three red gear-up lights come on—just about the time you accelerate past gear retraction speed and start really covering ground.

160 mph is a good speed for climb, giving a nice rate and good penetration at the same time. Jet engines produce more power the faster they go, so speed is important for a good climb. I found that if I flew a reasonable pattern at 160, by the time I was on crosswind I was nearly 1500 feet above the airport—well clear of traffic and headed to the practice area. This procedure was with the engine throttled back to 92% (maximum continuous power) once above 300 feet agl. Pitch stability in the climb was good, with fairly light forces. I was advised to keep the trim full nose up during climb, primarily because the spring bias system doesn't add much force, and the sensitive pitch channel requires little force to hold speed. This actually worked quite well, and I found no hunting or instability across a wide speed range. It is not strongly stable however—but this really helps you point it wherever you want to go—including *up!*

Once level in the practice area, my first task was to do some 360° turns, first with 30° of bank, then at 45°—and then increasing that to 60°. Once I got over 45°, opposite aileron was required to keep the bank from steepening—something the SubSonex shares with most constant-chord, low-aspect ratio wings. There was plenty of control authority to keep the airplane tracking in roll and yaw, and little effort was required to maintain altitude. Sitting well up front, with little beyond your feet for reference, it pays to frequently glance at the attitude indicator on the primary flight display (PFD) to make sure you aren't gaining or losing altitude.

Rolling out on a heading was a piece of cake (the smooth morning air making it even easier), but even the afternoon bumps didn't make the task difficult. With the area cleared of traffic by steep turns, I slowed the airplane

The Road to SubSonex PIC

The FAA is always a little uneasy when it comes to the word "turbine." Despite the SubSonex being a single-engine sport plane, the fact that it has a turbine engine means that they won't let just any private pilot walk up and fly it. Special training and licensing is required, and that training has to be specific to each type of aircraft. It can be especially tricky when the aircraft in question is a single-seater, since authorization has to be given to fly the airplane before the pilot has demonstrated their ability to do so. In the case of the SubSonex, the airframe and handling qualities are not that different from many light sport planes, and it holds little surprise for anyone with time in the Sonex, Onex, Mustang, or many of the RVs. But the FAA wants pilots somehow to train on the PBS TJ-100 turbojet and learn the little things that make turbine-powered aircraft different.

Enter the BonusJet TsT-14. A self-launching sailplane that uses the same engine and engine control system as the SubSonex, it has two seats, allowing inflight instruction on the operation of the jet. In addition, it can be used to provide new turbine pilots with training on the spool-up times required from pure turbojets, and help them learn to anticipate power changes, especially on final approach.

The training program developed for the SubSonex takes a private pilot through the necessary training in the BonusJet to get an authorization to fly that specific type—the Experimental equivalent of a type rating. This training is provided by Desert Aerospace at its Moriarty, New Mexico, facility and includes both ground and flight instruction. Their curriculum is thorough and comprehensive, and the web site outlines about eight hours of ground instruction and six hours of flight time before the checkride. This is not a fixed time, however. Depending on the student's experience and comfort in the airplane, it can be less—or more. Although a glider rating is not absolutely required, it will likely take considerably longer for a student to get comfortable with the BonusJet if they have never flown something with long skinny wings and lots of adverse yaw.

Assuming that student has a glider rating, the training ends with a checkride administered by an FAA Designated Pilot Examiner (DPE). The ride consists of air work, engine operations (such as inflight shutdown and re-light), and a number of landings. If the ride is successful, the student receives a new license authorizing them to act as PIC of the TsT-14.

With the rating safely tucked away, the DPE will contact the local FSDO for a Letter of Authorization for the pilot in the SubSonex. This letter allows the applicant to fly the SubSonex for a period of 60 days for the purposes of proficiency flights, practice for the practical test (for a permanent authorization), and for the practical test itself. Flight training in preparation includes familiarization flights in the BonusJet with the spoilers deployed and the pilot controlling glidepath with the throttle. This exercise gets the pilot used to the spool-up lag inherent in pure turbojets, such as the PBS TJ-100. Once that familiarization is complete, it is time for the pilot to strap into the SubSonex for their first flight!

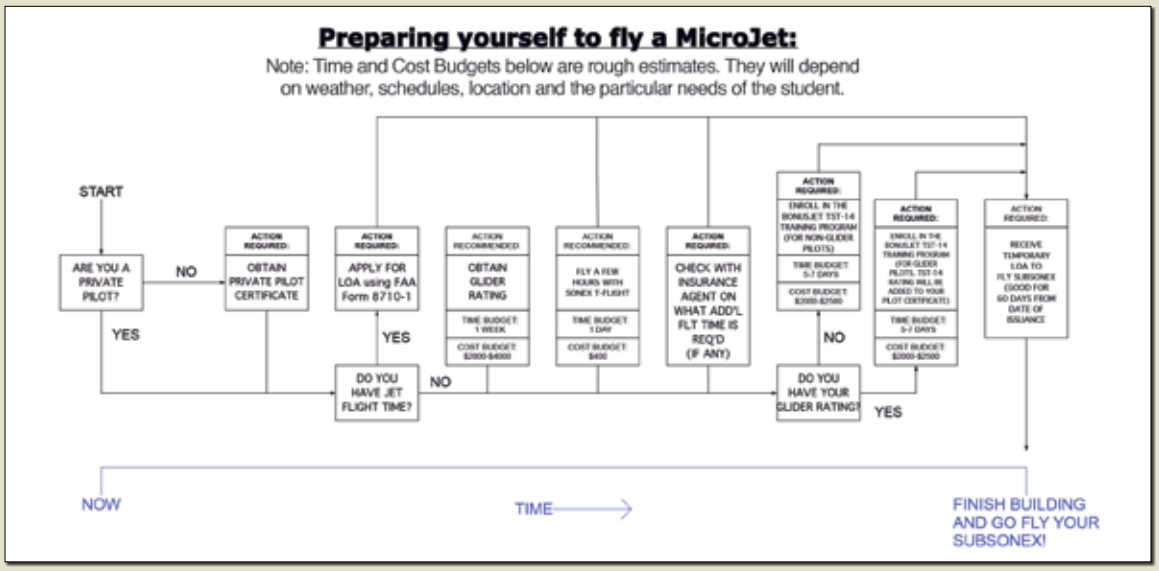
The final checkride for a permanent authorization is done the modern way—with a GoPro camera mounted in the cockpit, and a list of required maneuvers to be performed on the pilot's kneeboard. The examiner tells the applicant what he needs to see, and the applicant then takes off and flies the program. The video from the GoPro is analyzed post-flight, and pilots who do everything to the required tolerances are issued a permanent authorization on their license to fly the SubSonex.

So who can take the course? Legally, anyone with a private license (Airplane Single-Engine Land) or better. There is some debate on the need for an instrument rating; although the Letter of Authorization (LOA) is for VFR only, there are those in the FAA who believe that the instrument ticket is required for anyone flying a jet.

If the student does not hold a glider rating, they can't act as PIC of the BonusJet, and don't need the actual checkride in that aircraft (this path has not yet been explored as we go to press, since everyone who has gone through the process has had a glider rating), but can have the LOA for the SubSonex based on their satisfactory training on the engine operations in flight.

While the SubSonex is not overly challenging to fly, we'd recommend that pilots have a solid background in flying light, sensitive aircraft and be comfortable with a wide speed range. No matter your experience, as long as you feel comfortable getting started, the careful team at Desert Aerospace will guide you into the world of jets at a pace appropriate to your experience level.

—P.D.



Graphic: Jeremy Monnett

down to see how it stalled. Power on, power off, clean, or dirty—the stall was not a problem. This is not a swept-wing fighter, and the behavior was again very much what you would expect from a short-wing sport plane. There is no real rolling torque applied to the airplane at slow speeds, and while it did tend to fall off on a wing at the buffet, it seemed random whether it would go right or left. Recovery was simple and straightforward, with little loss of altitude. Deep stalls and spins were not on the agenda, and we understand that spins are on the test plan in the near future, so there was no need for us to rush the process.

For now, we felt it was prudent to leave the aerobatics to airshow performer and SubSonex test pilot Bob Carlton, although a few mild lazy eights showed no uncivilized habits. It would have been nice to stay up in the clear New Mexico sky all day—but there were landings to be evaluated and I was burning fuel, so it was time to start a descent and head for the runway. Preflight briefing emphasized a stabilized approach from a reasonably sized pattern, so I planned a wide downwind entry and got the speed down below 125 as soon as I was established. This is the current gear extension speed, so once leveled off, I threw the switch and the noise level increased as the wheels stuck out into the airflow. Three green lights rapidly appeared—a welcome sight on any first evaluation flight.

With no room for a standard smoke tank, Carlton designed a conformal fiberglass container that fits in place of the seat cushions for airshow work. It is quickly removable for normal flying.

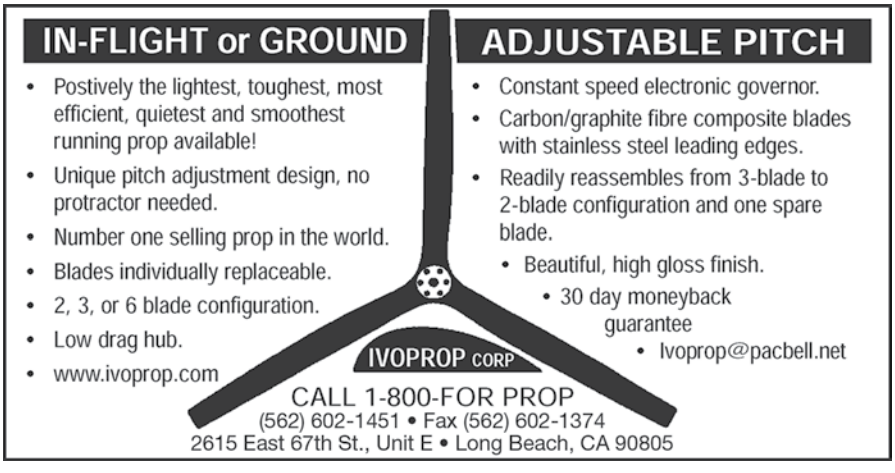
Pattern operations are fairly simple: Make sure the gear is extended on downwind and disable the automatic protection for the engine (this means turn the PDB on and verify the red light). Drop one notch of flaps at low key, abeam the touchdown point. Slow to about 110 and set power as required to maintain a nice glide path to the runway. Fly the pattern wider than you would for your typical short-wing sport plane—this is not an RV, and you don't want to be dropping in from a high, steep approach. Jets like nice, stabilized approaches that give you plenty of

time to get the speed and power right. I tried for about a mile on final for my approaches; clearly, with experience, this can be shortened up a bit.

Glideslope control is important—you don't get instant power response from the jet. Although the lag is not terrible, it is noticeable, so any deviation where you think you are going low needs to be corrected right away. If you find yourself chasing the throttle back and forth, it is probably a good sign that your approach is not stable, and a go-around would be appropriate. Too much speed is also going to be a problem; the airplane just won't slow down since there is always that residual thrust that you can't get rid of. There's no big constant-speed prop to act as a speed brake here—just smooth power. I slowed to 100 mph on base and pulled on another notch of flaps to add drag, then brought it down to 95 mph on final; this gave me a good feel between too fast and too slow, with a little extra energy if I needed it.

Pilots are cautioned that if they don't like what they see on approach, a go-around decision should be made early—not just inches off the pavement. It takes several seconds to get enough thrust out of the engine to arrest the sink rate and establish a climb, and the effects of the top-mounted engine is a downward-pitching moment when it really gets going. There is plenty of control authority to handle the pitch-down, but it can be a surprise the first time around, and it is best handled with a little altitude between you and the pavement. I performed a go-around early in the evaluation flights, just to experience the effect, and once I'd felt it, became comfortable with what is required. It's really a characteristic of the configuration rather than a fault—but it does mean that you need to stay ahead of the airplane (as with all high-performance singles).

Crossing the threshold at 85 mph seemed about right to minimize float, and then it was just a matter of feeling for the runway in a very low-slung airplane. Keep on flying it after you think you should have touched down—you



are probably still a foot in the air (unless you are used to flying tiny gliders). The touchdown itself was generally smooth, with no hint of bounce. The nose came down on its own almost immediately, and then it was up to the brakes. Make sure that the throttle is at idle; there's no need to add any more energy into the equation.

The current flap/brake lever is a bit tight for even an average-sized hand, but with a little practice, you can get your pinky on the safety catch and pull back with the whole hand to get brakes. Keep on braking because this is going to take a while. John Monnett has a design for a separate brake lever in the works, and this should make things much better. But for now, a longish runway is desirable. Touching down on speed makes a big difference as well, of course—on slower landings I used a lot less pavement to get stopped. If you're still rolling, keep braking! It'll stop. Bob O'Haver, the Designated Pilot Examiner (DPE) authorized to issue ratings for the airplane, suggested pumping the brake handle, and this worked better on my last flight. Steer with the rudder pedals, and no, pushing on them harder won't make you stop any quicker—they are just rudder pedals, not brakes! When you feel that you can make a nice 90° turn, go ahead and turn off the runway, then taxi with your hand on the brake lever and the throttle at idle. Thought you were done braking, huh? Nope—not until you get to the hangar!

Smiles seem to be one constant among those who have flown the SubSonex. Carlton (left) and Dye find it hard to stop grinning when talking about the jet.

Shutdown is as simple as the start: push the detent button in and slide the lever to the stop position and listen to it spool down. The control unit will keep motoring the engine two minutes more for cooling, so expect to hear it continue

to turn. When the spinning stops, you can power down the rest of the airplane according to the checklist. Stop any recording on the EFIS, turn the master off, and you're done. You can open the canopy while the engine is cooling down, a recommended practice in New Mexico, even in the early spring; that big piece of Plexi collects a lot of heat!

Lasting Impressions

The SubSonex is not a hard airplane to fly at all—just different in a few ways. You need to have some speed to get a good climb, and you need to be aware of the time it takes to spool up the engine on approach in case you find yourself low. A shallow approach can be nice and stabilized.

Slow flight in the airplane is comfortable because this jet actually has some wing; I have flown many homebuilts with bad stall characteristics, but this is not one of them. Because you are sitting ahead of the wing, and there is very little ahead of you, sight references for turns and other maneuvers are sparse—a quick glance at the attitude on the screen is a good idea.

It would be nice if the MGL EFIS had a velocity vector (flight path indicator) like other systems; this is generally the quickest way I know to make sure you aren't climbing or diving when sight references fail you. Nevertheless, I was able to make my way through a couple of 60° banked turns in some pretty good bumps while keeping the altitude plus or minus 100 feet.

The main areas of improvement are already being worked on by Sonex. Beefier brakes and a modified brake handle will make ground handling and rollout more comfortable. You couldn't ask for simpler systems operations: the engine is on, off, or throttled. There's no mixture to monitor or prop pitch to play with. The design is pretty mature, and while I am sure there will be additional changes as more pilots finish their ships and begin to fly them, I would be happy to fly the current airplane regularly if I had one available. For those Sonex customers receiving the first few SubSonex kits—you've got a lot of fun ahead of you.

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BonusJet—an Airborne Simulator

Training people to fly a new single-seat airplane has always been problematic. By definition, the first time a pilot flies one, they are going to be alone. In many cases, a two-seat version can be specially built. Other times, a two-seat airplane with similar characteristics to the single can be found in which to train. In the case of the SubSonex, a creative solution was found in an unlikely airplane—the BonusJet, a two-seat, self-launching sailplane with the same PBS TJ-100 turbojet engine as the SubSonex, but radically different flying characteristics and speeds. The SubSonex has a wingspan of 18 feet, while the BonusJet's impressive span is almost that in meters. And while the SubSonex redlines at a hair under 300 mph, you can't operate the BonusJet at more than 81 knots with the engine running.

Still, the BonusJet, developed by Bob Carlton of Desert Aerospace, has unique properties which make it an effective tool on the way to flying the SubSonex. Aside from it having the same engine, the view from the low-slung cockpit is remarkably similar, and the delayed response to throttle inputs inherent to a turbojet is a good match for what the pilot will experience in the SubSonex. Having the chance to experience these things with a good instructor in the seat behind gives confidence to the pilot who has to strap into the little jet solo for the first time.

As Simple as Practical

Carlton's redesign of the Bonus self-launcher included a new trapezoidal engine pylon that is operated by a single jackscrew to raise or lower the engine. Linear actuators pop the doors open and closed with the activation of a single cockpit switch. Most pilots I know can deal with a toggle switch labeled "Up" and "Down," and it truly is that simple. A sequencer includes a cool-down timer so that when the engine shuts down, two minutes must elapse before the motor will be allowed to stow—but the pilot can throw the pylon switch to "Down" concurrent with engine shutdown. The system will provide the necessary time delay.

This simplicity is matched by the engine operation itself: The controls consist of a switch labeled "Start" and "Stop," and a throttle. With the throttle at flight idle (about 50%), throw the switch to "Start" and watch the battery volts, fuel flow, and EGT as the engine computer goes through the necessary sequence of spin-up, ignition, rollback, and throttling to get to a stable idle. After a minute of warm up, make sure that the oil pressure light is out and you're ready to fly. An automatic protection system monitors the engine and will shut it down if limits are exceeded. A push-button switch overrides the system for takeoff and landing to prevent sudden loss of power. For critical flight phases, the engine is deemed more expendable than the pilot and passenger.

The fuel system consists of two wing bladder tanks that hold a total of 24 gallons of fuel. The two tanks feed a header tank, which feeds the engine. There are three fuel lines that exit the wingroots inside the cockpit and connect to the cockpit's rear bulkhead and then pass to the engine bay. Since sailplanes routinely sit with one wingtip touching the earth while on the ground, fuel will flow from the high side to the low, so the fuel quick disconnects have to be detached after landing, and then re-attached before the next operation. This is not a "kick the tires and light the fire" cross-country, everyday machine—it takes a little preparation and careful checklist work to fly safely.

Taking Wing

Once through the checklist with canopy fastened and ensuring that your passenger is ready to go, the process of beginning a flight is simple: Signal your wing runner with a twirl of a finger and take the engine switch to "Start." Monitor engine parameters as it goes through the automatic start sequence. It takes about as long to read that as is it does to happen—so you want to be ready and rehearse where your eyes go after confirming each step. If all is normal, the engine will whistle along merrily in just a few seconds.

Once a minute warm up is completed, signal your wing runner that you are ready to taxi. Taxiing is another cooperative effort—the pilot advances the throttle and touches the brake to control speed, but the wing runner steers. From a good start position, slowly move the throttle to 100% and get ready to steer with your feet, keeping the wings level with ailerons once the runner releases you. Raise the nosewheel just a few degrees at 40 knots. As you establish that attitude, it will fly right off. Accelerate in ground effect to 65 and maintain that, while

The key to the BonusJet is the PBS TJ-100 engine—in this installation using a bifurcated nozzle to avoid the vertical fin on the Bonus airframe.

The instrument panel on the BonusJet is standard glider—except for the jet engine monitoring panel at the bottom.

The throttle is the black handle, the speed brake is the blue. The green handle is the trim lever, and we never moved it more than one notch from the center position.

The compact engine incorporates a 60-amp starter/generator in the center/hub section.

bringing the power back to 98%. The engine limits are five minutes at full throttle, 30 minutes at 98%, and unlimited at 92%.

Once aloft and clear of the airport, normal air work proved the BonusJet's capability as both a sailplane and a powered aircraft. Stalls, slow flight, and steep turns are part of the transition, and once you get your feet and hands coordinated, you can fly with precision. Those who have never flown a high-performance, long-winged sailplane will discover their unique handling characteristics. Acclimatization to the effects of adverse yaw, the flexibility of the structure, and the slower overall speed range (redline is 111 knots) takes some time. There is little pitch change with power, and we flew with the trim always within a three-notch range. You can shut down the engine, allow it to cool for two minutes, and then stow the engine and pylon with a throw of a switch anytime you wish. In-air relights are even simpler—you can unstow and start the engine with no delay—and have power up and ready to go in about thirty seconds.

Back to Earth

Landing a "glider" under power is not really complicated—you just have to remember that you have at least 45 pounds of thrust all the time. The procedure is actually quite simple: Pull the throttle to flight idle (50% RPM) at low key, abeam the touchdown point, and fly it to landing like a glider, managing the glideslope with the spoilers. Fifty percent power is nowhere near enough to take off or climb, so it will simply make your descent slower and—if you are high—fly with the spoilers all the way out to get down.

This sometime-glider-pilot has occasionally landed far short of the desired parking spot and run out of energy on the runway, leading to an ignominious long push of the glider down the pavement by foot. Not so with the BonusJet's engine running—once planted with spoilers out, you can add power and taxi so long as you keep the wings level with aileron (assuming you have some airspeed). The very effective Beringer brake on the mainwheel can modulate speed to bring the aircraft to a stop precisely where you want it—with the wingtip in your waiting support crewmember's hand. Shutting down the engine, giving it a minute or two to cool down, and then making sure that you disconnect the fuel lines to prevent fuel from flowing between wing tanks secures the aircraft after flight. Once again, the checklist is important.

A Great Transition Trainer

Despite the obvious differences between the BonusJet and the SubSonex, it turns out that the one prepares you well for the other. And even if the SubSonex is not your goal, the BonusJet training program is available to anyone who would like to add that first turbine rating to their license—for a reasonable amount of money. For more information, go to *www.desertaerospace.com*. ✝

—P.D.

Bob Carlton, founder of Desert Aerospace and creator of the BonusJet.

The author about to go up for a training mission with instructor Bill Hill in the back seat.