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FLIGHT REPORT ON THE SUBSONEX PERSONAL JET

BY BOB CARLTON

LET'S FACE IT. MOST DREAMERS wish they had a jet, and most pilots are dreamers. Sadly, most pilots have resigned themselves to the fact that owning a jet will forever remain on their wish list—or will it? The SubSonex jet may be just the ticket to make that dream reality.

WHAT IS THE SUBSONEX?

The SubSonex is the brainchild of John Monnett, EAA 15941, of Sonex Aircraft. Most readers will recognize John's name as one of the most prolific designers of homebuilt aircraft. Since the 1970s, John has been the designer or co-designer of a

PHOTOGRAPHY BY **JIM KOEPNICK**

number of plansbuilt or kit aircraft, including the Sonerai racer series, Monerai sailplane, Moni motorglider, Monex, Sonex, Waiex, Xenos, and most recently the single-place Onex (pronounced One-ex).

A few years ago, John realized that small R/C model jet engines were getting bigger, possibly big enough for a manned aircraft. Ever on the lookout for novel but affordable flying ideas, he also realized that these tiny engines could burn peanut oil, which is cheap and readily available in late summer in Wisconsin. Using the time-tested, simple design philosophy from the Sonex, Waiex, and Xenos, John set about building the prototype jet, originally called the Peanut Project.

The prototype debuted at EAA AirVenture Oshkosh 2009, sporting a British turbine engine rated at 150 pounds' thrust. Unfortunately, the engine manufacturer failed to ship the engine controller, placing the Peanut Project (now renamed the SubSonex in a self-deprecating reference to its diminutive size) on indefinite hold.

THE ENGINE SOLUTION

John wasn't the only one who had realized the potential of small jet engines. For several years, I had been flying a light sailplane with two U.S. Microjet engines rated at 45 pounds' thrust each. While these tiny engines worked well enough, I was on the lookout for something bigger and more reliable when I discovered the PBS TJ-100 turbine engine. The TJ-100 is rated at 247 pounds of thrust, but weighs only 40 pounds. With its roots in military and aerospace applications, it was a scaled-down airplane engine, not a scaled-up toy engine. I first contacted PBS in the summer of 2007, and made a trip to the factory in the Czech Republic in January 2008 to present my jet sailplane concept and see the engine firsthand. After seeing the excellent quality of the engine, and meeting the professional PBS engineering staff, I was convinced. Within a few months, the TJ-100 engine was powering my aerobatic Salto air show sailplane.

I flew the TJ-100-powered Salto in the air show at AirVenture 2009, where I first saw the SubSonex prototype on static display. Being a newly converted jet aficionado, I was instantly drawn to it. When I discussed the SubSonex project with John, he lamented the fact that the British engine wasn't working out. I suggested he watch my performance in the TJ-100 powered sailplane that afternoon and see if he thought the TJ-100 might be a good alternative. The entire Sonex crew was at the flightline the next day, watching the TJ-100 engine push the Super Salto through its aerobatic routine.

After managing to get a partial refund on the non-working British engine, John ordered a TJ-100 engine. The engine installation took only eight days (including two days when the snow was too deep to reach the shop), and the first test runs were conducted on a very cold December day, with the engine doing a fair job of melting the chest-high snowdrifts around the hangar. With a complete and reliable engine, the SubSonex now awaited final inspection—and better weather.

Sonex founder John Monnett helps Bob Carlton strap in before the SubSonex photo mission.

PHOTOGRAPHY BY JIM KOEPNICK

DELAYED AGAIN

Wisconsin may have many virtues, but weather isn't one of them. As John says, "We have four seasons: June, July, August, and winter." By the time the winter weather (and John's schedule) cleared, and he finally got a chance to take the SubSonex out of the hangar for its first taxi tests, it was late in the summer of 2010. The first taxi tests revealed some control issues. The SubSonex was originally fitted with a single, centerline main wheel, wingtip balancing wheels, and a steerable tail wheel. It seems the high engine thrust line and fuel sloshing in the tank caused some control problems, resulting in a little cross-country excursion during a high speed run. After some rethinking by the Sonex design team, a new tricycle gear was installed to improve directional control at high thrust, and baffling was installed in the fuel tank to reduce sloshing. From an engineering standpoint, the problems were solved. However, elsewhere trouble was brewing.

It seems the little unplanned excursion, combined with the fact that the SubSonex was jet-powered, had raised some eyebrows at the FAA. A letter was issued stating that the control problems were

A molded fuel tank is located behind the pilot seat.

obviously caused by the "gyroscopic progression" (sic) of the jet engine, and the SubSonex operating limitations were pulled while the powers-that-be struggled over how to rewrite them. Once again, AirVenture came and went.

Finally, after visiting many government offices, and receiving approval stamps from high places, a corrected version of the operating limitations was issued. It read exactly like the old version! By this time, runway construction had begun at Oshkosh. By the time construction was finished, winter weather was setting in. The SubSonex was again on hold.

A FEW YEARS AGO, JOHN REALIZED THAT SMALL R/C MODEL JET ENGINES WERE GETTING BIGGER, POSSIBLY BIG ENOUGH FOR A MANNED AIRCRAFT.

PROGRESS RESUMES

By summer 2011, Sonex Aircraft was a busy place. With aircraft kits selling well, development work continuing on a number of research projects including the e-Flight Initiative and Turbo AeroVee, and the introduction of the Onex (with more than 50 orders received within a few weeks of its announcement), the poor SubSonex had slowly been worked to the back corner of a very full hangar. By this time, John and I spoke regularly on the phone and by e-mail. I suggested that maybe I could stay after AirVenture and help. We began the arduous process of adding me to the FAA paperwork. After assuring that I understood the dangers of flying an experimental jet, the FAA issued me a temporary letter of authorization (LOA) to fly the SubSonex. With everything finally set for a first flight, I donned my parachute and climbed into the cockpit.

John Monnett may be a giant in the world of experimental aircraft, but in person, let's just say he's not the tallest guy in the shop. Since the SubSonex was intended to be a prototype, it was designed around John's 5-foot 7-inch frame. At closer to 6 feet, I had to remove all the nicely upholstered padding and wear a padless chair-type parachute. The next morning I bought some thin-soled deck shoes, which the guys at Sonex immediately nicknamed my ballet slippers. John modified the side stick and cut a notch in one of the vertical stringers (no longer structural after the removal of the centerline main wheel) to allow some elbow room, and *voilà!* I fit. Actually, once I was shoehorned in, the cockpit was surprisingly comfortable.

ELEGANT SIMPLICITY

The SubSonex is of simple metal monocoque construction with low, non-swept, non-tapered wings in the classic Sonex form. Primary control is by means of a side stick and conventional rudder pedals. The generous flaps have stops at 15 degrees and 30 degrees, and may be manually pulled to 45 degrees for glide path control. Braking is accomplished with a single hand lever.

The SubSonex's panel is the ultimate in simplicity. The instruments consist of a digital altimeter/airspeed indicator and matching digital transceiver (graciously provided by MGL Avionics), digital fuel quantity, and fuel pressure gauges. The PBS-supplied engine display shows rpm, EGT, oil pressure, and generator status. The panel contains only four switches: master, engine, instruments, and fuel pump. Below the panel, the standard Sonex pitch trim knob is bracketed by the Hobbs and voltmeter. The engine thrust lever (or throttle) is mounted along the

PHOTOGRAPHY BY **JASON TONEY**

left canopy rail. This single lever controls engine start, stop, and thrust. Fuel is stored in a tank behind the seat.

ENGINE OPERATION

Like the SubSonex's other systems, the TJ-100 engine is extremely simple. To start the engine, you simply depress a detent with your thumb and slide the thrust lever past it. The engine begins spooling, and in a few seconds the high-pitched compressor whine is replaced by the roar of ignition. The EGT begins to climb rapidly. As rpm increases, the temperature subsides a bit, the yellow generator light goes out, then the temperature stabilizes as the rpm reaches idle at 50 percent (30,000) rpm. All this takes about 20 seconds, and requires no input from the pilot. The same lever used to start the engine now serves to control it. Shutdown is accomplished by simply depressing the detent and pulling the lever behind it. That's it. No carb heat, mixture, mags, or prop controls.

FIRST FLIGHT—FINALLY

After a day of final preparation and taxi testing, August 10 dawned clear and calm. John and I briefed the first flight, both agreeing that if all felt okay, the best thing to do was to fly smoothly up to a safe altitude before attempting any maneuvers. My flight plan called for a climb to 3,000 feet and exploration of the slow end of the flight envelope in preparation for the first landing.

After briefing the tower, I taxied to Runway 18, methodically ran through the checklist—belts, canopy, fuel pressure, etc. With such simple systems there really isn't much to check. I taxied into position and eased the thrust lever forward, stabilizing at 92 percent rpm (about 75 percent thrust) to allow for quick thrust reduction if needed.

Non-afterburning jets don't exactly leap off the line. The acceleration proceeds at a stately pace, but it never diminishes. What seems at first to be a lethargic takeoff quickly becomes a bit frenetic as the little jet accelerates through 75 mph on the tiny 4-inch main wheels, with the pilot's butt only inches from the ground.

I ease back on the stick, the nose wheel lifts, and suddenly—smooth. Once the wheels leave the runway, the smooth push of the turbine continues to accelerate the little plane quickly. I ease the nose down to stay in ground effect. There is no odd pitching tendency, no yaw hunting, just smooth, straight acceleration. I'm go for the climb-out. In no time, I'm passing through 110 mph, and I ease back again to maintain this speed. The response is instant as the plane streaks skyward. I begin a very gentle left turn to stay near the airport, passing 1,000 feet AGL before I have turned 90 degrees. I continue the bank and climb to 3,000 feet. Already time to level off. It's been just more than a minute. I pull the thrust lever back to 90 percent rpm and ease the stick forward.

MY FLIGHT PLAN CALLED FOR A CLIMB TO 3,000 FEET AND EXPLORATION OF THE SLOW END OF THE FLIGHT ENVELOPE IN PREPARATION FOR THE FIRST LANDING.

Once level, I perform a few very gentle turns to get the feel of the controls. I radio down that all is well and it handles beautifully, then back to work. Following the test flight task card, I perform a series of basic control checks, and then gently feel for the stall buffet in order to predict a good approach and landing speed. The initial buffet with flaps at 15 degrees and 30

degrees is 73 and 65 mph respectively. Slow speed control is still crisp, and control harmony is good.

After a few practice approaches at altitude, it's time for the critical test—landing. I hold the airspeed at 95 mph, and modulate the flaps between 30 degrees and 45 degrees to control approach angle. Over the fence, round out, and hold it off. With little float tendency, touchdown happens a bit below 70. The nose comes down quickly, and I'm on the ground. The brakes work well, and I'm stopped in about 1,000 feet. With most of a very long runway still ahead, I taxi briskly back to the shop. After the requisite high-fives, handshakes, and photos, we debrief the flight.

FLIGHT TEST CONTINUES

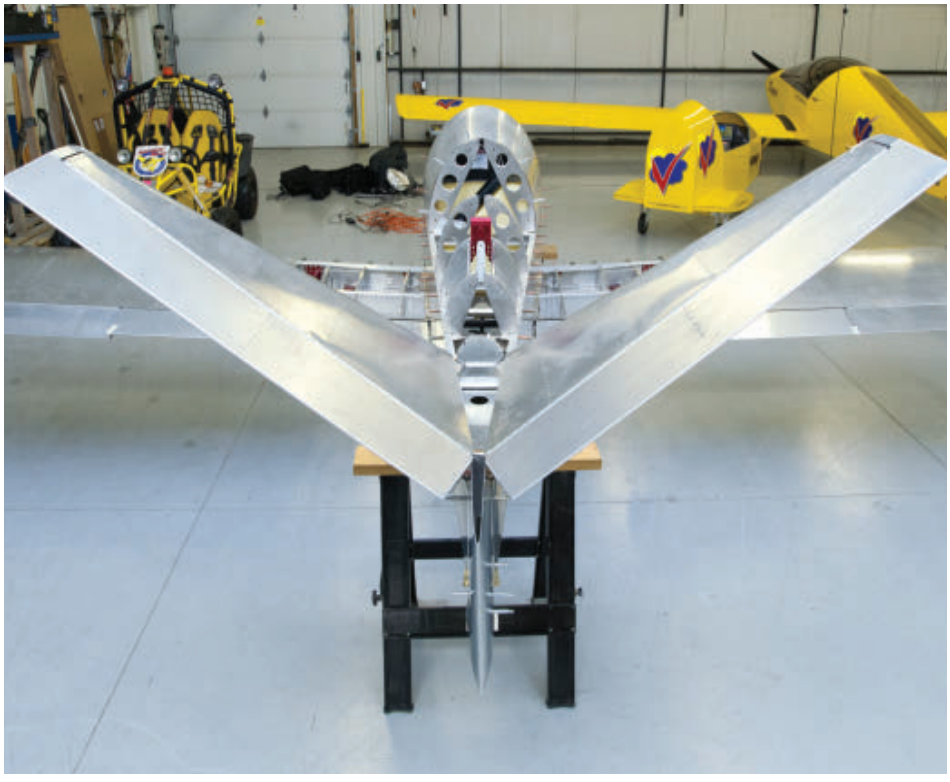
Over the next few days in August, and again in October and May (2012), we finished all of the tasks on our flight-test program and even did some aerobatics and a formation flight with EAA's photography crew. The SubSonex flies extremely well. As one might expect from its diminutive size, handling is sporty, but not twitchy. Control harmony is excellent throughout its speed range, and landings are straightforward as long as you remember the few extra seconds of lead time required for big power changes. The engine has performed flawlessly. After about 25 hours, with all flight-test program tasks completed and only a few minor squawks, the FAA released the SubSonex from its Phase 1 flight-test program and placed it into Phase 2 (normal) operation.

SUBSONEX JSX-2

The SubSonex prototype has proven the viability of the small jet concept. However, as with any prototype, a few changes needed to be made before committing the design to kit production, so the Sonex team set about creating a more customer-centric version, dubbed the SubSonex JSX-2 (following the prototype's internal JSX-1 designation). The JSX-2's cockpit provides more width and legroom, and an instrument panel large enough for the latest large-screen EFIS displays. The forward fuselage has been re-contoured for a more aesthetically pleasing shape. A BRS ballistic parachute has been installed for increased safety. The completely redesigned retractable main landing gear features a unique dual wheel structure reminiscent of a Boeing 737, and both nose and main gear struts have maintenance-free urethane spring suspension. A larger 44-gallon fuel tank, manufactured with Sonex Aircraft's traditional roto-molded cross-linked polyethylene, increases duration and range. The outer wing panels are easily removable just outboard of the main gear, allowing the JSX-2 to be rolled into a standard ATV or snowmobile trailer. Options include a cockpit heater, EDS oxygen system, and smoke system.

SO, HOW FAST IS IT?

Admit it—you thumbed to the performance section first. After all, it is a jet. All of the landing distance and climb rate numbers are secondary to the one burning question: How fast is it? The quick answer is about 245 mph at 100 percent rpm. (Now you can go back and read the beginning of the article.) Of course, the question of speed is quickly followed by



The slab-sided fuselage, narrow cockpit, and V-tail are familiar design features of the Sonex family.

PHOTOGRAPHY BY **JASON TONEY**

AIRCRAFT DATA BOX

SUBSONEX JSX-2

Seats: 1
Length: 15 feet 9 inches
Wingspan: 18 feet
Tail Configuration: Y
Primary Structure: 6061 aluminum
Cockpit Width: 24 inches
Fuel Capacity: 44 U.S. gallons
Stall Speed (full flaps): 59 mph
Stall Speed (clean): 64 mph
Landing Gear: Retractable (electric)
Controls: Single side stick
Engine: PBS TJ-100 (247 pounds)
Empty Weight: 416 pounds
Utility Gross Weight: (+4.4*g*, -2.2*g*) 800 pounds
Useful Load: 384 pounds

PERFORMANCE (predicted)
Range (30-Minute Reserve): 400 miles
Cruise Speed at 10,000 feet (TAS): 188 mph
Cruise Speed at 17,500 (TAS): 204 mph
V_{NE}: 298 mph
Max Speed at Sea Level (100 percent): 245 mph
Takeoff Distance: 1,200 feet
Landing Distance: 1,000 feet
Rate of Climb (150 mph): 2,000 fpm

questions regarding duration and range, which are a bit more complex.

RANGE AND DURATION

Unlike a propeller, which loses thrust with increasing speed, a jet has nearly constant thrust regardless of speed (at least in the speed range we're dealing with in the SubSonex). Jets also remain more efficient than piston engines as altitude increases. What this means is that, to an even greater extent than a piston-powered aircraft, a jet performs best when operating at high altitude where it can take advantage of the higher true airspeed and colder incoming air. Jets are also terribly inefficient at low power settings. In fact, the TJ-100 burns about half as much fuel at idle as it does cruising 200-plus mph at 17,500 feet. So, in the JSX-2, 44 gallons of Jet A will get you about 400 miles in about three hours, cruising at 17,500 feet (30 minutes VFR reserve and start/climb/descend/taxi fuel included). Certainly not Gulfstream numbers, but are you really going to fly coast to coast in a single-seat jet without golf club baggage capacity? As John is quick to point out, this is a sport airplane, not a bizjet. I prefer to think of it as the airborne equivalent of a crotch rocket motorcycle. Basically, the SubSonex is all about *fun*!

PILOT QUALIFICATION

Though there is some headway being made in the FAA's proposed tiered certification process, as of this writing, all pilots of type-certificated turbojet airplanes require a type rating. Lacking a type certificate, experimental jets require an LOA in lieu of type rating. Since new experimental jets are somewhat rare, the requirements for an LOA in a new experimental jet are a bit ambiguous. Suffice to say that some jet experience together with some sport aircraft experience will be required. In similar fashion to the T-Flight training program for its piston-powered homebuilts, Sonex Aircraft is developing a training program that will allow pilots to obtain the required experience at a reasonable cost. This program should be in place before the first kits are delivered.

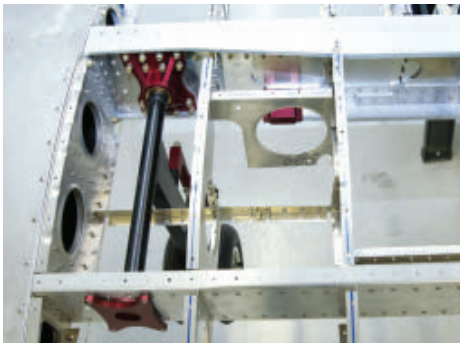
WHAT WILL IT TAKE TO GET YOUR VERY OWN PERSONAL JET?

Sonex Aircraft announced at AirVenture 2013 that it is accepting SubSonex kit orders. The introductory price, including the Ultra-Quick Build Kit and the PBS TJ-100 engine and accessories, is $125,000. A production slot can be held for a $10,000 deposit. The first two production-conforming JSX-2 aircraft are rapidly approaching completion and should be flying by this spring. The first kits are expected to be shipped mid-2014 and will have all of the fast-build features for which Sonex kits have become legendary,

ONCE LEVEL, I PERFORM A FEW VERY GENTLE TURNS TO GET THE FEEL OF THE CONTROLS.

as well as a host of spiffy new billet-machined hardware. Because of the extreme simplicity of the SubSonex, by the time the factory completes the usual fast-build tasks, the kit may no longer meet the 51 percent rule for experimental amateur-built (E-AB) status, so at least the first few aircraft will probably be registered in exhibition category, with E-AB coming later as the process is honed. The fact that the jet kits will have no cowling, baffling, propeller, spinner, or any mechanical engine control cables to build and install, and that the engine can be easily lifted by a single person and installed with only two bolts, should allow builders to finish a SubSonex kit in very short order. EAA

Bob Carlton, EAA 1011571, operates Vertigo Airshows and flies the jet-powered Super Salto sailplane.



Retractable main gear is a new feature in the SubSonex, and dual main wheels are extremely rare in light airplanes of any type.

PHOTOGRAPHY BY **JASON TONEY**