The Seawind Flyer

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"The evolution of an intelligent design." ™

Seawind LLC

P. O. Box 1041
Kimberton, PA 19442

Ph: 610-983-3377
Fax: 610-933-3335
www.seawind.net

FLIGHT TESTING

Almost nine months have gone by since we turned over the Seawind for flight testing. There have been a lot of starts, fits, stops, and restarts.

Most of the recent stops have been a result of a glitch or a detail in the design or calibration of the data system.

We last reported that the flight analyst, John Taylor, had provided a number of devices that might give us adequate flow across the rudder at idle power to recover from a stall/spin maneuver without the application of power.

Last quarter we reported on the spins to the extent of what we knew.

- The Seawind will not spin during a power-on stall. This is the most common case of take-off or missed approach stall/spins.
- The Seawind can be made to enter a spin during an idle-power stall. It can recover from the spin in less than one turn with the application of power. However, it has been determined that without the application of power, the rudder at idle power is marginal in recovering from the spin. This is the most common case of stall/spins turning final. However in the case of the Seawind, there would also have to be a total loss of power and the pilot would have to introduce a spin maneuver. As unlikely as that scenario is, the regulations require that there cannot be *any* condition in which a spin is not recoverable.

Needless to say this required our immediate attention, and we needed to determine why the rudder was not effective.

We spent two months performing investigations and searching for solutions.

~ The wings, fuselage, and tail were tufted so that the airflow pattern could be videoed.

We tufted almost the entire aircraft.

~ That was followed by test installation of vortex generators (VGs) on the mid deck and vertical tail.

~ That was followed by the installation of a strake at the base of the vertical tail.

~ That was followed by stall trips on the wings.

~ That was followed by larger mid deck VGs.

~ That was followed by a flap flow director.

Each involved a videoing flight and analysis of the results.

A flap flow director was added.

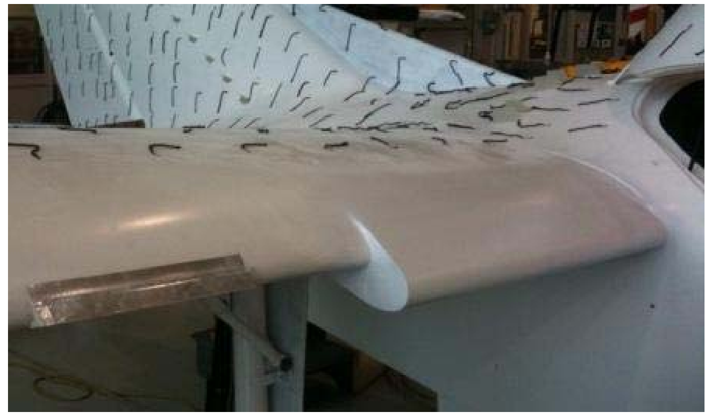
The idle-power stall air flow became a bit more attached to the rudder, but it still was not effective enough to satisfy the flight test team.

NOTE: At normal operating power settings, the rudder is very effective. The above conditions are only just below a manifold pressure of 15 inches of mercury.

It was finally determined that the Seawind requires a very high angle of attack (AOA) to stall even at idle power, requiring an AOA of 30° in order to enter the stall at one knot per second. It was determined that the stalled air blanketed the vertical tail and the dynamic energy was reduced almost to zero. Thus the loss of yaw control at idle power.

Our beautiful Seawind was being covered with trash.

Then we tested the wing droop leading edge shown in the photo and another shaped leading edge extension to determine if the rudder flow could be energized by either of those devices. It was not successful.



None of this made a significant difference.

We do have a solution called a stick pusher. It will be more expensive, but it will get rid of all the trash fixes, and it will make the Seawind both stall and spin proof.

We have made positive contacts with two suppliers in this regard. We have a lot to do to adapt this technology to the Seawind, but I am pleased that there is a solution.

HOW DOES A STICK SHAKER & PUSHER WORK?

There are one or two angle of attack (AOA) sensors on the wings. As the AOA increases, the AOA sensors signal a flight computer that has preset trigger points; for example, 14° for a stall warning and 18° for activating the stick pusher.

The shaker is an imbalanced motor that is mounted on the control yoke or column. Instead of the normal red light and horn, the small unbalanced motor literally shakes the stick to warn that a stall is imminent. If the pilot does not heed the warning and the AOA continues to increase, the stick pusher literally pushes the stick (yoke) forward to prevent the stall at 18°.

The regulations permit the use of a stick pusher as a means to prevent a stall. If an aircraft can't stall, it can't spin. For a Part 23 aircraft, the system must be reliable to 10^{-6}. Even at that, there is an override for a malfunction and for the final approach to landing. We still have to perform stall tests to calibrate and demonstrate the stick shaker and pusher.

SLOTTED FLAPS

Most amphibians have plain flaps. The Seawind has slotted flaps, which give higher lift and slower stalls. The following is a case where we shot ourselves in the foot.

We were not getting stall speeds as low as the kit Seawind, and the videos also showed turbulent flow over the flap. John Taylor suspected that the geometry of the slotted flap might be wrong. There are ideal lift coefficients for the gap between the wing and flap and the lap of the leading edge of the flap vs. the trailing edge of the wing.

Sure enough the kit geometry was closer to optimum than the certified version. Some draftsman who is no longer with us did not know how to copy the basic hinge geometry. Nor did he know how to call out bolt tolerances. We had been chasing wind-up in the flap drive system due, in part, to over-sized holes.

So the past three weeks were spent designing the wing/flap hinges to the optimum geometry, not to the kit geometry. We also looked at every bolt callout.

GETTING READY FOR FLUTTER TESTING

With no longer being concerned about stall/spin testing, we have only the last hazardous flutter testing to be completed. So far the accelerometers have not shown anything unusual.

Flutter has never been a concern. However, on the last test flight the pilot noticed the forward frame of the canopy started to lift and, at 175 knots (201 mph), the canopy started to vibrate from the air infiltration.

That clinched it. We decided to bring the test aircraft back to the factory where the work would go quicker.

The forward edge of the canopy did not properly conform to the nose deck. We repaired the miss match and reinforced the forward frame.

Again, we shot ourselves in the foot. The canopy latch on the first test aircraft was four inches aft of what it was supposed to be. It was slated to be moved four inches forward on the second aircraft, but instead it was moved four inches further aft, making it eight inches too far aft.

The two errors added up and caused the leading edge of the canopy to lift. The canopy is an airfoil shape and as such it has a lift load similar to the top of a wing.
Both of these discrepancies have been corrected and incorporated into the tooling.

WHY ARE WE TELLING YOU THIS?

Some people have wondered why we tell our potential customers what has gone wrong as well as what goes right. Every aircraft runs into problems and most incur endless delays. They don't tell you what they are, i.e.:

~ Boeing Dreamliner – they will survive the endless delays.

~ Eclipse – they did not survive.

~ Cessna Skycatcher – everybody assumed they would solve their spin problems.

~ Cessna Corvalis (previously Lancair Columbia) – everybody assumes they will solve their wing structural problem.

~ Thielert Centurion Diesel Engine – it did not survive.

~ Continental Engine – was just sold to AVIC International of Beijing, China.

For example, Continental Engine has been non-responsive to many of our questions, and I could not understand why. Maybe at long last this could be the reason.

You are not buying a toaster. Most of you are interested in knowing the ins and outs of the airplane you want to fly and why it is taking so long to be certified.

There is no question in my mind that by being transparent we maintained 50 of our pre-shutdown customers and, despite the delays, we now have issued positions 56 and 57.

FLUTTER TESTING

We are anxious to get back to flight testing and to complete the flutter testing. We are hoping to have the stick pusher equipment in time to install it as well. If not, we will resume flight testing and performance testing until the equipment arrives.

PRODUCTION

With the stall/spin testing resolved, we need only the flutter testing completed to make the decision to start Phase 4 Production and planning for the options testing for IFR, autopilot, etc.

QUESTIONS

We have received some questions that I am sure are of interest to all of you. In keeping with our privacy promises, we will use only the first name.

Jim from Alaska asked: *About the flaps, if the aircraft does not want to stall until high angles of attack are achieved, then why do the flaps need to be more effective?*

You are right, Jim. From a practical point of view, it does not make sense. The rules and regulations do not have to make sense. In fact they can be contrary to one another.

The rule and method of stall testing is, stall entry must be tested at a one-knot-per-second decrease in speed. According to power setting (idle vs. full power) the test pilots had to have an AOA of 30° to 35° to decrease speed one knot or more per second. That, in the words of John Taylor, is military performance. The rule that applies to the Seawind is for a Part 23 category aircraft having a stall speed of 61 knots or less and a weight less than 6,000 lbs. Because of the very high AOA, we barely meet the 61-knot criteria with the flaps less effective than they could be.

Now let's look at what is important both for land, water, or emergencies. What they all have in common is we want to touch down at the slowest possible speed.

~ Now forget the one-knot-per-second criteria.

~ Now slow your speed with an AOA of, say, 10° by about one knot every three seconds. We want the flaps to be effective so that we can lower our speed turning base to 80 knots. Then reduce your speed to 70 knots on final.

With effective flaps as we cross the threshold you can reduce power and when you are over the runway or two to three feet above the water keep the nose up and use the tremendous ground effect to bleed off speed until touchdown at 56 to 57 knots. I repeatedly land my Seawind at 56 knots.

Nobody seems to acknowledge the importance of this characteristic, probably because it's not a rule. I consider touchdown speed more meaningful to safety than stall speed at 7,000 feet above the ground. The pilot operating handbook will contain this procedure, which won't activate the stick shaker or pusher.

Warren from Arizona questioned: *Is the Seawind going to have the same flat hull or a "V" hull? Is there a problem hitting a boat wake and being airborne below stall speed?*

I frequently make water landings in an area of the Chesapeake Bay where there are wakes from barges, ships, large power boats and everything down to jet skis. Obviously I let the wakes from the larger craft pass before I take off or land. With smaller vessels, I still try to be aware of their operation vs. wind direction. If I encounter a boat wake at or near take-off speed, I freeze the controls and ride across the wake without any additional nose-up pitch. The Seawind can handle moderate boat wakes.

Regarding the hull design, the experimental version and the certified have the same constant force hull bottom design. For those who are not familiar with those terms, the constant force is a modified "V" design, which is concave on either side of the keel to give a uniform surface pressure to the hull bottom.

The difference is the certified hull bottom carries the modified "V" keel all the way forward including the nose gear doors.

The kit version had a "V" cuff separately applied to six feet of the keel forward of the step. The forwardmost six feet is close to flat. When landing on rough water, the Seawind would be remarkably smooth until the speed was reduced and the forward flattish bow would start to slap just before coming off the step. It was for this reason that we extended the keel "V" on the certified at the same time we molded the "V" with the hull bottom.

It is still a non-structural section, which protects the structural surface of the hull bottom above the "V". We also lowered the hull bottom and cabin floor two inches, which provided more headroom in the aft seats. The forward seat headroom had been adequate and is now almost two inches higher as well. It gave us two more inches of freeboard. By lowering the same step and holding the stern post position, we increased the take-off rotation another 1-1/2 degrees.

All of this will be reviewed during a demonstration flight when available and during transitional training during delivery.

Richard Silva