The Seawind Flyer

Fall 2011

"The evolution of an intelligent design." ™

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FLIGHT TESTING CONTINUES

I am very pleased to give you this report.

In the last *Flyer*, I identified the "glitches" that we were encountering. They were called glitches because they are fixable and occur only under certain conditions and affect limited characteristics that you may never notice but that are required for certification.

ELEVATOR & RUDDER

John Taylor came up with a cure almost immediately, which involved a somewhat high drag device currently being used on a number of smaller business jets. So we knew we had a fix for certification, but we would pay a performance price and the fix was not pretty. Our beautiful Seawind would have blemishes on the elevator and rudder.

We opted to take the time and spend the money to make a uniform modification to the trailing edges of the elevator and rudder and to test same. Nothing in aviation happens as quickly as it should. What I called the blunt-edge fairings were tested three weeks later and, after reviewing the data, John called and said "You won the lottery!" The beauty of the Seawind was preserved, and the drag increase should be minimal.

The trailing edge of the elevator and rudder were uniformly modified, including the trim tab.

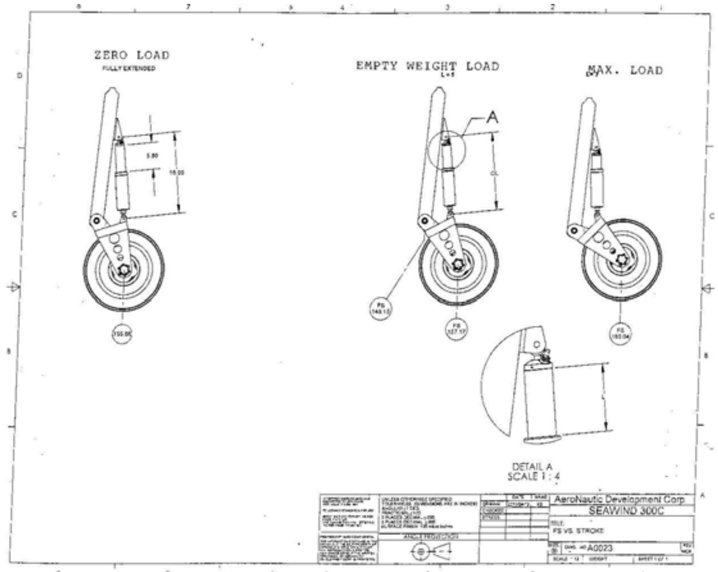
For flight testing, the modifications are covered with speed tape. That's why you see a silvery band on the trailing edge. That won't be on the production Seawind. The production molds will have to be modified.

AILERONS

We also found a glitch with the ailerons last month. After entering a bank turn, if the ailerons were not centered when you let go of the yoke, the ailerons did not always center themselves. John immediately found the cure, and it was flown and tested. It consisted of two aileron fences. The ailerons are now compliant throughout the envelope even with the unbalanced 46-pound test weight in the wingtip.

Again, while other maintenance and test configurations are being performed, we are installing some larger low-friction pulleys to reduce the circuit friction. We will test it and, hopefully, we can reduce the size of the aileron fences or possibly eliminate them.

The left wing aileron was modified at the junction with the flap and sponson (wingtip float).



AXLE POSITION VS. LOAD

LAND TAKE-OFF ROTATION

In aviation I have learned that, most times, if you gain something somewhere, you lose something else somewhere else. We have described the advantages of the trailing link landing gear, which are many, especially for the Seawind. The Seawind is the kind of aircraft you will use on turf or gravel runways. You will also taxi in and out of the water on firm sand or gravel beaches or boat ramps. The trailing link permits the tire to pivot and roll up and over rocks, ruts, and sticks. It is much smoother than a vertical leg, conventional landing gear, which was the type on the experimental Seawind.

The center of rotation of the aircraft on the runway is the main landing gear wheel axle. On the experimental version the axle had a fixed forward and aft position on the aircraft at Station 154.5, inches from the nose, and the forces were compliant.

~ The rotation point when in the air (even when the tires are only a fraction of an inch above the ground) is at the main wing spar STA 143.5, which is 11 inches forward.

~ With the trailing link the axle moves aft when the oleo is compressed in between STA 158 and STA 159, almost 4.5 inches further aft, giving a total of 15.5 inches further aft on the ground than in the air.

~ That means, while on the ground, that the cabin weight acts on a lever arm that is 15.5 inches longer than when in the air, and the elevator lever arm is 15.5 inches shorter, ergo much more elevator force is required for rotation.

~ As soon as the rubber leaves the road, the cabin lever arm reduces by 15.5 inches and the elevator lever arm increases by 15.5 inches, so the load reduces on the elevator.

~ As you power-up, the thrust also pushes the nose down.

~ What also compounds the situation is that the propeller thrust line is over eight feet above the axle on the Seawind when on the ground and only four feet above the vertical C.G. when in the air.

The VGs enhanced the elevator trim tab for rotation.

This is one of the most difficult design tasks for a flying boat, and the trailing link makes it more challenging.

John increased the airstream across the elevator trim tab using large VGs, and the rotation is now compliant even though the stick force is a little higher than on the experimental version. In the meantime, we are trying to slightly increase the elevator nose-up angle by 2° or 3° for the same stick force by using low-friction pulleys. We will check it one more time and, if successful, we will remove or reduce the size of the VGs. If not, we will settle on the VGs.

WATER TAKE-OFF

The point of rotation on water is much further forward at approximately STA 150, or about six inches aft of the airborne C.G. Therefore the forces on the elevator are much lighter than on land.

HOT FUEL TEST

Most times it seems like whatever can go wrong will. Well, we won one! A very important power plant systems test is the hot fuel test. It not only tests the vapor handling of the fuel system at takeoff, but it also tests at the service ceiling of the aircraft. A summary of the test is:

~ The ambient temperature at takeoff must be 85°F four to six feet above the ground

~ The main tanks must be full, i.e. with 80 gallons of fresh fuel tested for vapor pressure

~ The fuel temperature must be 110°F +5/-0

~ The maximum time allowed to heat the fuel is 180 minutes

~ The fuel temperature must be monitored during the entire test

~ The aircraft must take off and enter a continuous maximum rate of climb to the service ceiling without the engine burping – no burps, we pass

We were late sending our test plan for approval, and we were running out of summer in Canada. We had to request Transport Canada to expedite approval of our test plan. They were kind enough to do so, but they were only available to observe the test on Friday, September 2, and the forecast was marginal.

In order to heat the fuel, we moved the Seawind out on the tarmac in the sun and we covered the wings with black plastic and draped the plastic to the ground to form a tunnel from one wingtip to the other. We then fired up a 1,000,000 BTU-per-hour heater.

The Seawind was fueled with 80 gallons of fresh fuel.

Using a 1,000,000 BTU heater and a black plastic tent we heated the fuel to 111°F.

The 18,000-foot service ceiling is generally accepted for non-turbo charged, single engine aircraft. Above that you get into flight level requirements with the airlines and commuter aircraft.

SO WHAT'S THE WIN?

~ Well, the ambient air temperature four to six feet above the tarmac was 86°F, i.e., one degree above the minimum. It was the last 86°F-day in Ottawa since September 3 and probably won't be seen again until June 2012.

~ We got the fuel to 111°F, which was 1° higher than the minimum of 110°F.

~ The NRC got a block of airspace for as high as they wanted to go.

~ The pilot was cleared for an immediate takeoff and climb. The Seawind took off and climbed continuously at best climb speed without a burp and climbed through 18,000 feet. The rate of climb at 18,000 feet was 154 feet per minute. The pilot stopped climbing at 20,200 feet because of a faulty oxygen valve. The fuel temperature was 80°F at 18,000 feet.

~ Then he made a long descent back to Ottawa.

I was surprised that the Seawind was able to climb to over 20,000 feet when it was started at over gross weight. The Seawind started the flight at 3,600 lbs. and the gross weight at 18,000 feet was just over 3,500 lbs.

The topper was that there was no engine overheating during that long, steady climb at the best rate of climb. We have had excellent engine cooling performance all through the flight testing.

THE STALL PREVENTION SYSTEM (SPS) STICK PUSHER

The motor, gearbox, and capstan were all on hand in mid-August. The clutch, which engages the pusher, was due by August 15; then the end of August, then the beginning of September, then mid-September. It finally arrived September 28.

All the components went together perfectly, and we had a test board all ready to go.

The pusher servo has to meet certain requirements that were agreed upon by the flight analyst and test pilots.

~ It must move the stick from full nose up elevator to full nose down elevator in two seconds.

~ It must exert a minimum yoke force of 50 lbs. We selected a drive that could go as high as 75 lbs.

~ Upon recovery of the aircraft from the stall realm, it must disconnect the pusher drive system.

The purpose of the long-awaited clutch is key to the operation.

Antoine Moreau, who researched and recommended the suppliers, did the bench and in-house testing. First he tested the engagement and disengagement time, and then he tested the torque clutch when against the stops and the torque available. The system met all of those requirements.

Of course we are concerned about reliability in addition to engagement and disengagement. The system was tested on the test board over 370 times. It will be tested in the aircraft on the ground probably 100 times more before flight testing. Then a full qualifying test plan will be submitted to Transport Canada for qualifying the system for use in production aircraft. Such a plan may require some environmental qualifications as well.

The stick pusher is being installed as this newsletter is being released.

Richard Silva