



Thoughts on Phase 1 Operations

Written by Michael Farley, Waix 0056

July 1, 2013

Finally! The task is complete! You have taken a large collection of pieces and parts, and assembled them into a complete, finished airplane. Not only that, but you completed the project by going through all necessary paperwork and have just been issued your new Airworthiness Certificate from a DAR, or representative of your local FSDO. This is truly a magical moment and one to be cherished.

Now that you have a complete, certified airplane, let me ask you a question: have you thought about what happens now? Most people would eagerly answer that question with a yes, and respond to my question with a barrage of names of friends they want to take for an airplane ride, or trips they've been planning on taking once the airplane is finally finished.

But how about the first few flights? How about the restricted testing phase, known on your new Operating Limitations as Phase 1?

As it turns out, most builders and pilots of homebuilt airplanes are no strangers when it comes to Phase 1 limitations, and chances are the inspector of your airplane spent a lot of time discussing this testing phase by addressing how long you need to fly in Phase 1, where you are limited to flying during this time, and how to complete this testing time. One important item that may not get addressed quite as much, however, is what steps are to be completed throughout the actual Phase 1 flights. It seems that a lot of questions are left unanswered, and a lot of the requirements are, dare I say it...a little vague?

If I may, allow me to try and help in this matter a little bit. The good news is a lot of the answers we need are there if we spend a few quick moments digging for them.

One of the first things I recommend you take a look at is your official Operating Limitations that were issued at the same time your Airworthiness Certificate was issued. These Operating Limitations give a lot of very helpful information and do a nice job of spelling out what your specific rules and requirements are during the Phase 1 test time. Oh, one thing to note; don't forget that these Operating Limitations must stay in your airplane at all times, even after the Phase 1 test time is completed. I laminated mine so they'll last much longer!

In your Operating Limitations you will find a few specific requirements for your airplane. For instance, the limitations will be very specific in the minimum number of hours you will need to keep your airplane in Phase 1. In most cases, it's fairly simple; if your engine and propeller combination has been certified in a production airplane, you may only need to perform a Phase 1 of at least 25 hours. This may apply to certain homebuilt airplanes, such as my father's -



Wheeler Express kit plane. His engine and prop were certified together on the Rockwell Commander 112, and as a result his Express only needed to be in Phase 1 for a minimum of 25 hours. To the best of my knowledge though, no Sonex, Waiex, Xenos, or Onex has a certified engine and prop combination, so most likely everyone has been and/or will be assigned a 40 hour Phase 1 time.

Your Operating Limitations should also specify the geographic area where you are limited to during Phase 1. A few important items to note; this geographic area does not need to be centered on your home airport, and the size of this area can be tailored to suit your individual requirements. In my case, the FSDO inspector asked me prior to my inspection if I had a preference on a suitable testing area, and we agreed to create a 75 NM circle around an airport around 30 miles from my home airport, thus providing me with a large, unpopulated area to complete my testing.

Finally, your Operating Limitations should also restrict you to daylight flying only, in VFR conditions, and only with required crew members for your airplane. I know of several people who have taken a second "required crew member" along for record keeping during their Phase 1 flights, but I would strongly caution you against this practice. It might be much safer to mount a camera and record your flight to obtain needed data.

Now that we know some of the restrictions to uphold during Phase 1, let's now think about what our game plan will be once we finally get in the air. After all, the only thing that states the owner/operator is complete with Phase 1 is a simple logbook entry that should read just like this:

"I certify that the prescribed flight test hours have been completed and the aircraft is controllable throughout its normal range of speeds and throughout all maneuvers to be executed, has no hazardous operating characteristics or design features, and is safe for operation. The following aircraft operating data has been demonstrated during the flight testing: speeds V_{so} _____, V_x _____, and V_y _____, and the weight _____ and CG location _____ at which they were obtained."

But how do we get there? What maneuvers do we need to accomplish to prove that our airplane is safe? To answer these questions, I highly recommend you do the following two steps:

First, find an EAA approved Flight Advisor who is able to help you transition into your new airplane. The EAA Flight Advisor program is designed to help pilots with training and familiarization into their new experimental airplanes, thus promoting safety.



Read more information and look for a Flight Advisor in your area by following this link:

<http://www.eaa.org/flightadvisors/>

Second, download, print, and read the FAA AC 90-89 which you can find here:

http://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/23127

This wonderful bit of information is written to help create a plan for your aircraft flight testing. Included in this advisory circular is information regarding who should perform the initial test flying, which airport to choose, and how the airplane and engine should be prepared and tested prior to the actual first flight. One pointer you will read time and time again is what to do in the event of an abnormal or emergency situation; if anything unplanned occurs while on a test flight, remember you have one response: "FLY THE AIRCRAFT!" I believe this to be the utmost in importance for test pilots to remember as they perform flight testing, so always remember, "FLY THE AIRCRAFT!"

I'd like to share with you a quick story of my Phase 1 testing procedures as I accomplished it on my Waix throughout the spring of 2012.

My Phase 1 Experience

"Union County traffic, Experimental 569 Kilo Mike is taking runway 9 for takeoff."

I vividly remember these words coming out of my mouth on a beautiful spring evening, April 2nd, 2012. On that fateful day something truly magical happened to me. On that day, I was successfully able to complete the first test flight of my homebuilt airplane, a Sonex designed Waix kit plane.

I slowly taxied onto the centerline of the runway and performed one final check of all engine and flight gauges. Since I installed the MGL Stratomaster Ultra XL EFIS display in the middle of my panel, this scan only took a few seconds. I slowly advanced the throttle all the way forward, and was rewarded by the surprisingly powerful pull of the AeroVee engine up front as the RPMs slowly wound up to just over 3000. I could both hear and feel this awesome little airplane come to life right before my eyes.

All of those parts and pieces I had purchased over two years ago were now a complete, fully functional airplane, ready to defy gravity and slip the surly bonds of earth. All of those hours of cutting, drilling, de-burring, riveting, and painting flashed in my mind, and in that instant, I couldn't help but smile as I knew those days had drawn to an end.



I held full back stick to keep the tailwheel on the ground, thus providing direct steering control as the speed quickly built. After only a few seconds a quick look at the airspeed indication showed I was already nearing 50 miles per hour and accelerating rapidly. By this point, I knew I had positive rudder authority so I slowly relaxed the back pressure and to my surprise, the airplane departed the ground in nearly a three point attitude. Oh my gosh, this thing actually flies!

One concern I had on the first flight was the possibility of a hot running engine, mostly due to the fact it had not yet been broken in. With this in mind, I had preplanned to climb initially at around 80 miles per hour, then after reaching around 500' above the ground, I wanted to transition to more of a cruise climb of around 100 miles per hour. By following this plan I was fortunate enough to keep all of my cylinders at or below 400 degrees, which was my primary goal. As I continued this cruise climb, I took a few seconds to ensure that I had control of the airplane by immediately testing aileron, elevator, and rudder control pressures and authority. Thanks to the wonderful design produced by Sonex Aircraft, everything was working perfectly!

By having my airplane based at a country airport in central Ohio, I have the good fortune of having plenty of emergency landing strips in the form of corn and bean fields. Not wanting to tempt fate, however, I decided that for the first few hours the Waix flew, I was going to stay immediately over my home airport. With this idea in mind, as I reached my initial cruising altitude of around 2000' above the ground, I began a shallow bank back towards the airport itself, thus entering a big figure 8 pattern over the field. I allowed the engine to wind up and then slightly reduced the power, settling in at around 3100 RPM for the initial break in. By this time I was fully convinced the airframe itself was fully controllable and behaving normally, so the majority of my attention was focused on the engine readings. By some good fortune the AeroVee was performing flawlessly as it quickly took me in my racetrack pattern over the airport.

After 25 minutes of flying I felt I had accomplished enough for the first flight, so a slight reduction in power started me back towards the traffic pattern. I was happy to note that this also cooled the engine slightly, providing me with an added safety margin just in case I chose to perform a go around on the landing. I slowly entered the downwind leg and performed the standard GUMPSS check, then began reducing power once I was abeam of my landing point.

After adjusting the elevator trim to reduce any stick pressure, my airspeed was already bleeding below 100 miles per hour so I added the first notch of flaps, then adjusted the pitch to establish a descent at 90 miles per hour. Once the runway was at the standard 45 degree angle behind the wingtip, I made a gentle turn to base and adjusted the power to hold my descent rate.



All was looking good as I made the turn to final so I chose to keep the flaps at the first notch for landing, which is a 10 degree deflection.

My goal was to cross the end of the runway at 80 miles per hour which I knew would result in a float, but with over 4000' of runway available this wasn't a concern. I wanted to make sure I had plenty of energy for the flare. This worked out perfectly as I slowly closed the throttle, brought the nose up to my best estimate of a three point attitude, and waited. I didn't have to wait long to hear the satisfying chirp as all three wheels gently touched down at the same point, approximately 1000' down the runway. Stick slowly back and gentle braking brought the speed down to taxi speed, at which point I was able to exit the runway around the midfield turnoff.

I had done it! I had not only built an airplane with my own two hands, but I flew it as well! Not only that, but this awesome little airplane flew wonderfully! What a fun day that was.

After coming down from an emotional high, I took stock of the flight and all that happened during my time aloft, both good and bad. I knew right away that the Waix was flying normally and seemed to fly coordinated, with almost no "heavy wing" issue. Most electronics seemed to function normally, with a few small exceptions.

First off, as I was flying over the airport, my electronic oil pressure gauge was displaying a wide range of oil pressures throughout the flight. The average seemed to fall into the middle of the acceptable range so I felt comfortable to continue, but I knew I wanted that gauge to read accurately and reliably before I continued testing the airplane. I also noticed that my radio was working properly and I could hear other aircraft talking, but it seemed to have a somewhat limited range and received at a barely acceptable level. Finally, like several others, I was getting a less than smooth brake pulse when I applied the mechanical brakes.

Before the next flight, I performed a complete inspection of the airframe to ensure nothing had broken or rattled loose. I paid special attention to the engine compartment to ensure there were no leaks, drips, or errors which could become a big issue later on. After finding no other issues, I went to work on fixing these few little problems in preparation for another test flight.

First, I took my wheels off the airplane and ensured the mechanical brake backing plate was at the correct angle in comparison to the gear leg axle. I also used this time to shave off some of the brake material off the brake shoes, thus allowing me to reinstall the wheel and not have any dragging issues when I spun the tires. As for the oil pressure, my first step was to run a dedicated ground wire from the oil pressure sender body to the engine block itself, thus ensuring a good ground. I also took this opportunity to re-torque my propeller bolts as specified in the propeller manual.



After buttoning everything back up, I felt the airplane was ready for a second test flight. I decided that, for the time being, the radio was working at an acceptable level so flight testing could continue. Test flight #2 was virtually a repeat of the first flight and found me performing my standard oval pattern directly over my home field. This flight was also kept fairly short; after flying for around 35 minutes I slowly let back down into the pattern, and was once more rewarded with a smooth three point landing. The brakes, while still not perfect, were much better, as was the oil pressure reading which seemed much more accurate after adding a ground wire. By this time I had amassed a total of just over 1 hour total flight time, so it was time for some regular engine adjustments in the form of an oil change and a valve adjustment.

Over the next several flights, I was able to gain a comfort level with my new airplane while making several small adjustments on the airframe and engine. First off, I wanted to take appropriate steps in keeping my engine cool during this initial break in period. I was fortunate by performing my initial flights in cooler, springtime temperatures which helped keep my cylinder head temperatures from reaching redline, but they were still running hotter than I preferred. In order to help cool my engine I modified my cowling by enlarging the cooling exit area, which helped increase airflow. Ultimately I enlarged this exit area 40% more than the specified plans which helped my engine to run at cooler temperatures.

By the time I reached 5 hours of flight time on my WaieX, I was well into the testing regime and everything was working normally. The airframe was proving to be nearly perfect with almost no trim adjustments necessary, and the AeroVee engine was running very well as I continued breaking it in. One adjustment I decided to complete was the relocation of my radio antenna from on top of my instrument glareshield to the top of the fuselage, right behind the canopy. This change had a drastic effect on the clarity and range of my radio as I could now easily communicate with other airplanes well over 100 miles away. I also took this opportunity to install a mechanical oil pressure gauge into my panel to supplement the digital oil pressure readings that were still slightly erratic. The inexpensive mechanical gauge has proven to be 100% accurate and has been an excellent addition to my panel.

After reaching 10 hours on the WaieX, I decided to perform a "mini conditional inspection" on the entire airframe to ensure all was in order. This provided no surprises or abnormalities, so everything was reassembled so testing could continue. Once this inspection was completed, I had the confidence in the airplane to begin leaving the vicinity of my home airport to test for cruise speeds, fuel burns, and other necessary testing items.

Once I reached 35 hours of flight time, I had accomplished most of my necessary testing maneuvers and goals. The airframe and engine were proving to be very reliable and engine temperatures were stabilizing in normal temperature ranges. One final adjustment made to -



the engine at this point was a check of the secondary ignition which led to the discovery that my secondary ignition was slightly advanced. After making appropriate adjustments I was rewarded with an engine that not only ran cooler, but seemed to gain a slight amount of power as well.

Almost exactly two months after my first flight, I finished the Phase 1 testing on my Waiex. By this time I was completely confident that I had built a strong, safe, and reliable airplane that was properly adjusted and safe to sign off. After completing the necessary log book entries, I was able to celebrate the occasion by taking my wife up for her first ride. Shortly after, I was able to fly my airplane to Oshkosh for the AirVenture airshow, but that is a story for another day.

Thank you for taking the time to read my story. I wish you safe flying in your airplane, and be safe out there!

Mike Farley

Waiex N569KM

michaelfarley56@gmail.com

mike@sonexfoundation.org

www.sonexfoundation.org