THE FIRST FLIGHT OF YOUR AIRCRAFT

By Chris Heintz

[This article is part of a series, where aeronautical engineer Chris Heintz discusses light aircraft design and construction.]

With the mild spring weather upon us, it's time to get ready for that first flight of your homebuilt aircraft. The following information is not crash course on how to become a prototype test pilot; rather, it's simply instructions on how to perform that first flight of your aircraft built from plans or a kit.

For months you have been hard at work building your aircraft, spending all on your homebuilt aircraft. The following information is not a crash course on how to become a prototype test pilot; rather, current again - it's time to start getting ready for the first flight of *your air*craft.

If you feel rusty, get some dual, then fly solo and regain your confidence in an aircraft that's similar to the one you've just completed. Even "hangar flying" can be useful, if you can separate the truth from all the bragging and "big stories."

Of course, your aircraft must be ready as well, and this includes:

- Weight and balance within the designer's specifications.
  See Figure 3
- "Run up" of the engine as per manufacturer's recommendations. (This is especially important with the two-cycle engines that have become more and more popular recently.)
- A check of the powerplant (i.e., engine, carburetor, intake and exhaust manifold, reduction unit if applicable and propeller) to verify that it meets the manufacturer's static RPM. An easy way of checking the THRUST is to inflate the tires "hard," rest them on a smooth and flat surface - plywood works well and attach a large fish scale at the aircraft's tail end. Start the engine, warm it up, go full throttle and have a friend, without glasses, read the scale. Thrust in pounds should be approximately four times the horsepower for a cruise prop, five times the horsepower for a climb prop. You may want to do it several times for better accuracy.
- See Figure 1 and 2

Remember, though, the engine cooling system is not designed for indefinite full throttle on the ground. Do not exceed 30 seconds full open and allow three minutes cooling at 150 percent idle before the next test. Also note that the cowling must be installed as the baffling only ducts air past the cooling fins with the cowl properly installed. You can burn out the aircraft engine in less than 30 seconds full throttle without a cowl. The cowl is not only an aesthetic component but also an important part of the cooling system.

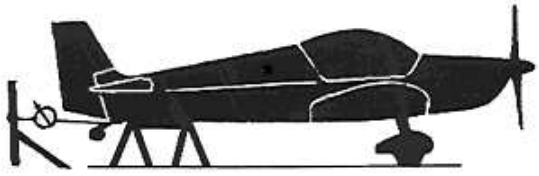

Figure 1

Of course, each time the engine is running either you or a knowledgeable pilot must be at the controls. Tie the aircraft down for extra precaution.

During ground run up of the engine, check that no part of the aircraft is shaking and/or vibrating heavily - check every 200 rpm from idle to full open and watch the tail and other control surfaces as well as the bottom of the fuselage.

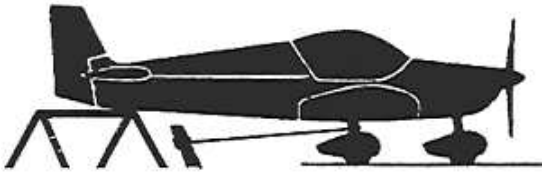

Figure 2

It is also vital to check that the fuel supply will be adequate in the most critical configuration - at full power usually in tail low attitude. The fuel "head", i.e. - height of fuel from carburetor to fuel tank must meet the minimum level for continued operation with little more than the unusable fuel in the tank.

At the same time it is important to check the fuel quantity gauge (empty equals when engine

stops running in above critical attitude) at 1/4, 1/2, 3/4 and full. This is not only important for fuel consumption and range check but also to detect quickly if sudden unusually high fuel consumption develops (i.e. leak).

And, of course, by this time you either know that you can easily inspect your engine because the cowl comes off with six DZUS fasteners or you realize that you should look under the cowl, even if it requires unscrewing 20 fasteners for inspection!

Taxi Tests

Do not start taxi tests unless the aircraft has 1-1/2 hour fuel supply and is loaded (with ballast if required) in the mid-range of its center of gravity travel; it you don't follow these guidelines, you may find yourself in the air because you are not at gross (lower stall speed) and your error in the indicated air speed may be significant. Remember, you also are in ground effect.

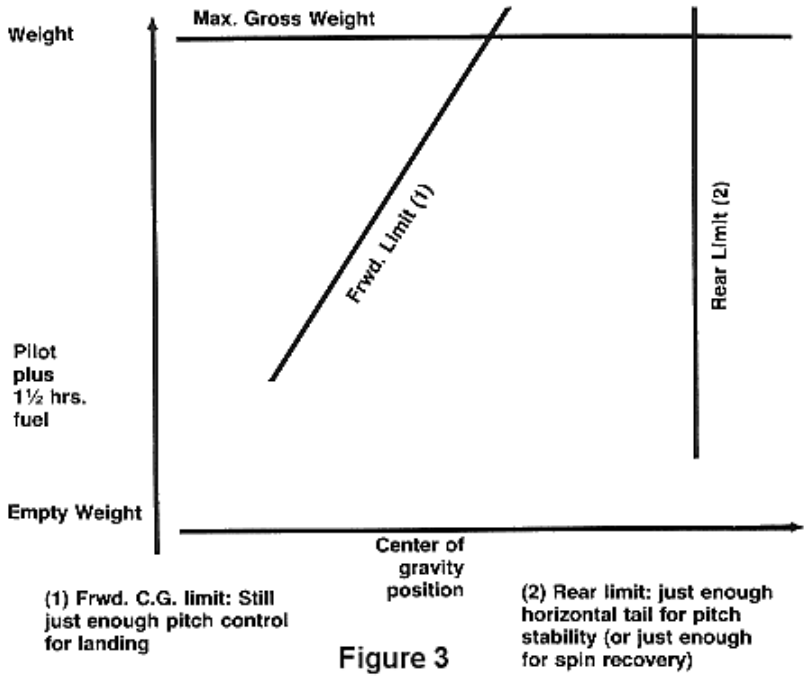

Figure 3

During the taxi runs, check the brakes, the steering and get familiar with the noise level, seat belt fastening and release, control position (carburetor heat, fuel valve, trim, mixture, etc.) and the important instruments such as air speed and rpm, altimeter, engine temperatures and pressures. When you do taxi tests at speeds above 50 percent of the stall speed given by the designer, be prepared to (accidentally) lift off. If there is enough runway left, throttle back and put it down again. Do not push it down, though - it's always such a shame to have to repair a brand new aircraft!

Make some 10 taxi runs on the runway to get the feeling of when to abort take off with sufficient runway to stop with moderate use of the brakes. This helps familiarize you with initial acceleration, and a bit (only a bit) with how the controls feel (light, heavy, sensitive, sluggish). Always trim at the mid-range as you are only guessing where it should be set.

Okay, your engine runs well, brakes work, instruments seem okay, you handle the aircraft with confidence on the ground (if it's a taildragger and you have little conventional gear experience that will take some time getting used to. A taildragger is less stable on the ground than a tricycle gear plane). It is very important you feel comfortable and "at home" in the pilot's seat.

First Flight

So it is time to go ....
Check once more your center of gravity at mid-range position from the full travel given by the designer. Check your fuel quantity, check it physically with your eyes or a dipstick, do not rely on the fuel gauge until proven reliable.

Okay, the aircraft is ready, but how about you?
First of all, you must want to do that first flight - do not let anyone push you into the air, even if

he/she is a well-meaning relative or friend. Second, you must be relaxed - you may check your astrological sign or biorhythms if you want - but the important thing is you simply feel this is the day! And definitely not with the help of a couple of beers!

Now, check the weather: There should be little or no wind, good visibility (no haze) and at least a 3,000 foot ceiling. Avoid the time around sunset if your active runway is 22 to 33! And, have as few friends around as possible. (They have a tendency to make us show off; we can do that later. Now, we just want to get up, gather important information, and come down again as safely as possible, and get a good feel of that beauty sitting out there waiting.)

I have found that the best time for smooth weather is when those so-called friends are still in bed, when only the one reliable friend you really want around shows up. This best time is approximately one hour after sunrise.

Proceed with your pre-flight - fuel check, drain fuel system for condensation, water. Then, start the engine, warm it up and taxi to the take off end, check ignition and carburetor heat. Set the altimeter and trim at mid travel. If you wish, check full throttle rpm (I usually do this during the initial phase of take off).

Line up with the runway and push the throttle full open, not too slowly but not too quickly either. Keep one eye on the air speed, the other on the runway and one ear to the engine; if anything seems abnormal, just shut the craft down, check it and fix it. In our lives we get many warnings. We should listen to them and not have a "stubborn ego." And, I repeat, checking is not enough. If something is wrong, we have to fix it and then try again! But, today, everything is fine, so we keep the throttle open and very slowly lift the airplane off as soon as you think you are fast enough. Be prepared, it may be very nose heavy or light; we do not know the trim position yet.

Now that you are in the air, remember the danger is to hit mother earth again before you want to, so climb gently at some 10/20 mph faster than your lift-off speed. Adjust the trim for comfort, check the rpm, airspeed, engine, instruments (if it starts overheating, throttle back a little) . . . and relax! Not too much, though - keep one eye on the airport to which you want to return.

At two or three thousand feet AGL, still full throttle, level off. Push the nose slightly down until altitude no longer increases, note the rpm (this should be less than 110 percent of the red line). Is there any unusual noise or vibration you should note?

Now, throttle back to about 90 percent of above full throttle rpm (this should be approximately 75 percent of cruise) and trim for level flight.

Finding the Stall Speed

Before you land you must know the indicated speed at which the aircraft will stop flying, so you better find out now when you are up high.

Relax! Carburetor heat on, throttle gently back (notice the tendency of the nose), now slowly raise the nose to reduce the speed. Do not use ailerons, keep the ball centered - or the wings level with your rudder. Do everything gently and stay relaxed. Keep one eye on the air speed and the other on the ball (or horizon and wing tips). Notice everything: buffeting, stick back pressure, control stops, "oil canning" or other noises....

Any well designed and correctly built light plane should have a gentle stall; its nose will gently (more or less!) drop. One wing may drop faster than the other (slight asymmetry in wing construction, or too little use of the rudder, or gusty weather). Notice the indicated stall speed then release the stick pressure slowly to increase the airspeed and reattach the air flow over the wing. Apply full power gently and climb at 130 percent of your stall speed. Trim (this trim setting will be your take off trim in this configuration, weight, C.G. and flaps up).

Check the airport (or are you lost by now?)
Make another two or three stalls to get a good average reading and feel comfortable.

Now come in for a landing: Use 130 percent of stall speed on base and final, aim a few feet above the runway entrance and reduce throttle, then speed only over the runway and just hold

her back until the aircraft settles by itself on the ground at the stall speed you now know (do not "pump" her down!)

Without stopping the engine, taxi back for another take off. This time set the trim for climb, make the take off rotation at the indicated stall speed, accelerate to 130 percent of stall and let her climb, downwind at "cruise," base and final at 130 percent stall as for the first landing.

Perform one or two more circuits before you bring her back to her tie down. Correctly done, the above exercises will take 45 to 60 minutes. And now you are no longer afraid of your aircraft: You know it flies and you can handle it! Your aircraft was designed and built to fly and it does.

Call the designer of your aircraft and share with him the pleasure of your first flight - both you as the builder and he as the designer deserve it.

Next time you fly, start using flaps (if applicable).

Next month we will talk some more about the testing that should be completed during those first 15 hours of flying your new light plane.

The Experimental Aircraft Association has excellent resources regarding flight testing your kit aircraft, including the highly recommended Flight Advisor Program.

This article is presented as part of a series, where aeronautical engineer Chris Heintz discusses the technical aspects of his light aircraft designs in laymen terms.

This article was published in EAA Light Plane World magazine (May 1986). © 1986, Chris Heintz.

Forward from EAA Light Plane World (5/86):

"*Chris Heintz has test flown all of his prototype aircraft to get the "bugs' out - so that builders can build a good aircraft with confidence. Chris' trust in homebuilders is shown by the fact that he made the first flight of several plans built Zeniths and Zodiacs (38 if his memory serves him correctly).*

"In the following, Chris shares with us some of these more important points he checks before and during that first flight of a plans built aircraft,- it's the method he's developed to make that first flight useful and enjoyable for the pilot."

[Back] [Chris Heintz Design College]

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