Rigid Wing 101 – Introduction to Control Bar Rigid Wings

Over a pilot's flying career, few things create more excitement and more angst than deciding which new wing to purchase. There are few decisions that impact a pilot's motivation and enjoyment of the sport to a greater degree than the choice of flying machine. In the past few years, the proliferation of the control bar rigid wing (rigid) has added an exciting new dimension to that choice. A lot of pilots have questions concerning the rigids. There are questions about durability, strength, transport, care, and flight characteristics. In this article, I'll focus on flight characteristics from a flex wing pilot's point of view. I'm going to attempt to give the flex wing pilot a little perspective on what to expect from a first flight in rigid.

Background

I'm limiting this discussion to "control bar rigid wings" or "hybrids". These gliders have conventional control bars that actuate control surfaces when moved laterally. The Flight Design Exxtacy was the first production control bar rigid wing. The rigids have evolved quite a bit from the Exxtacy. But, all of these gliders share some common characteristics. They all have lots of wingspan and short wing chords. They are all constructed using wing spars made from carbon fiber composite materials. The wing spars are usually referred to as D-Cells or D-Spars as a result of their D-shaped cross section. The D-Spar forms the leading edge of the airfoil and carries the flight load. Attached to the rear of the D-Spars are foldable ribs that define the balance of the airfoil. Most often, the ribs are carbon but there are some aluminum examples. The sail is a simple envelope that covers the airframe. Use of aluminum and stainless steel elsewhere is limited to the keel, brackets, and control frame although there are carbon control frames in use. The nose, tail, and side wires are conventional stainless steel, but, the side wires carry no flight load. Instead, the side wires activate the aerodynamic surfaces that control roll. All of the rigids have flaps that are activated by pulling a rope similar to a VG rope on the right side of the basetube. If the flaps are retractable, then a second rope on the left side of the basetube controls flap retraction.

Flex wing pilots often approach the first flight on a rigid with a fair amount of anxiety. Without doubt, these machines are quite different from a flex wing in construction and planform. While caution is always advisable when flying a new wing, all of the manufacturers have done an excellent job of making these gliders feel very flex-wing-like. Your flex wing experience and reflexes will work quite nicely in general. Despite some initial apprehension, the two most common reactions of flex wing pilots after their first flight on a rigid are surprise at how easy they are to fly and a big grin that won't go away.

Setup

The setup procedure for a rigid is surprisingly similar to that of a flex wing. Ribs have been substituted for battens and D-Spars for leading edges, but, the main difference is that the control surfaces have to be dealt with. As with any glider, developing an efficient setup routine makes all the difference in setup time. It takes a while to get a routine that is efficient, but, all of the rigids can be consistently set up in well under 30 minutes.

The setup proceeds in the usual manner. Unzip the bag, connect the basetube to the control bar uprights and stand the glider up on the control bar. Remove the keel stinger, nose tube and any removable tip ribs or wands from inside the D-Spars at the nose. Spread the wings about half way and install the tip ribs or wands. Zip the sail halves together and connect the rear sail anchors to the keel. At this point you can either spread the wings the rest of the way, close the nose catch, and then tension the ribs or do it in the opposite order and tension the ribs first. The ribs are easier to deal with before the nose catch is closed. But, if you're someplace like Chelan that is dust devil prone, the glider is safer with the nose catch tensioned first. The nose catch connects the right and left D-Spars together at the nose and is closed by an over-center

mechanism. A safety pin is inserted to be sure the nose catch can't open. The nose tube is inserted through a fitting connected to the nose catch adding a secondary safety mechanism. The nose tube helps prevent the D-Spars from coming into contact with the ground in case of a nose over. Once the nose catch is closed, inserting the stinger in the keel will get the wingtips slightly off of the ground. Attach the side and nose wires checking for proper operation of the control mechanism in the process. Attach any removable control surfaces, tip fairings, and you're done. You can easily stuff all the glider bags in the D-Spars if you desire.

Preflight

During the preflight, do quick visual of the D-Spars looking for obvious damage. Check that the nose catch is properly closed and safetied, ribs are all properly attached and tensioned, and that all wires and wire attachments are undamaged and correctly connected. Check for proper control surface operation and flap retraction if you have retractable flaps. Last, install the nose fairing and you're ready to go.

Ground handling

Once the glider is set up and preflighted, the first challenge is getting hooked in. The control frames on all these gliders are small. The easiest way to get hooked in is to leave the keel on the ground, crawl into the control frame from the nose and hook in. This also eliminates the possibility that you'll get your harness mains hooked on the wrong side of the lines that control the flaps. After you're hooked in, simply stand up, pick the control bar up by the uprights, and stand the glider up on its tail and wingtips. Get your shoulders under the uprights and pull the nose over level. The static balance will be pretty neutral. The glider is going to feel very short chord-wise and very long span-wise because it is! You're handling well over 40 ft of span. That's several feet more than you're used to. The control bar will also feel loose side to side. If you move the control bar sideways, you'll find that for the first inch or two there is no resistance at all. That's because there is an inch or so of slack in the side wires. The slack is there so that you aren't constantly activating one of the control surfaces. The amount of slack is adjustable and as you get familiar with the glider you can adjust most of it out. After you take up the slack, you'll begin to move the control surface. The required effort will still be low because you're pulling only against some bungee tension. Move the control bar far enough and you'll feel the control surface hit the end of its travel. The combination of long wings and loose control bar is going to feel quite awkward at first. But, I've never had a new pilot even mention that he noticed after the first launch step. Be very careful to never get the tail up when you're pointed downwind. It takes surprisingly little wind to flip these gliders over due to the long wings and short chord. You'll find that with the glider pointed into the wind, the easiest way to keep the wings level is to hold the basetube level with the ground. If one wing starts to rise, the control surface on that side will activate, bringing the wing back level. If you play around with the glider in the breeze for a few minutes you'll find that it's very easy to keep the wings level.

Launch

Rigids are very easy to launch. They have lots of directional stability because they have control surfaces to initiate roll. However, there are some differences that are worth discussing. I'm going to introduce the concept of "Sticky Pitch". It's the tendency for the nose angle to just stay where you put it with very little additional input required. It's really only noticeable on launch and landing. Even then it's a subtle effect.

During a flex wing launch, the pilot is usually pulling in slightly during the run to keep the glider accelerating. As the speed builds up, the effort required to keep the glider on the ground increases. This is due to the fact that the airfoil becomes more defined as the sail fully inflates and the airframe flexes some as it loads up. The rigid is different. Since the airfoil is completely defined by the ribs and D-Spar, there is no appreciable change in the airfoil or airframe geometry as you begin to move and load up the wings. If the pilot either sets the initial nose angle too low or pulls in too much during the launch run, the glider will just go faster. There is almost no tendency for the glider to pull you off the ground. That's the "Sticky" part. The pitch will just stay

glued where it is and continue to accelerate unless the pilot acts to change it. Once you get up to flying speed you will instinctively ease out a bit and you'll be away.

The combination of the rigid airfoil and neutral pitch is a nice advantage, especially in light or no wind conditions. Since the airfoil is defined from the very first step, rigids carry their own weight very quickly. In no wind, the glider will be off your shoulders in 2 or 3 steps. Also, since the pitch angle just stays put with little or no effort, you're completely free to concentrate on accelerating. Minor pitch corrections, if necessary, are nearly effortless. Since the glider doesn't try to nose up on launch, new pilots often launch with a little excess speed rather than not enough, especially in light conditions.

The launch itself is straightforward. Most of the time, launching with 15 -20o of flaps is recommended. If it's a strong ridge soaring day the glider is easier to manage with the flaps at 0. If it's a strong day and you have retractable flaps, you can retract them. Be sure to throw the flap rope over the nose or tail wires so you don't step on it. Level the wings and make sure the control bar is centered. A smooth acceleration will have you quickly airborne. Right after launch, you'll begin to experience another difference between rigids and flex wings. When making your first control input, you'll be almost guaranteed to wiggle the control bar back and forth rapidly. Nothing happens to the glider, but, it gives your buddies on launch a laugh. The wiggle happens because you fly a flex wing using lots of small corrections. The control inputs get directly transmitted to the glider through the side wires which are solidly attached to the airframe. In the air, the side wires on the rigid still have a little slack in them because the airframe geometry hasn't really changed. You're making small corrections against no resistance, so you end up wiggling the bar back and forth. This tendency will go away in just a few seconds. You'll find that nothing is happening, your reflexes will take over, and you'll make a bigger movement. Then you'll feel just how little effort it takes to turn one of these gliders. This is where the big grin gets started.

In straight flight, the glider is going to feel like it's on rails. Very little effort is required to maintain heading due to the directional stability. Pitch will be light, but, not overly so. The pitch pressure will build up quickly and progressively as you pull in. These gliders like to be flown a little faster than a flex wing. There is no advantage to slowing way down when you're thermalling or ridge soaring. In fact, your climb performance and sink rate will deteriorate if you slow down much below trim speed.

This is the one case where flex wing reflexes need to be kept in check. Most flex wing pilots are used to pushing out a lot in a thermal. Pushing out a lot in a rigid offers no advantage for the reasons mentioned above. If stalled with a wing down, it is possible to spin a rigid. In most cases, it takes a significant amount of push-out to initiate a spin. But, it's not worth testing your luck. Keep the glider flying!

When you apply roll input, you'll notice that the roll starts as soon as you move the control bar. The roll rate is slower than a flex wing because you have well over 40 feet of span to roll. But, the roll starts immediately and requires very little effort. You'll also find that pointing your feet, kicking them out to the side, twisting the basetube, etc. all have virtually no effect on the gliders response. All it does is make you tired. Try to stay relaxed, move the control bar and the glider turns. If you move the control bar to the point that the control surface hits the limit, the glider is turning as fast as it's going to. Trying to force the glider to roll more quickly will also just make you tired. Turn coordination will be very natural. You'll quickly figure out where in the turn you need to apply opposite control to roll out on your desired heading. Once you're well away from any obstacles, experiment with the flap settings. Increasing the amount of flaps will slow you down and cause the nose to rise a bit. Reducing the flaps to 0 will make a noticeable difference in your trim speed. If you have retractable flaps, pulling them in will increase your trim speed even more. If you're ridge soaring or thermalling, 30% flaps will give you a better sink rate. Much more than 30% and you're creating more drag than lift. Full flaps make an immense amount of drag, really reduce the trim speed and dramatically deteriorate the glide ratio. This is a very good thing.

Approach and Landing

Approach and landing are where the most dramatic contrast with flex wings appears. You have flaps! Pulling on full flaps will reduce the trim speed significantly. The glide ratio deteriorates to 7 or 8 to1 as long as you're flying pulled in. I say "pulled in" rather than "flying fast" because the glider won't go very fast with full flaps no matter what you do. If you slow down to trim speed the glide is still pretty good even with full flaps. So, you have adjustable glide slope control. If you want to get down shorter, fly faster! I recommend deploying full flaps as soon as you are committed to land so you can get a feel for the change in trim speed and glide ratio. Throw the flap rope over the nose wires to keep it out of your way after you deploy the flaps. Fly your entire approach with the flaps on. You don't want to be fooling around with that flap rope and trying to fly an approach at the same time. I also recommend that the approach be flown well above trim speed. This gives you more options. If your approach ends up a little short, you can improve your glide substantially by slowing down closer to trim. Pilots are always amazed by how quickly you can get a rigid down.

As you start to plan your approach, remember you have long wings and a slower roll rate than you're used to. Plan a conservative, aircraft style, downwind, base, and final approach. Avoid trying to fly reversals or figure 8 approaches. As you come to your final heading, you will likely wiggle the control bar again because you're used to small corrections on final. It won't bother anything. Rotate up at a comfortable altitude and stay pulled in. As you come into ground effect, the "Sticky Pitch" shows up again. The glider will quite happily fly quickly along the ground with very little pull-in force required. The pilot needs to actively slow the glider down. So, once you're into ground effect, begin slowing the glider down, and continue into a progressive, full, flare from about standing altitude. That should have you on the ground with one or two steps in no wind. With full flaps, the glider retains almost no energy. So, you're not going to pop up unless you flare with a lot of excess speed. Doing an aggressive, snap flare also doesn't buy you much and it makes flare timing more difficult. Smooth and progressive is much better. The flare window is reasonably wide and the glider will signal that it's time to get your feet down. As soon as you feel the glider start to settle, it's done flying. If you flare late, the glider will most likely just drop you on your knees. These gliders have very little tendency to nose over and whack. When they quit flying, they tend to just settle to the ground, nose up. Rigids are quite easy and predictable to land, even in no wind.

If you're seriously considering a new wing and have even the least bit of interest in the rigids, you really owe it to yourself to take a test flight on one or more. Even if you're just curious, you should try to talk your local dealer into a ride. At the very least, I can guarantee you a big grin for a couple of days. For this pilot, it was over from the first time I hooked in. I can honestly say I've never had more fun with a glider in all these 28 years.

A number of good, used rigids are beginning to come to the market. These gliders can be an excellent way to get into a rigid. Next time, I'll discuss construction and maintenance. Armed with this knowledge, you should be reasonably able to assess the condition of a used rigid.

Steve Daleo
US Aeros
5130 Foothill Rd
Pleasanton, CA 94588
(925) 997-3359
steve@flyaeros.com