This is a very difficult subject to write about, as there are many and varied opinions on how to best go about setting up a glider for efficient and responsive flight. There are advocates and detractors of the ‘Dive Test’, thermal duration pilots who say that tests performed on the slope are irrelevant to thermal duration applications and those who have their own methods for determining how their models fly best. Let’s just call this article an overview.

So, you’ve just bought your new glider kit, and are looking forward to building it, or assembling it if it’s an ARF kit. This initial stage is where you need to take care, in order to get a finished model which will fly sweetly right from its maiden launch. If you expect your sailplane to fly perfectly trimmed, right out of the box, you’ll be disappointed.

I will assume that if you have built this glider, it will be straight and the rigging will be perfectly aligned. The fuselage will be straight, the wings not warped or bowed and the tailplane and wings correctly aligned to each other. If it is an ARF, then check to see that the same basics are correct. I might take a specific glider kit and outline some of the steps taken to get it flying better than it did as a stock model.

How do we go about fine tuning our gliders? Assuming that the rigging angles are all good, and the push rods are all firm, smooth and non flexing, you can then check the decalage angle. What’s decalage you say? Well, it is the incidence angle between the wing and the stabiliser. For a glider to perform well, this angle should be zero degrees or just slightly negative, ie. The leading edge of the stabiliser is slightly down and or the leading edge of the wing is slightly up. The elevator setting should be neutral.

First, let’s take a popular 2 metre span glider aimed at beginners and experienced pilots alike. This model acquits itself quite well in both competition flying and sports flying alike. The Great Planes Spirit ARF is one which many new glider owners choose. I will stick with the ARF, as a majority of new pilots these days do not want, or cannot afford the time to build a glider from a kit.

First, let’s start with the wings. Place both wing panels bottom to bottom with each other. Each wing panel should be the exactly the same length. If they are not, they need to be modified so that the lengths are equal.

If your wings have bent up wing tips or are polyhedral in nature, place them on your work bench, trailing edge to trailing edge. The angles should match exactly.

The wings may be attached to the fuselage in many different ways. Held on with rubber bands or bolted on is typical. You need to ensure that the fin is perpendicular to the wings and the stabiliser is perpendicular to the wings. The wing saddles may have to be modified, to ensure the wing sits level, but generally, they are pretty good.

Now you need to balance the aircraft laterally. If one wing tip wants to consistently crash to the tabletop, you need to add weight to the opposite wing tip. If this step is not done, then the model will require constant aileron or rudder trim every time its speed changes. If for example, the left wing is heavier, then a little right aileron trim may...
be necessary to keep the model from rolling to the left at low speeds. However, if you pick up speed, the model will now want to roll to the right as soon as the unbalanced control surfaces overcome the heavier left wing. Trimming and fine tuning the model, will make these in flight adjustments unnecessary, and let’s face it, a glider or other aircraft which can fly consistently over a wide range of conditions with little stick movement, is much easier for the pilot to control than one which requires constant adjustments.

Getting back to the Spirit 2m ARF glider. Shown below, is a table with the recommended setup values for this kit.

<table>
<thead>
<tr>
<th>Model: Spirit 2m ARF</th>
<th>C of G: 83mm recommended to 91mm max.</th>
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<tbody>
<tr>
<td>Elevator Rates: 13mm left &amp; right</td>
<td>Rudder Rates: 38mm left &amp; right</td>
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The Spirit will certainly fly quite well at this setting, but it will be very stable and tend to want to fly at one speed. It will not be as responsive to inputs, as it could be, and performance and associated drag penalties make the glider a mediocre performer, rather than an excellent one. With a forward C of G, the glider will be very stable in pitch, whilst in the performance with a more rearward C of G, will make it an agile performer in both pitch and roll movements.

As standard, the Spirit has 1.5 or more degrees negative decalage. This means that when the wing measures zero degrees incidence, the trailing edge of the elevator/stabiliser has a lot of up in it. This contributes to lots of unnecessary drag and degrades performance. I used to fly my Spirit 2m at .25 degrees negative decalage, and was happy with the performance. I could have, and should have, continued fine tuning this model for optimum performance, but one tends to get lazy. To get the decalage down to .25 degrees, I packed the LE of the stabiliser up by about 2mm and then, after test flying, glued it in place. To get the Spirit flying a lot better than standard, I removed 62gm of nose weight, set the rudder to as much throw as I could get (60mm each way) and halved the elevator throw to 6mm each way. This set up was great for me, and I have many trophies won with my last Spirit, until blew I it apart on launch! I now fly the First, almost exclusively, but need to get it set up to suit my level of flying.

A really handy tool for checking incidence is, of course, the incidence meter. I use both a Robart and a Great Planes laser incidence meter. These inexpensive tools makes the adjusting of wings, or stabilisers, a piece of cake.

As you adjust the decalage, (in this case, the standard Spirit, as it came stock, and using the recommended C of G setting) it follows on, that you will need more up elevator to maintain level flight. To counteract this, take more lead out of the nose, thereby shifting the C of G further back. This will make the model more responsive in pitch. You will find that you will need to reduce the amount of elevator throw, or else you will be over controlling the glider in the pitch axis. You need less control surface movement to get the same response you previously had.

When you have set the decalage, take the model out to the field for some test launches. On a calm, windless morning, do some hand launch testing, or use a high start to get you low altitude launches. Try and get a consistent launch each time, and see how far the glider flies at neutral elevator trim. Add or take away nose weight, until you are satisfied that you have the best glide performance at a neutral elevator setting. This test should get you in the ball park for further fine tuning.

When you are happy with the glide, the next step is to launch the model to a decent altitude and perform a dive test. Put the glider into a shallow 30 degree dive for about 2 seconds, and take your thumb off the elevator stick. The glider should continue on at the same dive angle for a few seconds, then slowly pull out by itself to regain level flight. If it pulls up sharply, or even loops, then you have too much weight in the nose, and the C of G can go further back. If it picks up speed and begins to dive more steeply or tuck under, then you have the C of G too far back, and need to add nose weight. Once you have the glider giving the correct performance in the dive test, you can further fine tune it by moving the CG in either direction, to suit your flying style. Do this, by the addition or subtraction of nose weight. With a rearward C of G, you will have a much more responsive, but slightly unstable model, and you will have to control it more than a model with a more forward, stable C of G location. Rearward C of G also means you should decrease the rates of the pitch control, ie. elevator throw.

Testing a model for optimum performance is time consuming, but worth it in the end. When the C of G is right, then you can also experiment with the decalage angles to see if your particular model handles better with slight changes in wing incidence angles. The Spirit, and many other sailplanes and other models fly with the leading edge of the stabiliser ‘up’ (positive decalage) and leading edge of the wing ‘down’ (negative decalage). This creates a degree of stability, but comes at a high drag penalty.

Adverse Yaw is a secondary effect of the application of ailerons. It can be counteracted by the use of rudder in the turn, or by programming some differential into the ailerons. This procedure is explained in the DVD. Going off on a tangent, the Tiger Moth is one bi-plane which benefits greatly from aileron differential. See, there’s something here for power plane pilots too!
commercial sailplane kits have a flat plate stabiliser, which does very little if anything to generate lift, so adjusting the wing incidence, rather than stabiliser incidence, is the way to go.

Most of this information can be learnt or passed on from other pilots, but a lot of the information is really only explained in general terms, by ‘experts’ at the field or slope. It can more often than not, be a case of the blind leading the blind. Most pilots are happy if their model flies and pretty well does what they want it to do. Other pilots seem to be able to make their model perform so much better than someone who is following the exact same model. I have seen it countless times. The difference is not necessarily the pilot, but the set up of a finely tuned model.

At our Club, Heathcote Soaring League, we run and organise the very successful Millennium Cup, a 2 metre span thermal glider duration contest series. This is a great competition, and presents a fairly level playing field in terms of the type of glider you are permitted to fly. The trend over the past couple of years has been for competitors to fly the excellent 2 channel glider which is manufactured in Europe, aptly named the ‘First’. This glider is unbelievably strong and can take two man reflex hand tows or electric winch tows with impunity. The extra height gained on launch zooms, generally equates to additional flight times and this, coupled with the good design, makes it hard to beat at times. There has been a good deal of trimming and fine tuning carried out by pilots, on various Firsts, and the performance reflects the extra time spent on getting the model to suit their needs and flying styles. The same principles apply to this model as they do to any other pilot’s skills aside. One point I would like to make, is that regardless of which model you are flying, or how well it is set up, you will still need skill to put you in the winner’s circle. To gain this skill, you need to practice, and one of the best arenas to hone these skills is in competition against other pilots. You will learn lots from your fellow competitors.

If six pilots have the same model and are at different skill levels, they will come up with different optimum C of G locations to suit their style of flying. This is the best part about fine tuning your sailplane. It allows you to find the optimum balance point for your model, regardless of your skill level. In competition, I fly at minimum in weight of the time. I assume that I will not necessarily find lift, so try to maintain every bit of altitude, which equates to points for every second of the allocated task.

I hope that I have addressed the principles involved in trimming and fine tuning your glider (and other model aircraft) and to give you a better understanding of this process, we now have an excellent educational DVD produced by Paul Naton, of Radio Carbon Air.

Performance Tuning for Gliders DVD

This is a step by step tutorial of 1 hour and 50 minute duration. This DVD is very highly recommended if you are searching for ways to get optimum performance from your gliders and are not too sure on how to go about it.

Paul does a much better job of explaining the steps required than I could ever do with words alone. Seeing how something is done visually makes it so much easier to understand. You know the saying, ‘A picture is worth a thousand words’; well this teaching DVD exemplifies that phrase perfectly. Paul Naton shows how you how to build your aircraft straight and true, right from the outset as well as how to correctly set up the control surfaces, set up centre of gravity and balance, how to use tools such as incidence meters in assisting your setup and how to fix common flight problems. He also explains how to tune and optimise V tails, understand adverse yaw and how to set up flight trims and modes in a computer radio. There are also sections within various subjects, showing flight demos of models on which the fine tuning has been performed. It is surprising to see the differences in performance, obtained on a stock standard Spirit Elite sailplane.

Paul takes this model and goes through the steps taken, to transform it from an average performer, into a snappy and responsive glider, which is a joy to fly.

The Chapters in the Performance Tuning DVD commence with the following subjects:

- Beginning
- Rig it right
- Tuning Tools
- Double Neutral
- Incidence
- Incidence 2
- V-tail tuning
- Centre of Gravity
- Adverse Yaw
- Differential
- Flight Testing
- Radio Programming

In the opening chapters of this DVD, Paul covers the range of tools required to build and fine tune a model aircraft. Some of these tools are ‘must have’, and some others fall into the category of, “Wow, that would be nice to have!”

The necessary tools are a straight edge, a balance machine of some type, (this can be a simple as a block with a couple of triangular pencil erasers on it) an incidence meter or similar and a deflection gauge. These can all be made or purchased at a modest cost and will pay for themselves every time you set up your airplane.

The Laser Incidence Meter, CG Machine and Deflection gauge, manufactured by Great Planes feature prominently in this DVD, along with the Robart Incidence Meter and Paul’s own home made CG machine. There is also a tool which is quite expensive, and falls into the category of wing panel and component weights. In this section we are basically ensuring that the assembly and building of the kit is symmetrical and perpendicular to the fuselage centreline.

Performance Tuning has a look at a common problem which affects many models, and that is, double neutral. This is where the surface doesn’t return to the exact middle after a control command is given. This generally occurs when there is some binding on either control surfaces or rods. For example, when ‘up’ elevator is given and the transmitter stick is returned to neutral, the elevator doesn’t quite go all the way back to the centre, but stops with a little bit of ‘up’ travel or a little bit of ‘down’ travel. Double neutral makes accurate trimming just about impossible. Paul Naton demonstrates clearly how to identify why this is happening, it will either be the servo, the linkage, the actual control surface or a combination of all of these. It is easily corrected in most cases, and the DVD shows you how.

There is often a total misunderstanding amongst R.C. pilots, of what incidence or decalage is. Paul Naton does the job of explaining it, on this DVD, so there should be no more misinterpretations. The chapter focuses on using the incidence metres and how to check for warps etc. with them.

We also learn how to get the incidence and vertical alignment of a V tail setup right. This is often a difficult task, but it is made easier, as shown on the DVD. Also explained and shown, is how to set up control throws for V-tail aircraft. The tail halves are working as both vertical and horizontal control surfaces, so elevator or rudder throw affect each other. Depending on how much up and down throw you have, your plane may climb or dive with the application of rudder. It is all explained in this chapter.

Setting the CG (centre of gravity) is next, and Paul recommends that the viewer in the manufacturers instructions. After all, you are trying to optimise your model, right?

One comment in this chapter, should have gone into the ‘bloopers’ file. Paul states ‘Mark the aft-most CG point and then mark the rearward-most point.’ Aft and rearward, mean the same thing, so he was meaning to say ‘mark the forward and aft-most CG position on the wing.’ Most people will have worked out what he meant.

The next tutorial gives a little insight into radio programming, but as Paul mentions in the DVD, there is no way he can cover everything concerning radio setup. He explains why it is beneficial to programme a computer radio to get the best performance out of your aircraft, and leads you through some of the mixes used on a typical 4 control surface model.

The next chapter describes what adverse yaw is, and how you can stop it. The clip shown to depict the results of changing the C of G using the dive test. If you’re using flaps, Paul shows how to set elevator compensation, to prevent ballooning up of the model when flap is pulled in.

Performance Tuning for Gliders can be applied to a number of aircraft types, not just gliders, and the use of video footage, diagrams, and explanations shows exactly how the plane will react to certain trimming changes. All R.C. pilots, from novice to expert, will probably learn something new from this DVD. It is highly recommended as a learning tool, and will benefit the viewer in the quest to set up their models for the best performance. It is a ‘must have’ production, and hats off to Paul Naton for continuing his series of instructional films for the benefit of us all.