TRIMMING FOR AEROBATICS

Jon Tappin provides some useful trimming information for anyone who wants to improve their model's precision aerobatic performance

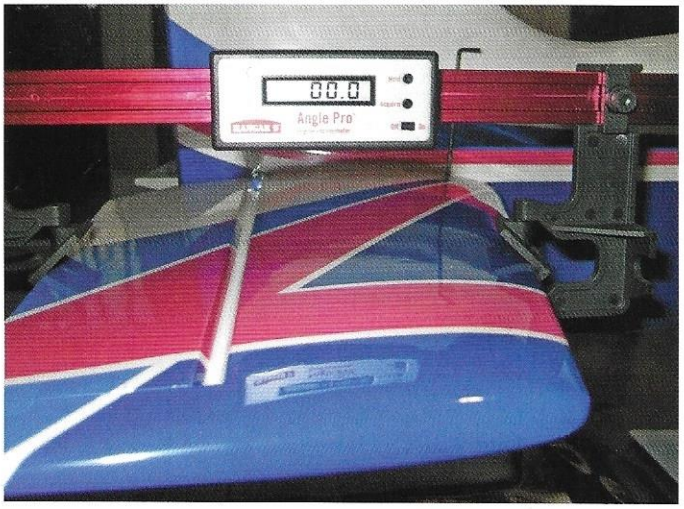
I flew my last competitive F3A event in 1999 and then decided to take a year off to catch up on some of the fun flying I had been missing out on. But although in the end I never went back to it, I have always kept my interest in this type of flying. Once you have flown a full blown 2 metre F3A machine nothing else quite compares to the pure, precise flying qualities of these types of models.

This article is based on the set-up for the Extreme Flight Vanquish 2M, which I reviewed for RC Model World's sister publication, Quiet & Electric Flight International last year.

ADJUSTABLE INCIDENCE

It is common practice with a competitive F3A airframe to have adjustable incidence, as this gives the pilot the scope to set the model up exactly as they wish and also to make adjustments to fine-tune the set-up after the initial test flights.

Different combinations of wing incidence and centre of gravity will affect the way the model behaves in vertical climbs and dives, and also affects pitch coupling with rudder. Top aerobatic models often come with incidence adjusters for the wings and the tail. They have to be installed as part of the build



A digital incidence meter makes setting up the wing and tail angles a lot easier and is highly recommended for anyone building a precision aerobatic model

On the Vanquish the zero datum line is the top deck of the fuselage, continually checked using a spirit level while making incidence adjustments

and therefore are not pre-set.

The process of setting the incidences is fairly straightforward but is quite time-consuming. I'll describe the process for setting zero degrees for the tail and 0.3 degrees positive for the wing (leading edge up). I borrowed a digital incidence meter from a friend which made this process a lot easier and I would highly recommend anyone building this model to get hold of one of these.

First off find the zero datum line of your model and pack the tail up until the bubble is centred on a spirit level placed on the datum line. I leave the level in place during the process so I can constantly check that the bubble is still centred when taking readings from the incidence meter. If you had a model with no 'pre set' datum, you need to determine a datum to work from, which would basically be the fuselage centre line.

The main thing though is to measure the relative incidences of the wing and tail and the thrust line. The starting point would be with the fuselage set level, the tail should be at 0 deg, wing at 0.5-1 degrees positive (leading edge up) and the thrust line at zero (with right thrust between 2 and 3 degrees).

Once happy with the level the next thing is to set the horizontal tail halves. On the Vanquish this adjustment is made by grub screws located at the top and bottom of the leading edge, which tighten down onto an aluminium pin inserted in a pre-installed tube through the fuselage. By winding the grub screws in and out with an Allen key the tail rotates around the carbon tube spar. Adjustments are then made by turning the grub screws a small amount, giving very fine changes of tail incidence.

Once both sides were set to show zero on the meter, while also checking that the bubble in the level was still in the middle, I ran a small drop of thread lock into the top grub screw recess. By locking the screw on one side, if the tail needs to be removed for transport the tail mounting screw is removed and the bottom grub screw is loosened a half turn so as to no longer grip the aluminium pin. When the tail is re-fixed the process is reversed, and as the top grub screw is locked in position the incidence setting will stay set. I do try to avoid taking the tail off as much as possible to reduce the chance of altering the settings. But I know that if I do remove it, I can be confident that it will go back in the same position.

Now on to the wing. The wing adjusters on the Vanquish are a little more fiddly but still do the job perfectly adequately. The wing is secured by a substantial carbon fibre tube spar with carbon pegs front and back. These pegs locate into the fuselage into a hole in an aluminium plate secured to the fuselage sides with 3 mm screws into vertical slots. The slots allow the plate to slide vertically up and down when the screws are loosened, which adjusts the wing incidence.

In order to set the wing incidence, I attached the incidence meter to each wing in turn at the wingtip, as this is where the incidence is most critical to roll trim.

In the old days of actually building models, when joining

Close-up on a wing incidence adjuster

foam wings it was always common practice in F3A to set the wingtips at equal incidence and to accept a slight misalignment at the root if both wing panels were not perfectly straight. Obviously, if the misalignment was too great it was better to scrap the offending panel or you would end up with an untrimmable model.

I set both wings at + 0.3 degrees as advised in the instructions by sliding the slotted plate in small increments and retightening the bolts until satisfied with the reading. I also had to remember to check that the bubble in the level was still centred. Having done both wings, I then checked the readings at the wing roots and found that they were also reading the same as the tips. This is good to know and proof that the construction process at the factory is producing not only strong and light, but also straight components.

Although the process described above is time-consuming the builder must not be tempted to rush it and make do with readings that are 'close enough'. It will just mean more time is required to trim the model after test flying. A slight warp can be trimmed out to some extent using a mixer but it will always be a compromise and never as good as a straight airframe.

Positioning of the main battery pack is the final job after all other equipment is installed. The position is determined by the final centre of gravity required by the pilot. I personally prefer to be slightly on the nose heavy side for precision flying as I find this improves tracking and gives cleaner breaks for snaps and spins. Certainly being anything like tail heavy is not recommended for a precision aerobatic model. That is for those who like wild 3-D performance – certainly not what an F3A model is designed for.

SET-UP

Now the control surface movements need to be set. This is another critical step towards a straight flying model. It is too easy to be lazy and rely on electronic travel adjustment and sub trims but it is important to have good geometry as a starting point. Where you have separate servos in pairs, as you have on elevator and aileron with the Vanquish, elevator halves should move exactly the same amount on either side, likewise for ailerons. If the geometry of the linkages and servo arm position do not match on both tail halves, for instance, the surfaces will not track each other exactly across their full range of movement, which can introduce a small amount of roll coupling with elevator, causing the model to 'screw' out in loops. Having set the linkage geometry, end point adjustment is used to exactly match the overall movements of the surfaces.

Final transmitter adjustments before the Vanquish takes to the air for the first time on a grey, windy day

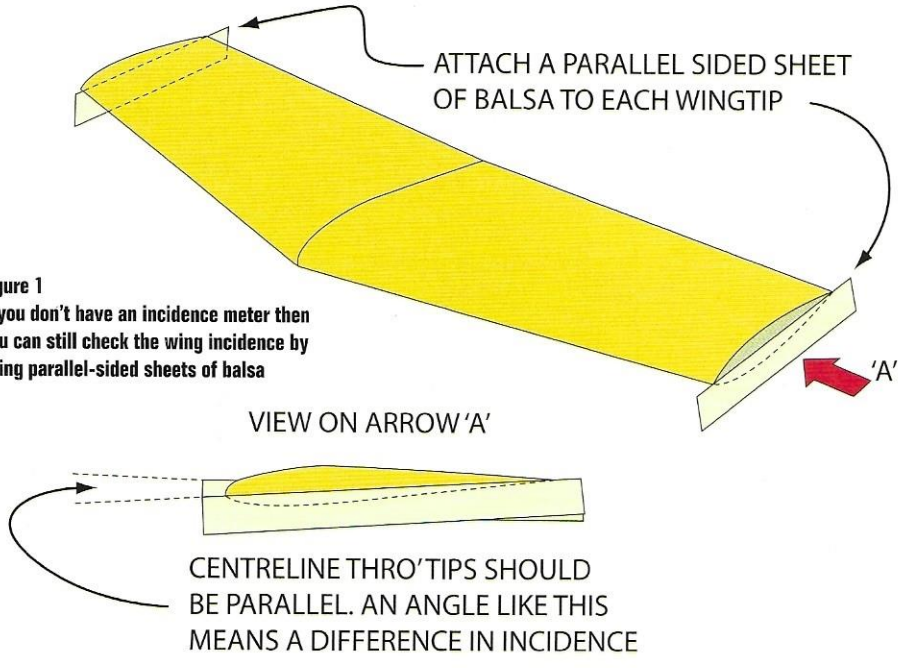


Figure 1
If you don't have an incidence meter then you can still check the wing incidence by using parallel-sided sheets of balsa

It is also important to mechanically set your linkages to get the best possible resolution from the servo. Start by setting your electronic end points to between 10 and 20% less than the maximum available and then connect the linkage to a suitable length servo arm to give the required surface deflection. This way you will use the maximum number of 'steps' across the range of servo movement. Avoid using the maximum end point value as there is a risk of overdriving the servo if you are using any amount of sub trim.

Aileron differential will usually be required to make the model roll along its axis. I always start by adjusting the throws with end point adjustment to give equal movement up and down on both sides

ABOVE: Jon's installation uses twin 5-cell Thunder Power packs connected in series. There's plenty of room to move the LiPo's to experiment with different C of G positions

BELOW At maximum stick deflection I set-up the maximum response I need. On ailerons this is during a roll at the top of a manoeuvre when the airspeed is at its lowest. Then use exponential to reduce sensitivity around centre

and then dial in 20% differential (more up than down) at the transmitter. This will usually be a good starting point in my experience but will probably need further adjustment after flying.

There are many different methods for setting up an aerobatic model and some may disagree with mine, but I have found this process to work well for me. I have to admit that I am perhaps not as thorough as others might be but trimming is all about making improvements to the flying qualities of your model. How far you want to take it is up to you; each pilot can decide when they feel they have gone far enough to satisfy them self.

Of course in this wonderful country of ours the opportunities to fly in flat calm conditions are few and far between. But this is the only time you will really know how true your model flies. You will probably think you have your model trimmed very well and then one day you will fly with no wind and spot something that's not quite perfect. Therefore trimming and model set-up is really an ongoing process. Of course, with wooden models like the Vanquish there is also the possibility that something will change slightly over time and need further adjustment.

Prior to the first flight, I had set-up the Vanquish exactly as per the instructions for control movements, centre of gravity and incidence settings. Test flight day was a grey, windy affair – pretty

The rudder on the Vanquish is very powerful

To achieve a well-trimmed aeroplane you must start with a well-designed and straight model. I was already pretty confident that I had this in the Vanquish

typical for early summer these days. Having carried out range checks and a final check over of the model, including control surface directions, it was time to go. The first flight was straight forward; a couple of clicks of up elevator and zero aileron trim were required but the model flew as expected – very smooth, with little control interaction. Plenty of performance was available from the Hacker Q60 with an APC 21" x 14" prop fitted.

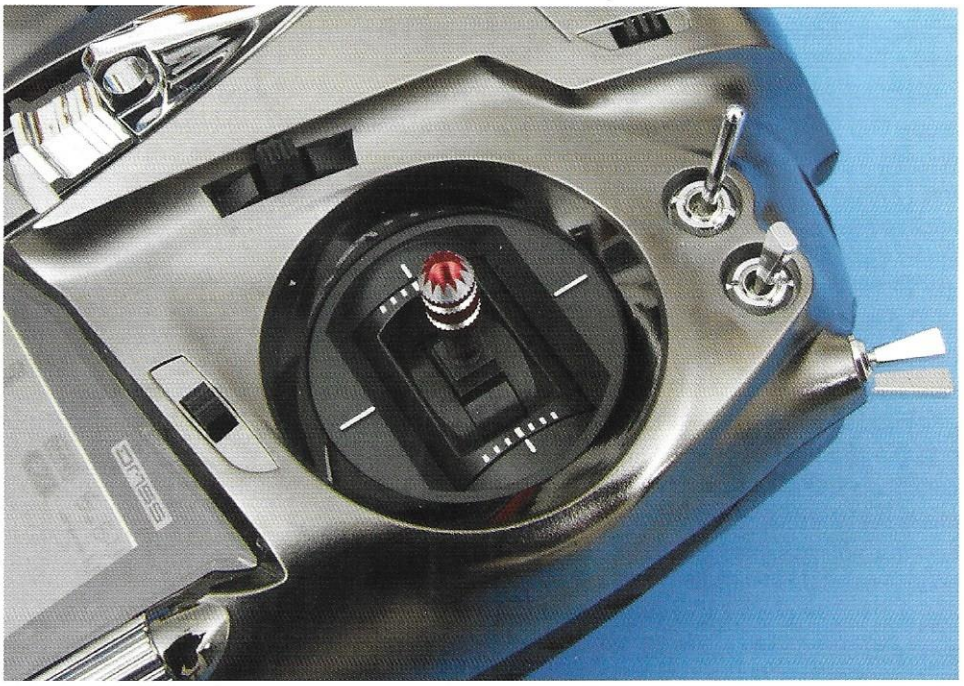
The rudder on the Vanquish is very powerful; it had some minor pitch and roll couple on the first flight, which was not enough to worry about at this early stage. I was able to easily fly a clean knife-edge loop on the first flight, the model pulled strongly over the top even in the strong wind and the exit at the bottom was flown with about half of the available rudder movement and a fairly low throttle setting. Impressive!

It was now time to start trimming it to make it even better. There is much more to trimming a model than adjusting the transmitter trims until the model flies straight and level hands off. Unfortunately this only works when the model is straight and level – not very often in aerobatic flying.

What we are looking for is an aeroplane that tracks in a straight line, whatever direction it is pointing. It will loop inside and outside with no tendency to corkscrew out. It will enter and exit snap rolls and spins cleanly and easily. It has controls that do not interact with each other (rudder only yaws, elevator only pitches and ailerons only roll). To achieve this you must start with a well-designed and straight model. I was already pretty confident that I had this in the Vanquish.

CONTROL RESPONSE

Firstly, set the control responses to your taste. My experience of flying other people's models is that the controls very often tend to be unbalanced, for example, sensitive on aileron and soft on elevator. This is a personal taste thing but I would recommend not having the controls too sensitive. I always set-up so that at maximum stick deflection I have the maximum response I need. For instance, on ailerons this is likely to be during a roll at the top of a manoeuvre when the airspeed is at its lowest. Having set this maximum deflection then use exponential to reduce the sensitivity around centre. Trying to make small corrections while flying manoeuvres is impossible with over sensitive controls. I always try to avoid having exponential values of more than 35-40% on precision rates. When you get above this figure you will find that at some point around mid stick position the sensitivity will suddenly increase, making control at partial stick deflections unpredictable. The Vanquish felt pretty good with the settings as per the instruction manual, so I only had to make minor adjustments to get the control feel I wanted. To be continued in the next issue. **RCMW**



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