

Tow Hooks

Brian Sharp



That's right, them funny bendy plastic things that you screw to the bottom of the fuselage so that it won't sit upright on the kitchen table.

Well, what about them?

At regular intervals I am approached by fliers who show me their new pride and joy. I am usually asked "Isn't it nice"? "What do you think of it"? Often these models are very well constructed and really look as if they will do the job. However when you turn them upside down, there, lurking under the fuselage, is a horrible plastic tow hook looking for all the world like some large, ugly, red or black slug, stuck to the bottom of the model.

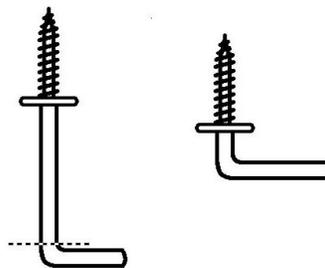
In my opinion you should rip this type of towhook off your glider immediately, take it in your right hand (or left hand depending on which way you sup your porridge) and then throw it as far away as possible. If you can hit the rubbish bin, so much the better. It will stop the countryside becoming littered with discarded tow plastic hooks.

So what is wrong with them?

They are big, clumsy and bendy, and they have the annoying habit of flexing and releasing the towline at the most embarrassing moments. In addition they are usual fixed at exactly the point on the plan that the manufacturer has recommended, or a little forward of that "just for safety". This in itself is not a crime — far from it in fact — it is a good starting place for the hook. It will however deprive you of a lot of precious altitude when you are launching the model.

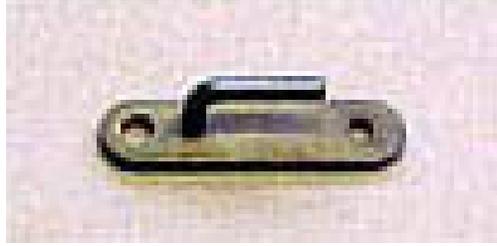
So what should we use for tow hooks?

For many years I used good steel cup hooks, with a straight shaft about 2,5 mm diameter as illustrated.



The angled bit is cut off (dotted line) and a new bend added about 5 mm below the flange, as shown. These hooks have a very substantial thread, which can be screwed onto a 5 mm ply plate built into the underside of the fuselage. This type of tow hook is strong enough to cope with a large open class model being launched by a power winch.

By the way, when I mention mounting on a ply plate in the fuselage. I am not talking about a 25 mm square piece of 1.6 mm ply glued to the bottom of the fuselage. I recommend serious timber! For a 2,5 m span glider I regularly use a piece of 5 mm ply, at least 25 mm wide and often 10 to 15 cm long, firmly epoxied into the fuselage. Overkill perhaps, but I have never had one break away.



I now use a slightly neater hook which is manufactured for me by my friend Brian Johnson in Newcastle. This hook consists of a brass plate 25 mm long by 6 mm wide, with a hole drilled in each end for the hold down bolts. A strong piano wire hook is brazed into a hole mid way along the length of the plate. This type of hook is seriously strong and I have never had one break or suffer an extraction from an aircraft.



Modern moulded gliders often have a towhook built into the structure as supplied. These usually comprise a substantial steel hook mounted in an adjustable frame. They are designed to take the power of a full-bore winch launch in any conditions. If one of these babies fails, you have got serious problems. I suspect that the broken towhook will be the least of your worries!

(This is a very nice piece of engineering, but is it really necessary? Once you've adjusted the position to suit yourself and the model, will you ever want to change it again? JL)

So where do you fit it? Under the fuselage of course!! But Where?

On most of the kit models that I have seen, the plan shows the tow hook in a relatively safe forward position. In days of dope and tissue the conventional wisdom had the tow hook set at 30 degrees forward of the centre of gravity. This resulted in a safe launch but gave poor height gain, as the aircraft tended to maintain an attitude about 45 degree nose up — not enough for a decent climb.

These days, with modern structures creating much stronger wings, we can afford to bring the hook much further back towards the C of G. This will result in the aircraft rotating almost to the vertical seconds after launch and heading skywards like a jet with full afterburner kicked in. In fact as a general rule, the closer you bring the towhook to the C of G, the more rapid will be the rotation to the vertical and the steeper the climb on tow.

It is possible to place the tow hook directly below the centre of gravity and this gives the theoretical ideal launch position. However it can also make for exciting (for exciting read hairy) launches, especially on calm days. Giving an effeminate launch to a glider with a very rearward hook position can see the model careering across the field in a knife edge attitude. This usually leads to the line collecting small children, dogs, and irate fliers. It also usually leads to structural integrity testing of the terminal kind on the airframe.

So how do you find the correct position?

At this point I should point out that there is no absolutely correct position, but you can achieve a very satisfactory compromise. I generally fly the model first to adjust the centre of gravity to the position where I am obtaining the handling characteristics that I require. During this initial setting up period the towhook is placed in a safe forward position.

Once I have more or less established my ideal CG position, I then mark its position on the fuselage at the wing root. A line is then drawn on the fuselage between the centre point of the wing leading edge and the trailing edge and the C of G position is then marked on this line. A further line is then projected down at 90 deg from this position and marked where it crosses the bottom of the fuselage. This is the point, behind which I would recommend that the hook should never be placed!

I then project another line at an angle 5 degrees forward of the vertical line, once again marking where that meets the base of the fuselage. This is the point where I would normally place the towhook. With the towhook in this position the model should rotate to the vertical immediately after launch and proceed to climb cleanly with little or no elevator assistance. It can also help if a javelin style launch is used, where the model leaves the launchers hand in a nose up attitude.

I would suggest that a good starting point would be a little forward of this, say at an angle of 10 degrees, and then to gradually move the hook back until you are happy with the handling.

To cover all eventualities I usually drill a series of holes 5 mm apart along the base of the fuselage in the area that the hook is going to be positioned so that I can move the hook back and forward as required.

It is worth remembering however that if at some point, you experiment with the C of G position by moving it slightly forward, it would be a good idea to move the towhook forward as well. You may well have moved the C of G in front of the hook position. (*) This is good fun for the spectators but not so much fun for you. Having a tiger by the tail springs instantly to mind.

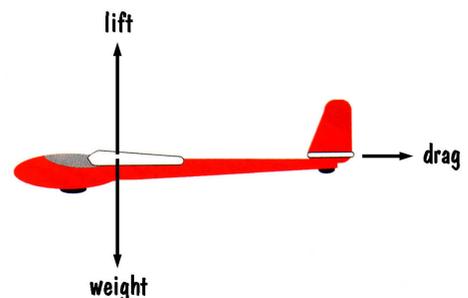
So there you are — a good flight starts with a good launch. Top competition fliers have claimed that the launch can contribute as much as 50% to the success or failure of a flight, so who are lesser mortals to disagree?

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(*) I have to take issue with Brian's comment about CG here . . .

Centre of Gravity vs Centre of Pressure

Three forces act on a glider in flight — weight, lift and drag. Drag can be ignored in this argument as it has a very much smaller value than any of the other forces. Weight acts (down) through the CG and lift acts (up) through the CoP or Centre of Pressure, and under normal conditions, lift and weight pretty much cancel each other, which means they must act through the same point. Thus, "trimming a model" in reality means "getting the CG and the CoP to cancel — act at the same point".

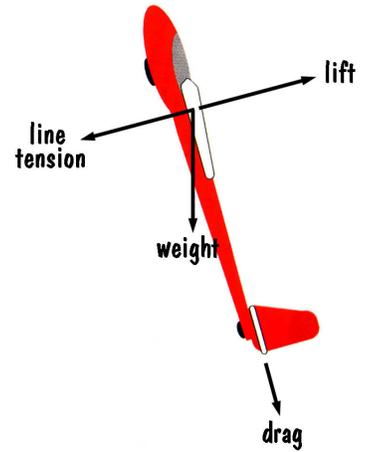


Now, the CoP is an aerodynamic point and would require complex calculations to identify — and to make things more difficult, it can move! Some models have shown a nasty habit of "tucking the nose under" at high speed. This is because the CoP has shifted back as the airflow over the wing changed, tipping the

nose down. It's much easier to assume that the CoP is somewhere between 30 and 35% of the chord and positioning the CG at the same point — after all, the position of the CG is easy to find.

So why did I object to Brian's statement?

On the line the CG plays almost no part in the launch! To start with, the model is almost vertical and the weight is acting (down) almost directly through the tail, so a different CG position will cause a miniscule difference to the aerodynamics. Also the weight of the model is between 2 and 3 kg, while the line tension is of the order of 50 kg (50 kg line has snapped under tow!) and the lift must match the line tension. A 2 kg force pales into insignificance in this company and makes no contribution worth considering!



A change in CG position will not affect the launch, but will show itself to a greater or lesser extent immediately on release, if it is in a different position to the CoP.

A different CoP position however, will have a serious effect on launch as it is decided by the aerodynamics of the flying surfaces.

Recently, I found my Sagitta going in every direction except straight up — I was wondering who had stood on it or kicked the trim lever on the Tx or . . . trim? . . . what was the elevator trim lever doing down there?

I had last flown a different model which needed more "up" trim and I hadn't reset it! The extra up trim had changed the aerodynamics, shifting the CoP forward (apparently moving the CG back, because few know and no one mentions the CoP), making the model highly unstable. When the trim was put back where it belonged for this model, it was as docile as usual! **JL**

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