Aero Towing out of Paddocks

When we go through our cross country endorsement we conduct the outlanding check in a two seater and usually the instructor heads for a paddock, a large flat paddock that will be suitable for the exercise. It may well be the case that this paddock is well known to the instructor. Also it will, in principle, be suitable for an aerotow retrieve subject to final checking. When we are racing cross-country the situation is different. I will certainly be looking for a safe paddock to land in, however an aerotow retrieve is a secondary consideration. The safe landing is the priority not the retrieve.

So when we have landed in our paddock what are the factors we should consider **before** calling up the tug? They are not necessarily in order.

- Is there a **total fire ban**, this may preclude any type of retrieve from the paddock.

- **600 meters is the legal minimum paddock length.** Walk the full 600 metres. There may be rocks, rabbit holes and small indentations that will break your undercarriage and are not immediately obvious. Remember there is no such thing as a short field take off, the paddock is long enough or not.

- Look for a suitable point for the tug to touch down and convey any relevant factors to the tow pilot before he lands. Work out what you are going to say in advance. This will keep the radio conversation brief while he prepares to land.

- Before the tug arrives have a good look at the surroundings. Each outlanding is unique, there are no fixed rules. Work out the best flight line out, is it better to take off into wind uphill or across wind downhill. The danger of uphill take offs are the slow and long ground roll. Beware also of downhill take offs with a tail dragger! The centre of gravity starts to move nearer the front wheels as the slope increases, this has proven very expensive in the past. If the paddock is harrowed, is it better to take off along the harrows? There is a risk of breaking the undercarriage if you take off across them. There are a lot of factors to consider, make sure you have assessed them all. You will have plenty of time to do so awaiting the tug. A few such factors are discussed below;

- **Look at where you will land if there is a rope break.** That is formulating an escape plan.

- **Discuss and plan the retrieve with the tow pilot once he has arrived**. Don't hook on and rush off as soon as the tug has landed. Consider the line you will take out of the paddock, where and at what point you should abort. Discovering the paddock slopes uphill halfway through the take off is too late, you could be in trouble. If in doubt release.

- **Is the paddock long enough?** Consider the paddocks slope, the wind direction and strength. Also the temperature, the hotter it is the less power the tug has. Discuss any radio talk required during the operation. State "I will call as soon as I am flying" so he knows your progress without looking in the mirror. But don't be preoccupied with radio communications, remember aviate, navigate, communicate. Spend plenty of time planning the whole operation, it is yours or the club's glider and your life.

- **Do not assume the tow pilot knows all.** It's a team effort and you don't have to proceed with the retrieve if you're uncomfortable with the situation.

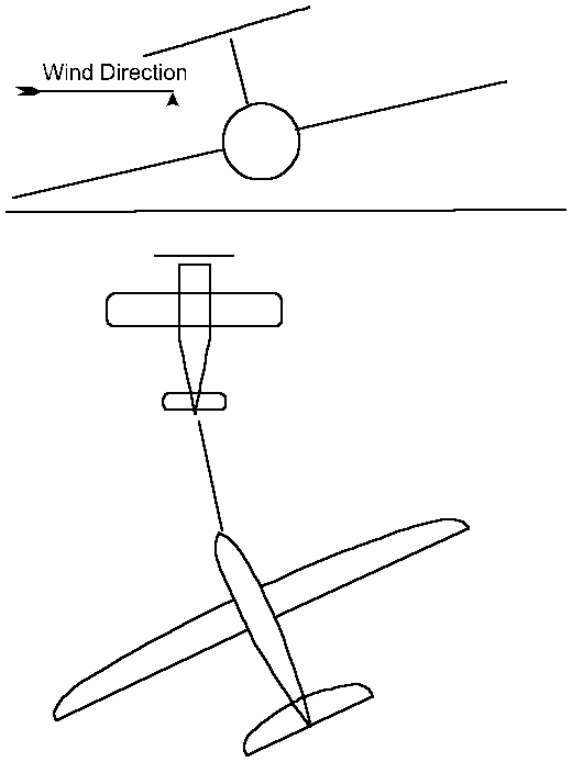
- **Push the glider back** to the limit of the paddock, in some cases this can be done alone, if not with the tuggies assistance. I am sure he will help. Remember one of the most useless things in aviation is "runway behind you".

- **Drink plenty**, as dehydration will make you stupid.

- **Prop up the wings** dragging a wing on the ground must place horrible strains on the airframe. When possible, I prop the wing up with sticks or fallen branches. These lie around the edges of most paddocks. Place one under each wing so that the wings are level prior to the start of the ground roll. A much less stressful launch for the glider and pilot results. As an alternatively a pile of rocks could be used instead of branches.

- One also needs to consider which wing should rest on the ground if you can't prop the wings level. Naturally you want to lift the wing as soon as possible. The greatest assistance you will have is the prop draft from the tug. The prop draft will give increased lift to the wing that it passes over. So how do you take advantage of this? If you are launching straight into wind place the glider slightly off line to the tug. Of course you have told the tuggie that you are doing this and why. Place the left wing on the ground with the center of the wing directly behind the tug. If however you have a crosswind let us say for example from the right, it is better to have the into wind wing, the right one in this case, off the ground as the wind will bend the prop draft over the lea wing that is on the ground. Don't rush the launch. Be sure when you start the ground roll all checks have been carried out and you are relaxed and confident. However, still be prepared to pull the bung if necessary.

Finally, if you think the paddock is not suitable for an aero-retrieve call for a trailer it's cheaper!



PERFORMANCE CHARTS – ***Luke Dodd***

It is in the glider pilot's best interests to have a basic knowledge of the factors affecting the take-off distance required, TODR, for a powered aircraft. After all an aerotow upset can really wreck your day. Don't assume the tow pilot is a 'full bottle' on TODR for his tug. Also you as the glider pilot do not have to accept his judgement for a particular take-off situation. As James has just

mentioned decisions are often unsound at the end of a long, hot, tiring day when the desire to get home is strong.

Okay so what affects the take off distance required, TODR, for a powered aircraft -glider tug? I hate to bring a formulae into the discussion but all pilots should have a basic understanding of this: $\text{Lift} = C_{Lift} . \frac{1}{2}\text{rho}.V^2.S$ where 'rho' is the air density, 'V' is the velocity of the aircraft and 'S' is the wing area. So the main factors affecting the lift produced by the tug's wing and hence its ability to fly is 'air density' and 'Velocity'.

Two factors determine air density- heat and altitude.

- Hot air is less dense, ie fewer molecules per unit volume, which reduces lift for a constant 'V', and it's also why thermals rise.

- Altitude/elevation, the higher you are above sea level the less dense the air.

On aircraft performance charts these two variables are combined into what's called density altitude. To generate the same amount of lift with a reduced air density requires a higher velocity (see formula). This is also why true airspeed (TAS) is greater than indicated airspeed (IAS) at altitude. IAS is a dynamic measurement proportional to $\frac{1}{2}\text{rho } V^2$, where TAS is the speed of the aircraft through the air. At 5000' TAS exceeds IAS by 8% and at 10,000' by 17%. I might remind pilots at this point that flutter is dependant upon TAS And not IAS.

A take-off on a hot day and/ or from an elevated runway will need a greater TODR. Why? With a reduced air density the tug needs to accelerate to higher 'V' where the lift produced enables the aircraft to fly. This requires more time, which equates to a longer ground run and hence requires more runway. Also a reduced air density decreases the maximum power produced by the engine, which has a further negative effect on the TODR.

The other essential element for lift generation by a wing is **velocity**. The velocity we are talking about is the velocity of the airflow over the wings, not the ground speed of the tug. Fortunately our ASI indirectly measures the speed of airflow over the wing. Our aircraft's ability to fly and its stall speeds are determined by reference to the IAS not the ground speed or TAS. So what significant factors affect the tugs ability to accelerate to the IAS or 'V' for take off? Runaway surface is significant. A rough, sandy or wet paddock or long grass will retard the aircraft's acceleration on the ground roll, as will an up slope. Hence the tug will take longer to reach the IAS for take off, a longer ground run results requiring a longer runway. I landed at Jindabyne one winter's day to take some friends for a joyflight over the ski fields. RWY elevation of 3400' and length was 1000m with long grass. The grass retarded the aircraft's acceleration much more than I expected and I could not reach TOSS. I elected to pull up into ground effect about 5' with the stall warning sounding. As I **maintained** this altitude the aircraft rapidly accelerated and I then commenced a normal climb out.

Wind speed is another vital element in the process of determining TODR. If you take off into a 20Kt wind the wing already has 20kts of lift producing airflow before the take-off roll commences so the tug will reach flying speed a lot sooner and hence have a shorter ground run than in calm conditions, hence less TODR. Have you ever noticed how slow FSJ is moving with respect to the RWY when on climb and taking off into a 15-20kt wind, yet IAS will be 60kts. The other benefit of taking off into the wind is the climb-out relative to the ground is steeper which has definite benefits for obstacle clearance, ie the trees at the end of the paddock! Of course taking-off down wind is not recommended. For a 10kt tailwind there will be no lift generating airflow over the wings until the aircraft has exceeded 10kts forward velocity, ie with a 10kt ground speed the IAS will still read zero! TODR in this situation can be frightfully long and the climb-out very shallow. Also for the glider pilot behind the tug, flight controls can be very ineffective during the initial ground run. NOT A GOOD SITUATION!

To summarise, a hot day combined with a rough boggy runway (paddock) surface with an up slope with nil wind should ring alarm bells for the pilot and he should realise that a greater TOD is required. In each powered aircraft's flight manual is a chart that allows you to input the temperature, runway elevation/slope/surface, and wind speed to actually determine the TODR. So once you have determined the TODR pace it out. If the Take of distance available, TODA, ie the length of the paddock does not equal or exceed the TODR then aerotow is not possible. Add a bit extra to this figure as the performance charts were compiled using a brand new aircraft/engine, which did not have a glider on tow. I am sure one of the Club's tow pilots would be happy to show you FSJ's 'P' charts. And finally **the Rwy/ paddock is either long enough or it isn't.**

Outlandings have accounted for 50% of glider incidents in the past 12 months. This should not scare the new cross-country pilot but each outlanding must be well thought-out and paddock selection must not be rushed. A significant number of these incidents involved experienced pilots!

Luke Dodd and James Cooper