17 - AEROTOW LAUNCHING

Many aerotow trained pilots look back on their training and remember how difficult it was to learn the aerotow. Some will admit to having been so discouraged that they almost gave up. This is usually the result of introducing aero-towing too early.

If a trainee cannot fly the glider in a reasonably straight and coordinated line in free flight, they won't be able to handle an aerotow. Ability to fly in a decent straight line suggests that the trainee can detect and correct for small changes in the bank angle - this is a must. Attempting aero-towing too early (say, after a set number of flights) will reduce a trainee's confidence and probably prolong the training to solo. This is certainly not 'giving value for money'. Post-solo pilots with wire launch experience only, generally find learning to aerotow much easier, and progress more rapidly. However, if tug upset accidents are to be avoided (see page 17-8), you need to be thorough with these pilots as well.

The trainee should not attempt the take-off and early part of the launch until he can maintain position successfully during the later part of the tow. Even experienced solo pilots converting to aerotow should follow this sequence, though they might be given the complete aerotow briefing in one session.

The demonstrations and the trainee's early attempts shouldn't begin until the tow reaches a height and position from which landing back on the airfield poses no problems. Good airmanship requires the trainee and the instructor to be aware of the circuit and landing options available during every moment of the tow. Then, if there is a launch failure, or you have to release unexpectedly, there will be less thinking to do. In the tow's early stages this reduction in workload can be critical.

The briefing and flying exercises are divided into three sections:

- positioning behind the tug, slack in the rope and releasing
- ground operations, ground run, take-off and initial climb
- launch failures, tug upsets and emergency signals.

BRIEFING POINTS

Vertical positioning behind the tug

- as the tug churns through the air the propellor and airframe leave behind a turbulent slipstream. During the climb this slipstream trails well below the tug
- if the glider is below the slipstream, it is said to be in the low tow position, and if above, in the normal tow position (see figure 2 overleaf)
- in the normal tow position the glider is positioned just far enough above the slipstream to keep the glider clear; making allowance for rough air, and the fact that the pilot will rarely maintain exactly the same position behind the tug
- the low tow position is common during dual tows, and occasionally on cross country tows.

Dual tows

- apart from any problems in the air, gliders attached to one tug by ropes of the same length would have difficulty taking-off without colliding, so the two ropes are of different lengths. The glider on the short rope takes-off first, maintains the normal tow position throughout the tow, and releases first (the shorter rope, unlike the longer one, can't strike the other glider). The glider on the long rope takes-off last, maintains the low tow position, and only moves up into the normal tow position just before release.

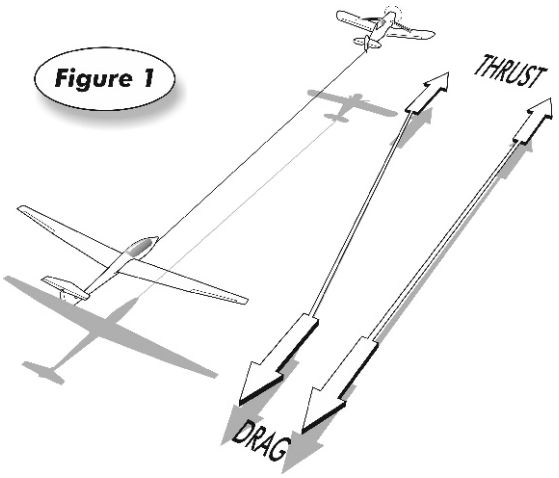
Cross country tows - single gliders

- when the combination is in level flight it is easy for a glider in the normal tow position, or above it, to start overtaking the tug, creating huge bows in the rope. With the combination in level flight a glider in the normal tow position is much closer to the tug's slipstream than during the climb. If conditions are turbulent and/or the rope is fairly springy, the glider can end up giving a good imitation of an upper air bungee launch, or worse. For any tow where the combination is likely to be in level flight for any length of time, such as an aerotow retrieve, the low tow position is far less tiring because the glider is, in effect, being towed uphill; 'springy bungee rope' effects and increases in speed will damp out more readily. Keep a hand on or near the airbrakes during any prolonged 'level' tow (see 'Slack (bows) in the rope', 17-3)

- the position in which the tug appears in the glider's canopy, once noted, becomes the glider's attitude datum (see figure 3, overleaf). By using elevator to keep the tug stationary at this datum (like a gunsight), the glider's position relative to the tug will remain stable. The technique works even if the true horizon isn't visible
- if the glider is a little high (perhaps the tug has just flown into sink - figure 4, overleaf), the tug will appear lower down the canopy, below the datum position. Lower the nose gently to return the tug to the datum position. 'Hold the tug' in the datum position using the elevator. The result is a progressive reduction in the glider's rate of descent, reaching zero when it is back in the normal tow position
- if the glider is returning to the normal tow position from low tow (figure 4), say, raise the nose gently to return the tug to the datum position. Hold the tug there using the elevator. The result will be as above, with the glider 'homing in' on the normal tow position.

Lateral positioning behind the tug

- where two forces pull out of line at opposite ends of a piece of 'string', the string will end up straight and the



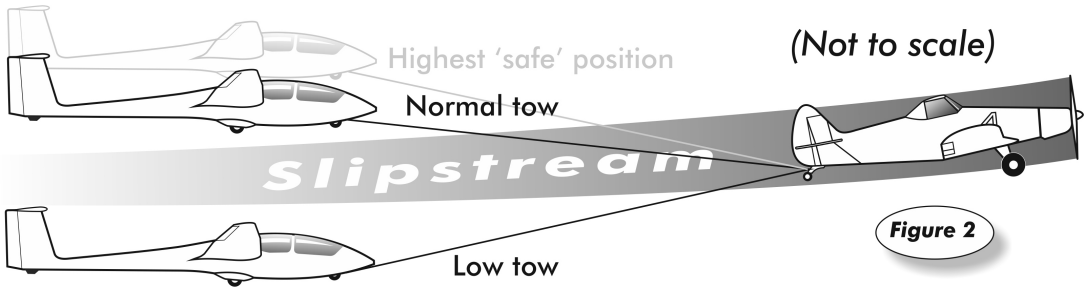


Figure 2

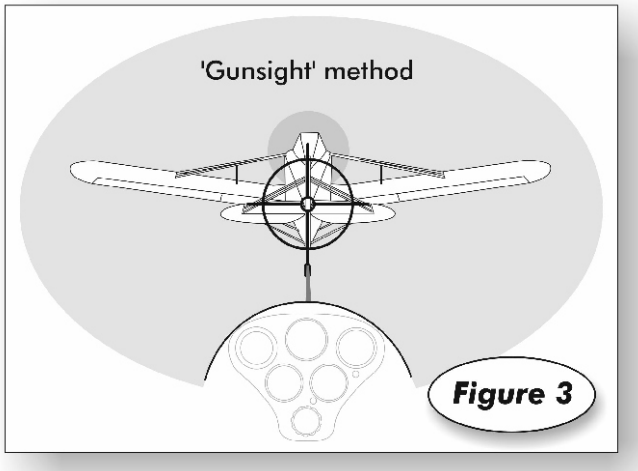


Figure 3

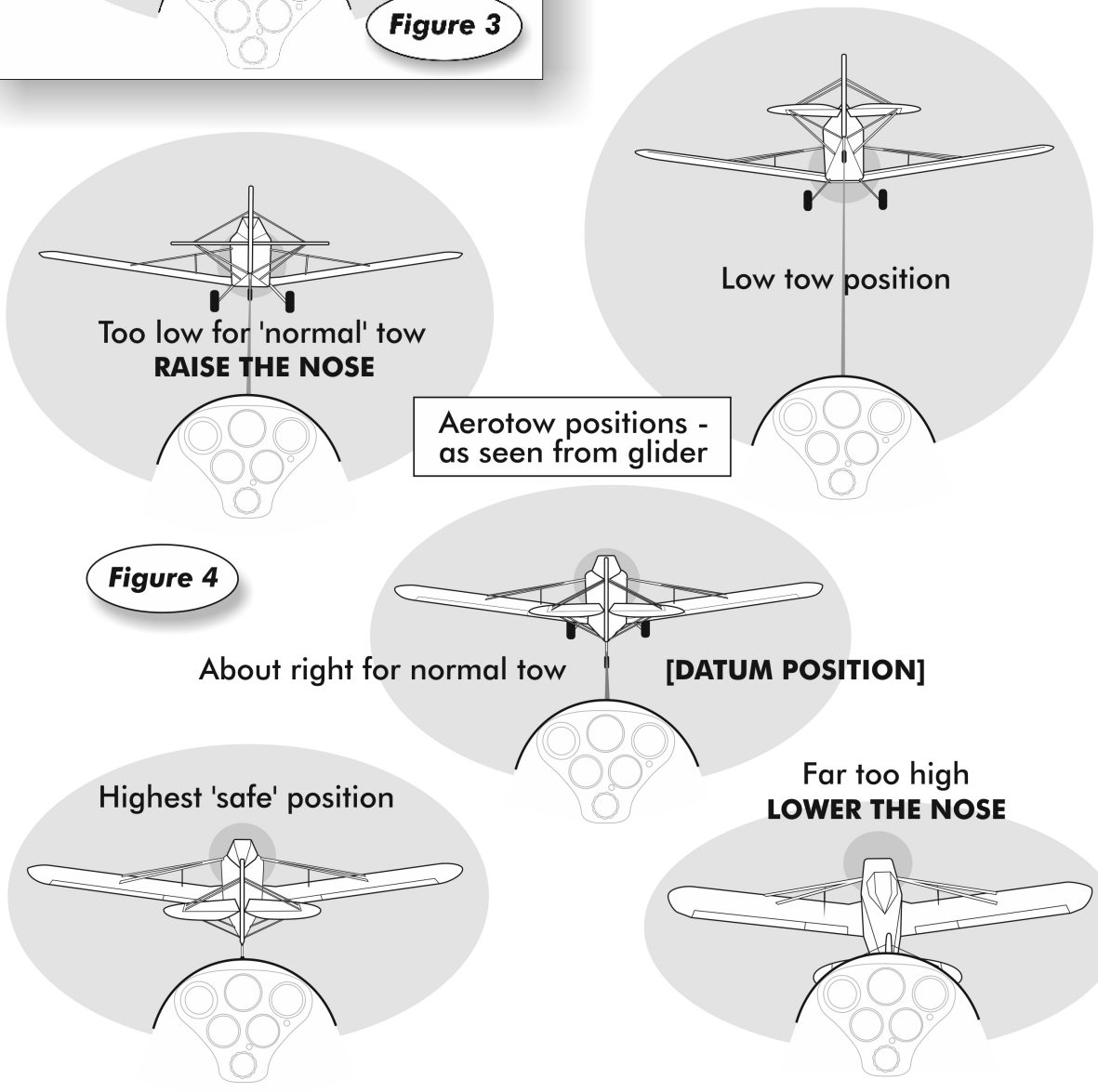


Figure 4

forces in line. As viewed from above (figure 1), the thrust of the tug's propeller at one end of the aerotow rope and the glider's drag, at the other, create a natural tendency for the glider to line-up directly behind the tug.

- the force required to keep the glider 'out of position' laterally can only be there if the tug and glider's angles of bank differ, so to maintain or return to the correct lateral position, simply keep the glider's wings at the same angle of bank as the tug's. It's worth noting that if the glider has a CG hook only, the lateral force and hence any 'self centring' tendency, may be very small
- higher flying speeds on tow make aileron/rudder coordination more difficult because:
  - rudder forces tend to be heavier
  - when the rope is taut and the glider is even slightly out of position laterally, it will yaw towards the tug, creating a strong rolling moment. When the ailerons are used to counteract this, adverse yaw gets worse, and tends to look much worse than usual because the tug is not very far away. Correct coordination here requires more rudder than usual.
- given that the above effect on a glider equipped with a nose hook will tend to automatically bank the glider towards the central position, banking deliberately is seldom necessary. However, if the glider does 'auto-roll' and is then left to its own devices, it will overshoot the centre position and begin a series of increasingly violent and divergent figure of eight manoeuvres (see figure 10), culminating in a broken rope
- in a turn the glider is not directly behind the tug. They are, in effect, flying around the surface of a cone, if the trainee holds the glider at the same angle of bank as the tug, the glider's nose will be pointing towards the tug's outer wingtip - exactly where will depend on the steepness of the turn - and the glider will then follow the path being taken by the tug (figures 6 through 8)
- even in straight flight the tug's tail may not always point directly at the glider. If the tug pilot uses too little rudder to counter the effects of the propeller's slipstream, the tug ends up flying sideways. The result is a slight reduction in the combination's rate of climb, and the glider having to fly sideways, apparently, in order to keep the string straight!

Slack (bows) in the rope

- small bows and horizontal displacements can be ignored. Bows will gradually pull out if nothing is done to worsen the situation, and any displacement will automatically correct itself. An experienced pilot might reduce the size of a large bow by using the airbrakes briefly, or sideslipping. Don't use large amounts of either. (Be aware that the airbrakes of some gliders are apt to suck out if opened at aerotow speeds, and with some types just cracking the brakes can start them juddering in and out.) Timing is important. Close the airbrakes or remove the sideslip just before the rope goes taut again, to avoid a violent jerk which may:
  - pitch the glider
  - yaw and roll it
  - break the rope and/or the weak link
  - catapult the glider forward and create an even bigger bow
- if you have to release with a big bow in the rope, wait until just before the rope goes tight again. Releasing without getting rid of the bow first can lead to the rings flying back and hitting the glider. In the worst case they can become entangled with it.

Releasing from tow

- throughout the tow both you and the trainee must remain aware of your position in relation to the airfield
- before release, look out for other traffic. Check your position relative to the airfield
- if the rope is released under tension a ripple will travel along it. This is a useful visual clue that it has released
- having established that it is clear to turn either left or right, and that the rope has released, raise the nose before starting a climbing turn to provide separation from the tug and rings, and to reduce the flying speed to normal. The preferred direction of turn after release depends on the club's local rules. Generally accepted are:
  - a left turn if the combination is flying straight at the moment of release, or
  - a turn away from the tug's direction of turn
- if the combination is climbing in a thermal, some clubs consider it acceptable and sensible for the glider to release and continue in the direction of turn
- trim to the required speed and check your position again in relation to the airfield.

GROUND OPERATIONS

The glider and tug should begin by pointing in the same direction, and in line. Depending on the wind direction, surface, and glider type, there is a good chance that if the combination isn't lined up properly to start with, that the glider will either ground-loop shortly after it starts moving, or run straight and uncontrollably in whichever direction it happens to be pointing. If the combination begins out of line, early trainees may have additional difficulty steering the glider on the ground.

Establish radio contact with the tug pilot if possible, so that changes to the towing speed, or instructions as to where to go, can be given during the tow. Radio contact can also allow the tug pilot - perhaps in conjunction with visual signals - see **Emergency Signals** box on page 17-6 - to warn that the glider's airbrakes are open, say, or should release immediately.

In accepting the rope, the glider pilot gives responsibility to the wing-tip man or launch marshal to issue the instructions to launch. A stop signal may stop or prevent a launch, but it must be stressed that if the pilot isn't ready, or for other safety reasons, he should release immediately.

Relaying signals to the tug pilot can be done by the forward signaller method, which is reliable, but care must be taken by the signaller not to be run-down, particularly if the glider drops a wing. Modern radio is another reliable method. Even if the tug is equipped with a rear view mirror, the tug pilot will find it easier and quicker to see and respond to signals from a forward signaller, or on radio. Using the rear view mirror alone, the tug pilot probably won't see a stop signal once he has been given the all-out and opened the throttle.

The glider pilot should keep his left hand on the cable release knob, so that if the wing drops, or for any other reason, the launch can be aborted immediately.

Aerotow acceleration is much slower than winch acceleration.

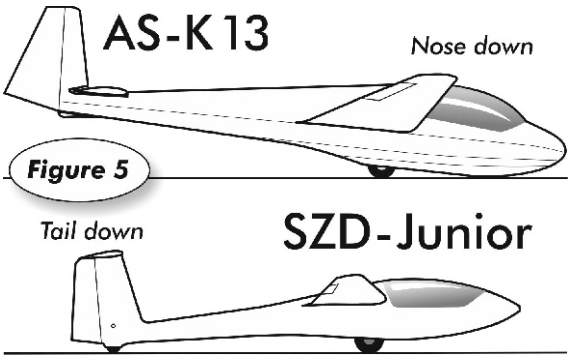


Figure 5

Glider which is nose down at rest

- the nose will need to be raised and the glider balanced on the wheel as soon as possible. Unless the wind is very strong, begin the ground run with the stick well back.

Glider which is tail down at rest

- best practice here, particularly in crosswinds, will depend on the glider type. The wing's angle of incidence affects the AoA, and is critical here. Raising the tail on some gliders can forcibly hold them on the ground even when they have flying speed.
  - for these gliders, pilot induced oscillations (PIOs) are a risk if the glider then hits a bump and suddenly takes-off. Best to keep the tailwheel on the ground by starting the ground run with some back pressure on the stick, relaxing it somewhat as the glider accelerates, and then allowing it to take-off in the two point attitude. Stick back during the early stages of the take-off run can also help to keep the glider running straight
- the above is more important during crosswind take-offs because:
  - the glider is likely to weathercock into wind. Some gliders, usually older single seaters, can be a real handful in almost any crosswind, e.g. Olympia 460
  - the rudder won't keep the glider straight during the first few seconds. A wingtip holder on the downwind wing can help the pilot keep straight until the rudder takes effect. (Note that an offset CG hook can either lessen any wind-induced swing, or worsen it, depending on the crosswind direction [chapter 15])
- for other 'tail-downers', the best technique is to begin the ground roll with the stick forward, to lift the tail as soon as possible. The wing's AoA will reduce as the tail comes up, and the ailerons will become more effective, reducing the risk of a ground loop. Raising the tail early will also prevent the glider becoming airborne at too high an AoA, and then wallowing and/or quickly trying to out-climb the tug. However
  - in gliders with all-moving tailplanes, trying to raise the tail too early can result in the tailplane stalling. It can unstall suddenly as the speed increases, and the tail then comes up very quickly. Following that, particularly if the normal elevator stick forces happen to be low, it's not difficult to bang the nose on the ground, or develop a bad attack of PIOs.

Effects of prop-wash

On calm days, especially when using short ropes (eg. aerotow field retrieves), the wash from the tug's propeller will tend to force down one wing of the glider, requiring prompt action with the ailerons. Accident reports often blame farm hands for throwing the wing on the ground, despite a briefing. In fact, the sensation of a wing being thrown down is almost certainly prop-wash! The greater the power of the engine, the stronger this effect becomes. American engines (Lycomings in Citabrias, Pawnees, Cubs etc) will cause the right wing to drop, while British engines (Gypsys in most Chipmunks, Tiger Moths etc) will cause the left wing to drop. The briefings to a wing tip holder, farmhand or not, should stress the need to hold the wing up or down. If no wing tip holder is available then the glider should start with the wing likely to go down, up. If in doubt, look at the tug's propeller - the downgoing blade will be on the same side as the potentially downgoing wing.

Take-off and initial climb

If the glider does not lift off by itself when it has reached a knot or two above the unaccelerated stalling speed, lift it off cleanly with a gentle back pressure on the stick.

Fly about 6 - 10' up. This not so low as to risk flying on again nor so high as to hinder the tug's take-off. The position is also close to the datum position for the main part of the tow.

If there is a crosswind, either yaw or gently bank the glider to make an appropriate heading correction to prevent it drifting off-line behind the tug. The glider should be wings level, string in the middle, after the correction. Trainees may have difficulty with simultaneously flying 'straight' through the air, sideways over the ground, and keeping correct station behind the tug.

Except for heavy and water-ballasted gliders during the first and slowest part of the acceleration phase, the glider will take-off before the tug.

The combination will accelerate more rapidly once the glider is airborne.

Depending on the initial trim setting, positive forward movement of the stick may be required to prevent the glider climbing (or climbing too quickly) during this acceleration phase.

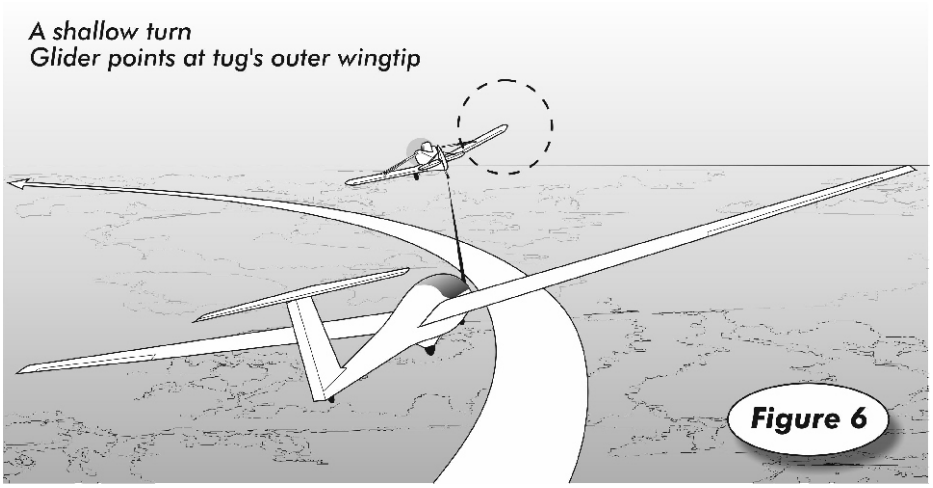
Once the tug is airborne it will accelerate, either staying level until climbing speed is achieved, or climb and simultaneously accelerate. Keep the glider in roughly the same position relative to the tug as it was shortly after take-off.

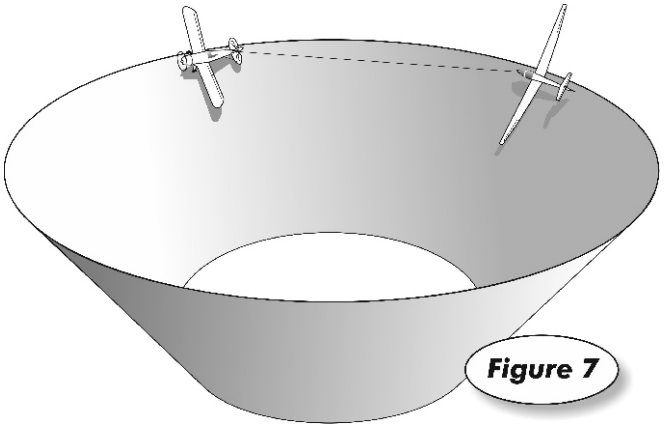
There will be an increase in airspeed if the combination climbs through a wind gradient. The effect will be more marked if the tug has been 'held down'.

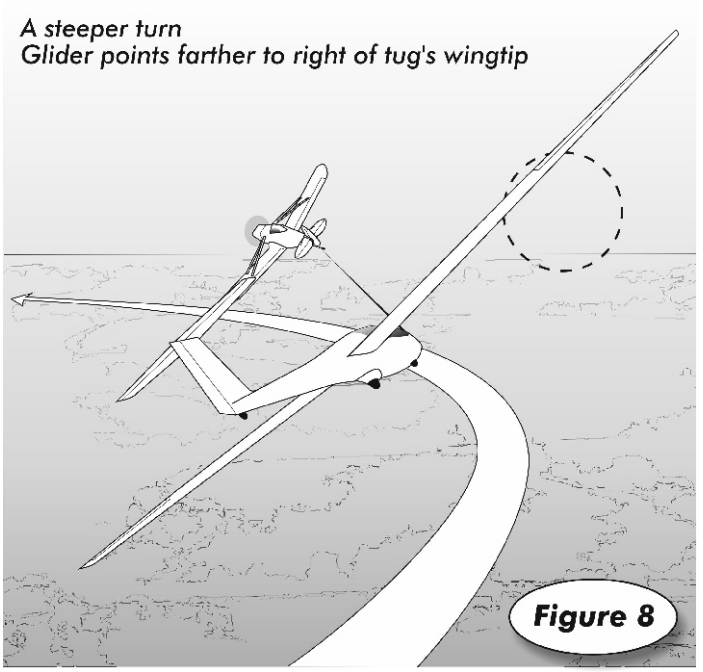
If the glider gets low in relation to the tug, a hurried climb to get back 'into position' can lead to the glider accelerating up through the wind gradient into a 'slingshot', and sending the tug straight into the ground (see later notes on 'tug upsets'). This can happen so quickly that the glider pilot may not recognise and/or react in time. Encountering the slipstream unexpectedly can also trigger this type of accident, and too low is potentially just as dangerous as too high. The risk is greater if the glider is towing on a CG hook - the one normally used for winching.

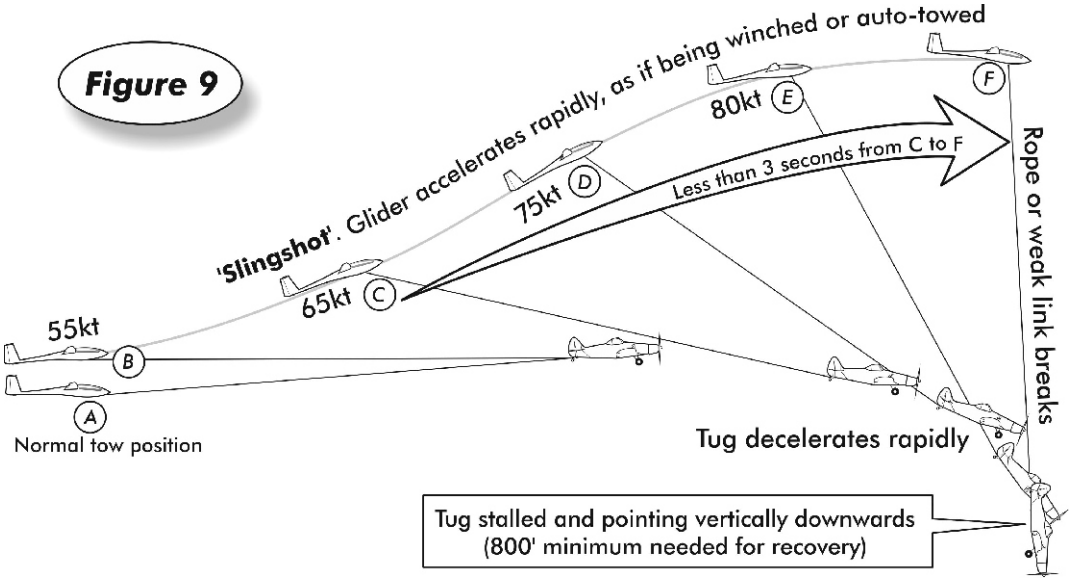
LAUNCH FAILURES

During the early stages of an aerotow, safe landing options are limited. Unlike wire launches, there can be a period when it isn't possible to land safely within the airfield boundaries. In the event, there is little time to think about the options or to search for places to go, so it's important to identify suitable off-field emergency landing areas during the tow, until height and position are such that a safe return can be made to the site.









Especially during the initial part of the tow it is important to concentrate on the emergency options and not be fiddling with the DV panel and such like.

Until the glider is at a safe height to turn back, the only options are to land straight ahead or a few degrees to either side. At some sites there may be a short period in which the only available option is a more or less controlled crash. The primary aim then is to avoid personal injury. Fly the glider onto the ground in a clear space and ground loop at the slowest achievable speed. (If you ground loop at too high a speed you can end up doing a spectacular wing-over). If the controlled crash option seems unpalatable, compare it with the risks of doing a low turn, catching a wingtip and cartwheeling, or spinning!

Most serious aerotow launch failure accidents result from the pilot having insufficient height and attempting to turn back to land on the site. Given that the climb rate of the combination usually exceeds the glider's normal sink rate by a factor of at least two, then theoretically the glider could immediately do a smart 180°, and arrive back at the launch point at something more than half the height of release. This nice and comforting scenario fails to work in the following circumstances:

- if the airbrakes have been open for all or part of the tow. Unless the tug is exceptionally powerful, or the glider's airbrakes rather ineffective, the combination will have crawled for miles before gaining final turn height
- if the combination climbed unusually slowly. Perhaps the tug's engine wasn't operating at full power
- the take-off was downwind
- the wind was strong. The combination's climb angle in relation to the ground will be steep, so a 180° turn could be inside or very close to the airfield boundary. In this case a downwind landing would almost certainly end in disaster. There might, nevertheless, be enough height for a short, tight circuit.

None of the above is intended to suggest, in any way, that a low circuit and even lower final turn are acceptable, only that in a light wind a downwind landing could be a possible option.

Practice rope breaks in gliders are almost always in positions from which a landing can be made on the airfield. This has the implication of negative training in that it can reinforce the tendency of the trainee (and some instructors!) to feel obliged to turn back to the airfield. Try to supplant this reaction with something more reflective - motor gliders are excellent for this sort of training - so that the trainee gains the confidence to land ahead, even off the airfield, if necessary.

A rope break will leave the rings and possibly some rope attached to the glider. Depending on the amount of rope left attached and the glider's speed, the rope will usually stream down sufficiently far below the glider to avoid fouling the tailplane or elevator. Unlike wire launching, most of the tow won't be over the 'sterile area' of an airfield. Dropping the broken rope and rings 'out in the country' after a rope break could cause damage or injury to persons or property. Unless there are control difficulties, **it isn't usual for the glider to release a broken aerotow rope.** Having said that, care needs to be taken to ensure that, during the landing, the dangling rope doesn't snag on a hedge or fence, or clobber cars or members of the public.

EMERGENCY SIGNALS

The tug waggles its rudder

A signal to indicate that there is a problem at the glider's end of the rope. The usual problem is that the glider's airbrakes are open, but if the glider has a braking/tail parachute, that could have deployed. If the combination is in difficulties as a result, and the tug pilot doesn't have time to signal and wait for a response, he will probably wave you off or simply release the rope from his end.

The tug rocks its wings (EMERGENCY WAVE OFF)

The glider MUST RELEASE. You may not know why you have been waved off, so immediately after releasing check that the airbrakes are not open.

If the glider is UNABLE TO RELEASE

If in a two-seater, try the other release first. If you are in radio contact, talk to the tug. Otherwise, fly well out to the left of the tug (to a position where the tug pilot can see you) and rock your wings positively from side to side. Rock left first and furthest, or you'll end up swinging back towards the middle. While out to the left you may need a small amount of airbrake to keep the rope tight. The tug pilot will tow the glider back to the airfield and there release his end of the rope.

TUG UPSET ACCIDENTS

These are serious, and have caused the deaths of a number of tug pilots. If the glider is allowed to climb rapidly behind the tug, it can very quickly become impossible to prevent it accelerating upwards in a slingshot action (rather like a winch launch), and tipping the tug over into a vertical dive (figure 9, previous page). Once that has happened only height can save the tug pilot from disaster. Downward displacement of the glider to a position below the slipstream is quite acceptable, but upward displacements are much more critical.

The glider pilot must release immediately if:

- the glider is going high and the tendency cannot be controlled, or
- the pilot loses sight of the tug

Factors which can combine to create a tug-upset accident are:

- a light pilot flying close to the minimum cockpit weight
- an inexperienced pilot - particularly wire launch pilots with little recent aerotow experience
- glider with a belly or CG hook
- an all-flying tailplane, or a glider with very light elevator forces
- short rope
- turbulent conditions.

As an instructor, not only is your vigilance required when you are actively teaching a trainee, but also when supervising solo pilots. You can contribute towards a lower risk environment for your tug pilots by:

- making sure that glider pilots don't attempt to launch in turbulent conditions that might be beyond their level of experience
- encouraging club and syndicates alike to fit nose hooks to gliders which are likely to be flown by inexperienced pilots. Nose hooks reduce the likelihood of a tug upset

- don't tolerate short aerotow ropes unless you have no alternative. The longer the rope, the easier the tow for any pilot, tyro or pundit.

If the trainee hasn't been shown the **EMERGENCY WAVE-OFF** (see box) they may well release when the tug flies through turbulence. Point out the difference between the tug pilot giving a signal, and the tug bouncing around randomly in rough air. When a signal is being given the tug will bank further, one way and then the other, with the appropriate aileron being applied before the roll occurs. In turbulence, the tug pilot responds to what's already happened, so the ailerons move after the wings. The emergency signal should be strictly complied with, and shouldn't be watered down by being used for any other purpose (say, to stop cheating on launch height).

Descending on aerotow may be necessary if the rope has failed to release from the glider end, or on a cross country tow to get under lower cloud or airspace. Open the airbrakes fully to prevent the glider overtaking the tug. Some gliders airbrakes snatch open at high speed, so watch out!

The Flying

Discuss which parts of the tow are going to contain demonstrations which the trainee should follow through. Introduce the vertical and lateral positioning demonstrations first, then get the trainee to practice staying in position using the tug as the attitude and bank reference.

Until the trainee is competent at maintaining position behind the tug and has been given the takeoff demonstration, he should not attempt the take-off. The instructor should demonstrate the effects and techniques described below. In turn, the trainee should use the techniques in attempting to maintain the correct position, but should not attempt to reproduce each demonstration.

Take-off

☑ Ensure the glider is pointing in the direction of takeoff and that the tug is directly in front.

☑ Complete the pre-take-off checks. When you are ready, accept the rope.

☑ If possible, establish radio contact with the tug.

☑ Decide on the initial stick position according to the type of glider (see 17:4).

☑ Keep your left hand <u>on</u> the cable release knob, ready to release if a wing drops or the glider overruns the cable.

☑ Monitor the launch signals that are being given on your behalf.

☑ Before the rope tightens, check that it is still clear ahead and that there is no conflicting traffic. If there is, release immediately. Otherwise:

- as the glider moves, steer with the rudder to keep directly behind the tug. Keep the wings level with the ailerons and balance the glider on its main wheel with the elevator - bear in mind the remarks (17:4) about glider types. This gives the best acceleration and shortest ground run
- once the glider is airborne, move the stick progressively forward to remain about 6' - 10' above the ground until the tug takes off, and keep the wings level with coordinated ailerons and rudder
- be ready for the tug to climb, and climb with it
- identify the changing options in the event of a rope break, which are to:
  - land straight ahead or slightly to either side, on the airfield
  - make an *arrival in <u>that</u> field*
- continue reviewing the options until returning to the airfield is again a safe option.

Vertical positioning behind the tug

☑ Use the tug's vertical position in the glider's canopy as an attitude datum.

☑ Confirm this is the correct position by locating the tug's slipstream. *Note the vertical position of the tug in relation to the glider's canopy*

☑ Begin by demonstrating the low tow position and how to recover back to the normal tow position.

- if the tug's position on the canopy rises, the glider is descending relative to the tug
- if the tug moves down the canopy, the glider is ascending in relation to the tug.

☑ Next demonstrate the high tow position. This is the highest safe position to which we would allow the trainee to go. Show how to recover to the normal tow position.

☑ To move back to the correct vertical position behind the tug, raise or lower the nose as appropriate until the tug is in the correct attitude reference position. Use the elevator as necessary to keep it there.

Lateral positioning behind the tug

☑ Use the tug's wings as a datum for the angle of bank.

☑ In straight flight the glider is directly behind the tug.

☑ If the glider's wings are not at the same angle of bank as the tug's then the glider will move off-line in the direction of its lower wing.

☑ Correct this by simply bringing the wings parallel with the tug's. Do not allow the inside wing to go down. Allow the rope to pull the glider back into position. (This only works reasonably well if the aerotow hook is some distance horizontally forward of the CG, so it can vary in effectiveness, and with some gliders may not work at all).

☑ When the tug turns, use the same angle of bank as the tug. Even though the tug pilot is supposed to be in charge of the combination, you should look-out at least briefly in the direction of the turn. The likelihood is that you will be able to see far more than the tug pilot in that direction anyway, particularly if the tug has a high wing.

☑ In the turn, the side of the tug is visible. The glider's nose points to the outside of the turn rather than at the back of the tug.

☑ Higher than usual force is required on the rudder pedals to coordinate with the ailerons and eliminate adverse yaw.

Trainee practice with prompts

The trainee should not attempt to copy any particular demonstration directly, but use instead the demonstrated techniques to maintain the correct position behind the tug.

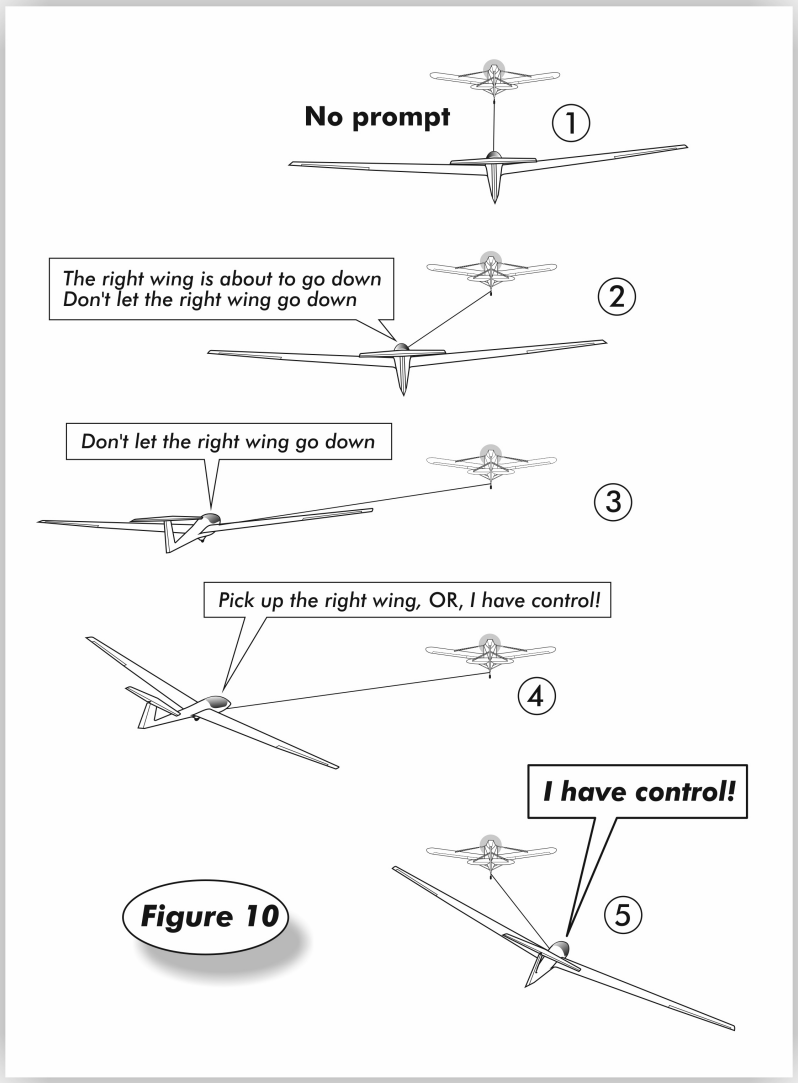


Figure 10

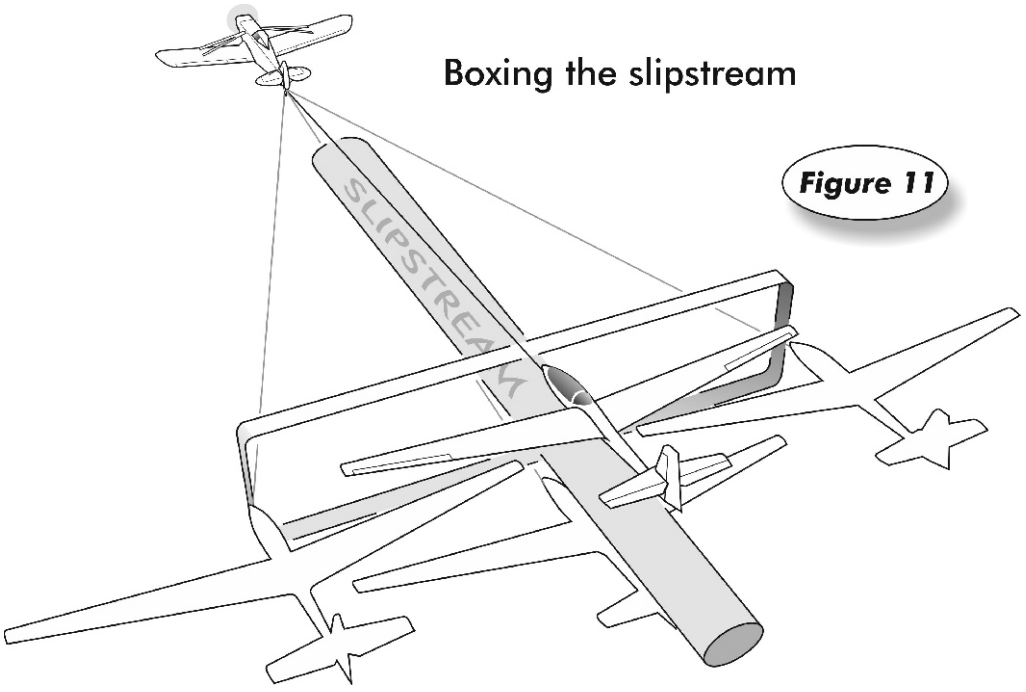


Figure 11

Releasing from tow

Prompt or demonstrate this as appropriate.

Approaching release height:

- check the position of the glider in relation to the airfield
- look out in preparation for turning but keep half an eye on the tug
- pull the release
- check that the rope has actually separated from the glider
- for maximum separation promptly raise the nose and then turn. Club's differ on which is the 'correct' way to turn off tow. Most usually it is to the left. If in doubt, up and straight ahead is probably safest. (In the UK there is no specific rule as to which way you should turn)
- once clear:
  - return to normal flying speed. Trim out
  - confirm your position relative to the airfield.

If you can't see the airfield, watch where the tug goes (this assumes the tug pilot knows).

Adverse yaw on tow

This demonstrates the large amount of adverse yaw on tow, and is used also to good effect when trainees are making small corrections on the ailerons, but failing to move the rudder enough or at all.

- create a yawing oscillation by making a series of very small aileron movements without any rudder
- *notice how much yaw there is*
- repeat, but coordinate with the rudder
- emphasise that even for tiny aileron movements, enough pressure must be applied to the rudder to move it.

Boxing the slipstream

This exercise should only be done by the trainee when his coordination and aero-towing skills are fairly well developed. In other words, not too early. The exercise serves to 'calibrate' for a range of positions to which a pilot might reasonably go, and helps consolidate the techniques for controlling the glider behind the tug (figure 11, facing page). Demonstrate the exercise before the trainee attempts it. Brief the tug pilot beforehand. Do the demonstration. Allow trainee practice only when the combination is in straight flight.

- descend through the slipstream until just below it, clear of the buffet. Hold that position
- the tug pilot will alter his attitude to counteract the downward pull of the tow rope, and this will slightly alter the position of the slipstream
- re-establish the position of the slipstream and again descend just below it
- staying the same distance below the tug, move at least the glider's semi-span out to one side, preferably more. If you go too far out a large bow will develop in the rope and you will start to overtake the tug. (Note that the longer the rope, the further out you can go)
- maintaining the same lateral position climb gradually back to the level of the normal tow. If you are sufficiently far out there should be no buffet as you climb up. The tension in the rope will tend to yaw the glider back in towards the centre-line, so a small amount of bank away from the tug will help maintain the lateral displacement, plus rudder to prevent the yaw and consequent roll
- maintaining the same vertical position, allow the glider to be pulled back into line
- complete the box if time allows.

Demonstrating divergent oscillation

These exercises enable you to check that the trainee who has learned to keep in position behind the tug also takes prompt and correct action to rectify divergent situations.

Take control and warn that you will hand back control for the trainee to take corrective action.

- roll the glider a few degrees from the tug's bank angle
- before the glider has moved very far, hand back control
- gradually increase the difficulty by:
  - allowing the glider to be further displaced
  - increasing the difference between the tug and glider's angles of bank
  - adding vertical divergence
  - move the glider half a span to a span to one side of the tug and banked slightly towards it.

Take care! Things happen fast here. Don't ask the trainee to do something which you can't handle!

If the situation illustrated in figure 10 opposite is allowed to develop of its own accord, the glider will swing more violently and bank more steeply at the end of each pass, eventually breaking the rope.

DE-BRIEFING

The de-briefing covers all those aspects of the flight related to aero-towing which have been demonstrated or practised.

ADVICE TO INSTRUCTORS

Aerotowing should not be taught before the trainee is capable of reasonably well coordinated straight and turning flight. Because most early trainees find the workload in this exercise very high, it is best to allow them to fly only the last 500' to 1,000' of the tow. Progressively increase the workload by lowering the height at which they take over control. Don't allow them to attempt the take-off and first 500' until they can keep station without assistance or frequent prompting on the upper part of the tow. As a rule, if trainees get out of position below about 400', take over rather than try to prompt them back.

Early pre-solo pilots are apt to get very tense under the high workload, so take control for a short while after release to give them time to relax.

Converting post solo pilots to aerotow is always a dilemma for instructors. The wire launch pilot isn't used to the relatively high cost of aero-towing, and the conversion is often associated with a holiday or expedition. Instructors feel under pressure to keep the costs to a minimum and let the pilot get on with their holiday. Forget the cost to the glider pilot and think of the life of a tug pilot and his bereaved family. Expect to take at least 4 to 6 dual aerotows, sometimes more, to convert a Bronze C level wire launch pilot to aero-towing.

A few trainees may grasp the principles of aero-towing so quickly that they never learn about the yawing force from the rope. Before sending them solo on aerotow, they must be given control when the glider is out of position and banked relative to

the tug and be able to demonstrate their ability to recover to the normal tow position. It is not enough to position the glider off to one side and then hand back to the trainee to correct. The trainee must be able to deal with a divergent situation where the glider is moving relative to the tug. The acceptable displacement depends on the controllability of the tug, and this in turn depends on the angle of the rope. The longer the rope, the more scope there is for allowing a trainee to get out of position.

COMMON DIFFICULTIES

Most Ab-initio trainees cannot perceive whether the glider wings are parallel with the tug's or not and are more likely to apply stick and rudder towards the tug regardless of which wing is down. You may need to prompt. For example:

- if the glider begins to move out to the left - *The right wing is about to go down, don't let the right wing go down* (because of the yaw caused by the tension in the rope)
- when out to the left and as the wings come parallel - *Don't let the right wing go down*
- if the right wing is allowed to go down despite your previous prompt, then say *Pick up the right wing*.

It is important to specify **which** wing. Remember, the trainee got into this position because they had difficulty perceiving that the glider was banked relative to the tug.

Gets into divergent horizontal figure of eight oscillation (figure 10). This starts due to failure to perceive small angles of bank relative to the tug, and is compounded by failure to appreciate the yawing and rolling caused by the rope. Judicious use of prompts can correct this, but when necessary, take over and reposition the glider.

Flies consistently too high or too low. This may be due to the stick loads if the trim is not set correctly. Until the trainee tries aero-towing, relatively light stick forces will have been the norm. Most of the pre-aerotow flying will have been at 40-50kt

Over-controls, resulting in difficulty in maintaining a steady position in relation to the tug. The trainee may not have acclimatised to the increased effectiveness of the controls at higher airspeeds.

PIOs result from successive over-large corrective movements. Remind the trainee to use the tug as their attitude reference, and only use sufficient control movement to make the tug appear in the normal place in the canopy. The PIO will be prevented and 'convergence' to the normal tow position is then a matter of small adjustments with the elevator. PIOs cannot happen if the controls are held still, preferably in the central position.

Yawing and rolling as normal lateral position is approached. The glider will yaw due to the tension in the rope as the normal position is approached and considerable effort is required to prevent the roll due to this yawing. (It can feel as though someone else is on the controls!).

Doesn't prevent adverse yaw. The controls are more sensitive at aerotow speeds, even though the control forces themselves may be heavier, depending on the glider. The problem may be due to failure to:

- apply sufficient force to the rudder pedals to move them. Remind the trainee about this and the need to judge the amount of rudder by eye rather than by feel
- realise that even the tiniest movements of the ailerons produce significant aileron drag. Give a demonstration of adverse yaw on aerotow showing the effect of a series of tiny ailerons movements with, and then without rudder coordination.

Loses position just before release. This could be a good sign as they are almost certainly concentrating on look-out!

Tends to rise above tug soon after take-off. Explain that (at least) until the tug climbs away, the combination is still accelerating, so the glider will rise unless it is prevented from doing so. The strength of this tendency will depend, to a large extent, on the trim setting at the time.

