11b - AEROTOW

SPL Syllabus: Exercise 11b Aerotow			
(i)	**Signals or communication before and during launch.**	**(vi)**	**On tow: straight flight, turning and slip stream**
(ii)	**Use of the launch equipment**	**(vii)**	**Out of position in tow and recovery**
(iii)	**Pre-take-off checks.**	**(viii)**	**Descending on tow (towing aircraft and sailplane).**
(iv)	**Into wind take-off**	**(ix)**	**Release procedures**
(v)	**Crosswind take-off**	**(x)**	**Launch failure and abandonment, simulated by releasing the cable at a suitable height, with and without response to a signal from the tow plane**

INTRODUCTION

Aerotowing is safe, but the tug pilot is at significant risk if we do not follow the correct procedures closely. Their safety is very much in the hands of the glider pilot, and emphasis is placed on this throughout this chapter.

Before commencing aerotow training, the trainee must be able to fly reasonably straight and be able to coordinate turns. Flying straight requires detection and correction of slight changes in bank angle, a prerequisite for aerotowing. If introduced prematurely they will not be able to aerotow, their confidence will be damaged and their training prolonged.

Demonstrations and trainee's early attempts should not begin below a height where the tug can safely recover if upset. This also means that if we need to release, we will be able to comfortably land back on the airfield. Both trainee and instructor should be aware of the circuit and landing options available throughout the tow. Then, should the launch fail, there will be less thinking to do.

Trainees find the workload in early aerotows very high. Initially, it is best to allow them to fly just the last minute or two of the tow. As they improve, the height at which they take over can be progressively lowered. However, do not allow them to attempt the take-off or fly lower 1,000' agl until they can keep station without assistance above that height. In the interests of the tug pilot's safety, if your trainee gets out of position below 1,000' agl, take over rather than prompt. This also applies when converting experienced solo pilots to aerotow.

Some trainees tend to become tense under high workload. It will be helpful in such cases to take control for a short while after release to give them time to relax.

After teaching the complete tow, train in detail how to deal with unusual or emergency situations. Also introduce the trainee to BGA's Managing Flying Risks.

Before sending someone 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 insufficient to simply position the glider off to one side and then hand back to the trainee to correct. The acceptable displacement depends on the controllability of the tug and the angle of the rope. Ensure the rope is an adequate length. The longer the rope, the more scope there is to allow a trainee to get out of position.

Converting solo pilots

Solo pilots with just winch launch experience usually learn aerotowing quickly and easily, but if tug upset accidents are to be avoided, we must be thorough. Do not assume that because they are able to follow the tug virtually immediately, that they fully understand or will cope safely if they get out of position. Some grasp aerotowing so quickly that they do not learn about the yawing force from the rope.

Converting solo pilots to aerotow can produce a dilemma. Winch launch pilots are not used to the cost of aero-towing and conversion is often associated with a holiday or expedition. As their instructor you may feel under pressure to minimise costs. However, the tug pilot's life is infinitely more important than cost and inconvenience to the glider pilot. Expect to take at least 4 to 6 dual aerotows to convert an SPL qualified pilot to aerotowing. See SFCL 155 for legal minimum.

SAFETY & TUG UPSETS

Responsibilities

The safety of the tug pilot is in the hands of the glider pilot. As an instructor you must never forget that. Right up to the moment of release, it is your and will later be your trainee's responsibility, to keep the tug pilot safe.

Below circuit height collision risk is very small but tug pilot risk is high: a rapidly climbing glider, either by mistake or pilot distraction, can irretrievably upset the tug with fatal consequences. Stay focused on maintaining position throughout the launch and do not get distracted, even by lookout.

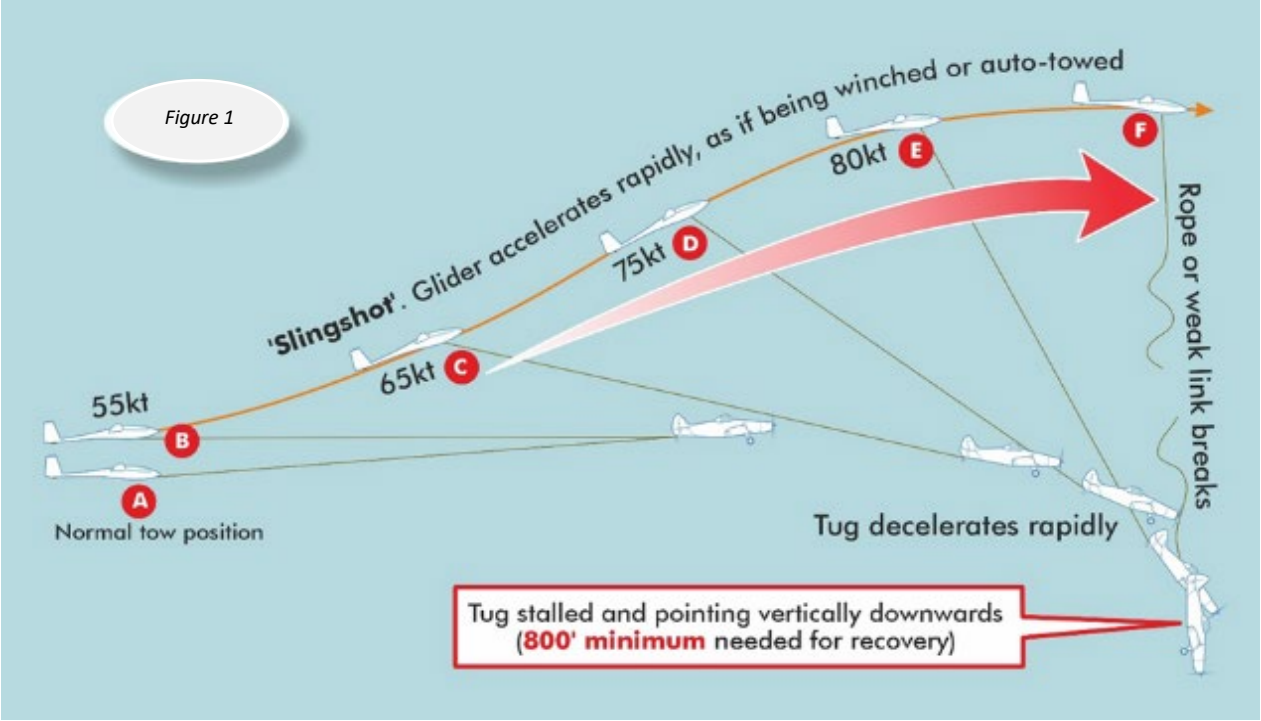
Above circuit height minimize lookout and looking in the cockpit and stay focused on maintaining position throughout the launch. The tug pilot is responsible for lookout for the

combination. Higher up, the glider pilot can help, but this must not distract from the primary task of maintaining the correct position behind the tug. Up to 1,000' agl the release knob should be held, albeit in a fashion where turbulence is unlikely to cause unintentional release. As already noted, existing winch launch pilots learn rapidly and, particularly if they are experienced, it can be difficult to tell them they need further training, but they must fully understand their responsibilities and know how to protect tug pilots. They will be unfamiliar with this responsibility.

The problem

So, why is the tug pilot at such great risk? The problem is that if the glider rises too high and puts a significant load on the rope, the tailplane of the tug, even with full up elevator, will not prevent the tug being tipped into a dive. As the glider accelerates into the climb, its total energy increases (due to increased height and speed. Alarming for the tug pilot at height, lethal if too low. The tailplane and elevator of a tug can generate a significant download; however, compared to the upload of a gliders wing, it is trivial.

There is no combination of tug and glider immune to the possibility of upset. 'Lightweight' tugs are more sensitive to upset than heavier tugs, but in practice, all can easily be upset. Accident and Incident reports indicate that upset accidents occur in several forms. The most spectacular involves the glider developing a high climb rate such that the load that develops in the rope slows the tug as well as lifting its tail. This is illustrated below. Fig 1.



Consideration of tug upsets is important for both glider and tug pilots.

Some tug upsets have started by the glider getting too low and the pilot trying to recover too quickly. For example, if the tug stays low too long immediately after take-off, rotates sharply into the climb and the glider pilot gets a bit left behind. A hurried climb to get back 'into position' can lead to the glider accelerating in 'slingshot' fashion and tipping the tug straight into the ground. This can happen so quickly that the glider pilot may not recognise and/or react in time.

Upsets are also caused by the glider pilot paying insufficient attention to their task or becoming distracted: a few seconds inattention is all it takes. This can be a result of inappropriate actions on tow such 'fiddling with the instruments' putting the undercarriage up or even simply closing the DV panel. Whilst it is the tug pilot who will suffer the consequences - sometimes fatal - it is the glider pilot who can prevent them.

It is essential to check that the rope has actually released as the knob was pulled, BEFORE initiating a turn or climb.

Tug Upset Prevention

When things have gone wrong, the pilot must release immediately if:

- the glider is going high, and the tendency cannot be controlled, or
- we lose sight of the tug.

The following factors increase the probability of upset:

- Low experience of glider and/or tug pilot
- Gliders fitted with C of G hook only.
- Glider's C of G towards the aft limit
- Turbulent air in the take-off area
- Rough ground in the take-off area

- Significant crosswind component
- Short rope
- Light-weight glider, low wing loading
- Pilot unfamiliar with glider or not current
- All flying tailplane

Do not underestimate the risk; just a few seconds distraction can kill a tug pilot.

Iron rule: If sight of the tug is lost, release immediately!

As an instructor, vigilance is required not only when instructing, but also when supervising solo pilots. Reduce the risk for tug pilots by considering and minimising any of the above factors. Do not tolerate short aerotow ropes. If your launch run is not long, you would be better advised to push your launch point back 10 metres rather than taking 10 metres off the rope. The advantage gained from a shorter rope is extremely slight compared to the increased difficulty of towing on a longer one. The longer the rope, the easier the tow for any pilot, tyro or pundit.

AEROTOW THEORY BRIEFING

SIGNALS & COMMUNICATION

Ground signals

Brief the trainee on how your club conducts its ground signalling, including any variations associated with different launch points. On the ground, the tug pilot will find it easier and quicker to respond to signals from a forward signaller or the radio. Using the mirror alone, the tug pilot probably will not see a stop signal once they have opened the throttle.

Airborne signals

All three of the airborne aerotow signals are best handled by radio, but given that radio is not 100% reliable, brief all of them. Trainees must see the signals demonstrated in the air so that they are recognised if encountered.

The Wing Rock to release is mandatory. It must be obeyed even if it comes at a difficult or inconvenient point. Explain the difference between the tug pilot signalling and the tug bouncing around in rough air. When a signal is being given the tug will bank one way and then the other, with the appropriate aileron being applied before the roll occurs. In turbulence, the tug pilot responds to what has happened, so the ailerons move after the wings.

Whilst immediate release is required on seeing a wing rock, it is still important to check the rope has gone before raising the nose.

The pilot **MUST RELEASE**. They probably will not know why they have been waved off, so immediately after releasing check that the airbrakes are not open. As the tug may have significant issues, keep an eye on it until it has landed.

The can't release signal. The 'Can't Release' signal should only be given after the other possibilities have been explored. First check that the correct release handle has been pulled and sufficiently firmly. Some take more pull under load. In a two-seater, get the other pilot to try their release. If you have radio contact with the tug use that.

If the signal is really needed, then move out to the left, as far as the wingtip or slightly beyond is appropriate. It may be necessary, particularly with high wing tugs, to change height to ensure the glider can be seen by the tug pilot. Positively rock the wings. Rock away from the tug first to save swinging back to the middle.

Return to the normal tow position and the tug will return close to the airfield - this may involve descending on tow - where it will release the rope. The rope will trail back under the glider and if towing on a belly hook it will depart via the back release. If using an aerotow hook it will trail harmlessly behind and below. The subsequent approach should be not less than a rope length above any obstruction.

PRE-TAKE-OFF CHECKS & GROUND OPERATION

The same pre-flight checks are used for aerotow as any other launch, but there are aerotow specific considerations. The trim is set for the anticipated tow speed, usually slightly forward of neutral (nose down). If the glider has flaps, they need to be set as per the flight manual.

The tow should start with the glider and tug pointing in the same direction and in line. Depending on the wind direction, surface and glider type, there is a risk that if the combination is not accurately lined up, the glider may ground-loop or run uncontrollably wherever its pointing.

There is little scope for changing direction whilst on the ground. If the combination starts out of line, early trainees will have difficulty steering the glider.

If possible, establish radio contact with the tug pilot and advise them of any specific requirements such as speed and intentions. Airspeed is relevant to gliders carrying water ballast. Once above a safe height you can also pass instructions as to where to go during the tow. Although discussing this before the launch helps minimise radio traffic.

In accepting the rope, the glider pilot starts the launch sequence, A stop signal may stop a launch, but it must be stressed that if the pilot is not ready, or for other safety reasons, they must release immediately.

Relaying the launch signals to the tug pilot can be done by radio or a forward signaller. If the latter method is used the signaller must be a significant distance off to one side and watchful for the possibility of the glider losing directional control and potentially colliding with the wing signaller. Radio is usually the better method.

TAKE-OFF

The correct hook must be used, and the pilot must start the launch with a hand on the cable release, ready to release immediately to abort the launch, in the event that they cannot maintain the wings level or control the glider for any other reason.

Initial Acceleration The vertical position of the tug in the canopy as the rope goes tight gives a good approximation to the correct vertical position on tow for most gliders. Until the glider becomes airborne, the rudder is used to steer the

glider, and the wings are maintained level with aileron control. As the acceleration is modest, the controls will be relatively ineffective for several seconds, particularly with modest headwinds. Full control deflections may well be required. Trainees are often reluctant or find it difficult to use full control deflections: it is something they will not have needed to do when handling the aircraft at normal speeds aloft. Stay directly behind the tug using the rudder control.

The take-off technique varies according to the glider. **With a nose wheel on the ground**, changing direction will be difficult until the nose comes up, particularly on paved surfaces. Balance the glider on its mainwheel as soon as possible by raising the nose. Unless the wind is very strong, begin the ground run with the stick well back.

A **glider resting on its tailwheel** before the start can be directionally difficult. When the glider rests tail down, like most single seaters, best practice, particularly in crosswinds, is type dependant. The wing's angle of incidence directly affects the AoA and is critical. Raising the tail can improve aileron control but may delay the point of take off. For these gliders, pilot induced oscillations (PIO's) are a risk if the glider hits a bump and suddenly takes-off. It is best to keep the stick neutral, aiming to take-off in the two-point attitude.

Aerotow in a Crosswind

Given a crosswind component during the initial acceleration, the pilot needs to anticipate the weathercock effect. The wind on the fin will try to turn the glider into wind. This can be prevented by applying downwind rudder. i.e. wind from the left – right rudder. Applying it before moving reduces the probability of swinging into wind. Lifting off with crossed controls is not a problem. Some gliders can be a handful in almost any crosswind; the rudder will not keep the glider straight during the first few seconds. A wingtip holder on the downwind wing can help keep the glider straight until the rudder takes effect. This particularly applies to gliders without a nose hook for aerotowing.

An offset CG hook can either reduce or increase wind-induced swing depending on the crosswind direction.

If the glider has not lifted off when comfortably above the unaccelerated stalling speed, gently apply slight back pressure on the stick to lift the glider off.

Initial Climb. Traditionally, except for very heavy and water-ballasted gliders, the glider lifts off before the tug. However, with lightweight tugs the opposite may be the case. Whist the tug is on the ground, it is VITAL not to climb. Hold the glider down, comfortably clear of the ground, but low, about the height of the top of the tug's fin or between 5 and 10 ft. Gentle progressive forward stick movement will be required to hold position as the tug accelerates. Depending on the initial trim setting, forward pressure on the stick may be required to prevent the glider climbing immediately after take-off. Downward displacement of the glider to a position below the slipstream is acceptable, but upward displacements are not.

The height to fly just after lift-off is best judged visually. Trainees often display little appreciation of what, for instance, 10 feet off the ground looks like, so, demonstrate what it looks on the early launches. As soon as the glider is reliably airborne i.e. not likely to touchdown again, either yaw or gently bank the glider to make a heading correction to keep it directly behind the tug. The combination of tug and glider will subsequently move as one unit, the tug pilot correcting for drift as required.

Remember what the tug looked like when the rope had just tightened and fly behind the tug. Not so low as to risk flying on again, nor so high as to place an upload on the tail of the tug. This position will be close to the optimum position for the main part of the tow.

Once the tug is airborne it should climb and simultaneously accelerate. Continue to keep the tug in the same position in the canopy. There will be an increase in airspeed if the combination climbs through a wind gradient and that 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 send the tug straight into the ground (see earlier section on 'tug upsets').

This can happen so quickly that the glider pilot may not recognise and/or react in time. The risk is greater if the glider is towing on the hook normally used for winching. Any climb from too low should be made steadily, not hurriedly.

If a position directly behind the tug is important – on normal or narrow strips - a small amount of bank into wind might be used, or you can yaw the glider slightly into wind to stay directly behind the tug. As soon as the tug lifts off, the glider should be returned to wings level, string in the middle. Trainees may have difficulty simultaneously flying 'straight' through the air, sideways over the ground, and keeping correct station behind the tug.

Aerotowing requires concentration; trainees need to monitor the tug constantly to respond immediately to changes in pitch attitude and relative bank angle. The pilot needs to be alert to small errors and promptly initiate smooth corrections. The longer the delay to make a correction, the more difficult it is.

Effects of prop-wash. The wash from the tug's propeller will often tend to lift one wing of the glider, requiring prompt aileron response. Sometimes there is a sensation of a wing being thrown to the ground and this is usually prop-wash. The greater the engine power and shorter the rope the stronger the effect. **Release if the wings cannot be kept level.** Once airborne, keep the wings level with coordinated aileron and rudder, whilst being ready for the tug to climb.

ON TOW

The key to maintaining the correct relative position is keeping the glider's wings parallel with those of the tug and using the elevator to keep the tug in the correct vertical position in the canopy. With many gliders that is close to where the tug appears to be as the rope goes tight on the ground. The tug's propeller and airframe cause a turbulent slipstream that trails behind the tug. Flying in the slipstream makes it harder to keep the wings level and maintain directional control. It is much smoother and easier to fly clear of the slipstream. The correct position of the normal tow is just above the slipstream.

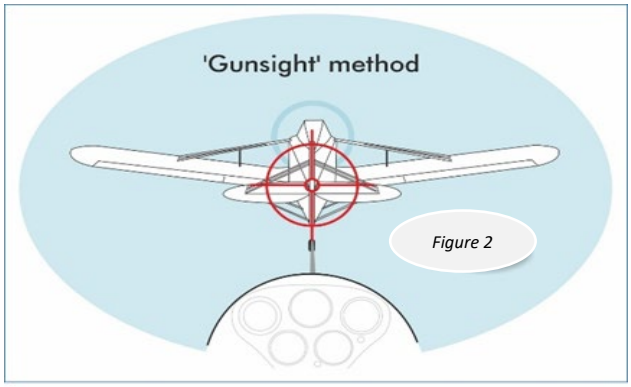


Figure 2

Many pilots find it helpful to imagine a gunsight fixed in front of them and work to keep the tug in the correct position vertically using that. This has the advantage that if a bump moves the tug high up or down, the pilot's response will automatically be proportionate to the size of the error. And, as the error reduces, the pilot will automatically move the stick to stop the glider moving as it returns to the correct position.

One reason for this is that gliders aerotowing do not share the same stability that they enjoy in free flight. On trainees' first attempts at aerotowing the tug is scarcely ever where it should be. This may be due to turbulence, the tug manoeuvring and/or poorly coordinated flying by the trainee. Reassure the trainee that this is normal in the early attempts at aerotowing.

Many students tend to over correct, or 'stir the pudding.' Aerotows are usually conducted at a higher airspeed than the preceding training exercises, so the trainee will need to adapt to higher control forces but more effective controls. Smaller corrections are usually appropriate.

Vertical Positioning Behind the Tug

If the glider is above the slipstream, it is said to be in the 'normal tow' position. If below the slipstream it is called the 'low tow' position. In the normal tow 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 position perfectly.

Limit - High

There is a firm limit for how high a glider can be on tow - i.e. how low the tug can be in the canopy. The pilot must always keep the tug in view and prevent a tug upset and must be able to deal with slack rope during a subsequent correction, taking the tug's available elevator authority (the tug's ability to pitch) into account. Do not climb too high, and maintain sensible margins well short of the limits. A high position needs careful management:

- Stabilise and do not climb any further.
- Pause! Think!
- Move back down slowly to minimise the possibility of a slack rope.

Limit – Low

The lower limit is defined by the tug's slipstream. Flying in the slipstream is not dangerous, just uncomfortable and inefficient. Slipstream effects are more marked with shorter ropes and more powerful tugs. A little back pressure on the stick will move the glider back to the normal tow position. Alternatively, instead of moving up, we can move down to low tow position. Though normal in Australia, the low tow position is little used in the UK. It should not be used unless the tug pilot has been briefed. The correct low tow position is just comfortably below the slipstream. Once that position has been established it can be maintained by keeping the tug on its new position on the canopy. The low tow position is sometimes used on cross-country tows and always used by the rearmost glider when dual towing.

Lateral Positioning Behind the Tug

When two forces pull out of line at opposite ends of a rope, the rope will end up straight and there will be a resultant lateral force that will tend to align the forces. The thrust of the tug's propeller at one end of the rope and the glider's drag, at the other, result in a natural tendency for the glider to line-up directly behind the tug.

The force required to keep a glider 'out of position' laterally only exists 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, and the force in the rope will do the rest.

Limit-Left/Right

Small lateral errors can easily be corrected. However, if we go further, rope/yaw/bank can become an issue. Flying well to one side can also make it difficult for the tug pilot to maintain direction, particularly with a lightweight tug. It is preferable to stay within the wingtips.

Divergent oscillation. Whilst aerotows are laterally stable, in that there is always a force trying to take the glider back to the centre, they are dynamically unstable. If not controlled the oscillation will become large and violently break the weak link.

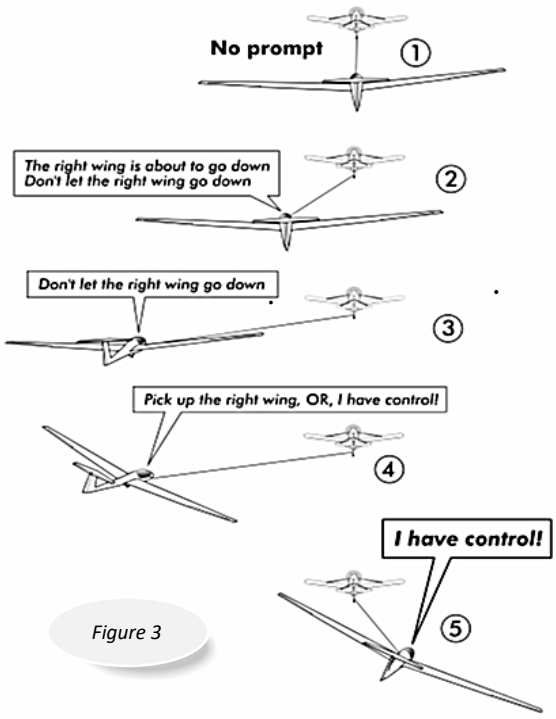


Figure 3

Generally, the further forward the release hook, the more stable the tow is in pitch but less stable laterally. Hence, if the glider is even slightly out of position laterally, the glider will yaw. If the pilot keeps the glider's wing parallel to the tug's wing, it will yaw towards the tug, but if the wings are not kept parallel, the glider will then roll in the same direction. When the ailerons are used to counteract this roll, adverse yaw makes the initial yaw even worse. Also, it looks worse than usual because the tug gives a clear point of reference.

Correct coordination requires firmer use of rudder than usual. If the initial yaw is allowed to develop roll, the resulting turn will move the glider through the correct position off to the other side. The pull of the rope will then reverse and yaw the glider the other way. It will then roll and turn, taking the glider back to the side it started from, but going faster and further. This leads to even more yaw and roll in the first direction. (See figure 3.)

Slack Rope

In turbulence or thermals, slack may develop in the rope. Small amounts can be ignored as they will be dealt with by normal position keeping. If a little more significant. just wait a moment to see if it will tighten itself. However, if the rope sags significantly, we can use a slight sideslip to tighten it again. If this does not work, carefully use airbrake, which will increase the drag and tighten the rope. The tug's thrust working against the glider's drag will usually restore things quickly. Just before the rope is tightened, close the airbrakes or take off the side slip. If the glider has lost height, climb gently back into position. **Do not release** the cable if a very large bow has developed until the slack is almost out. Then release just before it goes tight to avoid a rope break. Otherwise, the rope may flick back over or onto the canopy or wings.

When the tug flies through thermals or turbulence, it climbs and sinks immediately, but the glider follows a couple of seconds later. It is not always necessary to correct for this.

Turning

If both glider and tug were to turn on exactly the same radius then the glider would need to point somewhere alongside the tug on the outside of the turn. However, in practice most pilots continue to aim at the tug and are therefore actually flying a slightly smaller radius of turn. The glider is pointing anywhere between the fuselage and the outer wingtip is fine.

Lookout?

Below circuit height, collision risk is small but tug pilot risk high: so, stay focused on the tug. Only brief glances with minimum distraction from position keeping. The tug pilot retains the responsibility of looking out for the combination. The glider pilot can add an extra pair of eyes higher up, but only if this does not distract from the primary task of maintaining the correct position behind the tug.

OUT OF POSITION

If things are going wrong, we must react promptly but smoothly. The controls may feel more effective and heavier than usual, particularly in a training glider. Only when things are going wrong quickly is a rapid response needed – release the cable if rapidly getting too high. If several things are wrong with the position all at once, the best order for sorting them out is:

- Glider wings parallel to the tug wings
- Adjust the up/ down position.
- Adjust the lateral position (slowly!)

RELEASING

Usually, the glider pilot simply releases when they choose, but sometimes the tug pilot will initiate release by rocking the wing, at a pre - planned height. In that case, you must release immediately. However, best practice is that the wave off signal should be retained for emergency use.

Throughout the tow we must remain aware of our position in relation to the airfield. Immediately before release, look out for other traffic and check your position relative to the airfield.

The release procedure is:

- Check it is appropriate to release (height and position relative to the airfield?)
- Pull the release.
- Check the rope is clear.
- Raise the nose slightly.
- Adopt the normal gliding attitude and speed.
- Lookout and turn as appropriate.

If the rope is released under tension, a ripple may travel along it which is useful confirmation that it has released. **Always visually check that the rope has released before slowing down to ensure clearance from the rope.**

There is no rule as to which way to turn after releasing. But if your club has any local rules, such as 'Always turn left after release.' or 'Always turn into the ridge.' then brief accordingly. Having released, the distance between you and the rope will increase quickly. Carrying out an effective lookout before turning is always important.

DESCENDING ON TOW

Occasionally it may be necessary to descend on tow e.g. on a cross-country tow to get under airspace or cloud. When descending we need to use normal position keeping techniques. However, even level flight makes position keeping challenging. The tug's slipstream moves up a little, pushing the normal tow position a little higher and that can easily lead to descents which develop a slack rope.

As the descent rate increases, if the pilot tries to stay in the normal tow position, the glider will start to catch up the tug, this must be controlled by use of airbrake. Simply lowering the nose is appropriate only for the most subtle of descents.

Be cautious when opening airbrakes on tow, as some airbrakes snatch open. This is particularly likely on a cross-country tow where a higher than usual towing speed is common.

If the tug is not particularly powerful, then it may struggle to re-establish a climb if the brakes remain open. It is important that the airbrakes are used judiciously.

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AEROTOW AIR EXERCISES

TEACHING CONSIDERATIONS

Before teaching aerotows the trainee must be able to maintain straight and steady flight and make accurate turns

Demonstrations and trainee's early attempts should not begin below a height where the tug can safely recover if upset and the glider can make a return to the airfield in the event of a rope break or abandoned launch. Therefore, usual practice is to start the first demonstration on tow above about 1000' and then let them take over earlier as they gain competence.

(i) SIGNALS OR COMMUNICATION BEFORE AND DURING LAUNCH

AIR EXERCISE BRIEFING

In the case of the signals from the tug, the trainee needs to see them so that they will be recognised in the future. Subsequently, ***with prior arrangement*** with the tug pilot, trainees' understanding of these signals should be assessed.

The 'Wave Off' and 'Rudder Waggle' can be fed into training after the trainee has got the hang of the basics. Brief the tug pilot: ideally face to face or at worst by radio. Agree what signals are to be given, how often and at what heights. Keep in mind that the tug may need to use the signals for a real emergency, at any height so be prepared.

For the demonstration, a Wave Off signal can be arranged for the desired launch height and the release made forthwith. It is not good practice to use the wave off routinely. If some pilots 'stretch' the launch height paid for, charge them instead. Do **not** arrange the wing rock has demonstration for part way up the launch rather than at the top – they should not get the idea that it is ever acceptable to stay attached after it has been given.

TEM

Threats:	**Mitigation:**
Real signals may be mistaken for practice.	Restrict practice to a safe height band where release would be no issue.
Errors:	
Inadequate understanding between the tug pilot and Instructor causes confusion	Instructor must ensure that the tug pilot agrees with and understands of what is planned.
Distraction!	Ensure good position keeping throughout.

Describe the signals to be seen or practised , how to fly them and discuss when the trainee should or should not be on the controls.

TRAINEE ATTEMPTS

Tug Wing Rock (Emergency Wave Off) – Ensure that the trainee recognises the signal and understands its mandatory nature.

Tug Rudder Waggle – Draw the trainee's attention to what the rudder waggle looks like and ensure they understand what they need to do: in particular, check the airbrakes. If the tug pilot is briefed first the signal can be best demonstrated and then practised in response to the glider fully opening its brakes. This should not be below 1,000 ft agl.

Can't Release Signal – Remind the trainee to first check that before they give the signal they **would have**:

- checked that they have pulled the release firmly, and
- tried the release in the other seat in a two-seater.
- Tried to contact the tug by radio

Demonstrate the signal. Do not overdo the movement to the left, go far enough to be obvious, but slightly more than the wingtip is sufficient. To avoid the glider swinging back to the middle, the signal should be more; 'left bank – wings level – left bank' than 'left bank - right bank – left bank.'

Giving the 'Can't Release' signal requires a fair degree of handling ability and will come towards the end of aerotow training, after they have proved competent at both staying behind the tug and recovering from out of position. Having briefed the tug pilot, start off by getting them to hold position out to the left first, then checking that they can be seen by the tug pilot and finally, giving the signal.

DE-BRIEFING

For the signals given by the tug, check the trainee's understanding. De-briefing the 'Can't Release' signal should include checking the trainee's understanding of what should precede the giving of the signal i.e. checking they are pulling the correct control sufficiently etc.

(ii) & (iii) PRE-TAKE-OFF CHECKS & GROUND OPERATION

EXERCISE BRIEFING, DEMONSTRATION & LESSON

The aim is to teach the trainee how to ensure that they and the glider are ready and best placed for take-off and that they are aware of the important factors relating to aerotow ground operations. There may be variations due to the glider or conditions.

In specific relation to aerotowing, consider and agree:

- point of launch abandonment if not airborne,
- rope break/launch failure considerations.

Even with experienced pilots converting to aerotow, it is worthwhile demonstrating how to run through all the checks with reference to aerotow specific items.

TEM

Threats:	**Mitigation:**
Winch pilots may not consider aerotow issues.	Monitor all trainees carefully to ensure thorough checks.
Errors:	
Failing to note changing conditions.	Monitor conditions at all times.

DE-BRIEFING

Ensure that the trainee understands the importance of the pre-flight checks and is thinking them through, rather than just reciting words.

(iv) & (v) TAKE OFF – INTO WIND AND CROSS WIND

AIR EXERCISE BRIEFINGS

It is important that the trainee should not be allowed to take-off until they have proved, at a safe height, that they can maintain position correctly. Make sure the trainee knows what you expect them to do and when. Be alert to the possibility that they may try and pull the glider off the ground with the stick too far back. Winch launch pilots are sometimes feel tempted to do this as they are not used to such lengthy take off runs. Once airborne, be prepared to take over immediately if any significant divergence with the tug appears imminent.

TEM

Threats:	**Mitigation:**
The trainee might mishandle the glider	Monitor them closely at all times and take over early.
Errors:	
Tug Upset	Under all circumstances maintain a safe height behind the tug.

MANOEUVRE DEMONSTRATION

Ensure the glider is pointing accurately in the direction of take-off with the tug directly ahead. If possible, establish radio contact with the tug. Talk through the pre-flight checks and TEM with reference to aerotowing and accept the rope. Decide on the initial stick position appropriate to the type of glider and monitor the launch signals being given.

Immediately before moving, point out that you are holding the release, that you will be steering with the rudder whilst on the ground, keeping the wings level with use of aileron and using the elevator to get the glider running smoothly on the mainwheel as quickly as possible. If there is a crosswind, take the opportunity to point out the use of downwind rudder at the start of the take-off run.

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 movement commences get a little ahead of things by pattering what you know is about to happen and follow that with any oddities of the launch. (e.g. '*I'm needing full left rudder to keep straight.*') Point out what you are doing to keep the wings level and glider running on its mainwheel. In practice there is not time to patter everything that is happening, but over a number of take-offs it should be possible to cover all aspects.

DE-BRIEFING

There is much to do in little time and trainees often fail at their early attempts. Reassure them that this is common. Trainees are often reluctant to use and maintain full control deflection, which can be required to keep the glider straight with level wings.

(vi) THE AEROTOW ON TOW: STRAIGHT FLIGHT, TURNING AND SLIP STREAM

EXERCISE BRIEFING

There is little point in teaching aerotowing until the trainee has demonstrated that they can maintain a heading in straight and level flight. Only start teaching this when above 1,000' agl. (to reduce risk to the tug pilot) and if you are within gliding range of site.

Brief that you intend to hand control to them at an appropriate height.

Teach aerotow in the following sequence:

- Normal position
- Vertical positioning
- Lateral positioning

TEM	
Threats:	**Mitigation:**
The trainee may well miss handle vertically or horizontally.	Monitor them carefully, take over early, especially when less than 1,000' agl.
Errors:	
Permitting the trainee excessive latitude for position error.	Monitor the trainee closely and take over in good time.

MANOEUVRE DEMONSTRATION

Draw their attention to the position of the tug in the canopy as the rope goes tight at the start of the take-off. Once at a safe height show them the importance of keeping the glider's wings level with those of the tug and what happens if they are not.

Vertical Positioning Behind the Tug.

Demonstrate how to confirm the correct position by locating the tug's slipstream, moving up to the correct position and noting the vertical position of the tug in the canopy. Show them the effect flying in the slipstream.

The position in which the tug appears in the canopy, once noted, becomes the glider's attitude datum (see figure 2). 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.

- 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 climbing relative to the tug.
- if the glider is a little high, the tug will appear lower down the canopy, below the datum position.

Lowering the nose gently returns the tug to the datum position. Then 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 as it arrives back in the normal tow position.

Demonstrate the low tow position, how to establish and use a new reference in the canopy and how to recover back to the normal tow position.

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

Lateral Positioning Behind the Tug

Demonstrate use of the tug's wings as a datum for the angle of bank. In straight flight the glider should be directly behind the tug. When you are directly behind the tug, you can see both sides of the fuselage equally.

- Show that if the glider's wings are not at the same angle of bank as the tug's the glider moves out of position.
- Correct this by rolling the wings parallel with the tug's wings. Allow the rope to pull the glider back into position.

Point out that below the height that the tug might be expected to recover safely from an upset (1,000 ft. agl), you are restraining the urge to lookout but concentrating on keeping the glider in a safe position. Above that you may look-out briefly, particularly in the direction of turn. It is probable that we will be able to see more than the tug pilot in that direction, particularly with a high wing tug.

TRAINEE ATTEMPTS

Give the trainee control when the rope is taut, with the glider appropriately trimmed and in roughly the right place.

Hand over control in the usual manner. Let the trainee concentrate on parallel wings - take over (early!), if getting significantly out of position. Return the glider to the correct position and give the trainee further practice. If after a reasonable amount of practice, the trainee cannot maintain or regain parallel wings, consider:

- re-demonstrating, *or*
- postponing this lesson until the trainee's general handling and perception of where their wings are has improved in normal flight.

When they can make a reasonable job of maintaining the glider in the normal tow position and can follow the tug above 1,000 agl, then they are ready to handle the glider lower down and then attempt the take-off. After that, they need to be assessed that they can recover from a diverging position

back to the normal tow, introduced to releasing, the slipstream and the low tow, descending on tow and launch failures.

It will require several flights to satisfactorily cover all the items above.

TRAINEE PRACTICE WITH PROMPTS

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

DE-BRIEFING

Cover any difficulties the trainee encountered referring them to the correct methods to avoid them. Aerotowing requires good co-ordination skills so do not let them get demoralised if it takes a while to become proficient.

RELEASING

AIR EXERCISE BRIEFING

Brief your trainee about when you want them to release i.e. at your command or as they choose depending on their experience. Remind them of the release procedure:

- Check it is appropriate to release (height and position relative to the airfield?)
- Pull the release.
- Check the rope is clear.
- Raise the nose slightly.
- Adopt the normal gliding attitude and speed.
- Lookout and turn as appropriate.

TEM

Threats:	**Mitigation:**
The trainee may raise the nose having failed to release.	Pay particular attention and be prepared to release.
Failure to lookout	Ensure good lookout
Errors:	
The trainee may manoeuvre inappropriately after release or fail to slow down.	Be ready to take over immediately.

MANOEUVRE DEMONSTRATION

Point out that the time to release is imminent and that you are now checking that it is appropriate, in that you are where you want to be height and position wise. Normally that will be within comfortable range of the airfield. Get the trainee to look at the rope and pull the release. Assuming the rope departs, raise the nose to slow the glider by 10 kts or so, turn, after a good lookout and proceed with the flight.

TRAINEE ATTEMPT

Allow the trainee to do the release as briefed, and when instructed to. Ensure they check the cable has released before any manoeuvring.

DE-BRIEFING

De-brief their performance as appropriate.

OUT OF POSITION ON TOW AND RECOVERY

AIR EXERCISE BRIEFINGS

If things are going wrong, we must react promptly but usually, normal corrections are sufficient. Such corrections should be un-hurried, even though the controls may feel more effective and heavier than usual, particularly in a training glider. Only when things are going wrong quickly is a rapid response needed. If several things are wrong with the position all at once, the best order for sorting them out is:

- Glider wings parallel to the tug wings.
- Adjust the up/ down position.
- Adjust the lateral position (slowly!)

Brief them that you will be putting the glider out of position for them to rectify. As this exercise can only take place on tow you will also need to brief some post launch exercises.

TEM

Threats:	**Mitigation:**
The trainee may over control or miss-handle the required corrections.	Monitor them closely and take over in good time.
Errors:	
When placing the glider out of position it can be overdone.	Be mindful of this possibility and take care.

OUT OF POSITION MANOEUVRE DEMONSTRATION

Displace the glider from the normal tow position and then patter your actions as you restore it. Emphasise the correct order, as briefed, to restore the glider to the correct position.

TRAINEE ATTEMPTS

The intention of the lesson is to teach the trainee how to recover the glider back to the normal position after it has been disturbed. Start with modest single axis displacements, then two axis and finally two axis displacements with movement.

DE-BRIEFING

Debrief as per the trainee's performance. re-enforce the order in which to tackle things.

DESCENDING ON TOW

AIR EXERCISE BRIEFINGS

This exercise comes at the end of the trainee's aerotowing training, and a demonstration is essential. Remind them of the theory and describe the exercise.

One to one briefing of the tug pilot is essential. Agree the height at which the descent will commence, when it will finish and how many times it will be repeated. Radio communication with the tug is particularly helpful. The exercise should be completed above 1,000 ft agl given the increased risk of tug upset. Also, be aware that it is easy to fly out of gliding range when practicing descents. Embarrassing if the rope subsequently has to be released.

TEM

Threats:	**Mitigation:**
The trainee may mishandle early attempts	Demonstrate thoroughly and take over early
Errors:	
Failing to deal with a slack rope	Monitor carefully and use brakes in good time

DESCENDING ON TOW MANOEUVRE DEMONSTRATION

As you approach the agreed height to start the descent, draw the trainee's attention to the normal rate of climb. As that reduces through zero, point out that the normal tow position has moved up a little in the canopy and that the rope may be slacker. That is the time to smoothly open the airbrake which will start the descent. A slight nose up change in attitude will be apparent. Use sufficient airbrake to maintain a tight rope. Point out that the normal tow position is now noticeably higher than usual.

When the tug pilot re-applies full power point out the reduced rate of descent or climb rate as appropriate. Smoothly close the brakes and ensure they are locked. Resume the original normal tow position.

TRAINEE ATTEMPT

The demonstration should be repeated with the trainee flying. Be alert to the possibility that significant slack in the rope may develop. If slack develops, and does not immediately show sign of reducing, do not prompt, take over and deal with it. Be ready for a disturbance in the trainee's position keeping as the brakes are opened or closed.

DE-BRIEFING

Ensure that the trainee understands not only what they did right and wrong, but that they have taken on board the theory behind it. A thorough understanding is essential at this stage as it is not something that they are likely to stay familiar with.

COMMON DIFFICULTIES

Most Ab-initio trainees cannot perceive with sufficient accuracy whether the glider wings are parallel with the tug's or not. They are 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 roll resulting from the yaw caused by the rope tension).
- 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 the previous prompt, then say '*Pick up the right wing'* It is important to specify **which** wing.

Gets into divergent horizontal figure of eight oscillation (figure 3). Again, this is due to failing to perceive small bank angles relative to the tug, compounded by failure to appreciate the yaw and roll caused by the rope. Address their ability to monitor and respond to the glider's bank angle relative to the tug.

Flies consistently too high or low. This may be due to the stick load if out of trim. Encourage them to trim appropriately.

Over-controls, resulting in difficulty maintaining a steady position in relation to the tug. The trainee may not have adapted to the increased effectiveness of the controls at higher airspeeds. Re-patter small control movements.

PIO's resulting 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. PIOs cannot happen if the controls are held still.

Does not prevent adverse yaw. This may be due to:

- applying insufficient force to the rudder to move it sufficiently. Remind the trainee about this and the need to judge the amount of rudder by eye rather than by feel.
- failure to realise that even tiny aileron movement produce aileron drag.

If this is an issue consider the following exercise:

Adverse Yaw on Tow

This demonstrates adverse yaw on tow and should be used when trainees are making corrections with the aileron but not using sufficient rudder.

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

Tends to rise above tug soon after take-off. Take over immediately, there is no time for prompting. 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 largely on the accuracy of the trim setting.

Loses position just before release. This could be a good sign as they may be concentrating on look-out! Re-emphasise the importance of not becoming distracted. and the pilot's responsibility for the safety of the tug pilot.

Reluctance to use and hold full control deflection, which can be required to keep the glider straight with level wings on the ground.

AEROTOW LAUNCH FAILURES

Introduction

Aerotow launch failures are uncommon, but the pilot must be prepared for them. Launch failure options are site dependant, and their brief and study are important, but given the rarity of aerotow launch failure, easy to forget.

They may be best prepared for initially using aids such as drone video footage or simulators with the appropriate scenery.

THEORY BRIEFING

The procedures for an aerotow launch failure are different from a winch cable break. The rate of climb during an aerotow is much lower, so whilst the probability of failure is low, the period we are at risk is lengthy. The critical area for an aerotow launch failure starts when the glider no longer has room to land ahead and ends when, in the event of failure, it can safely get back on the airfield. A failure in this area will inevitably result in a land out.

Possible reasons for launch failure during the climb are:

- A rope or weak link failure.
- A Tug Upset, see page 2 of this chapter.
- The glider pilot is unable to maintain position behind the tug, maybe due to turbulence.
- A power loss or engine failure of the tug.
- The glider pilot fails to lock the brakes.

Aerotow failures share recovery principles with other launch methods such as winch launching. The decision-making chain is:

- Fly the aircraft.
- Form a plan.
- Fly the plan accurately.

Unfortunately, this needs to be accomplished by a surprised pilot who as a result will probably be performing at less than their best. There is only a very small chance of a low-height launch failure on any particular aerotow, but you must use the E-Eventualities item in your pre-flight check list to mentally prepare for it before every aerotow.

Towing speeds are usually close to approach speed, and the towing attitude only slightly nose up. Therefore, the abrupt nose down pitch needed after a typical winch failure is unnecessary, but a small pitch down is definitely required, or the glider will soon be dangerously slow. Maintaining speed remains vitally important.

If an aerotow launch failure occurs below the height where it is safe to turn back, the only option will be to land more-or-less straight ahead, off-airfield.

When instructing, keep track of the local field situation to brief your trainees (and solo pilots) on landing possibilities or the lack of them in the critical climb out area. Brief the minimum height to turn back to the airfield given the conditions and the desirability or otherwise of a downwind landing. Plan and discuss eventualities before every launch.

Whilst it is vital to concentrate on maintaining a safe position behind the tug, it is important to be aware of possible off-field emergency landing areas during the tow, until height and position are such that a safe return to the airfield can be made. This process should not be confused with normal field selection where every factor is taken into consideration.

The aim following a launch failure is to land safely. That is a key consideration in the pre-launch eventualities briefing. However, in practice there may be a short period in which the only available landing option is very challenging even for the most experienced instructor. It may be necessary, for example, to fly the glider onto the ground in a clear space and ground loop at the slowest achievable speed (ground looping at high speed can result in the glider cartwheeling). While this scenario is highly unattractive, it compares favourably with the risks of a low turn, catching a wingtip and cartwheeling, or spinning.

Most serious aerotow launch failure accidents result from turning back to the airfield with insufficient height. 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 180° turn and arrive back on site. Unfortunately, this 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 and/or the glider's airbrakes particularly ineffective, the combination will have crawled for miles before gaining final turn height.
- If the combination climbed unusually slowly, perhaps the tug's engine was not 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 be disastrous. There might, nevertheless, be enough height for a short, tight circuit.

None of the above is intended to suggest, 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.

A rope break will leave the rings and probably some rope attached to the glider. Assuming the glider was not low behind the tug when the rope broke, the rope will stream harmlessly below and behind the glider. Unlike winch launching, most of the tow will not be over a ‘sterile’ airfield, so dropping the rope could cause damage or injury. Unless there are control difficulties, **it is not usual for the glider to release a broken aerotow rope.** However, care must be taken to ensure that, during the landing, the trailing rope does not snag on a hedge or fence or endanger property or members of the public.

The SPL Syllabus suggests that practice rope breaks should be made by releasing the rope. However, few instructors choose to land out deliberately and as a result practice rope breaks in gliders are almost always given in positions from which a straightforward landing can be made on the airfield. Unfortunately, this results in 'negative training' in that it can reinforce the tendency of the trainee (and some instructors!) to feel obliged to turn back to the airfield.

A much better option is to employ a motor glider for this sort of training - so that the trainee gains the confidence to land ahead, even off the airfield, if necessary. In practice they are also likely to get much more practice if a motor glider is used.

AIR EXERCISE BRIEFINGS

As noted above this exercise can be conducted by releasing the rope from an aerotow, or, preferably using a motorglider to simulate an aerotow and throttling back to simulate launch failure. Whichever method is to be used, before it is conducted, the trainees understanding should be assessed on aerotows by asking, '*What would you do now if the rope broke*.' If sensible answers are not received, then a suitable de-briefing/re-briefing is required before eliciting further responses.

If the exercise is to be conducted by releasing the rope, then it should be delayed until you have flown at least one aerotow that day to establish conditions. It is easy to get it wrong. A demonstration of this exercise is appropriate, so at least two aerotows, albeit low ones, will be required. If this exercise is used as a test, on a surprise basis, be prepared for unexpected responses.

If the exercise is to be conducted using a motor glider, then ensure that the trainee gets or has had some previous handling time in it, as they usually have rather different characteristics and performance to the gliders trainees are used to.

If the simulated failure is intended to result in a simulated field landing do not forget the 500-foot rule and the neighbours. Some airfields have many 'structures' around them, some to such an extent that this may not be a practical exercise. Also, beware of conducting the exercise if the best option is a controlled crash. Whilst the motor glider can climb away, engine failure would leave it in a dangerous position.

Motor gliders are well suited to simulating getting back to the airfield. If handling of the exercise is lacking, then they can be repeated forthwith. A variety of 'failures' should be simulated.

However, the exercise is conducted, ensure the trainee understands that making the decision what to do rests with them.

TEM

Threats:	**Mitigation:**
A real failure may occur in the course of the exercise.	Be alert to this possibility and retain margins.
Errors:	
Running out of height for appropriate circuit	Monitor height & position

MANOEUVRE DEMONSTRATION

If you propose to conduct the exercise by aborting an aerotow, plan what you propose thoroughly. Make the tug pilot aware of the plan. Do not just pull the release. Having initiated a launch failure practice:

- adopt a safe attitude to maintain approach speed.
- decide what to do.
- execute the plan.

Throughout, emphasise the need to maintain a safe speed.

If using a motorglider, again plan what you propose to do and assume the engine will fail at the most awkward moment. Again, patter the process of dealing with it as above.

MANOEUVRE LESSON

The intention of the lesson is to teach the trainee how to deal with aerotow failures safely. Set up a start point as per your demonstration and allow the trainee to manoeuvre as they see fit, as long as it is safe and as long as a safe outcome to the flight remains assured. If the response is not optimum, do not hesitate, take over and turn it into a demonstration. Do not expect the trainee to tell you what they are thinking or doing. They do not have the capacity.

DE-BRIEFING

De-brief their performance as appropriate. Also, take the opportunity to discuss variations of the 'failure' and how their performance might be improved.

