Ground Launching

Dean Carswell

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Part 1: Training Objective.

The purpose of this Section is to provide instructors with the information necessary to give students adequate ground instruction and flight training so that the student can safely launch a glider by means of ground launch. The goal is to have the student qualify for the endorsement certifying proficiency in ground tow procedures and operations referred to in FAR §61.31 (j)(1)(i).

Part 2: Required Ground and Flight Instruction.

A. Ground instruction shall include knowledge of:

(a) Equipment to be used for ground launch and its correct operation.

(b) Signals used in ground launching.

(c) Cable/rope assembly requirements and inspection, including weak links.

(d) Minimum and maximum launch speeds.

(e) Safe climb profiles and release techniques.

(f) Crosswind launch techniques.

(g) Emergency procedures.

B. Flight instruction shall include instruction in the practical skills related to the knowledge subjects listed in Paragraph A until the completion standard set out in Part 5 has been reached. This must include safe recovery from launch failures (i) shortly after the launch has begun, (ii) once the full climb attitude has been achieved, (iii) near the top of the climb, and (iv) following simulated power failure of the winch/towcar. Note: It is recommended that the very low launch failure exercise be restricted to a demonstration.

C. It is presumed that the student is already qualified in aerotow, and what is being done is transition training for ground launch. If this is not the case, flight instruction of the ground launch should not be begun until the student can control pitch and roll, and use the controls in a reasonably smooth and coordinated manner.

Part 3: Equipment and Theoretical Considerations.

A. Launch Equipment. Modern powerful winches/towcars with cable/rope in good condition can launch a two-place glider to a reasonable height (pattern altitude) if the field length is adequate, achieving a still air height to ground distance ratio of 1:3 (winch) or 1:4 (towcar) – in other words, a towcar with a run of 4,000 feet can potentially tow the glider to 1,000 feet. With a 15 knot headwind, performance can increase by up to 50% (1,500 feet in the example). When less powerful equipment is used, acceleration and climb rate are reduced. It is important to know the performance of the system being used, and to modify techniques and teaching methods appropriately.

B. Glider. If the student has previous experience ground launching with gliders from an earlier generation (e.g. Schweizer SGU 2-22, SGS 2-33), modern fiberglass or metal gliders, which are materially heavier, add several new factors:

- slower acceleration to safe speed during the earlier part of the launch.
- higher stall speed, giving less margin for error.
- higher maximum launch speed, giving greater reaction time.
- lower drag assisting speed retention during launch failure pushover.

C. Speed Considerations.

1. Stalling Speed Changes and the Minimum Safe Airspeed. For the glider to climb, the wings must do extra work to oppose the pull of the cable/rope and to provide the initial vertical acceleration during the rotation into the full climb. This results in an increase in the wing loading which can increase the stalling speed up to 40% of its unaccelerated (1"g") value. To calculate a safe margin, take 150% of that value. That is the minimum safe airspeed in the full climb.

   The rotation into the full climb requires a vertical lift component, and the angle of attack increases while this is happening. A rotation which is too rapid for the airspeed can result in the critical (stalling) angle of attack being exceeded and the glider departing in an accelerated stall and, possibly, spin. This is worthy of emphasis! Pilots are accustomed to the stall resulting from reducing airspeed. Here the stall may occur despite a steady or increasing airspeed as the stall speed increases faster, and beyond, the airspeed. Figure 1 contrasts the issues involved in swift rotation into the climb (A) and normal rotation (B).

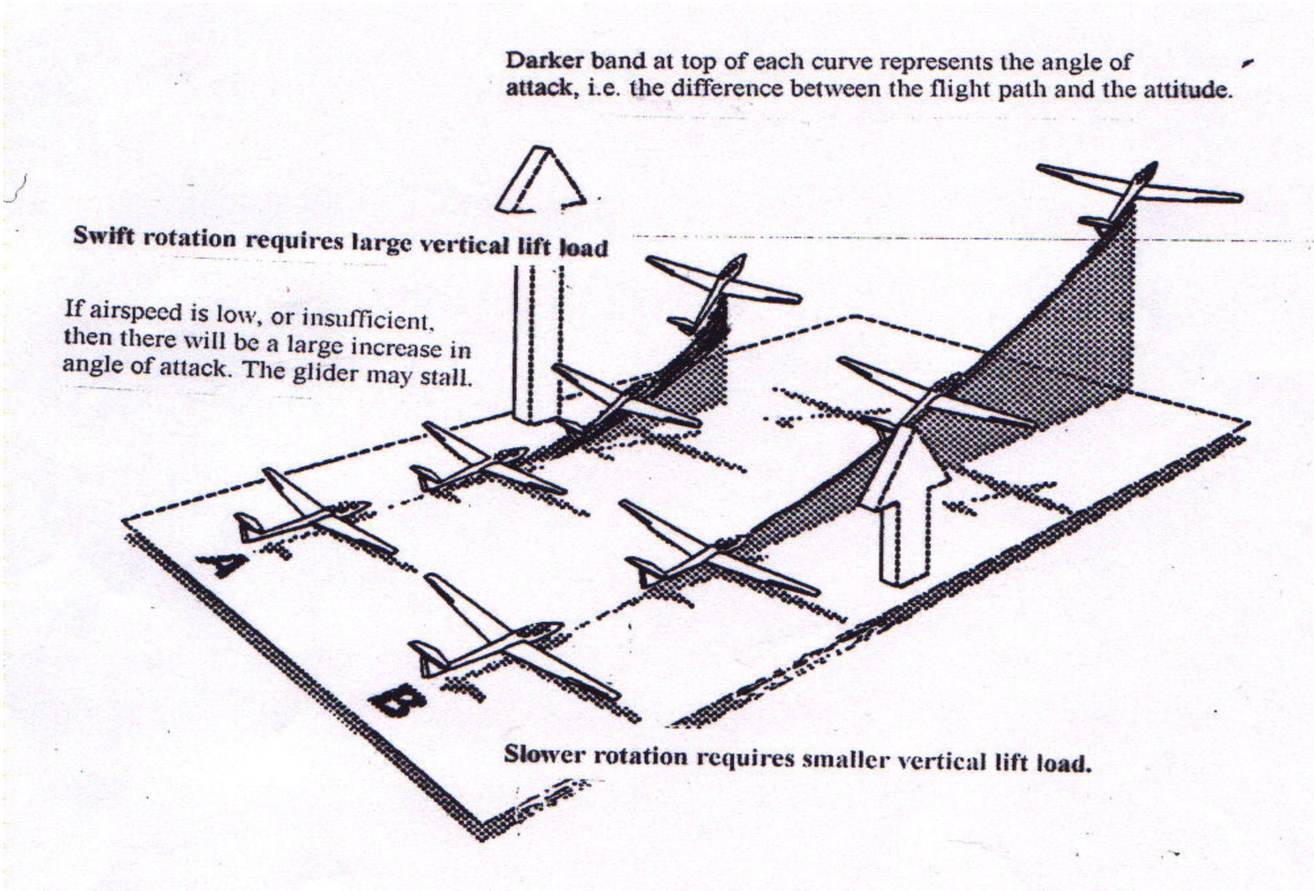

Figure 1: Rotation into the Climb.

Excessive climb angle can also result in the critical angle of attack being exceeded with consequent stall departure, or breaking the cable/rope or weak link. With a lower powered winch/towcar, excessive climb angle may slow it down and/or stall the engine.

As the glider nears the top of the launch – as it nears a vertical relationship to the winch/towcar – the downward pull of the cable/rope further increases the load factor, and the stall speed increases. In this position, if the stick is moved back, even a small increase in pitch attitude may induce an accelerated stall.

Note: Unlike in free flight, load factor on the glider caused by pull of the cable/rope cannot be felt by the pilot.

2. Maximum Winch/Autotow Airspeed. The maximum airspeed is placarded to safeguard the glider. The correct weak link is *supposed* to break well before structural overload, however, the link responds primarily to loads along its length, and some loads sustained during the launch lie in other directions. Remember there are few reliable sensations from which the pilot can judge the load on the glider. See "Too Fast" below.

3. Too Slow or Too Fast During the Launch

Too Slow: For safety reasons, there is no visual “too slow” signal. If the speed starts to decrease, lower the nose – relaxing the back pressure on the stick may be sufficient to cause the driver to increase speed, or allow a low power or constant tension launch system to increase the speed. If the speed picks up, smoothly raise the nose again; if it fails to pick up, or continues to drop, release at once and proceed as for a launch failure.

If the airspeed is dropping, do not hang on in hope – the distance available for landing ahead will be decreasing rapidly, and the glider may stall.

Too Fast: The correct technique for dealing with excessive speed depends on the stage of the launch. In the earlier part (the first half) of the launch, there is a relatively low risk of overstressing resulting from overspeed, particularly if the glider is not climbing steeply. At the same time, the risks associated with abandoning the launch may be high. If the speed approaches the maximum placarded speed, maintain the angle of climb, and signal ‘too fast’. If the speed is significantly faster than the maximum, maintain the angle of climb and abandon the launch when high enough to do so safely.

Do not try to slow the winch/towcar down by climbing excessively steeply, it risks breaking the weak link and may cause the speed to increase.

In the later part of the launch (the second half) the likelihood of overstressing the glider is increased. If the speed approaches the placarded maximum, relax the back pressure on the stick and signal “too fast”. Relaxing the back pressure reduces:

- the stresses on the glider.
- the likelihood of a cable/rope/weak link break or back-release.
- the possibility of an accelerated stall departure.

Continuing to use a large amount of up-elevator/back stick pressure whilst exceeding the placarded limit is not acceptable.

The goal must be to prevent the airspeed exceeding the prescribed limit. If the speed does not quickly decrease to a safe value, abandon the launch. Release with the cable/rope under tension to give a clean separation between the glider and cable, rings and associated equipment/rope. Unless close to the ground, pause briefly (but not too long) before lowering the nose as it is possible to fly under the cable/rope etc. and collide with it.

D. Signals and Equipment

(a) All winch/autotow launch and emergency signals must be given by lamp or flag/bat unless an uninterruptable radio system is available. For other purposes – e.g. passing pre-launch information to the tow vehicle driver, pilot requesting tow-speed changes, radio is acceptable. A signal lamp should be available in the tow vehicle and at the launch point.

(b) Lamp signals:

(i) Cable/rope hung up on glider: steady white light directed at glider from tow vehicle and launch point until it lands or cable/rope releases.
(ii) Take up slack: slow flashes (1 second on, 3 seconds off) white light.
(iii) Begin take-off: fast flashes (1 second on, 1 second off) white light.
(iv) Hold/stop: steady white light.

(c) Flag/bat signals (one flag/bat):

(i) Take up slack: flag/bat moved from side in arc in front of lower body.
(ii) Begin take-off: flag/bat moved from side to side in arc above head.
(iii) Hold/stop: flag/bat held steady above head.

(d) Visual signal by pilot: tow is too fast – pilot yaws (fishtails) glider

Note: (i) There is <u>no</u> signal for too slow; the former signal of rolling the glider wings risks tip stalling and a stall/spin departure from controlled flight.
(ii) The reason for the prohibition on use of radio for primary signals is the risk of a Stop signal being blocked out by another transmission. For safety, the Stop signal must be communicated and acted upon immediately. Even if telephone or uninterruptible radio is available, their use for primary signals may be inadvisable because of noise level within the tow vehicle operating at high power.

<u>Part 4: Teaching the Ground Launch.</u>

A. <u>Briefing Notes</u>.

1. <u>General</u>. Ground launching uses a wide variety of equipment, and the piloting technique required can depend on several factors including:

    - the type of equipment – winch, towcar, reverse pulley, etc.
    - the power of the winch/towcar.
    - the method of power transfer from winch to cable/rope.
    - the type of towcar transmission (automatic or manual).
    - the type of wire being used (stranded or solid) or rope.
    - the rate at which the glider can be accelerated from rest to a safe launch airspeed.
    - the glider's placarded maximum launch airspeed.
    - the position of the 'center of gravity' tow release.
    - the physical restrictions of the specific field.

2. <u>Pre-flight Preparation</u>. While launch by winch typically has a fast or very fast initial acceleration, even launch by autotow has a faster acceleration than experienced on aerotow. This means:

    - the tow release to be used (the c.g. release) must be checked not only for proper operation releasing the rope while under tension, but also for (a) free-fall release, and (b) overrun/back release –

once attached, the rope should be pulled downward and backward until it is released automatically.

- parachutes as back-cushions are fine, but any other packing or padding behind the pilot should be at least as solid.
- the pilot must not sit on soft and/or springy cushions – a high density seat pad is acceptable, and will reduce potential injury risk from heavy landing.
- the seat belts must be tight enough to prevent the pilot sliding up the seat back.
- the pilot must be able to reach all the controls, including the tow release, without stretching.
- the trim should be set, before takeoff, for the selected approach speed in case of a launch failure.

Besides the normal pre-takeoff checks using a standard checklist before takeoff like the following:

PRE-TAKE OFF CHECKS "CB SIFT BEC"

COMPLETE ALL CHECKS BEFORE ATTACHING ROPE!

CONTROLS - full and free movement in the correct sense (Note: positive check if glider just rigged)

BALLAST - cockpit load (including parachute) fit/remove ballast as required; tail dolly off

STRAPS - tight and locked

INSTRUMENTS - pitot/static covers removed, glasses intact, switched on as needed, zero or sensible readings

FLAPS - operation; set as required

TRIM – operation; set (neutral/mid position unless otherwise required)

(AIR)BRAKES – operation; closed and locked

EMERGENCIES – review wind strength, direction and affect; calculate approach speed following tow failure; review tow failure decision heights; emergency pattern

CANOPY – closed and locked

- the following additional items are worth considering:

- weak link – make sure it is the correct breaking load/color/type for the glider.
- tow release - make sure the cable/rope is attached to the correct release - ground launching using the nose tow release results in underwhelming launch heights.
- minimum safe airspeed – 150% unaccelerated Vs - this is the slowest safe airspeed at which the pilot can allow the glider to be in the full climb.
- launch failures – review the options available from various heights.
- cloud base - estimate this, and do not launch into cloud.
- all clear - not only above and behind, but in front.

Delays after the wire/rope has been attached can be potentially hazardous. Pilots should always be prepared to release the cable/rope if any uncertainty exists. After a long delay the pre-takeoff checks should be repeated from the beginning.

The ground launch involves teamwork between the pilot, signaler and winch or towcar driver. Vague signals or sloppy flying can be misinterpreted. For example, the normal procedure when the launch is a bit slow is for the pilot to lower the nose, to which the winch or towcar driver responds by adding more power, as he should. However, if the glider is already being launched at the correct speed, but isn't in the appropriate 'correct attitude', the driver may think that it's going too slowly, and put on even more power. The launch then gets too fast.

Note: (1) This Part is set out in the order that the various components should be <u>taught</u>, which is different from a chronological sequence.
(2) Parts in *italics* are suggested words which the instructor may want to use.

B. <u>Full Climb and Release.</u>

If already aerotow qualified, the student will be familiar with the pre-takeoff checks, but will need to be reminded of the trim setting, use of the correct weak link and the correct tow release, plus the launch failure options and who will fly the glider if one occurs. Remember, things happen a lot faster on ground launch than aerotow! Demonstrate the full climb and release, followed by student practice. Demonstrate the ‘too fast’ signal before the student attempts it. Once the student is handling the full climb well, go on to demonstrate the ground run, takeoff and initial climb. Figure 2 shows the climb profile when tow speed is too slow, too fast, and within the acceptable range.

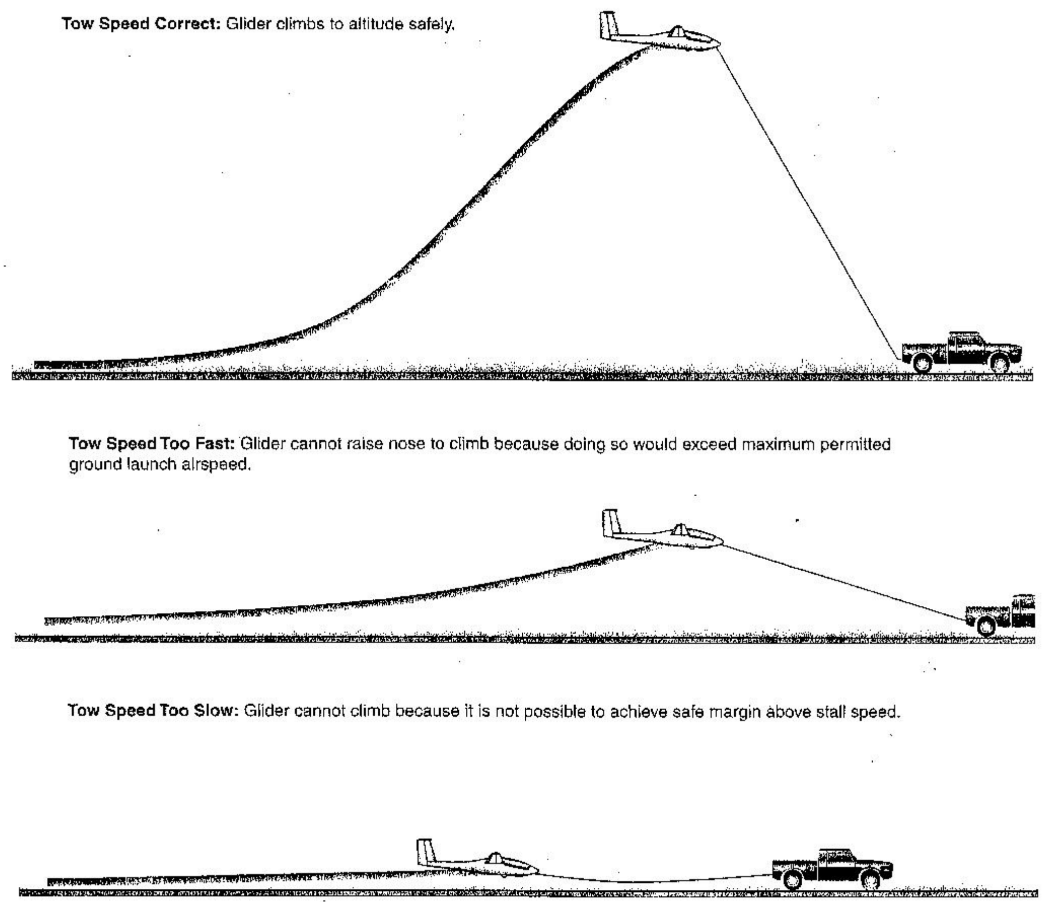

Figure 2: Climb Profiles.

1. <u>The Full Climb.</u>

The optimum attitude for the full climb is a compromise between (a) being sufficiently steep to obtain a high launch, (b) breaking the weak link or having other problems, or (c) ending up low at the wrong end of the field. In free flight the horizon is visible above the nose, but this is not so when the glider is pitching up into, and established in, the full climb. The attitude reference is a choice between the position of the horizon on each side of the canopy, or the angle made by the wings to the horizon. The normal attitude for the full climb is between 45° and 50° nose up.

Students often have difficulty keeping the glider going straight down the runway during the climb, and may wander off to one side or the other. Aiming at a suitable cloud helps to maintain the correct track, but if there are no suitable clouds, position has to be judged by the ground visible on each side of the cockpit. This method has the drawback that the 'cone of invisibility' produced by the glider's structure grows as the glider climbs. A long narrow field/runway can be completely out of sight during most of the climb. There is no way round this other than practice and familiarity with what the 'right line' looks like in relation to objects which may be well beyond the field boundaries.

Once the full climb is established and steady, at a suitable height hand over control to the student.

- *judge the climb attitude by the angle between the wingtip and the horizon.*
- *notice the position of the horizon in relation to the sides of the canopy.*
- *keep the wings level using coordinated aileron and rudder.*
- *monitor the airspeed trend. If it is falling back towards the minimum safe airspeed, lower the nose or relax any back pressure on the stick. If the glider is starting to go too fast, maintain the normal climb attitude, and signal. If it remains too fast, or gets even faster, release.*
- *glance from side to side to check the:*
    - *angle of the wingtips in relation to the horizon.*
    - *height above the ground and progress along the field.*
- *to counteract the downward pitching moment caused by the cable/rope - which increases as the glider nears the top of the launch - more up elevator may be required, but not normally very much.* Some older gliders may need plenty of back stick but the majority of modern gliders require little or none. If the glider starts to buck or hunt in pitch - more likely during auto-towing than winching - relax the back pressure on the stick.

2. <u>The Release.</u>

Assuming no launch failure, try to anticipate the end of the launch from ground references. At the top the nose will be pulled down by the cable/rope. This is one of the clues which indicates approaching the point of release. One of the following will then happen:

- a reduction in the noise transmitted up the cable/rope from the launch equipment, and/or a reduction in airspeed when the driver cuts the power. When this occurs lower the nose into the normal gliding attitude to relax the cable/rope tension as much as possible and pull the release twice. This is the preferred method of determining the point of release.
- if the winch/towcar driver fails to cut the power at the top of the launch, lower the nose sufficiently to reduce some of the tension in the cable, and pull the release twice.
- if the winch/towcar driver fails to cut the power and the glider passes the normal point of release, the rings will back-release. In no-wind conditions this may not happen until the glider has overflown the launch vehicle, which is then likely to have the cable/rope fall on top of it. This is best avoided. Avoid also hanging on and back-releasing under tension, as it can lead to cable/rope snarl-ups. Piano-wire cable coils easily and can be very springy as a result. Pull the release before back-release occurs.

3. Crosswind in the Climb.

Though maximum height is gained by keeping the wings level and allowing the glider to drift, at many fields this results in the wire/rope dropping onto no-go areas. To avoid this, fly the glider up the launch with the upwind wing held slightly low and the glider turned somewhat into wind. This is not a sideslip. The glider is flying into the crosswind, in balanced flight, towards the upwind side of the launch run, so that when the cable/rope is released it will fall onto the run and not downwind of it (Figure 3).

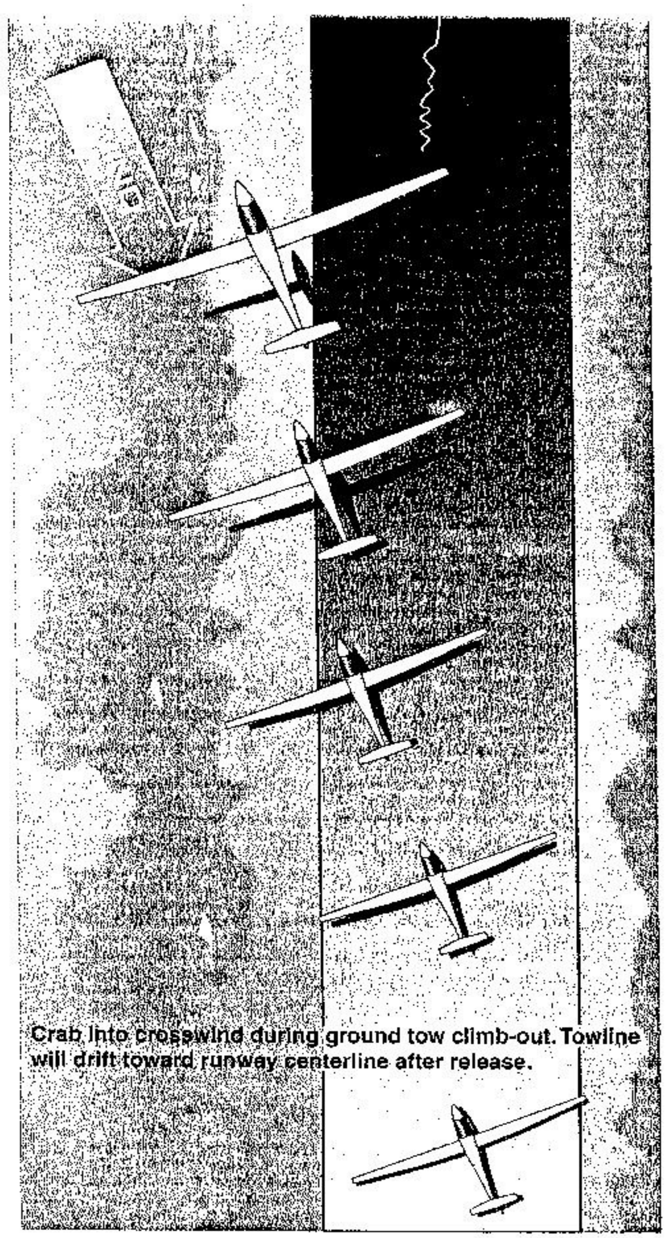

Figure 3: Crosswind Correction to Keep Cable/Rope Near Runway Centerline.

C. The Ground Run, Takeoff and Initial Climb.

1. General Considerations.

(a) With low power equipment delivering poor acceleration, the ground run may be protracted, particularly in light winds. With high power equipment with good acceleration, the ground run can be breathtakingly short.

(b) Stow loose articles before takeoff. Anything loose is particularly likely to fly all over the place during the initial acceleration, or after a cable/rope break.

(c) Decide who will do the flying in the event of a launch failure.

(d) During the ground run the ailerons and rudder need to be used independently of each other to keep the glider straight and wings level. Once the glider has become airborne, independent use of the controls must stop, and thereafter the controls need to be operated in the normal coordinated manner.

(e) Release the cable **immediately** if a wing goes down or anything else goes wrong during the ground run, e.g. an overrun. Keep the left hand near the tow release knob, or, depending on its position - for example, if applying left aileron will make it awkward to reach - actually take hold of it. If the stick is kept neutral the glider will normally lift-off naturally. Not all gliders react this way, and a few require an active forward pressure on the stick to prevent them pitching up too steeply during the initial rotation. At this stage very few require a positive back pressure – the increasing lift caused by the acceleration normally causes the nose to pitch up at least as much as required. The combination of stick central, approach speed trim and the pull of the cable/rope will rotate the majority of gliders smoothly into the climb, with attitude and airspeed safe. Figure 4 shows the glider in the acceleration and transition phases.

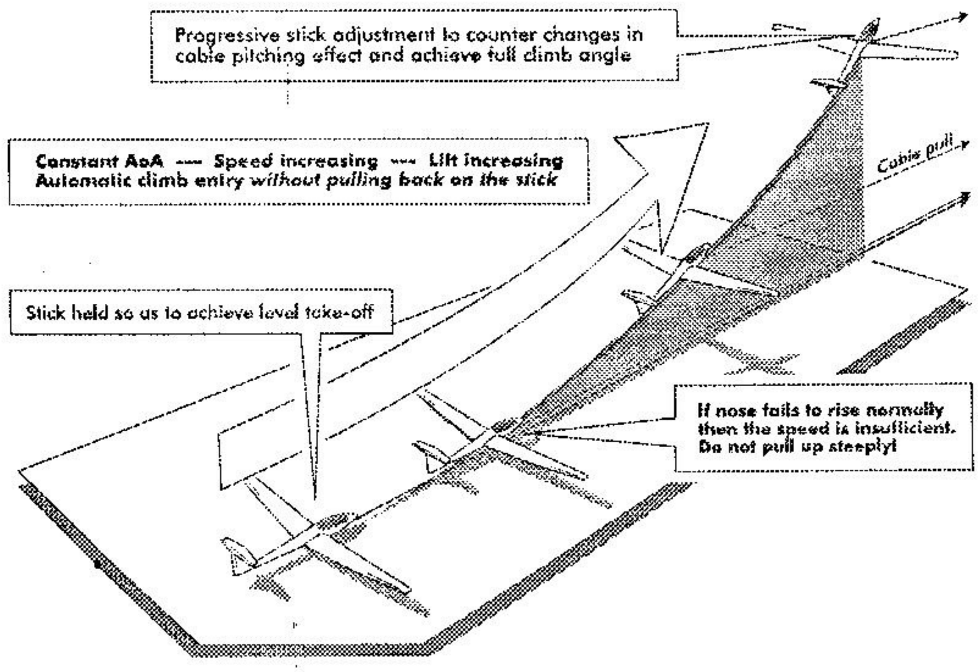

Figure 4: Acceleration and Transition Phases.

(f) If the glider is already doing exactly what's required, *and safely*, then any extra control inputs from the pilot can only lead to things going less well. The student should have been taught not to interfere with the controls if the glider is going where he wants and in the way he wants.

(g) It must be made clear to the student that even if the glider does 'auto-rotate' satisfactorily, (a) he is still flying it and must not let go of the controls - what if there is a launch failure? - and (b) he must actively monitor airspeed, height and attitude; all of which are critical at this stage of the launch.

(h) Satisfactory ground launches include a noticeable sensation of acceleration both before and after take off; particularly so with high power launching equipment. Any lack of, or interruption to, this acceleration suggests a problem. However, a feeling of acceleration can be produced by the glider pitching up, irrespective of its airspeed. This means that an 'acceleration' feeling alone is not a reliable indication of safe conditions for initiating the full climb. Meeting the safe conditions depends on:

- the glider type – its inertia, general 'dragginess', and its normal stalling speed.
- turbulence – a lull can cause a sudden loss of airspeed.

- wind gradient – when the glider takes off into-wind and climbs through a wind gradient, its airspeed will increase above that due to normal acceleration, particularly during the early stages of the climb. If the cable/rope breaks, the glider will have to descend back through the same gradient, and thus lose the extra airspeed gained while going up. A higher safe airspeed is required at the top of any wind gradient. Rotation into the full climb also needs to be slightly slower.
- rain – raises the stalling speed – DON'T LAUNCH!

(i) Throughout, the glider should be flown in such a way that if there is a launch failure, a safe landing is certain.

2. Teaching the Ground Run, Takeoff and Initial Climb.

The demonstration may include patter such as the following:

- *as the cable/rope tightens, ensure your left hand is close to, or on the release* (see earlier remarks about releasing).
- *as the glider moves forward, keep the wings level using the aileron. Large deflections may be needed initially.*
- *balance the glider on the mainwheel using the elevator.*
- *keep it straight by using the rudder, and continue to keep wings level by using the ailerons.*
- ***if a wing goes down, release immediately.***
- *when the glider has flying speed, it will take off by itself.*
- *feel the acceleration and notice the airspeed.*
- *keep the stick* (elevator) *neutral.*
- *allow the glider to pitch up; if it seems too rapid, or the glider is climbing too steeply for the speed, use the elevator appropriately to prevent it.* Note**.** Some gliders (e.g. ASK-8) will pitch up very strongly if left to their own devices.
- *check the airspeed and attitude regularly.*
- *at a safe height and with sufficient airspeed, a small amount of up-elevator may be needed to reach/maintain the full climb angle.*

Note: The glider is much more likely to pitch up steeply at rotation if the student has been trying to get it off the ground before it is ready to fly. Reasons for this include:

- light wind, no wind, tail wind, and/or a low power winch/towcar - the ground speed is very high and the glider looks as if it 'ought to have taken-off by now'.
- rough ground - in gliders without a sprung mainwheel, rapid pitch up at rotation can result from the student's desire, possibly subconscious, to stop being shaken about!

The remedy to the above is to make sure the glider is running on the main wheel, and to monitor the airspeed. If the airspeed says 20 knots, the glider will not take-off however hard the student tries to make it do so! One clue to an imminent sudden rotation at take-off, is the tail still on the ground and the stick well back, perhaps against the stop, when the glider ought to be in a level attitude with airspeed rising.

3. Crosswind During Takeoff.

It is unusual for all launches to be directly into wind. The chances of having to abandon a crosswind launch are increased by the possibility of:

- weathercocking, causing a loss of control that may lead to a ground loop.
- the into-wind wing lifting before there is sufficient aileron control to prevent it, again causing loss of directional control and the possibility of a ground loop.

Anticipate swing during the initial acceleration and apply an appropriate amount of opposite rudder *before* the glider starts moving. Four factors can cause a swing - consider all of them before the launch has begun:

- is there any crosswind?
- is the 'CG' tow release offset, i.e. not on the glider's centerline? (See 'out of line takeoffs' (in Advice to Instructors) for more detail on this and the next item)
- is there a bow in the cable/rope (cable laid out well to one side of the glider)? The yawing effect of a bow is worse on grass than on asphalt.
- which wing tip is being held? In a crosswind it is normal to hold the downwind wing to help prevent weathercocking.

Students often forget to take off rudder during the ground run that they have applied before it began. Remind the student that once the rudder becomes effective they need to actively steer the glider.

It is important, once the glider is airborne, but before it rotates into the climb, that the controls are neutral. Consider the case where downwind rudder has been applied to counter a weathercocking tendency. There is also a tendency for the into-wind wing to rise (dihedral causes an increase in the angle of attack of, and the lift from, the into-wind wing, and the opposite effect on the downwind wing). This rolling tendency will be countered by the pilot moving the stick in the direction of the rising (into-wind) wing, with a consequent increase in angle of attack of the downgoing aileron on the downwind wing. Failure to neutralize the controls before rotation means the glider is cross-controlled while the angle of attack is rapidly increasing, risking a low level stall – spin departure.

D. Launch Failures.

1. General Considerations.

Cable/rope breaks are usually obvious from the lurch and twang which normally accompanies them, but less so if the break occurs close to the winch or towcar end of the cable/rope. Even less obvious is a gradual failure of the launch vehicle's engine. After any launch failure the ONLY objective is to land safely. To achieve this:

- recover to a safe attitude while checking the airspeed.
- **regain the approach speed.**
- release the cable/rope.
- assess the situation.
- **plan a safe approach and landing – land ahead unless it is safe to do something else.**
- fly the approach and landing or a modified pattern variation to it.

2. The Recovery.

The extent of the recovery required varies with the height of the launch failure. Very shortly after take-off the glider's attitude will be approximately level, but in the full climb it may be 45° or more nose up. The amount and rate of control movement required to recover to the 'correct attitude' will vary from relaxing any back pressure on the stick, to a very positive forward movement. The 'correct attitude' will also vary, depending on the height. Reduced "g" is very likely during recovery from steeper attitudes, and is not always the result of over-controlling.

The indicated airspeed during the recovery provides a guide to how quickly and by how much the nose must be lowered. Regaining the airspeed may take some time, depending on the circumstances. Also, the pitch attitude will likely not give a true representation of the airspeed – the inertia of the glider causes the airspeed to lag up to several seconds behind what the pitch attitude suggests. Always check the airspeed indicator for a safe airspeed before starting a turn or opening the airbrakes. Use the time to assess height and position, and plan the approach. Decisions may be affected by the height lost while gaining speed.

Unless the glider is very close to the ground, the stick must be moved forward to lower the nose to an attitude steeper than would be normal for an approach in the prevailing wind conditions; this is what is called the recovery attitude. The approach speed needs to be gained quickly, particularly if there is a wind gradient to delay the acceleration. Any hesitation in lowering the nose from a failure which occurs in a steep climbing attitude will rapidly bring the glider close to the stall, if not actually cause it to do so.

Even if the glider is in a level attitude, a wind gradient can make a low-level failure fraught. In a moderate wind gradient, a Grob G 103 which suffers a launch failure at 30 feet and 50 knots may have gained about 5 – 10 knots of that from the climb up through the gradient, all of which will be lost again during the descent. Any delay in lowering the nose the small amount required will result in a further loss of speed, and the distinct possibility of a heavy landing, or worse.

3. Planning and Judgment.

Deal systematically with planning decisions. The only objective is a safe landing. Do not allow the often illusory 'convenience' of a shorter retrieve to influence the decision.

The first question is *Can I land ahead*? If the nose is not lowered sufficiently after a launch failure once the full climb is established, the field perspective will look wrong, and there will appear to be INSUFFICIENT room to land ahead. The student will reply *No* to the question, and almost certainly attempt to turn. Given the initial attitude and speed, a spin is highly likely. **The correct answer to the question (even if it is again *No*) is only apparent once the nose has been lowered to the approach attitude, or greater (the recovery attitude).** (Figures 5 and 6). If the answer to *Can I land ahead?* is then *Yes*, do so!

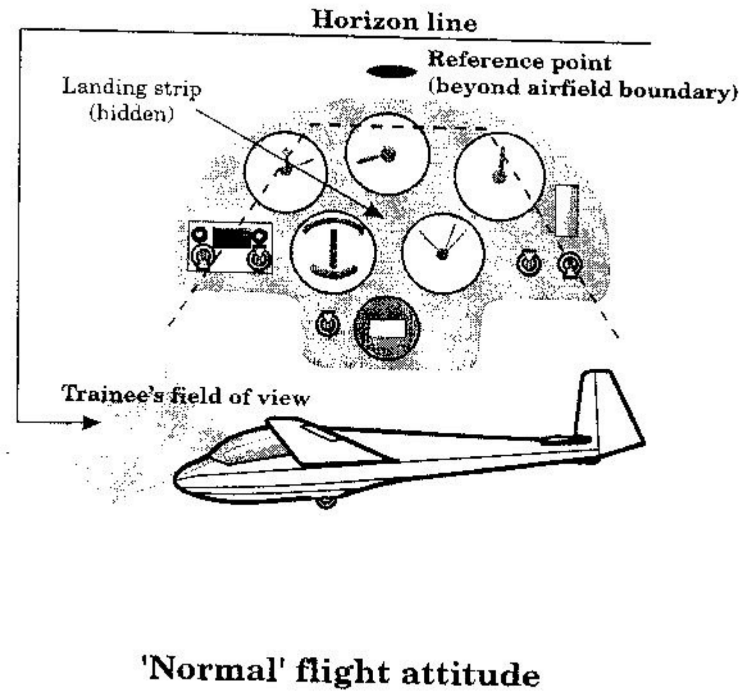

Figure 5: View Ahead at Normal Flight Attitude.

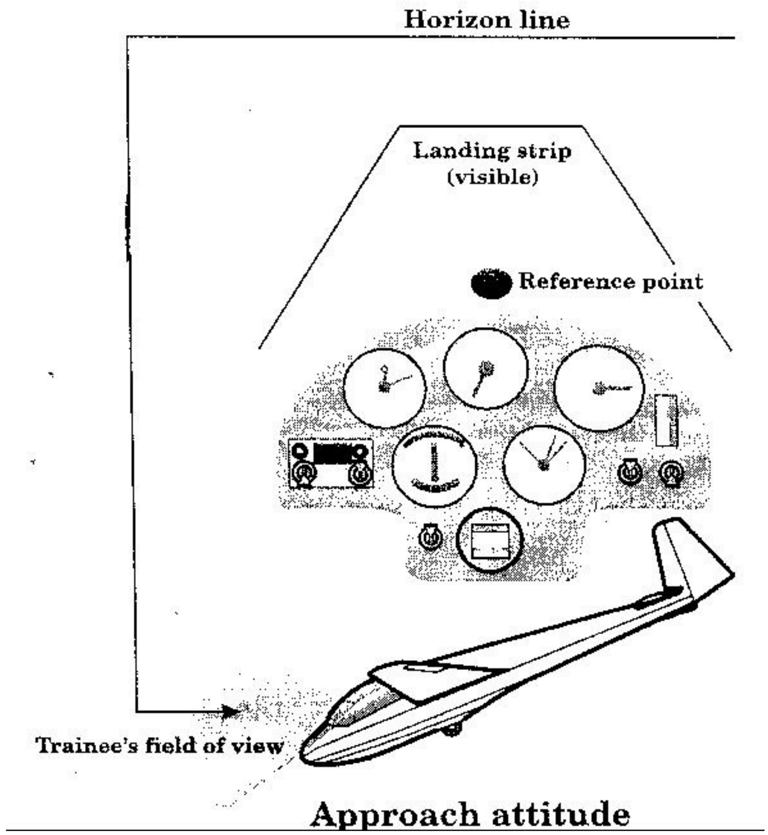

Figure 6: View Ahead at Approach Attitude.

In the early stages of a marginal straight ahead case the space available may seem insufficient, but usually proves to be more than enough. However, at small or restricted fields, *is there enough space to land ahead?* can be a tricky question. Assuming that you can land ahead, the next question should be *Do I have to land directly ahead*? Would a small change of direction make more space effectively available, by, say, taking advantage of any crosswind?

- if it is impossible to land ahead, decide which way to turn (a pre-takeoff decision which is based on any crosswind component, the field layout, and the terrain). In most cases, an upwind turn is not the best decision. The glider is committed to turning through more than 360° to get back to the takeoff direction. If the crosswind is strong and the break is at an awkward height, it may be impossible to return to the field. A downwind turn first is best, unless it takes the glider over the lee slope at a hill site, say, or is inadvisable for other reasons which are peculiar to the field. Those reasons apart, turning downwind offers more options, and the angle through which the glider has to turn is smaller.

- if the decision is to turn, ignore - but be aware of – apparent accelerations in relation to the ground. Pay attention to the airspeed!

- before turning too far, (i.e. when the upwind end of the field is still in view) the decision between an into-wind dog-leg or one across the field has to be reviewed. If a dog-leg is not possible, continue the turn to make a complete circle. You may not have to turn through the full 360°. There may be better choices after 270° or so.

- as a rule of thumb, if, after turning 270°, the glider is below normal final turn height, level the wings and land if it is safe to do so. Do not continue an already low turn simply for the convenience of landing into wind.

- depending on the circumstances, the circle may be extended into a more or less abbreviated pattern. The decision to turn in is then the same as the one to be made when running out of height in the pattern. The final turn should normally be completed at the same height as any other final turn. At restricted fields a lower than normal final turn may be unavoidable.

There are other possibilities apart from the straight-ahead, dog-leg, circle, and the various pattern options.

- the off-field landing - do not exclude this possibility at restricted fields, or elsewhere, especially when other choices might involve a very low final turn. An off-field landing might be an option at some hill sites.

- the 'S' turn involves a fair amount of maneuvering, often at low altitude, and even on narrow fields is seldom appropriate. It can lose more height than a straightforward circle, but if badly executed, the glider can arrive higher (in terms of getting into the available space) and nearer the upwind end of the field than it would with a straight-ahead approach using airbrakes.

Note: If possible, the student should be given a demonstration of the maximum practical descent rate with full airbrake in order that he/she may assess the minimum required distance for landing ahead. This can be accomplished on a high approach by pitching steeply nose down with full airbrake until the airspeed starts to get too high, then resuming a normal approach attitude.

4. <u>The Release</u>.

After a launch failure has occurred, the drogue chute (if fitted) and a length of cable/rope often remain attached to the glider. Pull the release knob to release the cable/rope and eliminate the possibility of a large increase in drag, or a dangerous attitude change if the cable/rope fouls an obstruction. If there is not time to release the cable/rope after a launch failure where, say, the landing will be straight ahead, **fly the glider**, and don't allow releasing the cable/rope to take precedence over that.

Be patient and DO NOT open the airbrakes or turn until the approach speed has been regained.

5. The Details.

(a) Launch failure training, while essential, carries possible hazards if misjudged or mishandled. An instructor needs to be experienced and in-practice before doing so. Until that is the case, instructors should consider treating every genuine launch failure as a demonstration, and take control rather than let the student attempt the recovery.

(b) Many large fields provide launch failure options which are plentiful and easy, but in principle the instructor should be teaching the student to deal with launch failures at any field.

(c) Training may be dictated by the state of the cable/rope. Cables/ropes in poor condition provide plenty of launch failures, but not necessarily at the right stage. Good cables/ropes may mean a concentrated session of training is required just before solo, and regular refresher training later.

(d) The student may have managed similar tasks, e.g. stall recovery, pattern planning etc., but the workload during a launch failure may be too high for him to cope. If the instructor is not demonstrating then he needs to be prepared to help by prompting.

(e) There are several parts to the launch failure exercise:

- recognition
- recovery
- judgment; planning
- execution of the approach and landing.

(f) Before demonstrating the launch failure on the cable/rope, demonstrate and practice it as an upper air exercise, after cable/rope release:

- describe a cable/rope launch failure that occurs during the full climb.
- dive the glider to about 70 knots, and then pull up smoothly into a 45° nose up attitude.
- immediately assume that the launch has failed.
- lower the nose to the recovery attitude (below the approach attitude).
- *release the cable/rope.*
- wait for the airspeed to increase to the nominated approach speed.
- don't turn or open the airbrakes until approach speed is attained.

(g) All launch failures except one close to the ground require the nose to be pitched down significantly. It is important that the student does not acquire the habit of pitching down the nose as an automatic reaction. To avoid this, start by demonstrating the very low failure first - explain that the nose is only pitched down significantly when appropriate and safe to do so. This is probably best demonstrated only.

(h) Next proceed with a launch failure and landing straight ahead well up the field, followed by one high up requiring an abbreviated pattern, then one at an awkward mid level (the most difficult case), too high to land ahead. When low, always guard the stick in case the student attempts to pitch the nose down significantly. Note: This order is progressive in its challenge to, and workload on, the student.

(i) Teach both simulated cable breaks (breaks tend to be sharp and obvious) and simulated winch/towcar engine failures (which tend to die away gradually). Before every launch consider the minimum safe speed/height combination for launch, and launch failure options, and nominate the approach speed before taking off.

(j) Standard procedure:

- unless close to the ground, lower the nose to the recovery attitude (below the approach attitude).
- release the cable/rope (only if time permits).
- check the airspeed.
- is it possible to land straight ahead?
- check the airspeed again.
- if it isn't possible to land ahead, select alternatives.
- don't turn or open the airbrakes until the approach speed is attained.

E. Inadvertent Cloud Penetration.

Avoid launching into cloud by releasing in good time. If you do enter cloud during the launch (by mischance or misjudgment):

- release under tension to avoid colliding with the drogue chute (if fitted). Do NOT lower the nose before release.
- after release:
  lower the nose to regain approach speed.
  DON'T turn until clear of cloud and airspeed is adequate.
  if the airspeed increases excessively, open the airbrakes.

F. Glider Release Failure.

While not strictly a launch failure, this is an emergency which requires correct and immediate handling. If the release failure occurs after a cable/rope break, the glider is free, and it is unlikely that the pilot will recognize that the cable/rope has not released. If he does, the glider should be flown 5 – 10 knots faster than normal, be kept within the field boundary, and be landed up the field taking care not to overfly any aircraft, vehicle or other obstruction. Throughout the flight, the tow release should, if possible, be held open until the glider has landed and stopped.

If the release failure occurs with the glider still attached to the tow vehicle, the pilot must, if height permits –

(a) Immediately lower the nose and open the airbrakes/spoilers. When overhead the winch/tow vehicle, commence steep turns to build up cable/rope slack. If the wind is strong, it may be necessary to straighten up momentarily when pointing into wind to maintain position over the winch/tow vehicle.

(b) When sufficient slack has been built up, fly downwind within or as close to the field boundary as practicable at 5 to 10 knots above the normal approach speed until there is room for the glider to turn into wind to land towards and close to the winch/tow vehicle, taking care not to overfly any aircraft, vehicle or other obstruction.

(c) Throughout the flight, the tow release should, if possible, be held open until the glider has landed and stopped.

Note: Do NOT attempt to break the weak link.

G. Debriefing.

Cover the following items, as appropriate:

- Placarded maximum ground launch speed.
- Minimum safe ground launch speed.
- Too slow.
- Too fast.
- Initial climb considerations.
- Stall speed on ground launch (increased load factor = higher stall speed).
- Launch failure procedure near the ground.
- Launch failure procedures at different heights.
- Allowing time to regain the approach speed before maneuvering and/or opening airbrakes.
- Appreciation that different gliders, launch equipment and fields may require different techniques.

H. Advice to Instructors

1. Hand Positions.

Be extra alert during the take off, initial climb, and following a genuinely unexpected launch failure. **Be prepared to release immediately during the ground run if a wing touches the ground.** Keep the right hand around the base of the stick ready to take over if the student tries to climb too steeply. Have the left hand near or on the release, but once the glider is safely airborne place it behind the airbrake lever to prevent the airbrakes being inadvertently or deliberately opened at the wrong moment. Be ready to prevent any or too much forward stick if there is a low level launch failure.

Close to the ground, the effect of a prompt on the student's conduct of the launch is both limited and critical. If a potentially hazardous situation looms, take over control. Hand control back once the situation is safe again. In the event of an unacceptably rapid pitch-up after take-off, taking over immediately and doing something about it safeguards the situation, and emphasizes to the student that something was not quite right – debrief later! If a hand is hovering around the base of the stick (don't actually touch it), then taking control here will come naturally and quickly.

2. <u>Speed and Crosswind Factors.</u>

Unlike normal free flight the airspeed during the launch is not directly related to the glider's attitude, so the airspeed needs monitoring frequently. The maximum acceptable crosswind component depends on the glider type. Gliders which always sit tail-down and have tail-skids are generally more susceptible to crosswinds. It is usual for the **downwind wing** of most gliders to be held at the start of the ground run, to reduce the risk of weathercocking.

3. <u>Out-of-Line Takeoffs.</u>

If the cable/rope is offset to any great degree to one side as the glider starts to accelerate for take-off, a strong and completely uncontrollable swing can occur. With lightning speed the situation can then go seriously wrong. Regardless of advice saying 'don't', pilots often pick up dropped wings and get away with it. That they sometimes do is not on account of their piloting skills, but blind and dumb luck.

In the 'out-of-line' scenario the violent yaw induced by the cable/rope pull can 'fly' the glider's forward-going wing and stall the other, which will then hit the ground and stay there; guaranteed in rough ground, and long or rough grass. The yaw and acceleration will continue and increase. There is no possibility of the winch/towcar driver reacting fast enough. Seconds later, sometimes following a spectacular 180° wing-over, the glider will crash.

A crosswind can worsen the situation. During the initial acceleration a glider with an offset CG tow hook - it does not have to be very far off the center-line either - will be prone to yaw away from the side with the hook. Any crosswind component will add or subtract to the swing, depending on the wind's direction and strength.

With a central hook and offset cables/ropes the only way to lessen the chance of a ground loop is <u>to be lined up with the cable/rope before the start</u>. With an offset hook a wingtip holder on the appropriate wing can help.

RELEASE IMMEDIATELY in the event of any unplanned/unintended departure!

4. <u>Low Power Winching Systems.</u>

Slow initial acceleration results in an extended ground run and a longer time before the controls become effective. Airspeed build-up after take-off will be more gradual, and rotation into the full climb must not be too sudden. Height, attitude and airspeed need monitoring more closely. Too vigorous a climb can stall the glider or the winch engine.

Slow acceleration can mean that a power failure at low height will be more difficult to detect. The pilot may be tempted to hang on for a few seconds longer than is safe, in the hope that power will be restored. Any power loss must be countered immediately by lowering the nose and aborting the launch.

After the initial stages the low powered winch launch can be handled like any other, except that in light or zero wind conditions even full throttle may be unable to maintain a satisfactory airspeed and climb rate throughout the launch. The height achieved will be less, as will instruction time, so pre-flight planning and briefing are more important.

5. <u>Autotow and Reverse Pulley Autotow.</u>

Much the same comments apply as for the low-powered winch. Additionally, some autotow vehicles with automatic gearboxes have the annoying habit of changing gear just after the glider has become airborne, which typically results in a brief and, if unanticipated, disconcerting power loss at 10 to 15 feet above the ground. Normal as that may be, once accepted as such it can mask a genuine failure when other wire launching equipment is being used.

In reverse pulley operations the driver may not be able to see the glider nearing the top of the launch and may fail to slow down. Be aware that the glider's rate of climb has reduced, and release to avoid dropping the wire onto the pulley.

6. <u>Launch Failures.</u>

(a) Never let a situation develop so far that it is close to the limits of the instructor's capability. Take over well before such limits are reached. <u>If in doubt about whether to take control or not, then there is no doubt - take control.</u>

(b) Do NOT simulate a launch failure to test a student at a height below which any delay, over-controlling or airbrake deployment, would tax the instructor's ability to recover. All launch failures must be pre-briefed and demonstrated before the student makes any attempt at the exercise. For the ultra-low level (below 50 feet) launch failure the pre-brief must contain specific advice not to over-control on the elevator. This particular exercise has produced far too many training accidents to justify surprise testing. If there is a drogue parachute in the cable/rope assembly, the exercise must only be done as a winch/towcar power failure. A low break initiated from the glider has the potential problem of the glider flying into the parachute.

(c) A student who has only had high-level failures will be programmed for recoveries from a nose-up attitude and consequently may over-control during a low-level failure. Guard against this by following the recommended sequence.

(d) For very low level failures at 10 feet or less, don't lower the nose at all. A number of accidents have been caused by lowering the nose into the ground.

(e) With some powerful launch systems, rotating directly into the full climb with ample speed may be possible on almost every occasion. The practice is potentially dangerous because the habit can prevail even when the speed is insufficient.

(f) Low-level maneuvering, particularly under stress and/or at low speeds, is a MAJOR source of all flying accidents. Plans-of-action following a launch failure or an abandoned launch should stress the need to land straight ahead if possible, which might mean an off-field landing.

(g) If the student decides to land straight ahead - assuming it is safe to do so - allow him to do so even if more convenient options are available. Only by allowing a student to carry out his decisions will his confidence increase.

(h) After a launch failure where the 'circle' has been extended into an abbreviated pattern, the final turn should normally be completed at the same height as any other final turn, but students may:

- turn in early and higher than usual because they are being tested, or they are nervous, or both.
- continue downwind and turn in lower than usual to reduce the retrieve distance. Discourage this, even though the situation does allow the instructor to see how well the student copes with the higher workload.

7. Converting Pilots to Ground Launching and Different Systems.

Beware of conversions from:

- **high acceleration launch systems** to lower acceleration systems. The pilot may rotate into a steep climb immediately after take off.
- **autotow or weak winch to powerful winch**. The pilot probably will not pull up properly and will get much too fast.
- **equipment with a noticeable gear change in the very early part of the launch** - the pilot may not recognize a low level launch failure quickly, and will hang on waiting for the power to pick up.
- **aerotow** – the pilot will not pull up at all. He will normally need at least 10 ground launches before becoming competent. Initially, this may dishearten him!

8. Order of Teaching.

See Part D 5 (f), (g) and (h). It is important that the first demonstrations and student attempts/practice at launch failures involve straight ahead landings, not high level and turn back launch failures (the law of primacy). A student should never be tested on launch failures without warning him first, unless he has already been taught how to deal with them correctly (i.e. has had them demonstrated and been allowed to practice).

I. Common Difficulties

(a) Too abrupt or too gentle a transition into the climb. This may be due to a tendency to look straight ahead rather than scanning from wingtip to wingtip via the airspeed. It may also mean that the student has never had a good demonstration of what it should look like in the current wind conditions. Do not be afraid to re- demonstrate if prompts or descriptions do not work. This part of the launch is over too quickly to give the instructor an opportunity of correcting the fault in flight, and each time the student climbs too abruptly, he is putting the safety of the flight at risk!

(b) Fishtailing up the launch. This is usually caused by a failure to apply sufficient (or any) rudder to counteract the adverse yaw which results from small and possibly unnecessary aileron inputs. The student may also be bracing himself against the rudder pedals and finding the rudder 'very heavy'.

(c) Incorrect rudder coordination in crosswind drift correction. Explain that drift correction is achieved by applying some bank with coordinated controls.

(d) Always turns upwind after release. Explain that not only must the nose be lowered but any bank applied for crosswind correction on the launch must also be removed promptly.

(e) Bucking or hunting at the top of the launch. Some gliders are particularly prone to this, often older ones. The symptoms can be a warning that the glider is near to the stall, or even stalling. The remedy is to lower the nose slightly, enough to stop the oscillation, and then gently raise the nose back into the climb attitude.

(f) Releasing under tension at the top of the launch. This can cause time wasting cable/rope breaks and tangles, particularly if its a winch using piano wire. Releasing under tension does not offer any significant height gain and it increases the wear on the tow release as well as unnerving the student.

(g) Poor directional control, wing dropping on ground run. The most likely reason is that the student has not yet learned how large the control movements at low speeds need to be. The problem is aggravated by the fact that on the ground the rudder is steering the glider as well as counteracting aileron drag. If the glider lifts off with substantial rudder deflection then the possibility of a spin when the power increases is quite high – centralize the rudder immediately it becomes effective and the glider is airborne. Release the cable/rope immediately if a wing goes down on the ground run.

(h) Wing rocking during the climb. This has two possible causes. Rapid small-scale wing rocking is a symptom of an approaching stall, and the remedy is to lessen the back pressure on the stick until the wing rocking ceases. Slower, large-scale wing rocking is usually caused by the student correcting for one wing low but not centralizing the ailerons when the wings are level and thus dropping the other wing. This over-controlling may be due to:

- failing to recognize when the wings are level.

- not appreciating the very small amounts of aileron required at the launch speed compared with the much higher sustained elevator force.
- a tense grip on the controls which may mask the stick forces being applied.

(i) Tries to take-off too soon. This should be discouraged as it can lead to very swift rotation into the climb at the worst possible moment. Watch out for this if the ground run is longer or faster than usual, and/or the ground is very rough. Get the student to run the glider on the main wheel alone, not the mainwheel and the tail-skid/wheel.

(j) Veers off to one side during the climb. The student needs a reference point to help keep the line of the launch.

Part 5: Completion Standard.

The student needs to demonstrate that he/she has the proficiency in ground tow procedures and operations, including emergency procedures, necessary to qualify for the endorsement certifying proficiency in ground tow procedures and operations specified in FAR §61.31(j)(1)(i).

Part 6: Sources and Additional Information.

The information in this article has been based primarily on the *Wire Launching* section of the British Gliding Association *BGA Instructors' Manual, Second Edition, 2003*. Additional general information is available in the SSA's *American Soaring Handbook*, Chapter 3, *Ground Launching*, the SSA *Soaring Flight Manual*, Chapter 13, and the FAA *Glider Flying Handbook*, Chapter 7. It should be noted that, in places, these contain techniques etc. which are no longer used – e.g. the too-slow signal. Where something appears contrary to the advice given in this Section, there is probably a good reason – before adopting a procedure which does not appear in this Section, the reason for its omission should be ascertained and understood.

Speed control in the launch using the procedure set out in this Section differs from those set out in some other texts, e.g. those in Part I, Chapter 6 of *The Joy of Soaring*, which are NOT to be followed although their use is technically correct and works, **provided** the weak link does not break. Using them, however, greatly increases the likelihood of a break, and if it happens, the glider will be left in a much steeper attitude making a safe recovery substantially more difficult.

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