INSTRUCTOR'S HANDBOOK

Published by:

The Gliding Federation of Australia,
(ABN 82 433 264 489)
Building 130, Wirraway Road,
Essendon Airport,
Victoria 3041
Tel: (03) 9379 7411, 9379 4629
Fax: (03) 9379 5519

PART 2

PRE AND POST-SOLO
STUDENT TRAINING SYLLABUS

INTRODUCTION AND SEQUENCE OF INSTRUCTION

INTRODUCTION

The flying training policy of the GFA is to produce glider pilots with a high degree of ability, understanding, initiative and safety consciousness, leading to safe, efficient and competent cross-country gliding.

Consideration has been given to the reduction of confusion in the student's mind which can easily be caused by overcomplicated explanation and demonstration and by introducing advanced techniques before the basic lessons have been fully understood. The training sequence has been designed to avoid over complication and premature introduction of the advanced sequences.

This "building block" approach to flying training is successful and none of the basic sequences can afford to be skimped in case the training structure is weakened. Although it may seem attractive to rush through some of the basic exercises and let the student fumble along, learning despite the instructor, there will almost certainly be misunderstandings in the student's mind which will cause trouble for someone later in the person's training.

SEQUENCE OF INSTRUCTION

In the recommended sequence of instruction shown at the beginning of this section, careful consideration has been given to the exact stage of training at which each exercise is introduced, the aim being that the sequence should proceed by gradual stages from simple steps to those of greater complexity.

Early instruction falls naturally into a number of stages, each of which contains a number of steps or exercises. It is important that the progress of the student through the sequence should be governed by his confidence, understanding and mastery of each stage, before proceeding to the next. Any tendency to take the student through a fixed programme of training, without regard to progress, is to be avoided.

Therefore no indication is given as to the length of time or the number of flights which should be spent on each exercise or stage. The only basis on which this can be judged is the progress of the student. These judgements should, if anything, be made on the conservative side.

Throughout training the instructor should bear in mind that the ultimate object of the training is to produce a safe, efficient and competent cross-country pilot. The teaching of the techniques of soaring and cross-country flying should be integrated into the basic training scheme at the earliest possible time.

AIR EXPERIENCE

THE CONDUCT OF AIR EXPERIENCE FLIGHTS

Introduction

Please refer to:
Operations Directive (OD) 01/16 The Air Experience Instructor.

There are two important things to realise when entering the world of air-experience flying.

1. **You are now responsible for someone else in the glider as well as yourself.** This means that the relatively carefree attitudes, which you may have got used to in solo flying, are now not appropriate. For example, you probably have never had to work to a deadline before. You have chosen your takeoff time and planned accordingly, slowly getting your glider ready and launching when conditions are right.

   Now you may be thrust into quite a different scene. There may be three or four people waiting for air-experience flights and you are one of the pilots chosen to take them. You will have pressures on you that you may never have experienced before, pressures which must be resisted if you are to avoid such pitfalls as rushed or interrupted checks or being distracted by people holding social conversations around the cockpit.

2. **You must realise it is their first flight, not yours at their expense.** The impressions you give during that first flight are extremely important - you can sign up a new member or turn that person off gliding for life. In this sense your responsibility is at least equal to the instructor who takes a student through the later training sequences - a student who does not get on with a particular instructor will find another instructor, whereas a newcomer having an unpleasant experience on the first flight will probably not even take another flight. He may be lost forever.

   Think back to your first flight in a glider and how the person who took you up treated you. It will probably help quite a lot in your handling of air experience flights.

Confidence

It may seem an obvious thing to say, but you must be confident of your own ability to fly safely and accurately. Not only this, you must convey this confidence to the other person, especially if you do not know each other. Put yourself in the other person's place – you have come here of your own volition to be exhilarated, but at the back of your mind is the thought *"I hope nothing goes wrong."* What you really want is to get down again safely and if you enjoy it immensely, so much the better. You are introduced to someone (a good pilot you hope) about whom you know nothing, and he says such things as *"I haven't flown one of these gliders for ages" or "I hope the rope doesn't break"*. Maybe an exaggeration, but if you had any sense you would be off like a shot or you might sit through the entire flight petrified. Loose talk, even if intended as a joke, can get you off to a really bad start. What you want to hear is that things will not go wrong, or if they do that your pilot will be able to cope with them in a trained, professional way. You will want to hear him say things like *"Rope breaks are very rare, but if we do have one, we will land in one of those paddocks over there, or if we're high enough we'll land back on the airfield."*

Note the “will” and not “might” or “maybe” and the fact that your pilot is making decisions and preparing for any eventuality. You think to yourself “I can trust this person with my life” because that is in fact what you are doing. Let your passenger know beyond doubt that you are going to look after him by being positive and decisive. Also remember that, like surgeons, air-experience pilots do not have the word “oops” in their vocabulary.

Obviously this confidence must be based on actual ability.

Early sensations

Most people on their first flights will experience fairly vivid sensations of positive and negative G and of slip or skid, though they probably will not know what they are called or why they happen. The fact that they do not know why these sensations happen is likely to make them even more vivid.

The fact is that the person on his first glider flight, unless experienced in some other form of flying, has spent almost all his life at 1G and now finds that, not only does he lean over every time you turn, but also gets pushed into the seat. Then, no sooner has he adapted to this extra body weight, you come out of the turn and he feels light-headed going back to 1G. It may be very disconcerting and the person may be convinced that he will never make a pilot because he has not got the constitution for it. The moral should be obvious – be honest and tell the person what to expect before you fly. Don’t lay it on too thick; there is no point in erecting unnecessary obstacles to a person’s enjoyment, but tell him that everyone has these sensations and he will become accustomed to them when his eyes have learned to discern the small attitude changes that cause them.

Avoid unnecessary jargon. Use of words like “attitude” and “high and low G” are useless without explanation. Better to use familiar and everyday expressions, like “that hump-back bridge feeling” or “that sensation you get at the bottom of the slope on the Big Dipper”. The person will know immediately what you are talking about and what to expect. It is also something you can reinforce when airborne and you fly through a down-gust causing low G “Did you feel that? Remember that hump-back bridge feeling I talked about before take-off...etc?” It is reassuring to your charge to know that you also felt something not altogether pleasant.

A very small percentage of people never really adapt to low G sensations (low G being defined as less than 1G), even though they can tolerate an increase in positive G. Such people become extremely concerned, even agitated, when they experience low G and it is worth keep a careful eye on all air experience passengers for any sign of this trouble. If you detect an abnormal sensitivity to low G, cut the flight short if the air is rough and discuss the matter with them on the ground.

Pre-flight briefing

The essence of a good briefing is just that keep it brief. The accent should be on the things that will directly concern your potential new member, like what to expect from the flight and how to enjoy it.

Unless interest is shown in the controls or instruments, do not volunteer lengthy explanations. Short and simple are the watchwords. Once aboard and the harness is comfortably secure, give a concise briefing about the new environment for the next few minutes. For example: *“As you can see, we have a control stick here (point) and some pedals on the floor (point). I will be using these all the time to control the glider, so please keep clear of them until I say so - I’m sure you would like to have a go when we get up there.”*

"Your harness is nice and snug, so you won't need to hang on to anything. However if you feel you do want something to hold onto, use this here (point to the appropriate place on your glider type). Please don't touch this yellow knob or the red handle here (explain why). The only other important control is this blue lever here (point) which works the airbrakes. You may see me moving that as we come in to land. You've got some instruments here which tell our height, speed and whether we are going up or down, but don't worry about them, I have the same set of instruments in front of me. Much better to keep your attention outside and enjoy the view."

"I am now about to commence a pre flight cockpit check to ensure that everything is in order before we take off."

Apart from explaining about the sensations, something like this is all that you need say. Obviously amplify your descriptions if you are asked, but don't get bogged down by intricate details of how and why everything works. Don't be evasive, but keep your explanations brief and untechnical.

Bear in mind that the technical knowledge you possess has been assimilated over several years. If you try to impart all this knowledge in a few minutes (quite a common error, even for experienced instructors), the newcomer may well think you are a superman for being able to operate all those knobs and levers at once and read all the instruments at the same time. He may not come back as a student if he thinks it will all be too complicated for a mere mortal such as himself. Therefore, be brief and truthful, but untechnical and reassuring.

Patter

You will find that after a few flights you will start developing your own patter. The aim here is not to tell you exactly what to say, but to give a few hints on how and when to say it.

You might find it difficult at first, but try to keep a steady and even conversation going. This is important for two reasons; firstly that an even (not monotonous) speech will be more reassuring than a sudden high-pitched babble when, for example, the cable has just broken; secondly, the two-way talk will give you an insight into how the person is coping with three-axis motion, as well as making him feel more than just nose-ballast. Talk about what you like, but make it interesting. For example, on tow you might talk about the gliding club, the aerodrome, the local area, in fact anything that is different from his everyday life and therefore interesting. Get the person involved in the conversation; although he does not know how to fly the glider, he can talk.

The other important part of good patter, and therefore good introductory flying, is to keep the other person informed about the flight; for example warning him before each manoeuvre and, if need be, what to expect. Almost every sensation will be new, tell him before it happens.

A couple of examples:

(i) On coming off tow. "*Any moment now I'm going to bung off tow and do a right-hand turn."* The elements are there and it is truthful, but "bunging off" is at best meaningless and may even suggest a violent manoeuvre.

Compare that with *"Any moment now - I'll tell you when - I shall be releasing the towrope and when it has gone I will bank the glider over gently to the right. The rope will leave us with a bit of a jolt, which is quite normal. OK, I m releasing now."*

See the difference? The newcomer is prepared for everything he is going to feel whether he is sitting through a right-hand turn or not.

(ii) On preparing to land. "*Well, we're down to 800ft and it's about time we got ourselves established on the downwind leg of the circuit. I'll try to get us down by the aerotow point but it might be tricky in this crosswind. I'm increasing speed and retrimming onto the downwind leg now. There may be a wind-gradient on finals. Turning onto finals now and open the brakes. 55 knots and going well . . . etc."*

All good stuff and quite truthful. Read it through again, see where it went wrong and try to think what you would say. There is a bit too much technical jargon and not enough confidence comes across that the pilot is really capable. Try this version.

"We're getting lower now and it is time to prepare for landing (getting nicely positioned on the downwind leg). What I'm doing at the moment is getting us positioned so that we will land on that grass strip at the end of the airfield where the tug aircraft is just landing. See it, down there on the right? We need extra speed for a safe approach to land, so any moment now I'm going to lower the nose slightly - you will feel that hump-back bridge sensation as I do it and you will also notice the air noise get louder (Lowers nose and retrims). One more turn and we will be lined up for a landing just to the right of the line of gliders. We've still got plenty of height, so I'm going to start to use the airbrakes. It might look like we're going to dive into the ground, but we won't; gliders usually approach quite steeply to land. . . etc."

The difference in this version is that the pilot is adjusting his own thoughts to what the other person can understand, pre-empting any apprehension and certainly not mentioning his own thoughts of downwind legs, crosswinds and wind-gradients. Saying the right things is often simply not saying the wrong things.

Adverse reactions

Apart from the rather unlikely event of flying somebody whom is acutely low G sensitive, the main problem you may encounter is airsickness.

Although it is true that some people are prone to any sort of motion sickness, a large proportion of sickness on early flights can be attributed to extended circling, unnecessarily violent manoeuvring and inaccurate flying by the pilot.

The general rule is therefore no aerobatics, no steep turns and no dolphin flying. It is also a good idea to limit thermal turns to less than about three in a row, as continuous circling is likely to disorientate the newcomer. Be careful how much bank you use too - keep the turns rather more shallow than you would use if you were by yourself. Naturally you should be keeping your conversation going, but if the other person is quiet or unresponsive, especially if the head is tucked down and looking inside the cockpit, suspect that you have a potentially airsick person on your hands. Do not ask, *"Ere, mate, you feelin' crook?"* or you will find out the messy way. Try *"If you're happy, we'll go in and land now; I'm sure someone else is waiting for the glider"*. It may not be strictly truthful, but it should at least provoke a response. Or you could try… *"How are you managing, feeling OK"?* If the reply gives you any cause for doubt, it is time to head back. The main thing is to keep his attention outside the cockpit from the start. Not only will he gain very little knowledge or enjoyment from staring at the instruments, his lack of visual awareness of the glider's motion will make all his sensations much more vivid and alarming. Try it yourself on your next flight - do a gentle pushover (low 'G') looking at the horizon then do the same manoeuvre looking down at the stick. That is what your hapless victim will feel.

Letting the other person fly

Showing someone the effects of the controls and how they are used to manoeuvre the glider is really a job for a fully trained instructor. However, with a little training and practice, you will be able to show them the basic effects of the three controls and how they affect the motion of the glider. The Air Experience Instructor is not authorised to go beyond this very superficial introduction to the effects of controls and must not allow the other person on the controls at all below 800ft AGL.

Some do’s and don’ts

DO reassure your charge and understand his feelings.

DO fly smoothly.

DO, if you can, fly your friends first. They already know you and probably trust you. You will already have overcome the biggest hurdle.

DO NOT do aerobatics.

DO NOT spend a long time continuously circling.

DO NOT do steep turns, but...

DO NOT compromise safety, inasmuch as you may have to turn steeply to avoid collision or do a well-banked turn onto final approach.

DO NOT apologise. For example, do not say *“What a sloppy turn I did there”* or “*what a terrible take-off*”. This person has trusted you with his life and does not want to hear things like that from you.

DO NOT use loose talk (Example above). Think what you want to say and imagine how it will be received before you say it.

DO NOT fly air experience flights in rough conditions and think very carefully about flying them in the middle of very hot summer days.

Flight safety in air experience flying

In air experience flying, you have the safety of someone else to consider, as well as your own. Nowhere is this more important than in the circuit. What is to you, the pilot a perfectly safe and controlled “running out of height” situation might come across to the other person as an emergency with things getting rapidly out of control. Even more so if you have already told him where you are going to land and then say you won’t be able to make it. Although you should always fly safely, the margins should be increased when you have someone else to consider as well.

Finally, introducing other people to your sport can be very rewarding. You will find it almost like learning to fly all over again and it will certainly add another dimension to your gliding. However, don’t collect a rating for the sake of having another piece of paper. In order to give your best to prospective new members, you should genuinely want to do that. Once you have the rating, use it as often as you can. Not only will staying current help your flying to be safer and more accurate, you will be giving much better value for money. Remember whose flight it is.

ORIENTATION

Now we start on the training sequence itself and this is the realm of the fully trained instructor. The orientation flight is intended to reinforce the points made on the air experience flight. In addition, the opportunity is taken to emphasise the three-dimensional nature of gliding and how to adapt to this from the two-dimensional world that the student has become accustomed to.

Walk round the glider with the student, show him where things are, answer any questions, but do not go into any great detail. Provide orientation as follows: Have him look at the landing area in use. Tell him that the glider will be landing back there and *"We can reach this area from the air at any time during the flight."*

Point out some prominent landmark in the vicinity of the strip, and suggest he should find this during the flight and see how it looks from the air.

At this stage, start introducing the fact that you are doing particular checks before flight, without necessarily bothering the student with too much detail.

Just before take-off give the student a realistic appraisal of the launch. In the case of a winch or auto-tow launch tell him he will find the climb attitude strange, but that this is quite normal. Mention the possibility of a cable break and tell him that if one occurs the nose of the glider will be lowered rapidly. Talk informally on the climb, perhaps about conditions at the time...normal, calmer than usual, etc. Near top, mention that releasing the cable will make a noise, and that he will feel a change of attitude and sensation.

During the flight, as on the air-experience flight, make all manoeuvres gently. Check on orientation several times by having the student point to the landing area and chosen landmarks.

On the base leg tell him that you will be using the airbrakes after the next turn, that these may make a noise and change the attitude of the glider, and that this is normal.

NOTE: The wise instructor will add nothing to the above procedure except informal conversation. He will check throughout the flight on orientation, relaxation and enjoyment, and will make his initial assessment of the student.

STABILITY

The object of this exercise is to demonstrate that the glider is a stable platform, which will fly itself without the assistance of the pilot. To make this demonstration effective, reasonably calm conditions are required. Trim is used but not stressed to the student.

Demonstrate the stability of the aircraft, 'hands off' several times, and further demonstrate that it will recover from displacement in the pitching plane keeping the degree of displacement within the stability characteristics of the aircraft.

During the flight, relaxation and orientation are checked, and a further assessment of the student's level of comfort and confidence is made. Do not proceed until this is established.

More sensation of movement may be provided if the student seems receptive.

LATERAL DAMPING

This is a very important factor affecting the glider's stability in the rolling plane. It is very simply explained.

If the glider rolls, either because of a pilot input or because it is tipped by turbulence, the down going wing will start to produce more lift than the up going wing. This is because of the difference in the angles of attack of the two wings during the rolling manoeuvre. The increase in lift on the down going wing tends to resist any attempt to make the glider roll; in other words it damps the rolling tendency. Hence the name "Lateral Damping".

Lateral damping is a powerful force that profoundly affects the behaviour of the glider in straight flight and during manoeuvres. It can, however, be destroyed, in which case the glider will become very unstable in the rolling plane and will roll uncontrollably until action is taken to restore the damping force.

Lateral damping can be destroyed simply by stalling the glider. This can cause the glider to roll indiscriminately, a rolling motion which can become autorotation, the breeding ground for the spin manoeuvre. It can be restored just as simply by unstalling the wings, whereupon lateral damping reappears and provides the glider with the roll stability it had before.

See also page 22 of this section of the Handbook and refer students to pages 14 and 27 of "Basic Gliding Knowledge" (3rd Edition).

ALTHOUGH THESE TWO SECTIONS APPEAR VERY SHORT AS WRITTEN HERE, DO NOT UNDERESTIMATE THE IMPORTANCE OF A GOOD UNDERSTANDING OF THEIR MEANINGS.

INTRODUCTION TO CONTROL

From now on, having completed the orientation flight and demonstrated the glider's inherent stability, the training will consist of close adherence to the methods of instruction covered in Part 1 of this Handbook. To reiterate the Methods of Instruction, here is the sequence again.

- Pre-flight briefing
- Airborne demonstration and patter
- Hand-over/take-over procedure
- Student practice and feedback
- Fault analysis and prompting
- Post flight debriefing

It is suggested that you go back to Part 1 of the Handbook to refresh your memory on the entire contents of Methods of Instructions before proceeding any further.

CONTROLS

COCKPIT CHECK

As from this stage onward the student will be handling the controls on every flight, it is appropriate to introduce the standard cockpit check. Refer to Instructor's Flight Reference Cards for details of the check. It should be explained to the student that the reason for this check is to ensure that the glider and crew are in all respects ready for flight and that the use of a standard check ensures that nothing is omitted.

The student should normally participate in the cockpit check before every flight and when he reaches the stage where he can perform the check without assistance he should be made to recite it aloud so that the instructor knows that the check has been completed satisfactorily.

As proficiency is gained in learning the cockpit check, it is opportune to introduce the Limitations Placards to the student. These placards cover the limiting speeds and weight and balance of the glider. See Appendix 2 of this Handbook for reference material.

ELEVATOR CONTROL

Pre-flight briefing

When planning a pre-flight briefing for this sequence, take into account the type of glider, the launch method and the soaring prospects. For example, a pre-flight briefing for a winch-launched Kookaburra on a non-soaring day will probably brief only one control at a time before flying, whereas an aerotowed IS28B2 would easily be able to accommodate all three controls into the briefing at once.

Using the elevator as an example, the important points to be covered during the briefing are as follows: -

The elevator controls the pitch of the glider and thereby controls its speed. It operates in a sense that will be natural to the pilot - stick forward, nose down, stick back, nose up. Demonstrate the movement of the elevator while moving the stick.

Airborne demonstration and patter

During the teaching of elevator the instructor controls aileron and rudder, isolating the effect to be observed. Emphasis in the early stages of training should be primarily on attitude with indicated airspeed mentioned as a cross-reference.

At this early stage of introduction to control, it is essential that all demonstrations and subsequent practice start from, and return to, the stable platform.

The air coverage could be as follows:

"I am now going to teach you the use of the elevator. When flying a glider we usually wish to maintain a correct attitude. Look ahead at the horizon. This is the correct attitude for normal flight in this glider. Note the position of the nose in relation to the horizon and listen to the sound."

"Now…see the nose go down as we move the stick forward. Notice how the nose goes below its usual position, how the sound increases, and that we are obviously flying faster. This is confirmed by a glance at the airspeed indicator."

"If we wish to raise the nose we move the stick back. See how the nose comes towards the normal glide position, and we can if we wish raise it slightly above that normal position. The glider slows down, as confirmed by the decreasing sound level and the lower reading on the airspeed indicator."

"Now we are flying again in our normal attitude."

The time has now come to hand the elevator control over to the student for him to try it for himself.

Hand-over/take-over procedure

At this early stage it is essential to set the pattern for a formal hand-over/take-over procedure between instructor and student, to eliminate confusion over who has control at any one time. Whatever expression is used - "your aircraft/my aircraft" is quite satisfactory – a formal procedure must always be followed. Similarly, whatever expression is used it must receive a response.

This formal hand-over/take-over procedure must **NEVER** be varied in instructional work.

Student practice and feedback

The elevator control is handed to the student and the appropriate response received. The air work continues along the lines of… "*Lower the nose; bring it back to the normal position. Fly a little faster; now a little slower."* And so forth.

"Now I want you to fly at the normal glide attitude. Watch the horizon. If the nose is too high and the speed too slow, ease the stick forward a little until the nose is in the right place, and then cheek your movement to prevent the nose getting too low."

Fault analysis and prompting

The student is allowed to practice, the instructor identifying any faults which may be present and offering the appropriate corrective advice, or if necessary some assistance on the controls. Prompting is better than interfering on the controls, but it is sometimes necessary to give the student some assistance in the early stages before a "feel" for the glider has developed.

Post-flight debrief

When debriefing, it is important to realise that the student will most readily remember that part of the flight that is most recent. That is of course the approach and landing. The vivid memories of the landing approach, especially if it was a steep approach on a windy day, will tend to suppress everything else. In these early stages, we don't particularly want him to remember the approach and landing, but parts of the flight that occurred earlier. The instructor must carefully take the student back to those parts of the flight he wishes to comment on, before attempting to embark upon a detailed debriefing.

When debriefing the use of the elevator, the important message to get across is that movement of the elevator causes a change in the total shape of the tailplane/elevator assembly. This causes lift to be produced in either an upward or downward direction and thereby forces the tail of the glider in the appropriate direction. Demonstrate this by taking the student to the rear of the glider and showing him exactly what you mean.

AILERON CONTROL

Pre-flight briefing

The ailerons control the bank or roll of the glider. The pilot's operation of the stick is again natural - stick left, glider banks left, stick right, glider banks right. Demonstrate the "one up, one down" movement of the ailerons when the stick is moved. Mention at this stage that banking turns the glider and that the ailerons should be regarded as the primary turning controls.

Airborne demonstration and patter

Once again it is important that all demonstrations should be given with the glider stabilised in straight flight so that the required effect may be clearly observed. The effect of aileron should be clearly isolated from the effects of the other controls.

A single demonstration, and brief practice by the student, should be sufficient for him to appreciate the effect of aileron while watching the wingtip. The horizon ahead is introduced as the reference as soon as possible. In all future practice see that the student orientates himself on the horizon.

The air coverage could be as follows:

"I am going to show you the use of ailerons. Notice the position of the wingtips in relation to the horizon. You will see they are both level. Now look ahead and you will see how the nose looks when we are flying level."

"Look again at the left wingtip. See the wing go down as I move the stick to the left and stop going down when I return the stick to the central position. I must move the stick to the right of the central position if I wish to return the wings to level again. The same principle of course applies to lowering and raising the right wing."

Hand-over/take-over procedure, student practice and fault analysis are exactly the same as for the elevator.

NOTE: Although controlling the glider laterally by using the ailerons is not difficult, confusion may result if it is not demonstrated to the student that the glider will stay at any bank angle it is taken to if the stick is centralised when the bank is obtained. Do not over-complicate matters - simply teach the truth.

Post-flight debriefing

The same principles apply as for elevator when dealing with the student's recall of the most vivid parts of the flight.

The debrief on the use of the ailerons should explain how the shape of each wingtip is changed when the ailerons are deflected. This is a similar argument to that used for the elevator, except of course that one aileron goes up and the other one down. This "unbalances" the lift around each wingtip, which imparts a rolling motion to the glider. This explanation is very clear when the glider is used as a model to demonstrate it.

RUDDER CONTROL

Pre-flight briefing

The rudder controls the yaw of the glider. Make sure you define the meaning of the word "yaw". Note that the pilot's operation of the rudder pedals is "push left to go left, push right to go right", which sounds natural enough to a pilot but can sometimes confuse a person thinking in terms of a bicycle or billy-cart, where the opposite effect is obtained. Demonstrate the movement of the rudder when the pedals are moved.

Airborne demonstration and patter

A demonstration is given which shows that the glider is yawed (not turned) by use of rudder. All instructors must recognise the disadvantages that arise in future flying if the effects of rudder are incorrectly emphasised. The student must be prevented from forming the impression that the rudder steers the glider in any way other than when the glider is on the ground. Therefore there must be no undue repetition of demonstration or practice when teaching this control. The purpose of the exercise is to indicate the existence of the rudder as a third (or auxiliary) control, and observe what the rudder does. The exercise should not go beyond this. During the demonstration the instructor can eliminate the further effect of rudder with aileron.

The air coverage could be as follows:

"I am now going to show you the effect of using rudder. Look straight in front of you and you will see we are flying towards that hill. If I apply left rudder by moving my left foot forward the nose swings to the left (or the aircraft yaws) and yet the aircraft still progresses towards the hill. Note that, although I keep the rudder applied to the left, the nose only swings so far and then stops."

"Now, you try that. Make the nose swing the other way." (Hand-over/take-over procedure, student practice and fault analyses are as before).

Post-flight debriefing

In principle, the same as for the other two controls, but this time the force acting sideways when the rudder is deflected. Ensure that the student is clear that although the heading changes in this demonstration the track remains unchanged. Be careful with this explanation, as it is important that the student does not become more confused than he was before.

FURTHER CONSIDERATIONS

Once the student is conversant with the functions of the controls the following may be pointed out:

- Control effectiveness is dependent upon three factors, the rate and amount of control application used, and the airspeed. Thus, to achieve the same response at different speeds, large control movements are required at low speeds and smaller control movements at high speeds.
- Irrespective of glider attitude, control response is always related to glider and pilot and not the ground.

AILERON/RUDDER CO-ORDINATION

Pre-flight briefing

When the aircraft is rolled by applying aileron, the down going aileron on the rising wing produces extra induced drag and yaws the aircraft in a direction opposite to the roll. This is known as aileron drag and is always present when the ailerons are deflected. The degree varies with different types. The effect produced by aileron drag is known as "adverse yaw" for the obvious reason that it produces yaw which is adverse to the required result.

Airborne demonstration and patter

"Now I am going to show you the effect of adverse yaw. Watch that point we are heading for (if you can, pick a prominent point, power station, fire tower, etc). In a moment I'll move the stick to the right and you'll see that in addition to the aircraft rolling to the right the nose will yaw to the left."

"Watch the point…now. See the nose move in the opposite direction." (Hand-over/take-over, student practice, etc)

"That movement in the opposite direction occurs whenever we use aileron. The more aileron we apply, the more pronounced it is."

Use of aileron and rudder together

It is now necessary to introduce co-ordinated use of aileron and rudder to eliminate this problem. *"We have just seen the effect of adverse yaw and I will now show you how the rudder is used to overcome it."*

"Watch and I'll use aileron and rudder together. Notice that time that the 'wrong' movement of the nose was absent."

"The point to be learned from all this is that whenever you move the ailerons you must co-ordinate rudder movement with them."

The student should now practise this co-ordination under the direction of the instructor. Various rates of roll should be introduced so that the student appreciates that varying amounts of rudder are needed.

IMPORTANT NOTE

As skill develops, there will be more and more handing over control from one pilot to the other. The basic Methods of Instruction must always be adhered to and their use has been covered in some detail in the "primary effects of control" sequence. For simplicity's sake they will not be spelled out in detail for every individual sequence from now on in this handbook. Use of the "shirt-pocket" Instructor's Flight Reference Cards will act as a constant reminder to utilise these basic methods at all times, in the interests of instructional effectiveness.

FURTHER EFFECT OF BANK

When bank is applied either by control movement or turbulence, the aircraft will tend to turn in the direction of the bank. However it will also show a tendency to slip towards the lower wing, and the weathercocking effect of the fin and rear fuselage will cause yaw to take place towards that lower wing. This effect can be demonstrated at this stage, but should not be over-emphasised or confusion may result.

APPLIED CONTROLS

After practice in co-ordinated use of aileron and rudder the student should now develop some skill at controlling in the three planes. With the instructor displacing the aircraft the student should then be required to return it to straight and level in the normal glide attitude.

Further effect of rudder

It is desirable that the further effect of rudder be introduced before the student attempts to co-ordinate the three controls in a turn. A ground briefing is essential.

"In straight and level flight when the aircraft is yawed with rudder the outer wing will be speeded up, develop more lift and create roll in the direction of rudder application."

This briefing must be followed by air demonstration.

Rolling on a point

The student is now in a position to practise the gentle rolling of the glider from side to side, without stopping at the wings level position. No more than 5 degrees of bank should be used, and the object of the exercise is to eliminate adverse yaw by developing the student's footwork in co-ordination with stick movements. It is not necessary to dwell too long on this exercise before moving on to maintaining a heading and beginning turns. Nevertheless the exercise is valuable, as it develops the skill necessary to fly the glider straight and level in turbulent conditions and to give "too slow" signals in winch/auto launching.

Maintaining a heading

The student should now attempt to maintain flight on a constant heading. When the aircraft is moderately displaced by the instructor the student should be able to return it to the previous stage by levelling the wings and regaining the original nose attitude.

CHECK LIST OF FAULTS IN LEARNING EFFECTS OF CONTROLS

1. **Problem.** Wavering nose attitude in straight and level flight.

   Probable cause: Over-emphasis on ASI; student trying to keep a constant speed instead of a constant attitude. Cover up ASI and practice attitude flying - fault will disappear.

2. **Problem.** Student appears afraid of moving the stick forward more than a tiny amount.

   Probable cause: Possible susceptibility to "Low G" sensations and may have found early experience of use of elevator unpleasant. Great care needed in analysing and solving this problem.

3. **Problem.** Student reluctant to bank and has a tendency to lean away from the direction of bank.

   Probable cause: Uncertainty about the glider's basic stability qualities. Re-demonstrate stability and the fact that the glider has no natural tendency to roll uncontrollably.

EFFECTS OF CONTROLS - MEMORY JOGS FOR KEY POINTS

1. Start and finish at the stable platform.

2. Attitude equals speed. Fly primarily by attitude.

3. Establish positive hand-over/take-over procedure.

4. Emphasise good lookout right from the start.

FURTHER REMINDER

Keep in mind at all times the correct instructional methods as described in the paragraph "Introduction to Control" on page 8 of this part of the Handbook. They will not be covered in detail from now on.

USE OF TRIM

At this stage it is advisable to introduce the use of the elevator trim to the student. Up to now, the instructor has (or should have) handed over a glider which has been accurately trimmed.

This is not an exercise that lends itself readily to demonstration. Done properly, there is nothing to see! Following a pre-flight briefing, the effect of the trim can be clearly demonstrated by handing over an out-of-trim glider to the student (having warned him previously what to expect during the briefing) and asking the student to hold an attitude regardless of the force on the stick. The instructor will ask the student what kind of force he can feel and in which direction. The instructor then cues the student to move the trim control in the appropriate direction to reduce the out-of-trim stick force to zero.

The exercise can then be progressed (not necessarily in the same flight) to get the student flying at various attitudes and speeds, trimming the glider at each change.

Reinforce that elevator is the attitude, and therefore the speed control. The trim control is used to get rid of residual stick load at any given speed. With this in mind, it is best to avoid the expression “trim to speed” during training. The preferred expression is “set your speed and then re-trim as necessary”.

TURNING

Lookout

The habit of keeping a general lookout is sharpened by insisting, on every turn, that the student examines the particular piece of sky into which the glider will turn. This should be made an inflexible drill, so that the habit of keeping a sharp lookout at all times becomes heavily ingrained, not only on entering the turn but also during the turn.

For detailed information on lookout technique and the limitations of the glider and its pilot, see Chapter 4 “The Development of Effective Lookout” in the GFA publication “Basic Gliding Knowledge”.

General

In the teaching of turns, the instructor must stress that the turn is directly related to bank. The primary turning controls are the ailerons.

To enter a turn, the ailerons are used with enough rudder to counteract the effect of aileron drag. The greater the application of the ailerons the greater is the amount of rudder needed. Remember that deflection of the ailerons produces a continuous rolling process and once the desired angle of bank has been approached the deflection must be removed. However, to maintain the desired angle of bank continual minor adjustments of aileron and rudder may be needed, especially if the air is rough.

In the early stages it is necessary to give each control its function - ailerons to give the desired angle of bank, rudder to eliminate adverse yaw, and elevator to control nose position on the horizon. In a co-ordinated turn the nose moves smoothly and evenly around the horizon. This picture is real, and can be used with effect to apply polish to turns, but mishandling of any control can spoil the picture.

When teaching turns, break up the sequence into three parts, as follows:

Rolling into the turn

Now that the student is familiar with aileron/rudder co-ordination, it is a natural follow-on to apply it to rolling into a turn.

Before any manoeuvre is commenced check that the area of sky in the direction of turn is clear.

Then look ahead and apply co-ordinated aileron and rudder in the direction of the intended turn.

When the desired angle of bank is achieved return aileron and rudder to the central position.

Maintaining the turn

Use co-ordinated aileron and rudder to maintain the desired bank angle or correct it as required.

Maintain the correct nose attitude with elevator. This will always need some amount of backpressure on the stick, the amount varying with the angle of bank. The steeper the bank angle, the more up elevator is required to maintain the correct nose attitude.

LOOKOUT must be of the highest quality at all times, but especially during turning, remembering to transfer responsibility for lookout to the student along with the responsibility you have handed over for flying the glider.

During the turn, monitor A (Aileron), R (Rudder) and E (Elevator) in that order. "ARE" we maintaining a correct turn?"

Rolling out of the turn

Maintaining an adequate lookout, apply co-ordinated aileron and rudder to remove bank. As the wings are approaching level remove the control deflection.

Relax the backpressure on the elevator.

Check that the glider is straight and level and in the normal glide attitude. In order to stop the turn on any particular heading it is necessary to initiate the rolling out slightly before the heading is reached, the exact amount of anticipation depending on the rate of turn and the rate of roll-out.

Faults in turns

Faults in turns can be in the categories of airmanship or flying skill.

Failure to **LOOKOUT** before turning is a common fault, and must not be allowed to persist. A student must understand that failure to look out is a major fault, no matter what that person's actual flying skill is like.

Insufficient rudder with the aileron is a common fault in rolling into and out of turns. The instructor should demonstrate how the glider LOOKS and FEELS when the co-ordination is correct. This is best done without the use of the yaw string or ball in the early stages - the student should learn to recognise that insufficient rudder at turn entry is characterised by a "hesitation" in the glider's nose moving around the horizon. Correct co-ordination results in the nose smoothly starting to track around the horizon as the bank develops. Spend some time in this area - it is well worth it.

Note that any faults in co-ordination of aileron and rudder during the entry to a turn will not be apparent to the student if he is still looking towards the wingtip at that time. The instructional sequence should be - check clearance in direction of turn, then look ahead over the nose, then roll into the turn with co-ordinated aileron and rudder. Resume lookout scan when the turn is established.

Another common fault in maintaining a turn is failure to apply sufficient backpressure to the stick. **NOTE:** This fault will not be apparent if the glider is only turned through about 90 degrees. A turn of 180 or 360 degrees will be necessary to reveal that a student does not understand correct use of elevator in a turn.

The correct use of aileron, rudder and elevator should be taught without the use of the slip/skid ball or yaw-string. Useful though these aids are, they are best thought of as devices to indicate that a fault has developed. They are corrective aids, not basic teaching aids.

Variations in turns

Introduce turns of:

- Varying speeds at the same angle of bank.
- Varying angles of bank at the same speed.
- Varying rates of roll.
- Rolling from one turn to the other.

- Small accurate course corrections to maintain heading.

If circuit direction is normally to the left, see that turns to the right receive due emphasis. The use of thermalling for turn practice should not be overlooked. Remember that gliders spend 70% of their time in circling flight. Failure to develop turning skills right from the start is unlikely to produce a successful soaring pilot.

CHECK LIST OF FAULTS IN LEARNING TURNS

1. **Problem.** Failure to "clear the turn" before entering the turn.

   Cause. Obvious. Although good lookout is important at all times, it is especially so before turning. Remember the law of primacy and get the airmanship lesson driven home early. After allowing a couple of errors of poor lookout before turning, do not allow student to turn until the message gets home that turning without looking is not acceptable.

2. **Problem.** Glider nose "hesitates" at the start of a turn.

   Cause. Insufficient rudder in co-ordination with aileron. This fault is very common. Assistance may be required to convince the student of the amount needed.

3. **Problem.** Crossed controls in the turn (glider turning left, stick to the right, rudder to the left).

   Cause. Ailerons centralised at the required bank angle but rudder still applied. Secondary effect of rudder causes increase of bank with ailerons central. Note that some older gliders have a natural tendency to need bank held off" in a turn, a tendency not so noticeable in modern gliders.

4. **Problem.** Wavering nose attitude.

   Cause. Same as level flight, concentration on ASI instead of attitude. Cover up ASI and practice turns like that for a while. Fault will disappear.

5. **Problem.** When coming out of a turn, rate of turn increases before the wings come level, causing glider to overshoot its intended heading.

   Cause. Same as 2, insufficient rudder in co-ordination with aileron. This time, adverse yaw causes nose to swing in the direction the glider has just been turning.

6. **Problem.** In the turn, glider's nose drops slowly and speed starts to build up.

   Cause. Failure to apply slight backpressure to stick to keep nose tracking round the horizon at constant attitude. **Note:** This fault will only be really obvious in fairly prolonged turns, say more than 180 degrees.

7. **Problem.** When coming out of a turn, glider's nose rises as wings come level.

   Cause. Failure to relax backpressure on the stick when straightening out.

ADDITIONAL CONTROLS - SPOILERS AIRBRAKES AND FLAPS

INTRODUCTION

As soon as the student understands the main controls and has gained some competence in controlling the glider in flight the purpose of airbrakes or spoilers and flaps (if fitted) should be explained and their effects demonstrated in the air. The student should fully understand these additional controls and have a reasonable competency in their use by the time he starts handling the circuit and approach. Both spoilers and airbrakes, because they reduce the lift, cause an increase in stalling speed and this effect should be demonstrated during the teaching of the stall.

Spoilers

The purpose of spoilers is to “spoil” the lift over the portion of the wing where they are mounted. They are usually spring loaded in the retracted position and do not usually have a positive lock.

The use of spoilers enables the pilot to steepen the approach path and increase the rate of descent when approaching to land. Spoilers do not produce very much drag, are not normally speed limiting and their effect is not very pronounced at higher speeds.

The effect of the use of spoilers on the nose attitude of the glider and upon the rate of descent should be demonstrated and student given practice in their use at height. The usual effect of spoilers is to cause a nose-down pitch when deployed, which needs a corresponding slight backward movement of the stick to compensate. This means that, when the spoilers are retracted in flight, the pilot needs to make a slight forward movement on the stick to compensate.

Air loads on spoilers are usually not high and the pilot effort needed to operate them is moderate. The dominant feel is the spring that is fitted to keep them closed. The pilot usually has to keep a pull force on the spoilers in order to keep them out; otherwise they will shut of their own accord.

Airbrakes

Airbrakes are used for the same purpose as spoilers - to increase rate of descent. In addition they are usually designed so that the speed of the glider in anything up to about a 30 degree dive can be kept within the safe ‘ never exceed’ speed - the maximum speed in smooth air.

The way in which airbrakes produce an increase in rate of descent is somewhat different from spoilers. The lift- spoiling effect of airbrakes is similar to that of spoilers, but in addition they produce a great deal of drag. This is because they are generally larger than spoilers and extend further, and they often extend below the wing as well as above.

The drag increases quite considerably as the airbrakes are extended and this causes the speed of the glider to decrease. The glider’s nose must be lowered to compensate for the speed loss, and it is this which causes the steeper glide path at a constant approach speed. The effect of airbrakes on the pitch trim of the glider may be either nose up or nose down, or may change at different settings. Familiarity with type is essential before embarking on pre-flight briefings and demonstrations of airbrakes.

Some airbrakes have a tendency to "suck out" after they are unlocked (e.g. Ka7, ASKl3). Such airbrakes have an over-centre lock fitted to prevent them opening until they are needed. The "break-out" force on some of these locking mechanisms can be rather high and need to be tried at height before wrestling with them on an approach to land. Most airbrakes need a push force applied to them at some stage of their travel once they are unlocked; some in fact need a very hard push force applied to them to close them from the fully open position (e.g. Blanik and early models of the IS28B2). This again needs to be tried at height to avoid unpleasant surprises near the ground.

Both spoilers and airbrakes cause an increase in the stalling speed of the glider (about 2 to 5 knots in most cases). Therefore retraction of either of these devices is a useful safety factor if the student mishandles a landing flare (as he inevitably will) - some energy is restored to the wing and this gives enough time for the instructor to either cue the student into the right technique or take over and land the glider himself.

Flaps

The effect of flaps is initially to increase lift with only a moderate increase in drag. As the downward deflection of the flaps is increased beyond about 10 degrees, the increase in lift becomes progressively less while the drag increases rapidly. Fowler flaps (fitted to Blanik gliders) also increase the wing area. Thus, unlike the use of spoilers and airbrakes, downward deflection of flaps decreases the stalling speed and enables a lower approach speed to be used.

In some high performance gliders the trailing edge flaps can not only be deflected downwards to increase lift, but also upwards to improve the performance of the glider at higher speeds. They do this by "reflexing" the trailing edge of the wing which limits the movement of the centre of pressure and thus reduces trim drag.

The characteristics of flaps (if fitted) and their effect should be demonstrated and their use taught so that (if appropriate) the student becomes proficient in the use of flaps for approach and landing, and for thermalling. In particular the instructor should ensure that the student appreciates the effect of use of flap on glide angle and penetration.

It is essential that instructors understand fully the aerodynamics of flaps and in particular the type of flaps fitted to the glider in which they are instructing or to which they are converting a pilot.

Notes on use of flaps

1. On some gliders the ailerons move in conjunction with the flaps. There are some two-seaters in this category. In such cases it is normal practice to use "negative" flap during the take-off roll and after touchdown, as it improves aileron control at low speeds and helps to prevent wing dropping. Make sure you know the characteristics of the glider you fly and instruct accordingly.
2. Because lowering flaps causes a reduction in stalling speed by increasing the lift coefficient (CL) of the wing, it follows that the stalling speed is increased to the original (clean) value if the flaps are retracted. Retraction of flaps near the ground to "save" a mishandled approach is therefore not an option. All pilots operating sailplanes fitted only with flaps for glide-path control should understand this. Remember that a pilot brought up on airbraked gliders will have an instinct to retract whatever is in his left hand if he gets into trouble near the ground. The critical retraction angles for flaps are between about 30 degrees and zero degrees.

Although there are no known training two-seaters in this category in Australia, such information is important for converting pilots to single-seaters so equipped.

STALLING

INTRODUCTION

The purpose of stall training is twofold:

1. To learn to recognise the symptoms of an impending stall and to take the appropriate action to prevent it.
2. Should the stall actually occur, to take the necessary recovery action.

Pre-aerobatic check

Before carrying out any manoeuvres which involve rapid changes of speed and/or direction and height or which may involve temporary loss of control, a "Pre Aerobatic Check" should be carried out. As stalling is the first exercise in this category to be taught, a start should be made on introducing this check and its importance impressed on the student. Further reference is made to this check in the sequence on Spinning and Aerobatics. The Pre-aerobatic Check will be found on the Instructor's Flight Reference Cards.

Objectives of stall training

The objectives are to teach the student to recognise the approach of the stall so that he may take immediate action to avoid it, then to learn what the full stall feels like and to recover from it with the minimum loss of height.

The stall - theoretical considerations

In order that a glider may fly at all, the wing must produce lift equal to the load it carries. The lift produced by a wing depends on the speed of the airflow around past it and the angle at which this airflow meets it. If the glider is flying fast, this angle (called the angle of attack) is quite small. When the speed is reduced the angle of attack is increased. But the speed cannot be reduced indefinitely, because at a certain angle of attack the airflow over the top of the wing breaks away and the amount of lift produced by the wing diminishes greatly. This is called the stall.

The wing will always stall at the same angle of attack - that is the same angle between the chord line of the wing and the airflow. For most airfoil sections this angle is about 15 degrees. This angle must not be confused with the angle at which the glider is flying in relation to the horizon. The glider will stall at any attitude whenever the angle of attack reaches the stalling angle.

The speed at which the stall occurs depends on the load carried by the wings. As the load on the wings increases, so does the stalling speed. The weight at which the glider is flown, usually, does not vary much and so in level flight the stalling speed will always be more or less the same. If, however, the glider is being flown round a curve, either in a turn or in pulling out of a dive, the wings will have to carry an extra load, due to centrifugal forces, and this will increase the stalling speed.

Stall characteristics vary from glider to glider. Some gliders show a tendency for the nose to drop naturally when the stall occurs. Others do not do this, and the nose remains in a constant position, higher than normal, with the stick fully back and the glider descending at a high rate of descent. The recovery is the same in both cases - the stick is moved smoothly and progressively forward to reduce the angle of attack of the wing and regain flying speed.

Loss of lateral damping

Some amount of wing-drop may be noticeable at or near the stall. This is caused by one wing reaching the stalling angle slightly before the other and may occur for a variety of reasons, such as slight twisting of the airframe as the glider gets older or maybe the rigging a bit out of alignment. When one wing stalls, the lateral damping which is such a powerful force in providing roll stability in unstalled flight, is lost. The glider suddenly becomes quite unstable in the rolling plane. If the stick keeps coming back, the glider will continue to roll uncontrollably in the direction of the dropping wing and will progress toward a spin.

Therefore, wing drop should be treated as a primary stall symptom and should provoke the same reaction from the pilot as any other stall symptom. It will be found that normal stall recovery action, i.e. the smooth progressive forward movement of the stick as described above, will be effective in preventing the wing dropping any further. Do not attempt to use further effect of rudder to restore the wings to the level position. Use only sufficient rudder to prevent any yaw in the direction of the dropping wing. As soon as the stall recovery action has started to take effect, the wings may be levelled with co-ordinated aileron and rudder.

The stall - practical considerations

Demonstration and practice, including

- Gentle stalls from straight and level (not very nose-high).
- Stalls from a climbing attitude (associated with winch/auto launch).
- Stalls from above conditions, but with airbrakes, spoilers or flaps at various settings.
- Stalls with wing-drop.

When the exercise is first introduced make the stalls gentle until the student gains confidence.

Pre-stall buffet may be noticeable on some types, not on others, but if evident should be pointed out.

For all stalling manoeuvres the aircraft should be trimmed for the normal glide attitude. The “Pre-aerobatic Check” should be made routine for all stalling exercises even if only gentle stalls are intended.

Airborne demonstrations and student practice

“We always carry out a “Pre-aerobatic check” particularly making sure there are no other aircraft nearby, especially below... *To make the glider stall, bring the nose above the normal glide attitude and keep it there by gently and progressively bringing the stick further and further* back... *Notice that the speed and nose are getting less, the controls are becoming less effective and you may feel the onset of buffeting over the tail section and/or rear fuselage… There’s the stall. The nose drops even with the stick right* back... We *move the stick progressively forward to recover, speed increases and we fly it smoothly out of the* dive... *You will note that we were unable to bring the nose up until we regained flying speed.”*

The foregoing description of a typical stalling exercise covers the case of a glider which has a natural nose-drop tendency at the stall. Note the key point - in spite of the stick coming back the nose drops. In the case of a glider which does not have a natural nose-drop tendency (e.g. Twin Astir), the key point is the stick arriving on the back stop and the variometer showing about 600 to 800 ft/min rate of descent.

Similarly, if a wing drops before the nose-down break occurs, this becomes the key point and should be treated accordingly.

The recovery in all cases is identical - smooth progressive forward movement of the stick. It is not sufficient to allow any natural nose-down tendency the glider may have to “self recover” from the stall. Positive action must be taken by the pilot. Neither is it sufficient to move the stick forward to some pre-determined point - the progressive forward movement must continue until the pilot recognises that the wing is unstalled.

Important note

Ensure that the student’s attention is directed outside the cockpit during stalling and recovery. This will take advantage of the strong visual impact of the nose in relation to the horizon which in turn helps to suppress any discomfort or negative G sensitivity which may be present.

Nose-high stall

“This time we’ll bring the nose higher above the horizon. Speed drops off much more quickly and the stall is more sudden. The nose drops further down. We recover as before, but more height is lost in the process.”

Stalling on winch/auto launch

Since the stalling speed can be higher at some stages of a winch/auto launch, the stalled condition can be approached if the speed is allowed to fall below the critical value of l.3Vs during the launch. In this situation the nose should be lowered to reduce the angle of attack, even to the extent of abandoning the launch and gliding safely down to a landing. See also section on winch/auto launching.

Stalling in a turn

This consists of carrying out exercises as described for the earlier sequences, but initiated from:

1. Varying degrees of bank in balanced turns;
2. Slipping and skidding turns.

Note that, in the recovery, the use of forward stick has the same effect of arresting any wing drop as it had in level flight. However, since in this case there is already some bank on the glider when the stall occurs, more opposite rudder will probably be necessary to prevent yaw developing towards the lower wing. Use whatever rudder is necessary to prevent that yaw. Make no attempt to level the wings with rudder. As in the level flight case, once stall recovery action has taken effect, co-ordinated aileron and rudder may be used as required to level the wings or set them at any bank angle required.

Safe speed near the ground

When flying near the ground, it is essential to fly at a safe margin above the stalling speed. (“Near the ground” may be defined as a height below that from which safe recovery from a stall or a spin can be effected). The speed which allows this safe margin is known as “Safe speed near the ground” and is normally l.5Vs (although in the early stages of a winch/auto launch l.3Vs is acceptable with certain provisions - see Section on winch and auto launching).

COMMON SYMPTOMS OF A DEVELOPING STALL

1. Nose higher than normal.
2. Buffeting of the glider’s tail caused by the turbulent air from the wings flowing back over the tail surfaces.
3. Controls becoming progressively less effective as the stall is approached.
4. Lower noise level as the stall is approached. Take care with this one, as modern trainers may have very little change in noise level between the stall and about 60kts.
5. Increasing backpressure required on the stick as the glider is forced out of its trimmed condition toward the stall. In some types this backpressure can be considerable.
6. The possibility of wing-drop accompanying or preceding the stall. 7. On types that have “classical” stall behaviour, the nose drops at the stall despite the stick coming back.
7. On types that lack sufficient elevator authority to produce a classic stall, a high descent rate develops with the nose in a higher-than-normal attitude and the stick fully back.

IMPORTANT NOTE

Not all the symptoms listed above are present on all types. Learn the characteristics of the type(s) you instruct on and instruct accordingly.

CHECK LIST OF COMMON PROBLEMS IN LEARNING STALLING

1. **Problem.** Glider does not stall, but pitches down before the stall is actually reached.

   Probable causes.

   (i) Pilot not ensuring that the stick is kept coming back until the stall occurs. This is very common and arises from lack of understanding of how the stall actually occurs. Re-brief.

   (ii) Pilot reluctant to fight against the developing out-of trim force on the stick. As already pointed out, this can be quite high on some types, e.g. Blanik.

2. **Problem.** Fear of stalling.

   Probable cause. At some stage, pilot has been introduced to stalling in a rough or inconsiderate manner, probably involving the discomfort of rapid application of some degree of negative G.

3. **Problem.** Reluctance to apply positive forward stick during stall recovery and a tendency to allow “nose-dropping” glider types to self recover.

   Probable cause. Similar to Problem 2. Ensure that pilots in these two categories are carefully taken through all aspects of stalling and recovery in a thoughtful but matter-of-fact way. Ensure also that the pilot s attention is directed outside the cockpit during the stall and recovery, to allow the strong visual effect of the horizon to suppress any discomfort that may be present.

SPINNING

INTRODUCTION

Thorough coverage of the section on stalling should have laid a firm theoretical and practical foundation for spin training. Again, in pre-solo training, the object is precautionary. The intention is to reproduce under controlled conditions an abnormal flight situation, to teach how to recognise, anticipate and deal with it.

The spin may be considered in three stages:

- The incipient or undeveloped spin.
- The fully developed spin.
- The recovery.

THE INCIPIENT SPIN

The most common ways of entering an incipient spin are: -

(i) From an uncorrected wing-drop in a straight stall

(ii) From a stall in a turn

In either of these two cases, the most successful recovery will be effected by progressively moving the stick forward, using only enough rudder to prevent yaw developing toward the dropping wing. Recover to level flight as for the "stalling in a turn" exercise, using co-ordinated aileron and rudder movement to level the wings once they are unstalled. The incipient spin and its recovery must be practised until the pilot's instinctive reaction is to move the stick forward when the glider starts to rotate toward the dropping wing. Take the student progressively further and further into the incipient spin, letting it go a bit further each time before recovering, and building up confidence that the glider can be brought back under full control from any stage of the manoeuvre.

Incipient spin - pre-flight briefing

(i) From straight flight. "*In this exercise, after carrying out the pre-aerobatic check, we will stall the glider from straight flight and if one of the wings does not drop of its own accord (it probably will) I will help to induce it by using some rudder. As the stall occurs, you will notice the wing drop further and the nose will go down and around in a yawing motion. This is the incipient stage of a spin. If I leave the controls as they are, the glider will begin uncontrolled autorotation or spinning. Before this happens I will take recovery action, which is to move the stick smoothly and progressively forward to unstall the wing, at the same time using just enough rudder to counteract any yaw which has developed.*"

Note: This exercise is valuable in the situation where a wing drops in a stall. Most accidental spins do not occur in this way. They tend to occur more commonly from turns.

(ii) From a turn. "*On this flight, after completing a pre-aerobatic check, we will allow the glider to enter the early stages of a spin from a badly executed turn. We will imagine that we are in the circuit and lower than we expected to be because of strong* sink. *Because we are low, we tend to fly slowly and not use very much bank in the turn. We will be practising it with plenty of height, but imagine what it would be like* if we *were low.*"

Incipient spin - air exercise

For the incipient spin from either a straight stall or turning flight, the air exercise follows exactly along the lines of the relevant pre-flight briefing. The exercise is repeated until the recovery action is thoroughly learned and is becoming a conditioned response.

A key point in the incipient spin departure is that the nose of the glider is not very high when the stall occurs, even though the stick is continuously moving back. This will link the exercise logically to the characteristics of the following exercise, the fully developed spin.

THE FULLY DEVELOPED SPIN

The driving force for the spin manoeuvre is “autorotation”, a phenomenon which occurs when one wing stalls before the other and the glider develops a rotation around that wing. We have just been discussing the first stage of development of this phenomenon and we have been recovering before it goes any further.

Once autorotation has begun, if recovery action is not taken as in the previous section, the glider will progress into a fully developed spin and will require a considerable amount of height to recover.

In a glider, the fully developed spin is characterised by a steep nose-down attitude, moderate to rapid rate of rotation and a height loss which varies according to the weight of the glider. Lightweight gliders, such as short-wing Kookaburras, lose about 250ft for each turn of a spin, heavy gliders like the IS2BB2 nearly double that.

Having taken the student through several incipient spins and recoveries and having built up his confidence in easily bringing the glider back under full control, it is time to investigate the fully developed spin.

As for the incipient spin, the full spin may be entered in a number of ways. The wing-drop at the stall and the stall in a turn are two of these. The latter case is by far the most common cause of accidental spins.

When the spin is allowed to progress to the fully developed stage, a number of factors become apparent which were not present during the incipient stages. These can be summarised as follows.

1. Confusion is likely, because we are dealing with a stalled condition in spite of the nose pointing steeply down. It is quite difficult to convince a student to move the stick forward at all, let alone progressively, under these circumstances.
2. Disorientation becomes a problem, because of the combination of the steep nose-down attitude and the rapid rate of rotation. Added to confusion which may already be present, it may be difficult to work out in which direction the glider is spinning.
3. Due to the rotating masses of the wings and fuselage in the spin, inertial forces come into effect to add to the aerodynamic forces already present. This means that a single, universal recovery action is necessary and must be learned.
4. Due to the sideways airflow around the rudder, much greater force needs to be applied to this particular control in order to get the desired effect.

The combination of these factors means that, once again, quite a lot of practice is needed to produce the conditioned response which is necessary in this critical phase of flight.

Practical considerations

Inadvertent spins have accounted for a number of glider accidents over the years. This is not surprising, because gliders spend a high percentage of their flying time in turning flight within 10% of the stalling speed. No pilot accidentally spins a glider from a nose-high attitude; the nose position is just too good a cue to ignore. The spins that catch pilots unawares are those that develop from nose attitudes which are almost indistinguishable from normal.

The best simulation of how an accidental spin occurs is carried out as follows:

> After completing the pre-aerobatic check, establish the glider in a gentle turn (no more than 5 degrees of bank) with the nose in the normal flight attitude. Then slowly but progressively increase the rudder movement. As secondary effect of rudder starts to slowly increase the bank angle, the nose will go down a little. Move the stick back to stop this occurring. Keep the progression of rudder movement going and keep the stick moving back to keep the nose on the horizon. Eventually, with the nose in a normal attitude and at about 40 degrees of bank, the lower wing will tuck under and the glider will enter a spin. There will be no warning of any kind, just a smooth roll-off into a steep nose-down attitude and a rapidly developing spin.

This is a very convincing and completely reliable demonstration. If any other attempt fails to spin the glider, this one will always succeed. This is just as well, because it happens to accurately simulate the way pilots get into trouble inadvertently.

Sometimes instructors have trouble achieving a convincing spin demonstration using this method. The problem is almost always that they fail to keep the rudder and stick going to the extremities of their respective ranges of movement. To achieve a satisfactory spin departure, full rudder and full back stick will be required. Note that neither of these controls are “slammed” against their stops - the movement is always smooth but progressive and the nose never moves from its “normal” attitude. This is exactly what pilots do when under stress and it is the reason why the demonstration is so convincing.

When thinking about problems encountered by instructors striving for a convincing demonstration, remember that what takes us so much trouble to perfect for demonstration purposes is achieved without difficulty by an inexperienced club pilot.

FULL SPIN RECOVERY

The standard recovery action from a fully developed spin is:

- Full opposite rudder
- Ensuring ailerons central, move stick forward until spinning stops
- Centralise rudder
- Recover from dive

This recovery method is universally known and accepted. It forms the basis on which gliders are certified in this critical area of flight. There is no justification for varying it.

SPIN AWARENESS

By studying numerous accounts written by pilots who have accidentally spun their gliders, some of them at low level and followed by a crash, a common thread emerges. All of the pilots describe their accidental spins as completely unexpected. None of them were aware that they were progressing toward a spin manoeuvre. Otherwise, of course, they wouldn’t have done it!

This implies that accidental spins occur without any warning. This is in fact the case; the description “unexpected” confirming it. A further implication is that spin training has not always been effective in the past in protecting pilots against the accidental spin. This is true too, which is what all the fuss is about.

Practice spins are carried out with full anticipation of what is about to happen. Although the experience of practising spinning is valuable because it helps to de-mystify the manoeuvre, it loses much of its effect if the method of spin entry is incorrect. We know that no pilot ever pulls the nose up and applies full rudder at low level - such action would be obviously suicidal and that is not the way accidental spins happen. What does happen is that the pilot unconsciously misuses the controls as described under “practical considerations” above and the glider eventually spins. By adding awareness of this crucial fact to conscientious spin training, we will provide the most practical training in avoiding the accidental spin.

Possibly the most useful contribution to practical spin awareness is the realisation that the following sequence of events is potentially disastrous: -

1. The glider is turning.
2. The nose attitude is remaining constant.
3. The bank angle is slowly increasing.
4. The stick is coming continuously back.

This sequence is really only a formal list of the spin progression previously described. Unless the sequence is broken, the glider will eventually spin, from an essentially normal nose attitude. If the pilot is aware that the stick is coming back and is having no apparent effect on the nose attitude of the glider, this should encourage an immediate reaction of forward stick movement. If this is done, it is almost certain that the glider will not spin.

Therefore, without having pilots flying around concentrating unduly on the stick, an awareness of continuing backward stick movement in turning flight is a major contributor to awareness of the likelihood of a spin developing.

For those who may think that it is easy to detect a backward-moving stick, especially on those types which have a heavy elevator control (leading to the expression “hard to hold the nose up”), remember that a pilot who accidentally spins a glider usually does so under stress. In these circumstances, situations that would normally be readily detectable are often missed, thus allowing the progression to continue toward an accident.

Since stress is one of the most difficult things to produce on demand and it has a widely varying effect on individuals, we are duty-bound to proof our pilots as best we can by developing a high degree of spin awareness and backing this up with conscientious training and checking.

COMMON SYMPTOMS OF A DEVELOPING SPIN

This summary of common symptoms is based on reproducing the sequence leading to a spin which occurs accidentally. It is not relevant to the outdated "nose-high, bootful of rudder" method of spin entry.

1. Glider in a gentle turn and the bank is tending to increase without application of aileron by the pilot.
2. Nose remaining in a constant position on the horizon, with the stick coming continuously back.
3. An increasing application of rudder without a great deal of yaw showing on the slip indicator/yaw string.

If any or all of the above symptoms are present, but especially the last two, the glider could be progressing toward a situation where a spin is likely. The progression is best broken by arresting the rearward movement of the stick before the glider gets to the stage where it spins.

CHECK LIST OF COMMON PROBLEMS IN LEARNING SPIN RECOVERY

In this checklist, the main concentration is on recovery from the developed spin manoeuvre, rather than how to get into the spin.

1. **Problem.** Insufficient opposite rudder during spin recovery.

   Probable cause. Failure to realise that the forces needed to apply rudder in a spin are considerably higher than in normal flight. Re-brief.

2. **Problem.** Full opposite rudder applied, but an apparent reluctance to start moving the stick forward.

   Probable cause. A mistaken impression that rudder alone will stop the rotation and the pilot is waiting for this to happen before moving the stick forward. Re-brief.

   Note: For some reason, this used to be a very common misconception in spin recovery. A number of protracted spins from well over 1,000 ft AGL may be attributable to this old-fashioned belief. A pilot under training must understand that the use of both rudder and elevator are necessary for recovery from developed spins, in accordance with the universal procedure. At this stage of training, he does not necessarily need to know why this is so, but he certainly needs to know that it must be done.

3. **Problem.** Pilot disorientated.

   Probable cause. Very difficult to determine, but there used to be an old Air Force recommendation that, when spinning, it is better to look at the ground through the windscreen than try to look at the horizon through the top of the canopy.

THE LAUNCH (WINCH & AUTO TOW)

GENERAL

Although the winch and auto-tow launch methods appear very similar in the way they are carried out, the initial rate of acceleration differs between the two and this makes for some differences in handling technique. They are both quite easy to learn from the manipulative point of view, much easier than aerotow. They do however demand a good understanding of the forces at work around the glider. Unfortunately this understanding is not present in some pilots and this is a problem directly related to the quality of their early training.

The following procedures should be regarded as of the greatest importance. The teaching method should be followed closely, as set out.

BASIC WINCH/AUTO LAUNCH CONSIDERATONS

There is no intention of delving into great depths of theory in this handbook. However, there are some aspects of winch/auto launching which would benefit from some clarification.

Because of the pitching moment which may be imparted to the glider during the initial acceleration, the pilot must exercise very close control over the climb angle at the start of the launch and must adhere strictly to the minimum speed requirement before steepening the climb. If the acceleration is very rapid, more likely during winch launching than auto-towing, the pitching moment is very strong and may be uncontrollable if the glider pilot is light and the glider’s CG is well aft.

However, the trim setting selected by the pilot (normally fully forward) may offset the pitching tendency and in some cases may override it. It is important that an instructor knows the characteristics of the trainer he flies and offers the appropriate advice to the student.

When the minimum launch speed (l.3Vs) has been confirmed and the speed is seen and felt to be steadily building up, the flight path is progressively steepened until the glider is in the full climb. There are no sudden changes of flight path; the correct technique is to allow the glider to climb progressively more steeply as the speed builds up and height is gained.

Every winch/auto launch has a maximum speed, set by the manufacturer and also to be strictly observed. This speed will be found on the placard.

The glider will be climbed throughout the launch at a speed somewhere between the lower (l.3Vs) and upper (placard) limits. The pilot keeps a watchful eye on the speed during the launch to ensure that it is kept within this “working speed band”.

As a general principle, once the full climb has been attained, the pilot may (or even should) increase the backpressure on the stick if the speed is reasonably high (but still below the upper limit) and reduce the backpressure on the stick if the speed should slacken. This should be developed as a basic instinct.

For efficient winch/auto launching, maximum use should be made of the early stages of the full climb, as this has the greatest effect on final launch height. Using a lot of back stick at the top of the launch will make hardly any difference to the height obtained but will greatly increase the chance of breaking the cable.

Stalling speed is increased during winch/auto launching. The exact amount of the increase depends on a number of factors, but it is important to realise that, if the speed falls toward the lower limit of l.3Vs, the pilot should be prepared either to signal for more speed or to abandon the launch. In any event, a lowering of speed should encourage the instinctive reaction of relaxing backpressure. The protection of the l.3Vs "buffer" is eroded if the pilot keeps the stick coming back with a falling airspeed.

LAUNCH STAGES

Ground run and separation

At this stage the glider begins to accelerate and should be placed in the flying attitude by the appropriate use of the controls (this will vary from glider to glider). When flying speed is reached the glider will separate from the ground and begin to climb away. Initial climb

This is the stage during which the attitude of the glider is carefully controlled by the pilot in accordance with the build-up in speed; the intention being to gently and smoothly steepen the climb to the full climb attitude if the speed is building up as required. Minimum speed for steepening the climb is l.3Vs. Failure of the speed to build up to l.3Vs must result in the climb being terminated and if necessary the launch being abandoned.

Full climb

Provided that the speed has built up to the required value, and the full climb attained, this is the stage during which the glider is maintained in the full climb attitude until the top of the launch is approached and the cable is about to be released.

Release

This is the stage at which cable release procedure is carried out.

THE INSTRUCTIONAL SEQUENCE

Full climb and release - pre-flight briefing

Although the launch sequence takes place in the order listed above, the actual instructional sequence takes place in the reverse order. It is suggested that the student should be introduced to the Full Climb and Release stages of the launch early in training, to utilise air time which would be otherwise wasted. Care should be taken, however, to ensure that the student is at ease with the use of all the controls before introduction to this sequence.

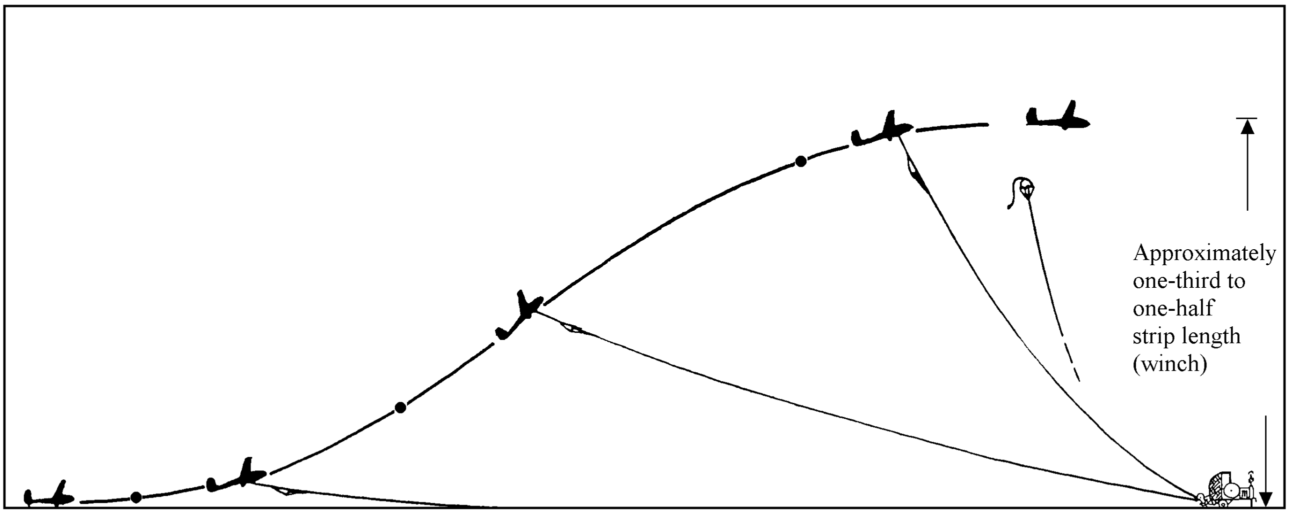
The ground-run, separation and initial climb stages all require a degree of skill and judgement far greater than that required in the full climb. Therefore it should be introduced after the student has mastered the full climb stage.

The student is given a general picture of the launch as a whole, the sections of the launch are described and more detailed consideration is given to the Full Climb stage, with which his early familiarisation will be concerned.

This introductory briefing should be along the following lines:

"Now that you are familiar with the effect of controls in normal flight, we will use *part of the launch as a form of practice, and to prepare you to handle the complete launch at a later stage."*

"For convenience we divide the launch into stages, which we teach separately. The curve represents the path the glider follows on the launch and we divide this curve into four parts." (Make a sketch or use a diagram as follows).



THE STAGES OF A WINCH/AUTO LAUNCH

"For the present we are concerned with the full climb and release stages."

"You will learn to judge the climb attitude by watching the nose position relative to the horizon. As you know from your previous flights, this is only possible by looking each side of the instrument panel, as the view directly ahead is totally obscured because of the attitude. It is always a good idea to glance towards the wing tip to check the angle of the wing against the horizon to help judge the full-climb attitude, particularly when you are not very familiar with the glider."

"On this, f light I will hand over control to you after I have completed the initial climb and the glider is in the full climb attitude, and you will practise this part of the launch."

"The climbing attitude is maintained by use of the elevator. As the glider gains height in the full climb, a slowly increasing backpressure is required to counteract the downward pull of the cable. However towards the top of the full climb stage this pressure should be relaxed a little, to minimise the chance of a cable-break, as this is a point of considerable stress on the glider and the cable. The climbing attitude should be maintained only when the launching speed is within safe upper and lower limits and you should always *learn what these limits are for any glider you are flying."*

"As we approach the end of the launch and it is getting close to the time we must release the cable, the climbing attitude will become less. You will be able to see the horizon appearing ahead of you once again. *At this point, the backpressure you have on the stick is gradually relaxed, allowing the glider to 'coast' over the top part of the launch. Shortly afterwards, the winch-driver will close the throttle to terminate the launch. This is felt in the glider by a noticeable slackening of the speed. At this point, lower the nose to ensure cable tension is removed and pull the release twice."*

"If this has *been correctly executed, the cable will drop gently away without affecting the attitude of the glider. You then fly straight ahead and establish attitude, speed and trim for normal flight."*

"If for any reason the winch driver does not close the throttle clearly at the top of the launch, carry out exactly the same release procedure described above. The only difference will be that the cable may leave the glider under a small amount of tension, which will do no harm."

Full climb and release - air exercise

The air exercise follows exactly along the lines of the pre-flight briefing. Prior to handing over control, the instructor should warn the student about any out-of trim forces which may exist on the particular glider being flown and should remain on the alert for any tendency to handle the controls in a rough or ham-fisted manner.

Drift correction

Drift is controlled by banking the glider slightly toward the windward side. Aileron and rudder in the same direction will usually need to be applied, and kept applied, during drift correction, to counteract the tendency of the cable to pull the glider straight.

Launch failure awareness

Speed and angle of climb throughout the launch are always judged so as to allow a margin of speed for recovery from any sudden interruption of the launch. At any angle of climb there must be sufficient speed to nose over into normal attitude if the launch should suddenly fail. Every launch has the potential for failure.

Ground-run, separation and initial climb - pre-flight briefing

When the student has had some experience in the "Full Climb" stage of the launch, it is appropriate to begin instruction in the ground-run, separation and initial climb stages.

The ideal path the glider should follow up from the ground is a smooth curve of gradually increasing steepness until Full Climb is reached. "Steps" in the climb are not necessary and are in fact undesirable, because they may well cause a cable break at a critical height, due to the application of a sudden load. Therefore, any tendency to hold the glider down during the initial climb, waiting for the full amount of the climb speed to build up, should be discouraged. The glider should be controlled in such a way that the airspeed builds up as height is gradually gained.

Here the Instructor should demonstrate with hand movements that the steeper the climbing attitude becomes, the more time it will take to recover to a safe attitude, the greater the height needed for a safe recovery and the absolute necessity of an adequate margin of speed throughout the steepening climb. These key points should be brought out with considerable emphasis and repetition so that it will remain in the student's mind for all time. As a guide, a two-seater of about 650kg mass (e.g. Grob 103 Twin 2) takes 6 seconds to achieve l.5Vs in straight-ahead flight following a cable-break in the full climb at 60 knots.

Exactly how steeply to climb at any point on the launch is decided by whether there is a reasonable margin above the absolute minimum speed. The minimum safe launch speed is that which gives the pilot an adequate margin of speed above the stall (on the launch) to enable him to carry out launch failure procedures. This speed is taken as l.3Vs.

An angle of climb that is safe at adequate speed becomes unsafe if that speed is reduced, and must be adjusted immediately.

Before adopting any particular angle of climb you must first have adequate speed for that angle. You will never assume that, because speed is increasing, it will continue to do so.

Ground Observation

Take up a position about 200 metres ahead of the launching point and about 200 metres to one side. If launches are being flown to a reasonable standard, separation and grading of climb will be readily observed and should be understood by the student without any difficulty.

The launches taking place should be discussed in an informal way with the student and questions should be encouraged. Launching faults should be pointed out, particularly the fault of climbing too steeply too early *(“What would happen if he had a cable-break now?”* etc.)

After two or three launches, if the student is getting the picture, the briefing may continue along the following lines.

“When the glider starts moving and as soon as the speed is sufficient to give elevator control, the glider should be placed in the attitude for take-off.”

The correct take-off attitude should be shown to the student during the ground observation exercise. Note: For the first time, the student is faced with the likelihood of having to use ailerons and rudder in isolation, rather than in co-ordination. It should be clearly pointed out that this is quite in order when the glider is on the ground, although of course co-ordinated use of the controls is once more required when the glider gets airborne.

“As the launch speed continues to increase, the glider, having been placed in the take-off attitude, will lift off the ground. At this stage, if the launch is accelerating, the take-off attitude is kept unchanged so that the glider rises away *from the ground in this attitude while the speed builds up to a safe value to allow a gentle steepening of the climb.”*

“If the launch is not accelerating, or speed is falling off, the glider must not be allowed to rise more than a few feet off ‘the ground, and if the speed does not increase in a reasonable distance, say a hundred metres or so, the cable must be released and the glider landed.”

“Remember that you *must never persist with an uncertain launch past the point where a height much less than usual will result, and you must never let an uncertain launch float you more than a few feet off the ground.”*

“If the speed is definite and increasing, the glider being several feet off the ground and still in the take-off attitude, it is allowed to separate further from the ground, gently steepening the climbing attitude as height builds up.”

“With regard to height, altimeter readings become inaccurate due to lag.”

“With regard to speed, upper and lower limits must be observed, and without becoming over-dependent on the instrument, it is desirable that the A.S.I. is used at intervals throughout the launch to ensure that the speed is within limits.”

“If the speed is above the minimum and is continuing to increase, the attitude of the glider is gently and evenly changed toward the full climb attitude.”

“As safety and ability to recover from launch failure increase according to increase of speed and height, we steepen our angle of climb accordingly, reaching the full climbing attitude at a height which is ample for recovery from this attitude if the launch should fail.”

It is dangerous to allow the glider to climb too steeply at too low a height. Regardless of speed, which the pilot may well consider adequate, climbing steeply close to the ground will not permit recovery if the winch engine should fail or the cable break. This is especially true if there is a strong wind gradient.

Ground-run, separation and initial climb - air exercise

The air exercise is carried out exactly in accordance with the briefing. Because of the proximity of the ground, the instructor is cautioned to be particularly alert to the possibility of rough or ham-fisted handling during this critical phase of flight.

Auto Tow

Winch launching methods apply to auto towing, with the following exceptions:

(1) Slower acceleration which results in a longer ground run, giving poor control in cross winds.

(2) In conditions of light winds it may be found that delay will be experienced in reaching safe initial climb speed and any attempt to initiate the climb before acceleration is satisfactory must be avoided.

Take-off Responsibility

In all methods of launching the pilot of the glider is in complete command and initiates the orders for the launch.

After the cable is attached, the pilot will confirm “all clear above and behind”; to ensure that all is clear in the blind spots. Having received confirmation of this, the signal “Take-up slack” is given, followed by “All out” (“full power” in some regions) when all the slack in the cable has been taken up.

Verbal signals from the pilot are entirely adequate for winch/auto launching. If hand signals are used by the pilot, it is unnecessary, even undesirable, to continue signalling from the cockpit during the “take-up slack” phase. Once the wingtip holder has received the pilot’s initial request for the signal, it is sufficient to leave the rest of the signalling up to him. The pilot’s left hand belongs near the release, in order to get rid of the cable if the need should arise (it can be useful for the wheel-brake too). The “all out” signal can be safely judged by the wingtip holder and given at the appropriate time.

If any unforeseen circumstances arise, such as over-run, drogue chute billowing over canopy, etc., the take-off will be abandoned by operating the release and calling out “STOP”.

Notes:

1. The terminology used in signalling is carefully chosen. “Take up slack”, three words, “All out” (or “full power”), two words and “Stop”, one word. Thus even in cases of poor communication, when clarity of words is lost, there is a back up in the number of words used. Variation of the terms used removes this useful back up.
2. It is acceptable to leave the launch signals to the wingtip holder, provided that the “take up slack” signal is definitely initiated by the pilot and the wingtip holder does not take matters into his own hands.

After the abandonment of any launch, the whole launch procedure is started again from the beginning.

Launch speed signals

The “too slow” signal is to lower the nose of the glider and roll the wings from side to side with definite movements of aileron and rudder, so that the result is a rolling movement of the wing, free from yaw. If speed does not increase, release. Note that the lowering of the nose is an integral part of the too slow signal, and the glider must not be rolled without doing it.

The absolute lower limit for launch speed is l.3Vs.

The upper limit of speed on the launch is the placarded maximum launch speed of the particular glider. This is the speed never to be exceeded on the launch and is fixed according to the design strength of the glider. If the launching speed is building up and approaching this figure, the “too fast” signal is given.

The “too fast” signal is to yaw the glider from side to side with definite movements of rudder. The signal should be given before the speed actually reaches the placard limit. If this is exceeded by a small amount, ensure that some of the backpressure is relaxed while continuing to signal. If speed continues to trend upward, release immediately.

Note:

Launch speed signals are precise manoeuvres and may be mishandled by a student, resulting in dangerous confusion for the winch-driver. The two critical cases are:

- Too slow. Lack of exact aileron/rudder co-ordination during a too-slow signal will result in residual adverse yaw, which may appear to the winch-driver as a too-fast signal.
- Too fast. Lack of appreciation of secondary effect of rudder will result in the glider rolling during the application of rudder in a too fast signal, unless some opposite aileron is applied during the signal.

It is likely that a student will not initially be able to produce the degree of accuracy needed for these signals, especially as there usually is not much time available to react to launch speed changes. There is some value in the instructor taking over for the signals until the student has acquired sufficient skill.

Launch abandonment

Launches may need to be abandoned in the full climb *stage* for a number of reasons, but usually because of extremes of speed.

When abandoning a launch because of excessive speed, pull the release before lowering the nose. This will ensure that the glider “balloons” upwards during the pitch-over back into normal flight, and will help to avoid entanglement with a drogue and cable assembly which may be oscillating because of the excessive speed.

When abandoning a launch because of insufficient speed, the nose is lowered before pulling the release, to minimise the chances of the speed falling to a dangerously low value before the cable is clear.

The winch driver will always stop the launch immediately he can see that the glider has abandoned for any reason. This minimises the risk of the glider becoming entangled with a “flying” or oscillating drogue chute.

LAUNCH FAILURE PROCEDURE, WINCH AND AUTO TOW

Introduction

Students should be introduced to launch failure procedure when they have had reasonable experience with the launch.

Briefing

Launch failure is the situation where a glider is unable to leave the ground once the launch has started, or when airborne it would be unable to maintain speed above the absolute minimum of l.3Vs when in a climb attitude.

Launch failure may be expected at any time during launching operations. Provided that correct procedure is followed, launch failures present no more difficulty than any other training sequence.

Launch failures occur from one or more of the following conditions:

(a) Mechanical failure or power loss at the winch or autotow.

(b) Faulty judgement of speed by the winch or auto-tow driver.

(c) Cable breaks.

(d) Wind changes causing down-wind launch.

(e) Faulty procedure by the pilot. (Glider over-running the launch cable.)

Launch failure when airborne

Action l. Regain and maintain the safe speed near the ground (l.5Vs).

Action 2. Operate the cable release mechanism twice.

Action 3. Land ahead unless above minimum height for a circuit.

The training of this sequence must be aimed towards making Actions 1 and 2 instinctive and automatic. In contrast, Action 3 is taken after calm assessment of the situation and after the correct A.S.I. reading has been observed.

Important. If a glider is held in a climb attitude after a launch failure it will stall within a few seconds. To prevent a stall the attitude of the glider must be smartly changed from the climb attitude to that for the safe speed near the ground. During the change in attitude there will be a noticeable delay of about five seconds before speed builds up to a “safe speed near the ground” and stabilises. If a turning manoeuvre is attempted before the speed stabilises there is every possibility that the glider will enter a spin. (See section on Spinning.) If the airbrakes are opened before sufficient speed has been obtained, it is likely that the glider will either stall or sink extremely rapidly. If the glider is close to the ground, either of these will probably result in damage and injury.

Practice launch failure is carried out by the instructor pulling the cable release (simulated cable-break) or arranging for the winch driver to cut the power at varying rates (simulated engine failure). Some winch designs do not take kindly to having the release pulled under tension and in these cases the winch driver will have to cut the power suddenly and apply the brake on the drum. This will give a reasonable, but not ideal, simulation of a cable break.

Extra practice in familiarising the student with the delay in regaining speed can be obtained by simulating a launch climb attitude when a glider is in free flight, but such practice should be a supplement to “live” launch failure training and must not be allowed to replace it entirely.

When the student is competent in taking effective recovery action and is convinced that there is a considerable delay before the speed stabilises following the recovery action, Action 2 is implemented.

When a launch failure occurs the drogue chute and a length of cable often remain attached to the glider. The drogue chute, together with the cable, must be released from the glider to eliminate the possibility of a large increase in drag or the danger of a hang up if the cable fouls an obstruction.

To release the cable, the cable release mechanism is operated twice, after initiating action to regain and maintain the safe speed near the ground. When the student is competent in the correct procedure for releasing the cable following a launch failure he should be introduced to Action 3.

Land ahead or circuit?

A launch failure can occur at any moment of any launch. Having completed Actions 1 and 2 the normal alternatives are for a landing straight ahead or for a circuit.

The pilot should plan to land ahead until satisfied that the height is sufficient for a circuit, taking into account the conditions and the performance of the glider. Then, when carrying out a circuit from a launch failure it should be stressed that the pilot should never feel under an obligation to land at the normal touch-down point and that a modified circuit with a down-field landing is quite acceptable, certainly much better than getting very low (thus closing off the last escape route) in an attempt to get back to the take-off point.

For several launches the Instructor should discuss with the student the landing situation at various stages of the launch. Instructors can assess a student's grasp of the landing situation by asking on the launch where he would land in the event of a launch failure. However, this alone is not sufficient to instil the correct instincts into a student. Simulated launch failures must be practised, live, at a variety of heights, in order to develop:

(a) The conditioned response of acquiring and maintaining a safe speed near the ground (l.5Vs).

(b) The flexible response of correct use of the height available after the failure, in accordance with all the relevant factors.

Simulated launch failures should be spread across pre-solo and post-solo training, to ensure that the principles of recency and repetition perform their functions of reinforcing the correct message. When the pressure of a real failure is present, the pilot will inevitably lean heavily on his training, which must be of the best quality in these critical areas.

Non-manoeuvring area

The non-manoeuvring area is the area of sky on a winch/auto launch in which, if a launch failure occurred, a glider is too low to carry out a circuit but too high to land ahead in the remaining strip length.

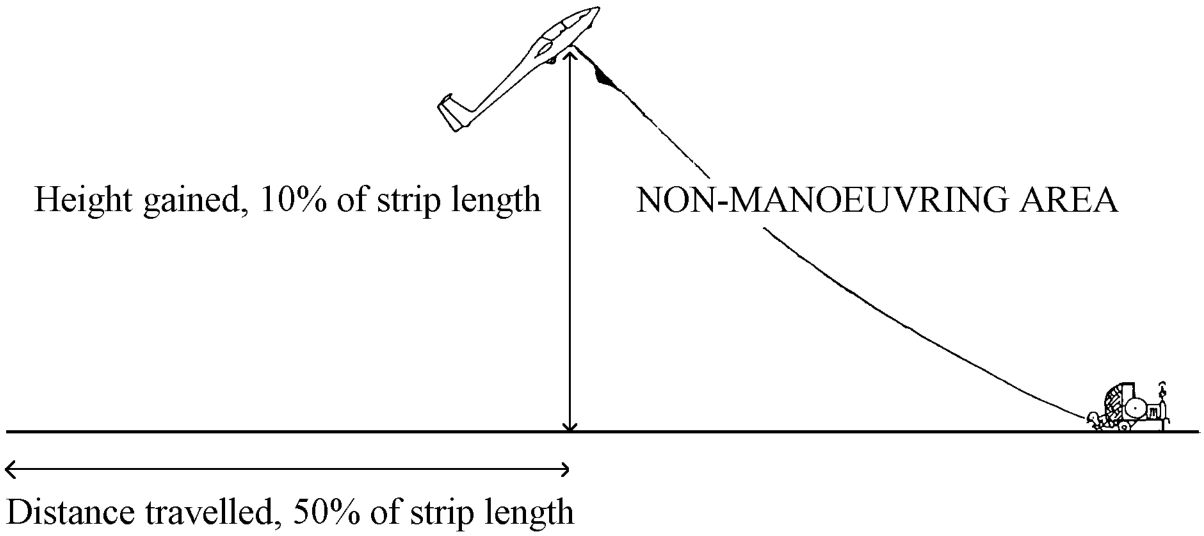
A guaranteed way to end up in the non-manoeuvring area is to be launched by a low-powered winch or autotow vehicle on a short strip. If the strip happens to be surrounded by unlandable terrain, wall-to-wall trees for example, the scene is set for a nasty accident. The obvious answer to such a situation is not to let it occur. Any indication that poor or acceleration on take off might lead a glider into a non-manoeuvring area, especially on marginal strips, must cause a pilot to abandon a launch to avoid getting into trouble. Stay *out of the non-manoeuvring area.*

What if a pilot drops his guard and ends up getting caught in the non-manoeuvring area? In this case, a circuit must not be attempted but discretion used in choosing the safest landing area available, to one side or the other, or even cross wind, and position himself by making turns, or in the worst case, 'S' turns. ('S' turns are not recommended for normal landings, but in an emergency they may provide the only means of making an approach into a confined area).

It should be pointed out that unlandable ground on the strip itself might result in the non-manoeuvring area changing its shape considerably.

CONCEPTUAL VIEW OF NON-MANOEUVRING AREA

The glider in the diagram (not to scale) is at a point about half way down the strip and at a height of one-tenth the strip length. This is a useful guideline for an "average" non-manoeuvring area, but should not be regarded as definitive. The pilot should not have allowed himself to get there, but should have released earlier and landed ahead.

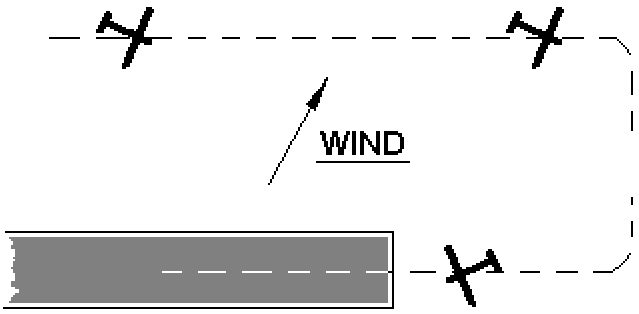


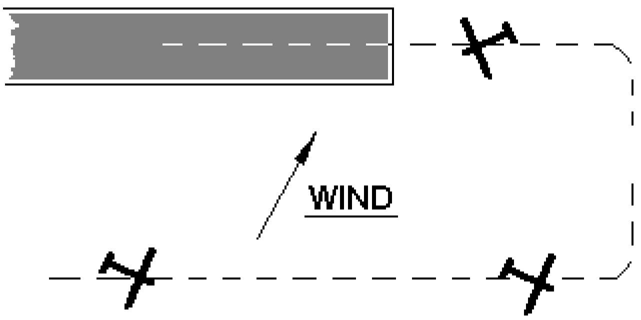
Notes:

1. The minimum field length for winch launching is 1200 metres (3930 feet) and for autotowing is 1600 metres (5250 feet). It is hoped that the above explanation of the non-manoeuvring area will help pilots to understand why such minima are imposed. It is possible to obtain RTO/Ops' permission to shorten these distances by a small amount for special reasons, but not by very much.
2. The are no heights mentioned in the foregoing description of the non-manoeuvring area. There are many variables to consider; for example glider performance (sink rate and glide angle), strip length and shape, wind velocity and effectiveness of airbrakes/spoilers. The pilot must decide in each situation whether a landing ahead is possible or not in the conditions of the day and in the particular machine being flown. Such decisions can only be made if the exercise has been practised a number of times during pre-solo and post-solo training.

Cross-wind conditions

Where there is a significantly strong cross-wind and a failure occurs at a sufficient height to complete a circuit a pilot should, after completing Actions 1 & 2, turn in the downwind direction but not allowing the glider to be drifted away from the strip. In fact the turn will be through an arc of approx. 225 degrees (See first diagram) and the glider will fly cross wind along a track parallel and close in to the strip, landing either into wind if possible, or cross-wind in the original take-off direction. Note that these are preferred situations, but they may need to be modified if particular circumstances dictate. If the glider initially turns into wind (second diagram), the glider is forced to point away from the strip on the downwind leg, making the task much more difficult.





General

One of the major requirements of safe flying is that a properly trained pilot knows beforehand how to handle any failure situation that might occur and is not surprised into doing the wrong thing. Before take-off there must be full awareness of as many factors as possible that will govern the probable actions following a launch failure: -

(a) The wind direction and strength.

(b) In the case of crosswinds, the preferred direction to turn if a failure occurs at height, taking into account aerodrome layout, etc.

(c) Possible overshoot areas or emergency landing areas.

(d) The point at which to abandon a slow launch to avoid being placed in the non-manoeuvring area.

The basic plan to counter possible take-off problems can usefully be considered at the “O” (Outside and Options) part of the pre-takeoff check (see “Flip” Cards). In this way, much of the surprise element can be eliminated from launch failures and training a pilot in this way breeds an awareness that every take-off is a potential failure, to be coped with in the appropriate way. This is preferable to a blind faith that everything will always go as expected, which always results in panic setting in at a time when the pilot least needs it. Launch failure on the ground

The same kinds of failure cases can occur on the ground as in flight. A cable-break is innocuous and will usually only result in the glider not going anywhere. Engine failure is similar, provided that the failure is not temporary and the winch driver is not tempted to coax a reluctant engine into keeping going. As long as the winch driver stops everything when a failure occurs, the worst that might happen is that the drogue chute might deploy and drape itself over the canopy, blocking forward vision. If the glider is at low speed and pointing in basically the right direction, this should not cause much of a problem.

A potentially dangerous situation exists if the glider over-runs the launch cable, due to hesitation of the winch engine or a very fast “take up slack”. A loop of the cable can foul on the wheel or skid or other part of the structure and, in the event of the back/release operating, which it probably will do, the drogue or twin-rings may foul around the glider and cause a hang-up and damage. Although the winch driver must abandon the launch if he suspects the likelihood of an over-run the pilot must not assume that this will be done. Thus, whenever a glider over-runs the cable, either on the ground or in the air, the release should be operated (twice) and if possible the glider smartly turned away from cable or drogue. This procedure applies when the pilot is satisfied that no hang-up has occurred.

If it is known or suspected that the cable has fouled the wheel or skid assembly, and that the launch is taking place despite the release being pulled twice, take all possible action to ensure that the glider does not leave the ground.

Apply full forward stick and open the airbrakes fully.

DO NOT ALLOW THE GLIDER TO FLY.

CHECK LIST OF COMMON FAULTS IN WINCH/AUTO LAUNCHING

1. **Problem.** Glider separates from ground prematurely and enters steep climb too early.

   Possible causes.

   (i) Pilot holding stick too far back.

   (ii) Pilot at or close to minimum permissible weight.

   (iii) Too much initial acceleration (not usually a problem on auto-tow).

   (iv) Trim set incorrectly.

   (v) Not enough cushions behind pilot, making it difficult to get sufficient forward stick movement. Note that very soft cushions behind pilot, while apparently comfortable, will compress under the acceleration of a winch launch and will create a similar problem to insufficient cushions.

2. **Problem.** Prolonged ground run, glider taking a long time to separate.

   Possible causes.

   (i) Pilot holding stick too far forward, either inadvertently or deliberately in an attempt to get the tail off the ground (gliders separate best in a two-point attitude and there is no reason for raising the tail).

   (ii) Failure to compensate for strong nose-down trim (e.g. flapped Blanik).

   (iii) Poor acceleration and insufficient speed for separation (this may necessitate abandonment of the launch).

3. **Problem.** Glider “wallowing” on launch.

   Possible causes.

   (i) Glider being launched too slowly and pilot persists in trying to make it climb steeply. This situation is dangerous and necessitates immediate action on the part of the instructor to reduce the climb angle and/or release the cable.

   (ii) Pilot correcting for minor disturbances due to turbulence, using aileron alone and not co-ordinating properly with rudder.

4. **Problem.** Glider back-releases prematurely.

   Probable cause. Pilot keeps excessive backpressure on stick at top of launch, instead of slowly relaxing backpressure as the nose is starting to get pulled down over the top.

AERO TOW LAUNCHING

GENERAL

Safe aerotow launching depends upon co-operation between pilots of both aircraft and mutual awareness of pre-arranged procedures. The standard towrope length is 55 metres, shorter ropes only being permitted for specified purposes. Refer to GFA Ops Manual for relevant procedures.

HIGH AND LOW TOW

Tug aircraft produce a turbulent slipstream in flight, consisting of a combination of wingtip vortices and propeller wash. Gliders are normally positioned either just above, or just below this slipstream while on tow. The positions are known as high and low tow respectively. Since in the high tow position the glider is almost on the thrust axis of the towing aircraft this is sometimes referred to as the “line astern” position. The low-tow launch is the standard procedure for GFA clubs using aerotow.

LAUNCH STAGES

Ground run and separation

Before take-off on aerotow the trim should be set as required during the cockpit check and the controls used to get the glider into the take-off attitude, from which it will separate naturally when flying speed is attained. The glider should not be abruptly “rotated” in the nose-up sense at the separation stage.

At this stage the wings are kept level (or banked slightly into any crosswind) with aileron, position behind the tug is maintained with rudder and take-off attitude maintained with elevator. Coarse control movements will be required until the glider gains speed.

Initial climb

Whether intending to carry out an aerotow in the high or the low tow position, the separation and climb-away stages are identical. The glider will lift off before the tug and should be held at a height of six to ten feet above the ground (about the height of the tug’s fin) until the tug also separates. In this situation the glider will be above the tug’s slipstream.

If intending to carry out a high tow, this position above the slipstream is maintained as the combination climbs away. Remember that high tow is, by definition, just above the slipstream, not above the tug. The slipstream is the primary reference, not one of the fixtures on the tug.

If intending to carry out a low tow, maintain station above the slipstream as the tug leaves the ground. When the tug is positively established in a climb, move the glider gently but positively down through the turbulence behind the tug until once again in smooth air. The glider is now in the low-tow position. Once again the slipstream is the primary reference. Do not go too low in relation to the slipstream - it is not necessary.

Important note: The glider going too low in the low-tow position results in the tug pilot needing more and more forward stick to compensate. Although this could get to the stage of running out of elevator power to keep the tug under control, it is rather unlikely to become this serious and in any case such a situation usually develops slowly enough for the tug pilot to release the glider before control is lost.

In contrast, it is dangerous to go too high behind the tug in high tow, because this situation can get out of control very quickly and the tug pilot may not have enough time to pull his release before a “tug upset” occurs. See section on “implications of glider going too high behind tug”. If the glider goes so high that the pilot loses sight of the tug, the glider’s release should be pulled WITHOUT DELAY.

Normal Climb

The glider should maintain position directly behind the tug (either high or low-tow) during straight flight and in turns when the bank angle of the glider will be that of the towing aircraft.

Small amounts of slack in the rope can be expected in turbulent air. These usually fix themselves without any special action from the glider pilot. If for any reason excessive slack develops in the rope, the problem is best alleviated by yawing or careful use of airbrakes. Action that results in the sudden tightening of the towrope is to be avoided should the glider pilot wish to remain on tow. With more powerful tow aircraft rope slack is seldom encountered.

It is important to trim the glider to fly “hands off” on tow. It considerably reduces student workload.

Release

The release is carried out from the position in which the glider is being towed, i.e. if towing in low-tow, release from low-tow, if towing in high tow release from high tow.

It is essential to check that, prior to release, the airspace is clear (a) to the right where the glider is just about to turn, and (b) to the left and below where the tug is just about to descend.

The release should be operated while the towrope is still under some tension and the glider pilot, on noting its separation, will immediately commence a clearing turn to the right thereby obtaining a maximum clearance from the rope. The tug pilot, after feeling “release” should check that the glider has in fact released and begin descending.

“Aerobatic” tug departures into the descent phase are prohibited.

Changing station on tow

During training the student will need to be taught both high and low tow, and the correct way to effect a transition between the two. There is ample time and opportunity; once basic aerotowing skills have been acquired there is very little to do except sit there and follow the tug. The time should be used profitably to expand the pupil s skills and to build confidence in the ability to change station smoothly and accurately.

Boxing the slipstream

This is a very useful exercise in co-ordination, understanding of the forces at work on aerotow, and confidence building. The glider should be flown out to the right, still in low tow, and held there for a moment. Then the glider is brought smoothly to the high tow position, still out to the right, and held in that position for a moment. Then, remaining in high-tow, transition across to a position out to the left of the tug, and pause there for a moment. Then back down to low tow, still to the left, and pause there. Finally, return the glider to the central, low-tow position. The object of the exercise is to describe a “box” around the tug slipstream, without actually touching the slipstream.

Once again, since there is very little else to do during aerotow training, once basic skills have been acquired, this exercise will be found very useful. Note that it is preferable to move to the right when starting this exercise, to avoid confusion with the glider unable to release” signal, which consists of the glider moving out to the left.

In any exercise involving deliberate station-changing on tow, the tug pilot should be advised, as a courtesy, prior to the tow.

THE INSTRUCTIONAL SEQUENCE

Normal climb and release - pre-flight briefing

Like winch and auto launching, the high stages of the aerotow are taught before those near the ground. The pre-flight briefing should emphasise that the stable platform is just as effective on tow as it is in free flight. This will be backed up by a demonstration. Point out during the briefing that, because the airspeed is higher than the student has been accustomed to in handling the controls in free flight, the control forces are higher, but at the same time the controls are more effective. Some gliders are very heavy on the ailerons at aerotowing speeds, others have a tendency to run out of elevator trim in low tow, leading to a residual push force. It is important to know the characteristics of the trainer in use and brief accordingly.

Warn the student that he will probably over-control and that this is quite normal. Emphasise the need for small movements on the controls, but remember that mistakes will need to be made in order for any learning to take place.

Emphasise also that the reference for establishing the correct towing position is the tug slipstream and if there is any doubt whether the glider is in the right place, find the slipstream and then position the glider accordingly.

“On this flight, I will hand over control to you on aerotow at about 800ft. The glider will be trimmed out, so you should not have much difficulty.” Note that the air should be reasonably smooth for a student’s first attempts at this exercise.

“When you take control, do very little at first, let the stable platform work for you. Get used to the feel of the glider on tow, then gently exercise each control to see and feel its effect. You can expect that the elevator will be more sensitive than you *are used* to, *while the ailerons will be quite a bit heavier. You will soon get used to* this. *The rudder feels about the same as in free flight.”*

Normal climb and release - air exercise

A common instructional error is to introduce students to flying the aerotow too early in their training. This often results in frustration and discouragement, which is the opposite of what an instructor should be trying to achieve.

As a guide, the student should not be handed control on aerotow until competence in smooth and reasonably accurate co-ordination has been acquired. Additionally, the student should have some idea of ANTICIPATION in the use of the controls, otherwise learning to aerotow will be just that little bit harder.

The student's air instruction should begin during the climbing stage of the launch above 800 ft, and it should be anticipated that he may have difficulty in maintaining station behind the tug due to over-controlling or poor co-ordination of aileron and rudder. Remember what you told him during the briefing. If serious over-controlling occurs, return to the stable platform demonstration, which works perfectly well on tow if the trim has been correctly adjusted. THIS IS AN IMPORTANT DEMONSTRATION. He should be shown that, should the glider get out of station laterally, it must be because bank has developed and the first requirement is to ensure that the glider's wings are parallel with those of the tug by gentle application of aileron and rudder. This will stop the glider getting further out of station, and in most cases the glider will tend to return to the central position of its own accord after a few seconds.

During the early air exercises in aerotowing, it is important to build confidence in the student, as it is easy to get demoralised by constantly getting out of station without apparently getting any better. Let them make mistakes, but analyse the mistakes very carefully to ensure that they are actually learning from them.

At the releasing stage, the instructor must emphasise the importance of LOOKOUT, to the right where the glider is intending to go, and ahead and to the left where the tug is likely to descend. Pull the release, observe the rope go (get the student to say clearly "rope gone") and begin a right turn without delay.

Note: Locate, identify, operate

Since the release stage of the aerotow will be taught before the take-off stage, it is opportune to introduce the concept of "Locate - identify - operate" at this time. This means that any ancillary control, in this particular case the release, should not be operated until it has been positively located and identified as the one required. This eliminates any possibility of error in selection of the wrong control. The principle applies to all ancillary controls.

Ground run, separation, initial climb - pre-flight briefing

There are three parts to this briefing, viz.:

- Glider and tug on ground.
- Glider airborne, tug still on ground.
- Both glider and tug airborne.

<u>Glider and tug on ground</u>. Due to the slow acceleration of the tug/glider combination, the briefing should point out that the controls will be very sluggish and unresponsive at the start of the launch, and will become more responsive only slowly. The glider should be placed in the flying attitude as soon as the controls are functioning and kept in this attitude until flying speed has been attained.

<u>Glider airborne, tug still on ground.</u> When the glider lifts off, it will start to climb higher and higher as the airspeed continues to increase. This must be resisted by a progressive forward stick movement.

<u>Both glider and tug airborne.</u> When the tug lifts off, maintain the glider in a position above the slipstream until the tug is positively established in a climb. Then move gently but positively down through the turbulence of the slipstream until the glider is once again in smooth air.

Ground run, separation, initial climb - air exercise

As a prolonged ground-run is normal with aerotowing, it may be expected that a student will initially have difficulty in keeping position behind the tug. However, he must be allowed to practice and make mistakes. It is unlikely that a clean separation will occur on the first attempt, but the instructor should not interfere unless absolutely necessary.

When the tug separates, it is likely that the student will have difficulty in moving cleanly into the low-tow position. Once again, errors will have to be permitted, provided they are not gross enough to endanger the combination.

EMERGENCIES

General

Glider pilots must guard against complacency during aerotow as although it is normally a straight forward, simple and safe procedure rapid action is called for should any emergency occur.

Rope break

Although rope-breaks on aerotow are not as common as wire-breaks on winch/auto tow, they can and do occur, especially if the glider gets out of position and puts a lot of strain on the rope when returning to the normal position behind the tug.

The first priority following a rope-break is to ensure that the speed does not decay below l.5Vs. The next job for the pilot is to decide how to use the available height as safely as possible. Very low rope-breaks necessitate a straight-ahead landing; some strips may allow such a landing up to a considerable height, say 300 or 400 ft. Above the cut-off height for a straight-ahead landing (and this height will vary from day to day, from tug to tug and from strip to strip), a modified circuit of some description will be possible. The degree of modification will vary in accordance with the previously-mentioned factors; a rope break just above the cut-off height will probably mean a 360 degree turn and a landing ahead or maybe two S-turns and a landing ahead, whereas a higher rope-break will enable an almost normal circuit to be made.

Rope-breaks are simulated by the instructor pulling the release. They should be actively taught in the early stages, before being used as exercises to check pilots' reactions to them. Start high and work down to low-level simulations. They are not an option; they must be done. Remember that they are spread across pre-and post-solo training.

Emergency release

Should the tug-pilot require the glider to release, he will rock his wings. When this signal is received, there must be no hesitation; the glider pilot must release immediately or the tug pilot will jettison him. This signal should be given to the student several times during training and the instructor should ensure that the appropriate action is taken on each occasion. It should be instilled in the student that there is no such thing as a "practice" emergency release signal.

Post-release priorities and actions are exactly the same as for the rope-break.

"Airbrakes out" signal

When a tug pilot knows or suspects that a glider's airbrakes or tail-chute are out during a launch, he will waggle the tug's rudder to advise the glider pilot to check these items. If the tug is not in imminent danger the tug pilot should tow the glider to an adequate height above the strip before giving the "airbrakes out" signal. The instructor should arrange with the tug pilot to have this signal demonstrated several times during the training of a glider pilot.

Release failure - glider end

In the event of failure of the glider to release, it should be flown out to the left of the tug, still in the low-tow position, until acknowledgement is obtained from the tug pilot. Upon receipt of such acknowledgement, the glider is returned to its normal position behind the tug. Then the glider is climbed through the slipstream into high-tow, from which position it will be released at the tug end when the tug pilot is satisfied that the combination is within gliding distance of the field. The glider should make a higher than normal approach to land, to avoid the still-attached towrope fouling any obstructions.

In the event of failure to release, as well as carrying out the above procedure, KEEP TRYING TO RELEASE. Further attempts are often successful, especially after a change of position behind the tug.

Release failure - tug end

If both glider and tug releases fail to operate, it will be necessary for the glider to descend with the tug, maintaining low-tow position and keeping tension in the rope by use of airbrakes as necessary. Land behind the tug using all braking available. If overtaking the tug during landing steer to whichever side is feasible as dictated by any prevailing crosswind. The tug pilot will assist by not using his brakes during the landing run and allowing the glider to brake the whole combination to a halt.

Power failure on take-off

Should the tug have a power failure during the take off the glider pilot should release immediately and keep clear of the tug as in previous paragraph.

Flying level on tow

In level flight, with the tug/glider combination not climbing, e.g. cross-country ferry flights, the feel of the glider is quite different, as follows -

(a) The trim of the glider is considerably affected - the trim control will almost certainly need to be reset.

(b) Slack will develop in the rope very easily. Airbrakes may be used to help keep the rope tight, or the glider can be i7own in the tug slipstream - this creates quite a lot of extra drag.

(c) When releasing from tow in level flight, there must be no delay in making the right turn, otherwise the rope may get quite close to the glider. This is true whether releasing from the high tow or the low tow position.

(d) The slipstream may be in a slightly different position compared to where it usually is. However, as usual, low-tow is still just below the slipstream and high-tow just above.

Descending on tow

Slack ropes are inevitable when descending on tow, and the use of airbrakes is essential. It is obviously necessary to acquire the skill of descending on tow before a landing on tow (See paragraph "Release failure, tug end") is attempted.

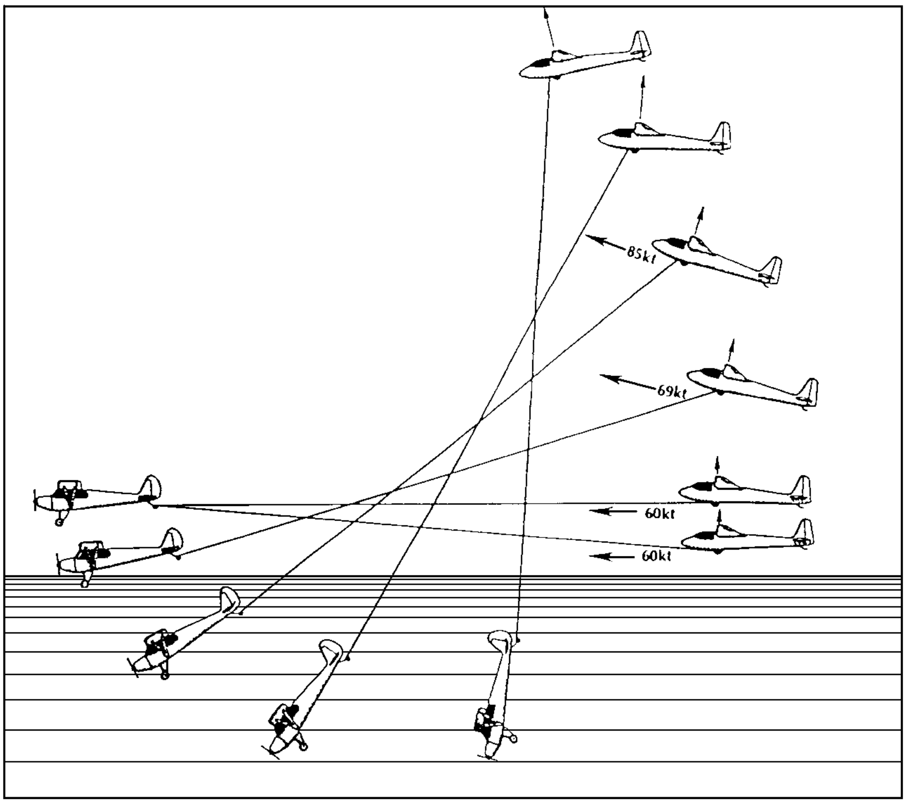
The exercises of cruising and descending on tow are not necessary before first solo, but are part of the post-solo training for the "B" Certificate.

THE IMPLICATIONS OF GLIDER GOING TOO HIGH BEHIND THE TUG

The problem begins when the glider gets too high in relation to the tug. The tug pilot, wishing to prevent his tail being pulled, applies up elevator to press the tail back down again. But if the glider continues to climb behind the tug, eventually one of two things will happen:

1. The tug will be up-ended into a steep dive, or
2. The tug will stall under the influence of hard up-elevator if the glider pilot dives back into station or releases the rope. There are many cases of both on record.

Let's examine the first situation in more detail. Suppose the glider keeps on "kiting" upward behind the tug; for example by a too hurried transition from low-tow to high-tow, resulting in the glider overshooting the high tow position and carrying on upwards. This situation is made much worse if the glider has a belly-hook or an all-moving tail or if the rope is too short. Too short in this context is anything less than the recommended length. A combination of all three factors is potentially deadly. The situation which develops is illustrated in the diagram.



Note how the glider speed increases rapidly as the "kiting" manoeuvre develops, the tug suffering a corresponding loss of speed. Not only does the glider speed increase when the kiting manoeuvre develops, but it may be impossible to stop the manoeuvre getting worse. Full forward stick may reduce the rate at which the kiting develops - it may not stop it. It may also be impossible to fly the glider out of one of these situations once it has developed. The only solution is to prevent the glider getting into that situation in the first place.

It is therefore essential to instil in a student that the glider must be released instantly if the pilot loses sight of the tug.

CROSSWIND CONDITIONS

Crosswinds affect the ground-run, separation and climb-away stages of the launch. Like the into-wind take-off, the crosswind take-off should be considered in three stages.

Both glider and tug on the ground

With glider and tug both on the ground and accelerating to the glider's take off speed, the glider will try to "weathercock" into the wind. This tendency will be more marked if the glider's wheel is ahead of the centre of gravity and if the glider is being aerotowed on its belly-hook. The glider pilot needs to use the ailerons to stop the wing from lifting under the influence of the crosswind, and to apply rudder in the downwind sense to prevent weather-cocking. Proceed in this manner until separation takes place. Note that aileron and rudder are crossed during this ground run phase.

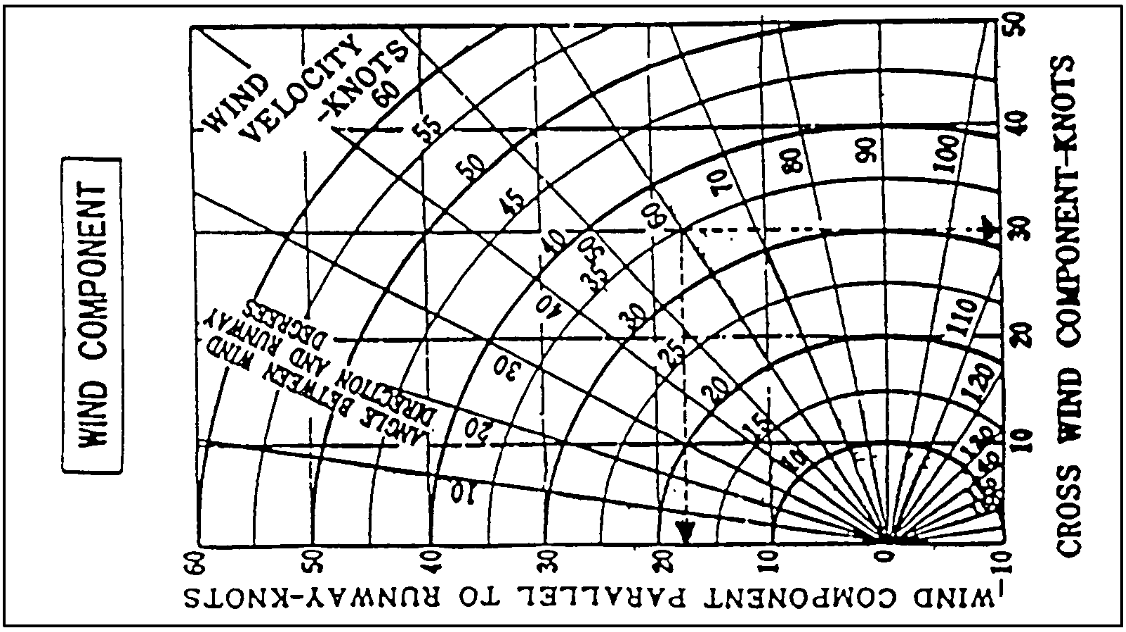
Glider airborne, tug on the ground

With the glider airborne and the tug still on the ground, the controls should be uncrossed and the glider turned into the crosswind by an amount necessary to cancel out the drift. The glider is then held in that position with ailerons and rudder centralised, until the tug lifts off. Note that the glider heading and the tug heading are markedly different during this phase, in order for the glider to maintain a track over the ground exactly behind the tug.

Both aircraft airborne

When the tug lifts off, it too will angle its nose into wind in order to correct for the drift, leaving the glider displaced to the upwind side of the combination. When the tug is well clear of the ground, say 50 ft, the glider is gently turned into station directly behind the tug and the aerotow proceeds normally.

There follows a crosswind component chart. To use this chart, simply find the intersection between the wind speed (on the curved lines), and the angle of the wind to the runway. In the example shown, a wind of 35 knots at 60 degrees to the strip gives, perhaps surprisingly, a headwind component of 18 knots and a crosswind component of 30 knots.



CHECKLIST OF COMMON FAULTS IN LEARNING AEROTOWING

1. **Problem.** Glider swinging from side to side behind tug.

   Probable cause. Student trying to use aileron alone to control the glider in roll, thereby inducing large amounts of adverse yaw.

2. **Problem.** Glider much too low behind tug (very common)

   Probable causes. Failure to use slipstream as primary reference for towing position. Failure to adjust trim to provide stable platform in normal low-tow position.

3. **Problem.** Glider rolling from side to side on ground, wingtips sometimes getting very close to the ground.

   Probable cause. Student does not appreciate that rudder alone is used to keep position laterally behind the tug when on the ground, and is trying to get behind the tug in a co-ordinated turn.

4. **Problem.** Student over-controlling on aerotow.

   Probable cause. Student has forgotten, or has never been instructed, that the stable platform works just as well on tow as in straight flight. A good demonstration of this will produce excellent results.

5. **Problem.** Having got out of position and managed to start moving the glider back into position, student has difficulty in stopping the glider in the correct place.

   Probable cause. Student has not developed the required amount of anticipation needed to apply corrective controls a little before the glider gets into position. Student may possibly have been put onto aerotowing too early in training.

NOTE: This Section on 'Circuit Approach and Landing' has been supplemented by advice in Operational Safety Bulletin (OSB) 01/14 - 'Circuit and Landing Advice'. Where differences exist, the advice in the OSB takes precedence.

CIRCUIT APPROACH AND LANDING

Objective

Before any ground briefing is undertaken, the Instructor must define to the student the object of Circuit Planning:

(1) To establish a suitable landing area.

(2) To select a landing direction.

(3) To establish a final-approach path with a safe margin over obstacles.

Therefore, the object of circuit planning is to position the aircraft on the required final approach.

Briefing

Using a dirt sketch, blackboard or briefing diagram the instructor should run through the main points on the circuit explaining to the student the reasons for these and the possible modifications. This illustration, prior to the flight, should not be missed.

When using the diagram, it will be appreciated that it represents an idealised situation, based on an “average” 10 knot wind. Drift may need taking into account on crosswind legs and the glider must be flown at all times within the proximity of the landing area so that if, for example, we run out of height because of unexpected strong sink, we can turn in and land.

“Whatever exercise we have been doing in the air, we break it off while we have adequate height to reach the Circuit Joining Area and complete a normal circuit and approach.”

“There is a Break-off Point for every flight, not just for training circuits. Every flight is broken off at a point which leaves adequate height to reach the Circuit Joining Area relative to our landing field. You should form the habit of always breaking off with enough height to carry out a proper circuit, with a downwind leg, a base leg and a normal Final Approach Path.”

“At the Break-off Point, the flight, as such, is broken off decisively.”

Circuit joining area

“We proceed from the Break-off Point to the Circuit Joining Area and join the down-wind leg. Flaps (if fitted) are set for the circuit and undercarriage is lowered and locked down (if applicable). *Then the airspeed of the glider is set at the ‘safe speed near the ground’* (I.5Vs). *We maintain this safe speed, never getting below it throughout the remainder of the flight. We never break this rule at any time. The glider is trimmed to maintain the safe speed.”* Refer to the “flip” cards for checklist for these actions. (F.U.S.T).

Note: The flaps are set as appropriate for the type in use. Because of the variety of types and their associated flap systems, it is impossible to make a hard and fast rule about any specific flap setting at this stage of the circuit. The only thing that must be ensured at this stage is that the flaps are not in their reflex or negative position for the circuit.

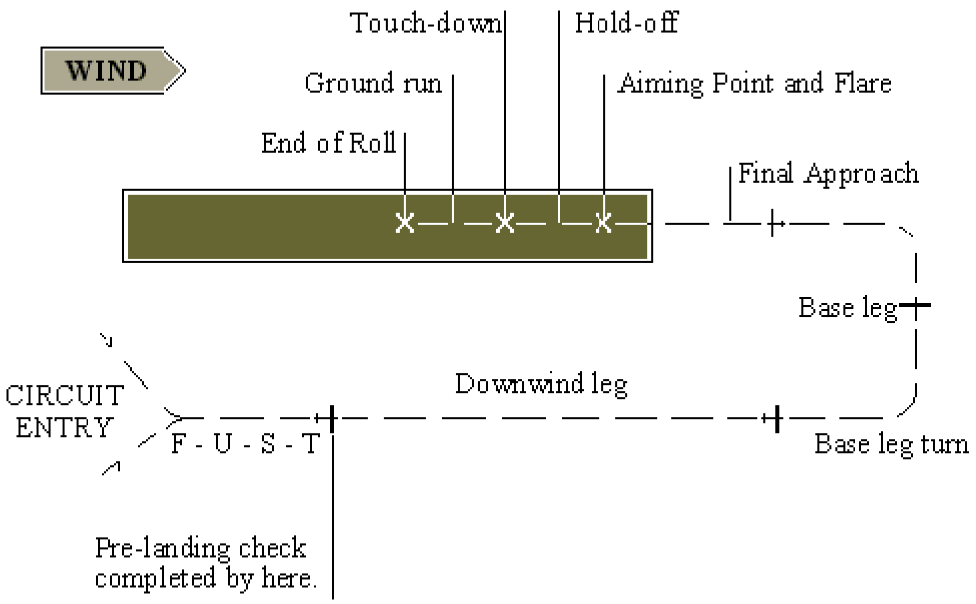
Remember to keep a particularly good lookout in the circuit joining area. There might be other gliders or powered traffic intent on joining the circuit too. The circuit joining area can be a very busy part of the sky.

SAFE HABITS

After reaching the circuit joining area, the following habits must be emphasised from the earliest training on circuit planning.

Check for:

1. Safe speed near the ground. (l.5Vs). (Remember this must be constantly monitored despite having been positively set during the pre-landing checks.)
2. Other traffic.
3. Wind strength and direction.
4. Landing area obstructions.



Downwind leg

"We establish the glider on a track parallel to the selected landing path. On this downwind leg we check whether height is sufficient to make the chosen landing area. We do this by (a) estimating our height above ground and (b) continuously judging the angle from where we are to the landing area. This is a fairly coarse estimate and is relatively easy to make after a little practice." Note that the altimeter must not be used for the height estimate and can usefully be covered up.

"If our angle to the landing area is too steep (we are too high and/or too close) we move our downwind leg away from the field, taking care not to turn our back on the landing area or lose sight of it."

"If our angle is too shallow (we are too low and/or too far away) we move our downwind leg closer to the field."

"If the shallow angle persists and appears likely to become VERY shallow, we abandon our previous plan and turn in immediately for a landing on the nearest available safe landing area. This situation is known as a "modified" circuit."

During the downwind leg remember to check the wind-speed and direction by whatever means are available. This information is important for selection of the Base Turning Point, for predicting drift on the base leg and for establishing the speed to use on final approach.

Base turning point

"We continue downwind to our base turning point making adjustments according to our angle/distance assessment and visualising the required Final Approach Path which will give a clearance over obstacles and take us to the desired landing area. *If there are obstacles we must ensure that our final approach path clears them by approximately one wingspan."*

The turn on to Base-Leg is made so that the resulting base leg flight path will intersect the intended final glide path at the height and position.

Other factors determining when to make the turn on to base leg are:

(a) Wind strength and direction - the stronger the wind the earlier the base leg turn should be made. (Unless the wind is 90 degrees to the landing area - special case).

(b) The turn should never be made so late as to make the angle to the landing area too flat. Turn before it becomes too flat.

On completion of the base leg turn:

(a) Increase speed to final approach speed. (1.5Vs plus half windspeed).

(b) Locate and identify airbrake/spoiler control: place free hand on it. From this point on the hand should not be removed from airbrake/spoiler control unless essential to adjust flaps, etc. Return hand to airbrake control as soon as any other adjustments are complete.

(c) Assess whether we will meet the final approach at the point originally predicted or whether we will go above or below it.

(d) Check for traffic on a straight-in final approach or cutting inside our own base leg. Shadows are useful for this purpose if it is sunny day.

"If we would pass above the final approach we change direction away from the field (but don't go too far) to meet it where it is higher."

"If we would pass below the final approach we move in towards the field to meet the final approach at a lower point."

"If we will intersect it we make no alteration."

The student should be reminded that at all times he is free to turn in and land if it appears that he has misjudged badly.

Notes

1. If the angle to the landing area is assessed as too steep during the downwind leg, any adjustment should be made early rather than late. For practical purposes, turning away from the field ceases to be an option once the glider has passed abeam the intended touchdown area. Do not move too far away from the field at any stage of the circuit. An area of unexpected sink could result in failure to get back to the field. It is preferable to use airbrake or spoiler in this situation, rather than go too far away.

2. Early on the base leg the pilot places a hand on the airbrake or spoiler lever, to avoid any possibility of selecting the wrong control on the final approach. Remember "Locate, Identify, Operate".

3. In the case where there is excess height on the base leg, airbrakes or spoilers should be used rather than going too far back. However, if this has to be done, unless strong lift has been encountered, it is likely that the circuit has been misjudged and some analysis of the circuit planning will be needed at the debriefing.

4. The opening of the airbrakes during the turn on to base and the final turn should be discouraged during training.
5. ‘S’ turns at a late stage in the circuit should be discouraged. 360 degree turns on base leg and final approach are prohibited.

THE APPROACH

The final turn should be precise and should align the glider for a straight approach to the landing area. It should be initiated early enough to avoid overshooting the centreline of the intended approach.

Once the turn is completed, the approach speed and direction are checked, adjusted if necessary and then maintained to “Check 1”.

Our position relative to the final approach path to our intended landing area is now assessed. Airbrakes should not be used until the pilot has assessed that he is beginning to overshoot his intended touch down area and will clear all obstructions. Airbrakes are then used as required to maintain the correct final approach path until Check l.

AIMING POINT

The aiming point is an approach aid. It is a point (or to be more practical an area) on the ground which will appear stationary from the cockpit when the glider is stabilised on the selected final approach path. If the glider is in an overshoot situation (i.e. it is above the final approach path), the aiming point moves downwards and tends to disappear out of view under the nose as the glider overshoots it. If the glider is undershooting (i.e. it is below the final approach path), the aiming point moves upwards in the windscreen.

An OVERSHOOT requires further extension of the airbrakes/spoilers to steepen the final approach path and restore the aiming point to a stationary position. Note that in the case of airbrakes, the nose needs to be lowered slightly as the brakes come out further, in order to prevent the speed from decaying due to the increased drag.

An UNDERSHOOT requires retraction (not necessarily full retraction) of the airbrakes/spoilers, in order to make the approach path less steep and once more restore the aiming point to a stationary position. Again, note that with airbrakes, retraction of the brakes necessitates a slight raising of the nose to keep the approach speed constant.

It is very important that students are coached in the correct use of airbrakes or spoilers. These performance-reducing devices are never used on final approach until a positive overshoot situation has been achieved and identified by the pilot. It is particularly important to guard against consistently high, steep approaches during training, as this encourages “automatic” opening of the airbrakes/spoilers as soon as the final turn is completed. Thus a student never understands the use of the aiming point technique, because he has always been in an overshoot situation and has never seen any great variation. Trainees should be shown the undershoot situation and trained in the necessary techniques to correct it.

NOTE: This Section on 'Circuit Approach and Landing' has been supplemented by advice in Operational Safety Bulletin (OSB) 01/14 - 'Circuit and Landing Advice'. Where differences exist, the advice in the OSB takes precedence.

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Overshoot/undershoot detection problems

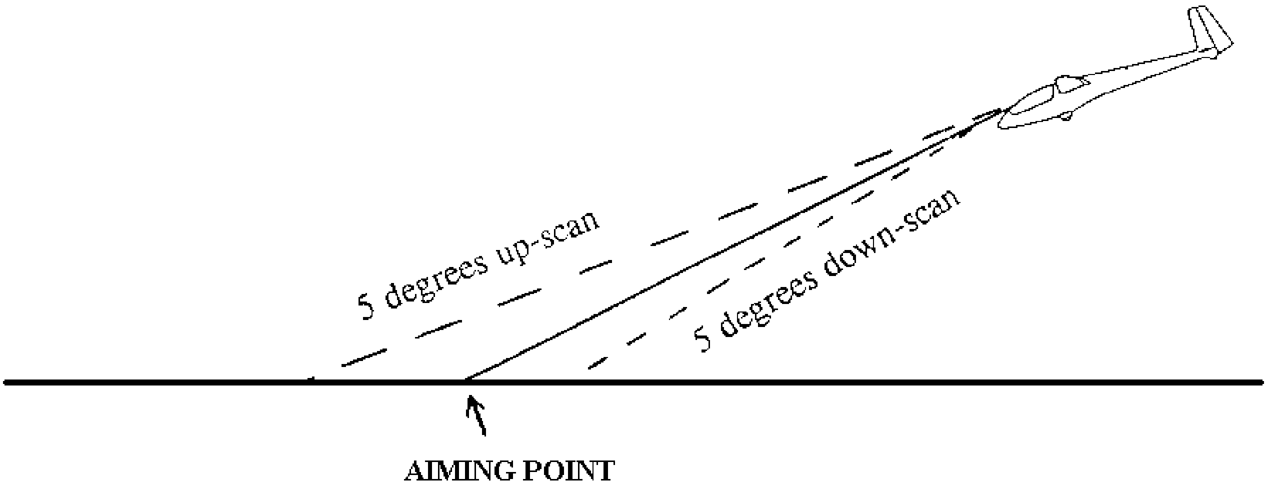
It is much more difficult to detect a shift in the aiming point in the undershoot case than it is in the overshoot case.

A glider overshooting only has to go a little way above the approach path in order to detect that it will in fact overshoot.

A glider undershooting has to go a long way below the approach path before it becomes obvious that the aiming point has shifted and that the glider is in an undershoot situation. The undershoot situation is potentially dangerous, because, once it has been detected it may not be possible for the glider to regain the previous approach path. A new, flatter approach is therefore inevitable, and if obstacle clearance was previously limited it may now become impossible to achieve.

The overshoot/undershoot illusion

Showing the difference in the area of scanned terrain when the pilot's eyes scan above and below the eye-line to the aiming point.



For any given up and down scan of the pilot's eyes, for example 5 degrees in each direction, there is a difference in the amount of terrain "taken in" by the eyes in each case.

If the pilot's eyes scan downward, a 5 degree scan covers a relatively small amount of terrain. For a glider in an overshoot situation, with the aiming point moving toward the pilot, the aiming point only needs to move a small amount in order to become obvious very quickly.

If the pilot's eyes scan upward (the undershoot situation), the same scan takes in approximately twice the amount of terrain and the aiming point has to move much further before it is apparent that the glider is undershooting.

The stabilised approach

A glider on the correct approach path, going in exactly the right direction at the correct approach speed is said to be on a stabilised approach.

Check 1 and check 2

The aim in landing is to place the glider in an attitude just above the ground so that it will touch down gently at the minimum possible speed.

At the end of the stabilised approach, when the ground ahead appears to flatten out, the pilot should disregard the aiming point, transfer his gaze forward about 300 to 400 metres and raise the nose of the glider to check the rate of descent and prevent the glider from flying into the ground.

This means that a small initial backward movement of the stick will be necessary, and when the rate of descent has been reduced to zero this movement should stop momentarily. The glider will decelerate and the stick will then need to be moved progressively backward to keep a level flight path just above the ground as the speed decays.

The initial movement to change from the approach path to the level flight path just above the ground is known as **Check l.**

The resumption of backward movement of the stick near the ground is known as **Check 2.**

The pause between Check 1 and Check 2 is generally of the order of 1 to 2 seconds, but the exact length of the pause depends on the approach speed and the airbrake setting. The higher the approach speed and the smaller the airbrake setting, the longer the pause.

Failure to introduce a pause between Check 1 and Check 2 will usually result in the glider ballooning. Experience indicates that use of the “Check 1, Check 2” technique greatly reduces the anxiety suffered by instructors in this critical phase of training and also improves the student’s understanding of the actions required to safely land the glider.

After touchdown the stick should remain back (especially if the wheel brake is used), the glider held straight with use of rudder and the wings kept level with the ailerons. Note that, as on take-off, aileron and rudder are used independently of each other when on the ground. Coarser control movements will be needed as the speed decreases. In normal circumstances the direction in which the glider landed must be maintained until it stops (assuming of course that it was correct). “Taxiing” the glider is not permitted (but see section on directional control on ground).

Further comment on circuit training

Because every flight ends up with a circuit, the planning process is informally introduced in stages from quite early in the pilot’s training. By the time the student has acquired reasonable skill in handling the glider, the instructor has explained quite a lot about the way in which circuits are flown and how to make the judgements necessary to put the glider in the correct position at any stage of the circuit. By exposure to this series of informal explanations, the student is well placed to start flying the circuit with a reasonable understanding of the objectives. Detailed briefings will then be introduced for specific points in circuit planning and the student will be receptive to these because they equate well with his actual experience to date.

Make sure that the student is really able to judge the final approach path, that he maintains “safe speed near the ground” at all times and that he has a sound understanding of the whole procedure. Ask him to “talk his way” around the circuit; this allows the Instructor to know what is going on in the student’s mind.

Insist on the highest standard of circuit planning thereafter.

Train for Medium turns near the ground (as distinct from shallow turns). The circuit is planned for medium turns and reluctance to carry out a proper medium turn should be watched for and discouraged.

NOTE: This Section on 'Circuit Approach and Landing' has been supplemented by advice in Operational Safety Bulletin (OSB) 01/14 - 'Circuit and Landing Advice'. Where differences exist, the advice in the OSB takes precedence.

The table below gives a guide to the various factors to be considered in making turns. The table represents a modern training two-seater of about 600kg AUW and 34 to 1 glide angle. The quoted speed is a bit fast, but this is manufacturer’s data and can be scaled down a bit for our purpose, in which case the figures will be somewhat smaller.

To complete a 180 degree turn at 65 knots.			
Bank angle	Time (Secs)	Height loss(ft)	Turn radius (ft)
10 degrees	60	240	2,100
20 degrees	30	120	1,000
30 degrees	20	75	650
40 degrees	13	55	450
50 degrees	9	50	350

STRONG WINDS

Landing into wind

Due to the steeper final approach path required, the base leg must be closer to the landing area and care taken to counteract the increased drift on the base leg. Due to the effect of the wind during the turn, the turn on to base should be commenced earlier. The final approach should be made at a higher airspeed (l.5Vs plus half wind speed) and the ground speed will be relatively low. See also section on Wind Gradient.

Landing Cross-Wind

Because the ground speed on the base leg will vary according to the direction of the crosswind the time spent on the base leg will also vary.

Where there is a following wind on the base leg the final turn should be commenced earlier. With a head wind on the base leg the final turn should be delayed. Where practicable the circuit should be flown so that there is a head wind component rather than a tail wind component on the base leg.

Illusions

As the glider gets lower, the pilot is likely to fall victim to a number of illusions. The most important of these is a high ground speed when flying a downwind leg in a strong wind, giving an illusion of a high speed through the air. Monitoring of the actual speed indications on the ASI is the only sensible precaution against this problem, and such monitoring of speed must be actively taught, not only when strong winds are blowing, but also AT ALL TIMES near the ground.

Strong winds will also give an illusion of slipping or skidding in turns in the circuit. Careful co-ordination is especially important here.

PRACTICAL HINTS

Train pilots to use break-off point for all flights, and to break off high enough to reach the circuit joining area.

It is essential to train pilots eventually to judge height and air speed without reference to instruments. Formal training exercises are wise here.

- For height, train to judge the apparent size of ground objects; cattle, people, fences, trees, etc. (As a rough guide, individual fence posts are easily recognised from 1,000 feet and the legs of farm animals can be easily seen from 500 feet).
- For airspeed, attitude, feel and sound are the primary references, but keep in mind that modern gliders are very quiet and there is not much change in sound level for quite large changes in attitude.

The altimeter should be used with discretion as a height reference during training. The limitations of the instrument should be clearly understood - mechanical inaccuracies, barometric changes and uselessness as a height reference over varying terrain.

No person should fly solo unless capable of carrying out accurate circuits without reference to the altimeter. It is remarkably easy and a great builder of confidence. Cheap rubber soap holders, with multiple sucker-pads, make handy instrument covers and are easily obtainable from supermarkets.

A pilot trained to find a suitable circuit joining area relative to any landing field, and from there complete a normal approach and landing, is far less likely to be upset by strange conditions on early cross-country flights.

With this in mind, train right from the start that the first thing to do after deciding to break off a flight will be to say *"Which is the most appropriate place to land and where do I place my circuit joining area to achieve it."* This avoids the setting up of a circuit "by rote" from the place the pilot took off from. If there has been a wind change during the flight (e.g. sea breeze front) the place of take off may no longer be the best place to land.

When teaching the actual landing it is much better to train pilots to commence the roundout early and by a small amount, rather than late and by a large amount. The former case is much easier to do and much easier to correct if slightly mishandled. The latter case can be downright dangerous if even the tiniest error is made.

Beware of very long straight-in approaches. In such situations it is very difficult to identify undershoots until it is too late.

Finally, any rules are likely to be broken in real emergency, sometimes with advantage. Train strictly for accurate circuit planning but avoid letting the student become a victim of inflexible rules.

Don't train him so that he will attempt to turn in a perfect circuit when, for some reason or other, this becomes impossible.

USE OF AIRBRAKES/SPOILERS

The final glide path is based on a half to full airbrake setting, therefore the airbrakes/spoilers will only be used to a sufficient degree to maintain this glide path. Again it must be stressed that elevator is the speed control, airbrakes or spoilers are used to control the rate of descent.

In the early stages it may be helpful for the student to fly the approach using the primary flight controls while the instructor controls the airbrakes/spoilers. It is not necessary with all pilots, but some students respond very positively to this technique, which significantly reduces their workload in the early days of learning landings.

Ground observation exercise

In order to illustrate the final approach path, the student may be taken to a point 200-300 metres to one side of the strip in use and well behind the touch down area used by the gliders flying at the time.

Let the student evaluate the angle of the final glide path which the gliders are following.

Mention of definite angles (or figures for distances, speed and height) should be avoided. Figures etc., given only as general guides or minimum's tend to be slavishly followed in all conditions.

The landing sequence should be explained simply and clearly when formal teaching of landing is to begin, though by this stage of training some instructors may have introduced the student, informally, to the landing control actions.

A neat landing is difficult to make from a bad approach and easy to make from a good one. The instructor should therefore ensure that the student makes a well-planned circuit and stabilises his final glide as early as possible so that he may give full attention to the roundout and landing.

If a student has trouble in the early stages of the approach (this is quite common, because the workload is rather high) it is better for the instructor to take the glider early and stabilise the approach. Then the glider can be handed back to the student for the landing. Leaving the take-over too late will result in insufficient time to hand back to the student, and the landing will be wasted. Do not underestimate the importance of getting the glider accurately stabilised early in the approach.

Airbrake/spoiler setting

Although the amount of airbrake/spoiler used during the approach will probably have been varied to maintain the aircraft on the final glide path, the recommended setting for landing should be made before Check 1 is commenced. This setting should then ideally remain unaltered until touchdown. Once the aircraft has touched down the airbrakes/spoilers should be fully deployed to reduce the length of the ground run.

Landing with limited use of airbrake/spoiler

If the student is having problems of control after round out there is value in using only a small amount of airbrake before the round-out and giving the student the experience of flying for an extended period close to the ground.

Bounced landings

Bounces on landing usually occur because the glider has been rounded out too late and by an insufficient amount. The glider strikes the ground with a residual rate of descent and is rebounded back into the air. This effect is particularly marked if the glider is of “taildragger” layout, i.e. with the CG behind the mainwheel. The reason for this is that a tail-down movement occurs when the mainwheel strikes the ground, and this results in an increase in angle of attack of the wing. The resultant increase in lift produces a very marked bounce.

The main point to watch for in bounced landings is that the student does not move the stick rapidly forward after the bounce has occurred. This will almost certainly result in a very heavy landing, which will cause glider damage and may cause back injury to one or both pilots.

The correct action in the case of a bounced landing is to select and hold a steady level attitude and retract the airbrakes or spoilers. A second attempt at the landing can then be made without further problems.

Ballooning

The tendency to “balloon” is usually the result of failure to understand the need for a short pause between Check 1 and Check 2.

During the landing sequence the Instructor should always keep his hand on the airbrakes/spoilers so that if the student misjudges his Check 1 and balloons the aircraft, the instructor can close them to prevent a stall. Once a safe attitude and speed has been re-established a further attempt at landing may be made. Once again the stick should never be moved rapidly forward at this stage.

Extended approach

In cases where the student is having problems in the landing *phase* due to the rapid sequence of events on the approach, a longer final approach may be helpful in allowing the student more time to stabilise the approach and line up for the landing. Do not overdo the extension of the approach, as this can make the judgement of overshoot/undershoot rather difficult.

Landing in light winds, no wind or downwind

In conditions of light or following winds effective control of the glider on the ground is lost due to loss of airspeed while there is still considerable ground speed. Gliders of “taildragger” layout are directionally unstable on the ground and if control is lost under the above conditions it may be impossible to check an involuntary ground loop. The pilot should concentrate on keeping the glider straight after touch down.

Wind gradient

Advantage should be taken of windy conditions to demonstrate the effect of wind gradient and the low-level turbulence caused by topographical features adjacent to the landing area.

Wind gradient, which is the name given to the progressive slowing down of the wind when nearing the ground, is due to the effect of ground friction on the layers of air near the ground. Thus a glider descending through a gradient is meeting air moving at a progressively lower speed and this causes a fall off in airspeed. This effect is countered by entering the gradient at a higher approach speed, i.e. the higher speed on the approach is chosen when it is assessed that there may be a wind gradient.

If there is any wind gradient, it may be expected that there will be a fall-off in airspeed near the ground. The only cure is to carry extra airspeed from the beginning of the approach. Note that when speed decays due to wind gradient it is impossible to regain it when the glider is close to the ground.

In any case a higher approach speed should be used in a strong wind to ensure adequate control in turbulence.

The rate of descent through a gradient is naturally higher and care must be taken with the flare. The pilot should be ready to close the airbrakes to assist the flare if a severe fall-off in speed occurs.

Influence of lift and sink in the circuit

Glider pilots must be familiar with the normal rate of sink of their glider at normal circuit speed and must appreciate that lift or sink when encountered in the circuit has considerable effect on angle/distance relationships due to changes in rate of descent. Pilots (particularly power pilots with little gliding experience) must be taught to recognise the effects quickly, especially in case of sink, and take immediate action before the situation gets out of hand.

Monitoring the variometer in the circuit provides good early warning of an impending change in the angle/distance relationship and a pilot should make intelligent use of the instrument for this purpose, without become slavishly addicted to it.

Running out of height in the circuit

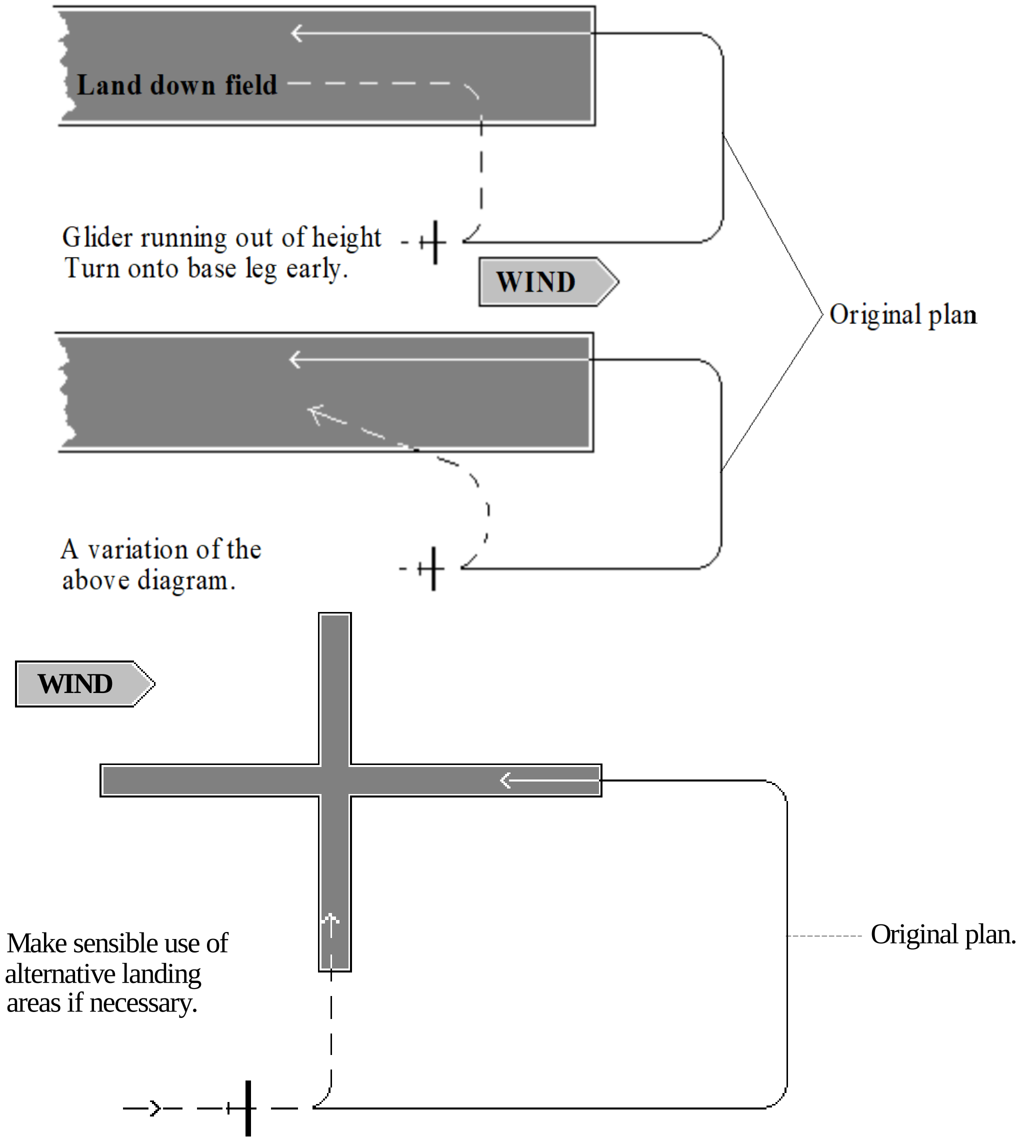
Further to the considerations of lift and sink in the circuit, it is essential that an instructor contrives to run a pilot out of height in the circuit during training. This should occur several times. The object is to ensure that the pilot is trained to modify the circuit, turn on to base leg early and land down the strip or on whatever safe landing area is available. The exercise is especially valuable if it is carried out without an altimeter.

A modified circuit is defined as any circuit which does not end up as originally planned. A pilot caught out by strong sink, and this can happen to anyone, must be conditioned to modify a circuit with only safety in mind; convenience does not come into it. Never risk a low base leg and final approach. Such a situation may be impossible to fly yourself out of, regardless of your flying skill.

Part of an instructor’s job is risk management. Failure to modify a circuit leaves a pilot without an escape route, which increases the risk to an unacceptable level. The answer is obvious.

Some examples of modified circuits follow. They are not exhaustive, as the possibilities are almost endless. Keep in mind that if you are caught out in strong sink in a low performance glider in, say, the base leg area, it may be necessary to land outside the airfield. If that area is unlandable, you have a problem. Never, never, stop paying the utmost attention to all the factors involved in circuit planning, especially the critical ones as outlined here.

SOME EXAMPLES OF MODIFIED CIRCUITS



CHECK LIST OF COMMON FAULTS IN CIRCUIT, APPROACH AND LANDING

1. **Problem.** No apparent understanding of angle/distance relationship.

   Probable cause. Pilot likely to have been trained to fly the circuit using fixed reference points on the ground. Considerable re-training necessary to ensure the student is using the glider's position in relation to the landing area, in order to develop the necessary judgement.

2. **Problem.** Poor speed control in circuit.

   Probable cause. Poor understanding of the use of trimmer (very common problem). Repeat trimming exercise until learned correctly.

3. **Problem.** Student flies consistently too close and too high in the circuit.

   Probable cause. Student has always been taught to fly circuits this way and does not have the judgmental expertise to vary the pattern. Possibly victim of a nervous instructor who is (unnecessarily) afraid of being caught out. Develop the required expertise by varying the circuits until the student can adjust the glider's position accurately at any stage and fly a variety of patterns without anxiety.

4. **Problem.** Student consistently opens full airbrake immediately after the final turn.

   Probable cause. This problem is almost invariably linked to Problem 3 above. High, close circuits will usually need airbrake to be used very early in the approach. Fixing Problem 3 will go a long way to fixing this problem, but the instructor should check very carefully to ensure that such is the case.

5. **Problem.** Student going too far downwind, getting very "shallow" on base leg turn and possibly getting into an undershoot situation.

   Probable cause. Usually failure to keep the landing area in sight as the glider proceeds downwind past it. Looks for any tendency to stare straight ahead during the latter part of the downwind leg, instead of checking regularly on the glider's relationship to the landing area. This problem is responsible for some people criticising the "square" circuit for creating an undershoot risk, when the real problem is lack of monitoring and/or action on the part of the pilot.

6. **Problem.** Failure to flare.

   Probable causes. Student looking too close to the front of the glider during the latter stages of the approach, instead of consciously looking farther ahead as the flare approaches; or insufficient back movement on stick at flare.

7. **Problem.** Student "balloons" on landing.

   Probable causes. Student not using "Check 1, Check 2" technique. Although successful landings can be made using other methods, this particular technique makes it easier for students to understand the principles involved and also remove much anxiety from the instructor; or student using "Check l, Check 2" technique, but uses too much back stick to flare the glider.

STEEP TURNS

INTRODUCTION

A steep turn is no different to any turn of a lesser angle of bank save in degree and all control functions are the same.

Exercise

From a medium turn, select a suitable speed and adjust the nose attitude. Increase the angle of bank to the required angle and maintain the nose position with elevator.

Practical considerations

Considerable up elevator will be needed to maintain the nose position in a steep turn.

Heavier loads are placed on the aircraft during a steep turn and consequently the stalling speed is increased. The speed to maintain the turn should be increased in proportion to the angle of bank.

Care must be taken to maintain the attitude. If the nose is allowed to drop the speed will build up very rapidly and the glider could enter a spiral dive. To correct, ease the backpressure on the stick and reduce the angle of bank with the ailerons.

TABLE OF TYPICAL STALLING SPEEDS AT GIVEN ANGLES OF BANK

ANGLE OF BANK	'G' LOADING	TYPICAL STALLING SPEED
0 degrees	1	33
10 degrees	1.02	33
20 degrees	1.06	34
30 degrees	1.15	35
40 degrees	1.2	38
50 degrees	1.56	41
60 degrees	2.0	46
70 degrees	2.92	56
80 degrees	5.75	79

SIDESLIPPING

The purpose of a sideslip is to steepen the approach path and increase the rate of descent without increasing speed. For sailplanes without airbrakes or spoilers, the sideslip is the only method of approach path control. Such machines are rare nowadays.

However some early-generation fibreglass gliders have fairly weak airbrakes and, combined with their very flat glide-angles at the normal approach speed, accurate glidepath control can be difficult. In such sailplanes the sideslip can be a useful aid to supplement the airbrakes, especially in outlandings.

It is recommended that the manoeuvre be initially taught at height using a line reference and then used on approach when some skill has been achieved.

To initiate a sideslip the aircraft is rolled to a moderate bank angle. It is this bank angle which will ultimately govern the descent rate. Before the further effect of bank can turn the glider, rudder opposite to the bank is applied, sufficient to cancel the turn that would otherwise result. The aileron and rudder are adjusted in opposition to each other to

(a) Maintain a constant bank angle.

(b) Maintain a constant heading.

The speed in a sideslipping approach should be exactly the same as in a conventional approach. Unfortunately the nose-mounted "pot" pitots fitted to most modern gliders have very large errors in a sideslip and the airspeed indicator is useless in the manoeuvre. It cannot be relied on and therefore should not be used. The only sensible way to maintain a constant speed in a sideslipping approach is to monitor the nose attitude very carefully. Generally speaking, gliders are not capable of sustaining very large angles of sideslip, and it is usually possible to maintain an accurate speed in a slipping approach by keeping the nose in the same position as for a conventional approach. Because of the dynamics of a sideslip, this will require a slight backpressure on the stick. The greater the sideslip angle, the greater the nose-up attitude required and the greater will be the backward stick movement. But as already mentioned, gliders have strong spiral instability and are unable to sustain a sideslip at more than about 10 degrees of bank, so a slip with a pronounced nose-up attitude will not be necessary. This limitation ensures that a high rate of descent in a sideslip cannot be sustained in a glider.

To recover, roll the wings level and control any tendency to yaw with rudder. Maintain a constant attitude by relaxing the backpressure on the stick.

Point out that in the sideslip the glider does not move in the direction it is heading, but at an angle to the same side of the nose as the lower wing. This must be allowed for when planning to straighten up on a definite line.

Show that a sideslip may also be used to move from a position to the side of a desired line onto the line by maintaining the fuselage parallel to the line and slipping towards it.

The sideslipping turn may be demonstrated from the sideslip by either increasing the bank or reducing the rudder. Demonstrate also that a normal turn may be turned into a slipping turn.

In a slipping turn, as distinct from a straight sideslip, it will be necessary to adopt a higher nose attitude than in a normal turn. This is because the rate of descent in a slipping turn can be very high, much higher than in a straight sideslip and some of the downward velocity resolves itself into an increased forward speed. Hence the high nose attitude. It is obvious that the practice which is necessary to determine exactly how high the nose should be raised must be gained at altitude before it is tried on an approach.

It must be realised that in a well-developed sideslip it takes a little time and loss of height or to reduce the rate of descent as recovery is made. This is even more so in the case of a slipping turn.

Full allowance must be made for any likely wind gradient and recovery must always be made at a reasonable height otherwise it is easy to misjudge and put a wing tip into the ground.

Sideslipping with spoilers or airbrakes out will usually cause a buffeting on the elevator. Some glider types suffer a strong nose-down pitch when sideslipped with the airbrakes extended. This pitching motion may not be correctable unless the airbrakes are retracted. The Instructor should ascertain whether such a manoeuvre is permissible on the type (see type handling notes) and explore the extent of the buffeting and/or any unusual or undesirable behaviour over the sideslip and speed range before giving instruction.

CROSSWIND LANDINGS

GENERAL

There are two methods of making a crosswind landing, the crabbing method and the wing down method. Each has its particular merits for certain situations, and often the more experienced pilot uses a combination of the two.

THE CRABBING METHOD

The glider is turned onto the final approach so that it heads sufficiently into wind to track along the required line of landing. The approach is made with the wings level and without any skid or slip, drifting along the desired line. This is continued until the glider is almost about to touch down when the rudder is used to swing the nose into line with the path of flight over the ground.

When the glider touches down, there is no sideways load on the wheel or skid. After landing the glider should be kept straight as long as possible and the "into wind" wing kept below the horizontal. After coming to a standstill, this wing should be put on the ground by using the aileron, so that there is no chance of the glider blowing over before the retrieving crew arrives.

This method has the advantage that it can be successfully used in very strong crosswinds. Care and practice are required to swing the glider with the rudder at exactly the right moment. If the rudder is applied too early, the glider will begin to drift while it is being held off for landing and a further application will be required to avoid landing with drift.

Note that, when rudder is applied to remove the drift, secondary effect will produce roll and the glider's into-wind wing will tend to lift, thus negating some of the object of the exercise. Therefore, as rudder is applied, a little opposite stick will be needed too, resulting in slightly crossed controls at touchdown.

After landing, do not allow the glider to leave the ground or it will begin to drift again.

THE WING-DOWN METHOD

In this method the glider is turned directly into line with the landing path and sideslipped by applying bank and opposite rudder so that this path is made good. As the glider nears the ground, a normal landing is made except that the angle of bank is reduced at the last moment to avoid any risk of touching the wing tip on the ground. The landing is made with the into wind wing low and it should be kept in this position after landing, while the glider is held straight with rudder. This method is particularly suited to landing across sloping ground with the wind blowing up the slope. In this case the bank gives greater wing tip clearance which is a great advantage in a glider with a large span low set wing. On flat ground the method has the limitation that only a small amount of bank can be safely used, particularly if the sideslip characteristics of the glider are poor.

If the crosswind is very slight, this method is the easiest as it is only a matter of making a normal landing with a little bank applied.

CONSIDERATIONS

Sooner or later you are bound to misjudge a crosswind landing and land with drift. If the landing happens to be a heavy one, damage will often be caused to the skid, skid fixings or rubber shock absorbers. The chances of such damage can be greatly reduced by making sure that the initial touchdown is made on the wheel, as this will stand all but the heaviest sideways load without damage. If the landing is made with drift, a violent swing into wind will usually occur and must be prevented by immediate firm use of the rudder.

When landing out of wind, avoid approaching near to obstructions or other gliders so that even if the drift is not fully corrected, there is no danger of drifting too close to them or swinging towards them after landing.

There is always a tendency for the glider to bank when the rudder is applied to yaw the glider straight. This must be prevented by using the ailerons to keep the wings level or slightly wing down into the wind. The glider will start to drift seriously if it banks out of wind and a firm correction would then be required on the rudder to swing the nose of the glider further out of the wind to eliminate the drift. If the crosswind is strong, it is easier to keep the into-wind wing low if the landing is made with a slight over correction of drift.

As previously identified, gliders with the wheel mounted forward of the CG have a strong tendency to weather-cock into wind. Special care must be taken with these machines, as, once a serious swing has developed, the rudder may be quite inadequate to keep control.

PRE SOLO ASSESSING AND FIRST SOLO

CONSIDERATIONS

A student only becomes really confident in his own ability to fly when he proves he can do so without the aid of an instructor. Therefore, there are obvious advantages in allowing him to go solo as soon as he is fit to do so.

On the other hand, there is considerable risk in sending a student solo before he is ready for it. The danger is not only one of physical damage to the student and the glider, but also the effect on the student's confidence if he flies badly.

It is clear from these two considerations which are to some extent contradictory, that the instructor must exercise careful judgement in the matter.

Safety before polish with the skill to handle the degree of responsibility given him, is the standard a student must attain before first solo.

Assessing a student is a continual process throughout the training syllabus, and the instructor or instructor panel can *assess* a student as ready for first solo when he has completed the training syllabus with a reasonable degree of proficiency in all sequences.

It is advisable to have a training syllabus check list for the student and each sequence signed by an instructor when the student has proved his ability and can communicate enough information to convince the instructor that he understands the essential points of the exercise.

Instructors should be careful in their assessment of a student's ability and make sure that he really understands each sequence, is completely orientated and not just flying on the rails using fixed reference points around the aerodrome, using fixed altimeter heights, etc.

The first solo always seems to be a big step to the student. The instructor can do much to make this step appear in its proper proportion - simply a normal part of training.

ASSESSING

The Principles of Instruction outlined in Considerations, namely, Responsibility, Communication, Orientation, Skill and Safety, form the basis for assessing a student's preparedness for solo flight.

The rule that instructors should apply in their assessment of the student is **“Safety before polish with the skill to handle the degree of responsibility given”.**

As the student is being sent solo in the dual aircraft in which he has been trained and while he must be able to fly this aircraft without reasonable risk of damage, he does not need the skill required for immediate conversion to a solo machine.

The instructor or instructors' panel must carefully assess that the student has attained the standard of safety, has communicated an understanding of the basic theory of the exercises in the training syllabus, has the degree of skill and the mental/physical orientation that is sufficient to cope with this responsibility.

What does the instructor look for and require from the student to arrive at the decision that he is ready for solo flight?

RESPONSIBILITY

Has the student shown that he is ready to take over responsibility from his instructor? For example, can the instructor sit back relaxed on several flights with the student, without having to handle the controls or cue the student at any stage?

On the other hand, if the instructor feels if necessary at any *stage* to be close to the controls, or give advice during any sequence or stage of the flight, the student requires further training before solo.

COMMUNICATION

Has the instructor got over to the student all the information he needs to know? (Check training syllabus and see all sequences have been covered).

Has two-way communication been established? The student can feed back sufficient information about each sequence to convince the instructor that the student does, in fact, understand the essential points of the sequence.

It is important that the instructor knows why a particular student makes an assessment and what cues are being used.

When doing, say, circuit work, the student should be able to tell the instructor how things are going. For example:

"The angle looks a bit steep at this stage, so I will move out a little ".

By having the student communicate in this manner, it is easy for the instructor to see if the student's assessment is correct or not.

If the student has had more than one instructor, it is important that the instructor's panel, or the instructor concerned, should have agreed in principle that the student has absorbed all aspects of the syllabus and is ready for solo subject to final flying checks.

ORIENTATION

Physical Orientation. Is the student flying on fixed references?

The instructor scrambles the fixed references by placing the student out of position in the circuit to see how he recovers the situation. If he is thoroughly orientated and not in fact using fixed references (specific physical turning points, altimeter heights, etc), he should be able to plan a circuit giving a normal base, approach and landing. As an extension of this, a student pilot should be comfortable in both left and right hand circuits.

Mental Orientation. Is the student likely to panic if he gets into a tight spot?

The instructor not only scrambles the fixed references, but also puts the student in a position where he is faced with very little time to scan the situation and decide on the course of action.

It is desirable to place the glider in such a position that the student is faced with two alternatives - one would be the right one, and the other obviously wrong. The student must, at some stage before solo, be deliberately run out of height in the circuit. The instructor must be sure that the student will confidently carry out a modified circuit and not be tempted to return to the launch point.

SKILL

Has the student acquired sufficient skill to fly the glider solo safely?

The student has not necessarily acquired polish at this stage, but consistent flights do prove that he can fly the glider where he wants to go. A short check list for skill assessment could be as follows:-

- Reasonably accurate turns.
- Good judgement in respect of altitude.
- Good judgement around the circuit.
- Reasonably accurate speed assessment by relationship to sound and attitude. Some experience in flying with air speed indicator and altimeter blanked out.
- Consistently good take-offs, launches and landings.

The student, having satisfied the instructor or instructor's Panel of his proficiency on the outlined checks, would certainly be assessed as being prepared for solo flight.

SAFETY

Checking on safety should be continuous throughout the training programme.

Just because a student checks out satisfactorily on say, spin and recovery once, the instructor should not let the spin and recovery check drop from the programme. Checking must be continuous on all points of safety until they become instinctive safe habits in the student.

The instructor or Instructors' Panel should not consider the student prepared for solo flight until he has acquired a high degree of safety.

Considering that the student is not highly skilled at the first solo stage, we reduce the possibility of an accident to a minimum by insisting on the high standard of safety habits.

Tenseness. Tenseness may well be a predominant factor in a lot of accidents. The student must be reasonably relaxed in his flying. This could be assessed by noting student's ability to cope with an altered situation (e.g. sudden loss of height on approach or having to land from an unfamiliar position) and whether he is able to carry on a conversation on other subjects while flying. Has the student proved by demonstration and communication that he has acquired safe habits and the knowledge and limitations of all sequences?

Final assessment should take into account:

- Cockpit checks.
- Airmanship.
- Good Lookout.
- Launch Failure Procedures - *all stages – use caution on early stage of launch.*
- Placard Speeds and Limitations.
- Good Circuit Procedure, Approach and Landing.
- Stalls.
- Incipient and full spin recovery.
- Awareness of impending spin.
- Safe Speed near the Ground.
- Knowledge of Flying Rules and Regulations.
- Flight without instruments.
- Modified circuits

FINAL CHECKS

The instructor, having satisfied himself that the student has completed the training syllabus, must base his decision as to when to send the student solo - not only on flying ability and degree of responsibility, but also on health and mental outlook at the time.

The student should not be promised a future time at which he will go solo; nor should he be asked whether he feels competent to do so.

The student may protest and a few reassuring words from the instructor may be required. However, if the student cannot be reassured, under no circumstances should he be forced to fly solo against his will. The instructor should ascertain from the student any sequence about which he feels apprehensive, and further dual flights should be made with emphasis on the sequence in question until the doubt in the student's mind as to his ability to handle the sequence is eliminated. At this stage the prospect of solo will usually be most acceptable to the student.

The instructor must resist any pressure from an overconfident student to send him solo prematurely.

Female pilots. It may be particularly dangerous for female pilots to fly during the first three months of pregnancy, or to fly solo during pregnancy. Instructors should bear in mind that the physiological make-up of women is such that it may be periodically inadvisable for them to fly.

PRE-FLIGHT BRIEFING AND SOLO

Everything should be in readiness so that the student can be sent off after a dual flight with the minimum of delay and in the same glider.

Briefing should be kept to a minimum and only those things which he will find different (e.g. improved rate of climb on the launch, lower rate of sink, different trim positions and glider "feel") when flying solo should be mentioned.

These points should be stated in an easy manner to show that the instructor has every confidence in the student. The instructor should carefully observe the flight and make appropriate post-flight comments.

BASIC PILOT CERTIFICATES

THE "A" CERTIFICATE

Provided the first solo flight is satisfactory, a second solo flight may be authorised immediately or shortly following the first. Subsequently, for a period depending upon his progress and the frequency with which he flies, dual checks are recommended each day before the student flies solo. Instructors should carefully observe these flights and make appropriate post-flight comments. This leads naturally into the test for the "A" Certificate.

The test consists of two parts, theoretical and practical.

"A" Certificate theory test

The theory test consists of an oral examination, set by GFA and provided to each club for the testing of individual pilots. It is a very simple and straightforward test, consisting of Basic Theory and Flight Rules and Procedures. It may be carried out by any instructor at the discretion of the club CFI. The working reference for the student is "Basic Gliding Knowledge", published by GFA. It is left up to the instructor to carry out the test as sensibly and honestly as possible, with the objective of ensuring that the pilot has no basic misunderstandings about the two areas tested. It is not a "pass or fail" examination and the book may be referred to if necessary during the test.

"A" Certificate practical test

This is no big deal either. The instructor knows that the student has received training in all basic flying sequences, otherwise solo flight would not have been permitted. The check may only take place after the student has completed five solo flights with normal landings and should consist of

(a) an awareness of pre-spin symptoms and a demonstration of the correct action to prevent a spin developing;

(b) an accurate circuit without reference to the altimeter; and

(c) correct handling of selected emergencies at the discretion of the instructor.

NOTE: "Awareness" of pre-spin symptoms does not supersede the need for full spin training. No pilot will be permitted to fly solo in the first place unless this has been completed satisfactorily.

When the instructor is satisfied that the student has met the requirements of the theory and practical tests, the appropriate paperwork is completed, signed and forwarded to the address on the form.

An "A" Certificate pilot may only fly solo under the direct supervision of an instructor and may carry out local soaring only.

THE "B" CERTIFICATE

The "A" Certificate is the first step in the training of a pilot. From this stage on, if dual training is neglected, the pupil will not appreciate how much he does or does not know and may become under or over-confident. On the other hand, if he is subjected to too much dual he is liable to become impatient and bored, has less chance of developing initiative and may be at a loss if his instructor is not there to look after him.

If is therefore necessary to strike a balance between dual and solo exercises and gradually lead a pilot to where he is fully competent. The purpose of the "B" Certificate is to achieve this balance.

The "B" Certificate requires another theoretical test but no practical test. There are, however, certain flying requirements that must be met before a “B” Certificate may be applied for.

"B" Certificate theory test

This is similar to the "A" Certificate test, except that Basic Airworthiness is added to the subjects to be tested and additional questions are asked about Basic Theory and Flight Rules and procedures. The introduction of Basic Airworthiness into pilot training is designed to make it easier for pilots to become qualified as Daily Inspectors as their flying training progresses.

"B" Certificate flying requirements

(a) A total of 15 solo flights with normal landings, including at least one soaring flight of not less than 30 minutes duration. (Note that this means a grand total of 15 solo flights, not 15 since the "A" Certificate was gained).

(b) Completion of post-solo training syllabus and all post-solo sequences signed off in the pilot's logbook and/or training card.

The post-solo syllabus is as follows:

- Revision of stalling sequences.
- Revision of incipient and full spinning sequences.
- Revision of launch emergencies.
- Problem circuits (instrument failure, running out of height, different circuit directions, etc.).
- Cruising and descending on aerotow.
- Use of flaps and retractable undercarriage (if not covered pre-solo). Sideslipping. Steep turns.
- Thermal centring techniques - most efficient use of lift (if not covered pre-solo).
- Launch speed signals (auto/winch), if not covered pre-solo.
- Crosswind takeoffs and landings.
- Formal radio procedures.
- Revision of Rules of the Air.
- CTAF/MTAF procedures.

The "B" Certificate pilot is limited to local soaring and may carry out mutual flying with a pilot of similar or higher qualifications, under the direct supervision of the Duty Instructor, who shall designate the command pilot for the flight(s).

THE "C" CERTIFICATE

The purpose of the "C" Certificate is to prepare the pilot for two further steps:

(i) Cross-country flying.

(ii) Carriage of "family/friend" passengers.

With this in mind, the "C" Certificate calls for further demonstrated soaring ability, some basic outlanding training and a passenger awareness briefing. Specific requirements are as follows :-

"C" Certificate theory test

Similar in method of conduct to "A" and "B" oral theory tests. Subjects to be covered are: -

- basic theory;
- basic navigation;
- basic meteorology;
- airways procedures;
- outlanding hazards;
- post-outlanding actions;
- SAR requirements; and
- basic principles of passenger awareness.

"C" Certificate flying requirements

1. A total of 20 solo or mutual flights, including two solo soaring flights of at least one hour's duration each. (Note that (a) this means a grand total of 20 solo/mutual flights, not 20 since the "B" Certificate was gained, (b) only time in command of mutual flights counts).
2. Trained and checked in ability to carry out a safe outlanding.
3. Received a "passenger awareness" briefing", using the "Air Experience chapter of this Handbook as a reference.
4. Demonstrate satisfactory spin entry and recovery. This may be carried out dual or solo (observed from the ground) at the discretion of the supervising instructor.

The "C" Certificate pilot may fly cross-country and/or carry "family/friend" passengers (not Trial Instructional Flights and not Charter flights) at the discretion of the Instructor's Panel and under the supervision of the Duty Instructor.

FLYING IN MORE DIFFICULT CONDITIONS

A pilot should be coached in flying in more difficult conditions in line with his demonstrated ability on dual and solo flights. The Instructor should consciously consider this aspect of a pilot's flying and not let it develop haphazardly. Initially, being brought forward to the middle of the day from the calmer conditions will be a step.

Some aspects of more difficult conditions are:

- Strong winds;
- Gustiness;
- Turbulence;
- Areas of strong sink;
- Stronger crosswinds;
- Wind gradient;
- Effect of rain on laminar flow wings.

AEROBATICS

Introduction

Although aerobatics are not an essential part of pilot training, they may be used to build confidence in manoeuvring the aircraft. No manoeuvres should be permitted to be carried out solo unless dual training has been satisfactorily completed (and the fact recorded). Solo aerobatics must also be authorised by the Duty Instructor, unless the pilot is considered by the panel to be suitable to hold a logbook endorsement authorising aerobatics to be carried out without direct authorisation.

Some gliders are permitted to carry out simple aerobatic manoeuvres such as the loop, stall turn, and the chandelle or wing over. These may be used as exercises in manoeuvring the aircraft in the three basic planes.

With the introduction into club service of high performance sailplanes with practically no control forces and high rates of acceleration, quite high "g" loadings can be applied before the pilot is aware of the loadings involved. In addition many such sailplanes have semi or fully reclined seating positions, and pilots flying such machines do not feel "g" forces to the same extent as in a glider with a more upright seating position. For these reasons aerobatics in this type of aircraft should be treated with caution and should never be carried out unless an accelerometer is fitted.

Aerobatics should not be carried out in turbulent conditions. Placard speed limitations must not be exceeded. The pre-aerobatic check must be carried out immediately prior to manoeuvring the aircraft.

Air exercises

Before attempting aerobatic manoeuvres or approaching extreme attitudes the following exercises are recommended to familiarise the pilot with the "feel" of the aircraft: -

1. Flying at safe speed

   The pilot should fly the aircraft at varying speed throughout the full range of the flight envelope and be familiar with the varying "feel" of controls.

2. "G" Loading

Positive "g" loading can be effectively applied in a steep turn. The pilot should be familiarised with positive loads up to 3 "g" with respect to stick force. Confirmation by accelerometer is essential.

3. Exercise airbrakes at speed

   The airbrakes should be exercised cautiously whilst flying at all speeds up to maximum allowable for their operation.

Orientation

All aerobatic manoeuvres should be performed with reference lines such as a line feature on the ground and/or on the horizon. Thus aerobatics should not be attempted in conditions of poor visibility.

The loop

This is quite a simple manoeuvre if executed properly.

Basically it is a 360 degree rotation in the pitching plane. Entry is made from straight and level balanced flight along a line feature after the correct speed has been obtained in a dive. (Refer Pilot's notes for aircraft). The stick is eased back progressively until the required rate of rotation is obtained. The back movement is increasing continuously as the speed decays on the "up" side of the loop, and in most gliders is almost all the way back as the glider reaches the inverted position. The wings should be maintained level whilst horizon reference is available. The backpressure is maintained as the aircraft approaches the inverted position. The nose will fall past the horizon and the aircraft should be flown out of the dive along the line feature with the same rate of rotation as was established initially. On the way down the reverse occurs, i.e. a gradual easing of the stick forward in order to prevent too much build up of "g" in the latter stages of recovery to level.

If the initial rate of rotation is too slow, a nose high stall, and possibly a tail slide, may result. If this situation appears imminent, the controls must be held firmly with the stick and rudder neutral.

Common looping faults are:

(a) too abrupt a pull-up at the start of the manoeuvre;

(b) failure to progressively keep the stick coming back as the glider pitches up into the loop; and

(c) failure to relax the back stick after the glider has passed the inverted position.

The chandelle

This is a positive "g" manoeuvre in the pitching and rolling planes in which the aircraft is turned through 180 degrees with maximum gain of height.

Entry is made as for the loop, slightly less speed being required. The stick is eased back until in a steep climb when bank as for a steep turn is applied. Angle of bank may not exceed 90 degrees. The aircraft flies over in the direction of the bank. Positive "g" is maintained.

Note that the "Stall Turn" manoeuvre is not recommended in gliders, due to the risk of a tailslide.

The wing-over

The wing over is useful for maintaining a lookout between other aerobatic manoeuvres and for establishing a dive in any direction. In this case, the turn is not necessarily through 180 degrees.

Caution, high-speed stall

It must be remembered that a wing stalls when the critical angle of attack is reached, irrespective of the air speed. Care must therefore be exercised in any aerobatic manoeuvres to ensure that too rapid or coarse movements of the elevators do not cause a very rapid pitch up which, coupled with the inertia of the glider, results in the stalling angle of attack being exceeded. A high-speed stall may result in a violent rolling flick manoeuvre that may cause damage to the aircraft, and pilot disorientation.

Rolling manoeuvres

Rolling manoeuvres should only be carried out in gliders that are cleared for such manoeuvres. See Flight Manual or C of A. Until a suitable aircraft becomes available in Australia to give dual instruction in slow rolling and inverted flying, a pilot wishing to carry out these manoeuvres should obtain experience in a suitable powered aircraft accompanied by an authorised aerobatics instructor. Due to loads imposed during rolling manoeuvres, especially if mishandled during practice, such manoeuvres must never be attempted solo, without proper instruction beforehand.

Flight loads

All potential aerobatic pilots and particularly Instructors should be familiar with typical flight loads imposed by aerobatics, with respect to the glider's manoeuvre envelope. See "Basic Gliding Knowledge". It is desirable that all instances of possible overstressing of aircraft are reported and pilots should be encouraged to do so. Such reports require careful handling by the instructor to prevent pilots becoming reluctant to report future incidents.

CONVERSION TO ANOTHER TYPE

This section is concerned primarily with conversions from two-seaters to single-seaters. It is not intended to cover the case of conversion between two-seaters, where there is an instructor on board at all times.

This conversion syllabus is in two parts:

1. Initial. This part will enable the pilot undergoing conversion to safely operate the glider in the local area.
2. Advanced. This prepares the pilot to operate the glider on cross-country flights or into the more advanced areas of soaring.

Initial

Before starting the conversion, the instructor should check that the pilot meets any prerequisites for conversion to type. These may include things such as check flight results, Instructor Panel approval, etc.

The pilot undergoing conversion should read and understand the Flight Manual or handling notes for the type.

Before seating the pilot in the glider, the instructor should point out the following: -

- Ground-handling equipment in use for the type.
- Daily Inspection requirements.
- Pre-flight inspection points.
- Towhook positions.

- Tail chute attachment and jettison/repacking procedures.
- Weight and balance, ballast weight attachment.
- Placard speeds.
- Canopy locking/jettison system.
- Seat and rudder pedal adjustments.
- Location and operation of wheel-brake control.
- Airbrake and flap operating system.
- Undercarriage operation, warning system, test procedure and interaction with airbrakes.
- Tail chute operating procedures.
- Cockpit ventilation system.
- Instruments, electrical system, radio, oxygen.
- Trim setting for take-off.

As the pilot undergoing conversion may never have worn a personal parachute before, a briefing on the wearing and use of this item should be covered, ensuring that the parachute harness is properly adjusted so as not to create a hazard if the pilot should need to bail out.

The pilot should be encouraged to use his imagination in trying to predict the likely handling qualities of the new type. For example, a small tail and long-ish nose are likely to bestow poor directional stability qualities on the glider (e.g. Std Libelle) or a deep fuselage and aft-mounted belly hook are likely to produce a steep climb on a winch/auto take off, especially with a light pilot (e.g. Ka6CR). In this way, the pilot can learn how to "self-brief" and eliminate surprises when meeting new gliders for the first time.

The flight performance and handling characteristics of the glider should be discussed, even though the pilot may have read about some of them in the Flight Manual. Topics for discussion are: -

- Pre-stall warning and stall quality.
- Spinning and recovery.
- Sideslipping (some glider have unpleasant characteristics if slipped with airbrakes out).
- Minimum sink and maximum L/D speeds.
- Circuit and approach speeds.
- Working speed-band on winch/auto launch.
- Any operating restrictions and/or peculiarities.

The pilot should strap into the cockpit, with parachute (if applicable), and sufficient time should be allowed to become familiar with the layout. All controls should be within easy reach. With the canopy closed and locked, show the pilot the tail-down landing attitude, raise the tail to show the level attitude and rest the nose on the ground to show the extreme nose-down attitude. The briefing should end with the exercises to be covered and the area in which to operate.

The pilot should be launched without undue delay, while the briefing is still fresh in the mind. The briefed exercises should be covered and as much of the flight as possible should be observed from the ground by the instructor responsible for the conversion.

Advanced

Instruction in the advanced aspects of a conversion may cover the following items: -

- Water-ballast system (wing-mounted water). This will include filling and dumping procedures, dumping time and safety precautions. The pilot should carry out at least one local flight with water-ballast before flying cross-country in that configuration.

- Water ballast (fin-mounted water). This will cover CG control, relationship of fin water to wing water and procedures for establishing how much water to put into the fin.
- Rigging/de-rigging. This should be covered before the pilot carries out a cross-country flight.
- Electronic vario/nav system. General briefing on its various functions.
- Oxygen system. General briefing.

General notes

When carrying out the check flight prior to a conversion, it is a good idea to put the conversion pilot into the back seat of the two-seater. This is especially valuable to accustom pilots to the restricted forward visibility of some types (e.g. Std. Jantar 2). Following successful completion of the conversion the instructor should annotate the pilot's logbook. Individual clubs may have specific requirements for the amount of local flying in new types before being allowed to take them cross-country. This should be kept in mind by supervising instructors.

ELEMENTARY SOARING

General

Elementary soaring can be taught in both pre-solo and post-solo stages. Indeed, a soaring flight can be most valuable as it not only provides instruction or practice in thermalling but the height gained is invaluable for teaching or practising other sequences. When the student has completed his basic "turning" training he can attempt to stay in a thermal. The Instructor should do the initial finding, centring, working to a safe height and such subsequent centring as is required. During the practice, the Instructor can apply a little polish to the turning, and provide a little information on thermals and thermalling in a free-and-easy conversational manner. This gives a practical introduction to soaring and also, as thermals are often a little turbulent, excellent practice in maintaining turns.

The importance of a good lookout must be stressed. The Instructor should watch for signs of fatigue or airsickness. If the student has been flying reasonably well, towards the end of the period the Instructor can say that prolonging the flight will be entirely up to the student. He can then fold his arms, admire the view, and keep silent. The student generally gains great satisfaction from the first soaring he knows he has done entirely unassisted, even if the gain is only a few hundred feet.

The experienced power pilot is a special case. Frequently it will only be necessary to explain the technique (though the explanation could be lengthy) and to demonstrate one thermal. Follow up can be as circumstances warrant.

Thermal indicators

Such points as clouds, other gliders soaring, windsock indications, birds, dust, smoke, agitated trees, ploughed ground, known good areas as thermal pointers and possible sources should be mentioned casually in conversation on the ground and tried as opportunity offers in the air. Later, a suitable search plan may be recommended.

Centering

Most pilots develop their own ideas, methods and variations on the centring, etc and discussion among gliding people can become very involved, so that it must appear most bewildering to a new pilot. The Instructor should decide on some simple method for basic centring and instruct with this. The necessary variations can come later. The following is suggested as a simple yet effective method: -

- If the thermal can be felt, with a surge on entering and a drop on leaving, roll level on the surge and after a few seconds, roll into the turn again.
- If the thermal cannot be felt, use a mechanical method such as "tighten on the sink" or "roll straight for a few seconds, 60 degrees after the worst heading". Details of the methods, especially the mechanical ones, should be on charts on the Club Room walls. Excellent diagrams can be found in the standard gliding textbooks. These charts give the pupil a chance of self-study.

For the initial training on centring, the best advice that can be offered is not to make it too complicated.

An easy and general method is: -

- After three seconds of lift, roll into an accurate turn

  (a) on the side of the up going wing;

  (b) into the wind;

  (c) whichever way looks like being right by any other indications;

  (d) in the absence of any of these, either way.

  Make two complete accurate turns to assess the position before making a correction. When centring, fly by attitude and be sure to keep a lookout scan going.

Airmanship

As occasion offers, draw attention to possible dangers and points of airmanship such as: -

(a) the danger of low thermalling (Clubs should specify a minimum height)

(b) the danger of drift

(c) spinning out of a thermal

(d) the safer areas to search with regard to circuit planning

(e) misjudging the height, speed, and distance after a long flight.

Last, but by no means least, the quality of the pilot's lookout must be constantly checked. The Australian average is one mid-air collision between gliders per year. Gliders seek out relatively small areas of rising air and are bound to congregate together on a busy soaring day, so there is a definable risk that must be managed.

It is wise to specify that the first few solo flights be non-soaring circuits with the whole attention devoted to circuit planning. In the early solo flights that follow, the Duty Instructor should brief carefully as to what soaring is permitted and he should stipulate what conditions he feels should be adhered to in the interest of safety, taking the ability of the pilot into account.

Thus we have our early solo pilot able to centre on and keep in an average good thermal, flying at first under fairly close supervision.

At this stage the student has a little basic knowledge and experience of thermalling, and although he should be further instructed on the ground and with advantage on dual flights, he is now in a position to take part in discussions on soaring with other club members. From these discussions he will learn much from the experience of others. However, the instructor should tactfully warn the student against accepting all the advice he receives. The student should sift it and try it out for himself.

In these ways he can gain knowledge of how to work narrow thermals with strong cores, of holding on to "no sink", thermalling in strong winds, use of clouds, use of cloud streets and use of the ground, etc. This process can extend over a long period, possibly a full soaring season or more.

An instructor should be on the lookout for potentially dangerous habits that may develop, e.g. drifting too far from the strip, flying to the limit of gliding distance. An outlanding under these circumstances will need careful investigation to establish the cause. However, it is wise to remember that, if caught out, an outlanding is a better alternative than attempting to regain the field with marginal or insufficient height.

The danger of accidentally entering cloud should be stressed.

If possible, some practice should be given of flying with another glider in the same thermal. The first glider entering the thermal sets the direction of the turn and any others joining the same thermal, whether above or below, must turn in the same direction. Rules of the Air deal with this subject. See the GFA publication "Basic Gliding Knowledge".

It is essential that pilots are coached in the correct methods of joining a thermal and sharing it with other gliders. Pay special attention to keeping out of the blind spots of other gliders. The dangers of aggressive and selfish behaviour must be emphasised, and the instructor must follow up any such reported cases. Pilots must realise that sharing a thermal will usually result in a reduced rate of climb for all concerned, due to the need to keep each other in sight, and this must be accepted.

ADVANCED SOARING

Thermalling

Finding and using the thermal are the key points to cross-country flying. The more efficiently a pilot can do this, the greater distance he can travel or the higher average speed he can maintain. Thermalling is a continuous process, but for analysis it may be examined under the following headings: -

- When to thermal;
- Areas of Search;
- Methods of initial centering;
- Holding and improving the climb; Leaving the lift.

The information provided on each section may be regarded as a starting point for the instructor to expand on from his own experience.

When to thermal

(a) Use all available thermals when:

1. Aiming for duration;
2. Very low;
3. The thermal ceiling is low (i.e. ,2,000 feet);
4. The distance between thermals is large.

(b) Be selective but be prepared to lower requirements as height diminishes when:

1. The thermal ceiling is moderate;

2. Thermal strengths are moderate (2 to 3 knots); 3. Thermals are frequent.

(c) Be very selective when:

1. The thermal ceiling is high;
2. Thermals are strong (6 to 10 knots).

As the flight progresses, from the thermals encountered the pilot will be able to set a minimum strength level that the next thermal must reach, before he will make even an exploratory circle.

This acceptance level may vary considerable during the flight with time of day and sailplane height.

Areas of search

The following areas have been found to produce useable thermals. Allowance must be made for the wind causing position changes with height.

1. Light wind conditions:
   - Dark fields
   - Dried up swamps
   - Small and medium towns
   - Isolated forest areas
   - Sunny upwind slope of a hill
   - Areas with major changes in the surface colour.
2. Moderate wind conditions:
   - Tree lines along large rivers.
   - Wind shadow area of a hill
3. Afternoon:
   - Sunny slope of a hill.
   - Moderate size area of shallow water.
4. At or near Cloud level:
   - Under the darkest area.
   - Under the most concave area.
   - On the upwind side.
   - On the sunny side.
   - Close under lines of clouds.

More on centring

One mechanical centring method has been described in the elementary soaring section. The Instructor may provide other methods and even demonstrate if the opportunity permits. A number of methods are described in a wide range of commercially available books by a variety of authors.

It is suggested that with these mechanical methods, the pilot uses them and after some experience he will adopt those which he has found most successful.

If the pilot is having difficulties the instructor should be brief on one or two methods at most and carry out some dual soaring providing assistance if necessary, but using only the methods selected.

As the thermal strength increases, the sailplane may be flown at increasing speeds between thermals, under the guidance of the McCready ring and up to the placarded Rough Air speed (Vra).

The pilot will require considerable practice on each sailplane type to reduce speed and enter a turn that centres the thermal with the minimum of readjustment. Watch for any tendency to pull up steeply into a thermal, as this poses a great risk of collision with a glider which may be in the blind spot to the rear.

Using a speed-to-fly ring on a total energy compensated vario will aid this by indicating a reduced speed before the turn is started. However, on a strong day, sharp edged thermals are often encountered.

For the pilot who aspires to longer cross-countries and competitions, this skill is one which can greatly improve his performance.

Maintaining and improving the climb

Once the sailplane is reasonably centred, it must not be expected to remain so until the top of the thermal. Some reasons are: -

- Variations in direction of the thermal;
- Discontinuities due to a wind shear;
- Roughness.

This may cause a well-flown sailplane to lose the centre or contact altogether. The thermal will have to be recentered or perhaps discarded.

Unless the indications are exactly even all around the circle or at maximum reading, it must be considered that the thermal is imperfectly centred. The pilot should continue his centring action until this is achieved.

If the indication is even, but a lower value than hoped for, the circle should be widened in a search pattern and recentered on any better indication found.

Leaving the lift

The thermal should be left when sufficient of the following conditions are met, consistent with adequate height: -

- The sailplane is high enough for a final glide;
- The lift has fallen to equal the acceptance strength;
- The legal distance from cloud base is reached;
- The thermal has become too rough or broken for efficient flying;
- The presence of other sailplanes is causing a reduced rate of climb;
- The height is causing lack of oxygen.

CROSS COUNTRY FLYING

Simulated restricted landings

Before a pilot is allowed to land out, even dual, it is preferable that he undergoes some practice on the airfield.

The normal circuit, approach and speeds are used. However, the pilot should display a degree of polish well above the minimum standard.

The Instructor should select an area of the field where the pilot has not landed before. A visit to a nearby field could be used to advantage. This is to remove the familiar approach surroundings as pilots, however unintentionally, use them to assist judgement.

The area should be marked up by any suitable markers. A cotton fence with paper streamers to make it visible is very useful at the approach end. A suitable area is about two wing spans wide and about 50% longer than the minimum length required for landing taken from a safe height above a fence to full stop.

It is most important that the marked area has a safe undershoot and over-run area available.

Many clubs have used a point scoring system and use it as a contest. This can be very useful (and entertaining) on days when no soaring is available and numerous solo pilots are present.

The Instructor must watch the approach and landing and assess the following: -

- The standard circuit was used;
- The normal approach path was used and there was no "hopping" over the fence;
- The airbrakes were not excessively worked in and out;
- The landing was normal, not forced on or "floated" over the fence;
- No excessive nose skid grinding or excessive wheel brake was used;
- The aircraft stayed within the selected areas.

If any of these features are noted, the Instructor should re-brief the pilot before a further attempt. If a pilot does very badly, the Instructor should provide more dual training.

Such landings may be done as part of normal club flying. However, the mere marking out of an area provides pressure that may reveal that further training is required.

Outlandings

It is recommended that pilots do at least one satisfactory "real" outlanding (dual) before being permitted to fly cross-country solo. A ‘C’ certificate is the minimum qualification for solo cross-country flight and full outlanding training is a requirement for this certificate.. Some clubs may have some difficulty meeting this requirement due to their poor surrounding terrain, hence the "recommendation" rather than a "requirement".

Before any outlanding it is essential that the Instructor provide a thorough briefing.

The pilot must have selected a suitable paddock at any time a landing appears likely - i.e. below 2,000 ft. Several paddocks should be selected and the choice narrowed as the glider becomes lower. By the time the glider has to be in the circuit joining area, the paddock should be decided upon and the approach planned.

The basic features to examine in selecting a paddock are:

Size.	Must be adequate.
Surface.	Sufficiently smooth. If furrowed the sailplane must be landed along them even if out of the wind. Stubble is good. Grazing fields must be carefully examined for stumps. Be cautious that bright green fields are not swamps. Standing crop may cause damage if high. Select one without animals, or land in the opposite side.
Slope.	Slope is fairly difficult to detect from the air. Note should be made of any streams or erosion marks to help show slope. If at all steep, the sailplane should be landed up the slope. Care must be taken as it stops that it does not roll down backwards. Generally speaking, if slope is detectable from circuit height, it is probably too steep to contemplate landing in that paddock. If forced to land - go up the slope as

pointed out, but approach a little faster than normal and flare a tiny bit earlier; otherwise possible heavy landing.

Stock. Care is needed if a glider is compelled to land in a paddock containing animals. Sheep are not usually much of a problem. Horses may panic. Cows eat gliders.

Surroundings. Look for power lines, telephone lines, high trees in the approach path. These may force the approach path to be so high that a smaller paddock or shorter direction may have more effective length. SWER (Single Wire Earth Return) lines are the worst hazard, as they are very difficult to see and the poles are a long way apart.

As usual, plan to land into wind. If there is no indication of wind use the longest run. Usually the pilot will be aware of the wind from his drift, dust, smoke, dams or other signs.

Pilots must be trained to assess drift at circuit height. If drift can be detected, that establishes landing direction; other things being equal. If no drift can be detected, landing direction is unlikely to be critical; again other things being equal.

BASIC CROSS-COUNTRY TRAINING SYLLABUS IN 2 SEATER GLIDERS

INTRODUCTION

This section of the handbook contains a GFA recommended syllabus for basic cross country training for pilots of "C" standard, the intention being to prepare them for the Silver badge attempt. The FAI Sporting Code states the intention of the Silver badge as follows: -

> "The Silver badge is intended primarily to develop the self-reliance of the new soaring pilot. The distance flight should be flown without navigation or other assistance given over the radio (other than permission to land at an airfield) or help or guidance from another aircraft".

Therefore the syllabus covers the basic needs of the aspiring cross-country pilot, at the same time preparing him for sharing the air with other users of the airspace.

SYLLABUS

Pre-flight preparation

- Meteorology.
- Task Selection.
- Navigation.
- Flight Planning.

Flight preparation

- Thermalling techniques.
- Meteorology.
- Navigation.
- Radio procedures.
- Airspace types, limits and restrictions.
- Turning point photography.
- Landing areas.

- Outlanding procedures.
- Break-off point.
- Outlanding considerations.
- Post landing actions.
- Retrieve actions and considerations.

More detail on pre-flight preparation

- Meteorology. Information required.
- Synoptic chart and developments.
- Wind direction and speed.
- Cloud, Type, base, tops and amount.
- Fronts, Cold, warm or occluded.
- Dew point. Freezing level.
- Actual temperatures at height in 1000 ft intervals.
- Maximum expected ground temperature.
- Newspaper and T.V. synoptic situation.
- Other lift sources.
- Meteorological hazards. Thunderstorms. High winds. Fronts. Squall lines.
- Weather interpretation and assessment from available weather information.
- Estimated convection time available.
- Assessment of task distance and type.
- Geographical and airspace considerations.

Navigation.

- Charts.
- Compass,
- Heading,
- Track.
- Altimetry.
- Map reading.

Flight Planning.

- Track required.
- Distance.
- Heading required.
- Final Glide.

Flight Preparation.

- Aircraft.
- Pilot.
- Instrumentation.
- Crew.
- Trailer/car/tug.
- Task declaration

Radio.

- Radio preparation.
- Battery.
- Correct use of radio.

In-flight sequences

- Thermalling techniques.
- Lift Sources.
- Entry into thermal.
- Centering/efficient turns.
- Speeds.
- Safety considerations.
- Estimation of drift.
- Orientation.
- When to leave.

Meteorology

- Cloud reading.
- Ground reading.

Navigation

- Use of compass.
- Magnetic variation.
- Map-reading.
- Drift assessment and correction.
- Position fixing.
- Rate of climb.

Radio Procedures and airspace use

- Frequencies.
- Procedures.
- *Discipline.*
- Airspace limits and restrictions.
- Danger, Restricted and Prohibited areas.
- Control Zones and Control Areas.
- Requests for clearances.
- MTAF/CTAF procedures.

Turning Point Photography

- Preparation.
- Technique.
- Position

Outlanding procedures

- Decision height.
- Selection of suitable landing area.

- Break-off point
- Paddock suitability. Size, Surface, Slope, Stock, Surroundings (including hazards).
- Wind direction and strength

Post landing actions

- Glider security.
- Retrieve arrangements.
- Outlanding report form.

Aerotow retrieve actions and considerations

- Paddock suitability.
- Non-manoeuvring areas.
- Take off with or without wingtip runner.
- Last light considerations.

Recommended reading

- Soaring Cross-Country - Bill Scull.
- New Soaring Pilot - Welch, Welch, and Irving.
- Theory of Modern Cross-Country Gliding - Weinholtz.
- Meteorology for Glider Pilots - Wallington.
- General and Aviation Meteorology - Australian Government Publishing Service.
- CAA Radio Telephone Operators Manual.

AVIATION MEDICINE

High-altitude flight

Human beings are so built that ideally we need certain conditions of temperature, pressure and atmosphere composition. As conditions begin to differ from the ideal, compensating mechanisms within our bodies give warnings, and come into action. Above about 10,000 ft some of these compensating mechanisms reach their limit and, unless we take special action, we can be in danger.

Effects of oxygen lack (Anoxia or hypoxia)

Haemoglobin in the blood takes up the oxygen in the lungs, and gives up oxygen to the body tissues as it passes through the capillaries. As the supply of oxygen decreases the less there is available for supplying the tissues and organs. Thus all body organs are susceptible to oxygen lack. In most cases of the body being subjected to conditions it is not meant to withstand, warning is given in the form of pain or discomfort. The insidious nature of the effect of oxygen lack is due to the fact that the first part of the body to be affected are the cells in the brain that give rise to the sensation of pain. In many cases acute lack of oxygen resembles alcoholism. There is no set pattern to attacks. They vary from individual, and even in the one individual; on the rapidity of the attack and the duration of the attack, the muscular activity, and the remaining effects of previous oxygen lack. Excessive smoking raises the level of carbon monoxide in the blood. Carbon monoxide combines with the haemoglobin to the exclusion of some oxygen. Fatigue has a detrimental effect.

A decompression chamber test, clinically supervised, can acquaint a pilot with some of his individual characteristics when subject to oxygen lack. This may be of assistance to a serious Service or Commercial pilot, but could conceivably fall down with glider pilots, who for example, out of sheer joy of the flight, are perhaps not in a suitable frame of mind to be analytical, even if decompression tests were available. However, if such a test is available through a local military base, it is very useful and well worth the moderate charge which is made for the test and its associated lectures.

At 10,000 to 12,000 feet a feeling of hilarity often develops though in some individuals this may be replaced by a feeling of drowsiness. There is an effect on vision that increases with height. As the ascent continues the capacity for self criticism is lost, and the pilot is totally unaware of this. In fact, he is convinced his performance is excellent. Memory is dulled. Hearing begins to be affected at about 18,000 feet and 20,000 feet there is often a fixity of purpose. The ability to reason or judge is lost. A pilot will persist in some action until he becomes unconscious. He has no feeling of the approach of unconsciousness. Death may follow.

Time reserve, if suddenly deprived of oxygen, varies with individuals, but average figures are: -

20,000 feet - 1 and one half minutes;

25,000 feet - 30 seconds;

35,000 feet - 15 seconds.

The effect of oxygen lack on certain body organs is interesting. Co-ordinating of voluntary muscles (those we can move at will) suffers above 12,000 feet. As height increases, the muscular effort possible becomes less and twitching may develop. If may be physically impossible to attend to the oxygen system.

Oxygen should be used above 10,000 feet and must be used above 15,000 feet - heights above Sea Level, NOT Ground Level.

Head cold or similar complaint

Normally pressure on either side of the ear is balanced by the drum being open, on one side to the outer ear, and on the other side to the throat via the eustachian tube. With a head cold etc., the pilot may experience severe earache or even rupture of the drum. The danger to the ear is almost non existent while climbing as air can usually force itself out. While ascending, however, the tube tends to close and remain closed, and this descending presents the greater hazard and is a situation the glider pilot may have little control over.

To free a blocked eustachian tube, it is usual to swallow, chew or even shout. The method of holding the nose and forcing the passage clear with a breath carries with it the danger of transferring infection to the middle ear.

The air in the nasal sinuses expands with altitude. If infection blocks the exit severe headaches result. The sinuses are cavities in the bone, more or less behind and above the nose.

Bends

Dissolved gases are released as bubbles in the blood as pressure decreases. As one ascends, nitrogen bubbles are formed. With the rates of ascent normal to a glider little trouble is likely, as the excess gas escapes without forming bubbles, and in any case, there is little likelihood of trouble under 25,000 feet.

The bubbles, if they form, tend to lodge in joints causing pain. There can be a feeling of itchiness of the skin, sensation of heat and cold in localised areas, at times muscular weakness, vertigo, disturbances of the central nervous system, and perhaps in extreme cases, convulsions, coma and even death. This trouble is known as decompression sickness, aeroembolism, bends, diver's diseases, etc. (It is the same as that suffered by divers returning too quickly from great depths.) Fortunately, the pilot has a quicker and surer method of recovering than divers - he need only descend. It has been shown recently that there is a real danger of trouble if a skin diver flies high after diving.

Other physiological effects

Some other physiological effects of lowered barometric pressure become evident when gases expand within the body as the pressure decreases. There are several areas in the body which contain air or gas. Briefly these can be summarised as the stomach and intestines, the paranasal sinuses and the cavity of the middle ear and perhaps also carious teeth which have been filled or attended to by a dentist.

To deal with the stomach and intestines first, some of the gas in the stomach and intestines is swallowed air. Other gases are produced as a product of the digestive processes. As one ascends the outside pressure becomes less. These gases will expand and in doing so they can sometimes be got rid of from the stomach by the well-known process of eructation and from the low intestines by the less delicate method which everybody knows.

Usually these effects don't give rise to much trouble but a very rapid climb to a reasonable height, for example somewhere around 15,000 feet, may cause such distension in the intestines that physical pain can result. The remedy of course is not to consume any sort of food or liquid that may contain gas before flying. One of the best known liquids in this regard is the carbonated soft drink.

Do not swallow a soft drink before you intend to fly to relatively great heights, especially if you think the climb may be rapid.

Airsickness

Airsickness is most likely to occur in those subject to sea, train and carsickness. It is caused through rough and turbulent air or during manoeuvres of the glider. It appears to be due primarily to over-stimulation of the labyrinth of the inner ear, as a result of acceleration. Technically, a turn is also an acceleration, but linear acceleration seems to be more potent than angular acceleration.

Susceptibility is greater when external visual reference is excluded as is the case when on instruments.

We may list the following causes of Air Sickness:

- Fear Cold
- Hunger Fatigue
- Hangover
- Excessive smoking
- Vibration
- Noise
- General ill-health - especially upper respiratory tract infection and blockage of eustachian tube or sinus infection
- Expectation of being sick
- Sight, sound or smell or others being sick

- A period of absence from flying.

The tendency towards airsickness may be lessened by

- Gradual conditioning
- Being in good general health
- Avoiding fatigue and undue excitement
- Having adequate ventilation
- Being seated for maximum visibility
- Having harness firm
- Not looking in cockpit
- Fixing the vision on a point a long way off
- Avoiding repeating a troublesome manoeuvre
- Avoiding undue movement of body and vision
- Having a sip of water
- Increasing the glucose intake by sucking barley sugar
- Nibbling a biscuit
- Taking medically prescribed drugs. Some motion sickness drugs are known to produce side effects in some people, and so may be unsuited for a pilot.

The ear

In the inner ear we have the bony labyrinth. From it runs the nerve to the brain and to it is attached the chain of vibration transmitting bones from the eardrum. This part of the bony labyrinth (some of the centre part and a spiral snail-shell shaped attachment) for the hearing section.

Another section of the centre part and the semi-circular canals are concerned with balance. The centre part is concerned primarily with the position of the head in relation to the rest of the body. Branching from the centre part are three semi-circular canals, one horizontal and two vertical, set at right angles to each other. Each canal has a swelling close to the centre part of the bony labyrinth. This is the seat of the centre of balance dealing with the maintaining of equilibrium of the whole body.

In the two balance sections mentioned above are sensory hairs set in a liquid. On the hairs are small particles. Any change in position causes a change in tension on the particles. The hairs change position with motion of the fluid. The nerve endings in turn are stimulated and this is transmitted to the brain by the auditory nerve.

Vertigo

Both eyes and ears play their part in our balance. If outside visual reference is removed it is impossible to maintain an accurate knowledge of our attitude by our ear balance mechanism. Balance may be lost within seconds, certainly within minutes. Vertigo is the term used for a feeling of dizziness due to an upset of the ear balance mechanism. In flying it is also used to refer to the almost overpowering false impression of attitude that sometimes develops. This false impression has been the cause of many accidents.

G loads

It is not proposed to discuss the physics of how "G" loads are applied in flight. Suffice to say that in turns and pull-up from dives, the body is subjected to loads - measured in multiples of ordinary weight - so many "G"s. Standing upright, one is subjected to a load of 1 G. It is not uncommon for soldiers at attention to faint due to insufficient blood being received by the brain - this at a loading of 1 G.

In an aeroplane, subject to 2 G (a reasonably tight thermalling turn) the body seems to press to the seat and hands and feet feel heavy. At 3-4 the limbs can only be moved with difficulty. A normal pilot can withstand 5 G for only a short period. Tolerance varies with individuals and can, to an extent, be developed. It is higher after a meal. Very high loadings can be withstood in the supine or semi-reclined position, but we are dealing with orthodox seating here.

As G loads increase, blood accumulates in the legs, thighs and veins of the abdomen. This blood becomes so heavy that flow in the veins to the heart, below heart level, practically ceases. The heart is inadequately filled and cannot pump blood into the arteries - so blood pressure falls. The eye retinae do not receive their necessary blood supply and sight fails. This is the well-known blackout, usually preceded by grey-out. If G loads continue, unconsciousness results through failure of blood supply to the brain.

G-induced loss of consciousness (G-LOC)

Notwithstanding the foregoing comments about grey-out and blackout, research indicates that it is possible to apply enough G to induce loss of consciousness without passing through those two warning stages. The research was carried out on aerobatic light aircraft, not on high-performance military aircraft. The findings are therefore applicable to gliding.

G-LOC may occur if G loads are suddenly, rather than progressively, applied. The phenomenon is therefore unlikely to occur in most gliding operations. However, pilots flying fully aerobatic gliders, possibly in aerobatic competitions, should be aware of the problem.

Medication and flying

Many flying accidents and incidents have occurred as a result of pilots flying while medically unfit. Although common ailments such as colds, sore throats and abdominal pains may cause relatively little discomfort or hazard in the normal course of events, they can be dangerous when associated with flying, and the more exacting the flying task, the more likely are these minor indispositions to become more important.

The ideal situation, that no one should fly at all unless he is 100 % fit and needs no medication, is not always practicable. Since many common drugs and remedies have powerful side effects, however all pilots should know how these may affect their performance.

It is important to realise that not only those medicines prescribed by your doctor, but those readily available over the chemist's counter have undesirable side effects when flying. If taking any medicine, you should ask yourself:

- Do I really feel fit to fly?
- Do I really need to take medication at all?
- Have I given this particular medication a personal trial on the ground at least 24 hours before flight, to ensure that it will not have any adverse effects whatever on my ability to fly?

Medicines to watch

The following are some of the types of medicine in common use which may impair reactions:

- *Sleeping tablets dull the senses, cause mental confusion and slow reactions. The length of time they act on any one individual varies, but may be prolonged, and pilots must have expert medical advice before using them.*

- *Antibiotics - penicillin and the various mycins and cyclines - and sulpha drugs may have short term, or delayed effects which affect the pilot's performance. They are also of importance, however in pointing to the fact that a fairly severe infection must be present to warrant their use. Apart from the effects of the substances themselves, the side-effects of the infection will almost always mean that a pilot is not fit to fly.*
- Fear is normal and provides a very effective alerting system. Tranquillisers and sedatives depress this alerting system and have been a contributory cause of fatal aircraft accidents. You must not fly when taking them.
- Anti-histamine drugs are widely used in "cold cures", and in the treatment of hay fever, asthma and allergic rashes. Many easily obtainable nose-spray and drop preparations contain anti-histamines. Most, if not all, of this group of medicines, tend to make you drowsy. This together with the effects of the illness will prevent you from answering the three basic questions, as above, satisfactorily. Admittedly, very mild conditions of hay fever, etc., may be adequately controlled by small doses of anti-allergic drugs, but a trial period on the ground to establish the absence of side effects is absolutely essential before flying. For those pilots afflicted with allergic conditions requiring more than the absolute minimum treatment, and in all cases of asthma, there should be no flying at all until one of the above-mentioned sources of advice has been consulted.
- "Pep" pills (e.g. caffeine, Dexedrine, Benzedrine) used to maintain wakefulness are often habit forming. Susceptibility to each drug varies from one individual to another, but all of them may cause dangerous overconfidence. Overdosage causes headaches, dizziness, and mental disturbances. The use of "pep" pills while flying cannot be permitted. If coffee is not sufficient, you are not fit to fly.
- Drugs for the relief of high blood pressure cause a change in the mechanism of blood circulation that can be disastrous when flying. If in any doubt about your blood pressure, do not hesitate to seek advice.

Check effects before flying

Many drugs and medicines are now marketed in combination. It is essential that if there is any change in medicine or dosage, however slight, the effects should be observed by the pilot on the ground prior to flying. Ensure that the drug is taken in good time so that its effects can be observed in safety.

Alcohol has similar effects to tranquillisers and sleeping tablets, and may remain circulating in the blood for a considerable time, especially if taken with food. You should not fly less than eight hours after taking moderate amounts of alcohol, and larger amounts require a longer recovery period. The effects of even small amounts of alcohol in combination with other drugs, notably sleeping tablets, tranquillisers, or sedatives, are greatly magnified and may be lethal.

Coffee will not cure a hangover. It merely produces a wide-awake drunk. Time is the only cure.

Following local and general dental and anaesthetics, a period of time should elapse before returning to flying. The period will vary depending on individual circumstances, but it will usually be at least 24 hours. The dentist or anaesthetist should be asked about this.

Many forms of medication, although not usually adversely affecting pilot performance, may do so in individuals who are oversensitive to that particular drug. You are, therefore, exhorted not to take ANY drugs or medicines before or during flight unless you are completely familiar with the effects of medication on your own body. If you are in any doubt at all, ask a doctor experienced in aviation.

Blood donation and flying do not mix. The disturbance of the circulation following blood donation takes several weeks to return to normal, and although effects are slight at ground level, there are risks when flying during this period. It is recommended that pilots do not volunteer as blood donors while actively flying, but if blood has been given, a minimum of 48 hours should elapse before flying.

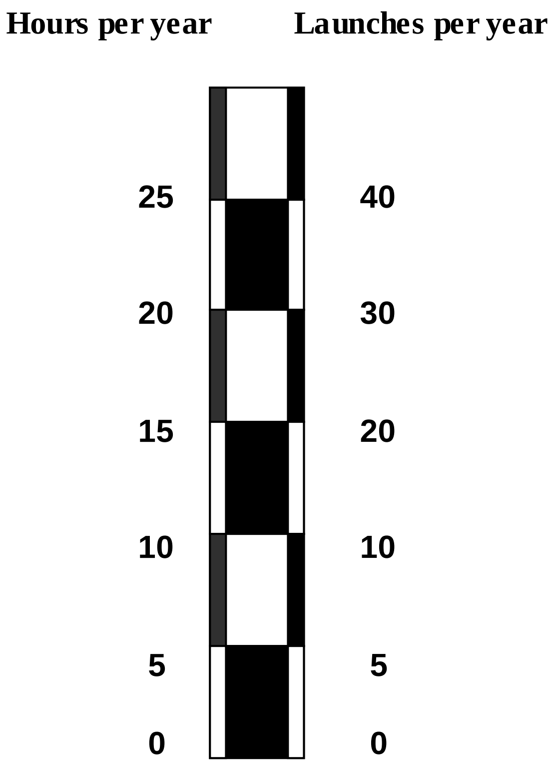
To sum up, the effects of medication on his or her flying performance, is the direct concern of the individual pilot. If in doubt consult the medical sources mentioned for advice.

GUIDE FOR ANNUAL FLIGHT CHECKS

GENERAL

It is a GFA requirement that all pilots undergo an annual competency check by the club CFI or suitable deputy. Regardless of pilot experience, there are certain common factors essential to safety in the air. The following is a guide to carrying out a competency check on a pilot of any experience level. You will notice that the checking procedure contains no reference whatever to any aspects of performance flying. This is not by any means to suggest that such matters lack importance in soaring - indeed they are very important. It does suggest that they are not essential to survival in the air. It is with the problem of survival m the air that we seriously concern ourselves here.

The "Training Condition Barometer" shown below is a useful guide to probable competence. Use it carefully and warily.



Your training condition (in other words, currency) is good, but take care. Watch particularly for bad approaches, sloppy cockpit checks and lack of preparedness for launch emergencies.

You are not as good as you think you are! Be very careful, especially in difficult weather conditions.

You are rusty! Your training condition is unsatisfactory. Seek advice and preferably have a check flight before flying.

PRE-FLIGHT ACTIONS

Check the pilot's logbook. Any unwillingness to allow an instructor to inspect a logbook must be regarded with a healthy suspicion. Check how often the pilot flew, how many different types and at how many different sites. Does the pilot hibernate during the winter and only surface to give us all a fright in the spring? What you see in a pilot's logbook, together with a frank discussion about that persons flying background, can lay a lot of useful groundwork for the flight(s) to come. Bear in mind that the traditional method of glider pilot training used to mean quite intensive instruction to first solo standard, a reasonable amount of supervision to, say, about 20 hours experience, and almost nothing at all after that. Unsafe habits develop unchecked and a lot of retraining may be necessary to ensure that the pilot is steered back in the right direction.

Pilots vary greatly in their attitudes towards check flights. Some object strongly, others take fright at the thought. The great majority accepts the need for such flights, while at the same time suffering some degree of nervousness about the imagined ordeal. This is especially true if spinning is contemplated during the check. It is also quite common to meet pilots who agree that check flights are necessary, but only for someone else.

Define accurately what you want the pilot to do on the check flight. This is an age-old instructional principle, but is still often forgotten by many instructors. There is nothing worse, in either training or checking, than to go into the air with one or both parties uncertain of the objective of the flight. If the pilot being checked has any doubts or fears about any aspect of the flight, now is the time to talk them over. Spinning is once again a good example here - many pilots have fears about this subject that can easily be alleviated by a considerate and competent instructor. It goes without saying that the checking instructor's ability should be beyond reproach, both as a pilot and as a coach.

The whole point of a check flight is that the instructor should recognise any weaknesses in the pilot's flying and rectify them. No more, no less.

THE CHECK FLIGHT

It is of course impossible to check everything on one flight, so we have to decide what it is essential to check, and what we can check if we get time.

Airmanship

One basic essential is airmanship. Does the pilot do a decent walk around inspection before stepping aboard? Again before stepping aboard, does he check the controls properly? Is an emergency plan made before hooking the cable on? It can eliminate a lot of surprises if a pilot expects an emergency on each launch, instead of sitting there, fat, dumb and happy assuming everything will be OK. What about the pre-take off check itself? One of the first signs of overconfidence in a pilot is a tendency to treat checks in a slapdash manner, so watch closely for this one. Pilots trained very rapidly to solo (a course, for example) can demonstrate skill levels greatly in excess of their airmanship capability. Such pilots will need much more careful checking and post-solo training than the average club-trained pilot - a course-trained pilot may never have experienced strong winds or turbulence, for example.

Still on the subject of airmanship, there are several things in this category which are somewhat elusive and difficult to judge. Not so lookout - the single most important aspect of airmanship and usually the first to fall victim to complacency and overconfidence. The pupils are not altogether to blame for this - many instructors spend a lot of time on analysing manipulative and judgement faults, sometimes to excess, while ignoring the fact that the pilot hasn't looked out for some time.

It is sufficient to say that poor lookout is one of the few things which, if not positively improved on during the flight, constitutes definite grounds for curtailing further solo flying and returning the pilot to the two-seater for more instruction.

The launch

On winch or auto-tow, the development of overconfidence is revealed by an early rotation into the full climb, usually on the grounds that "there is enough speed there". It doesn't matter what the ASI says, if the glider is rotated too early into full climb, and something goes wrong (the defensive pilot always reckons that something will go wrong), a very hazardous situation can develop. Don't let them do it.

On aerotow, lack of decent station keeping is usually an indication that the pilot doesn't care very much, and the instructor should insist on a higher standard. One useful pointer to aerotowing skill is to ask the pilot to "box the slipstream". Tell him before take-off that you want him to do this - otherwise he may be uncertain what you mean. It means of course that you will need to explain carefully what you want. During the exercise if something goes wrong, release the rope yourself and take control - in that order. Do not delay. If high tow is used, look for any tendency to go too high in the high tow position. High tow is by definition just above the slipstream, and this will usually result in being directly behind the tug when the position is correct - in fact it can be a little below the tug if the tug is a powerful one. The exercises chosen by the instructor will vary somewhat, but since we are talking about annual checks, will always include spinning (unless it is known beyond doubt that the pilot has done some spinning very recently). If you operate a non-spinnable two-seater you have a problem. Since there is no concession to the spin training and checking requirement, you will simply have to gain access to a spinnable glider. If this means you have to go to a neighbouring club for these check flights, then so be it.

Co-ordination

This is a much-underestimated exercise. To fly in a co-ordinated manner is not only a desirable thing from the point of view of being a smooth pilot - it is absolutely essential to safety in the air. The reason for this is not always clearly understood. Gliders spend a lot of their time at low speed, sometimes at speeds only a few knots above the stall in circling flight. It is a known fact that low speed plus any significant amount of yaw can result in the glider entering a spin. If insufficient speed is the big villain of the piece in stall/spin accidents, then the presence of yaw on the aircraft is surely the second biggest. Uncoordinated flight, especially over-ruddering, carries with it the real risk of loss of control if the speed is allowed to fall.

Spinning

There are 3 stages of spin training in gliders; spin prevention, recovery at the early or incipient stage, and the full spin and its recovery. Glider characteristics in stalling and spinning have changed somewhat over the years, and it is sufficient to say here that a pilot should be conversant with the qualities of the glider he flies, in terms of its pre-spin behaviour and warning symptoms and its behaviour in the various stages of any spin which may develop. Strict adherence to the concept of "safe speed near the ground" should in theory be enough protection to keep spin problems at bay, but life isn't like that and we get enough spin accidents and near-accidents in any one year to make it necessary to train pilots to be knowledgeable and confident in all aspects of spinning. No part of spin training and checking can be neglected.

Circuit, approach and landing

This stage of the flight more than any other tests the pilot's accuracy, airmanship and judgement all at the same time. Watch for over-reliance on the altimeter and any tendency to fly with reference to fixed objects on the ground. These characteristics will almost certainly be present in pilots who have become site-bound, and it is essential that these pilots are retrained in the use of the angle/distance relationship when planning the circuit. Keep your eye open for loss of co-ordination at low altitude - it is a known characteristic of pilots under training, and if it remains unchecked can be very hard to eradicate.

Inexperienced pilots will often over-rudder base and final turns. MOST IMPORTANTLY, check for any tendency to let the glider fall below its safe speed near the ground. This often happens with early pilots, especially if they get a bit lower in the circuit than they intended to. Even quite experienced pilots sometimes do it unconsciously if they get a bit low. Don't nag your pilot under check, especially if the air is rough and the speed is varying a bit - just keep your eye on any tendency to fly generally too slow. Finally, on the approach, look for any tendency to open the airbrakes "automatically" as soon as the final turn is completed. Such action almost certainly means that the pilot is not consciously monitoring the overshoot/undershoot situation on final approach, and is known to have caused many problems of undershooting into the boundary fence. Pilots who do this may never really have been taught the proper use of airbrakes - yet another case of training work needing to be done on a check flight.

Low G

One further thing to be looked at on an opportunity basis on check flights. The phenomenon of low G is a problem area which has only recently been recognised, largely through the circulation of an excellent paper on the subject by Derek Piggott. For those who haven't read the paper, the problem arises when a sensitive pilot is subjected to G forces less than one. Now it is important to understand that this does not involve great quantities of negative G - in fact we are talking about a situation where we don't even get as far as zero G. We are talking about the "lightness" one feels when the stick is moved forward at cruising speed, a sensation which has been likened to driving over a humpbacked bridge. There would be no more than about one third to one half G involved, if that.

The main problem occurs if a pilot has been trained in stall recovery by pushing the stick forward quite hard, and thus producing an increment of low G. This pilot then equates a low G sensation with the stalled condition and is likely to continue pushing the stick forward in an attempt to cure what he thinks is a stall. This he will do whenever low G is encountered, turbulence or sudden sink for example, and of course the more the stick is moved forward in a mistaken attempt to "unstall" a glider which never was stalled, the more vivid the sensation of lightness becomes. Eventually the pilot can become quite irrational about the whole thing and continue to push the stick forward despite an ever-steepening dive and increasing airspeed. This phenomenon could explain some otherwise inexplicable accidents in the past.

Pilots can be checked for their sensitivity to low G in the following manner. Get the pilot to dive the glider gently to about 55 kts and pull the nose up to about 20 degrees above the horizon. Then get him to push gently, asking him to stop the glider when it is once again in the normal glide attitude. Any undue sensitivity to the "lightness" mentioned earlier will show itself in a tendency to keep pushing past the normal attitude. An extreme case will probably show a tendency to throw the head back, the arms tending to straighten and the stick therefore being driven even further forward. If it gets to this stage you may have to assist in the recovery.

One thing that will positively assist any undue sensitivity to the low G phenomenon will be to instruct the pilot to make an effort to look at the horizon, rather than fix his gaze dead ahead or, worse still, in the cockpit. The strong visual impact of the horizon in front of him will tend to suppress the sensations of lightness experienced by the pilot. Such techniques are essential in cable-break recovery training. Simply assess the susceptibility of the pilot under check to the low G phenomenon, and do all you can to assist if you find he is sensitive. Do not use the exercise as an excuse to generate great quantities of negative G, something which many people find acutely uncomfortable and some find frightening.

INSTRUCTING IN POWERED SAILPLANES

Introduction.

The most important thing to remember about instructing in powered sailplanes is that we are training glider pilots, not power pilots. This may seem obvious, but is often forgotten in the enthusiasm of having an engine to play with. Many powered sailplanes, especially two-seaters, are rather poor compromises between adequate performance as gliders and adequate performance as self-launchers. Furthermore they are often complex and awkward to operate, and place demands on an instructor which may not have been encountered before.

The main points of difference, together with some operational recommendations, are listed below.

Instructor qualifications

A person may instruct on powered sailplanes in accordance with the following conditions.

(i) Trained and endorsed to act as pilot in command on the relevant powered sailplane/s in accordance with the GFA Ops Manual.

(ii) Holds a valid instructor authorisation at the level appropriate to the flight to be undertaken.

Pre-takeoff checks

In order to emphasise that the powered sailplane is primarily a glider with a self-launching facility, the standard GFA pre-take off check CHAOTIC must be adhered to. However the following items must be checked by the instructor prior to take-off, but should not be stressed to the student unless the flight is part of a powered sailplane endorsement for that student.

- Fuel - On, contents adequate.
- Cowl flaps - Open
- Propeller - Fully fine.

Ground handling and taxiing

Ground handling. The ground handling characteristics of powered sailplanes depend more than anything else does on their undercarriage design. Machines with conventional glider undercarriages (central mainwheel plus tailwheel) will have either wingtip wheels or midspan outriggers on stalks. High performance single-seaters with retractable engines usually have wingtip wheels and these machines are ground handled and parked just like conventional gliders. Two seaters, and a few low-performance single seaters, having conventional glider undercarriages, have mid-span outriggers and need more care in their ground handling. The outriggers are usually made of springy nylon and are prone to breakage, especially when the glider is pushed backwards on rough ground. It is essential that one person on the handling crew holds the wings level to keep the outriggers clear of the ground. The outriggers must be regarded as absent when the powered sailplane is pushed backwards.

Some two seaters have aeroplane type undercarriages, i.e. two mainwheels and a tailwheel. These are ground handled and parked just like a light aircraft. There may be some powered sailplanes with a nosewheel layout, but they are the exception rather than the rule.

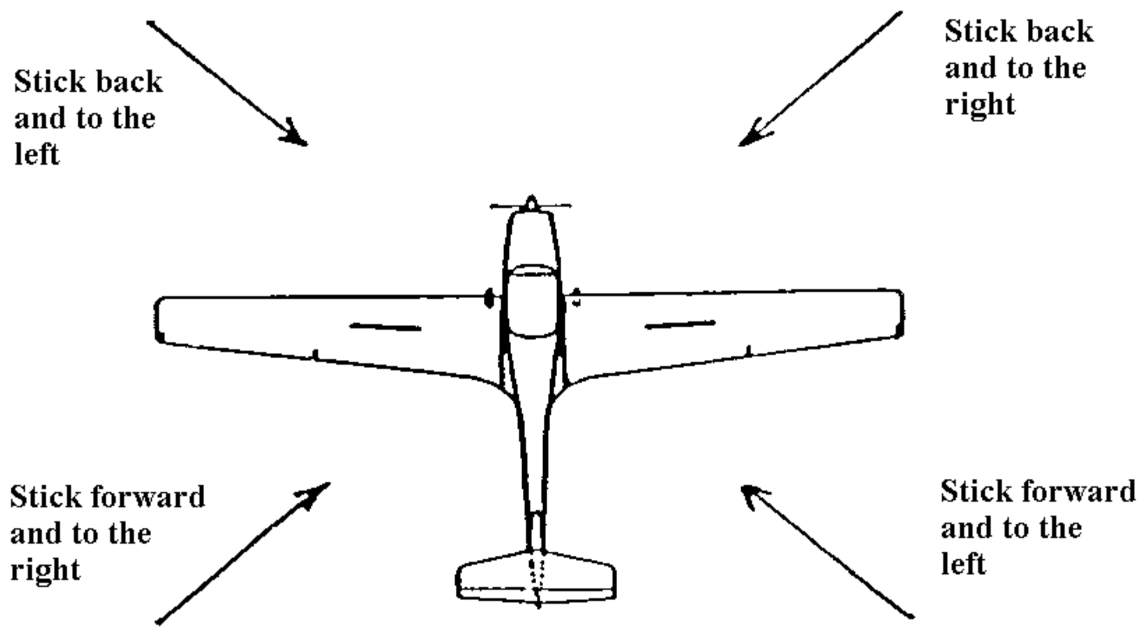
Taxiing. Of the powered sailplanes with conventional glider type undercarriages, most production models have steerable tailwheels that are connected to the rudder pedals. This may not be the case with homebuilt designs or conversions of production gliders. Generally speaking, even those powered sailplanes with steerable tailwheels tend to be awkward and ponderous on the ground and they all have rather large turning circles. Keep this in mind when taxiing in confined areas or near other aircraft. When clear of obstacles, powered sailplanes should be taxied at a speed sufficient to keep the outriggers clear of the ground. This may or may not be possible, depending on the wind. (See taxing diagram).

Glider pilots are not used to taxiing and need to think consciously about wingtip clearance.

Wheelbrakes vary in effectiveness and method of operation. Know your type and be sure to keep within its operating limitations.

Powered sailplanes with aeroplane type undercarriages are taxied in the same way as a light aircraft, i.e. by a combination of steerable tailwheel and differential mainwheel braking. This usually gives better manoeuvrability than the outrigger/wingtip wheel types, especially in tight spots.

For all types, the control positions for taxiing should be in accordance with the following diagram. Arrows denote wind direction. Note that, whenever the stick is forward during taxiing, the wheelbrakes must be used with extreme caution.



Takeoff and climb

Generally speaking, the engines fitted to two-seat powered sailplanes have power outputs ranging from 30 to 65kw (about 40 to 90 h.p.). Despite this rather modest power output, most powered sailplanes swing quite badly to one side on the take-off run when full power is applied. The direction of the swing depends on the direction of rotation of the engine - engines which rotate clockwise (when viewed from behind) will swing to the left under power, and the converse is true of engines which rotate anti- clockwise. Almost all the two seat powered sailplanes have Volkswagen-derived engines, which rotate anti-clockwise when seen from the cockpit and will therefore cause the aircraft to swing to the right, demanding left rudder to keep straight during the take off run.

The reason for the swing is a combination of slipstream effect and asymmetric blade effect. It has little, if anything, to do with torque, which is negligible on such small engines. Slipstream effect results from the spiral propwash striking the fin on one side and causing a swing. On VW engines it strikes the RH side of the fin, causing the nose to swing to the right. It is present to some extent at all attitudes and speeds, but is most marked at low speeds.

Asymmetric blade effect is most marked on aircraft of taildragger layout, such as powered sailplanes, and is caused by the thrust line being inclined at an angle to the relative airflow. This results in the down-going blade having a higher angle of attack than the upcoming blade, and the net result is that the thrust line becomes offset to one side of the crankshaft. Again using the VW as an example, the thrust line is offset to the left, causing a RH swing. Asymmetric blade effect is present in the tail-down attitude, for example at the start of the take off run and during a climb. It is absent in straight and level flight and this is a valid reason for raising the tail of a powered sailplane early in the take-off run, other things being equal (e.g. crosswinds) and with due regard for the limited prop clearance on some types.

All this means that a powered sailplane demands an application of rudder when flown under power, and this will be alien to any pilot who is used to pure sailplanes. To make matters worse, many two- seaters are marginal on power and demand that the slip/skid ball is centred during the climb in order to make it go up at all. It is therefore not possible to ignore the often considerable rudder pressure needed in these machines, and this makes them somewhat tiring to fly. It also gives them a very unbalanced feel in the climb, particularly as the rudder is already much heavier than a pure sailplane because of the springs and linkages to the steerable tailwheel. Further adding to the fatigue factor is the very high engine-on noise level in most powered sailplanes, and a day's instructing will usually leave one hoarse.

Cylinder head temperatures and oil temperatures must be watched carefully during the climb, when power setting is high and airspeed is low. Generally speaking it is a mistake to reduce the throttle setting during the climb, as doing so may take the power- jet (if fitted) out of operation. The power jet provides an excess of fuel at full throttle and this excess is essential for cylinder cooling. Climb speeds must be kept as high as practicable, to maximise under-cowling pressure and ensure that cooling air reaches behind the rear cylinders.

To complete the picture on powered sailplane takeoffs, it is NEVER justifiable to use less than the complete take off run available. The rate of climb of a powered sailplane when out of ground effect is not good, especially in summer, and the whole runway must be used if the pilot is to avoid creating a very large non-manoeuvring area. And NEVER take off with wet wings.

During the climb the view ahead will be restricted by the engine. Instructors must ensure that the powered sailplane's heading is changed regularly during a climb to ensure elimination of all blind spots. Because of the poor climb performance of some two-seat powered sailplanes, the climb-out pattern must be planned to ensure that the aircraft remains within reach of landable areas during the climb. As a guide, do not take a powered sailplane anywhere you would not be happy to go on aerotow.

Takeoff emergencies

1. Aborted take off

   Take-offs may be aborted for a number of reasons

   (a) Failure to become airborne by a predicted separation point. This emphasises the need for instructors to know the take-off performance of the powered sailplane, and the effect on that performance of factors like long grass, soft ground, upslope, downwind component or ambient temperature.

   (b) Complete or partial failure of the engine on the ground run. Complete failure on the take off run leaves the pilot with no alternative but to abort. Partial engine failure leaves the pilot with a decision to make - to continue or to abort. On the assumption that the aircraft will not have achieved its predicted separation point (otherwise it would be airborne), the throttle should be closed and the takeoff aborted. There is no case for continuing the take-off run with an ailing engine in the hope that the aircraft will become airborne before the boundary fence.

   (c) Loss of control on ground run. For whatever reason (long grass catching in outriggers, excessive crosswind, mishandling), loss of control on the ground run demands an aborted take-off. Even if the machine does eventually leave the ground in apparent safety, it can quite easily be so far off line that it may collide with obstacles well outside the normal take-off path. Better to abort the take-off than to tempt fate.

2. Engine failure during climb out

   Engine failures can occur for a number of reasons; mechanical failure, fuel starvation or fuel exhaustion are the most common. Whatever the reason, if the failure is complete the powered sailplane is in a situation similar to a glider on aerotow which experiences a rope break or failure of the tug engine. The comparison is not completely apt because the powered sailplane pilot will have the opportunity to choose exactly the take off flight path most appropriate to the conditions, whereas on aerotow the glider pilot is at the mercy of the tug pilot. In any case, the action following complete engine failure is very nearly the same as for a glider suffering a rope break or tug failure, with the obvious exception that it is not necessary to pull the release. The first priority is to set the speed at the "safe speed near the ground" (Minimum l.5Vs), then choose further action to be taken in accordance with the height and position of the powered sailplane in relation to the take-off strip. (Note: glider pilots will have no difficulty with this concept, but an aeroplane pilot coming to powered sailplanes will show a tendency to go straight ahead regardless of better options available. This is because he is unaccustomed to the flat glide angle of the powered sailplane in comparison with the machines he is used to. (See also section on "Converting power pilots to powered sailplanes").

Partial engine failures are subtler. Without detailing all the possibilities here, the pilot must decide whether to rely on any small amount of power which may be left following a partial failure, whether to try to rectify the problem (it may, for example, be carburettor ice), or whether to shut the engine down completely and carry out a safe landing as a glider. In circumstances of partial engine failure, it is most important to give priority to keeping the aircraft under full control, and not be distracted by trying to coax a recalcitrant engine into life.

Engine shut-down procedures

It is very poor practice to shut down an engine straight from its full-power climb setting. In fact in the case of most VW-derived engines it will not be possible to do so - the engine will be so hot that it will just keep running even after it is switched off. If this happens the engine is trying to tell you something. The message is that a proper cooling down procedure must be followed before switching the engine off. This procedure must be known for each powered sailplane type and must be strictly observed in the interests of satisfactory operation and reasonable engine life. Almost all powered sailplane maintenance problems are centred around the engine.

When the engine is stopped the propeller should be set in the position recommended in the Flight Manual (usually horizontal in front-engined types) and feathered if applicable. The propeller brake may be needed to stop the propeller in some cases, but before using it check that the IAS is not too high. Cowl flaps should be closed.

In-flight performance and characteristics

Engine off

Two-seat powered sailplanes with the engine and prop stopped have sink rates and glide angles considerably worse than their closest equivalent pure sailplanes. The sink rate suffers because of the extra weight of the engine and its associated electrical and fuel system, as well as the fuel itself. The glide performance suffers because of the increased cross-sectional area of the engine installation, the propeller and the more complex undercarriage necessary to provide propeller clearance on the ground. Propeller drag may be minimised by feathering (mechanically twisting the prop blades to align with the airflow). Whatever the glider performance, the fact remains that a powered sailplane has a higher sink rate than a pure sailplane and in the case of trainers this can often be a significant degradation. This is not surprising in view of the fact that the dead weight being carried by the machine easily amounts to that equivalent to an extra person, and a large person at that. Remember that the pace at which an instructor needs to work is in inverse proportion to the performance of the glider. Many training powered sailplanes have very poor performance engine-off and this can cause significant workload problems.

Propeller windmilling

This is defined as the engine being switched off but no effort being made to stop the propeller. The propeller is driven against the engine compressions by the passing airflow and the drag is enormous - about 2 to 3 times that of a stopped (non-feathering) propeller. Furthermore, even a small increase in speed incurs a disproportionate increase in drag. Avoid this situation at all costs - ensure the propeller is stopped, using the brake if fitted. If no prop brake fitted, slow the powered sailplane down, right to the stall speed if necessary, and that will usually stop the propeller.

Engine running at various power settings. In this situation a powered sailplane behaves more or less like a light aircraft, although this is only strictly true at the higher power settings. Between idle and, say, 60% power, the throttle may be set to simulate glide angles ranging from the powered sailplane's basic glide angle to the much flatter glide angles of high performance sailplanes. This is a useful asset when carrying out exercises like cross-country navigation training.

Re-starting the engine in flight

There are two cases to consider here; the normal start, using the particular starting system fitted to the type, and the dive start, which is used when the battery is flat or there is some other problem with the starting system.

The normal start.

Powered sailplanes are seldom critical as to the airspeed needed for restart. To start, simply ensure fuel is on (and there is some in the tank!), place magneto switch to "On" and start, using the particular method recommended in the aircraft Flight Manual. Note that full power cannot be applied immediately, and if the engine is cold it will have to be progressively warmed up prior to applying full power.

A powered sailplane engine must never be relied on as a "save" from an outlanding. The reasons are (a) the engine might not start, or (b) the necessary warm up time precludes the use of full power in sufficient time to be of any use. Any imminent outlanding should be planned as for a normal glider so that if the engine does not start as anticipated the landing can be carried out without problems. If it does start, it's a bonus and you can fly home. This is an extremely important point, and it is worth stressing again - NEVER RELY ON THE ENGINE TO SAVE YOU FROM AN OUTLANDING. It will therefore be obvious that, far from allowing a pilot to cut margins, cross-country operation of a powered sailplane makes it necessary to make decisions earlier rather than later.

The dive start.

If for some reason the starting system is inoperative, most powered sailplane engines can be started by diving and pulling up to get the propeller rotating. It is very unlikely that the propeller will start rotating in a straight dive, even if the speed becomes very high. A pull up of about 2 to 3g is needed to effect the necessary change of angle of attack on the propeller blades, and it is during this pull-up that the blades will start to flick over the compressions. If all the necessary settings of fuel and ignition have been made before the manoeuvre is started, the engine will probably start quite readily. This technique of engine starting is very height- consuming, several hundred feet being needed in the case of a low to medium performance powered sailplane. It is therefore obvious that it cannot be relied on as a "last resort", as it would certainly leave the machine much too low to safely complete a landing off a proper circuit if the starting attempt failed. Its sole virtue is that it will enable operation of a powered sailplane with a known defective starting system, with the proviso that all re-starts must be attempted above 1500 feet within easy gliding range of the landing area and with the actions in the event of failure to start being pre-planned.

Circuits, approaches and landings

This is the area where the powered sailplane is open to the greatest abuse. This is because it is very easy to use the engine to solve problems which really ought to be solved by using judgement, or to get as many landings as you can into a particular session without regard for how the circuits relate to how a glider normally flies circuits. It is also tempting to land with the engine running, with a view to carrying out "touch and go's" to achieve the objective of doing as many landings as possible. All of these things have pitfalls.

It is important to stress once again that we are training glider pilots and that the effort must be made to ensure that the powered sailplane is flown just like a glider. It is a glider with a self-launch facility. The circuits, approaches and landings must be carried out with this in mind.

Some guidelines can be laid down as follows: -

1. Fly circuits, approaches and landings engine-off. This emphasises the gliding purpose of the training and has the added benefit that everyone concerned with the operation is continually reminded that the machine is primarily a glider. Thus, powered aircraft integrating with the gliding operation regard it as just another glider and have no expectation that it will ever get out of their way. This is ultimately to the benefit of the gliding operation. From the student's point of view, use of the powered sailplane as a glider makes subsequent conversion to pure gliders easy and straightforward.

   Propeller clearance on most two-seat powered sailplanes is very limited. Even slight mishandling of the landing by the student can cause the propeller to hit the ground, especially if a bit of pitching occurs during, for example, a bounced landing. This will splinter a propeller and possibly cause damage to the engine. The expense of a new propeller, possible damage to the engine and the loss of flying revenue more than overcome any imagined loss of efficiency in circuit training caused by landing engine-off.

   The final nail in the coffin of engine-on landings is that the instructor may be tempted to rescue a mishandled landing by using power. This is generally not possible because we are not equipped with enough hands to cope with all the required actions. The right way to fix any mishandled glider landing is by a combination of attitude and airbrake control. Forget about the engine.

2. Join the circuit in exactly the same way as a glider does. Above all, do not climb the powered sailplane along the downwind leg. This is tempting, as it can speed up the circuit training process, but it is a highly dangerous practice because the powered sailplane will be climbing underneath gliders which are descending. Both types of machines will be in each other's blind spots and the danger is obvious. Do all the climbing upwind of the field, cool the engine down, switch off and join the circuit normally.

3. A touch and go landing is another tempting way to speed up the training process. The hazards of landing engine-on have already been pointed out and it would be foolish to ignore them. However it is possible to carry out a touch and go from an approach with the engine stopped if the engine is reasonably warm and the powered sailplane has an electric starter. On balance, though, it is not a recommended practice, especially at busy gliding fields and especially at a combined glider/power operation. The last thing a visiting pilot expects, if he sees a powered sailplane on finals with the prop stopped, is for the machine to do a touch and go. Much better to do a full stop landing, taxi back and take off again. This has the added benefit of reinforcing a pre- takeoff check before every flight, an invariable gliding practice which is not adhered to in the power-plane practice of touch-and-go landings.

In summary, circuit training in powered sailplanes demands a high degree of discipline if the right emphasis (i.e. on training glider pilots) is to be achieved. Techniques that might seem superficially convenient may prove counter-productive in the long term.

Cross-country and outlanding training

One of the most useful functions of a powered sailplane is cross- country training. Navigation, thermal centring, height-band selection, etc, can all be done with equal effectiveness by a pure sailplane, but the ability to carry out several circuits and approaches into outlanding paddocks in any one flight is unique to the powered sailplane. '

Note the intentional use of the term "circuit and approach" in this context, intentionally omitting any reference to the landing itself. Oulandings generally entail more risk than landings back at home base, the principle reason for this being lack of detailed knowledge of the paddock itself and in particular of its immediate surroundings. With the powered sailplane's ability to fly from paddock to paddock, it is tempting to land in any paddock which appears superficially suitable for training purposes, and it is very easy to get caught out by, for example, an undetected single wire earth return (SWER) power line. There are numerous cases of this kind of accident on record.

It is therefore recommended that approaches into outlanding paddocks be terminated at a break-off height suitable to (a) the characteristics of the paddock and its surrounds as assessed from circuit height, and (b) the instructional effectiveness of the exercise in terms of assessing whether the student would have successfully landed on the paddock. If you cannot tell at, say, 50 ft AGL whether the techniques used during the circuit and approach would result in the landing being successful, it is questionable whether you are suited to the job of instructing in that particular role. The exception here is where a club has a number of regular paddocks for outlanding training which have been properly assessed, their surrounds and surface are known and the owner's permission obtained to actually land in them.

Simulated launch emergencies

Powered sailplanes can adequately simulate the following emergency situations: -

(a) Aerotow rope break. Because the climb-out pattern of an average two-seat powered sailplane is fairly similar to many aerotow combinations at about 400 FPM, a reasonable simulation of an aerotow failure such as a rope break can be given by closing the throttle at varying heights during the climb-out. Like actual rope-break practices, they should be started high (about l000ft) and worked downwards as confidence develops. Exactly the same principles apply as to gliders, priority being given to preserving adequate speed in order to conserve total energy. Instructors should beware of becoming "rope- break happy" with a powered sailplane, in the process ending up pointing back at the strip at all kinds of strange angles and positions and acquiring for themselves a reputation for possessing zero airmanship. Use the machine intelligently and it can provide quite sensible simulations of real emergencies.

(b) Winch/auto cable breaks. This is a more contrived exercise than the aerotow failure case and demands very careful setting up in order to be realistic and safe. It is not easy to establish a 45 degree climb angle in a powered sailplane without diving to a considerable speed before pulling up into a simulated winch/auto climb. Therefore the machine is first dived to a speed of about 80 knots and pulled up to about 45 degrees with the throttle being opened fully as the final climb angle is achieved. Then, with the climb at 45 degrees, when the speed falls to 55 knots indicated the throttle is closed to simulate the cable-break. This gives adequate training in the control movements and sensations experienced in the cable-break case, and is a very good introduction to the lag experienced in establishing a safe speed following the pitch-down manoeuvre. This is probably the limit of the usefulness of the powered sailplane in this exercise, because if the machine is used to teach the judgement of "what do I do with the height I have now", it becomes a nuisance to other users of the aerodrome, who have difficulty predicting what the machine is going to do next.

GENERAL WARNING. Be very careful of low level emergency simulations. Powered Sailplanes are generally not over-endowed with power and it is easy to get into a situation which is very difficult to get out of. This is especially true on summer days - remember that an airfield at l000ft AMSL becomes effectively 4000ft AMSL on a 35 degree C day, with its consequent effect on engine power output and wing and propeller efficiency. Once again, do not go anywhere in a powered sailplane that you would not be prepared to go on an aerotow.

Type conversions

Keeping in mind all the foregoing guidelines, for instructing in powered sailplanes, conversion from one two-seat type to another is no different in principle from converting from one two-seat pure glider to another. The conversion is simply done by an instructor experienced and current on type.

Conversion to single seat powered sailplanes is not quite so straightforward, because they come in such a range of types,1ayouts and configurations. Some features are not fitted to basic training two-seaters and it is therefore impossible for instructors to gain experience in their operational characteristics. Guidelines on some of these features are as follows.

1. Two-stroke engines. These are common on single-seat powered sailplanes and are quite different in their handling and characteristics from four-stroke engines. Some of them only run really smoothly at high RPM and are reluctant to run continuously at any intermediate settings. Careful attention to the engine/aircraft operating manual is the only answer to correct operation of this kind of engine.

2. Retractable engines. These are common on high performance single seat powered sailplanes and are usually manufacturers' conversions of established sailplane types. The engines and props are usually fitted to the top deck of the fuselage behind the cockpit and retract into a well in the rear fuselage, where they are completely covered by a system of doors. With engine retracted, the glide performance of this of powered sailplane is exactly the same as the original type from which it was derived. The sink rate, however, is much higher, for the same reasons as previously explained - in the glider configuration the engine and its systems are so much dead weight.

   Significant points for converting pilots into retractable-engine powered sailplanes can be summarised as follows: -

   (i) Ensure thorough understanding of the engine extension and retraction system and have the pilot run through the procedure several times on the ground.

   (ii) Bear in mind the rearward shift in CG when the engine is retracted.

   (iii) A powered sailplane with an optimum glide angle of 1 in 40 with the engine retracted will suffer a reduction to 1 in 16 or worse with the engine extended and windmilling. This figure is the best that can be expected, and only applies if the manufacturers recommended speed is adhered to exactly. With an increase in speed beyond this figure, the drag is extremely high - an example of this is a 1 in 40 sailplane degrading to 1 in 16 engine extended at 43 kts. The performance further degrades more or less linearly until at 70kts the glide angle is 1 in 9 and the sink rate over 700ft/min. The implications of this on engine failure after take off or failure to start after extension on an outlanding are obvious.

(iv) Based on the information at (iii) above, landings with the engine extended should be treated with extreme caution. In particular, any drag producing devices, flaps, airbrakes, etc should be used sparingly if at all.

3. Other types. These vary greatly, from fixed engines with folding propellers, to engines on stalks fixed behind the cockpit and faired with a smooth cowling. They may be either homebuilt designs or homebuilt conversions of existing series production sailplanes. Because of the diversity of types, engines, propellers and individual layouts, it is not possible to cover their operational aspects in any detail here. All the previous guidelines apply, but there may be other specific warnings to comply with. These must be checked with the designer/converter before operating them or clearing someone to fly them.

Converting power pilots to powered sailplanes

In this section, the term "power-pilot" is used to cover a person who is qualified to fly VH-registered light aircraft and who holds a Student or higher licence, or a person who is qualified to fly ultralight aircraft with three-axis controls and who hold a Pilot Certificate from the Australian Ultralight Federation. The syllabus for conversion of power pilots' to powered sailplanes is confined to any differences which may be apparent between the type/s the pilot has previously flown and the type he/she is about to fly.

We are primarily concerned with the practical aspects of conversion from the instructor's point of view. Significant points are as follows: -

(a) Centreline undercarriage. Although some two seat powered sailplanes have powerplane type undercarriages, the majority have "conventional" glider undercarriages. The power pilot will therefore have to adjust to keeping wings level on take-off and landing, something which has previously not been a factor to anything like the same extent.

(b) Taildragger layout. Most power pilots are trained on tricycle-gear aircraft nowadays and may not be prepared for the directional instability of an aircraft of taildragger layout. Combined with (a) above, this could make considerable demands in the early stages of conversion.

(c) Poor rate of climb. Power pilots are unlikely to be aware of using thermals (and avoiding sink) to augment climb-rate after take-off. Although circling in thermals with the engine at full-throttle causes considerable airmanship problems, the intelligent use of lift and sink in the climb- out pattern is a skill that will need to be taught to the power pilot.

(d) Use of spoilers/airbrakes. The power pilot has been trained to use the elevator to control speed and the throttle to control rate of descent. This is similar to the gliding concept of using elevator to control speed and spoilers or airbrakes to control rate of descent. Where confusion sometimes sets in is if the instructor does not make it clear that the engine is NEVER used in a powered sailplane to make any adjustments to the descent rate. This point has already been made earlier but it is worth reinforcing here. It is essential that the engine is not used (and preferably should be stopped and feathered) during the approach, to drive home the message that the spoilers or airbrakes are the descent control and the approach is adjusted by their use in conjunction with the elevator, AND BY NO OTHER METHOD.

(e) The power pilot may not be skilled in the use of an aiming point to establish a datum for approach control. Whereas a glider pilot converting to powered sailplanes will establish an overshoot situation on final approach before using spoilers/airbrakes, a power pilot may not realise the importance of this and may be quite happy to get into an undershoot situation with a view to relying on the engine to get himself out of it.

(f) Co-ordinating between elevator and spoiler/airbrake. This is an acquired skill, whether it be to counter the nose-down pitch typical of spoilers or the more complex trim changes associated with use of airbrakes. It requires practice at height before being relied on to provide accurate control of the final approach path to touchdown.

(g) (g) Many powered sailplanes have their throttle controls spring-loaded OPEN, for reasons of safety in the event of failure of part of the linkage. If the friction nut is not tight it is quite common for the throttle to creep open, which can go undetected on a power-on ;, approach and makes it impossible to control the final approach path with the feeble spoilers fitted to some training types.

Power-assisted sailplanes

Sometimes referred to as "turbo" sailplanes, these are defined as being capable of cruising but not of self-launching. The low powered engine and multi-blade folding "fan" are designed purely as a self retrieve function. Power assisted sailplanes are generally manufacturers' conversions of existing high-performance designs. They are launched normally, by winch or aerotow, and their engine/prop functions are entirely automatic under one single extend/retract control. Most of them do not have a starter motor and can only be dive-started. Neither do they have a throttle, only a decompressor to aid dive starting. Because of the absence of complex systems and the fact that they require no great degree of management, they should be regarded for conversion purposes as conventional sailplanes, the pilot being converted only needing to become acquainted with the relatively simple self-retrieve installation.

However, as far as cross-country flying is concerned, the same rules apply as for powered sailplanes. The engine must not be relied upon to "save" a flight and in particular the decision to extend the engine must not be left too late.