BRITISH GLIDING ASSOCIATION

Instructor Manual

2025 Edition · Beta Version

This compiled manual brings together all sections of the BGA 2025 Instructor Manual, with 2017 content where 2025 sections are not yet available.

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A - GIVING YOUR BEST AS AN INSTRUCTOR

Teaching & Learning

Introduction

This section of the Instructors Manual is not intended to be an exhaustive resource for the theory of teaching and learning, but it gives an overview of some of the elements of this important subject.

Benefits of focussing on teaching and learning techniques

Engaging with trainees effectively and use of good teaching practices, enhances overall flight safety. In addition, organised and effective teaching methods make the experience more enjoyable for both instructor and trainee. Research shows that it is effective interaction with instructors and organised training that retains trainees to SPL stage and beyond. Good instructing techniques may well contribute to retaining members and increasing gliding participation numbers.

Why is the instructor there?

You are primarily there to teach the trainee to fly, but your goals should be much broader than this. Hopefully, you want to teach them to become a safe and competent pilot, who has the skills to develop further to achieve their goals – whether that is local soaring, aerobatics or a top competition pilot. This means helping engender appropriate attitudes and airmanship, not simply good flying skills.

Teaching is a skill; it can be improved like any other skill. So, becoming an instructor is not simply about 'what to teach' but 'how to teach.' You could start by thinking about the qualities that make a good teacher:

Empathy: recognising the needs of your trainees and how they can be addressed in an appropriate and sympathetic manner. Judging the pace that they can learn at, encouraging them and helping them through patches if they get demoralised.

Communication: finding different ways to explain things, or at a level that match their previous education and level of knowledge.

Preparation: delivering some of the training will become 'bread and butter' to you but giving the long theory briefings require preparation. Anyone who ever made anything look easy, had practised first. There are tools to help such as the instructor exercise training cards or prepared power point presentations. Having lectures prepared in advance for rainy days to help trainees get through the Knowledge Test are always welcomed.

Being a good role model; both in terms of your flying skills but more importantly your airmanship and behaviour to others.

Flexibility: very few instructors have the full repertoire of skills, either educationally or in terms of flying skills. Try to expand yours – one-to-one teaching is different from delivering a lecture, but both take practice. Think about expanding your flying c.v. – do you want to develop your aerobatic skills or a TMG rating for example.

Enthusiasm: It is easy to keep your enthusiasm on wonderful soaring days – perhaps less so delivering classroom briefings in the rain. Just remember that enthusiasm is infectious – find ways to make it enjoyable.

Self-reflection: we can always improve – do not be afraid to ask your trainees for feedback on your performance and think about ways to improve.

Why is the trainee there?

Gliding draws its trainees from a massive cross section of society and occupations. People decide to take up gliding for a variety of reasons and different motives. Some specifically want to learn to glide, whereas others may wish to use gliding as a stepping stone to other flying. Hopefully, they will enjoy being part of a club and the team approach, but maybe they are just looking for the next hobby to conquer.

Understanding what motivates your trainees may help you to use the appropriate teaching style. Some may not appreciate too much motivational push from their instructor, but almost everyone thrives with encouragement.

What does your trainee know already?

Some trainees - perhaps the ones with some aeronautical knowledge - will be able to be brought on very quickly, because they already have some prior knowledge of the subject. With others, no prior knowledge can be assumed, and they will need more detailed handholding.

Trainee needs

Imagine you were embarking on a new adventure – for example, learning how to sail. What would you expect when you turned up at the sailing club for your first lesson? How would you expect to be treated? You would probably like:

1. an enthusiastic instructor who was interested in you.
2. to feel confident in the instructor's ability and knowledge.
3. to think the standard of your training was important to them
4. to feel comfortable and safe in the physical and mental environment.
5. to be given a coherent syllabus and some idea of how to attain the goals within it.

Addressing each of the above points:

1. It's easy to get stuck in a rut when the weather isn't to your liking, or there is a problem with the winch and you are keen to get home at a decent time, but the trainee is your (and your club and the whole gliding movement's) customer. It is essential to remain positive about things and get to know the trainee so that you can tailor their teaching

2. How would you feel at the club if a scruffy, unkempt individual arrived and announced that he was your instructor? It is good to present a (reasonably) professional first impression to the trainee. A confident and organised manner instils confidence but be honest if something is not in your area of expertise. Bluffing you way through will not inspire confidence and is potentially dangerous in some circumstances. Say you don't know or are not sure and engage your trainee in finding out the answers.

3. Make time for your trainee. Get to know what stage of training your trainee is at and their strengths and weaknesses, ***before*** flying. Take time to explain exactly what is about to be demonstrated. Think about it as a complete training session, not just the flying time.

4.The trainee needs to feel comfortable in their environment. For example, not being intimidated by the instructor, having the teaching environment being at a reasonable temperature, the seats being reasonably comfortable and the trainees being well hydrated, nourished and rested.

5. At the start of training, give the trainee the syllabus and explain where they can read up on the elements of that syllabus. After a training session, give them a steer about what they may be learning next, and where to find out about those elements of training. It is important to deliver the training at the correct pace for the individual trainee. It is no good forcing a trainee to spin a glider after the first few sessions if they will be frightened by the experience. 'Calibrated frights' and similar extreme teaching methods do not work.

TEACHING METHODS

Often gliding instructors love the flying side but are less keen on the theoretical training. Nonetheless, giving your trainees a sound theoretical basis will facilitate and accelerate their flying training. No matter how good an instructor you are, not every trainee will connect with every instructor or every teaching method. Some people prefer formal teaching sessions, others like group discussions and some prefer private study. Similarly, you may be comfortable giving a lecture but less comfortable leading a group discussion, but prior preparation always helps.

Giving a lecture

Before the lecture:

- **Define your goals.** Before planning your content, decide on the key takeaways you want students to remember.
- **Understand the knowledge level** of your audience– for instance, you will pitch a talk on cross country flying differently to a pre-SPL student compared to someone wanting to improve their cross-country speeds for a competition.
- **Structure your content.** The old adage is:
  - Say what you are ging to say
  - Say it
  - Say what you have said.

This may sound dull but a proper introduction, followed by the main subject, and finishing with a summary of the key points that you want them to remember, works.

The educational concepts of 'primacy' and 'recency' suggest that people remember best what they heard first and last in a talk.

- Organize your material into short segments. Pause and check for understanding after each segment, take a brief moment to summarize the key points and ask students if they have any questions. This gives them time to digest the information and seek clarification.
- For longer topics or a series of talks, incorporate a short break/s to maintain focus.
- **Consider using visual aids.** Use presentation software such as PowerPoint support your key points, Preferably, not just text but appropriate and appealing images and graphics. Check the audiovisual equipment will work and have a back-up plan in case it doesn't!

  Having a suitable model to hand in the teaching room is useful but it is amazing how much you can explain just using a ruler to act as a visual prop for the wings of an aircraft. Whatever you do - **avoid reading directly from your slides.** Either know them well enough that you don't need to or print off a paper copy as notes to have to hand. A handout for trainees means they can focus on the lecture instead of copying everything verbatim or save trees by offering to email thema copy of your slides!
- **Plan for interaction.** Questions to stimulate discussion, can engage the audience, rather than simply telling them information. Or incorporate a short activity e.g. lead them through plotting out the flight envelope, rather than simply putting the diagram up on a slide.

During the lecture:

- **Master your delivery.** Speak clearly and with enthusiasm, varying your tone and pace to keep students' attention. Use a conversational style rather than reading from a script, and maintain eye contact with the entire group. Think about whether you will sit or stand. If sitting down, it may pay to sit on a higher stool or chair in a larger group – people can both hear and see you better and you can see them to make sure you are keeping everyone engaged.
- **Make it relevant.** Real-world scenarios and anecdotes help keep interest but not simply a serious of disaster stories about 'accidents you have known and loved!.'

After the lecture:

- **Gather feedback.** Encourage students to give you feedback, e.g. through post-lecture survey. This helps you understand what is working well and what could be improved.

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- **Seek peer observation.** If getting formal feedback from your trainees sounds a bit OTT, ask another instructor to observe one of your lectures and provide specific, balanced feedback on your delivery and trainee engagement.

Other Hints, Tips and Issues

Questioning

Asking questions at the appropriate place and time can be a good way to engage the student and helps you to appreciate their current level of understanding is so that you can tailor the information you need to deliver. Conversely, continual questioning when the trainee does not know the answers can feel threatening and demoralising.

If you have done a thorough theory briefing 'in the classroom.' then it is often an effective use of questioning to ask the trainee what items they need to refresh themselves on for the pre-flight briefing.

This technique will give you some idea of their understanding without asking the question *"Do you understand?" which usually receives a meaningless 'yes.'* If they have already grasped the aims and objectives for the lesson, then you can just re-enforce the key points if necessary. Otherwise go back over the exercise plan and aims in more detail to ensure their understanding before flying the exercise.

Being a Role Model

One way that the trainee learns is by example from their instructor. This means that the example and style of flying set by the instructor is an indicator of how the trainee will fly when solo and beyond. For example:

- If the instructor flies a very conservative circuit and always turns in early if the circuit is a bit low, then the trainee will do the same.
- If the instructor turns final at 200' and tells the trainee **not** to do the same thing themselves, the trainee will have that view of the circuit entrenched in their mind and will do it themselves, thinking everything is safe.

Even when flying solo, the instructor should be setting an example and acting as a positive role model to others.

Facilitating trainees' learning

Most people welcome structure and a syllabus, but very occasionally, some members may perceive organised instruction as being pushed too hard. Try to listen carefully and respond to the needs of the trainee. Agreeing to goals throughout training, however modest, will provide the structure needed to make progress.

Responsibility

Being an instructor of whichever category requires that you take responsibility for the high-quality training of your trainees. It also means that if something is spotted that needs rectifying, you personally ensure that this is carried out by yourself, or by another suitable instructor. This is especially the case when supervising the solo flying of inexperienced pilots.

Enthusiasm and fun

Safety is always paramount but remember this is still supposed to be fun!

Use of simulators for training

Increasingly simulators are finding a useful place as part of the training armoury. Experience is showing that many of the exercises can usefully be demonstrated and practised first in the simulator. (See chapter J)

The obvious advantages are:

- It is not weather dependant.
- It can be arranged at a bookable time.
- At any time, the demonstration or exercise can be stopped for further discussion or explanation
- It allows the exercise to be repeated multiple times.
- It is cost efficient.

Giving Feedback

The de-brief at the end of an exercise is an opportunity to give the trainee feedback to help them improve. Research suggests that you need to say 5 positive things to an individual when giving feedback for every negative point you make, no matter how constructively you put the criticism - otherwise they may feel demoralised.

One technique is to ask the trainee what they felt went well and then what could be improved. If they recognise their own strengths and areas for improvement and effectively debrief themselves, you simply need to reinforce the key bits that you want them to focus on. Trainees will often focus on a mistake they made, so give them a friendly reminder of all the things they did get right and the progress they are making.

STRUCTURING FLYING TRAINING

The framework within which we should be teaching consists of:

- **Theory brief** (formal classroom teaching/lecture)
- **Pre-fight briefing** ('by the glider')

  The basic components of the pre-flight briefing are:

  - the aim;
  - the air exercise(s) (what, and how and by whom);
  - flight briefing
  - check of understanding; and
  - airmanship. (TEM)
- **Air exercise**

  Demo manoeuvre followed by trainee practice
- **Debrief**

  The debriefing should cover:

  - what went well
  - what can be corrected or improved; and
  - whether the student pilot has reached the required level of competence or the exercise needs further practice.

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The Theory Brief

Theory briefs are often for teaching a brand-new area of theoretical knowledge. A subject can be taken from the theoretical syllabus. These briefings should ideally not be more than 40mins max. depending on the subject.

Pre-flight/air exercise briefing

Usually on the airfield but ensure you at least find some-where away from the launch queue, so your trainees are not distracted.

The aim of 'ground briefings' is that the trainee understands the purpose of the flight, what is going to happen during the flight and why. Do not brief the poor trainee to death, especially out on an active airfield. Equally, there is no point getting airborne and trying to explain a complicated exercise such as approach control. It is an inefficient use of flying time and is much more effectively done on the ground first.

It helps if the instructor writes down the brief and ideally uses diagrams. These briefs should use a standard structure. See the 'BGA Instructor Reference Cards' on the BGA website.

- **The aim**: what are you as the instructor expecting the trainee to be able to do by the end of this lesson.
- **Exercise**: This is where you set out your plan and what you want the trainee to watch/take part in/have a go at. It should not go into a great deal of theoretical detail, but a very brief reminder of the relevant theory may be appropriate.
- **TEM - Threat and Error Management:** also known as Airmanship. What might be different about this flight - in relation to others - that may require you and your trainee's attention? Lookout is almost always included. Other examples might be; range to the airfield, minimum heights for stalls/spins, when to take control etc. Some people prefer to do the TEM at the beginning of the briefing rather than at the end and either is acceptable.

A pre-flight brief should never be longer than 15 minutes. If you are tempted to brief for longer it is either turning into a brief on the theory, or you are trying to cram too much teaching/information into the session.

'By the glider' Brief

This sort of brief is simply to reinforce any salient points. Something like, "*OK - Remember, I'm doing the launch, then you will have control when we have released. You're going to practice your speed control and trimming, I'll then talk you round the circuit and I will take control for the approach and landing*."

Airborne Exercises

Having briefed thoroughly, the trainee should be clear about what is going to happen in the air. The teaching sequence to use in the air should be:

- Demonstrate (to show the trainee what the end product should look like)
- Teach (remember to split the exercise into manageable chunks)
- Task (get them to have a go and remember – manageable chunks)
- Praise/debrief and if required, re-teach/return to one of the above.

During demonstrations, tell your trainee what you are going to do just **before** you do it. For example, "*When I move the stick forward, the nose of the glider will go down"*, then move the stick forward. This arms the trainee against the unexpected and the glider's response reinforces what you have just said.

Trainee's Attempts and Prompting

For the first attempt or two it may be necessary to give the whole of the patter. Prompting should be the minimum necessary to encourage sufficient movement of the con-trols and the required change of attitude. Prompts such as "*Lower the nose - that's enough,"* should be sufficient if the briefing and demonstration have been understood. Be con-scious of the right amount of control movement in terms of *too little*, *too much* and *just righ*t. 'Just right' is a matter of personal preference; some pilots are much more positive than others in their use of the controls.

In all demonstrations and practice it must be quite clear to both pilots who is flying the glider at any given time. In normal circumstances, when you take control, say clearly, "*I have control"* and do not start flying the glider until you have heard the trainee say, "*You have control"*. Similarly, when you give or hand back control .... "*You have control* ....*I have control* ..." take your hands and feet off the controls. Do not abbreviate the handover words to "*I have"*. The one possible exception might be a sudden emergency where there is not time to say all, or any of the words. Say the words if you can. The trainee will be more likely to let go the stick if you do.

Prompting and taking over control

Prompting a trainee is part of the instructor's toolkit and can be very powerful, even if the prompt is quite indirect. Think about prompting in the circuit. With some trainees, even a cough could be interpreted as a prompt. You might ask the trainee what they think about their position in the circuit but beware that this may be taken to mean their position is wrong. In a judgement exercise like this a prompt can be tantamount to taking control. One solution would be to tell them you will frequently ask if they think their position is correct, even when it is perfect. This can encourage them to consider it and make a judgement.

Sometimes you may wish to give the trainee a direct prompt, for instance, "*Turn left now*." If you want the trainee to now attempt to plan the rest of the flight, you must verbally hand control back to them. Perhaps, "*OK. I'll leave you to plan the rest of the circuit*."

You may decide to take over control physically from the trainee. If you do, you should make it clear why. It might be that you want their attention while you explain something in the air. You should tell them that you are taking over for that reason, as they may think that you have taken over because they have done something wrong. If you take control from the trainee to avoid an undesirable situation then, especially if it is near the ground, do this earlier rather than later and demonstrate correct handling. Late takeover is the cause of many instructing accidents.

De-briefing

Possibly the most important part of the lesson. Do not omit this.

Any debrief should be constructive, talking about and reinforcing what has been learnt from this session. Praise what went well, point out where improvements can be made and discuss how that might be achieved. Then focus on what the likely activities for the next session will be, and what to do to prepare/read for the next lesson.

When observing and feeding back trainees' faults during their flying, it is important to diagnose the cause of the fault before talking to the trainee. Explain what they did well and then be specific about any faults and how to correct them.

For example, the trainee over-rotates during the winch launch. If you simply tell the trainee to stop over-rotating, they may not understand how or why to do this.

You need to try to analyse why it is happening e.g. are they over-rotating because they are not using appropriate visual cues (looking from side to side and judging their angle), or they have been told they can slow the winch down by pulling back harder (possible on some types and some the older winches). It is important to diagnose the problem correctly before suggesting a remedy.

It is tempting to point out all the points that could be improved upon at this point. When a pilot is learning, there will be a lot of these. Concentrate on the pertinent points and always end on a positive note.

What's next?

Before considering how to teach an exercise, first think through and decide which exercise to teach.

Talk to the trainee to ascertain their present knowledge and look at their logbook and record cards. Then work out the most appropriate exercises to teach or continue working on, based on the trainee's aptitude and previous experience, as well as the weather and available aircraft.

If previous training has been to a high standard, trainees will already know what they are likely to be doing today and may even have read up on the subject.

Some exercises follow on naturally from others but, it is useful for instructors to ask themselves what skills the trainee will need to attempt a new exercise.

Take approach control as an example. The trainee needs to be able to:

- have good speed control,
- know what the effects of the airbrakes are, and
- be able to fly in a coordinated manner in a straight line towards a fixed-point accounting for drift.

If the trainee cannot do these things accurately, they do not have a hope of flying a reasonable approach.

Continuity

Flying with a single instructor throughout a trainee's entire training is not ideal, as different instructors will have different methods of teaching a skill to a trainee. However, being taught by a large variety of instructors – a different one perhaps every week for a couple of months - makes continuity of training difficult. Good communication, via the logbook and in some cases by e-mail and word of mouth, is essential. Writing a recommendation for the next exercise in the logbook is a huge help. Structured courses will be immensely beneficial for a trainee's progress.

Teaching ' in chunks'

Trainees rarely have the capacity to absorb more than a few points at a time; likewise, instructors rarely give convincing demonstrations when involving more than a handful of items. Lessons can be more effective when split into easily digestible chunks.

Each 'chunk' can contain a demonstration followed by trainee practice, then analysis and perhaps more practice. For example, you might choose to select simply 'staying in the turn' as a 'chunk' of the turning demonstration for one or two winch launches to ensure the trainee is happy before moving on to the rest of the turn.

A lesson built from a series of 'chunks' sounds slower, but this is generally false. A trainee taught in this way will more often progress more swiftly than one who is expected to do everything at once.

Conclusion

If instructors put themselves in the position of the trainee learning to fly, much of the above is common sense. The basic structures described above work. Training is most effective for the trainee, when a little time is given to preparing the correct exercises and tailoring them to the needs of the trainee. Although we normally charge by the minute in the air, good instruction starts as soon as the trainee drives in through the gate. Grasp the opportunity to give them the best 'training session' you can.

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B - THREAT AND ERROR MANAGEMENT & AIRMANSHIP

Very few accidents are completely unavoidable. Catastrophic failure is a rare phenomenon in the gliding world and there is no 'new way to have an accident'. Yet accidents continue to happen, so we need systems to try to avoid them and deal with them when they occur.

There are many tools to help – some of which are very well explained in the CAA Skyway code. Recommend it to the trainees as essential reading.

Threat and error management needs to become embedded as a routine part of every pilot's preparation. From the instructor's perspective, understanding and awareness of common errors that trainees make will improve your ability to respond and prevent them escalating to an accident or incident.

Threat and Error Management (TEM)

The overarching objective of TEM is to provide a system for pilots to plan for and manage potential threats, errors, and undesired aircraft states. It can be summarised as:

- anticipation
- recognition
- recovery.

The key to anticipation is accepting that while something is likely to go wrong, you can't know exactly what it will be or when it will happen. In this sense, TEM training can be framed as 'defensive flying for pilots.'

Threats are defined as events that occur outside the influence of the pilot. (i.e. not caused by the pilot).
They increase the operational complexity of the flight and require attention and management, in order to maintain safety margins.

Put simply, threats come 'at' the pilot, while errors come 'from' the pilot.

Importantly, a mismanaged threat has the potential to induce a pilot error.

Threats (such as a defective winch cable joint), **errors** (such as a pilot failing to follow the correct launch failure procedure), and **undesired aircraft states** (such as a stall on the subsequent recovery) are events that pilots have to manage.

Examples of a threat could be crossing difficult terrain, deteriorating weather conditions, a winch or tow plane malfunction (e.g., lack of fuel), or other people's errors, such as pedestrians walking across a landing area.

Threats normally fall into three categories:

- Anticipated i.e. factors that you should be aware of in advance, such as a poor weather forecast, or high density of traffic such as in a gliding competition.
- Unanticipated i.e. cannot be specifically anticipated, but a good pilot will consider the possibility of them in advance e.g. a GPS failure.
- Latent threats such as external time pressure, fatigue, insufficient pilot skill, knowledge or poor attitude to safety.

Threats can also be considered in an organisational context, for instance clubs accepting poor flying standards or a poor safety culture would be a latent threat to safe operations.

It may help to consider two main areas of threats

- Environmental threats, such as weather, terrain or aircraft traffic
- Organisational or operational issues such as aircraft malfunctions and ground issues such as distractions, equipment or maintenance issues.

See examples below.

Gliding clubs can help manage organisational threats and prevent pilot errors by providing daily briefing on weather and operating procedures, and regular refresher training

Whilst threats occur independently of the pilot, they increase the pilots' workload and need to be thought about and planned for. Sometimes they can be managed in isolation and sometimes they interact with another issue, further complicating the necessary management.

Good TEM management starts before the pilot arrives on the airfield, by good preparation – being in a fit state to fly, checking the forecast and notams, maintaining equipment in good condition, and familiarity with programming GPS etc

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Threat Examples	
Environment	***Organisational***
Weather – strong winds/turbulence, crosswinds, rain storms, wave rotor	Aircraft - damage or equipment failures
Visibility - icing, misting, low sun	Launch crew – poor training, causing distractions
Surface – rough airfield, rabbit holes	Visitors – poor organisation or briefing
Traffic – ridge traffic, non-glider traffic such as paragliders	Communications – non-functioning radios, failure to communicate procedural changes
Terrain – unlandable areas, hilly or mountainous	Operational pressures – launch rates, ratio of ground crew to pilots
Navigational issues – complex airspace changes	

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Errors

Errors may be the result of a momentary slip or lapse or induced by an expected or unexpected threat. For example: a distraction during pre-launch checks could result in the pilot not completing the checklist properly, causing the pilot to take off with a canopy unlocked.

Other errors are more deliberate: known as **intentional non-compliance errors** or sometimes known as violations. These occur when individuals or organisations deliberately disregard rules, regulations, or procedures. These errors are distinct from unintentional errors like slips or mistakes, as they involve a conscious choice to deviate from established norms. For example: shortcuts used by the pilot to save time even though they violate club SOP's for instance: towing a glider to the launch point without someone walking in front or driving straight across the airfield instead of around the perimeter.

Errors can be divided into:

- aircraft handling,
- procedural or
- communication

See table 2 opposite.

Aircraft handling errors may include flying errors such as poor speed and approach control, incorrect use of controls such as confusing the airbrake and flap levers, or technological errors, such putting the wrong settings in a GPS. They may be a consequence of poor training and/or lack of currency. (See BGA currency barometer for further guidance.) Aircraft handling errors may be addressed by better training and a self-awareness of skill level – many glider pilots do not fly that often and therefore loss of aircraft handling skills is a significant risk. The Competency Matrix or glider pilots gives a structured way of helping to identify these issues. (ref.)

Procedural errors are pilot deviations from regulations, flight manual requirements or club standard operating procedures. These may be the result of insufficient checklist discipline or airfield safety discipline.

Communication errors involve a miscommunication between the pilots, or ground crew. They may be due to lack of training or lack of proficiency with radio telephony.

An error that is recognised and effectively managed has no adverse impact on the flight. Conversely, a mismanaged error reduces safety margins and may induce additional errors and negative outcomes.

A common cause of all error types is distraction and/or mental overload. For example, VFR flight in complex airspace and around busy aerodromes often involves high workload. This can be mitigated by better planning and anticipation, task prioritisation and removal of unnecessary distraction.

We are all human and our response to making or identifying an error, has consequences.

For example, does the pilot:

- detect and recover the error quickly,
- do they acknowledge the error but do nothing, perhaps because they believe it is inconsequential
- or do they only 'see' the error when it escalates to a more serious undesired aircraft state?

Examples:	
Aircraft handling errors	Incorrect use of controls – flaps, airbrakes, etc
	On the ground – landing towards parked aircraft or obstacles. Landing in confined spaces
	Field landings – late field selection, poor judgement on approach
	Equipment – failure to check fully operational, mis-programming, incorrect settings
Procedural errors	Failure to read or comply with SOP's
	Inadequate pre-flights checks
	Failure to read or comprehend placard limits
Communication errors	Failure to attend or listen to briefings.
	Misunderstood communication, failure to communicate instructions.

The drill should be recover first, analyse the causes later.

For example, a pilot incorrectly enters a waypoint into his GPS such that the aircraft track now passes through class A airspace. Once the pilot executes the incorrect entry and the GPS unit directs him towards controlled airspace the 'error' has already occurred. When the error is spotted (hopefully not too late) the pilot can either analyse what is wrong with the GPS and fix the problem (causing a distraction from flying and lookout) or, better, concentrate on re-routing and avoiding the airspace. Analysing the cause of the error can wait until the flight is completed.

Errors can lead to a safety-compromising event called an undesired aircraft state (UAS). A UAS is when the aircraft is in an unsafe attitude, configuration or location. It usually reduces the safety margins. It may result from pilot error, actions, or inaction; such as incorrect speed and coordination in thermalling leading to a spin, incorrect speed on approach leading to a heavy landing, mis-rigging, incorrect flap settings etc

TEM: Tools & Techniques

Some of the safety management tools, the 'hard' safeguards, are associated with aircraft design, and include automated control connection systems, instrument displays, and aircraft warnings. The Flarm collision avoidance system, which provides pilots with visual and audio warnings of nearby sailplanes to prevent midair collisions, is a good example of a 'hard' TEM safeguard. Even with the best designed equipment however, these 'hard' safeguards are not enough to ensure effective TEM performance

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The 'soft' safeguards are very common in gliding (and other high-risk sports). They include regulations, standard operating procedures, and checklists to direct pilots and maintain equipment; and licensing standards, checks, and training to maintain proficiency.

With the hard and soft safeguards in place, the last line of defence against threat, error, and undesired aircraft states, is still, ultimately, the pilot.

TEM in Action:

Pre-flight Planning: We all know the 5 P's: Prior preparation prevents poor performance. Preparation starts well before the flight. Identify potential threats (e.g., weather, terrain) and develop countermeasures.

Effective use of checklists: Checklists/ drills and procedures only work if pilots use them. They are even more effective said out loud. The 'point and say' technique is surprisingly effective. When you say, for example, the recovery airspeed, put your finger on it on the ASI.

Monitoring and Cross-checking: actively monitor the situation, systems, instruments, and actions. Alert ground crew may prevent launch accidents by noticing mistakes or omissions by a pilot, for example.

Effective Communication: Clear and concise communication using standard phraseology.

Error Detection and Recovery: Recognizing errors early and implementing corrective actions.

Maintaining Situational Awareness: Being aware of the surrounding environment, potential threats, and the aircraft's status.

The inclusion of TEM as a standard part of every pre-flight briefing serves several purposes. Obviously we must consider the TEM for the flight that's about to happen, but the instructor is also giving training in identifying what the likely 'gotchas' are in various flight scenarios and, thirdly, helping to instil the TEM habit in the trainee, in the hope they will carry this into all of their own flying as an ingrained part of their preparation.

Airmanship and Human Factors

Many glider pilots will have an accident or incident at some point in their flying careers. If you read an accident report and think 'what kind of idiot would….?' the answer is anyone could.

If a pilot thinks they are unlikely to have an accident because they are experienced / skilled / smarter / or an above average pilot (delete where applicable) then simply replace those descriptions with 'arrogant / overconfident / unrealistic / unaware' (delete where applicable) and we see a different picture.

It is easy to define the qualities that are common to poor airmanship, but harder to define good airmanship. The CAA Skyway code references a way of defining it as:

Knowledge: Aircraft, environment, risk

Skill: Physical, cognitive, communication, management and team

Attitudes: Professionalism, discipline, self-improvement, knowledge of hazardous attitudes

It is helpful to stop thinking about 'check flights' and work towards providing an opportunity for refresher training and giving the pilot the opportunity to reflect on areas for development and improvement. Skills should not simply be flying skills, but wider competencies, such as situational awareness or decision making.

Much of your role as an instructor is about improving knowledge and skills, but we need to give equal emphasis to developing positive attitudes. The descriptors of the 5 hazardous attitudes (see chart below) in the Skyway code should be required reading.

Changing attitudes and behaviours is challenging and must be part of changing the wider culture in which the individual operates.

Useful techniques for working with an individual can be found in the chapter on developing pilot competencies.

The Five Hazardous Attitudes	Antidote
Anti-authority: "Don't tell me." This attitude is found in people who do not like anyone telling them what to do. In a sense, they are saying, "no one can tell me what to do." They may be resentful of having someone tell them what to do or may regard rules, regulations, and procedures as silly or unnecessary. However, it is always your prerogative to question authority if you feel it is in error.	**Follow the rules. They are usually right.**
Impulsivity: "Do it quickly." This is the attitude of people who frequently feel the need to do something, anything, immediately. They do not stop to think about what they are about to do, they do not select the best alternative, and they do the first thing that comes to mind.	**Not so fast. Think first.**
Invulnerability: "It won't happen to me." Many people falsely believe that accidents happen to others, but never to them. They know accidents can happen, and they know that anyone can be affected. However, they never really feel or believe that they will be personally involved. Pilots who think this way are more likely to take chances and increase risk.	**It could happen to me.**
Macho: "I can do it." Pilots who are always trying to prove that they are better than anyone else think, "I can do it–I'll show them." Pilots with this type of attitude will try to prove themselves by taking risks in order to impress others. While this pattern is thought to be a male characteristic, women are equally susceptible.	**Taking chances is foolish.**
Resignation: "What's the use?" Pilots who think, "What's the use?" do not see themselves as being able to make a great deal of difference in what happens to them. When things go well, the pilot is apt to think that it is good luck. When things go badly, the pilot may feel that someone is out to get them or attribute it to bad luck. The pilot will leave the action to others, for better or worse. Sometimes, such pilots will even go along with unreasonable requests just to be a "nice guy."	**I'm not helpless. I can make a difference.** *©CAA*

6 - AIRMANSHIP & THREAT MANAGEMENT

Airmanship includes good lookout and considerate behaviour in the air, as well as being ahead of events rather than dangling behind them like someone struggling with an out of control lawnmower. It also involves such apparently futile activities as looking both ways before crossing a one-way street, and not plunging boldly into areas where our ignorance seriously outweighs our competence.

Good airmanship is not simply about how we protect ourselves, but how we avoid putting other people at risk. For example, when thermalling with other gliders we should do so in such a way that not only are we are visible to them, but they don't have to keep manoeuvring to get out of our way. If pilots constantly leave thermals when you arrive, it may not be because they don't want to be out-climbed. Airmanship is good manners and caution, not aggressive behaviour towards other users of the air, either through 'stock car' styles of flying or bad-mouthing them over the radio.

As a subject, airmanship is difficult to teach. We all agree on good lookout and some of the other major components of good airmanship, but the rest often consists of 'opinions' about the best way to do this, that or the other, and some aspects of airmanship are extremely subtle. Teaching it is further complicated by the fact that the trainee's attitude and relationship to the world in general is a highly significant factor, for good or ill. When good airmanship is being exercised it goes unnoticed because nothing very dramatic happens. Good airmanship is usually most obvious when it's not there!

It is most important that the trainee understands that good airmanship is not something you turn on every now and then during a flight. Airmanship begins before you leave your home for the airfield.

Physical and psychological condition

I'M SAFE

ILLNESS

You don't need to have a raging fever to be ill and unsafe. If you had a fever you wouldn't go to the airfield at all, you'd stay in bed. Not feeling 100%, though less dramatic, probably wouldn't stop you although it could be just as dangerous to your safety. Even a mild headache can mean that you won't concentrate fully on what you should be concentrating on, namely the flying. Have you a blocked nose or ears? Apart from the obvious distractions of such miseries, flying at any altitude with these conditions can damage your inner ear and lead to various other infections.

MEDICATION

Some drugs can cause drowsiness, blurred vision, nausea, and produce various allergic reactions. Why are you taking the drugs in the first place, and are you safe to fly if you are?

STRESS

Non-professional pilots often use flying as a way of winding down from the grind of work. Gliding can be a therapeutic pastime, but be very sure that when you climb into the aircraft you really have forgotten all your troubles, otherwise you are quite likely to find yourself playing host to a few more.

Anything which prevents you from concentrating on the flying puts you at risk. People are, on the whole, very bad at recognising their own lack of awareness, though they'll notice that of others readily enough. Pre-occupation with something other than the task in hand will make you more concerned with what's filling your head, than with anything that might be trying to come in from outside. Emotional stress of the 'slightly more than I'd actually wanted or felt I could enjoy' variety can make you vulnerable to potentially dangerous mistakes. If the marriage is crumbling, your partner is ill, or the girlfriend/boyfriend is about to/has dumped you, or you've bought a new house and had a row with the neighbour(s), then take care! If you know that your attention is, or is likely to be less than 100%, don't pretend it's anything else. Either make suitably broad allowances, or don't fly at all, which is probably the safest if not the most attractive option.

ALCOHOL

The un-coordinating effects of alcohol are indisputable, unless of course, you happen to be drunk and argumentative with it. The RAF's old 'eight hours from bottle to throttle' rule referred to a very modest amount of drink. In reality, any residual alcohol in the system will have an adverse effect which may not be very apparent to anyone, least of all you. In any event, the military - who can't afford to lose pilots or aeroplanes - now demand that 'no alcohol be consumed 10 hours before flying duties, including not more than 5 units in the previous 24 hours'. Being drunk is one thing, but the resultant hangover can be far worse for your flying competence than any illness.

FATIGUE

Did you have a good night's sleep? Have you already done lots of launches today? While tiredness is something with which you may be familiar and can allow for, boredom and even long spells of hard concentration are also forms of fatigue whose capacity to undermine your intelligence shouldn't be underestimated.

FAMILIARITY

Are you in current practice? When did you last practise stalling or spinning, or have a launch failure? Not that you should give yourself a real failure just for practice, but when was the last time you really thought about what you would do if you had a genuine launch failure? When was the last time someone else looked at your flying? Are you totally familiar with the aircraft you are about to fly? Have you read the Flight Manual recently/at all? When did you last fly the aircraft? When did you last fly at the site? Is the weather as expected? Have you flown in these conditions before?

If you are doubtful about your currency with any of the above then have a check ride or read the glider's manual. In addition to your own health, what about the 'health' of the aircraft you are about to fly? Who DI'd it? Were they as thorough as you would be? Would it be a good idea to do a quick walk-round before you get into the cockpit, just to be sure, especially if this is the very first flight of the day? Have you done positive checks on the control connections?

EATING

If you go for several days without proper meals your blood sugar level falls and can cause lack of concentration. In extreme cases you can become unconsciousness. A touch of food poisoning, however mild, won't do you any favours either. The first question asked by accident investigators after at least one gliding fatality was, *What had the pilot had to eat?* and *Where was it prepared?* Inadequate fluid intake can also have potentially serious effects. Dehydration can rapidly incapacitate if not actually kill you. In one incident a glider pilot became ill in the air, landed safely, and was found unconscious in the cockpit.

Pre-flight

- have you checked your weight recently?
- is any ballast properly secured?
- is any packing going to give on the initial part of the launch?
- are all loose articles stowed correctly?
- is the weather suitable for the forthcoming flight? If it's hot and blue, don't forget to wear a sun hat and to roll down your sleeves. This helps to prevent dehydration, sunstroke, and being lightly crisped
- are you prepared for emergencies such as cable breaks?
- what is the purpose of the flight? Whilst it is unnecessary and sometimes counter-productive to be forever striving mightily, meandering aimlessly about after the launch doesn't improve your flying skills, or increase your chances of a long life. Stay awake and alert by having something to aim for; preferably not another glider.

PRE-FLIGHT BRIEFING

There is no Airmanship Pre-flight Briefing as such. The subject is broad, has blurred edges, and tends to be learnt by osmosis. A club with a poor 'atmosphere' and a lackadaisical attitude to safety, for example, can create pilots whose airmanship will be as bad as if they had been deliberately taught and lectured on how to make it that way. As an instructor, and whether you want it or not, you are often the example by which such matters as Airmanship and its usefulness are judged. If you have any degree of derring-do this can sometimes be intensely frustrating, but there is no refuge whatsoever in that hypocritical old adage, *Don't do as I do, do as I say*. When your trainees are solo, and probably when you aren't there, they will be apt to do exactly what you did, whatever it was you said, and with a lesser degree of competence. If you are a fan of low turns and 'Look at me' styles of flying, blaming your trainee when he tries the same thing and cartwheels into the clubhouse, does somehow seem to miss the point.

What needs putting over in every way possible, short of actually spreading yourself across the airfield, is that really good pilots are thoughtful and look after the interests of other pilots - which includes helping them to stay alive. Whether X can do a 300kt beat-up with the merest splinter of daylight under the fuselage or not has no significance, except perhaps to X. Leave X's problems to X. Safe doesn't mean dull.

As well as the emphasis on airmanship and safety throughout the training, you should also (as part of your own good airmanship) discuss the whys and wherefores of any decisions you are making, jointly or singly. Gradually introduce the trainees to more responsibility for the safe conduct of their flights. In that way they'll learn to be safe, considerate and thoughtful pilots, and you'll be able to save your voice and nerves. Oh yes, and enjoy their flying.

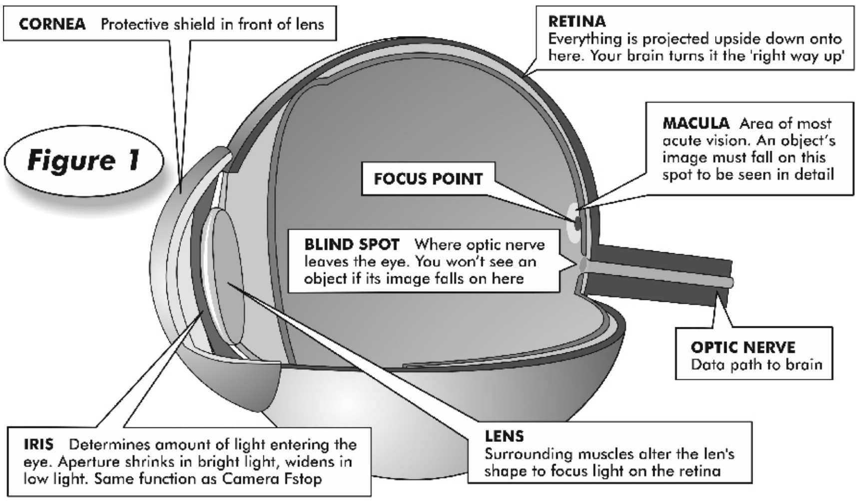
If you cannot honestly say *I'm safe*, then don't fly.

5 - LOOKOUT

The chief cause of mid-air collisions and air-misses is failure to see other aircraft soon enough, or at all. How many times have you been surprised by the closeness of another glider, or seen a pilot sail by with his eyes fixed on something in the cockpit?

Mid-air collisions are serious, and even a seemingly light and glancing contact with another aircraft can result in major structural damage - perhaps even incapacitating damage to the pilot. The glider may become uncontrollable, or suffer progressive and not necessarily instantaneous structural failure. The lower the collision's altitude, the slimmer the chances of a successful bail out, and if the glider starts gyrating it doesn't take much of an increase in G to pin even a young and fit pilot into the cockpit.

Given the above, it makes very good sense to cultivate habits that reduce the risk. Like any habit, good lookout needs instilling right from the start. Trainees who fail to acquire it early on find it very much harder to acquire later. This is why Lookout appears before the chapter on the Effects of Controls. No-one's lookout is 100%, but anyone who isn't doing it well, or at all, increases their own AND everyone else's level of risk; a point that needs emphasising. Your trainee's lifespan may be affected by how you teach the early lessons, but how you teach lookout might ultimately affect yours.



Since we use our eyes all the time, the obvious question is 'why bother to teach trainees a skill they already possess?' Regrettably, there's little to show that we necessarily use well what we may or may not use a lot (take sex and food, for example), and human vision is hobbled by an unhelpful combination of psychological and physiological factors whose effects are much more critical in the air than they are on the ground.

An awkward message

Lookout/scan strategies must make due allowance for our various limitations. However, it isn't easy to talk realistically to trainees about these limitations without mentioning the very high risks involved in ignoring them, and whilst there is no point in beating about the bush on the subject, tread carefully. Many hear the message as 'gliding is dangerous', but in the context it is 'people' who are dangerous, and that includes them. They will react to this not always welcome message according to how they understand it, and either:

- fail to see that what you're saying has anything to do with them, and ignore it or just switch off. (I have this arrangement which protects me!) This 'other planet' reaction is unfortunately quite common
- become rather anxious and be put off; this is the most likely, understandable, but usually temporary reaction. (I sort of realise I won't last forever, but please don't keep reminding me)
- understand the message and act upon it, not react to it. (If I've got any say at all in the matter, I'd like to last as long as possible).

Whatever the response, risk is everyone's lot in life, and pretending that things are different neither changes the facts nor magically protects anyone from harm.

Eye and brain - the visual system

The basic setup

The human visual set-up is that of a predator, not prey. Our eyes are at the front of our heads, like owls and tigers, and not at the side, like pigeons and mice. For the predators the practical result is good depth perception, in 3D.

Our visual field is divided into three main areas. The first is concentrated in a very small oval shaped arc subtending about 3°, and centred in the direction of our gaze - rather like the narrow beam of a searchlight (see figure 2 overleaf). To see an object in any detail we have to look directly at it so that its image falls on the macula - an area at the back of the eye where the light receptors are most densely packed. Just below the macula, the optic nerve - the data cable to the brain - dives through the back of the eye. This is the 'blind spot', (figure 1 opposite). Any image which falls on it is effectively invisible, even if the object is right in front of you.

Both the central area and the second and far larger area immediately surrounding it, are in 3D because each eye sees the same object from a slightly different viewpoint. Within limits, depth perception in the central area is good. The resolution of the second area is lower than that of the central portion, and detail poorer. The third and peripheral area marks the edge of our visual field and would seem redundant, given that vision here is very poor and 2D, but it is particularly sensitive to movement.

While the central processor is undoubtedly the brain, the eye itself part-processes visual data before sending it, so to speak, 'down the pipe'. Exactly how the complete system works is far from being well understood. Current explanations, as you'd expect, make heavy, obsessive, and possibly inappropriate use of computing analogies. As analogies go, they are quite handy, and make it easy to talk about the visual system in terms of 'processing' and 'data'. Nevertheless, don't make the very common mistake of thinking that such things 'belong to the brain', or 'take place in the eye', as if they somehow belonged to someone else. They all belong to you, and so do the results.

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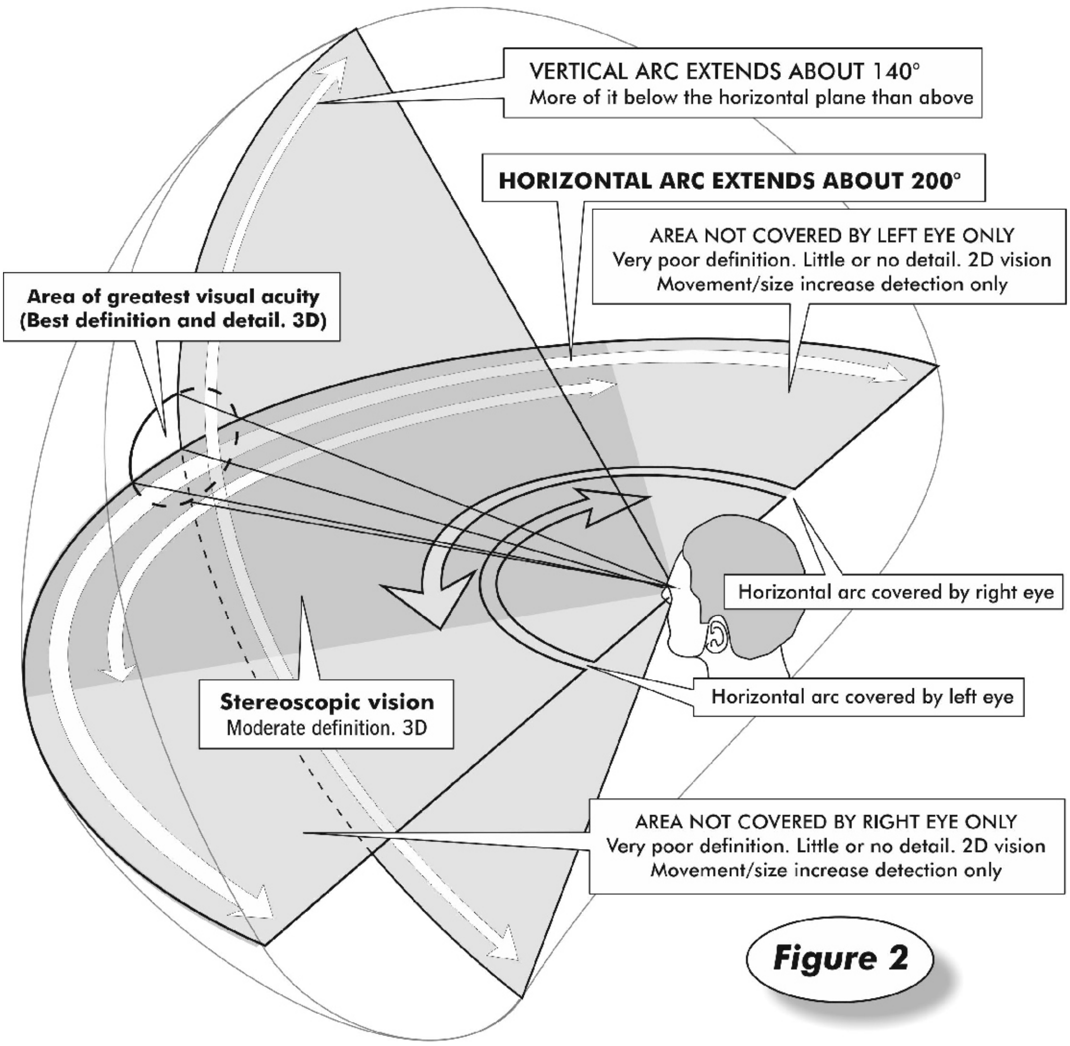

Figure 2

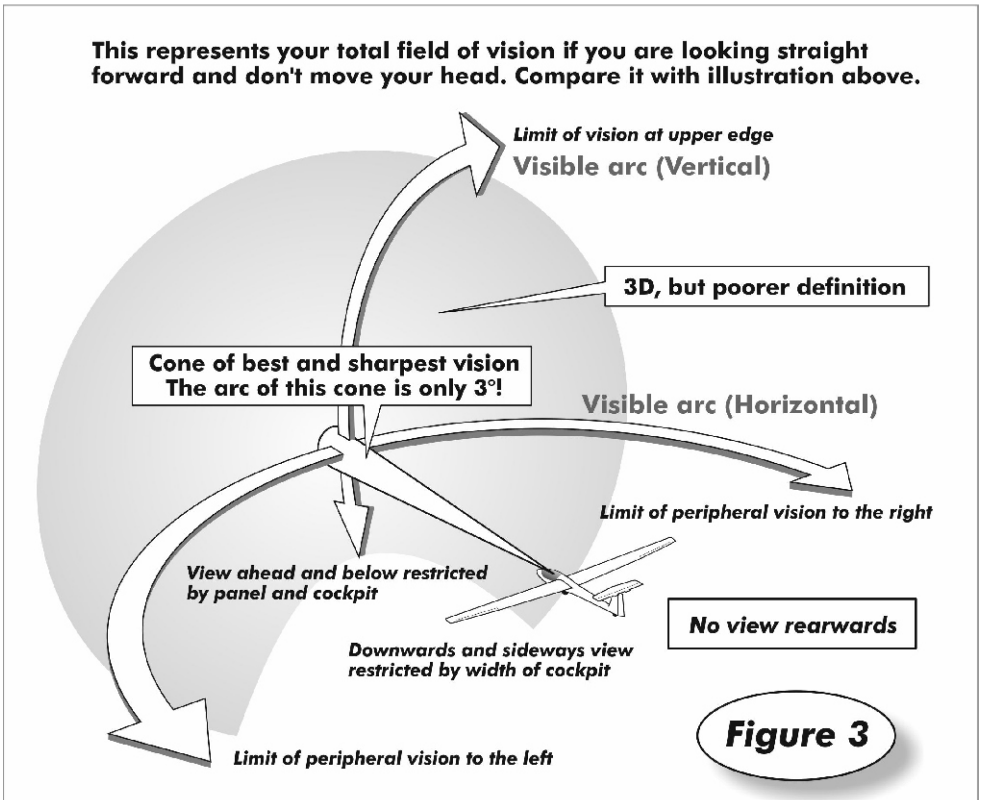

Figure 3

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Getting the right information is one thing. Interpreting it correctly is another

The computing phrase 'garbage in, garbage out' applies equally to human perception, and the entire visual/sensual system is vulnerable to input and interpretation errors, some of which are very subtle. 'Garbaging' has two main causes:

- (1) **biological afflictions** such as fatigue, inappropriate emotion, illness, age, alcohol and medication, etc. The next chapter gives more detail, but someone who, in effect, can't be bothered (whatever the cause) can receive good visual data - i.e. they see everything they need to see - and then do nothing about any of it
- (2) **corrupt or ambiguous visual data**. If the canopy is scratched and/or dirty, or visibility is bad, or both, then you'll see less than you would otherwise, and the less you see the more likely you are to misinterpret whatever visual data does manage to squeeze through to your brain. This can hugely increase the risk of a mid-air.

It would appear that the brain requires a certain minimum level of data inflow in order to stay in touch with what's going on around and about - total sensory deprivation leads to hallucinations - and if visual input is very low, data from another 'service' such as the balance mechanism in the ears, can assume far greater importance than normal. Getting 'the leans' (vertigo) while cloud-flying would be an example of this. Equally, severe pain, acute discomfort, or even panic, can totally obliterate every other input, thoughts of sensible self-preservation included. What's more likely is that something far less dramatic, be it physiological or psychological, consistently erodes the pilot's ability to pay attention to the whole picture.

Unfortunately for pilots, humans are adapted for life on the ground, and because the aerial environment is not the one for which our eyes evolved, it is not rich in the appropriate visual clues and cues. Those for depth perception, approach of objects etc, are either less obvious to us in the air, or missing.

For example, when a car approaches us down a road, we work out its position and approach speed by reference to its known size (it's a Porsche), how rapidly that increases in relation to the surroundings (what stands behind or in front of it?), plus a number of other very strong perspective clues - which include the vanishing point, shadows, haze and colour cast, and the car's observable level of detail.

Figures 5 to 7 on the next page provide some examples. A World War Two military glider, an Airspeed Horsa, was used in figure 5 because most of us have little or no idea of its size. Were it to be replaced by an AS-K13 or an AS-K21, we'd know exactly where it was in the picture; which indicates that expectation and experience count for a lot (it's a K13, I've seen them before, and I know exactly how big they are in relation to the average house ....), and so on.

In the air apparent size is a major visual clue, and when we don't know how big an object is we have to rely on its relative position as defined by the shadow on the ground, and some weak and rather ambiguous perspective clues. When we're high up, of course, a ground shadow may not be visible. As a conflicting aircraft approaches the perspective effects become stronger, along with the clues provided by the detail level (the paint on the nose is peeling). Jumbo jets are a good example of not seeing quite what you think you're seeing. Even now, when they are familiar, it's very easy to get the scale completely wrong and actually 'see' a smaller aircraft, fairly close, and not going all that fast.

Outside the narrow cone of greatest visual acuity, our vision is geared largely to detecting movement, and signalling 'LOOK AT THIS!', but these alerts only work well if:

- (1) the pilot is already paying attention to his surroundings
- (2) the object is moving in relation to the background
- (3) the object grows in size - which amounts to the same thing as (2)-, and
- (4) it stands out from the background.

Airborne objects are particularly difficult to spot if they are:

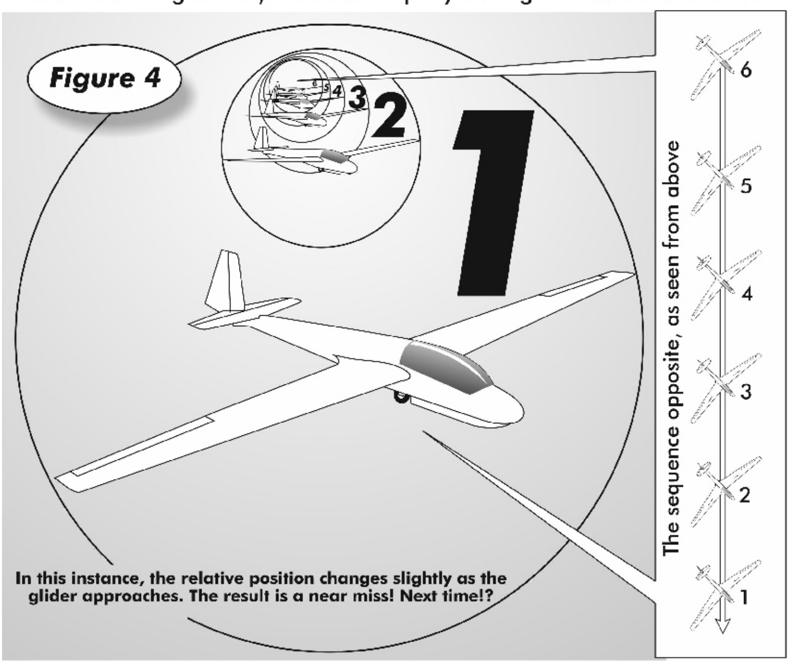
- on or near the horizon, and
- maintain the same relative bearing to us.

Though the major 'distance' clue is apparent size, as described, it is the rate at which that increases or decreases which tells us whether an object is closing on us, going away, or staying at the same distance. The 'gotcha' here is that if we're not paying attention when an object maintaining the same relative bearing comes towards us, its image size on our retina only starts to increase at a rate sufficient to trigger a 'LOOK AT THIS!' response when the object is just about to hit us, or pass perilously close (figure 4, below).

None of this is to suggest that we won't or can't see an object when it's a long way off, just that if we aren't consciously looking we're far less likely to spot it.

The eye also does two things which seem contradictory. First; what literally excites the visual system is changing rather than constant stimuli. Our eyes help create this by constantly making lots of tiny little movements; a kind of visual 'fidgeting'. If this is suppressed (staring very hard can do it) the input doesn't change and the eye eventually stops responding. Second; if we

Note that the conflicting glider's apparent size (represented by the surrounding circles) increases rapidly during the last second or so.



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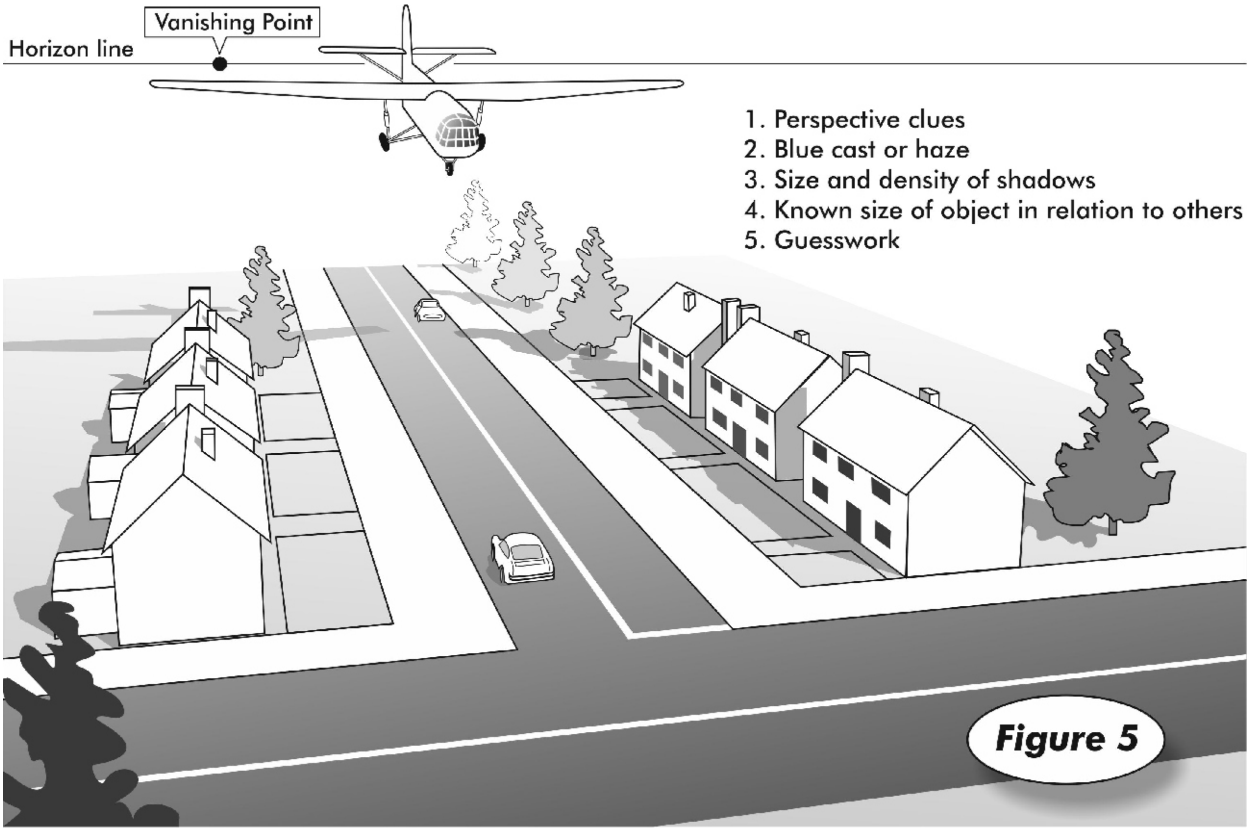

Figure 5

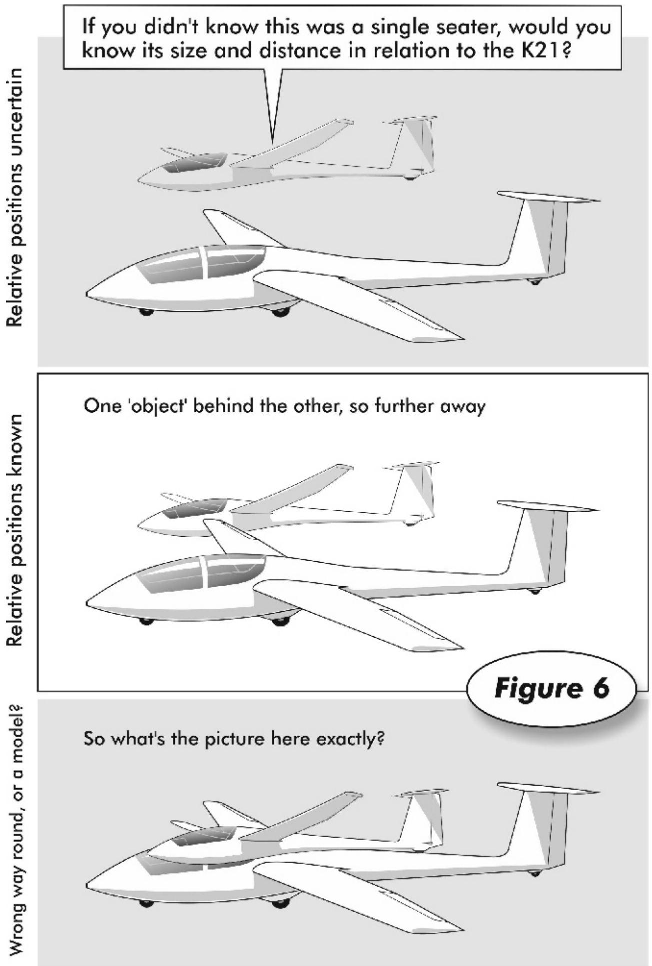

Figure 6

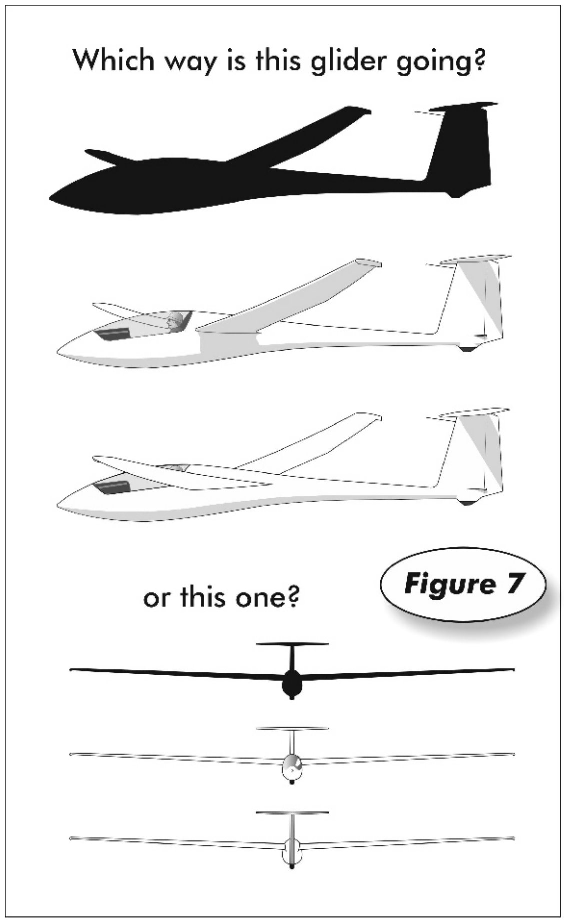

Figure 7

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shift our gaze quickly more than a few degrees, our visual system registers very little that's recognisable. We think we're seeing 'things', but only because our eyes keep stopping briefly (fractions of a second), to lock onto interesting blurs and blobs. In effect, our eyes 'stutter' across any scene. A useful scan pattern has to cover a sufficiently large area relatively quickly, but must have resting points where we can focus onto approaching 'things' in order to find out what they are, and whether they're dangerous or not.

In certain conditions the visual system can go into idle, and we then get what is known as *empty field myopia*. We think we're looking way ahead, but our eyes have relaxed and are focussed on a spot only a few feet in front of our noses, and we don't see anything further away than that. The fact that empty field myopia is not obvious to us makes it particularly dangerous. The worse the visibility, the more likely it is to happen, so it is important that the pilot periodically focuses on the most distant ground objects visible.

Eyetraps and 'I' traps

Though the eye has to stop moving in order to register anything, it is can far too readily come to a grinding halt on, say, an instrument. The variometer is one of the chief targets, followed by the ASI, and, to a lesser extent, a GPS unit, a speed to fly director, or even the yaw string. In the circuit it may be the altimeter. Any of the above can become an eye-trap, and any of them can kill you and probably someone else as well. Trainees have the additional problem that their understandable anxiety about the stability and safety of aeroplanes in general - gliders in particular (no engine!) - makes them hang every hope of survival on the instruments. It's worth pointing out that this may not have quite the result they intend.

The above causes apart, it is also very easy to be psychologically blind. Something important can go unnoticed simply because it either wasn't what we expected to see, or we didn't want to see it. When we do finally notice, a measurable time is needed - sometimes seconds, not milliseconds - to work out exactly what it is, or what's happening, or both. To this has to be added the time to work out what to do, and the further time required to get the glider to do it. If you add all that lot up, given even the most favourable circumstances, it can take many seconds before you start to move out of harm's way.

A daydreaming pilot staring out into space is a prime candidate for a mid-air, but so is the one who has made too many unsupported assumptions about what's happening around and about. These assumptions can range from the egocentrically daft 'Nobody is going to hit ME' - they may not intend to, but they still can -, to the terminally rash 'It's obvious. I can't see the other glider because it has left the thermal and by now is miles away'. On the other hand, it could be right up your tail, and flown by someone who left his guide dog behind (it gets airsick).

LOOKING OUT

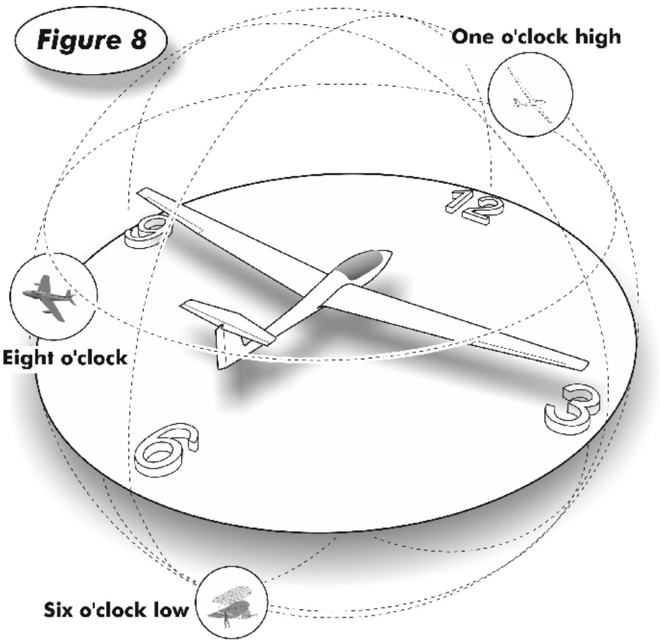
Using the Clock

In two-seaters, clock terminology is a useful way of quickly identifying the location of a potential threat. Teaching it to trainees who are only familiar with digital watches may prove difficult, but in any case it can take a bit of getting used to.

Imagine your glider is fixed at the centre of a clock face, oriented as in figure 8, opposite. Three o'clock is off the right wing, nine o'clock off the left wing, with six o'clock behind you. Points in between are relative to the respective hours. Half hours are never used; not only is that degree of accuracy not required but it takes slightly longer to say 'half past eight' than it does 'eight o'clock'.

Though a clock face is two-dimensional, the sky is not. You can be hit by anyone from any direction; a light aircraft descending from several thousand feet above you to land at a farm strip, or an aerotow combination climbing out from way below, to name but two possibilities. The 'hours' by themselves don't cover these situations, so 'high' or 'low' are added to the clock position, depending on whether the aircraft is respectively above or below you. For example, *Four o'clock high* or *Four o'clock low*. If the other aircraft was at the same level, you'd just say *Four o'clock*.

Figure 8



The Scan Cycle

Theoretically, equal attention to all areas would be the most effective scan, but only when the risks are truly random; in other words, when you've no idea from which direction a threat will appear. In practice, some areas hold more risk than others. Sitting outside an ATZ, off the end of a nearby active runway, increases your risk from that direction, but won't automatically make it zero from everywhere else! Likewise, using a cloud street increases the risk from ahead - closing speeds with other gliders can exceed 150kts - but also from above and below.

Whatever the scan pattern, it has to be adaptable. Since the areas of highest risk change during a flight, depending on where you are and what you're doing at the time, flexibility of mind and a capacity to think ahead are attributes every bit as useful as good eyesight.

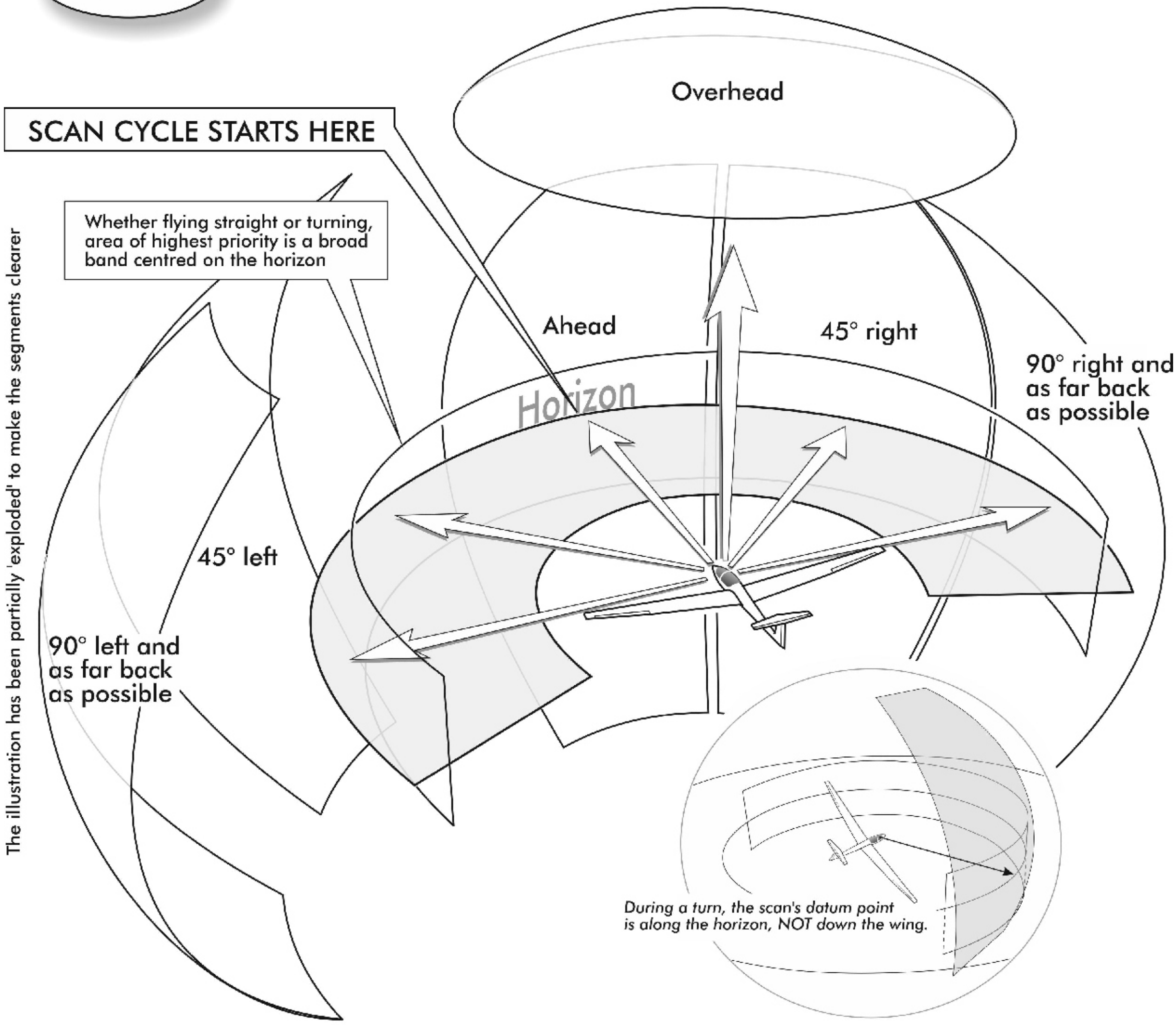
The basic pattern of the Scan Cycle is:

- **lookout**
- **attitude**
- **instruments.**

Where to look - basic pattern

In straight flight attention has to be directed forwards (twelve o'clock), but the whole area from seven o'clock through to four o'clock (or as far back as you can see on each side) needs

Figure 9 THE SCAN CYCLE: Lookout Attitude Instruments



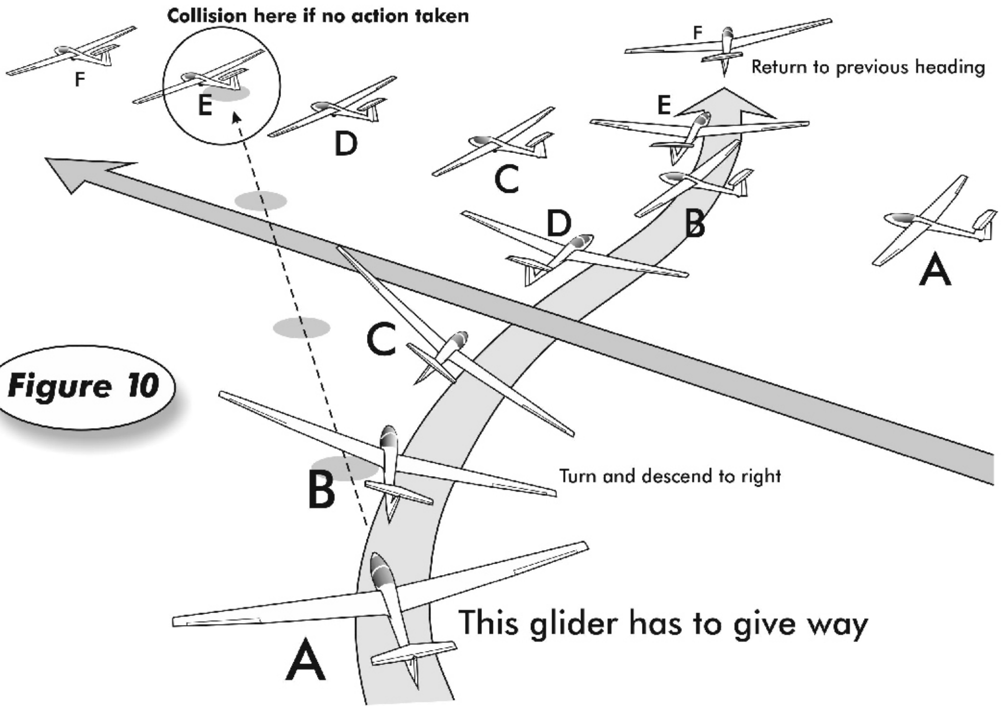


Figure 10

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scanning, both above and below the horizon. Directly overhead needs checking regularly.

Begin the scan by looking far ahead, over the nose. Focus on the most distant objects visible. Check the attitude, and look above and below the horizon. The total area which needs to be scanned is large (figure 9), so merely looking ahead is not sufficient.

Glance briefly at the instruments (this could be included with the initial check on the attitude), then look to one side or the other about 45°, refocus on a distant object on the horizon, and scan the associated segment. Neither the attitude nor the instruments should need checking at this point, so shift your gaze to 90°, and scan that segment. (The front seat pilot of a two-seater will have a far wider field of vision than the rear-seat pilot and will need to look round more than 90°). After looking as far back as you can, look directly overhead, then forwards to check the first segment again, and the attitude and the instruments. Continue the scan at the 45° and 90° points on the opposite side, as far back as possible, then overhead once more - and so on.

RULES OF THE AIR

☐ **6.3** The aircraft which has the right of way shall maintain its course and speed, according to the following rules:

- **Converging.** When two aircraft are converging at approximately the same altitude, the aircraft which has the other on its right shall give way.
- **Head-on.** When two aircraft are approaching each other head-on, or approximately so, each shall alter course to its right.
- **Overtaking.** Overtaking aircraft shall at all times keep out of the way of the aircraft which is being overtaken by altering course to the right, provided that a glider overtaking another glider in the UK may alter its course to the right or left.

☐ **6.4** Whereas aeroplanes shall when converging give way to aero-tows and gliders, and gliders shall give way to balloons, it is nevertheless the responsibility of all pilots at all times to take all possible measures to avoid collision.

☐ **6.7** Aircraft following roads, railways or other lines of landmarks in the UK shall keep such landmarks on their left.

Exactly where you look within each segment is a matter for argument, but in terms of the scan pattern, you are focussing at the right distance and then relying on your visual system's ability to pick out 'off-centre' objects which are moving relative to the background. In principle an uninterrupted scan with no attention paid to anything else would be the best, but you need to pay attention to other things every now and then, and in any case, there are practical objections to constantly having to swivel your head here, there, and everywhere. Whatever the pattern adopted, if you are to see anything at all it must have a number of 'stop and look' points, and whilst it doesn't need to be done continuously, it **must be done regularly and frequently**.

The scan pattern described is an idealised one, and should be regarded as an elastic framework rather than a pattern to be rigidly adhered too. The first and most important point is to have a scan pattern that covers everything that needs to be covered. The second point is that the pattern should become so ingrained that the pilot will continue to look out even when tired, which is one occasion when it tends to get forgotten.

Scanning just before and while turning

The view directly backwards from most gliders is non-existent, and the position of the wing often doesn't help. Before turning, say, to the right, look round and well back to the left. This is not the obvious way to look for a right turn, but you don't want to turn your back on an approaching aircraft which you may not be able to see again until you've turned through nearly 180°. Having looked left, briefly check the attitude and speed, then look right, where you're going to go. Assuming it's all clear, look ahead again and initiate the turn. The process is nowhere near as long winded in reality as it seems on the printed page!

Once established in the turn, adopt the scan so that, in this case, its centre is displaced to the right. Attitude checks are still 'straight ahead' in relation to the glider, but the centre of your scan will now be off to one side (figure 9, small inset). What was previously the overhead part of the scan is now a look in the direction of the turn.

When turning, look along the horizon and treat that, rather than looking down along the wing - which in a decent turn will be way below the horizon - as the centre of that segment of the scan.

If very steeply banked say, to the right, anything to your left may be underneath you, and invisible. Before rolling out of a turn, check below the raised wing as well as ahead, or, alternatively, check ahead about 90° before you intend rolling out.

Collision avoidance

The obvious response to an imminent collision is to manoeuvre out of the way. Exact head on collisions are rare and most gliders have relatively low rates of roll, so, despite what the rules say (box above), what you can do may depend on the circumstances and, to a degree, on what the other aircraft does. In the case of an aircraft going in your direction at exactly the same altitude, and converging from the right, the rules oblige you to give way. One possible response, again depending on the circumstances, would be a diving turn towards them (figure 10, facing page) so that you pass below and behind. It's worth noting that in this case the aircraft that's giving way has the other in view all the time. Had you turned left (OK in some circumstances) you would have turned your back on the other aircraft, and increased the chances of being run down from behind by the same aircraft.

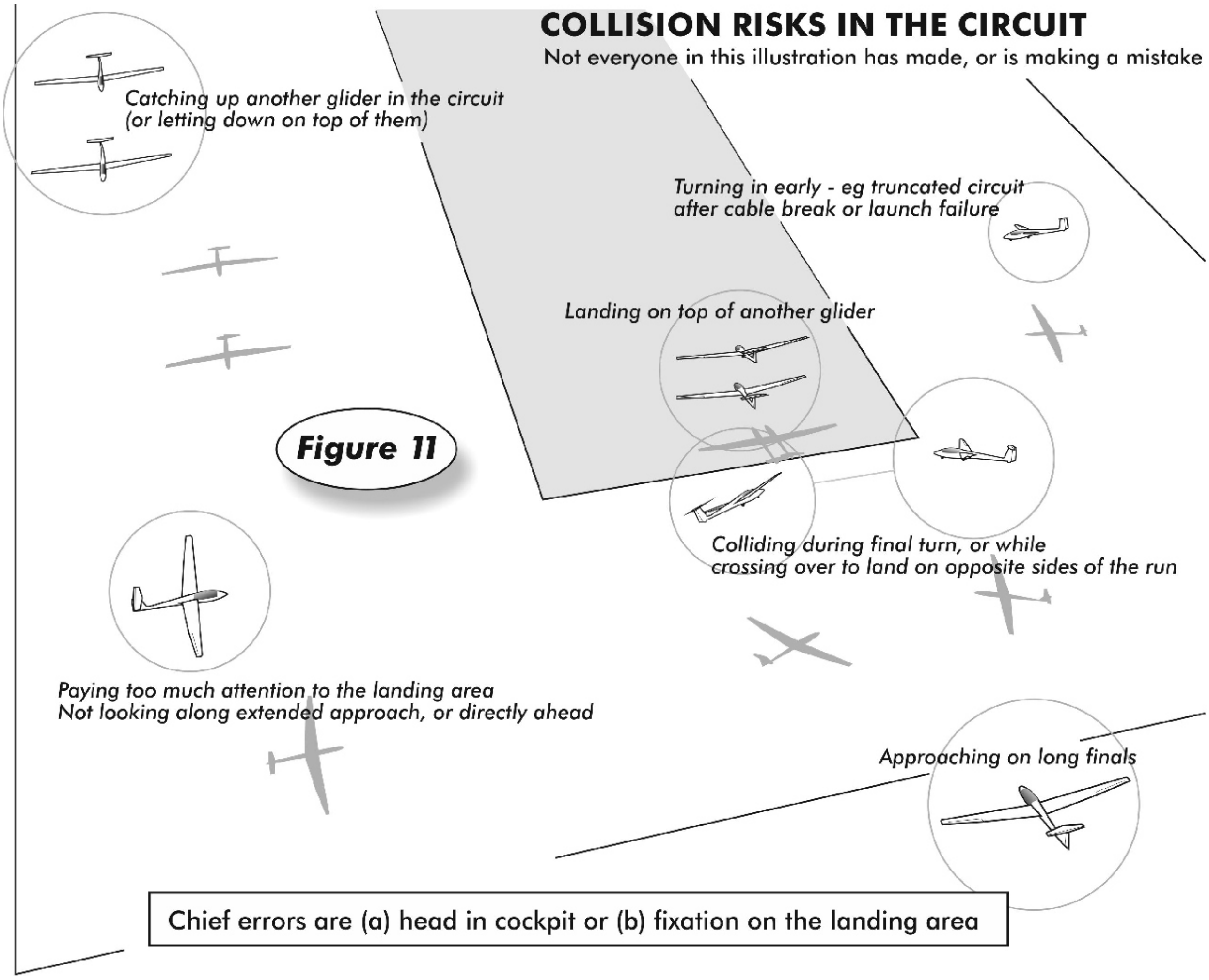
Given that many gliders have less than sparkling rates of roll, the only options in a head-on situation where you don't see each other until the last second, may be up or down, which is 50:50! If you both go the same way, tough. Encourage trainees to try and engineer things so that they never have to bet their lives (or yours) on odds like that.

Every pilot, power or glider, will have read the Rules of the Air, no doubt, but they won't apply them if they haven't seen you, so don't assume they have.

Should you have just avoided one collision, try not to be so relieved that you stop paying attention and collide seconds later with someone else. Watch out for gaggles, particularly if the gliders are quite close together. They may be taking more notice of their neighbours than of anyone coming the other way!

PRE-FLIGHT BRIEFING

The emphasis of the pre-flight briefing should be on the practical rather than the theoretical aspects of lookout. Some of the more theoretical/technical aspects have been described because it is important that you, the instructor, understand why processes we take for granted have their limitations,



particularly in the air, and very often aren't anything like as accurate as we believe.

BRIEFING POINTS

Areas of risk

Risk is everywhere and variable, but the degree posed by aircraft which you spot, as against those which you don't (easily the most dangerous) can be difficult to judge. There is an important element of 'thinking ahead' to lookout, so check the position of other aircraft regularly, even if they seem to be going away. They could change course and come back. Assess whether the risk is reducing, remains the same, or is increasing. If it stays constant or starts to increase, take appropriate action to reduce it.

As far as other gliders are concerned, flying/thermalling in gaggles, running a ridge or in the circuit, are all times when the risk is higher than normal, and good lookout is very important. The closing speed between a glider and a military jet could be 400kt plus, but despite the understandable notion that something faster must be riskier, the biggest threat to gliders is other gliders. Furthermore, most collisions aren't head-on, but when one aircraft converges on another from the rear quarter. It is extremely important, therefore, that **every** pilot maintains a good lookout.

The aircraft that will hit you is often the hardest to see

- if it is on or very near the horizon
- if there is insufficient contrast between it and the background
- if the relative angle between it and you remains constant, and the aircraft is approaching. This won't be at all obvious until it starts to increase in size (see figure 4).

Most collisions occur when the workload is already high

Workload is relative, and depends to some extent on the pilot's level of experience. A pre-solo pilot's workload can be very high when thermalling, and go into overload when the thermal is crowded and/or other pilots join.

The increased risk in such situations may not come from lack of lookout, but from the trainee's lack of ability/skill in handling the glider. You, the instructor, will be familiar with the environment, but the majority of early trainees certainly won't. They can find it difficult to assess any collision risk realistically. So, even if your trainee sees every other glider in the vicinity and tells you where they all are, don't assume that he won't then collide with any of them.

Situations where the relative speed of the potential victims is constantly changing can mask a risk, and make last minute avoidance of a collision much more difficult. An example would be two gliders thermalling at more or less the same level, but with the centres of their respective circles not coinciding [see illustrations in chapter 24].

Lookout in the circuit

The important points to remember about the circuit are that traffic density is likely to be high, your altitude isn't, and most importantly, everyone is heading for more or less the same spot.

- one purpose of the circuit is to set up an orderly traffic flow and reduce the collision risk, but the close proximity of other aircraft will increase a pilot's workload. If everyone flies circuits in the same direction, closing speeds are likely to be low, but aircraft in a pilot's 'peripheral' area of vision will then converge quite slowly, by stealth, as it were. Circuit collisions are most likely when a pilot's attention is 'eye-trapped' by looking for too long at the landing area from, say, the low key point [chapter 14], or just before the final turn (figure 11 opposite)
- on the base leg, remember to look away from the airfield, along the approach line, for anyone creeping in on long finals. Look straight ahead also for gliders approaching on an opposing circuit. They can be very difficult to spot if they are just above the horizon and against a background of cloud. The direction of the Sun can also be critical.
- if your club requires use of radio in the circuit don't assume ever radio, yours included, is working. Not hearing anyone doesn't mean that nobody is there.

Two pairs of eyes are better than one

Regrettably the above heading isn't always true. What can happen in two-seaters is that one person either consciously or unconsciously allocates 'look-out' to the other, and then, because 'someone else is doing it', stops looking out themselves. The other person might well be thinking the same thing. If you want your trainee to do the lookout, say so. Check periodically that they are doing it!

Some practical precautions

Allow for the blind spots of other aircraft. If they are ahead of you and moving in the same direction, they won't see you at all. It's your responsibility not to run them down. Likewise don't get too close, particularly if above and behind, just in case they suddenly pull up into lift.

The only effective method of scanning below and behind is to turn or weave, which isn't energy efficient during the glide, nor always practical. Though the risk from below is relatively small, check there every so often, perhaps by doing an elongated S turn. Don't forget to look directly above you, particularly when about to enter a thermal.

When descending rapidly with airbrakes out, do so in a series of S turns, or circling; either is usually safer than letting down in a straight line, dependent, of course, on the exact circumstances.

When thermalling, always try to position yourself so that you can see as many of the other gliders there as possible, and they can see you. Since early trainees often find it very difficult to turn accurately and keep a good lookout at the same time, the instructor needs to be particularly vigilant.

If you wear a hat (an essential item in hot weather and during long flights) make sure that the brim doesn't obstruct your view. Baseball caps are not acceptable.

Don't use knee-mounted equipment. In 1998 knee-mounted GPS units were reckoned to be a significant contributory factor in two fatal mid-air collisions. GPS equipment should be mounted as high as possible on the instrument panel or canopy frame, but not in a position which seriously obstructs your view.

ADVICE TO INSTRUCTORS

At first the trainee will not know where to look and focus, what there is to see, nor how often to look. For these reasons, lookout is part of every lesson and attention needs to be paid to it at all times. Emphasise it, but not to the detriment of everything else. Initially the workload associated with keeping a good lookout and flying the glider will be high. Be patient. You may have to accept temporarily a lower standard of flying accuracy. After early struggles, your trainee will learn to lookout relatively effortlessly, and his flying accuracy should then improve.

Car drivers have deeply ingrained scanning habits which are OK on the road, but not always helpful in sporting gliding. A driver's scan is inevitably concentrated in a relatively small arc directly ahead, and involves minimal head movement. Trainees who drive, particularly the older ones who've been doing it for a long time, often find it difficult to look all around, partly because you seem to be contradicting all the good advice they ever had about in-car lookout.

One aid to good lookout is to make sure trainees get into the habit of flying by attitude. During the middle part of the flight there's no reason why they should spend more than a fraction of their time looking at the instruments. It's not as if gravity is going to pack up suddenly. Time freed by using attitude leaves more for scanning, and every second counts!

If a trainee fails to look out prior to turning you should immediately prevent the turn, and say something like, *I have control! Do you know why I have stopped you from turning?* The message you are trying to get over is that *looking out before turning is as necessary as moving the stick*. Prompt as necessary, but don't allow the turn unless the trainee understands why you stopped it. As against that, don't fly off into the sunset as you wait for the penny to drop.

You won't know if any of your trainees are really looking out unless they tell you what they can see, or take deliberate avoiding action. Even if they are moving their heads, it may be all they're doing. Likewise, they may be swivelling their eyes and head swiftly and continuously, but seeing nothing because they aren't stopping to look. Ask them to tell you when and where they see other aircraft. If they can master the 'clock' terminology, so much the better for both of you.

Lookout should be a considered and regular process, not an occasional and haphazard glance out of the cockpit when there's nothing better to do.

Do not allow poor lookout to go unremarked.

SUMMARY

One pre-flight briefing won't be enough to make trainees aware of all the problems associated with lookout, so continual reference must be made to them throughout training. To repeat the main points:

- make due allowance for the limitations of eye and brain - include your own psychology (certain types of behaviour are extremely risky)
- check yourself:
  - your eyesight and mental and physical condition
  - wear glasses if you need them, and carry a spare pair to the same prescription. If flying with trainees who needs glasses, insist they have a spare pair handy so that the habit is established early on
- minimise the time you have your head in the cockpit:
  - make sure canopies are clean. If necessary, clean them before you fly. If the sun is in the right direction and the canopy is dirty, wet or misted, you may be completely blind
  - compensate for the glider's blind spots. They aren't that small!
  - plan ahead
- fly by attitude wherever possible, and appropriate
- the scan cycle is
  - LOOKOUT
  - ATTITUDE
  - INSTRUMENTS
- scan the entire visible area in an orderly fashion (45° segments, or smaller) and don't forget to look overhead
- in a turn make the central part of your scan in the direction of the turn, along the horizon and not down the wing
- never rely on radio to tell you where everyone is
- remember that traffic density in the circuit can be high and everyone is heading for more or less the same spot

Lastly, don't lookout to the exclusion of everything else!

COMMON DIFFICULTIES

Failure to move the head. Encourage the trainee to scan by moving his head rather than just shifting his eyes. When the trainee moves his head it is more obvious that something is being done. You will still have to get him to tell you where other aircraft are, to be quite sure he really is looking.

Looking down the wing in turns can lead to disorientation and poor speed control. Given that the likeliest threat when thermalling with other gliders, say, is along the horizon, the trainee is looking in the wrong direction. Remind the trainee that he should be looking outside, not 'Looking out'. Once the difference has been pointed out, speed control and coordination will also improve.

Failure to lookout before rolling into a turn is extremely dangerous. Take control immediately and prevent the turn. This action emphasises lookout's importance. Ask *Why did I stop you from turning?* Only when the trainee has given the correct reply, and actually looked out, should you let him recommence the turn. If this happens just before the final turn, don't wait for illumination, take control.

Failing to look about before rolling out of a turn is just as dangerous as the above, all other things being equal. Same remedy.

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E - HOW TO READ A LOGBOOK

It is a legal requirement that all pilots keep an accurate record of their flying i.e. a logbook. Whether paper or electronic, it must be in a format that allows the instructor to both read and add a comment/s. More than just a slightly dog-eared souvenir for its owner, a logbook helps instructors plan the next stage in a trainee's progress and helps ensure that nothing vital has been missed. It is also a significant aid to any subsequent instructor conducting, say, a check flight at another club - allowing the level of experience, as distinct from their handling skill to be assessed, or to reveal if the owner has not flown for a long period.

During training, the instructor should write most of the comments in the trainee's logbook to ensure that accurate information is passed on to following instructors. The trainee may, of course, write his own comments, but the word 'demonstration' say, has a more specific meaning to fellow instructors than to trainees. A trainee might write 'Wonderful flight. Instructor very pleased' a comment which, while possibly true, conveys little practical information, but may tell you something about the trainee's psychology.

The SPL Progress Cards normally used during pre-solo training are a supplement to the logbooks. The chief function is a record of satisfactory completion of training for each of the SPL exercises. It specifies those which need to be completed before first solo as well as those required for SPL licence standard. Unlike the logbook, the Training Progress Card must be held by the training organisation and retained with a copy of the completion of training certificate. (Whether in electronic or paper format)

ADVICE TO INSTRUCTORS

Always insist on looking at the logbook before flying. What you are looking for will depend to some extent on the pilot's experience:

- is the flight a solo flight that needs authorising; a visitor to your site, for example?
- Is it a check ride or a training flight, or a bit of both?

After the flight(s), form the habit of writing something informative in the logbook. What you write will depend on the exact nature of the flight. Was it a dual flight for training purposes, or a check ride for a conversion. What was the result?

Most importantly, suggest what the next exercise should be. This is helpful to the next instructor, and you can also suggest to the trainee that they read up about it, to prepare.

[1] What to look for in a Logbook

How current is the pilot?

- how many launches/hours in the last month/the last three months/the last year?
- watch out for the pre-solo pilot who has done 27 launches in the last year, but only two of these in the last quarter; they can do things that can take even experienced instructors by surprise.
- a solo pilot with the same history might be out of practice, but this will depend on the average flight times. One launch per three weeks may be fine for an experienced pilot if the flights average an hour or more. Less experienced pilots can easily be caught out by different weather conditions from when they last flew.
- Keep in mind that low currency is frequently seen on accident report forms. If in doubt, ask where they are on the BGA Currency Barometer and if they do not know what that is, educate them.

[2] How many years has the pilot been flying?

The solo pilot with a hundred hours in his first year deserves plenty of encouragement but may become over-confidence. Most solo pilots will average twenty hours or fewer per year and as a consequence, may be lacking in confidence, not to mention practice. Pilot confidence is an important factor in general progress and performance. The same is true of the pre-solo pilot, though a trainee who has done a hundred hours in his first year and not gone solo, could rightly be regarded as slow, and may be unlikely ever to be alone in the air. However, taking a long time to go solo is not necessarily the mark of a poor pilot.

[3] At how many clubs has the pilot flown?

A drifter? If so, why? Their job may post them about a lot, or they may never have found a club that would send them solo. The solo pilot who drifts from club to club may also do so because of being posted about by their job. It may also be that successive clubs, have quietly suggested they go elsewhere, or, just as likely, disagreements with the club, its policies, its members, its committee, or whatever, have made a break necessary. Alternatively, they may just like extending their knowledge and experience by flying at other sites.

[4] Have there been any long breaks, particularly before the first solo?

This often but not always indicates frustration. Perhaps the trainee is not a fast learner, and it all took 'too long.' They may have been financial issues, or the club they were at might not have been pro-active. Whatever the reason, repeated breaks in training are disadvantageous to the trainee. Vital lessons like stalling may have been overlooked.

[5] How many launches did it take to go solo?

Youngsters may learn very quickly but older trainees will probably take many more launches to go solo. Training at some clubs in areas of difficult terrain may also take longer. However, many factors can and often do increase the launches required. Infrequent flying or large gaps in flying always extend training. Also, as gliding clubs train all-comers, poor aptitude can occasionally be an issue. The latter may occasionally prevent progression to solo flying but can usually be overcome by patience and plenty of flying.

There may be reasons for taking a long time to go solo; poor instruction, or lack of instructional continuity e.g. too many different instructors. The trainee may have been ready for solo for ages, or they may be a slow learner. Equally, most of

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the training may have taken place during the winter, or on unsoarable evenings. Do not assume that the trainee is the one who has the problem.

[6] How long did it take to go solo - in months?

The length of time to go solo varies considerably but within a year might be a reasonable goal. Attendance on a week's course should have got them a good way towards solo – weather allowing. Longer periods might indicate that they have suffered some of the problems mentioned in the previous paragraph.

[7] When did the pilot last do any launch failures - real or simulated?

What are the trainees' total hours? Are they solo? If pre-solo, at what stage? From their level of experience, are you confident they will be able to cope if there is a break?

[8] When did they last do any stalling or spinning?

Will they recognise the approaching stall and are their recovery habits correct? Previous comments in the logbook, even in the training syllabus sheet, may not always provide sufficient information on this, particularly if the trainee or solo pilot is unknown to you.

[9] How experienced and current is the pilot on the type of glider to be flown?

Do not expect too much if the glider is a new type, particularly if the trainee is early pre-solo. Even quite experienced pilots can appear remarkably clumsy if the type is significantly different from anything they have flown previously. Does the pilot require a type conversion briefing? If they have done fewer than half a dozen flights on type, or appears nervous, then a quick re-brief would be in order. (see chapter on type conversion)

[10] Can they soar yet?

For solo pilots, soaring flights of an hour or more are the ones to look for. It is usually good news if pre-solo pilots have managed a few flights of, say, half an hour or so, as they will have had plenty of practice in coordination etc, and will be a bit more relaxed about flying.

Questions and Answers can amplify comments in the logbook and help break the ice with the trainee, be they solo or pre-solo.

[10] Does the pilot appear to be 'out of check'?

Part SFCL has recency requirements that include two training flights with an FI(S) in the previous 24 months. This is a minimum requirement, and many clubs will maintain a requirement for an annual check. These training flights must be used as an opportunity to develop a pilot's skills as well ensuring the basic competency level.

<u>WHAT TO WRITE IN A LOGBOOK</u>

A basic entry for a pre-solo trainee should include -

- What was demonstrated on the flight.
- What the trainee flew well.
- What was attempted but did not work out. Be honest here but avoid giving offence.
- Your suggestions to the next instructor as to the content of the trainee's next flight. For example, *'Trainee to attempt the launch but may require prompting throughout. Demonstrate spin and recovery. Should attempt circuit and landing without prompts*. The next instructor will not then have to use most of the flight finding out things which you already know.

For an experienced solo pilot who has just had a conversion check, the obvious comments would be *OK for the XYZ* or *Needs more practice at* ... (possibly adding a very brief reason).

Licensed pilot check flights and DoA's (Demonstration of Ability) for endorsements – what to write?

SPL recency requirements include a required number of training flights with an FI(S). SFCL.160SPL.

A suitable form of words might be:

> *'Training flight completed in accordance with SFCL 160 signature/name/licence no.'*

For record of endorsements such as cloud flying:

> *'SCF training completed in accordance with SFCL xxx Signed, dated and licence number.'*

For 9-year Demonstration of ability:

> *'9 yr Demonstration of Ability IAW SFCL.360 (a)(2) Instructor signature/name/date/licence no.'*

F - SUPERVISING FLYING

INTRODUCTION

This chapter covers aspects of airfield supervision including the organisation of First Flights for members of the public. Other supervisory tasks, such as looking after solo but unqualified pilots and managing type conversions, are covered elsewhere in this manual. There is some overlap between the guidance here and that given in *Managing Flying Risk – Supervision* on the BGA website.

Naturally, many of the practical aspects of airfield supervision will be site specific and clubs will have their own procedures. Here we give an overview of the various considerations that need to be borne in mind.

FUNCTIONS AND RESPONSIBILITIES

In setting up our airfield supervision for the day, we are aiming to provide a safe, efficient and enjoyable operation. There are many practical tasks involved:

- Checking weather and NOTAMs
- Deciding where to put the launch-point and setting it up
- Deciding which gliders are needed, getting them out of the hangar, DI-ed and towed into position
- Keeping the logs, signalling, wing running, retrieving – all the jobs that make the launch-point run smoothly
- Briefing and debriefing pilots in training, those not yet qualified, those attempting early cross countries, type conversion, or similar new ventures
- Making sure everyone is aware of the day's arrangements, perhaps through a morning briefing for all pilots
- Looking after any visitors, such as pilots from other gliding clubs or members of the public coming for First Flights
- Ensuring everyone is accounted for at the end of the day.

A well-supervised operation covers some softer skills too:

- If a flying list is being used, ensuring it is fair
- Looking out for newer and less experienced members
- Encouraging early solo pilots in particular to get the most out the day – helping them set a goal for their flight and discussing it afterwards
- Being vigilant for any incidents that could disrupt the operation and ideally catching them before that happens.

This is a great deal of work and it needs to be shared by a team. If unqualified pilots are flying there must always be a FI(S) supervising, but ideally that person should not be trying to directly manage **all** the jobs mentioned above on their own.

One approach might be for the club to identify experienced and competent individuals and train them for launch point supervision, so that they can manage the people doing the practical tasks, whilst keeping that overall eye on the operation which is so vital. These 'ground supervisors' would be acting under the delegated authority of the duty instructor and helping to free that valuable resource for concentrating on instruction and pilot briefing.

AIRFIELD SETUP

Every airfield has its own peculiarities that will affect how the gliding operation is set up for the day. If your club has only one runway, or uses only one launch method, the setup decisions will probably be simpler than at, say, a circular field that can support many launch directions, and where a mixture of launch methods is used. Nevertheless, there are common factors applying everywhere.

The first step will be to check weather and NOTAMs because either of these may preclude flying at all. The weather may be flyable now, but is forecast to deteriorate. This should to be briefed to the team, to avoid the scenario of continuing flying as conditions gradually worsen to the point where it becomes unsafe. The aim should be to create an atmosphere where any member of the team can raise concerns.

Assuming flying is possible, these are some of the considerations for how to set up the field:

- Where should the launch-point be for today's wind direction?
- What is the state of the field? Are there areas that have to be avoided, e.g. for landing or towing over? If so, has everyone been briefed?
- If launching by more than one method, do we have adequate separation, e.g. Aerotow to winch cables?
- Is there room for manoeuvring gliders and vehicles as required at the launch-point?
- If winching, where should the winch be positioned to ensure the cable can fall safely? Are there particular dangers today, such as cables drifting over power lines, buildings, trees and so on, following a break?
- Will low sun become a problem for launching or landing as the day goes on?
- If aerotowing, does the tow out route take account of local noise abatement issues?

It makes sense for decisions on these points to be made in consultation with those chiefly involved, such as the tug pilot and winch driver.

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MANAGING THE LAUNCH-POINT

The launch-point is typically the hub of the flying operation. Ideally, on busy days there should be one person who is not performing any of the individual jobs but is keeping an overall eye on things. An efficient launch-point means more flying, which means more income for the club and happier pilots. It also means a safer operation, with things happening according to plan and anomalies being easy to spot.

There may be a complete mixture of experience at the launch-point, and the club will have some method (perhaps a 'ground handling' training card) for training new members in the jobs that need to be done. Some of these jobs – such as running the wing – are safety critical and the person in charge needs to ensure that members are trained before they attempt them. The jobs include:

- log keeping
- cable attaching
- wing running
- signalling
- cable towing for winching
- retrieval of landed gliders

Whilst everyone should be paying attention and be encouraged to speak up if they see a potential problem, it will be a big help if there is a supervisor, who is able to stand back and watch – to see that the signaller really is checking that it's 'all clear above and behind', that the pilot has not left the tail dolly on, that the brakes really are closed and locked, that there isn't a stray visitor about to wander across the launch line, and so on. This person may also have time to keep an eye on who should be flying next with which instructor, notice whether someone is doing more than their share and needs a break, and make sure that the new member is not missing their turn through being too diffident.

As well as the practicalities of launching gliders, there may be a lot of other interactions going on in the vicinity of the launch-point:

- Instructors briefing and debriefing trainees
- People chatting or giving their attention to their phones
- Pilots going back and forth for cushions, weights and suchlike
- People wanting to check the logs, or check their place in the queue
- Radio messages to and from winch drivers and tug pilots, and to and from airborne gliders.

There should be some way of keeping the actual launching free from distraction, involving just those people needed, who are all focused on the job in hand.

AIRCRAFT AND VEHICLES

Most clubs have rules about where private vehicles can drive on and around the airfield. These may be dependent on the state of the field e.g. a grass field that's too soft to drive on. Anyone driving on the airfield, whether in a private car or a club vehicle, needs to be aware of all aircraft approach paths and landing areas and keep a good lookout.

There may be preferred tow out routes for gliders. When gliders are towed behind a car the lookout may be less effective than when there is a crew walking with a towed glider. There may be preferred routes for retrieval of landed gliders, so that blockage of potential landing areas or further launches is minimised.

All these considerations should be briefed to members and visitors and documented in the club's site manual. Visiting members of the public need to be individually briefed and, if possible, escorted or driven around the airfield by club members.

Training for club pilots needs to cover ground handling of gliders and club vehicles, including:

- hangar packing and unpacking, and who is allowed to do this or supervise
- storage of batteries and parachutes
- defect reporting
- how to DI gliders, and who is allowed to do this
- how to DI club vehicles, who can fuel them, drive them etc if there are restrictions
- how to tow behind a vehicle as the driver, as the wing holder and as the person by the nose
- how to park a glider if leaving it unattended on the airfield
- where to push and pull when manoeuvring gliders on the ground by hand
- how to handle canopies to avoid expensive damage.

FIRST FLIGHTS

Club members will be aware of the risks involved in the sport of gliding, and hopefully how to mitigate them. This does not apply to members of the public coming for First Flights, who will expect the experience to be completely safe, and should be correct in that assumption.

There is extensive guidance elsewhere on how IFPs and instructors should manage these flights and the PIC's training should have prepared them for all aspects of their role. The key point for the pilot flying a member of the public is that the flight should be well within their limits. One way of putting it is that the member of the public should find it exciting but the PIC should not.

If the PIC has a rating lower than an FI(S), then a higher rated instructor must supervise the flying operation. If the supervising instructor is also in charge of club flying on the day, there needs to be a mechanism to ensure sufficient oversight. Considerations include:

- Are visitors escorted while airside? This includes friends and family of the person who is actually going to fly.

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- Have the visitors been briefed adequately? Have weight limits been checked if there is any doubt? (The limits should be made clear at the point of booking the flight, but there needs to be provision for checking on the day.)
- Is the weather suitable? Club flying may sometimes continue in conditions that are unsuitable for First Flights.
- Is the PIC suitably qualified and current on the launch method and aircraft to be used?
- If the PIC is an FI(S) are you, as overall supervisor, sure they understand the criteria for First Flights? Sometimes it is the experienced instructors who try, inappropriately, to give 'extra value,' or continue in inappropriate weather in ways IFPs and BIs would not dream of.
- If possible, does the PIC have helpers – to meet and greet, talk to the non-flying friends and family, provide escort to and from the launch-point, help with getting in and out of the glider?

Members should be made aware when flights for the public are going to happen alongside normal club flying. Then they will be primed to be friendly and welcoming to visitors, and it helps with understanding if there are any delays or slow launch rate. Many clubs prefer to keep this kind of flying to specific times rather than mix it with club flying, so that full attention can be given to the visitors and club activities are not disrupted.

END OF THE FLYING DAY

At the end of the flying day the airfield supervisor needs to oversee all the tasks involved in dismantling the airfield for the day:

- Towing away, whilst maintaining lookout discipline as gliders may still be landing.
- Cleaning of aircraft and vehicles as required by club policy.
- Hangar packing, storage of parachutes and batteries.
- Dealing with the logs.
- Checking all gliders are accounted for.

On winter days when there are just a few club gliders flying this is straightforward. On summer nights when some gliders will be away cross country, returning long after club flying has stopped, it is a different matter. There is no requirement for the club to monitor the activities of qualified pilots but, particularly if we are talking about challenging terrain, nobody wants their friends to be left on a remote mountainside, possibly injured and hoping someone will notice they're missing.

Your club should have a policy on what is expected of the airfield supervisor. Given the prevalence of electronic conspicuity, it may be reasonable to expect the duty supervisor to look online for any gliders not landed back when they finish for the day. Many clubs have reporting procedures they require their cross-country pilots to follow (e.g. after a land out), to avoid the unfortunate duty supervisor being left wondering whether or not to call the emergency services for search and rescue. However, qualified pilots must look after their own safety and there is no question of the airfield supervisor being responsible for them.

All pilots should be aware that when they land safely it is vitally important to make sure their landing was logged.

ACCIDENTS AND INCIDENTS

If a serious accident occurs there are defined procedures that need to be followed; these are documented on the BGA website under the *Safety* section.

The club should have an emergency action plan ready to be followed by the airfield supervisor or any other individual taking charge. They must be familiar with the plan. The immediate actions are likely to be:

1. Stop launching.
2. Call the emergency services if required.

After that, there is time to think and follow the steps of your plan.

A serious accident in this context is an occurrence associated with a flight resulting in fatal or serious injury to a person, or substantial damage to an aircraft.

Incidents which are less serious but which have safety implications beyond the club must also be reported to the BGA. Most clubs have systems for recording **all** incidents with safety implications, even if they are considered (typically by the Safety Officer or the CFI) too minor to be worth a BGA report. Such incident recording is useful in determining measures to prevent recurrence.

The debriefing of pilots who have had an 'incident' of some kind is covered elsewhere in this manual but it is worth stressing the basic point that when someone has made a mistake two things are needed:

1. They must realise they made a mistake.
2. They must understand how to avoid it in future.

The duty supervisor dealing with the incident should bear in mind that sometimes a cooling off period is needed before step 1 can be achieved.

HUMAN FACTORS

If you have read this far, you will realise that a great deal is encompassed in 'airfield supervision.' On a busy airfield with lots of pilots and gliders, this collection of tasks should be shared and not left entirely to one over-worked individual. An important aspect of Threat and Error Management is to recognise the threat of any member of the team being overloaded and avoid the error of making them carry on when they need a break.

Being out of doors on an airfield for many hours may result in dehydration or heat exhaustion at some times of year and extreme cold at others, not to mention hunger and low blood sugar. Look out for yourself in these respects and also try to keep an eye on other members of the team.

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G - TYPE CONVERSION

INTRODUCTION

Introducing trainees to a new type of two-seater is easy – you will probably be flying it with them to remind them about anything they have forgotten!

Single seaters are different. You have one chance to brief them on everything, and they have one chance of remembering it all. Once they have taken off, they are on their own.

Whilst a briefing is helpful, (if not essential), it is the pilot's responsibility to ensure they are familiar with the aircraft, so they must **read the glider's flight manual**, plus any briefing notes which are available.

The subsequent briefing should contain only the minimum essential information needed by the pilot to be safe (so that they stand a chance of remembering it). Take into account their prior experience on other, similar types.

To brief for type conversion, the instructor should be appropriately familiar with the aircraft and be able to list the significant points that are required. Otherwise find an instructor or senior pilot that is familiar with it.

In general trainees will be keen to progress onto new types but are seldom 'converted' until they are well up to the standard required. Nonetheless, a disproportionate number of accidents occur during type conversions or early on flying a new type. This may be contributed to by a 'briefing failure', or lack of supervision.

It is not the handling characteristics so much as the workload that makes new types difficult. It is the overall combination of pilot and glider which matters, not the glider itself. The briefing's objective is to reduce the pilot's workload so that they can concentrate on the flying.

Type conversion flights can be stressful, so the pilot needs to be properly prepared, and the weather needs to be suitable.

The trainee's suitability for the type may need to be reconsidered in the light of their reaction to the briefing points made. Very occasionally, it may be prudent to delay the conversion until another day, perhaps when the weather is a little easier and the workload correspondingly lower.

THEORY & BRIEFING

In the case of 'type conversions' the presence of the glider in question is required at some point.

Not all the material below will be relevant to a particular glider, and instructors should be experienced enough to emphasise or ignore items, as appropriate. Alternatively, a type conversion card is a good way of ensuring that nothing gets overlooked.

- The briefing should be conducted by **one** instructor or nominated senior pilot – other contributions may simply be a distraction or cause confusion.
- The instructor should be familiar with the type being converted to, and the one from which the conversion is being made.
- An external walk-around similar to a DI can be a useful introduction to the glider, especially if it is a completely unfamiliar type.
- Unless the basic flight controls function differently from gliders flown previously by the trainee, they do not usually need mentioning.

If the glider has a retractable undercarriage the important points are:

- how to raise and lock the undercarriage up
- how to lower and lock it down
- is there an alarm?

After the launch (at sufficient height), try retracting the undercarriage then cycle it, (i.e. lower it and retract it again) so that any unforeseen snags can be dealt with calmly.

It may be worth practising raising the undercarriage on the ground: the technique can be best practiced by supporting the glider in its belly dolly (preferably rigged), making sure that the wheel is clear of the ground. It is worth wearing a parachute and closing the canopy for this.

The airbrakes may also be different. Common variations include:

- The airbrake lever may look like and/or be right next to the wheel and/or flap lever (not uncommon), requiring positive visual identification before use.
- The cockpit ergonomics may be different restricting full range of travel. Check before launching the first time.
- Enormously powerful over-centre locks, -if the pilot does not realise the lock is not engaged, it would easy to take-off with the brakes unlocked.
- The airbrakes may be less effective than the pilot is used to, or they may be quite fierce (more common amongst older gliders.)
- They may suck open and require substantial force to close - especially at higher speeds - or a positive force may be needed to hold them open.
- Variations in deploying the wheel brake.

Flaps should be taught in a two-seater, but this is often not available. [For more detail on flap usage, see chapter 5a]. The minimum advice required is:

- always read the flight manual
- the flap setting for take-off
- the nominal setting in free flight and limiting speeds for the various flap settings.
- the setting for landing. Warn the pilot that if landing flap is used, the approach speed must be maintained.

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Care should be taken, even with experienced pilots where large differences in performance from the type(s) they are familiar with exist. Higher performance is rarely an issue, but a pilot who has not flown anything worse than an ASK 21 will be at great risk when encountering sink or unexpected headwind in the circuit flying most wooden gliders. Undershooting is a real risk.

Pre-flight preparations

In addition to reading the flight manual and a briefing, the trainee should:

- sit in the glider for a sufficient time, before arriving at the launch point, to become thoroughly familiar with the positions of the instruments and all controls. Including canopy latches and ventilation, and jettison.
- check that they can adjust the straps to properly secure themselves. (Do not use soft, compressible cushions behind the pilot. 'Cushions' under the pilot **MUST** be either impact absorbing foam, or solid.)
- check that they can easily get full movement to:
  - reach all the controls, especially full forward stick and full airbrake.
  - apply full rudder and stick together, in the same direction. Check that when full left rudder is applied, for example, the pilot's left leg is not at full stretch, making it impossible to apply full left stick at the same time.
  - reach the cable release easily.
- know and understand the various limiting speeds, especially maximum manoeuvring speed (V_A), maximum winching speed (V_W) and the never exceed speed (V_{NE})
- decide sensible minimum launch and approach speeds for the day.
- Nominate stick and trim positions for take-off.

The use of ballast is strongly recommended, unless the is a very experienced pilot. For trainees this should be at least 10kg (22 lbs) above the placarded minimum figure.

Ancillary equipment should be understood, especially on/off and volume controls for the radio and any audio variometer. If the variometer is complicated, what is the minimum the pilot needs to know to get something sensible out of it? Some kit may be better switched off for a first flight.

In the air:

Ideally, a type conversion should take place at a familiar site, using a launch method with which the pilot is comfortable. Too many 'firsts' in one flight, increase both the workload and the risks significantly.

The most dangerous phase of any type conversion flight is a launch failure during the first few seconds. If the pilot is familiar with and in practice at aero-towing, it is preferable to winching for a first 'on-type' flight. Things tend to happen more slowly, and more height - and therefore time - can be taken.

If a real or perceived emergency arises, the pilot may revert to previously learned, but in the circumstances, inappropriate behaviour. For example, the undercarriage is cycled up and down in mistake for the airbrakes.

Immediately before the first flight, double check that flying conditions remain appropriate for the trainee to make this conversion. and consider TEM for this exercise.

TEM

Threats:	**Mitigation:**
'Helpful' friends or Syndicate partners may confuse the pilot with unhelpful or irrelevant information.	Ensure only the most current and knowledgeable conduct the briefing.
Errors:	
The pilot may confuse or misuse unfamiliar controls in a more complex type.	Ensure the pilot is thoroughly familiar with all the controls, particularly 'new' ones before flight.
The pilot may not allow for large differences in performance.	Brief and ensure the pilot understands the issues and how to allow for them.

During the flight the pilot should, as a minimum, assess the low-speed handling characteristics of the glider and find out the stalling speed. Soaring out of range of base is not normally appropriate.

The trainee's first flight on a new type is effectively a first solo, so try and be around to monitor its progress. and if possible, the circuit and landing.

DE-BRIEFING

A re-briefing rather than a de-briefing is often required. It should emphasise the main points again, explaining subtler points that, in the interests of brevity, were left out of the original briefing. The trainee will extend their knowledge gradually on second and subsequent flights.

Ask your trainee some open questions about the glider's characteristics. The answers will tell you what they have discovered, and whether it has been understood.

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COMMON DIFFICULTIES

PIO on take-off owing to holding the stick forward initially.

Wheel-up landing. This often happens if the wheel was left down throughout the flight and then retracted as part of a pre-circuit 'check.'

Poor speed control initially, as the attitude may be different from the type the pilot is used to and through not monitoring the ASI

Poor speed control on approach is often associated with inadequate skill in using the airbrakes, commonly compounded by using a much too close 'super-safe' circuit, followed by an inevitable overshoot.

This may lead to excessive wheel-braking to 'spot-land'. The glider tips on its nose and then the tail slams back down.

After landing the pilot reports sink 'everywhere.' This may mean that they were flying much too fast. Another possibility is that the airbrakes were not locked properly on take-off and were partially out for some of the flight. Pilots are reluctant to admit this when it happens. It is also conceivable that there really was sink just about everywhere!

Unpreparedness for cable-break or other emergencies.

Full conversion and exploration of the type does not take place after the initial flight resulting in problems later.

I - GROUND HANDLING

INTRODUCTION

The first lesson in any proper training course is a ground briefing. Many trainees will have already taken a trial lesson before deciding to learn to glide, and if it was their first flight ever the briefing will usually have been fairly brief.

When the trainee decides subsequently to take up gliding and joins a course or a club, they will be expected to participate in the team side of flying - running the launch point, driving retrieve vehicles and so on. So, a fuller briefing is needed.

This should include the following key areas:

- Airfield discipline - SAFETY FIRST
- Glider and tug handling

BRIEFING POINTS

[1] Launch points

Launch point locations for different wind directions, and how to reach them safely. Are there separate launch points for winch and aerotow?

[2] Moving about the airfield

Where to look for traffic in the circuit (and for unexpected traffic arriving from cable-breaks or simulated field landings etc)

How to decide whether a winch launch is about to take place or not (perhaps by looking at the movement of the cable retrieve personnel/tractor, or by looking for a glider wings level, or other signalling)

Whether cars or other vehicles are permissible on the active airfield and if so, under what conditions. How to tow gliders out to the launch point in the morning.

[3] Cable runs

Where they are and why they might be dangerous. Which way the wind will drift the wire as it falls.

[4] Team effort

Retrieving landed gliders, etc.

[5] Glider and Tug handling

Handling points - grab handles, leading edges, wing tips, cockpit frames, tail or wing dollies and tow-out gear are all useful.

Non-handling points - trailing edges, tailplanes, rudders, 'no push'/'no handling' labels, canopies, propellers, etc

[6] Canopy discipline

Do not reach through the DV (Direct Vision) panel to release the cable and do not lift the canopy by the DV edge. Do not leave canopies open or closed in such a way that they can fall shut and shatter or blow open and do the same. Keep canopies clean- only use a scrupulously clean cloth. If the canopy has visible dirt on it, rinse off first with clean water, before wiping with a wiper blade or clean cloth.

[7] Keeping the log and keeping it up to date

A legal requirement. Names should be entered fully – not simply first names or nicknames.

[8] Hooking on gliders and signalling

Include briefing on weak link strengths/colour codes, and who is allowed to initiate a 'stop' signal.

(see chapter 3 Preparation for Flight)

[9] Parking Gliders

Those that are susceptible to blowing over need parking with the into-wind wing down and enough tyres on it to hold it down - clean any grit off the tyre before placing it on the wing. Heavier gliders can safely be left with the into-wind wing up but will still need to be picketed in moderate or strong winds. Care needs to be exercised if vintage types are being parked as their low wing loading makes them very vulnerable to blow over and few of us are now accustomed to the degree of care required.

Always close and lock the canopy.

Removing the tail dolly will help to prevent weather-cocking.

Packing in a hangar can easily result in "hangar rash". Care should be taken to adequately brief those moving the aircraft and those checking clearance, including anyone's use of the command 'stop!

[10] Towing behind cars

Confirm the undercarriage is locked down and close and lock the canopy

A rope at least as long as the wingspan is a good idea. The rope should not be elastic and ideally should have a weak link. Loops at the end of the rope instead of proper rings (or a simple chain link) are a false economy.

Attach the cable to the winch hook so that in an emergency it back-releases.

Hold the into wind wing except when approaching a potential obstacle, in which case steer by holding the wingtip nearest the obstacle – that way, the obstacle's proximity to a wingtip is obvious.

Drive at walking pace.

Have someone by the nose of the glider to act as a human buffer. Anticipate overruns (e.g., when approaching a downslope).

Keep the glider straight behind the car if overrunning slightly - do not to hold one tip back and accelerate the other into the car's rear windscreen! It is the job of the person by the nose to prevent any overrun.

Ensure the car driver is alert, with the radio off and a window open, so that they can hear requests such as STOP.

If tow out gear is used, Check the towing equipment is serviceable and is fitted correctly to the glider.

[11] Tugs and their propellers

Approach tugs and motor gliders from behind the wing. PROPELLERS CAN KILL.

Tugs and motorgliders should have been left with the magnetos off but do not assume this is the case. Stationary propellers are just as dangerous as moving ones because the tiniest movement of the prop can cause the engine to start. Always treat them as live.

Do not pull an aircraft by the propellor unless the flights manual specifically says that you can and you have checked it is not 'live.'

If you are aware someone is starting an aircraft by 'swinging the prop', ensure the person involved has no loose items on, such as scarves, and ensure someone is at the controls.

Be aware of the effects of prop-wash.

[12] Daily Inspections

Daily inspections need to be carefully taught and trainees checked out for each glider type. Emphasise the importance of rig checks and positive control checks at every DI. If in doubt, do them again. [Fuller details in chapter L, Rigging, De-rigging & Daily Inspection].

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J - USING GLIDING SIMULATORS FOR TRAINING

The use of gliding simulators has become widespread as clubs recognise their value for improving SPL and instructor training There are many different configurations, using various types of software. Probably the most commonly used software is Condor (https://www.condorsoaring.com/) and this chapter has been written mostly with Condor in mind.

Some clubs have sophisticated setups involving a two-seater fuselage with working controls and multiple projectors showing realistic scenery. Much simpler and cheaper arrangements can also provide real value, perhaps just a PC with a screen and joystick. Clubs that have laid out on expensive hardware and software have often found that they can recoup the investment gradually by charging members for using the simulator. After all, it does provide real value and can save a trainee a lot of time and money by significantly reducing the airborne work needed.

This chapter is concerned with gliding training, by instructors, on the standard syllabus. Of course, simulators have other uses too, such as entertainment and 'taster' flying for visitors, wet day amusement (as well as serious training), races and competitions, exploration of new territory and preparation for visits to other sites, and probably many more ideas.

A range of members will enjoy using the facility, but users must be aware that training in the syllabus exercises should be carried out by qualified instructors.

If using a simulator, the plan should be to brief the exercise first, then 'fly' it on the simulator to allow repeated practice and to clear up any misunderstandings, and then fly the same exercise in a real glider. By this point the trainee should have a good grasp of it and for many exercises just one flight may be sufficient. This process has proved particularly valuable for instructor training, where a group of candidates can discuss the points of an exercise, using the 'pause' function, and subsequently a set of several exercises may sometimes be covered in a single real flight because they have been thoroughly explored first.

The BGA 'Instructor Resources' web page includes material on simulator use. There are several short example videos illustrating how a simulator can be used for exercises where it is especially valuable: ballooned landings, ultra-low launch failures, low aerotow failures and as an introduction to spins and spiral dives.

IDEAL SIMULATOR EXERCISES

These exercises are listed as 'ideal' not because they are more important than other exercises on the syllabus but because they are ones where using a simulator is particularly helpful. This may be because they are potentially dangerous to fly, putting pressure on both instructor and trainee, or because most trainees require repeated practice. Whilst a gliding simulator is never the same as the real thing, it can be a very good approximation and experience shows that trainees find it valuable.

The details of these exercises are explained elsewhere in this manual so only an overview of how to perform them is given here.

In Condor, one can create flight plans with all the desired configuration for a particular exercise (starting airborne or doing a launch, wind speed and direction, choice of glider, position of airborne start, and so on) and save them as labelled exercises that can simply be loaded by the instructor wanting to train that exercise.

Ballooned Landings

Most people learning to land will do the odd balloon landing at some point; but the instructor will naturally take over, so they may not get an opportunity to practice recovering the situation themselves. It is important that they don't have to do this for the first time when flying solo. Yet setting up a deliberate balloon landing for a novice to recover from can be hazardous and both crew in the glider may be somewhat tense.

The Condor 3 simulator is particularly good for this exercise because it can be set up with an 'in air' start half-way down the approach, that can be repeated as many times as desired, without the need to reload or to fly around to that point. This saves a great deal of time and makes the exercise much more focused. The instructor must remember to set the trim and airbrakes each time before restarting.

As with any exercise, the instructor should brief, then demonstrate and then let the trainee practise. A range of different balloons can be executed, from very small ones where the pilot simply holds the attitude and allows the glider to sink onto the ground, continuing the round-out as appropriate, to high balloons where the airbrakes must be closed and the attitude adjusted to ensure no further loss of energy. One can experiment with situations where it is possible to regain airspeed and re-open the airbrakes and contrast these with ones where the pilot has enough airfield ahead (and a low airspeed) and patiently waits for the glider to touch down with no airbrake.

The instructor may choose to set up the balloon and handover control at that point, or to let the trainee experiment with creating the balloon themselves. It can be instructive to pause the simulator immediately after the balloon and switch to an external view of the glider. If one saw this view from the launch-point one would anticipate a crash, but then we return to the cockpit view, restart, and sort the situation out. This practice is especially useful in instructor training.

Ultra Low Winch Failures

Because of the risks involved, this exercise is a 'demonstration only' in the glider. However, it will increase a trainee's confidence if they are allowed to practice handling ultra-low launch failures themselves, on a simulator.

The setup is different from the ballooned landing: one starts a winch launch and pulls the release just after take-off (unlike in a real glider, where of course the winch must initiate the failure). The subsequent handling is very similar to the ballooned landing, however, without the extra complication of the airbrakes being deployed. The attitude must be adjusted to ensure no further energy loss, but without diving into the ground and, just as with the balloon exercise, the airspeed must be monitored and a decision made whether to patiently 'feel' one's way back onto the ground, or to very carefully open the airbrakes if there's sufficient airspeed but a shortage of room ahead.

The point of release can be varied from just after take-off, to, say, 50 feet up, and the recovery can be contrasted with that required for a higher failure.

For both this and the balloon exercise, the trainee may well have difficulty producing a good landing in the end, but to an extent this does not matter. The point of the exercises is to get the muscle memory and reinforced picture of how to adjust the attitude slightly and what to do with the airbrakes. To begin with, trainees probably won't be able to monitor the airspeed effectively, but that too is a matter of repeated practice.

Low Aerotow Failures

As is discussed in the Aerotow chapter, practising aerotow failures by pulling the release and (invariably) returning to the airfield, can be regarded as negative training. There have been a number of serious accidents where pilots attempted to return to the airfield from an aerotow failure when much too low to manoeuvre safely. It is better to practise these failures in a motor glider, and the simulator also provides a cheap and useful option.

These simulations are easy to set up: start on aerotow and pull the release at a suitable height. Multiple attempts can be made at different heights. These exercises could be combined with showing, for example, drone footage of flying over local landable fields.

A drawback with Condor is that one has no control over the flight path taken by the tug, and it may not correspond to local practice.

Spins and Spiral Dives

Many trainees are apprehensive about spinning and introducing the exercise on a simulator can boost their confidence and let them understand what to expect. The G sensations will not be present but the attitudes will look the same and the trainee gets invaluable practice in reading the instruments and moving the controls correctly. Indeed, unlike many training gliders, the simulator will not recover from a developed spin unless the full correct control inputs are given, so this is a chance to establish for sure that the trainee knows how to do a full spin recovery. Achieving the same amount of practice in the air is very expensive in terms of height.

Of course, it is very important that the trainee flies these exercises in the air, especially the spin avoidance ones. The simulator is very useful, but it cannot provide the 'feel' of an approaching departure that the trainee needs to be able to recognise and recover from.

OTHER EXERCISES

Instructors with access to a simulator will find for themselves which exercises it can help with, but here are some ideas.

For beginners, the effects of controls can mostly be taught well. The effectiveness of the rudder may not correspond to the real glider the trainee will fly, but the basic movements and results can be shown. All of the early handling exercises up to and including turning can be usefully and cheaply practised. This can be a great way of using a bad weather day.

For landing, the advantage is that the trainee can have repeated practice; the disadvantage is that, at least in Condor's case, a fully held off landing is harder to achieve than in a real glider.

On the other hand, approach control exercises – managing airspeed and airbrakes and the reference point – can really help trainees, just because of the opportunity for repeated practice. Similarly to the ballooned landing exercise, one can set up a flight plan in Condor 3 starting at the top of an approach, from which the pilot should fly forward to intercept the ½ to ⅔ brake line, then open the airbrakes and continue down towards the round-out.

Circuit practice can be useful, and has the advantage that one can pause the flight at any time to point things out and discuss options. However, for this to work well one needs the kind of wide field of view that multiple projectors provide. Some clubs use a virtual reality headset as an alternative, which works well for the trainee wearing it but can induce nausea in the supervising instructor viewing a mirrored screen. It makes it difficult or impossible for the instructor to take over control for a demonstration, as they don't have control of the viewpoint.

In Condor the winch launch is not completely realistic and of course there is no sensation of acceleration. On the other hand, the simulator is excellent for introducing winch launch failures, assuming there is a sufficiently wide field of view, as just discussed. The recovery, airspeed monitoring and decision making can all be practised.

Aerotow practice will help trainees who are struggling with this. Be sure to adjust the rope length to be much longer than the default.

Variable amounts of wind can be programmed in different flight plans, plus cross winds during take-off or landing.

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Surprisingly, given the lack of G sensation, simulators have been found to be useful in aerobatic training. They can let trainees practice the sequence of control movements, speed monitoring and sequence planning, before they lay out vast sums on high aerotows.

INSTRUCTOR TRAINING

Instructors trained recently will already know that simulators are becoming a routine part of BGA instructor training. Coaches doing local training should consider their use, if the facility is available.

As mentioned above, it can save a lot of time if exercises are briefed and flown on the simulator one after another, and then a single flight can usually cover several exercises. The opportunities for group discussion of exercises are very instructive. The candidates themselves become familiar with how to operate simulators so they should be able to carry back that expertise to their own clubs and benefit their future trainees.

Clubs wanting to increase their usage of a local simulator need to ensure that their own instructors are trained in its operation. A collection of labelled flight plans that can be loaded for specific exercises is convenient.

ENTERTAINMENT

It seems a pity not to mention what a huge amount of *fun* simulators can provide. One can fly in breathtaking scenery and push limits that only the bravest and most skilful pilots attempt in real gliders. (Be sure *never* to do in real life some of the things that are enormous fun in Condor.)

Many clubs organise cross-country races on simulators and, as well as being terrific fun, these can hone some of the more basic cross-country skills. The pilot soon learns the importance of knowing the best speed to fly and when to stay in a thermal and when to press on. Understanding McCready settings for the final glide will separate the race winners from the runners up. Of course, this is very different from the real world, which is rather more unpredictable than Condor and the consequences of crashing before the finish are considerably more serious! However, beginners can learn the principles of McCready theory in a very engaging way. Incidentally, Condor contains, in its setup parameter screens, an excellent interactive graphical display of the relationship between speed and glide angle, at different MC settings and different head or tail winds.

More practically, it can be useful to ‘fly’ at another site that one is planning to visit on an expedition.

If one links a moving map programme – such as XCSoar, which makes this connection straightforward – one has a safe environment in which to get fully familiar with the software without the ‘head in cockpit’ dangers of learning the software in the air.

So, if you don’t already have a simulator at your club, maybe you should be thinking about setting one up.

K – RADIO TELEPHONY (R/T)

INTRODUCTION

Increasingly, glider pilots need to talk to airfields who are not on the gliding frequencies, Pilots who routinely fly cross-country should get a FRTOL; if flying in busy airspace, such as a Military Aerodrome Traffic Zone (MATZ) this will allow them to give their position to the relevant Air Traffic Services Units (ATSU), thus enhancing everyone's situational awareness. Holding a FRTOL may also allow entry to ATZs and controlled airspace, which is sometimes helpful when looking for lift or wanting to land at a licensed aerodrome. The BGA provides online FRTOL training; see the BGA web site for details.

Judicious use of radio enhances flight safety, especially in the circuit. An instructor's radio calls will be heard, and potentially imitated, by many pilots, so it is important to set a good example, even when not formally instructing.

Basic radio use should be taught as part of the following exercises in the SFCL SPL Syllabus:

Ex 2: Emergency procedures

Ex12: Circuit, approach and landing

- Collision avoidance

Ex17: Flight Planning and In-flight navigation

- use of radio and phraseology
- procedures for transiting regulated airspace or ATC liaison
- uncertainty of position procedure
- lost procedure
- joining, arrival and circuit procedures at remote aerodromes.

LEGAL ASPECTS

A radio installed in a glider must have an Aircraft Radio Licence, which is straightforward to get from OfCom (for a small fee). This licence also covers any handheld radio used as an in-flight backup but does not allow that same handheld radio to be used for ground to air communication; that requires a different, Aeronautical Ground Station Licence.

A glider pilot does not need a FRTOL, or any other type of operator's licence, to communicate with other aircraft (whether glider or powered), or use the radio, on one of the gliding-specific channels, or the emergency channel, 121.5. Similarly, someone using an air-band radio on the ground at a gliding club does not require a ground station operator's licence, so long as they are using the channel assigned to that airfield and not providing an Air Traffic Service.

However, under section 139 of the Air Navigation Order 2016, a glider pilot must hold a FRTOL to communicate with 'any air traffic control unit, flight information unit or air/ground communications service unit', which is normally a prerequisite for entering ATZs.

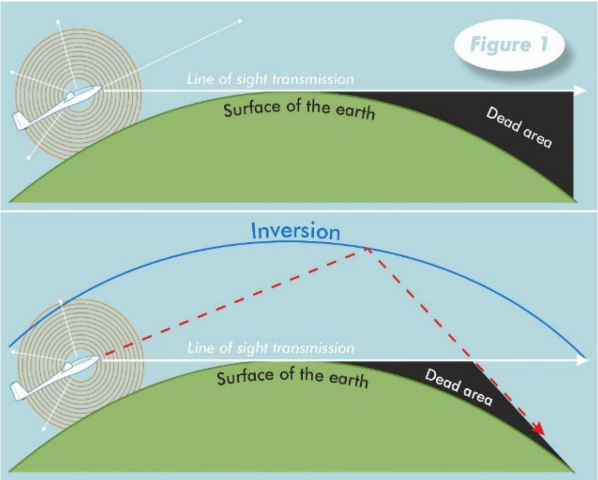
THEORY BRIEFING

Characteristics of VHF radio

Very High Frequency (VHF) radio signals do not penetrate water or solid ground, and travel in more-or-less straight lines.

The range of an aircraft radio is often limited by the distance to the horizon (at high altitudes, this distance in Nautical Miles is approximately the square root of the altitude in feet, so that at 5000 ft AMSL the horizon is about 70 NM away). If you call another glider or a distant ground station and get no reply, it could be because it is below your radio horizon. Climb higher before calling again. In certain atmospheric conditions (usually high-pressure systems with strong inversions), radio signals reflected off the inversion travel much further than normal. However, there can still be a 'Dead' area in the middle (figure 1).

If an air-band radio is not receiving a signal, a continuous, irritating hissing noise would normally be heard. The squelch control suppresses this by turning off the loudspeaker unless a strong voice transmission is being received. If the squelch is adjustable, use the lowest setting that eliminates the hiss between transmissions.



VHF CHANNELS

The current standard of radio equipment in the UK employs 8.333 kHz frequency spacing and is permitted to operate between 118 to 137 MHz. That means there are nominally 2,280 separate operating frequencies, of which six are allocated to gliding and another two shared. The result that is that the frequencies we do use are somewhat crowded on good days.

Channels are sometimes referred to as 'frequencies' and may be incorrectly given a 'MHz' suffix. When transmitting a channel number, say the digits individually, pronounce the decimal point as DECIMAL, and omit the word 'channel.' If a

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channel number ends in the digits 00, omit them, so that channel 121.500 would be said as ONE TWO ONE DECIMAL FIVE.

The table below outlines some of the shared frequencies available to glider pilots and their uses as determined by the BGA and agreed with the CAA & Ofcom. The frequencies should only be used in their secondary role when the primary frequency is exceptionally busy.

Frequency	Primary Use	Secondary Use
129.905	Ground Retrieve (Shared with Hang-gliding & Paragliding.)	Nil
129.980	Common glider field frequency within 10NM and up to 3,000 ft above certain approved airfields.	Nil
118.685	Common glider field frequency within 10NM and up to 3,000 ft above certain approved airfields.	Nil
130.105	In-flight situational awareness	Nil
130.130	In-flight situational awareness	Nil
130.535	Cloud flying	In flight situational awareness
129.890	Competition flying	Coaching
130.405	Competition flying	Coaching
121.500	Distress	Nil

The two Common Glider Field Frequencies (CGFFs) in the table above are shared by specific gliding airfields, where they are typically used for pre-landing radio calls and aerotowing. However, there can be overlap between the coverage of the airfields, and calls to one may be heard at another.

Other frequencies are assigned to (particularly the larger) airfields in such a way that there should not be overlap between airfields.

Airfields generally have a Designated Operating Coverage (DOC), and you should only call an airfield within that – generally within 10 NM and below 3000 ft AMSL for gliding airfields.

A gliding airfield may also have a ground station, which may simply be a handheld radio carried by the person running the launch point; if so, the BGA recommends addressing the ground station at (for instance) Borton Gliding Club as BORTON BASE. The call-sign BORTON RADIO must only be used by operators who hold a CAA Radio Operators Certificate of Competence (ROCC).

Someone at a gliding club launch point who does not hold an ROCC (or other CAA ground station operator's licence) can talk to aircraft on that airfield's frequency, but must not give air traffic control instructions, not even 'Take off at your discretion.' However, the standard aerotow signals of UP SLACK, ALL OUT and STOP are permitted.

Other gliding channels are assigned to competition start and finish lines. Contestants will be briefed on which frequencies to use, and how.

There are also frequencies assigned to in-flight situational awareness, which basically means communication between gliders in flight. However, they should not be used for chit-chat.

R/T VOICE PROCEDURE

The definitive reference for UK aviation radio phraseology is CAP 413: Radiotelephony Manual, available online. Whilst it covers R/T procedures that can only be used by licensed operators, it also covers basic procedures that every pilot should know and use.

Teaching students to use the radio properly from their early flights will give them a good foundation on which to build when they later study for a FRTOL. Some words and phrases used by aviators in other English-speaking countries, such as 'go ahead are not part of UK phraseology and should not be used. However, if there is no CAP 413 standard for what you want to say, or you have forgotten it, just use clear, concise English.

CAP 413 lists standard words and phrases used in radio calls some of whose meaning may not be obvious:

AFFIRM	Yes
GOING AROUND	I am abandoning my landing and will try again
NEGATIVE	No; Permission not granted; Incorrect; Not capable
PASS YOUR MESSAGE	Proceed with your message (do not say 'Go ahead')
READ	Radio-speak for 'receive' or 'hear'
ROGER	I received all your last transmission (Does not mean I will comply)
STAND BY	Wait and I will call you (No acknowledgement required)
STATION	A radio base or aircraft radio.
WILCO	I understand your message and will comply with it

CALL-SIGNS AND THE PHONETIC ALPHABET

Transmit aircraft call-signs by spelling them using the ICAO phonetic alphabet. If a glider has CAA registration letters on its fuselage (e.g. G-CHSK), then this is its official call-sign. However, most glider pilots use their fin number as the callsign.

To help other airspace users understand the capabilities of their aircraft, when on other than gliding channels, glider pilots should prefix their own call-sign with the word GLIDER (e.g. GLIDER SIERRA KILO. The phonetic alphabet can also be used to spell out other groups of letters, but some aviation acronyms (such as QNH and QFE) as 'part of aviation terminology' which should be spoken using their constituent letters, not the phonetic alphabet.

TRANSMISSION TECHNIQUE

When transmitting, speak clearly and distinctly in a normal conversational tone and at a constant volume. If the microphone position is adjustable, speak directly into it from 10 – 30 cm away. Speak at a constant rate of no more than 100 words per minute (which is somewhat slower than normal conversation). To avoid pauses and hesitations, plan what to say before pressing the Push To Talk (PTT) switch. Avoid courtesies like 'Good afternoon,' 'Goodbye' or 'Thank you,' which take up valuable airtime.

MAKING CONTACT

Before using the radio, check the following:

- Is it switched on and on the correct frequency?
- Are the volume and squelch adjusted?
- Who do you wish to contact and do you know their call-sign?
- What do you want to say? Press the transmit button just before speaking, otherwise the first syllable of your message may not be transmitted. (Clipping.)

Then:

- Listen for a few seconds to make sure no one else is talking at the same time.
- Transmit the other station's call sign, followed by your own and wait at least 10 secs for a reply.

They should reply with your call sign and '*pass your message'*

You can then ask for, or pass the appropriate information, e.g. *Booker, 925, what is the wind direction?*, or *Booker base, 925 landing near Aylesbury*.

If your initial message is very short, you can give it immediately at the end of the initial call. In subsequent transmissions, if you are sure that the other station is listening, transmit messages immediately. This prevents the frequency from being cluttered up with unnecessary calls.

If you transmit but do not get a response, wait at least 10 seconds before transmitting again.

The words OVER ('I've said my bit, now you can say something') and OUT ('That's it, nothing more to say') are still part of R/T phraseology but have fallen into disuse because of the vast improvements in radiotechnology. As in normal conversation, it is usually obvious when a transmission has finished.

There can be several reasons for not receiving a reply to your initial call:

- You could be out of range.
- You have not switched the radio on.
- The volume and squelch are incorrectly adjusted.
- You are on the wrong frequency.
- The person you are calling is not listening, or their transmitter is not working.

If you can hear the other station talking to other gliders then you should assume that your radio is not transmitting properly. Check once with another glider that you can be heard clearly.

There may be occasions where it appropriate to make a blind call, simply assuming that you are being heard, even though you are not receiving a response.

If no transmissions have been heard for a while, check that the PTT is not accidentally being held down, thereby broadcasting the sound of your vario to half the country. This is known as a 'stuck mic Most radios have a transmit indicator – if the channel is quiet, check it occasionally. Having the volume set too low or the squelch too high would also stop you hearing anything.

Always remember that radio time is a limited resource, and that no-one else can transmit at the same time as you. Transmissions should be **CONCISE, PRECISE** and **INFORMATIVE.**

PRE-LANDING RADIO CALLS

The BGA recommends that gliding clubs encourage pilots to broadcast pre-landing radio calls, to aid everyone's situational awareness. Clubs may have a specific landing call radio procedure.

At airfields with a shared frequency in which transmissions might be heard elsewhere the standard procedure is:

- Begin a pre-landing call by identifying the airfield. You are addressing other traffic, not a ground station, so if in-circuit at (for instance) Borton Gliding Club, use the call-sign BORTON TRAFFIC.
- Next, give your own call-sign, using the GLIDER prefix if appropriate.
- Then say where you are in the circuit, for instance: DOWNWIND, LEFT-HAND, RUNWAY TWO TWO.
- Finish by naming the airfield again.

Pilots at other airfields may also be able to hear your call; repeating the name of the airfield at the end of the transmission reduces the risk of confusion. So in this example the whole call is:

BORTON TRAFFIC, GLIDER SIERRA KILO, DOWNWIND, LEFT-HAND, RUNWAY TWO TWO, BORTON

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At airfields with their own (protected) frequency, a much cut-down procedure is used, for example:

GLIDER SIERRA KILO, DOWNWIND, LEFT-HAND, RUNWAY TWO TWO

Downwind calls are commonly made at gliding sites, and base and/or final calls at some, but pilots landing at small GA airfields typically also make a call when about to take off (using the phrases LINING UP FOR DEPARTURE and TAKING OFF), and when on final approach. The word JOINING signifies that the pilot intends to land but is not yet in the circuit.

If landing out at an unattended airfield (such as a farm strip), where there is no radio operator whose job is to coordinate traffic, if there is no channel assigned for use at an airfield, use the national SAFETYCOM channel, 135.480, to make pre-landing calls when within 10NM and 2,000 ft AAL.

Remember - making circuit radio calls aids safety but flying the aeroplane accurately is always the highest priority.

EMERGENCIES

If someone is in serious or imminent danger and requires immediate assistance, you should make a Distress call, beginning with the words MAYDAY MAYDAY MAYDAY. Do so regardless of whether it is your own emergency or someone else's; for instance, seeing a road traffic accident, a crashed aircraft, or an isolated building on fire all merit a MAYDAY call.

A MAYDAY call (or a PAN-PAN call which indicates a lesser emergency) has priority over all other R/T use.

A MAYDAY call can be made on any channel, but channel 121.5 (sometimes called the 'Guard Frequency') is reserved for emergency use. It has monitored 24/7 by the Distress and Diversion (D&D) Section at RAF Swanwick, callsign LONDON CENTRE, and by airliners at high altitude. No FRTOL is required to transmit on 121.5 in an emergency or if lost and using it in preference to another channel will maximise your chances of getting help.

If you **cannot** use 121.5, make your emergency call on whatever channel you can, including simply pressing the PTT and calling on the channel to which your radio is already tuned.

If you have made a MAYDAY call but no longer require assistance, call CANCEL MAYDAY. If you have established contact with any other station during an emergency, do not change channels unless you let them know.

If you land safely and cannot raise London Centre on 121.5 to cancel, you can also 'phone them on 01489 612406; you might want to put this number on your phone now, so it is there if you ever need it.

While any radio call prefixed with the words MAYDAY MAYDAY MAYDAY will summon help, ideally you should use this format:

- MAYDAY, MAYDAY, MAYDAY
- The station being called, if appropriate
- Your own call-sign
- The nature of the emergency
- Your intentions
- Your position and altitude
- Any other useful information

An example MAYDAY call directed to D&D on 121.5:

MAYDAY, MAYDAY, MAYDAY,

LONDON CENTRE,

GLIDER GOLF CHARLIE HOTEL SIERRA KILO,

HAVE SIGHTED GLIDER UPSIDE DOWN IN A FIELD,

WILL REMAIN IN THE AREA,

SIX MILES SOUTH BICESTER, THREE THOUSAND SIX HUNDRED FEET QNH ONE ZERO TWO ZERO

You should announce any less serious emergency as a PAN call on the same frequency i.e. 121.5mhz, such as being lost above cloud in a mountainous area close to the sea. A PAN call (*PAN-PAN, PAN-PAN, PAN-PAN*) has a lower priority.

If you hear a MAYDAY or PAN PAN call, stop transmitting on that channel until the emergency is cancelled or the emergency traffic transfers to another channel. However, try to note down the details, and stay on channel to see if anyone responds. If you do not hear an acknowledgement, relay the details, as you heard them, to a suitable ground station. If you can offer relevant assistance, do so. However, wait for a short while before transmitting it to avoid conflicting with other transmissions. Otherwise, keep quiet until the emergency is over.

UNCERTAIN OF POSITION, OR LOST

If 'unsure of your position,' call D&D on 121.5 and ask them to use their direction-finding facility to fix the position of your radio transmission. Before doing so, listen for half a minute to ensure that there is not an emergency in progress.

If not, make a call in this form:

- *LONDON CENTRE, GLIDER GOLF CHARLIE HOTEL SIERRA KILO,*
- *UNSURE OF POSITION,*
- *REQUEST POSITION FIX*

Assuming you are high enough and they can get two or more bearings on your transmission; D&D should come back within a few seconds to give you a position relative to a prominent 1:500,000 chart feature and offer further help if required.

Dialling up 121.5 on your radio and transmitting puts you in touch with people who want to help. In most parts of the UK, once you press the transmit button on the radio, the distress and diversion people also know your location. So, if you need help, are lost and think you might be close to controlled airspace, or any other situation which is or could lead to an emergency, do not hesitate to call. You can also initiate a practice on this frequency.

RADIO TELEPHONY

SUGGESTED EXERCISES

There are no specific standalone SPL exercises for the use of the radio, but it is important that trainees become comfortable using the radio enough to use it as required (even if not fluent).

Unlike many aspects of flying, radio calls can easily be practised on the ground. Rehearsing pre-landing calls will reduce the stress when they come to do it in the air for the

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first time. Encourage the trainees to listen to other aircraft making downwind calls etc and emphasise that to get the full safety benefit, it is important to assimilate pre-landing calls from other aircraft, visually acquire those aircraft if possible, and adapt the circuit flown if necessary.

PRE-LANDING RADIO CALL - Practice call

Emphasise the importance of using the correct phraseology, including, if on a shared frequency:

- Beginning the call with the airfield name, followed by the word TRAFFIC
- Using the GLIDER prefix and aircraft call-sign
- Ending the call by repeating the airfield name

The circuit is a busy phase of the flight, when a pre-solo trainee may be task saturated. If necessary, take control and fly the glider while the student makes their first attempts at a pre-landing radio call. Ask the student to recite their intended call to you before actually transmitting, and correct it as required. Prompt the student to make the pre-landing call as early on the downwind leg as possible.

If the call made is incorrect, transmit the correct version. including the phrase CORRECTION I SAY AGAIN and make the correct call.

UNCERTAIN OF POSITION, OR LOST - Practice call

D&D staff welcome the occasional practice calls from pilots who are not actually lost. Brief the trainee to change to channel 121.5, listen for 30 seconds to ensure that no emergency is in progress, then make a call in this form:

- *TRAINING FIX, TRAINING FIX, TRAINING FIX*
- *GLIDER GOLF CHARLIE HOTEL SIERRA KILO, TRAINING FIX*

When D&D responds, they may ask how accurate their fix was. Afterwards, be very sure to sign off with D&D before changing back to the appropriate gliding channel.

To maximise the chances of success, make a call for a training fix when the glider is as high as possible, for example at the top of the winch launch, or shortly after releasing from aerotow.

EMERGENCIES

There are **no practice MAYDAY calls**; everyone hearing that word on a radio channel should assume there is a genuine emergency. Hence MAYDAY calls can be practiced in the briefing room or simulator, but not over the radio.

COMMON DIFFICULTIES

Call-signs in the wrong order in an initial call. Always begin by identifying the station being called, then give your own call sign (and then optionally a short message).

Clipping the start or end of the transmission. To avoid this, consciously pause very briefly between pressing the PTT and start speaking; one way to do this is to breathe in, briefly. At the end of the transmission, consciously pause for a fraction of a second before releasing the PTT.

Imitating incorrect or outdated procedures used by others. R/T procedure has evolved over the years, and 'old hands' are not always kept up to date, so students hear a variety of non-standard radio calls and call-signs.

Not knowing what to say before pressing the PTT, leading to stumbles and long hesitations. If this is a problem, tell the student to rehearse the transmission beforehand.

Stuck mic that transmits cockpit conversations and the vario's beeping to half the country, blocking all other transmissions on that channel. If the PTT is on top of the stick, this can be caused by the student holding the stick with their thumb pressing down on the top.

Using filler words like 'this is' or 'and,' or unnecessary pleasantries like 'Good Day' or 'Please.'

Long, rambling transmissions. Plan what to say before transmitting.

Transmitting, but not listening.

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DEFINITION OF TERMS

Radio Telephony is a technical subject, and its discussion invariably includes some terms and phrases not in day-to-day use. The list below covers some of the common ones, but it is ~~certainly~~ not exhaustive.

Carrier wave This is transmitted when the transmit button is pressed. If no message is passed the receiving station will hear a mushy - hissing 'shhhhh' noise.

Clipping This is the practice of pressing the transmit button at the same instant as speaking. Typically, this results in the first syllable of the message being lost and often results in the need to repeat the message.

Distress A term used to describe an aircraft or vessel in imminent danger and requiring immediate assistance.

Ducting VHF radio waves travel in straight lines and normally travel only slightly beyond the line of sight. However, in certain atmospheric conditions (usually high-pressure systems with strong inversions), radio signals can reflect off the inversion and travel much further than normal

FRTOL Flight Radio Telephony Operators License.

Modulation This is what happens to the carrier wave when you speak into the microphone. It is converted back to speech at the receiver. If the circuit which modulates the carrier fails, information can sometimes be passed by 'blipping' the transmit button in response to questions.

Squelch This is a function of the receiver that suppresses the hissing noise, between received messages. If it is manually adjustable it can be used to filter out electrical noise, either from the local environment or a turn and slip, for instance. However, care should be taken that it is not set to suppress the messages that you want to hear as well as the noise.

LEGISLATION RELEVANT TO RADIO REQUIREMENTS

1. Wireless Telegraphy Act 2006

Under the Wireless Telegraphy (WT) Act 2006 it is an offence to install or use radio transmission equipment without a licence. Ofcom is responsible for **administering and issuing all UK Aeronautical Radio Licences**, which cover radio equipment for aircraft and ground stations for voice and navigation purposes. Their responsibilities include managing applications, collecting fees, and maintaining license details, though the CAA retains responsibility for assigning frequencies and issuing safety approval.

All radio transmitting equipment fitted or carried in a glider or used on the ground to transmit messages to equipment fitted to or carried in a glider, is required to be issued with a WT Act radio licence. However, only one licence is needed per aircraft even if more than one radio is fitted.

An Aeronautical Ground Station licence is required for any radio equipment used on the ground. A handheld or portable radio used on the ground to communicate with equipment in a glider, even when it has been issued with an aircraft transportable licence for when the radio is carried in a glider, is required to be issued with an Aeronautical (Ground) Station Licence.

It is not necessary to licence the GPS equipment used in gliders for navigation or as an aid to collision avoidance.

Contact information is available via their website on:

www.ofcom.org.uk/about-ofcom/contact-us

CAA email : frequency.approval@caa.co.uk

2. Airborne VHF Radio Equipment Approval

The CAA website contains detailed information about aircraft equipment approvals. The database of aircraft equipment approved under the British Civil Airworthiness Requirements (BCARs) can be searched directly from the same page.

The CAA Directorate of Airspace Policy, Radio Licensing Section staff will check whether the radio equipment declared on application forms for an aircraft (WT Act) radio licence is approved.

3. Ground VHF Radio Equipment Approval

The radio equipment used in Aeronautical Ground Radio Stations is required to comply with the Radio and Telecommunications Terminal Equipment Directive (R&TTED) 1999/5/EC from the 20th of October 2005.

The CAA, Air Traffic Services Standards Department, CNS/ATM Standards Section, Communications Systems Specialists will check whether the radio equipment declared on application forms for an aeronautical (ground) station (WT Act) radio licence is acceptable

4. Flight Telephony Operator Without a Licence

The ANO notes how a person may act as a flight radiotelephony operator within the UK without being the holder of an appropriate licence, if the following conditions apply;

(a) the pilot of a glider on a private flight and does not communicate by radiotelephony with any air traffic control unit, flight information unit or air/ground communications service unit; or

(b) being trained in an aircraft registered in the United Kingdom to perform duties as a member of the flight crew of an aircraft and is authorised to operate the radiotelephony station by the holder of the licence granted for that station.

Note: An 'appropriate licence' in this context means a Flight Radiotelephony Operator's Licence which may be issued as a stand-alone licence, or in conjunction with a flight crew licence.

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31 - RIGGING, DE-RIGGING & DAILY INSPECTION

There are about as many different ways to 'pin' gliders together as there are types in existence, but GRP gliders are more alike in this respect than their wooden and metal counterparts from the 50's and 60's, and often less hassle to take apart and put together. Nevertheless, a few GRP gliders are a bit quirky; the Astir series has a novel and initially baffling take on how to stop the wings coming off. As for the older gliders, a few of them belong to the 'we've got all day' knitwear school of rigging, and required ingenuity, a patient crew, and a large mallet.

Rigging and de-rigging are usually straightforward, but gliders can, and have been damaged - occasionally seriously - in the process, so it is important that everyone involved knows what they're doing, and if they don't, to be well supervised by someone who does.

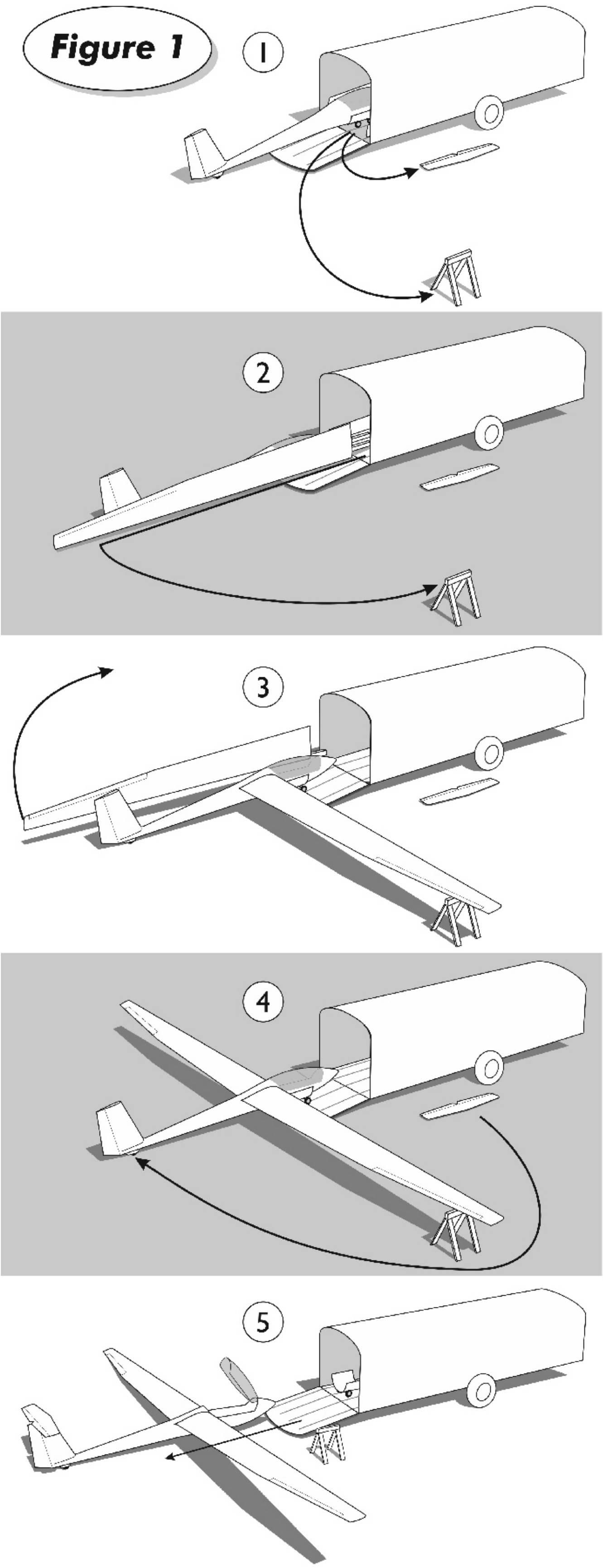
Unfortunately, opportunities to learn or even hear much about the skills are apt to be a bit thin on the ground. Landing out isn't exactly an everyday occurrence, and rigging and de-rigging don't figure much in general club conversation except as part of unhelpfully hilarious and/or horrific stories about retrieves. If clubs hangar their gliders at the end of flying, the opportunities for learning are even fewer. Private owners aren't much help here because they either rig on their own, have T hangars, or, not surprisingly, prefer to keep unskilled labour well away from their investment. Pre-solo pilots are, so to speak, 'uncalibrated'. They've no idea how heavy and unwieldy glider components can be, nor which bits are easy to damage and those that aren't. They don't know what 'take the twist' means, let alone what it involves. Does 'relax' always mean let go? … and so on.

Suitable days for teaching rigging and de-rigging also require that the glider isn't flying, so any practice is more likely to take place on cold grey days when, at best, it isn't raining; the sort of days most people try to avoid. As a result, a solo trainee who flies club aircraft may only discover what de-rigging involves when they're roped in to retrieve someone else, or they themselves land out. The usual assumption in both cases is that whoever is in charge of the retrieve will know what to do. This appears to work, but as a teaching method it is haphazard and leaves a bit too much in the notoriously careless lap of the gods. Prior unhurried and unharried practical instruction in the techniques is preferable, accompanied by a short explanatory briefing on the subject. It doesn't have to be complicated. Always refer to the aircraft's flight manual for advice on rigging and de-rigging.

Rigging

A first rig and/or de-rig needs to be closely supervised by whoever is in charge, and it's preferable that the trainee is by this time fairly well on in the training process and generally familiar with gliders. Though there are variations, at its most basic the sequence is more or less as illustrated in figure 1;

- 1) tailplane out, fuselage out
- 2) first wing out
- 3) second wing out (tips/winglets on)
- 4) tailplane on. Connect all controls. If appropriate, lower and lock the undercarriage
- 5) push glider off trailer. DI



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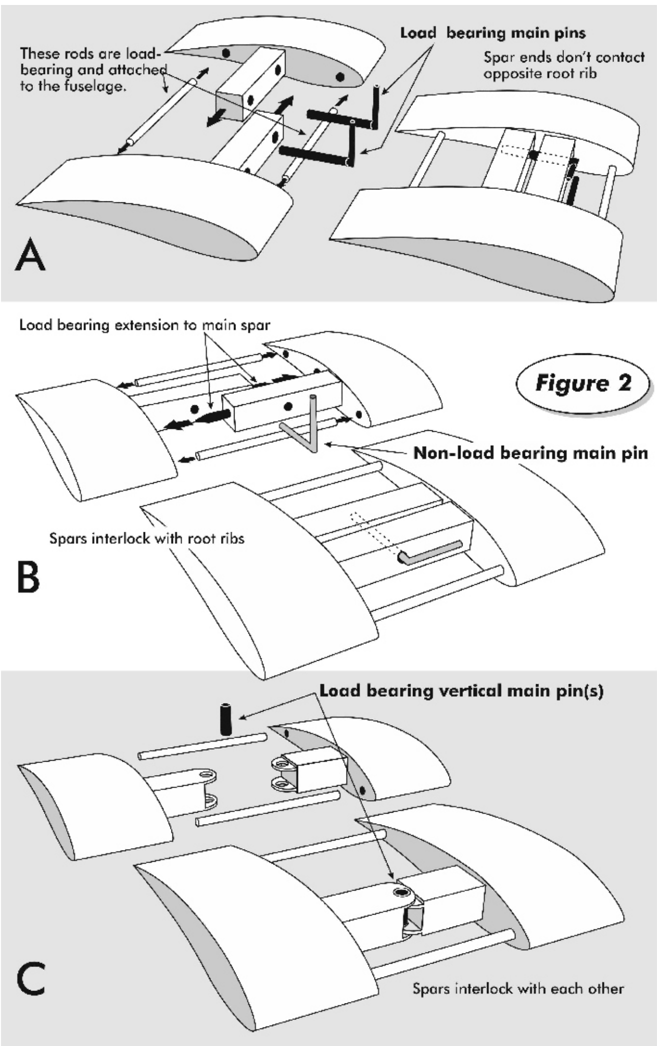


Figure 2

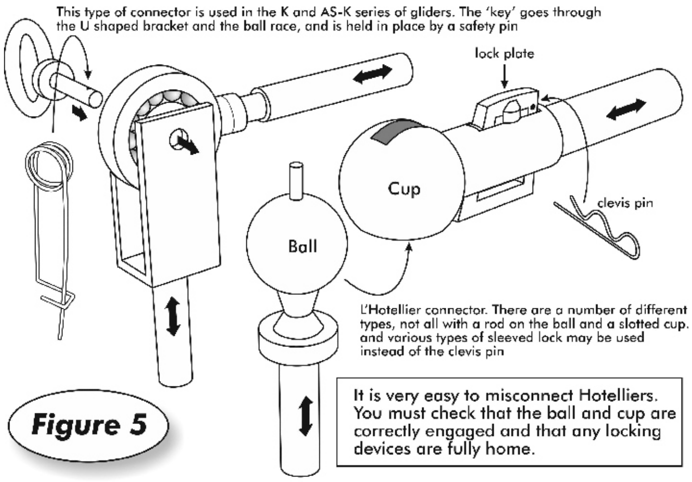


Figure 5

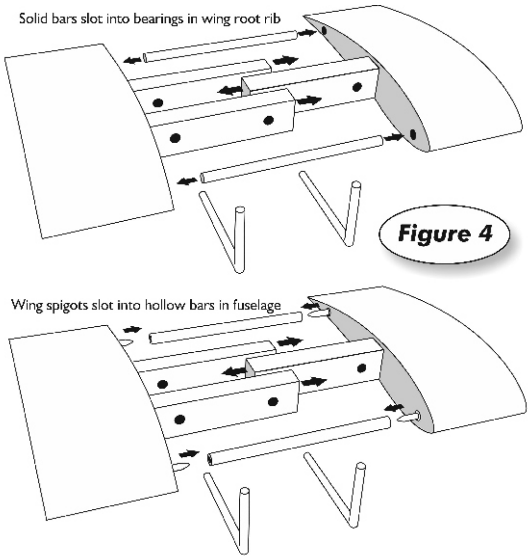


Figure 4

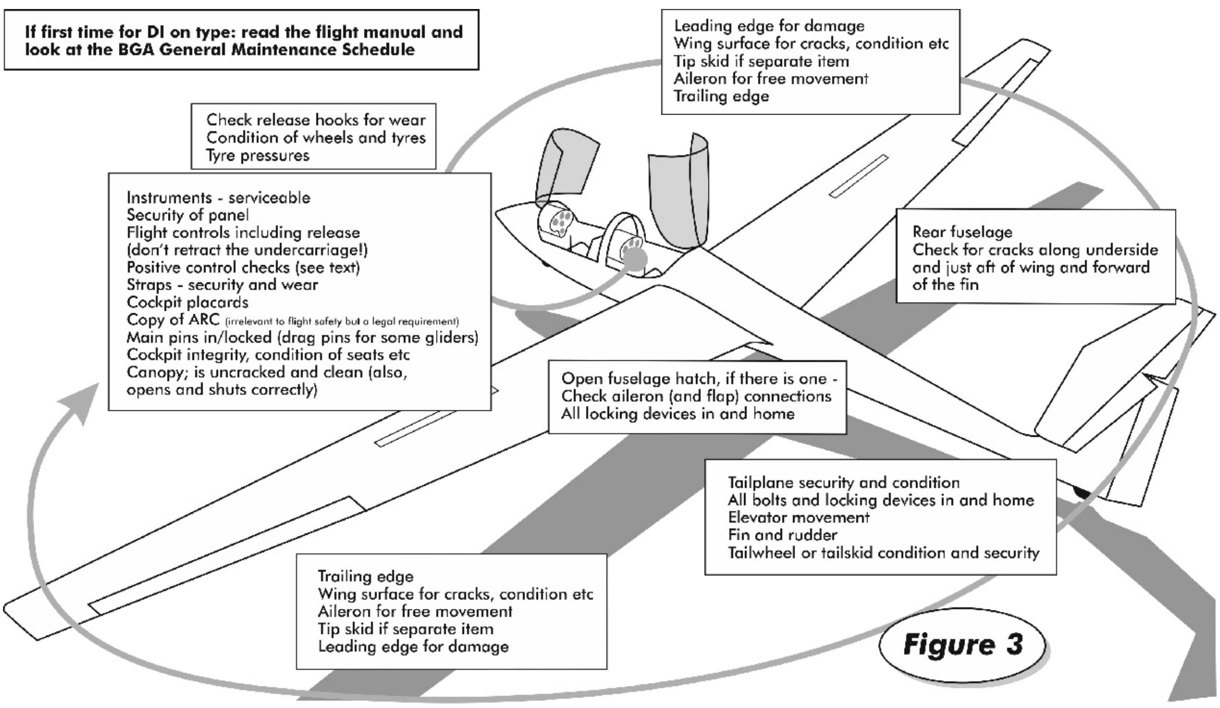


Figure 3

↑ Contents

This list isn't overly informative and takes absolutely no account of type specific quirks/design features, amongst other things. Obviously the teaching needs tailoring to the aircraft being rigged, but there are more general points to be made along the way. Type specific detail also includes the trailer and its fittings, which are likely to have more individual variations (some of them bizarre) than there are glider types, though the situation with modern glider trailers is more uniform. As part of any instruction it is worth pointing out the pitfalls, or any areas which, on a general basis, can cause problems.

The instructions in this section are general and for guidance only. Always refer to approved published manufacturers information, in conjunction with the BGA GMS (Glider Maintenance Schedule) which outlines definitive rigging, de-rigging and DI tasks and procedures.

The following covers some of the points involved in rigging a 15m GRP glider, though almost all are applicable to any glider of any vintage:

- you must have read and understood the Flight Manual's rigging instructions for the glider, plus any notes that the club might have made about it
- fully understand the purpose and use of any tools and rigging aids, as specified by the manufacturer. Never use unauthorised tools or rigging aids as they can cause serious damage
- for almost every modern glider the trailer is a key item in the mechanics of rigging and de-rigging. Check it out before removing anything. This will give a good idea of how it's supposed to look when everything's back in. Trailer fittings vary, but at the least, note how they work on the trailer being used
- wind strength and direction can be a crucial factor. If the fuselage is wheeled out side on to a strong wind it will try and weathercock, particularly if the glider has a tail-skid. Rubber block type skids aren't very good on grass, but the metal ones common to older gliders are bad on concrete or tarmac. Also, taking a wing out of the trailer broadside on to the wind can be awkward and require more people than usual to handle. The wing has been designed to work exceptionally well when the wind/airflow blows onto its leading edge. If you offer it up to the fuselage leading edge into a strong wind, it will try to do exactly what it was designed to do, and either lift up or dive down. You may not be able to stop it. Best to have the wind blow along the span, either wholly or partially. Other factors may mean that there's no choice of trailer orientation. In which case rally lots of clued-up helpers
- be careful rigging when the trailer is sitting on even a slight slope along its length. The belly dolly which provided sufficient friction when the trailer and glider were on level ground may turn out not to provide as much as you thought
- if the tailplane needs to come out first, place it alongside the trailer where it won't be stepped on, or blown away if there's any appreciable wind
- NEVER put the tailplane on before the wings, and always take it off first. If the fuselage rolls over with the tailplane on very serious damage can occur. A few gliders have tailplanes which fold up on the fuselage and can't be taken off. Don't lock them down until the wings are on
    - set up wing tip trestles where they're supposed to go, or where they're easy to reach
- roll out the fuselage
    - does it stay in the dolly, on the trailer tailboard/ramp, or have to be lifted or rolled off? If rolled off, does the fuselage remain in the dolly for rigging or does the fuselage have to be supported (undercarriage fixed or retractable?) by a crew person - very common amongst older gliders
    - does the canopy have to be taken off before the wings are put on? If so, put it somewhere safe. Its usually safer to remove side-hinged canopies before offering up the wings - it can depend what gets in the way and what you might need to get at. Front hinged/swing-up canopies can be left open .. but watch out for the wind slamming them shut
- a specific wing may need putting on first, though it isn't usually a disaster if you do the wrong one. If one wing has a single root end spar and the other has two, the two pronged one usually goes on first (figure 4)
- obvious as it may sound, try not to fall over while handling anything, especially the wings. Dropping a wing leading edge down onto, say, concrete from only a few feet (or from slightly higher onto grass) is a good but destructive demonstration of mass, inertia and acceleration
- push the first wing home and check that, looked at from above, the gap between the root rib and the fuselage is broadly parallel sided. Check the dihedral angle - it should be about the same as for normal flight
- put the trestle under the wing and check that it's secure. If the wing falls off the trestle there's a good chance of the fittings being bent and/or the spar end going through the top of the fuselage
- make sure the main pin or pins are within easy reach, and then offer up the second wing. The wingtip holder should provide about the same amount of dihedral in relation to the fuselage as on the opposite wing. (Note: if the fuselage isn't upright this can be tricky). Push the wing home. This can be a bit of a tussle with glider's using wing locking methods B and C (figure 2). B in particular because it requires 7 'pin and socket' joints (including the main pin) to be correctly lined up
- when the second wing is home check the other one hasn't come out
- insert the main pin (or pins) and push it/them fully home. Check that safety pins are in place or spring loaded catches connected. If the glider has a central vertically expanding main pin (figure 2C), make absolutely sure this is fully extended and fully home **at both ends**. The drag spar and front spar connections are automatic in modern gliders because the relevant load bars are built into the fuselage and either slot directly into the root end rib, or the root end spigots into them (figure 2), but on K13s, for example, there are drag and front spar pins instead. Make sure they are fully home and with their spring loaded 'hook' locks in place.

One might think that if the main pin wasn't in it would be impossible to get the glider clear of the trailer without the wings falling off, but in some gliders the main pin(s) are only there to prevent the wings sliding apart - (figure 2, B. C is a slightly different case in that it does both). Even when the main pin isn't in it is possible to get type B to the launch point without anything untoward happening, likewise if the main pins of A and C aren't fully home. With A you might get away with it, but not with B or C. When the wings are put under load and bend, as they will on a winch launch or if manoeuvring vigorously after release from an aerotow, they'll come off.

- get help with the tailplane if there's an appreciable wind - the aerofoil is very efficient whichever way up it is and the unit is typically very light. It can also be big. Once the tailplane's properly located and pushed home, put in the locking bolt or bolts! If they're threaded (some stay in the fin and are both unthreaded and spring loaded) don't over-tighten them; finger-tight plus a bit more should be sufficient. Make sure any safety pins or spring-loaded safety locks are in place.

NOTE: L'Hotellier connectors (figure 5) are almost universal in modern gliders. They aren't fail safe. If the internal spring fails and the safety pin isn't in, the cup and ball will eventually part company. There are more types of connectors around than just the two illustrated in the figure. Almost none are completely fail safe. It is up to you to understand how they work, how they might not work, and to ensure that they are connected correctly and any safety pins/devices are properly engaged. Check.

- connect the elevator push rod. Put in any safety pins and check the connection visually, and additionally, try to pull (no brute force required) the push rod away from the actuating arm on the elevator
- connect the aileron and airbrake push rods. If the glider has flaps make sure they're connected. Put in the safety pins. Before closing the access hatch - if the glider has one - pull against the control rod connections to double check their security. A visual inspection isn't usually enough because even in bright sunlight it's often difficult to see inside
- don't assume that because the controls of some gliders are 'auto-connect' that they invariably do. In any situation where something is 'highly unlikely' or 'virtually impossible' there will almost inevitably be a set of circumstances where it's neither. Check
- if the glider was rigged on the trailer and has a retractable undercarriage, remember to lock it down before pushing the glider off the dolly
- tape the gaps between the wings and the fuselage, the tailplane and fin, and around the access hatch. This is important on modern gliders because not doing it can create considerable extra drag (and noise) and reduce the glider's performance
- do the DI

> **NOTE:** If you drop anything into the glider (a safety pin down the fin, for example) during a rig, retrieve it before you do anything else, even if the item seems small and insignificant. If you leave it wherever it happens to be it probably won't stay there, and will start moving around. You may then be faced at some point during flight with a jammed control which no amount of effort on your part will unjam.
>
> The glider should be treated as U/S until you have retrieved the dropped item.

De-rigging

Even though this is rigging in reverse it is generally a bit easier to get the glider apart than put it together. Putting the glider into the trailer without damaging either, or both, is slightly more of a problem, partly because de-rigging tends to be done in strange faraway places, and not always in ideal conditions.

- **NOTE:** if taking anything apart seems to require rather a lot of force, check - before you apply even more force - that you're not trying to do something impossible, like remove a wing with the controls still connected
- if you're in a field, check you've packed everything up before you leave

Daily Inspections (DI)

The main purpose of the DI is to check that the glider has been assembled correctly and is both structurally sound and fit for flight.

Damage during rigging or de-rigging is one thing, but gliders can be rendered unairworthy by things that don't cause any direct damage. Failure to connect the controls correctly, or at all, is still a cause of serious accidents even though the DI and positive control checks ought to catch things like this. That they sometimes don't is often because the person who rigged the glider also did the DI, and was in a hurry. Genuine component failures do happen, but they are rare.

Only 'licensed pilots' can DI club gliders, so this bars pre-solo pilots from doing them. However, when training someone to do DIs, the first few sessions must obviously be 'guided tours' given by a suitably competent person. It will also be preferable - if not always possible - for the trainee to have been involved in at least one supervised rig or de-rig beforehand; this will give them a much better idea of what a DI's about, and why it is necessary.

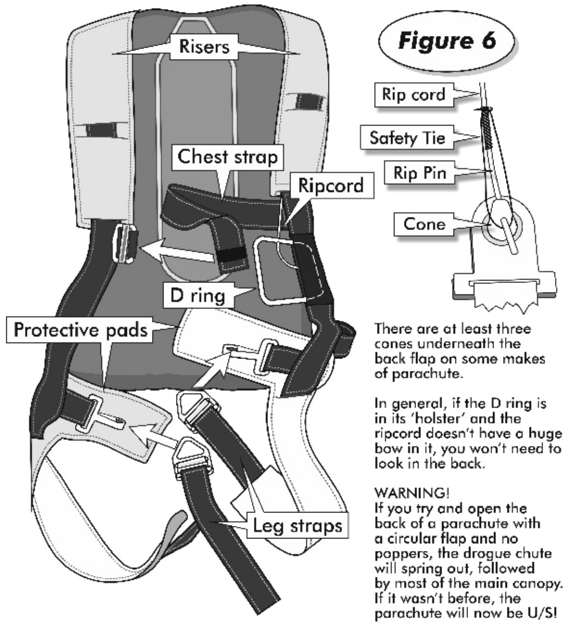
Points of general discussion might include:

- what we're looking for (both good and bad), and why are we looking for them (causes and consequences!)
- how do we know when something's wrong (eg., should we be able to wobble the fin sideways as much as this?)
- how serious is any particular fault likely to be (eg., superficial crack in the paint or something that's also in the structure underneath?)
- what needs to be done about it (is the glider U/S or not?)

Inevitably the first few demonstrations/walk throughs will be a bit wordy, but it is important to stress to the trainee the need for consistency and thoroughness. It's a mistake to assume that because a glider was 'alright' yesterday that it will be 'alright' today. This is how cursory DI's become the norm, and they are not 'alright'. The last landing of the previous day may have damaged the glider, and the pilot in charge might not have been aware of what happened, so there won't be any mention of it in the DI logbook. Nobody will know about it. Just occasionally a pilot may have known something went wrong and then have decided not to mention it. Regardless of what one might think about that, it's yet another reason for doing a 'proper DI'.

In addition, make these points to the trainee;

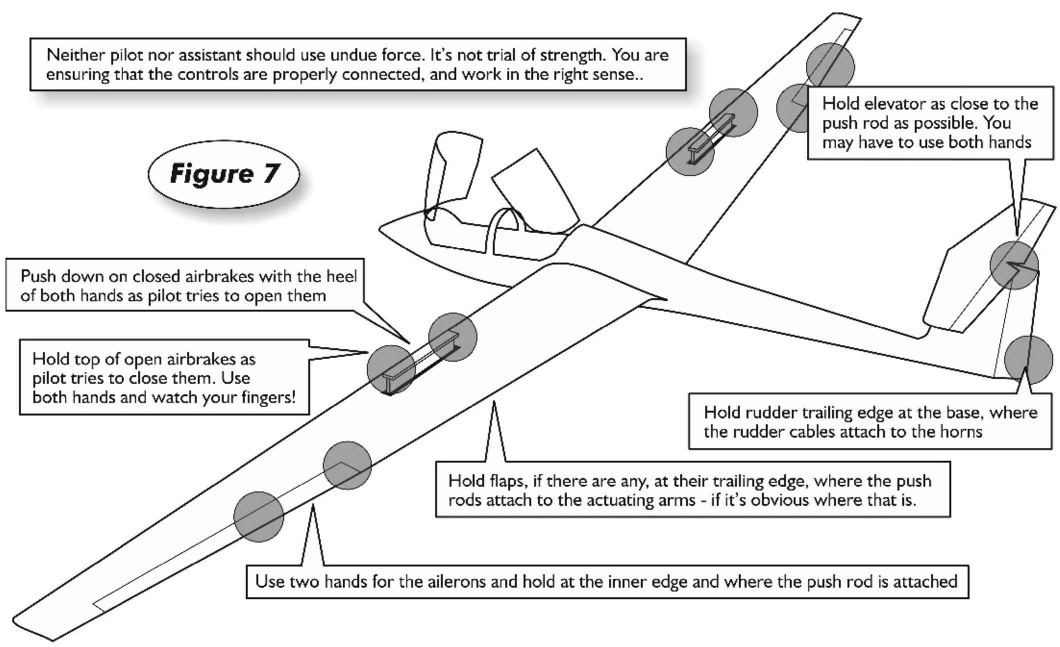
- give the DI your full attention. It's potentially life critical
- whether you rigged the glider yourself or not, be methodical. Follow a sequence. Start at the cockpit and work your way round the glider and back to where you started. Figure 3 lists most of the items that need checking, but refer to the BGA General Maintenance Schedule (GMS) which gives more detail on what's required



NOTE: It is very important that you don't allow yourself to be distracted or interrupted. If you are, go back one stage before continuing. Don't interrupt anyone else doing a DI unless there's a very good reason.

- if you're not sure about something you've come across, however trivial it may seem, ask
- leave looking at the glider's daily inspection book until you've finished the DI. It's easy to miss other things if you already know what you're looking for. When you do refer to the DI book and find you missed something, you'll know to be more thorough next time
- fill in the DI logbook and leave it in the glider
- parachutes are normally stored elsewhere and not left in the glider, but they are part of the DI. Be careful about how you check them out. Some have poppers (or velcro) and a flap on the back which you can open, allowing you to see whether the rip pins are properly through the cones (figure 6). Others don't have this, and if you try and open the flap (usually circular) the drogue parachute will spring out like a Jack in the Box and most of the main canopy will follow it. You can't just stick all this back into the pack again. The parachute is U/S until it has been re-packed.
- Other points:
  - under an openable back flap there should be a thin thread around the rip cord and the rip pins (figure 6). While the thread can break, that doesn't make the parachute U/S - providing the rip pins aren't about to pull through the cones. The thread should never be replaced by wire or stronger thread as this may prevent the parachute from deploying
  - the rip pins should be unbent
  - with all parachutes check the release handle is being held in place and is neither flopping about, or looks to have been partially pulled
  - the harness should be in good condition, as should the pack and the metal fittings
  - check with the packing log card (which may be kept elsewhere) that the parachute is in date
  - if the parachute feels damp, it is U/S
- make sure that any documentation you are legally obliged to have onboard is actually there. Some of it has nothing whatsoever to do with flight safety, but you can still be prosecuted or invalidate the insurance for not having it to hand
- check that the cockpit information placard is legible and in date
- by all means check visually that the handle of a retractable undercarriage is in the correct detente, but during the cockpit checks try not to retract it

The most critical DIs are after a rig, and before the first flight following any major inspection/work, such as the C of A. Check that the controls work in the right sense. Rare though it may be, it is easy to connect cable operated controls - common in older gliders - the wrong way round when putting everything back in place. Applying right rudder might then give you left rudder, and vice versa. Cross connecting the ailerons is much more serious because, judging by accidents in the past, you don't have any time to work out what's wrong if you've just taken off and a wing starts to go down. Cross connecting rod operated controls is far harder because it



usually requires them to be bent over each other using sheer brute force. You'd probably notice! Check.

It is very important to be aware that the person ultimately responsible for the safe condition of the glider - even if they've done none of the maintenance or the DI - is the pilot in charge, the P1.

Positive control checks

These are to check the security of the connections and that the controls are moving in the correct sense. There are two ways to do this, one with the pilot holding the stick central, and the other with the assistant preventing the control surfaces from moving. In most cases it may be better for the pilot to move the stick against the assistant's resistance, and the advice that follows assumes this convention.

In T-tailed gliders the elevator can go up (stick back) and down (stick forward) even when not connected to the vital push-rod that comes up through the fin, simply because the elevator rests on the end of the push rod. In flight the elevator will stream in the airflow, and even if small amounts of 'up' are available by virtue of the push rod contacting the elevator, there won't be any down. Check the connection!

As far as the ailerons, airbrakes (perhaps flap) connections are concerned, the access hatch in modern gliders is small and getting two hands in is difficult. It's usually dark inside and not easy to see what you've done, or even to do it in the first place. L'Hotellier connectors are clever devices, but it is possible to half connect them. They will look OK until any force is applied, whereupon they pop apart and disconnect. This is not something you want to happen when you're in flight.

In all the above cases positive control checks should pick up the problem.

Don't be heavy handed with these checks. If a held aileron starts to bend when the pilot moves the stick it means it's not being held near the actuating rod - which isn't always in the most convenient place for the check. Two hands might be better; one across the gap between the aileron and wing (see figure 7) and, if possible, the other adjacent the push rod.

One important part of the positive control check is not to provide the person holding the control surface with the answer to any questions you ask them. For example, don't say *Elevator up*? It is not unknown for the assistant, despite all physical evidence to the contrary, to say '*Yes*' when the right answer would be '*No*'. Box clever on this. Say *Elevator?*, for example, and *Left aileron?* If your assistant knows exactly what you're asking, then he has to look at/feel the control surface movement before giving you an answer.

Pilot maintenance: gliders and motor gliders

If you have found a problem with the glider during a DI, or you want to do maintenance work on it such as change a tyre or replace an instrument, are you allowed to do it? Two important principles are involved:

- Firstly, you must have permission from the aircraft's owner(s) to do any work. If you happen to be the owner you obviously don't need to ask your own permission, but if you intend working on club aircraft (even if it is only to change the tyre) you must obtain the Club's permission. Strictly speaking this would be through the club's committee, but it is more likely that on the grounds of common sense and simple practicality they will have designated 'a responsible person' (or persons) to make such decisions on their behalf.
- Secondly, you are only permitted to do work which you are competent to carry out. If you're not sure how to do something, you can do the work under the supervision of someone who is officially regarded as competent - who may decide that you're not. It is they who will take final responsibility for the quality of your work.

If the aircraft is part of the BGA maintenance organisation you can find a list of what you can and can't do in the BGA Airworthiness and Maintenance Procedures Manual (AMP), available in the technical section of the BGA website. If you can't face wading through the ever expanding paper work, refer to a local BGA inspector, who will be able to advise, guide and train you to do simple maintenance tasks.

Walk round before flight

The person ultimately responsible for the 'safe condition of the glider at take-off' is the pilot in charge, the P1. If you're the owner, rigger and DI'er, there are no problems. You get it wrong, your fault. The situation is slightly more complicated if you're not the owner (it's a club two seater, say), and you neither rigged it nor did the DI. Don't assume that if you are getting into a glider which you don't own that all the pre-flight actions have been carried out. At the very least have a look at the DI book.

It pays to do a walk round before you get into the glider. This is not a DI, it is a final check to confirm that the glider is fit for flight and that you haven't forgotten something obvious, such as leaving on the tail dolly.

Tail dolly piece

Taking off with the tail dolly still attached makes keeping straight on the take-off or landing ground run a bit fraught - particularly if there's a cross wind. You could argue, somewhat flippantly, that if the glider does a ground loop during landing - which is quite likely - at least the castoring tailwheel will help stop the fuselage breaking in half, but the most serious problem you're likely to encounter is far more dangerous. Tail dollies are heavy and about as far away from the CG longitudinally as it is possible to get, and if you're already towards - or at - the bottom end of the allowable range of cockpit weights, the CG may be pushed way outside limits. You're then highly likely to be faced with a serious control problem at the worst possible moment - just after you become airborne.

A further depressing aspect of tail-dolly incidents, risk to life and limb excluded, is that not only does the pilot not notice anything wrong before he straps in, but neither, apparently, does anyone else; not the wingtip holder, the launch marshal - no-one. Are we paying attention?

M - CHECK LISTS

Check lists are a vital part of the preparation for flight. A significant proportion of accidents are due to checks being improperly done – often due to distraction. Consider making the rigging area and launch area a sterile area whilst checks are being done.

Checklists/ drills and procedures only work if pilots use them. They are even more effective said out loud. The "point and say" technique is surprisingly effective. When you say, for example, the recovery airspeed, put your finger on it on the ASI.

Pre-Flight Walkaround Checks ABCDE

Airframe - Look for anything unusual or that may have happened since the DI. Include: soft tyres, damaged trailing edges, or control surfaces etc.

Ballast- before getting in check the ballast. Fit or remove ballast as appropriate. Remember the possibility of tail ballast.

Controls- Check that the controls move in the correct sense. Check all required equipment present/fitted especially back rests etc.

Dolly - Check the tail and wing dollies have been removed.

Environment - Change in wind, weather, potential obstruction, or interruptions to launching.

Pre-Take-off Checks CB SIFT BEC

Controls - Once **both** pilots are strapped in, move each individual control slowly and smoothly to the limit of its travel, to check full and free movement.

Ballast - Check that the glider will be flown within the placarded weight limits. (For early solo or conversion flights ensure the pilot(s) are at least 13kg/30lbs over it.)

Check should also include water ballast if appropriate; is the CoG still within limits? Is the glider within other loading limitations?

Straps - Ensure lap strap is over the pelvis and as tight as possible and shoulder straps are pulled down. Check for a 5th strap. The trainee's check should include checking the rear seat pilot is properly strapped in.

Instruments - Check set the instruments to zero or as appropriate. Check they are reading correctly and that the glass faces are not cracked or broken.

Check the correct operation of any electrically powered instruments and on as required. Check radio on as required to correct frequency.

Encourage the trainee to always make a mental note of the panel position of critical instruments like the ASI so that they can identify them quickly in the event of a launch failure.

Flaps - Identify whether fitted. If fitted, set for take-off.

Trim - When setting the trim, take account of the type of launch and conditions.

For a winch launch the trim lever should be set for approach speed - usually a little forward of neutral. Further forward in strong wind conditions.

For aerotow, set for anticipated aerotow speed. These initial settings can only be estimates of what is required, so re-trimming may be necessary later.

Discourage trainees in the early stages of training from trying to re-trim shortly after take-off as this can lead to Pilot Induced Oscillations.

Brakes - Checked on both sides, above and below the wing making sure they close together. Locking is critical make sure the over-centre lock is engaged.

Eventualities

As a minimum:

- Hand on the yellow knob to release immediately if the pilot is unable to keep the wings level.
- Procedure in the event of a launch failure – in particular, the brief to lower the nose to the recovery attitude and wait for the nominated speed
- A look round for any last interruptions or potential complications to the launch (wind changes/personnel in the launch area etc

It is NOT the time for a re-brief, so keep it short and to the point.

Canopy

Canopy closed and locked including a physical check with upward pressure on the canopy frame. Close the DV panels before take-off. In a two-seater both pilots should verbally confirm that their '*canopy is closed and locked.'*

HASSELL checks

Any manoeuvre likely to result in a rapid and significant change of height - deliberate or inadvertent - should be preceded by a HASSELL check. This check applies to aerobatic manoeuvres such as spins and loops, as well as stalls and demonstrations of reduced 'G.'

Height

Make allowance for the. total height from start to the lowest point of manoeuvre and allowing for height at the end point of recovery sufficient for return to the airfield. Be aware of the height of local terrain at the point of the manoeuvre.

Airframe - Check that the glider is certified for the intended manoeuvres.

Maximum airframe G loading should be noted and the accelerometer reset.

Nominate the values of the manoeuvring (V_A) and never exceed (V_{NE}) speeds.

If the undercarriage is retractable, check that it is up.

Straps - Make sure that all the straps are fitted into the buckle, and still tight.

Security - Check the cockpit to ensure that no loose articles can fly around and damage either the glider or the pilots. This check is best done before take-off so that likely 'flying objects' can be removed. Make a second check in the air.

Engine if applicable

T's and P's good and carburettor heat appropriately set for lowest anticipated height.

For retractable engine sailplanes: if down, check doors closed if engine shut down.

Location - Ensure the glider is: not over a town or active airfield (without appropriate permission) or in controlled airspace.

Lookout - Execute two well banked clearing turns in each direction, to ensure a thorough check that the airspace is clear of other traffic and will remain so long enough for the manoeuvre(s) to be completed. Using 'S' turns signals to other gliders that you are NOT thermalling and that they should steer clear because you are about to do something unusual)

Check beyond the immediate area in anticipation of potential traffic flying into your 'manoeuvring zone.' Look above and below. Repeat it frequently during any extended series of manoeuvres.

Pre-circuit Checks WULF

WULF is the recommended pre-circuit (rather than 'downwind') check. The pilot is better off flying the glider correctly, in the right place, and looking out during the circuit.

Water – dumped (In good time.)

Undercarriage - down and locked (Look at the lever.)

Loose articles - this includes the pilot i.e. tighten the straps

Flaps - if fitted, set appropriately. They may need adjusting later in the circuit. Avoid adjusting the settings while turning onto the final approach.

ADVICE TO INSTRUCTORS

Pay attention to the trainee's conduct of the Pre-Take off checks and to the glider. If distracted for any reason, ask the trainee to begin the check again and/or do the check yourself to focus yourself.

At some clubs, the person attaching the cable asks; *Airbrakes closed and locked?* and requires a positive response from the pilot before putting the ring anywhere near the hook. At other clubs ground crew are briefed to look and listen for canopy and brakes being locked and query with the pilot if in doubt – to make the query the exception not the rule. Such a double check does not remove from the pilot the responsibility for the safe conduct of the flight.

Allow sufficient time for the trainee to run through the check list. The first few times may be a long, drawn-out affair and you need to allow for that. Pressure from other pilots waiting to launch behind you must be avoided. If necessary, pull your glider off the launch grid for a while.

In most cases it is possible to do some of the HASSLL check while still on the ground or during the late stages of an aerotow, leaving only Height, Location and Lookout to be done after the launch.

COMMON DIFFICULTIES

In the early stages trainees have difficulty remembering the check list letters, never mind their meaning. Encourage them to learn the lists by heart before their next flight.

Due to the added workload of flying the glider, trainees can waste considerable time and height trying to recall a check list in the air.

Working through check lists becomes habitual and potentially boring for trainee and instructor alike. It is all too easy for trainees to forget why the check is being done; they may remember the list but not necessarily what it means. It is also all too easy for the instructor's concentration to wander, wearily, as the familiar litany is recited for the umpteenth time.

As solo pilots become more experienced, they speed up the checks, sometimes so much that little remains except a quick stir of the stick round the cockpit. This is one with potentially dangerous consequences. Make sure the checks are done properly.

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N – PATTER NOTES

INTRODUCTION

These 'Patter notes' serve two purposes:

- to ensure that the patter, wherever used, is consistent.
- to ensure the relevant patter emphasises points of particular importance, and choice of words is appropriate.

Having to learn the patter may offend you. But experience has shown that learning the patter verbatim gives a base from which you can develop a more personal style, with a variety of words and phrases.

How Much?

A limited time is available, especially during some exercises such as winch launching or spinning exercises, so the patter must be concise and timed accurately to coincide with what is actually happening. In order to achieve coordination between the control movements and the patter it will normally be necessary to start with the patter slightly before the control movement. During your instructor training you will need to show that you not only know the words, but the principles involved - timing, emphasis and the right choice of words.

Practise the words and then attempt to match the actions to the words in flight - simulators are ideal for this. It is essential to fly in a two-seater with a Flight Instructor Coach who has been standardised. Expect them to be 'picky' about use of inappropriate words such 'push' the stick forward instead of 'move' the stick.

Terminology

Certain words used in an aviation context may be unintelligible to a lay person. It helps to have explained the terms to the trainee before the flight.

Some Examples:

<u>Attitude</u>: used to define the relationship between the nose of the glider and the horizon, as seen from the cockpit. Hence 'normal gliding attitude' implies the normal relationship between the nose of the glider and the horizon.

<u>Altitude</u> Why not use 'height'? Height is one's distance from the ground, and altitude is one's height above sea level.

<u>Follow through:</u> Meaning, 'place your hand and/or feet on the controls and when that control is moved do not resist (its movement).'

<u>Pitch, Roll and Yaw.</u> Use of terms such as *the nose rises* or *the nose goes down* are no less concise or explicit than *the glider pitches nose up* or *down*. Explain roll (movement around the longitudinal axis) and yaw, rotation round a vertical axis, and angle of bank – a steady state, not a movement.

<u>Elevator, Aileron and Rudder</u> You are familiar with the terms but they may not be clearly understood by the trainee. They must learn them and their use in the context of their effects.

Choice of Words

<u>Move/Ease</u> When describing control column movements, the word 'move' has been used. A common alternative is 'ease' which implies the need for gentle movements. This can be over-emphasised as in *ease the stick gently forward*, which may actively discourage positive use of the controls.

<u>Pull/Push</u> In contrast, push or pull may result in over-harsh use. 'Move' reinforced by a positive action during the demonstration should achieve the desired result.

<u>Lowers/Goes Down versus Drops</u> *The nose goes down* is interchangeable with *the nose lowers*. *Drops* would be a bad choice in the context of a control movement, having associations with falling or losing control. It might be appropriate in stalling exercises.

<u>Centralise</u> This does not accurately describe the actual movement of the controls but is used in the interests of brevity.

How much of the patter must I memorise?

It is advisable for new instructors to learn the first few exercise patter notes reasonably well to get into good practice using appropriate terminology. This applies particularly to parts of Exercise 5 (Effect of Elevator and Effect of Ailerons) and Exercise 8 (Turning). In these exercises there is a very precise sequence of control movements that need to be co-ordinated with their description. The words of the patter are carefully constructed to give all and only the significant points; it is unlikely you can better them with different wording. Make an effort to learn these exercises as given, and to make your demonstrations match what you say exactly. These exercises are fundamental steps in the trainee's journey to accurate flying and need to be conveyed clearly and succinctly. This is a stage when many trainees are having to concentrate particularly hard, as everything is unfamiliar. They may fly with several different instructors while mastering basic flying skills, and it is helpful if those instructors all use the same words.

Patter notes for a large number of other exercises have been given here as ***examples*** of appropriate patter – **you do not need to, and you SHOULD NOT, learn them all verbatim.**

LOOKOUT Ex 5	**Remarks/Teaching Points**
Patter	Good lookout is fundamental to survival; hence lookout is introduced before flying skill.
While flying, we must always keep a good lookout. Help me with this. Scan the field of view, pausing from time to time, looking both above and below the horizon as well as on it. Whenever you see another aircraft or glider, tell me. I'll do the same …	Introducing lookout from the outset should mean that by the time the trainee is taught turning they will be scanning effectively.

EFFECT OF ELEVATOR Ex 5	**Remarks/Teaching Points**
Patter	The general principle for these exercises are: Say what you are going to do Say what effect that has on the glider as you do it Describe the new picture
Now I will show you how the controls work. First, the elevator.	
Follow through on the stick.	
Look ahead over the nose and see the relationship between the nose and the horizon, or the amount of ground in view.	This covers conditions of both good and bad visibility.
It remains constant. This is the normal gliding attitude.	
When I move the stick forward a small amount ….	Say this **before** moving the stick.
… the nose of the glider goes down. More ground comes into view; the glider takes up a new attitude and the speed increases.	Not so much to alarm the trainee. Alter the attitude to give a speed change of about 10kt.The trainee will not be aware of the attitude/ speed relationship, but this should be introduced at the earliest opportunity. You might mention the change in the airflow noise.
When I move the stick back again….	
…. the nose rises, there is less ground in view, and we begin to slow down. You can hear that the airflow gets quieter. We are in another attitude.	But not to the point of stalling the glider. Again, you might mention the change in the airflow noise.
Now I'll return the glider to its normal attitude.	
The attitude is constant and the speed is steady. I'd like you to try that. You have control.	The trainee should be encouraged to respond I have control. Most will need to change the attitude a few times to get the feel of it.
I have control.	Remind the trainee to let go of the stick

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EFFECT OF AILERONS Ex. 5 **Patter: Visual reference for level flight**	**Remarks/Teaching Points**
Now I'll show you the effect of the ailerons and how we roll the glider.	The trainee should have been briefed on these terms.
Look ahead and see that the cockpit edge is symmetrical with the horizon. The wings are level.	This wording is slightly clumsy but covers all aircraft. In a K21, say, you might say "...see that the top of the instrument panel is parallel to the horizon..." because it is conveniently flat.
If the wings were not level, then the view ahead would look like this.	Roll the glider using coordinated controls to about 30° angle of bank, but do not allow it to turn more than 20° or 30° from the original heading
Follow through on the stick.	But not on the rudder, to avoid distraction.
LOOKOUT	
Look right first.	Assuming a turn to the left
Make sure that it is clear to the left. look as far round to the left as you can.	Sufficiently far round to see the tailplane
Remember to tell me if you see any other aircraft.	Reinforcing the point made earlier. Alternatively, you can ask if they see any other aircraft.
Now look back over the nose.	
MANOEUVRE	
If I move the stick to the left, the left wing goes down.	Say this **before** moving the stick.
It continues going down until I centralise the stick.	The word 'centralise' is not accurate, but it is used in the interests of brevity.
The glider is now banked and therefore turning.	
To maintain the attitude, I need to apply a slight backward pressure to the stick.	Thus, introducing the requirement to coordinate elevator with aileron.
Coming out of the turn	
To come out of the turn we must first lookout. See that it is clear to straighten up, especially behind and below the upper wing	
To raise the wing, I move the stick to the right and centralise it when the wings are level.	In this instance 'centralise' is correct.
As the wings come level, I relax the backward pressure to maintain the correct attitude.	Further consolidating the need to coordinate ailerons and elevator.
Now you try. You have control, on the stick.	You must use the rudder to coordinate while the trainee moves the stick.
Trainee*: I have control.*	Ensure the trainee confirms they have control.

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PRIMARY EFFECT OF RUDDER Ex. 5	Remarks/Teaching Points
Patter	
Now I'll show you what the rudder does.	
Follow through, feet on the rudder pedals.	But, to avoid confusion, not on the stick. Ask them to move the pedals a bit, so you know they have actually found them.
Notice that we are flying along this road (Line feature).	Any suitable into wind line feature.
*If we press the left pedal the glider yaws to the left but, **as long as I keep the wings level**, the glider continues to travel in the same direction.*	Introduces the term 'yaw.' -ensure the terminology is briefed before the fight. Emphasising keeping the wings level is important, because otherwise the glider will roll.
When I centralise the rudder, the nose returns back to point in the original direction.	
The rudder only yaws the glider and does not turn it.	Stress this point
Now you try. You have control, on the rudder pedals.	Keep the wings level while the trainee practices

PATTER FROM THIS POINT IS FOR FI(S) CANDIDATES ONLY

COORDINATED ROLLIING AND ADVERSE YAW Ex 6	Remarks/Teaching Points
Patter	
Now I will show you another effect of the ailerons and why we need to use the rudder.	
Follow through on stick and rudder.	
Because the glider will turn in this demonstration we will look out in that direction (left or right) then over the nose again.	This further reinforces 'lookout' and to help maintain the emphasis on looking out at all times.
Watch what happens when I move the stick to the left without moving the rudder.	
Which way did the nose swing?	To confirm that the trainee has seen it.
This is adverse yaw. It results from aileron drag. To counteract this, we need to use rudder in conjunction with the aileron. If we use left (right) aileron and rudder together the nose no longer yaws to the right (left).	
We always use aileron and rudder together, so it is stick and rudder to the left, or stick and rudder to the right.	Make two or three turns/ reversals without altering the heading by more than 20° or 30°.
Now you try. You have control.	At this stage, the trainee's coordination will be just a first approximation, giving them an idea of the amount of each control to use. Do not continue too long as the trainee's attempts may make both of you nauseous.

ASI & AIRSPEED MONITORING Ex 7 **Patter**	**Remarks/Teaching Points**
You have control.	A demonstration is not appropriate.
Fly the glider in the normal attitude and note the ASI reading .... what is it?	Best to ask the trainee to say, so that you know they can read it. There could also be a discrepancy between the instruments in the front and rear cockpits.
Lower the nose to an attitude you think will give you a speed of 55kt.	..or whatever will give about a 10kt increase.
Glance at the ASI, while maintaining attitude, until the speed is steady. Notice that it takes some time to increase to the new value.	
If you haven't got the speed you want, make a further attitude correction. Wait, then check the ASI again.	

The trainee should learn to monitor the airspeed indicator and be required to fly within specified airspeed limits as soon as possible. However, use of the ASI must not be to the detriment of lookout.

If, as a result of the above demonstration the trainee tends to watch the ASI, continue with the following and, perhaps, cover the ASI.

AIRSPEED MONITORING - 'Chasing the ASI' demonstration **Patter**	**Remarks/Teaching Points**
If you try to select a new speed solely by watching the ASI then you may end up chasing the airspeed - let me show you. I have control.	
If I lower the nose until I get (say) 50kt ... like this...... ...the speed eventually goes beyond that figure.	
If I now raise the nose until 50kt is indicated, then the speed will fall below that figure.	
The only way to control the glider is by setting the attitude, waiting for the speed to settle and if it is not right, adjusting the attitude again.	Chasing the airspeed may result in a phugoid oscillation which may get worse.

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TRIMMER EXERCISE EX 7 **Patter**	**Remarks/Teaching Points**
Now I'm going to show you how to use the trimmer. I have control.	Trim the glider correctly.
See that if I take my hand off the stick that the glider continues to fly itself and the speed is steady. The glider is stable.	Rough air may make this difficult to show.
Now you take control and continue to maintain this attitude.	Stress attitude.
I will alter the trim.	Usually move the lever forwards.
Keep the attitude constant.	Prompt.
You are having to apply a force to the stick. Tell me the direction.	Wait for the trainee's response.
Now you adjust the trim to reduce the stick load to zero. When you have done that, release the stick.	Either the trim is correct, or it is not. Use the appropriate patter as a prompt.
Good. The attitude hasn't changed.	
OR	
No. That's not quite right. Put your hand back on the stick and reselect the original attitude.	Possibly introduce at this stage a cross reference to the airspeed if you have not already done so.
*Check the airspeed. Yes, **kt will do fine... Sense the load on the stick. Adjust the trim again. Check by releasing the stick. Good. That's fine.*	At no time during this exercise does the trainee follow through on the controls, or the instructor demonstrate.
*Now increase the speed to **kt. Trim for that speed.*	
From now on, always fly the glider in trim.	Encourage them to trim whenever they are going to be maintaining that speed e.g. established in the turn or in the glide.

THE STRAIGHT GLIDE (& SCAN CYCLE) **Ex 7** **Patter**	**Remarks/Teaching Points**
Now I'm going to show you the straight glide and how to recognise and achieve it. Follow through on the controls.	
This is the normal gliding attitude. Look ahead over the nose and see the relationship between the nose and the horizon, or the amount of ground in view. We know we are flying in a straight line because if we pick a point x in the distance, we continue to move towards it	If there is a significant wind, then this is best done up or down-wind to minimise drift.
To keep the glider flying straight we need to keep the wings level. If the wings were not level it might look like this…	Select an incorrect attitude with one wing down.

.....we roll the wings level using the ailerons and rudder together, centralising the controls when the wings are level, and select the correct pitch attitude with the elevator.	At this stage ignore the fact that the glider has probably turned slightly off the original heading. Returning to a heading is covered after turning has been taught.
I will now put the glider into a different attitude, and I want you to return it to the normal wings level gliding attitude.	Select an incorrect attitude, with one wing down, as before.
You have control.	The trainee should respond with, *I have control and* return the glider to the normal gliding attitude.
Repeat the exercise when turning has been taught, this time focusing on heading:	
Look ahead in the distance and identify a point we are flying towards. Remember, we know we are flying in a straight line because we continue to move towards that point, and it stays in the same position in the canopy.	
If the nose has moved away from the original heading, then we roll gently back towards it. As we reach the original heading, we roll the wings level and check the correct pitch attitude.	For small heading changes do not use too large an angle of bank.
Scan Cycle	
I have control. I will now show you how to maintain the straight glide and carry out the scan cycle.	Before this part of the exercise the 'clock' system must have been covered in the pre-flight briefing.
The sequence of events is lookout, attitude, and then instruments.	The scan cycle.
Begin by looking directly ahead. Focus on the horizon, looking above and below it. *Move your head to approximately the two o'clock position. Focus on the horizon and then look above and below it.* *Move your head to the 3 o'clock position. Focus on the horizon and then look above and below it* *Now look back as far as possible. Then look directly upwards, above the glider.*	If you choose to look left first it will be approximately 10 o'clock and then 9 o'clock.
Look forwards again. Check the attitude. If it is not correct, level the wings with coordinated aileron and rudder and use the elevator to return the glider to the normal gliding attitude.	
Check the trim and adjust if necessary.	If trimming has been taught.
Instruments. Check that the yaw string is central.	
Variometer. Check the glider's rate of ascent/descent.	
Altimeter. Do we have enough height to stay on this course, or should we be starting our return to the airfield?	You are responsible for the glider remaining within easy gliding range of the airfield, but the trainee needs to learn what the safe gliding range looks like.
And now back to lookout, this time to the left.	Repeat the scan cycle, this time to the other side (left or right).
Now, you try. You have control.	Let the trainee practice and do not worry if the glider's heading changes.

TURNING Ex 8	**Remarks/Teaching Points**
Patter	
I have control.	
Now I will show you how to turn the glider using all three controls together.	
There are three stages to the turn; going in, staying in and coming out.	This helps to break up the exercise into manageable chunks.
We've been maintaining a good lookout. But before turning left, we look round and behind the right wing, then scan ahead of the aircraft, above and below the horizon, then to the left and as far back as possible.	Reinforcing points made earlier.
Look ahead over the nose.	Principally to monitor the attitude.
Roll the glider using the aileron and rudder together.	
At the desired angle, use the aileron to stop the angle of bank increasing, and reduce the amount of rudder.	
As the angle of bank increases, keep the attitude constant with a slight backward pressure on the stick.	
The glider is now established in the turn.	Pause here before continuing.
Now look out again.	
STAYING IN	
Notice how the nose moves steadily around the horizon.	
Continue the scan cycle and keep a good lookout - especially in the direction of the turn.	
Keep the angle of bank constant, making any necessary corrections with aileron and rudder together.	If there are no disturbances that require correction, alter the bank angle to reinforce aileron and rudder **together.**
COMING OUT	
To come out of the turn we must first lookout. See that it is clear to straighten up, especially behind and below the upper wing. Other gliders may have joined you.	
Roll the wings level with aileron and rudder together. Relaxing the backward pressure as you do so and centralising the controls. when the wings are level.	
There are three stages to the turn. Going in, staying in and coming out.	
You try that. You have control.	Break it into sections and practise one at a time before asking the trainee to perform the complete turn.

N.B. Whilst 'Going In', 'Staying In' and 'Coming Out' is the obvious way to approach the teaching of Turning, many trainees respond better if they are first asked to restore the glider from an established turn, followed by maintaining the turn and finally entering the turn. See 'Chapter 8 Turning', of this manual.

TURNING Ex 8 Slip and Skid	**Remarks/Teaching Points**
Patter	
Follow through on the controls.	Set up an under-ruddered turn.
I am using too little rudder. Notice that the yaw string is deflected towards the outside of the turn (the slip ball falls into the turn).	They should understand that the yaw string indicates where the relative airflow is coming from and that correcting means yawing in that direction.
I need to increase the amount of rudder to bring the yaw string back to the centre. At the same time, I also need to keep the angle of bank constant.	
Have a good lookout.	
This time I am using too much rudder. Notice that the yaw string is deflected toward the inside of the turn (the slip ball rolls to the outside of the turn).	
I need to reduce the amount of rudder to bring the yaw string back to the centre. At the same time, I need to keep the angle of bank constant.	

SLOW FLIGHT – Ex 9a	**Remarks/Teaching Points**
Patter	
Before we look at Slow Flight, we do a HASSELL check.	
Now I will show you the symptoms associated with slow flight. *If I raise the nose slightly above the normal gliding attitude;* *The glider slows down, the airflow is quieter and to maintain this state I need to hold the stick somewhat further back than usual.* *This is 'slow flying' and is very close to the stall. You may notice that the controls are less effective, so I am having to put in more input to keep the wings level.* *To recover I move the stick forward.*	Take care to patter **only the symptoms that occur.**
Flying too slowly is both inefficient and potentially dangerous.	
Now you try. You have control.	Unless carrying straight on to mush stall
STALL Ex 9b – a mushed stall **You can continue the slow flight exercise into a mushed stall**	**Remarks/Teaching Points**
We are now flying with the stick hard against the back stop, and the glider is stalled or 'mushing.' Look at the high rate of sink.	Draw the trainee's attention to the variometer when the sink rate is high.
Recover, as before. Move stick centrally forward. Regain flying speed and return to the normal flying attitude.	
Now you try. You have control.	They must reduce speed **slowly**.

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STRAIGHT STALL Ex 9b	Remarks/Teaching Points
Patter	
Before I show you the stall and recovery, we do a HASSELL check.	
Now I will show you the symptoms of the approaching stall. Follow through on the controls. If the nose is raised even a little above the normal attitude ....the airspeed reduces, the noise of the airflow changes. It is quieter.	Only say that it is quieter if it actually is.
The effect of the ailerons may change …	Sometimes the ailerons are more effective, sometimes not. Leave this symptom out if short of time.
.... and the glider buffets.	The buffet may have started earlier. In which case, comment as it occurs.
In spite of my attempts to hold up the nose, it drops	You should aim to say the nose drops as it does so you may need to reverse the order of the phrases – i.e. *the nose drops in spite of my attempts to hold it up*
To recover, move the stick centrally forward, regain speed and return to the normal gliding attitude.	
Now you try. You have control.	Remember to re-clear below you at intervals, if doing several stalls.
WING DROP Stall Ex 9b	**Remarks/Teaching Points**
	Again, approach the stall, pointing out the symptoms
A wing may drop.	Induce the wing drop with rudder if there is no convenient gust
Recover, as before. Move stick ***centrally*** *forward. Regain flying speed, level the wings and return to the normal flying attitude.*	Stress unstalling the wings before trying to level them
Now you try. You have control.	

STALLING – Accelerated Stalls Ex 9b Stall in a turn	Remarks/Teaching Points
Before I show you the stalling in a turn, we do a HASSELL check.	
I have control - I'm putting the glider into a normal 30° turn - and slowing down towards the stall. *Note the unusual position of the controls required to maintain the attitude and angle of bank.* *Note the airspeed at the start of buffet - and the glider stalls.*	
*To recover – move the stick **centrally** forward. Regain flying speed, level the wings and return to the normal flying attitude.*	
Again, I'm putting the glider into a normal 30° turn - and slowing down towards the stall. *Note the start of buffet – but this time I relax the back pressure on the stick and the buffet goes away. This action reduces the angle of attack and prevents the stall.* *A stall can be prevented by moving the stick forward.*	Repeat the exercise but recover at the buffet stage by relaxing the back pressure on the stick. Explain that this action is to prevent a stall, not recover from it.
Now you try. You have control.	The trainee may have difficulty controlling the bank but if possible, they should experience this stall while on the controls themselves, particularly the recovery at the buffet.

STALLING – Further Stalling The differences between stalling & reduced G	Remarks/Teaching Points
Before I show you the stall and recovery, we do a HASSELL check.	
Now I will show you a particular symptom of the stall. Follow through on the controls. If the nose is raised noticeably above the normal attitude and held there ..... the glider stalls ..... and we feel light in our seats. *The elevator will not raise the nose. We are stalled. I must move the stick forward to recover.*	Conduct a stall with a clear nose drop. As the nose drops past the horizon, knock the stick against the back stop to show that the elevator is ineffective in the stall.
Now we will look at reduced G. *I am accelerating before pulling up into the climb. This time I lower the nose earlier to push over the top and the glider is not stalled.*	Slightly increase speed then gently pull up and push over. Push sufficiently firmly to produce the same amount of reduced 'g' felt in the stall.
Notice the same sensation, but this time the elevator is effective and air speed OK; *Stick back to recover to the normal attitude* *Note the similar sensation – but absence of other symptoms. Reduced G is not a reliable indication of stalling.*	Demonstrate the elevator is still effective raising the nose as it drops past the horizon.

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SPINNING **The Spin**	**Remarks/Teaching Points**
Before we look at spinning, we do a HASSELL check.	
Describe a scenario in which you have got a little low and/or far away from the site and unintentionally fly slower than usual trying to stretch the glide.	
Notice that the nose is not high - only just above the normal flying attitude. Check height from the altimeter. *We are in a turn with a shallow angle of bank. The glider doesn't turn quickly enough so you try to bring the nose round faster with the rudder.* *This appears to work because the glider looks as if it is turning more quickly.* *Not wanting to increase the bank angle near the ground, we apply opposite aileron. The nose starts to go down. We try to stop it with the elevator, but even with the stick fully back the nose won't come up.* *We are now spinning.*	
Notice the low or flickering ASI reading (the needle has possibly gone backwards against the stop). *Notice the high rate of rotation. Notice the normal G.* *The stick is fully back but not raising the nose.*	Try to patter what actually happens. There is little hope that the trainee will absorb all this in one go. It will need to be demonstrated several times, so if there is not time to get all the words you want to say out, get them done across multiple demonstrations.
To recover we: • *Centralise the ailerons* • *Apply full opposite rudder* • *Move the stick progressively forward until the spinning stops* • *Centralise the rudder and recover from the ensuing dive.*	

THE SPIRAL DIVE	
Before we look at the spiral dive, we do a HASSELL check.	
Look, we are well banked, the nose is below the horizon and both speed and G are increasing. The rate of rotation is lower than when spinning. To recover: *Level the wings with coordinated aileron and rudder and* ***then*** *ease out of the dive.*	Try to make use of those occasions when the glider fails to spin and instead enters a spiral dive. Otherwise, do it as a demonstration Do not delay recovery too long.

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SPINNING – Further Spinning **Changing Effect of the Rudder at the Stall**	**Remarks/Teaching Points**
Before we look at the changing effect of the rudder at the stall, we do a HASSELL check.	
I have control, please keep your hands and feet clear of the controls. *We are flying at a normal flying speed.* *I'm going to apply full left rudder, and I want you to tell me how much yaw and roll occur.* *How much yaw and how much roll was there?*	Hopefully, the trainee will reply with figures in the order of 30° yaw and 10° roll or 'lots of yaw and not much roll'.
OK, I'm going to repeat the exercise but note that we are now flying quite near the stall.	Fly the glider just above the stall. The glider may need to be 'on the buffet' for this to work.
I am going to apply full left rudder again and again tell me how much yaw and roll you see. *How much yaw and roll?* *Move the Stick centrally forward to unstall the glider* (Centralise the rudder).	Hopefully, this time the trainee will reply with figures in the order of 70° roll and 15° yaw or 'a lot of roll and not much yaw'. Emphasise that misuse of the controls near the stall makes the glider spin.

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STALL & SPIN FOLLOWING A LAUNCH FAILURE	Remarks/Teaching Points
Part 1 *Take note of this attitude – we are flying at the normal attitude.*	
Do the HASSELL checks.	
I am increasing speed to 70kts just so I can pull the glider up into the full climb winch launch attitude. *The launch has failed!* *I am lowering the nose to the approach attitude and trying to maintain it.* *The glider has settled into a mushing stall.* *I lower the nose and recover*	After a short 'hesitation' recover to the demonstrated normal attitude, in a mush stall. This takes practice.
Repeat the HASSELL check and note the height.	
Part 2 *Again, I am increasing speed to 70kts just so I can pull the glider up into the full climb winch launch attitude.* *The launch has failed!* *I am lowering the nose to the normal attitude, trying to maintain it, and starting to turn.* *I am using the controls normally trying to correct the attitude.* *The glider has departed from controlled flight and is still stalled/spiral diving/spinning.* *Use the appropriate recovery action.* *How much height have we lost?*	Make the same recovery but this time turn.
Repeat the HASSELL check.	
Part 3 *Again, I am increasing speed to 70kts just so I can pull the glider up into the full climb winch launch attitude.* *The launch has failed!* *This time I 'm lowering the nose to the recovery attitude. More nose down.* *Now I wait, wings level, string in the middle and wait until I have my safe speed on the ASI.* *Then I look over the nose and ask myself the question: Can I land ahead?* *If the answer is yes, that's what I do.* *If the answer is no, then whilst maintaining my safe speed I turn in the nominated direction.* *I neither turn or use the airbrakes until my safe speed has been reached and the decision made.*	This time, recover immediately, with no hesitation.
Ask the trainee to repeat part 3 of the exercise, giving them control at the point of simulated launch failure.	

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WINCH LAUNCH	**Remarks/Teaching Points**
Before we accept the cable, we make sure we have completed our checks and that the area ahead is clear both ahead and above the winch. *Ensure the cable is on the correct hook with the correct weak link.* *We make sure the cable is lined up with the glider and that we can anticipate any swing from a cross wind or the cable lie.*	
As the glider is rolling: *I keep the wings level with the ailerons and balanced on the mainwheel with the elevator.* *As we become airborne, I may need to check the stick forward to maintain the glider at or close to the take-off attitude.* *I note the airspeed increasing through the safe minimum (50kts on most gliders) and feel the acceleration, so I can then allow the glider to transition smoothly and steadily towards the full climb attitude.*	This patter is difficult to deliver exactly in time due to the speed of the launch, so may need delivering over several launches.
One the ground run, my left hand will remain on the release, so that if at any stage I cannot keep the wings level I will release immediately. *Look out to the sides to check the climb angle and monitor the speed. Continue to monitor the speed and the climb angle during the climb. Once we are in the full climb we use a steadily increasing back pressure to oppose the downward pull of the cable.*	If lay off is required – establish the layoff once you are in the full climb, with appropriate patter
At the top of the launch the nose will start to come down despite the back pressure. When you feel the power decrease bring the nose down to the normal attitude and the cable will back release. If you don't feel the cut in power, then lower the nose and release. *Pull the release to check the cable is gone.*	

AEROTOW **Patter**	**Remarks/Teaching Points**
During the ground run, I will steer the glider with the rudder, hold the wings level with the ailerons, and balance it on the main wheel with the elevator. *My left hand will be on the release. If at any stage during the ground roll the wing goes down despite the application of aileron I will release immediately.* *I will start the ground roll with the stick Back/Neutral because the glider sits on its Nose/Tail.*	Having completed the usual pre-flight checks, ensure the towrope is attached to the aerotow hook. Stick position is dependant on the glider.
As the rope pulls tight, note the vertical position of the tug in the canopy. This is a good first approximation to the correct vertical position of the tug whilst on tow.	
As we accelerate, I balance the glider on its mainwheel, then progressively move the stick forward to stay balanced on the mainwheel, until we become airborne.	
Once airborne allow the glider to climb very slowly until comfortably clear of the ground – like this. This the correct height above the ground whilst the tug further accelerates. *Maintain the gliders wing parallel to the tug's wing.*	5 to 10 feet above the ground is fine, but your trainee will not know what that looks like, so show them.

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The launch failure options are….	During the initial climb-out note the changing launch failure options until sufficient height has been gained to re-enter the circuit. However, stress that our entire focus at this point is on the tug. The launch failure options are pre-briefed, known fields, or ones we are aware of in our peripheral vision.
Concentrate on maintaining the correct vertical position behind the tug. Until 1,000 ft agl, even to the exclusion of lookout.	
To establish the correct vertical position behind the tug, whilst keeping our wings parallel to the tugs, I gently lower the nose of the glider a small amount and the tug moves up the canopy. Can you feel the rough air?	
This is the tug's slipstream. So, I move the stick slowly back a little to the correct position. Note the vertical position of the tug on the canopy. This is the normal tow position.	.
If I lower the nose of the glider a small amount the tug moves up the canopy and we fly down through the slipstream. Notice the air is now smooth again. This is the low tow position. Look at the new position of the tug in the canopy. Note how high the tug is. This is the lowest position you should go on aerotow	
To return to the normal tow position, I raise the nose of the glider gently until the tug returns to its normal position on the canopy and then hold it there with the elevator.	
Now I will show you the maximum safe height on tow. If I raise the nose of the glider a little the tug starts to go down the canopy. *Note the new position of the tug in the canopy, notice how low it is. This is the maximum height that it is safe to go to. If you get any higher than this or* ***if you lose sight of the tug, you <u>must</u> release immediately.*** *To return to the normal tow position, lower the nose of the glider gently and wait until the tug returns to the correct position on the canopy and then hold it there with the elevator. The glider will fly back in the normal tow position.*	Reinforce the importance of not getting too high or changing height behind the tug rapidly before and after this demonstration. Ensure that they understand the life of the tug pilot is in their hands.
In order to maintain position laterally behind the tug, we must keep the glider's wings level with the tug's wings. *If the glider's wings were not level with the tug's, the glider will move out to one side. Watch, if I allow the left wing to go down relative to the tug's wings, the glider moves out to the left of the tug. To move back into position behind the tug, I must level the glider's wings with those of the tug and not allow the inside wing to go down. The rope will now slowly pull us back behind the tug.* *As we get back in line behind the tug, I roll the glider slightly and briefly to the left in order to prevent overshooting and then level the glider's wings with those of the tug. We are now back in the normal tow position.*	
To follow the tug when it turns, we continue to do the same – keep our wings parallel to those of the tug and keep the tug on the same place on the canopy with the elevator.	
If we get out of position: Promptly stop any further divergence. Restore the gliders wings parallel to those of the tug, then slowly correct the vertical position by returning the tug to the correct position on the canopy.	
Before releasing the tow, it is vital to make sure it is clear in the direction we wish to turn, and all around. We then look back over the nose, pull the release and visually make sure the rope has separated from the glider. When you are certain the rope has released, slow down to gain separation from the rope. When you have separation, you may turn if you wish.	Emphasise the importance of being certain the rope has released.

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P - BASIC AEROBATICS

SPL Syllabus: Basic aerobatic exercises			
(1) Confidence manoeuvres and recoveries			
(i)	**Slow flights and stalls**	**(v)**	**Spins and recovery;**
(ii)	**Steep Turns**	**(vi)**	**Recovery from spiral dives**
(iii)	**Sideslips**	**(vi)**	**Recovery from unusual attitudes**
(iv)	**Engine restart in-flight (if applicable)**		
(2) Aerobatic manoeuvres as per point SFCL.200(b)(1).			
(i)	**45-degree climbing and diving lines performed as aerobatic manoeuvres**	**(iv)**	**Lazy eight**
(ii)	**Inside loops**	**(v)**	**Spins, with an exit onto a heading**
(iii)	**Wingover**		

INTRODUCTION

Many trainees are excited by the prospect of experiencing some aerobatics in the early stages of their training. Those that wish to go on to learn aerobatic more formally will benefit in terms of:

- improved handling and coordination skills.
- improved confidence, especially in their ability to recovery from unusual attitudes.
- being able to safely undertake and enjoy simple aerobatics.

Hopefully, by ensuring these benefits are maximised by thoughtful and structured training, some trainees will go on to more advanced aerobatics and competitions or become the advanced aerobatic instructors of the future.

These notes are intended to form a basic teaching framework for aerobatics. The emphasis is on making sure that the manoeuvres listed below can be undertaken and enjoyed safely. The relevant parts of theory such as the flight envelope should be taught in more detail in a classroom theory session.

The basic aerobatic manoeuvres in this chapter can be done in any airworthy glider approved for aerobatics. All aerobatics, including the most basic, should be planned and well executed, and within the glider's particular limitations.

It is important that the trainee aerobatic pilot is under no illusions as to exactly which aerobatic manoeuvres they are cleared to fly solo and unsupervised, and those they are not. The logbook and training syllabus progress cards provide an excellent means for conveying this in an unambiguous manner. Logbook entries should aim to provide the next instructor with a clear indication of any problem areas, and things to watch for.

Standard of competence for aerobatic training

There is no reason why some aerobatic training should not be given to ‘appropriate’ pre-solo trainee pilots, to help them build confidence and get accustomed to flight at higher speed regimes. More formal training should only start when a pilot has an SPL.

Instructors should also recognise that aerobatic training provides solo pilots with an excellent, face-saving excuse to fly with an instructor to help sort out flying problems. Such cries for help do occur from time to time and it is important that instructors recognise and respond to them.

Before teaching any aerobatic manoeuvres, a full revision should be done of all the confidence flying manoeuvres including slow flight, spinning and spiral dives (as covered in Chapters 9 and 10).

This revision should not be treated as a box-ticking exercise, but as a progressive refresher to ensure that the pilot is fully comfortable with operating the aircraft at all ranges of the normal envelope. Exercises should be flown with increasing precision and with discussion of what the pilot is experiencing, so that confidence is built step by step. Emphasis should be placed on recognising and recovering from unusual attitudes, handling the aircraft accurately at low and high speeds, and demonstrating positive control in dynamic situations.

The aim is to ensure that both instructor and trainee are satisfied that basic handling skills are secure and that the trainee is mentally prepared for the demands of full aerobatic manoeuvres.

A training syllabus and record card are essential. Ideally training should involve a mixture of dual flying and observed solo flights, with suitable feedback from each.

BASIC AEROBATICS THEORY

(1) Human Factors and Body Limitations

Spatial disorientation

The brain usually has input from the vestibular system in the inner ears as well as visual cues which help orientate us in the environment. Whilst flying aerobatics manoeuvres pilots are subject to motion, speed, forces, and variations in gravity (both positive and negative) which they are unfamiliar with, which can lead to a false perception of orientation and relative movement.

There three specific consequences of this:

- The leans – a false perception of the horizontal
- An illusion of turning in the opposite direction
- The Coriolis – a sensation of tumbling or turning on a different axis.

These illusions can be unsettling if not understood. The leans occur when the body's balance organs adapt to a prolonged gentle roll, so when the aircraft is levelled the pilot falsely feels tilted. The illusion of turning the opposite way can arise after a prolonged or rapid turn, when stopping the turn makes the pilot feel as though they are now rotating in the other direction. The Coriolis illusion happens if the pilot moves their head during a sustained turn, creating a powerful and disorienting sensation of tumbling or turning on a completely different axis. Recognising these sensations as normal illusions and relying on visual and instrument references rather than bodily feel, is key to avoiding disorientation.

The instructor should make the trainee aware of these issues and appropriate methods of avoiding spatial disorientation such as maintaining a disciplined instrument scan, keeping external visual references wherever possible, cross-checking seat-of-the-pants (proprioceptive) sensations against visual and instrument cues, and most importantly, pausing between manoeuvres to re-orient if doubt arises.

If disorientation does occur despite these precautions, the trainee should be taught to adopt a simple recovery strategy: stop any further manoeuvring, level the wings, establish a safe pitch attitude using reference to the horizon, and regain full situational awareness. The emphasis should be on positive, deliberate control inputs and not rushing to continue the manoeuvre until fully re-oriented

Airsickness

It is common for motion sickness to be triggered by the movements of aerial manoeuvres, creating conflicting signals between the eyes, inner ear, and brain. As well as nausea it can cause sweating and dizziness. It may be exacerbated by anxiety, fatigue, and dehydration. To mitigate it, pilots can focus on visual cues like the horizon, maintain hydration, get sufficient air from vents, and avoid stimulants. Some pilots report that anti-nausea medicine helps to alleviate these symptoms, but it is entirely a personal decision for the trainee whether taking such medication is appropriate for them.

It is helpful to gradually increase exposure to more extreme manoeuvres and time spent in manoeuvres to increase tolerance to airsickness. Most individuals gain some resilience over time, but this may vary considerably.

Body stress and G-forces, and effects of grey- and blackouts

Whilst pilots should be aware of the potential effects of G-forces both positive and negative, the most serious consequences such as blackout only occur at sustained levels of G at +8 or -4. These levels of G force are highly unlikely except in specialist gliders doing very high g-manoeuvres. Nonetheless there may symptoms such as dizziness or brief greying out of visions at levels as low as 3.5g particularly with abrupt changes from positive to negative, that the pilot should be aware of. Older pilots may be more susceptible.

(2) Legislation affecting aerobatic flying

Under SFCL legislation SPL holders shall only undertake aerobatic flights in sailplanes if they hold the appropriate aerobatic privileges in accordance with SFCL.200. This section specifies the theoretical knowledge requirements and flight training required. The attainment of the privilege must be documented in the pilot's logbook by documenting completion of the training by the Head of Training – normally the CFI of the responsible training organisation.

Always comply with the Rules of the Air, as set out in the UK Standardised Rules of the Air (UK SERA) and the Rules of the Air Regulations 2015. For more details, read the Skyway Code. Note that Rule 4 of the Rules of the Air Regulations 2015 prohibits aerobatic flight over the congested area such as town or cities. Aerobatic flight in controlled airspace must always be approved by the relevant air traffic control unit.

(3) principles of aerodynamics to include slow flight, stalls, and spins, flat and inverted.

The trainees require an understanding of the basic aerodynamics for the flight manoeuvres they will be performing. Slow flight and spinning are covered in the relevant chapters of the Instructor Flight Manual Chapter 9.

The flight envelope should be covered in greater depth, so it is included as an appendix to this chapter.

Specific reference needs to be made to:

- the graphical pitch plane representation of glider strength (manoeuvring envelope)
- maximum manoeuvring speeds (Va)
- velocity never exceed limits (VNE)
- effect on the manoeuvring envelope of using the airbrakes the ailerons, multiple axis control inputs (e.g. up elevator and right aileron together)
- load factor limits at different speeds
- the specific manoeuvring envelope of the glider to be used for training
- an appreciation of the relative strengths of different glider types.

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(4) general airframe and if applicable, engine limitations

It is important that the Flight Manual should be read thoroughly before performing any aerobatic manoeuvre including spins and stalls. Any limitation on manoeuvres must be adhered to and any deviations such as atypical spin recovery must be carefully noted and understood. The placarded limits in terms of weight and balance as well, as limiting speeds in particular Va, and VNE must be carefully noted.

Safety considerations

Aerobatics should only be flown in appropriate weather conditions – e.g. a visible horizon is essential for training flights with a suitable cloud base.

The permission of the appropriate authorities such as the CFI/duty instructor should be obtained before take-off. Let other pilots know that it is an aerobatic flight - start height, approximate area, and position of box etc.

Carefully prepare the glider before flight. A good DI, vacuuming the cockpit and cleaning the canopy - loose items can jam the controls and/or injure the pilot(s)

Other considerations:

- Always maintain an excellent lookout, particularly during between aerobatic manoeuvres.
- Avoiding conflict with local airfield traffic requirements.
- Adhering to pre-agreed altitude limits for aerobatic sorties e.g. from 4,000' to 1,500.'
- Particular attention should be paid to ensuring straps are correctly and tightly fitted during the flight.

Setting and sticking to these altitude limits provides a clear 'hard deck' below which no manoeuvre should be continued. This ensures a safe margin above the ground, helps both instructor and trainee manage workload, and builds the discipline of planning sequences to fit safely within the available height. The instructor should emphasise constant height awareness, the importance of recovering with adequate margin, and terminating a figure early if it risks infringing the agreed lower limit.

(5) Emergency Procedures

(i) recovery from unusual attitudes

Never 'pull through' from inverted flight. The standard recovery technique to avoid excessive airspeed is to push the nose above the horizon to reduce speed below Va and roll back to erect flight.

Tail slides must be avoided in gliders not specifically cleared to undertake them. If one occurs accidentally or seems imminent, immediately brace all controls against the stops (The recommendation used to be to hold the stick rigidly central, but in practice this is impossible and almost invariably results in the controls slamming violently against the stops. This is not very good for them, and they are likely to fly off on their own after such treatment.)

(ii) drills to include the use of parachutes and aircraft abandonment are covered in Chapter 2 of the instructor manual.

A TEM assessment must be done before any aerobatic sortie.

TEM

Threats:	**Mitigation:**
Collision	Maintain thorough Lookout
Pupil reaction	Check if there has been any reaction to reduced G on previous flights
Reduced situational awareness	Build up progressively
Errors:	
Running out of height for appropriate circuit	Monitor height & position
Incorrect control inputs	Structured briefing and demonstration
Incorrect recovery from unusual attitude	Instructor takes control immediately
Trainee mishandles controls, with risk of over-stressing or tailslide	Brief and demonstrate thoroughly and guard controls (as far as is possible)

ADVICE TO INSTRUCTORS

Weather minima

Aerobatics need to be taught in smooth conditions so that the trainee can directly relate control inputs to the resulting motion of the glider. Turbulence can add significant and dangerous airframe loads to those already created by the manoeuvres. Ideally, aerobatics should be undertaken at the beginning and end of the day.

If there is extensive cloud, reference points can be difficult to see. These conditions may compromise good lookout during manoeuvres, so it is a good idea to avoid them.

Demonstrations

Always demonstrate a proposed manoeuvre or sequence before allowing the trainee to attempt it. This 'demonstration' is invaluable as it helps the trainee gain a feel for the figure(s) and gives them time to observe things which they might not notice when performing the figure(s) themselves.

Trainee Physical Responses

The trainee's reaction to aerobatics may be quite different to your own. Watch for signs of mental overload, adverse reaction to G etc. When things go wrong, the trainee's uncertainty may cause temporary paralysis of all useful mental functions. Be prepared to take over early if required. If the trainee shows signs of tiring, resort to simple figures or simply terminate the lesson.

Pre-flight HASSLL checks must be made immediately before each aerobatic session. These should be conducted on the ground and confirmed when airborne.

Height - Particular attention should be paid to the height level, as the height band of the proposed aerobatic session is likely to be much greater than that usually covered by the stalling and spinning exercises. Repeat the pre-agreed lower altitude limit so there is absolutely no ambiguity.

Airframe - Confirm that the glider is certified for the intended manoeuvres. Maximum and minimum airframe G loading should be noted and the accelerometer reset. Confirm the values for maximum manoeuvring (V_A) and never exceed (V_{NE}) speeds. Best practice is to point to these values on the instruments so at a glance, the trainee can quickly see if they are approaching these values in flight. If the undercarriage is retractable, check that it is up.

Straps - Make sure that all the straps are fitted into the buckle, and still tight.

Security - Check the cockpit to ensure that no loose articles can fly around and damage either the glider or the pilots. This check is best done before take-off so that likely 'flying objects' can be removed but repeat in the air.

Location - Ensure the glider is: not over a town or active airfield (without appropriate permission) or in controlled airspace. Confirm if the glider has been towed to the pre-agreed location by the tug pilot, and if not, either reposition or adapt the sortie plan accordingly.

Lookout - Execute two well banked clearing turns of 180° in each direction, to check that the airspace is clear of other traffic and will remain so long enough for the manoeuvre(s) to be completed.

Lookout needs to be especially vigilant. For example, looking for aircraft initially at a much lower altitude and still some distance away approaching the proposed aerobatics box. Aircraft directly below, etc.

PREFLIGHT BRIEFING

Before each flight, the exercises to be flown should be planned and briefed. The following items should also be covered:

- Target entry and exit speeds should be agreed. Ideally, the exit speed from one figure should approximate the entry speed for the next.
- Describe and discuss the method of flying each figure.
- Agree the proposed aerobatic box and the reference or aiming points to be used. Discuss the proposed interaction with local traffic and the local airfield requirements.
- The characteristics of the glider to be used e.g. how well does it spin. Identify any control weaknesses such as a small rudder or elevator etc.
- The glider's flight limitations.

Whilst not essential, it is advisable to draw an Aresti diagram for the proposed figures or sequence to be flown. The Aresti system is the international 'language' of aerobatics, using standard symbols to depict each figure and its direction of flight. If the trainee decides to move onto advanced or competition aerobatics, getting them familiar with the nomenclature and pictorial form of figures, will provide a useful foundation, making it easier for them to understand and brief sequences, communicate clearly with other pilots and judges, and ultimately prepare them for the standards and practices expected in advanced aerobatic training and competition. Information on Aresti is on the FAI website here:

https://www.fai.org/news/understanding-aresti-figures-aerobatic-competition

MANOEUVRE DEMONSTRATIONS

During these, trainee gains both a feel for the figures to be flown, and an appreciation of the key points to be looked for and controlled for the figures to be flown correctly.

These include:

- Aerobatic box axis aiming points both ahead and behind the glider, as well as on the horizon in the direction of the wing tips. A ground line feature such as a road, a railway or a runway provides the best axis reference of all.
- Load factors as measured on the installed G-meter, and as felt by the pilot.
- Airspeed indications on the ASI as well as the sound of the airflow.
- The relative height of wing tips above the horizon and the wing flex experienced during changing G loading.
- Attitude reference points for pitch control - ground, horizon, or cloud features.
- Wing tip reference triangle properly aligned to longitudinal axis of glider to provide indication of horizontal, vertical and 45° lines.
- Position of the controls.
- Yaw string and wing roll angle relative to horizon.

As with all instructing, the eventual aim is to enable the trainee to analyse and improve the accuracy of their own performance.

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AEROBATIC MANOEUVRES

45° DOWN LINE

Identify both entry and exit speeds before commencing the procedure.

Commence from slow level flight with the level wings and no yaw:

- The entry speed should be low, typically 5kts above the stall speed. The trainee should look ahead and check that the wings remain level as they start to pitch down.
- The pitch down should be an even curve.
- Initially the trainee should look over the nose and use the horizon reference to keep the wings level.
- After approximately 30 degrees of pitch down, the trainee needs to look at the wingtip sighting device and watch it until the aircraft is at the correct angle. i.e. 45° down line
- Then stop the pitch and check if the angle is correct before looking ahead.
- Use a forward aiming point directly in front of the nose to maintain constant attitude control
- The longitudinal stability of the glider will try to pitch the aircraft up as the speed increases. So it is necessary to increase the forward pressure on the stick to keep the ground features in the same position
- As the airspeed indicator needle passes through the threshold speed, start a smooth but rapid pitch up to horizontal
- Pull out to horizontal flight at the correct (preselected) airspeed.

Common faults

- Dive too shallow. Ideally use a wing tip triangle and not the wing tip to judge.
- Dive shallows-out as speed builds.
- Incorrect pitch control as stick forces vary.
- Exit speed incorrect. Use a transition speed of, typically, 10kt less than the target speed - use pull out speed of 10kt less than target.
- Speed not maintained after exiting the down line due to a 'nose high' attitude.

Teaching Points

It is vital at this early stage of aerobatic training to ensure that the trainee looks at the sighting device and not merely glances in that direction. Therefore, the instructor should watch the trainee's head and prompt as vigorously as necessary. Once the aircraft is established in the dive at the correct angle, the trainee will look ahead. It is a common fault to see a diving line that becomes progressively shallower. The instructor can emphasise the use of a reference point to maintain the attitude. In this case, 'horizontal' is noticeably lower than for normal low speed flight to prevent the speed bleeding off between figures.

45° UP LINE

Identify both entry and exit speeds before starting the manoeuvre. Begin from level flight with the wings level and no yaw present.

- For training, the entry speed should be around 50kts above the stall speed. The target exit speed should be 5-10kts above the stalling speed
- The trainee should look ahead and check that the wings remain level as they start to pitch up
- The pitch up should be an even curve
- After approximately 30 degrees of pitch up, the trainee must look at the wingtip sighting device and watch it until the aircraft is at the correct angle. i.e. 45° up line
- The longitudinal stability of the glider will try to pitch the aircraft nose down as the speed decreases. So, it is necessary to keep back pressure on the stick to keep the ground features in the same position
- push over (at typically 15-20 kts above exit speed) to achieve horizontal flight a little above stalling speed.

Common faults

- Climb angle too shallow/too steep/not constant - use attitude reference e.g. clouds.
- Incorrect exit speed - use the ASI to judge correct push over speed.
- Pitch up to 45° not sharp enough - use the 3G load factor.
- Exit speed too slow - push over at VS + 20kt indicated airspeed.

Hazards Stall off the top – avoid this by pushing over further to regain speed.

WARNING! Most gliders are very susceptible to spinning in this condition.

Teaching Points

The ability to pitch up to the full 45 degrees is a key to later figures and trainees must establish the correct technique as a habit. The instructor should watch the trainees head to ensure that they look at the wing tip triangle: there is no other way of judging the angle. The figure must start with adequate speed to allow a definite line. The natural stability will tend to shallow the climbing line. However, the effect is not as noticeable because the climbing line is short. Some gliders are prone to stall if the pitch down is left too late.

INSIDE LOOP

An inside loop should be a horizontal line followed by a constant radius circle in the vertical plane with a horizontal exit line on the same heading.

Begin from horizontal flight at the correct entry speed 2.5 x Vs

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- At entry, the wings must be level and the glider must be free from yaw.
- The pull-up should be progressive, typically with 3G load applied in first quarter.
- As you start to pull back, check the horizon and the yaw string to ensure that you are still correctly lined up with level wings.
- In the second quarter, as speed decays and the effectiveness of the elevator reduces, progressively ease back on the stick to maintain a constant radius.
- At the top of the loop the wings should be level and no yaw present. The load factor should remain positive (0.25G) the stick should be on rear stop.
- When you reach the inverted position at the top of the Loop relax the back pressure slightly, for a moment only, to reduce the rate of rotation and keep the radius constant with minimum speed. This will delay the dropping of the nose which will otherwise tend to fall too rapidly into the second half of the Loop, tightening the circle as it does so.
- Pressure should then be quickly but steadily re-applied and the stick moved slowly aft again to maintain the shape of the third quarter. (NB: the backpressure must not be relaxed too much at the top, or for more than a moment, otherwise speed will start to build rapidly in an inverted dive.)
- At the vertical up/ down position, the wing tips should be equidistant above the horizon.
- As you progress into the fourth quarter, speed will be building fast. Monitor speed closely and relax back-pressure steadily as the elevator becomes more effective in order (a) to achieve the target entry speed for the following figure and (b) to avoid an unnecessarily harsh pull-out and tightening of the Loop
- During the second half of the loop the elevator control must prevent initial over-tightening of the circle, whilst ensuring a horizontal exit at the same speed as the entry - or the selected target speed for the next figure.

Common faults

- Harsh pulling and/or pushing of the stick.
- Tightening of the circle during the second half of the figure.
- Entering the loop from a dive rather than from level flight.
- Incorrect lines and glider orientations throughout manoeuvre.
- Shape not circular.
- Segmented (angular sided).
- Failure to finish in level flight by pulling up into a climb to reduce speed.

Hazards

Insufficient speed can lead to an inverted stall before the top of the loop. Avoid this by pulling back fully and recovering from the dive – this will avoid a tailslide. Pulling back to hard over the top of the loop can stall the glider and induce a flick roll – if this happens, recover from the spin.

Teaching Points

If possible, the loop should be performed directly into the wind. That way the aircraft will be travelling against the wind at high speed at the entry and with the wind at low speed near the top.

Once the horizon has dropped below the nose, the trainee should look up as much as possible to catch an early view of the far horizon. Then as the far horizon approaches, slacken the loop by reducing the back pressure on the stick to 'float over the top.' That is an opportunity to check that the wings are still level.

Finally, the trainee must be confident in pitching without introducing unintended roll. In either case, the trainee must 'float the aircraft over the top' and wait for the nose to drop significantly before starting to tighten the pitch. If the trainee starts to pull as soon as the nose drops through the horizon, the third quarter of the loop will be very tight. Unless the trainee then has a slack fourth quarter, the loop will finish higher and slower than the entry. Once the trainee starts to pull in the middle of the third quarter, they need to progressively tighten the pitch as the speed increases. The maximum G will be just before the trainee stops the pitch at horizontal.

WINGOVER

A wingover (non-Aresti figure) is a smooth, climbing turn with wings vertical (no more) halfway round, then descending to exit on the reverse heading with wings level. i.e. essentially a more relaxed version of a Chandelle, using less than 45 degrees pitch up and less than 45 degrees of roll.

Entry and exit speeds should be 80kts or more.

Begin from horizontal flight at the correct entry speed.

- The aircraft is pitched up-to a maximum 45-degree line. Stop the pitch.
- Then roll to a maximum of 45 degrees of bank whilst on that line.
- Centralise the ailerons to stop the bank increasing. Pull round the turn by maintaining back stick pressure.
- The aircraft will perform a 180 degree turn on that inclined plane until it is diving at up-to 45 degrees in the opposite direction to the entry.
- Look for the exit direction. This will be parallel to the reference line and pitched 45 degrees down. Keep pulling until the nose is on the exit line.
- Then apply a good firm forward movement on the stick to stop the nose on the exit line. After a slight hesitation, roll hard until the wings are level in a 45-degree dive.
- Wait for the speed to build whilst preventing the nose rising.
- At 10kts short of the entry speed for the next figure, start to pull into straight and level flight.

If performed well, at the highest point the fuselage will be horizontal, pointing 90 degrees to the entry direction with the wings vertical. The aircraft will still have a fair amount of speed, so the wings are generating enough lift to keep pulling round the turn.

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Common Faults

- Too slow an entry will result in the aircraft falling out of the turn.
- Not pitching up sufficiently. If the aircraft is then under-rolled, the pull will lift the nose high until all speed is lost and the aircraft falls out.
- After rolling, it is common to keep on some roll as the aircraft is turned. This results in the wings being over-vertical at the top and an exit off heading. The instructor should emphasise the need to fully stop the roll before pulling round the turn.

Hazards

The main risk is entering the manoeuvre too slowly and running out of energy part-way through, which can lead to a wing-drop or stall. Over-rolling at the top can also result in the wings going past vertical into inverted flight. Excessive or mistimed elevator input while slow can provoke an incipient spin. Height loss is modest when flown correctly, but poor coordination can increase it significantly, reducing margins for recovery.

Teaching Points

At first sight, this seems like a good figure to introduce early in training. It is reasonably gentle, it does not involve extreme attitudes, the height loss is modest and so you can do several in a row. Unfortunately, it is quite a difficult figure to get right, as it involves coordinating many different movements of the controls. Therefore, it is best postponed until the trainee is good at the pitching manoeuvres.

This figure benefits from a ground rehearsal of the control and head movements. Without a ground rehearsal, many trainees will hesitate too long between the various stages and so run out of speed.

LAZY EIGHT

A LAZY EIGHT is non-Aresti figure and consists of one 270-degree turn followed immediately by a second 270-degree turn in the opposite direction, both flown at a constant speed and 45-degree angle of bank.

Before starting pick a clear linear feature to use as a reference line. Start from level flight at an appropriate entry speed.

- Roll on 45 degrees of bank whilst maintaining heading. Stop the roll.
- Pull round the turn whilst ensuring the pitch attitude remains appropriate to maintain the selected speed. Note: trainees will tend to 'pull' the nose above the horizon as they are used to the normal gliding attitude.
- Once perpendicular to your reference feature, immediately roll to 45 degrees of bank in the opposite direction whilst maintaining the heading. Stop the roll.
- Pull round the turn whilst ensuring the pitch attitude remains constant. Once the second 270 turn is complete and you are flying parallel to your reference feature, roll wings level whilst maintaining the heading.

Common Faults

- Shallow angle of bank / pulling too hard resulting in speed loss through the turn.
- Failure to anticipate the roll out of turns.
- Rolling into/out of the turns without maintaining a constant heading.

Hazards

The Lazy Eight involves steep angles of bank coupled with continuous turning, so the most common hazard is loss of speed awareness. Pulling too hard during either turn can bring the aircraft close to the stall, particularly if bank angles are shallow and back pressure is increased excessively. If bank angles are too steep, trainees may find themselves entering a spiral dive, with speed and G loadings increasing quickly.

Teaching Points

Compasses in gliders suffer from significant turning and acceleration errors rendering them unusable for aerobatics. It is therefore necessary to pick a clear reference feature for this manoeuvre such as a runway or railway If starting parallel to the reference feature, then the first 270 turn will result in flying perpendicular to the feature. The second turn in the opposite direction brings the glider's track back parallel to it.

This is likely to be the first time the trainee has been asked to roll the glider, whilst maintaining a heading. This skill is essential to fly aerobatic figures accurately, particularly during competitions. During the rolling phases of the manoeuvre, the heading can be maintained by utilising adverse yaw; by using slightly less rudder than is required for a co-ordinated turn, the nose will stay on a particular heading until the roll is complete, at which point the trainee should resume a normal co-ordinated turn.

The transition from turning in one direction in the first half, to the other direction in the second half, involves a roll through 90 degrees but with practice, the heading can be maintained using the same method.

SPIN AND EXIT ON A HEADING

Entry from horizontal flight at VS plus 2kt with no discernible pitch-up:

- Exit should be exactly on desired heading e.g., one turn, one half turn etc.
- Exit dive should be momentarily vertical followed by transition to horizontal flight.
- The recovery 'lead' angle must be clearly defined with regard to useable ground reference features e.g., roads, railway lines, runways etc.

Common faults

- Entry not clean. Any amount of initial pitch up should be avoided.
- Spin not maintained.
- Spiral dive develops.
- Exit dive not on heading, and/or yawed.
- Transition from vertical to horizontal flight too gentle

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Hazards

Incorrect entry may result in a spiral dive rather than a fully developed spin, creating high speeds and load factors. Over-rotation or late recovery can cause the aircraft to overshoot the intended heading and lose more height than planned. Mishandling the recovery can delay recovery or flatten the spin. As spins are often disorientating, the trainee may experience sensory illusions that could delay or confuse recovery if not well-briefed.

Teaching Points

Trainees should already be familiar with spins and spin recovery. Spins and slow flight are a confidence manoeuvres that trainees must revisit before embarking on their aerobatic training. Aerobatic spins require the pilot to accurately enter a spin with no noticeable pitch up and exit on a heading. The direction of the spin does not matter. During competitions, pilots are expected to exit a spin on to a momentary vertical downline, but that does not need to be taught at the basic level.

The glider should be slowed to just above the stall speed (Vs + 2kts) with the wings level. The spin is entered using full pro-spin rudder. Once the nose begins to drop, full up elevator should be used, with continued pro-spin rudder to maintain the spin. The trainee must also anticipate the desired exit heading, and 'recover' from the spin accordingly. For a one turn spin, beginning the recovery action somewhere between ¼ and 1/8th of a turn before the desired heading usually works well, but is depending on the type of glider and how vigorously the trainee applies the recovery action.

Once the spin has stopped, recover to a horizonal, wings-level attitude.

DE-BRIEFING

A structured de-brief is essential to consolidate learning. The discussion should be supportive, factual, and encourage self-analysis. Key points to cover include:

- Pilot self-assessment: Invite the trainee to describe how they felt, what went well, and where they struggled.
- Achievement of objectives: Review whether the planned lesson aims were met and highlight specific progress.
- Accuracy and safety: Discuss adherence to altitude limits,, speeds, lookout, recovery margins, and safe handling practices.
- Recognition of sensations: Reinforce what the trainee saw, felt, and heard during manoeuvres, linking these perceptions to correct control responses.
- Error analysis: Identify any common errors (e.g. control coordination, over-rotation, height loss) and explain how to avoid them next time.
- Confidence building: Emphasise strengths and reassure the trainee that errors are a normal part of learning aerobatics.
- Preparation for next lesson: Set clear, achievable aims for the following flight so the trainee remains motivated and focused.

The aim is to ensure the trainee leaves the flight with a clear understanding of their progress, specific areas to work on, and confidence in their ability to continue developing safely.

COMMON DIFFICULTIES

Trainees encounter a range of recurring difficulties when learning aerobatics. Most of these are not signs of poor ability, but simply reflect the unfamiliarity of the forces, sensations and unusual attitudes experienced, and the increased workload that brings. Instructors should anticipate these issues and be ready with strategies to address them.

Loss of height and speed awareness due to increased workload is a common problem early in aerobatic training. In the focus of maintaining attitude and symmetry, trainees may delay recoveries or allow figures to over-run the agreed speeds. Instructors should reinforce the discipline of constant cross-checks, use of reference points, and terminating figures early if needed.

Incomplete lookout and orientation, particularly when heads are kept rigidly forward rather than moving to maintain full situational awareness. Trainees often struggle to look in the right place at the right time: over the nose to judge wings level, or at the wingtip sighting device to establish correct 45° or vertical lines. Looking in the wrong place leads to poorly aligned figures and inaccurate lines.

Turning the head while under G can create disorientating proprioceptive and vestibular sensations, which can unsettle the trainee and reduce their confidence. Instructors should brief these effects in advance and stress the importance of deliberate, well-timed head movements linked to key references.

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BASIC AEROBATICS -The Flight Envelope

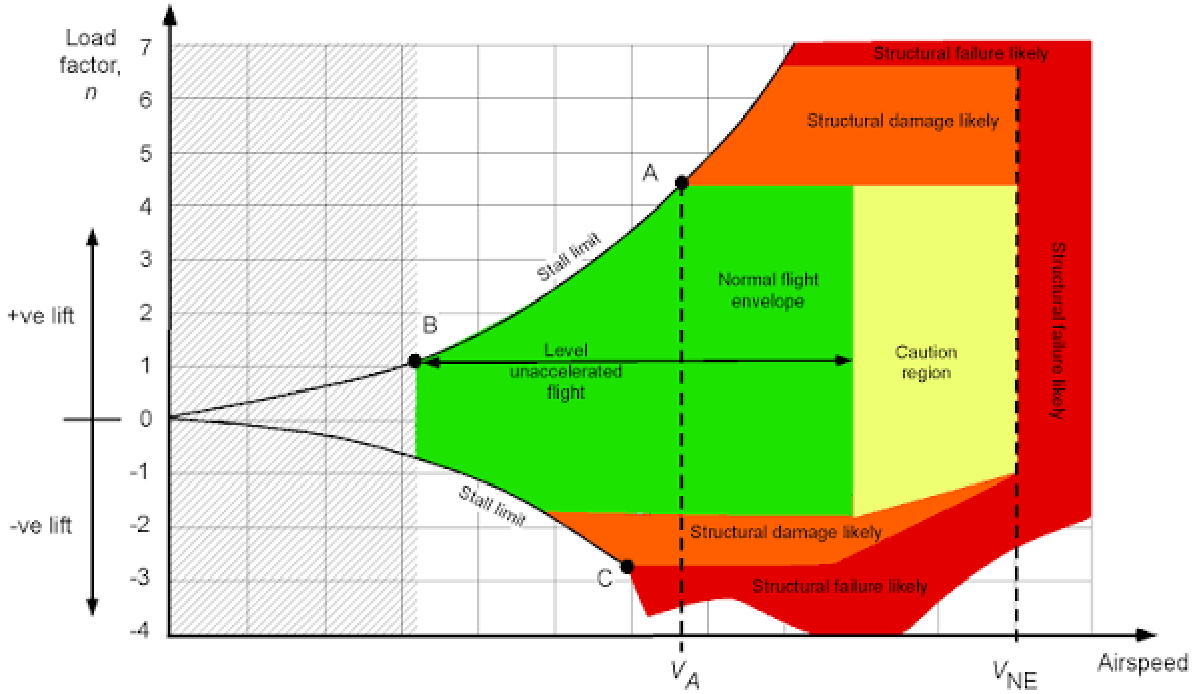
The flight envelope outlines the operating limits for aircraft. The key difference from a powered aircraft is that a glider lacks an engine, so its performance is driven by gravity and atmospheric lift rather than thrust. The flight envelope for a specific glider model is represented on a chart plotting airspeed against the load factor.

Load Factor is the effective weight of the aircraft that takes into account the actual weight and other acceleration factors and dividing it by the actual weight. Greater than zero is often referred to as positive G and less than zero is the area that applies to negative G manoeuvres.

The upper curved line is the stall speed of the glider at various loads – i.e. stall speed increases at higher g loadings.

Gliders are designed to withstand and operate satisfactorily up to their flight limit loads without any permanent structural deformation. Most gliders are limited to 5 g. The ultimate strength is required to be at least 1.5 times greater, with an ability to resist these loads for at least three seconds before failure occurs. Gliders designed as specialist aerobatic aircraft have a higher flight limit load up to 7G.

Fig 1 Simplified flight envelope



Low speed limits: are defined by the stall speeds.

High-speed limits:

Vne is the never exceed speed under any conditions. (Marked by a red line on the ASI) Vne is determined by the manufacturer during the certification process to ensure structural integrity and includes a safety margin for potential errors. Exceeding Vne can lead to catastrophic failure due to issues like uncontrollable flutter or parts breaking off the aircraft. It is normally set at 0.9 x Vd.

Vd is a theoretically calculated speed at which the aircraft would be safe to fly in completely smooth air. The aircraft will never have been flown at this speed.

Va is the manoeuvring speed. This is the maximum speed at which you can have full deflection of more than one control surface (nominally the elevator) without risking structural damage due to high loads. Wings are designed to be strong in tension but not in torsion. As speed increases Centre of Pressure, moves backwards hence wing twisting and flutter.

The torsion caused by the CoP moving backwards effectively reduces the strength of wing as speed increases. The use of ailerons makes it worse, as does the use of airbrakes. Therefore, max g allowed decreases as speed is increased

Vb (or Vra) Maximum rough air speed. The highest speed recommended for flight in turbulent or gusty conditions to avoid structural stress. It is calculated based on the maximum load factor which is imposed upon the airframe in response to a standard knife edged gust of 15 m/s velocity in the vertical direction. Often **Va** and **Vb** are often the same speed, but **Va** may be lower than **Vb** for some aircraft.

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Gust envelope: Gust lines at 15m/sec and 7.5 m/sec can be superimposed on the flight envelope to display the gust envelope. i.e. a representation of how upward and downward gusts of varying intensity affect the aircraft's load factor at different speeds. This includes specific speeds for strong and weak gusts. (see fig 2.)

Factors affecting the flight envelope

Significant additional forces can be imposed on the airframe by the following:

- **Use of rudder to generate yaw forces**

  Simultaneous use of full rudder and full elevator is normally confined to flick manoeuvres. Where these are authorised for the glider type, the Flight Manual will specify a limiting entry speed. That value should be treated as the maximum safe speed for applying rapid, full deflections of both controls together. In many training gliders this limit is significantly lower than the published manoeuvring speed — for example, around 55 knots on an aircraft with a Va of 90 knots.

Note: flick manoeuvres cause huge twisting loads and should not be performed unless specified in the flight manual that they are permitted.

- **Use of aileron to generate roll forces**

  When roll control is applied, an additional load limitation applies to the aircraft. This ‘rolling G limit’ is lower than the maximum structural load factor since the wings must resist both the normal bending forces and the extra twisting forces generated by aileron deflection. The Flight Manual often shows this as a separate rolling limit line on the manoeuvring envelope diagram.

In practice, most rolling manoeuvres are flown at light to moderate g, so operating within this reduced envelope is not usually restrictive — provided full aileron deflection is avoided above manoeuvring speed (Va). More caution is needed in figures that combine higher airspeeds with elevator and aileron inputs together, where the combined stresses can be significant. Typical examples include Cubans, cloverleafs, and barrel rolls.

- **Use of airbrakes**

  The use of the airbrakes causes a significant increase in the loads applied to the glider, requires limitation of the Flight Envelope in a similar way to the ailerons. The reasons are:

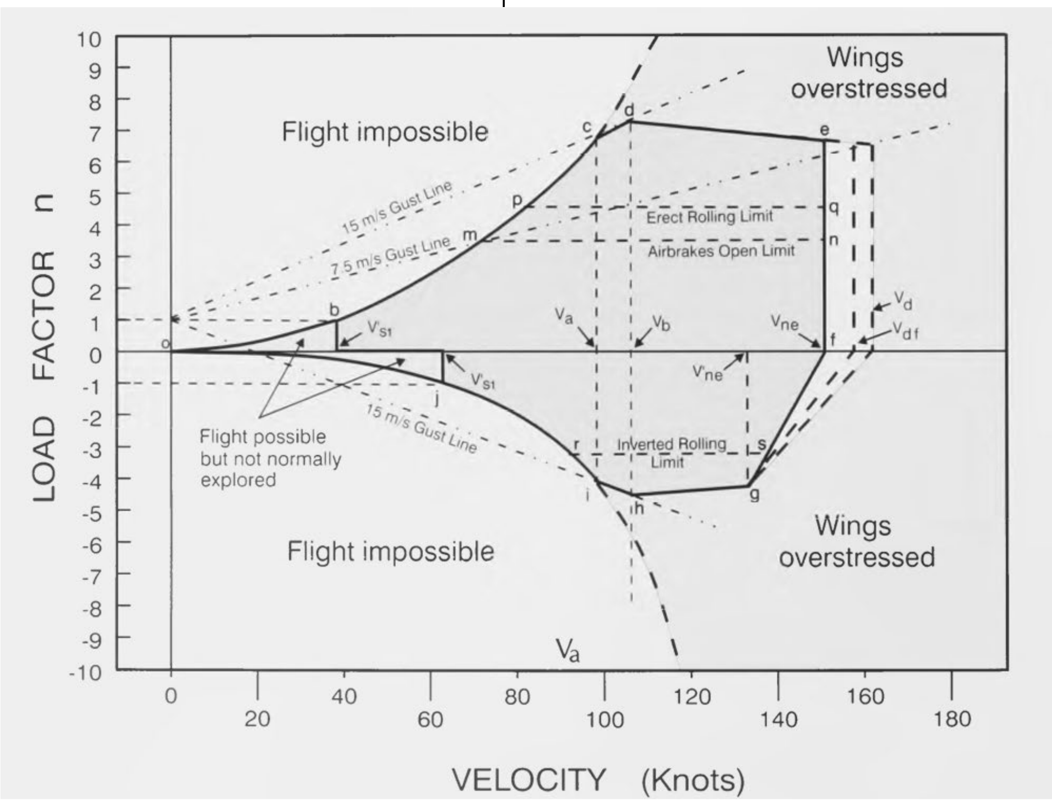
  (a) the airbrakes destroy lift over a fairly large inboard section of the wing causing the spanwise wing lift distribution to move outboard. This substantially increases wing bending moments.

  (b) the airbrakes also generate drag loads on the wing, a proportion of which become an additional load in the pitch plane direction.

Note: It is nearly always better to slow a glider by 'pulling g' rather than by opening the airbrakes

This limitation is displayed as an airbrake opening limit on fig 2 below.

Figure 2



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28 - AEROBATIC TRAINING

The majority of the aerobatics described in this chapter should only be done in a glider which has been designed to be fully aerobatic. The more advanced figures must be taught only by instructors who have an Advanced Aerobatic Instructor' rating. It would be the height of stupidity, not to mention extremely risky, to try and teach rolling manoeuvres, say, if your only experience of them was via the hit and miss of self teaching; or these days, in a computer flight simulator. Clearly, at some point, someone had to teach themselves the manoeuvres, but in those distant days - when aviation was bright and new - a high fatality rate was quite romantic. Not any longer.

Aims

☑ To improve glider pilots' handling and coordination skills.

☑ To improve their confidence in recovery from unusual attitudes.

☑ To enable them to safely undertake and enjoy simple aerobatics.

Scope

These notes are intended to help BGA instructors who do not have an aerobatic rating establish a basic teaching framework for aerobatics. The emphasis is on making sure that the manoeuvres listed below can be undertaken and enjoyed safely. Figures to be covered include:

- 45° up and down lines
- loops
- humpty bumps - canopy down
- stall turns using a 60° up line
- chandelles
- spins, with an exit onto a heading.

This chapter focuses on aerobatics as flown in competitions. Training for and taking part in this competitive aspect of the sport is a superb way for a pilot to develop his/her skills, although there are other sorts of aerobatics. All aerobatics, including the most basic, should be planned and well executed, and within the glider's particular limitations. Competition pilots have a disciplined approach to aerobatics which has much to commend it.

INITIAL AEROBATIC BRIEFING

Prior to aerobatic training flights the trainee should be fully conversant with the following:

Flight Manoeuvring Envelopes

Specific reference needs to be made to:

- the graphical pitch plane representation of glider strength (manoeuvring envelope)
- maximum manoeuvring speeds (V_A)
- velocity never exceed limits (V_{NE})
- effect on the manoeuvring envelope of using
  - the airbrakes
  - the ailerons
  - multiple axis control inputs (e.g. up elevator and right aileron together)
- load factor limits at different speeds
- the manoeuvring envelope of the glider to be used for training
- an appreciation of the relative strengths of different glider types.

Pre-flight HASSLL checks to be made immediately before each aerobatic session [chapter 4]. Particular attention should be paid to the following two important factors:

- that the check is a good moment to remind oneself of the glider's loading limitations, and the appropriate manoeuvring and V_{NE} speeds
- since the height band of the proposed aerobatic session is likely to be much greater than that usually covered by the stalling and spinning exercises, lookout needs to be especially vigilant. For example, looking for aircraft initially at a much lower altitude and still some distance away approaching the proposed aerobatics box. Aircraft directly below, etc.

Basic aerobatic disciplines

- always fly a preplanned Aresti sequence - e.g. 45° down line, loop, 45° up line - with suitable diagrams stuck to the trainee's and to the instructor's panel
- aerobatics should be performed along imaginary perpendicular axes orientated to, and referenced by, suitable ground features (aiming points)
- aerobatic flight lines should be vertical, 45° up or down, and horizontal. A 5° down line is allowed to maintain energy in horizontal flight
- sequences must consist of discrete individual figures. Each should be properly set up, flown, and completed before going onto the next. Emphasise the dangers of not doing this eg., G wind-up in continuous loops.

Safety considerations

Whilst these are, in the main, no different from those that might apply to any other flight, there are some which are specific to aerobatics. These include:

- adhering to preset altitude limits for aerobatics eg. from 4,000' to 1,200'
- avoiding conflict with local airfield traffic requirements
- maintaining an excellent lookout at all times, particularly during actual aerobatic manoeuvres
- tail slides must be avoided in gliders not specifically cleared to undertake them
- the need to:
  - immediately brace all controls against the stops if a tail slide seems likely. (The recommendation used to be to hold the stick rigidly central, but in practice this is impossible and almost invariably results in the controls slamming violently against the stops. This isn't very good for them and they are likely to fly off on their own after such treatment)
  - avoid 'pulling through' from inverted flight. The standard recovery technique to avoid excessive airspeed is to roll back to erect flight
  - avoid aerobatics in strongly thermic or turbulent air

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- carefully prepare the glider before flight. A good DI, vacuuming the cockpit and cleaning the canopy - loose items can jam the controls and/or injure the pilot(s)
- before take-off, let other pilots know that it is an aerobatic flight - start height, approximate area and position of box etc. Get the permission of the appropriate authorities (e.g., the local CFI) if required.

A training syllabus and record card are essential. Ideally training should involve a mixture of dual flying and observed solo flights, with suitable feedback from each.

PREFLIGHT BRIEFING

Before each flight the routine to be flown should be planned, and an Aresti diagram drawn up for the trainee and the instructor. The following items should also be covered:

- target entry and exit speeds should be agreed and clearly annotated on the Aresti diagram. Ideally, the exit speed from one figure should approximate the entry speed for the next
- describe and discuss the method of flying each figure
- agree the proposed aerobatic box and the reference or aiming points to be used. Discuss the proposed interaction with local traffic and the local airfield requirements
- the characteristics of the glider to be used eg., how well does it spin. Identify any control weaknesses such as a small rudder or elevator etc
- the glider's flight limitations.

ADVICE TO INSTRUCTORS

Weather minima

Aerobatics need to be taught in smooth conditions so that the trainee can directly relate control inputs to the resulting motion of the glider. Turbulence can add significant and dangerous airframe loads to those already created by the manoeuvres. Ideally, aerobatics should be undertaken at the beginning and end of the day.

If there is extensive cloud, reference points can be difficult to see. These conditions may compromise good lookout during the course of manoeuvres, so it's a good idea to avoid them.

Demonstrations

Always demonstrate a proposed sequence before allowing the trainee to attempt it. This 'demonstration' is invaluable as it helps the trainee gain a feel for the figure(s), and gives him time to observe things which he might not notice when performing the sequence himself.

Trainee Physical Responses

The trainee's reaction to aerobatics may be quite different to your own. Watch for signs of mental overload, adverse reaction to g etc. When thing go wrong, the trainee's uncertainty may cause temporary paralysis of all useful mental functions. Be prepared to take over early if required. If the trainee shows signs of tiring, resort to simple figures.

Preparation

It is vital to brief the trainee before each flight, and to test his understanding of the pre-flight discussions. A properly annotated Aresti diagram encourages essential reference checks from an early stage. Never fly aerobatics without one.

Progress and approval status

It is important that the trainee aerobatic pilot is under no illusions as to exactly which aerobatic manoeuvres he is cleared to fly solo and unsupervised, and those he is not. The log book and training syllabus progress cards provide an excellent means for conveying this in an unambiguous manner. As always, log book entries should aim to provide the next instructor with a clear indication of any problem areas, and things to watch for.

Standard of competence for aerobatic training

Ideally, aerobatic training should begin when pilots are approaching Bronze standard. There is no reason why some aerobatic training should not be given to 'appropriate' pre-solo trainee pilots, to help them become accustomed to flight at higher speed regimes. Instructors should also recognise that aerobatic training provides solo pilots with an excellent, face-saving excuse to fly with an instructor to help sort out flying problems. Such cries for help do occur from time to time and it is important that instructors recognise and respond to them.

The Figures

Instructors should not teach aerobatic figures without having first achieved a reasonable degree of expertise themselves, so this section will not describe in detail how the manoeuvres are to be flown. The focus is on the key points to be briefed, observed, checked for and picked up during the course of demonstrations and trainee' attempts.

All trainee' attempts should be preceded by an instructor demonstration of the proposed sequence. During this the trainee gains both a feel for the figures to be flown, and an appreciation of the key points to be looked for and controlled in order for the figures to be flown correctly.

Such points include the following:

- aerobatic box axis aiming points both ahead and behind the glider, as well as on the horizon in the direction of the wing tips. A ground line feature such as a road, a railway or a runway provides the best axis reference of all
- load factors as measured on the installed G-meter, and as felt by the pilot
- airspeed indications on the ASI as well as the sound of the airflow
- the relative height of wing tips above the horizon
- attitude reference points for pitch control - ground, horizon or cloud features
- wing tip reference triangle properly aligned to longitudinal axis of glider to provide indication of horizontal, vertical and 45° lines
- position of the controls
- yaw string and wing roll angle relative to horizon.

As with all instructing, the eventual aim is to enable the trainee to analyse and improve the accuracy of his own performance.

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45° down line

Commence from stalled level flight with the level wings and no yaw:

- use the wing tip reference to check the 45° down line
- use the forward aiming point to maintain constant attitude control
- pull out to horizontal flight at the correct (preselected) airspeed.

COMMON FAULTS

Dive too shallow. Ideally use a wing tip triangle and not the wing tip to judge.

Dive shallows-out as speed builds. Incorrect pitch control as stick forces vary.

Exit speed incorrect. Use a transition speed of, typically, 10kt less than the target speed - use pull out speed of 10kt less than target.

45° up line

- begin from level flight with the wings level and no yaw present
- use the wing tip reference to judge the 45° up line
- push over to achieve horizontal flight a little above stalling speed.

WARNING! Most gliders are very susceptible to spinning in this condition.

COMMON FAULTS

Climb angle too shallow/too steep/not constant - use attitude reference eg., clouds.

Incorrect exit speed - use the ASI to judge correct push over speed.

Pitch up to 45° not sharp enough - use the 3G load factor.

Exit speed too slow - push over at V_S + 20kt indicated airspeed.

The Loop

- begin from horizontal flight at the correct entry speed 2.5 x V_S
- at entry, the wings must be level and the glider must be free from yaw
- pull-up should be progressive, typically with 3G load applied in first quarter
- at the top of the loop
  - the wings should be level and no yaw present
  - the load factor should remain positive (0.25G)
  - the stick should be on rear stop
- at the vertical up/ down position, the wing tips should be equidistant above the horizon
- during the second half of the loop the elevator control must prevent initial over-tightening of the circle, whilst ensuring a horizontal exit at the same speed as the entry - or the selected target speed for the next figure.

COMMON FAULTS

Harsh pulling and/or pushing of the stick.

Tightening of the circle during the second half of the figure.

Entering the loop from a dive rather than from level flight.

Incorrect lines and glider orientations throughout manoeuvre.

Shape not circular. Segmented (angular sided).

Failure to finish in level flight by pulling up into a climb to reduce speed.

The Chandelle

- entry should be from horizontal flight at the chosen entry speed
- with level wings and no yaw present, the glider should be pulled up into a held 45° line
- a 180° direction change is effected via a 45° banked turn. Combined with the 45° up line this results in wings vertical after 90° change in heading
- a 45° held down line of equal length to the up line should precede a return to horizontal flight at the same speed as at entry to the figure.

COMMON FAULTS

45° lines too steep or too shallow with no check at the 45° line before commencing the turn.

Wings not horizontal/ vertical when required.

Axis orientation compromised.

Glider stalls rather than flies around the turn due to insufficient energy, ie. the manoeuvre becomes a shallow stall turn.

45° up and down lines of unequal length.

The canopy down Humpty Bump

This is an excellent figure for introducing trainees to vertical flight. Entry speed from horizontal is generally high, typically 2.5 x V_S plus 15kt. As this is well above V_A, care must be taken to limit the G during the pull-up.

- vertical lines must be vertical; ideally use a wing tip reference triangle
- the glider must not yaw or roll during the figure
- a 3G pull-up to the vertical line is required
- the pull over at the top should be effected whilst the glider still has sufficient (but not much) airspeed. The glider must fly, not fall over the top
- the vertical down line should be held briefly before a 3G pull out to horizontal flight at the target exit speed.

COMMON FAULTS

Vertical lines not vertical or of even length.

Entry and exit speeds substantially different.

Glider yawed in vertical line - check distance of each wing tip above horizon in both horizontal and vertical lines.

Glider falls off the top of figure as a result of pulling over when too slow.

Glider flies over top of figure at too high an airspeed so that vertical lines are not distinct, causing the figure to resemble an elliptical loop.

The Stall Turn (60° up line)

The entry conditions are similar to those used for the Humpty Bump although lower airspeed can be used with good effect on a 60° up line.

- to avoid the inherent dangers of a tail slide, this manoeuvre should only be taught at 'club' level from a 60° rather than a vertical up line
- the glider should yaw cleanly about the chosen wing tip, with no more than a single wingspan of lateral displacement.

COMMON FAULTS

Wings yawed and rolled once up line established

60° up line not held constant

Rudder kicked too early resulting in yawed upward flight and excessive lateral displacement

Rudder kicked too late, resulting in tail slide or 'fallen' figure

Up/ down lines of unequal length

Exit and entry speeds substantially different

Glider does not stop cleanly after yawing around to the down line (People grossly underestimate the difficulty of this figure in gliders!)

Spin and exit on a heading

Entry from horizontal flight at V_S plus 2kt with no discernible pitch-up:

- exit should be exactly on desired heading eg., one turn, one half turn etc
- exit dive should be momentarily vertical followed by transition to horizontal flight
- the recovery 'lead' angle must be clearly defined with regard to useable ground reference features eg., roads, railway lines, runways etc.

COMMON FAULTS

Entry not clean. Any amount of initial pitch up should be avoided.

Spin not maintained. Spiral dive develops.

Exit dive not on heading, and/ or not vertical and/or yawed.

Transition from vertical to horizontal flight too gentle.

1– FAMILIARISATION WITH THE SAILPLANE

SPL syllabus: Exercise 1 Familiarisation with the sailplane			
(i)	**Characteristics of the sailplane**	**(iv)**	**Cable release and undercarriage**
(ii)	**Cockpit layout: instruments and equipment including radio**	**(vi)**	**Checklists drills and controls**
(iii)	**Flight controls: stick, pedals, airbrakes, flaps (if available) and trim**		

INTRODUCTION

This chapter deals with glider familiarisation for the first few flights. Type conversion is covered in a separate chapter. If this is their first time on the airfield, you will have already covered the safety aspects and orientation to the airfield before moving onto this stage.

For many people, their first flight in a glider will be the first time that they have sat at the controls of an aircraft. It is often a daunting and strange but exciting experience. There is a balance to be achieved in not flooding them with too much information, but on the other hand making sure that the basics are covered clearly and accurately. As a minimum, you need to give them enough information to know what they can safely touch during their first lesson/s, and what they need to know for safety drills, such as an instruction to bail out.

There is also a whole new vocabulary associated with the aircraft and the skill of flying. Terms such as attitude or aileron are routine for pilots, but you need to check that your trainee understands what you are saying and describing. If they have already had an introductory flight and are committed to learning to fly, it is worth going back to a more detailed talk through/walk round the aircraft, to make sure everything has been covered thoroughly.

You can either start with the walk round the aircraft or show them the cockpit area – which ever works best in the circumstances.

The walkaround

Present the type of sailplane which will be used. Ideally show them the cockpit layout in the glider you are going to fly, but a similar glider, even if it a single seater may have to serve the purpose.

Point out all the key control surfaces and the basics of what they do. Where they may or may not handle the aircraft and canopy. Where the rope hooks on. How to open the canopy and the emergency jettison. The fact that gliders are inspected *or 'DI'd'* every day.

The cockpit

Reassure them that the two-seater glider has all the controls duplicated in both cockpits so that even if you ask them to have a go at an exercise that you have demonstrated, you can still take control at any point. Explain the cockpit layout: the flight controls and the colour coding system: stick, pedals, airbrakes, flaps (if available), cable release, trim and undercarriage (if available). Explain to them how to hold the stick and what you mean if you ask them to 'follow through.' The trainee needs to understand what you mean by 'I have control/you have control' and that they must release the stick if you say 'I have control' at any point.

Point out the basic instruments and how to read them. Include the ASI/vario and altimeter but do not overload the trainee with the technicalities of more complicated electronic instruments on the first few flights. If there are any switches that you might ask them to adjust in the air e.g. volume on the vario

Check that the trainee knows how to put on a parachute and adjust it and to avoid accidentally deploying the parachute by inadvertently pulling the handle. Explain the use of the parachute and bail out procedure. You might perceive this as raising anxiety levels in your trainees, but the analogy with the safety briefing on an airliner might help put it into context. The use of a parachute is extremely unlikely, but it might just save their life. (see chapter 2)

Explain how to get in and then sit the trainee in the glider (having checked their weight) and check the position of the student on the seat for comfort, visibility, ability to use all controls and obtain free and full movement. Demonstrate how to adjust the rudder pedals and if necessary, how to adjust the seat back. Explain how the canopy locks and how to open the scoop or DV panel to get some fresh air if they need it. Point out the canopy jettison, but it is usually best to advise them not to open the canopy on their own when you land for the first time.

Explain the use of the harness, including adjustment and its release mechanism.

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Briefly explain all checklists, drills, and controls – it is reassuring to the trainee to see you do the final walk around and helps it establish this as part of your (and subsequently their) standard behaviour/routine. Explain the need for/give an outline of the pre-take-off checks before you get to the stage of getting in at the launch point.

Finally, give them the opportunity to ask questions and then check that they have understood the key safety points i.e.

- What they may and may touch
- Hand over routine for air exercises
- Canopy jettison and bail out drill

Threat and Error considerations

As always, we you are conducting any exercise with a trainee you must consider the Threat and Error management considerations. In this case they are:

Threat and error management

Threats:	**Mitigation:**
Damage through careless handling	Re-enforce where the fragile parts of the glider are, especially canopy handing.
Trainee not seated correctly to reach controls	Check the trainee seating, especially on new type.
Trainee misinterprets instruments	Check trainee identifies instruments when changing to different glider
Errors:	
Trainee moves controls or knobs inappropriately	Check trainees understanding of different controls and release mechanisms.

2 Emergency Procedures

SPL syllabus: Exercise 2 Emergency Procedures			
(i)	Use of safety equipment (parachute)	(iii)	Bail-out procedure drills
(ii)	Reaction to system failures and errors	(iv)	Parachute landing fall drills

INTRODUCTION

The concise version of this chapter could simply be:

'FIRST FLY THE GLIDER'

Don't over-react:

- FLY the glider
- assess what has happened
- make a plan.

Technical failures in gliders are fortunately rare, and often a consequence of poor or faulty preparation: failure of a thorough DI, rigging checks or pre-flight checks. Nonetheless, considering what to do if a canopy flies open, a mid-air collision occurs, instruments fail or a major control fails forms a useful discussion. In an emergency, our brains get overloaded, hence we have emergency drills to fall back on.

Launch failures are the most common emergency and are covered in the relevant chapters on launching (Chapter 11).

(i) use of a parachute

The overwhelming majority of collisions in gliding occur between gliders, so the reasons for always wearing a parachute are obvious. Emergency parachutes are not subject to regulation, but there is a BGA Operational Regulation that requires glider occupants to carry emergency parachutes when flying in cloud.

Mental preparation and visualisation of the emergency response such as going through the bail out drill, has been shown make a big difference to a successful outcome. When one military pilot who had to bail out was asked at what point he finally decided to 'bang out', he replied, 'twenty years ago'. Encourage trainees to think about or practice how they would bail out.

When explaining the use of a parachute, the analogy with the safety briefing on an airliner might help put it into context. The use of a parachute is extremely unlikely, but it might just save the trainee's or passenger's life.

Care of the parachute

There is no point in having emergency equipment that you cannot rely on. Parachutes are very susceptible to damp conditions. When not in use, store the parachute in a bag, in a well-ventilated area away from direct exposure to sunlight, oils, and/or acid, and preferably heated cabinets. Leaving them in the glider overnight is undesirable. Do not leave them outside or put them down on damp ground. The 'chute may also get damp in the cockpit on warm "sweaty" days and should be put somewhere safe to air.

Emergency parachutes in gliders are lifesaving equipment and should be serviced in line with manufacturers requirements and referred for service whenever exposed to an event that introduces doubt as to the integrity of the emergency parachute. This may include exposure to moisture and concerns about harness or fastener integrity.

Warn the trainee to avoid accidentally pulling the D-handle as they put it on – it helps to put the left arm in first. The handle should be in the holder, and the Velcro should be in good condition. Attach the legs straps first in case of accidental deployment in windy conditions. If the chest strap is connected without the leg straps, the strap can rise up and potentially drag the person across the airfield with the strap around the neck. Adjust it so that it is a comfortable fit.

Very few gliders/parachutes in the UK utilise a static line system but as an instructor you should understand and explain how they work. The principal risk is accidental deployment if getting out without disconnecting the static line.

(iii) The bail-out procedure

Encourage your pupils always to get out of the glider with their parachute on, so that in the event of a bail out they do not undo their parachute straps as well, in a panic.

The trainee needs to be shown how to jettison the canopy in an emergency, but equally, how to avoid jettisoning it on the ground when they get out. If the canopy jettison is wire locked, it should be with a single twist in the wire. It is well to check that no-one has put a cable tie or other extraneous fixing that will prevent the canopy jettisoning if needed. Ensure you advise your trainee that in the event of the need to bail out, you will precisely state 'Bail out Bail out' or something similar that makes the order unambiguous. The drill for pulling the ripcord is to 'Look, find, pull' – although it sounds obvious, in reality, people may forget to look first.

The sequence for an emergency bail-out is:

1. jettison the canopy
2. undo the straps
3. get out of the cockpit and, when clear, deploy the parachute.

If the straps are undone first, there is a danger of falling against the locked canopy and being unable to open it.

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(iv) landing guidance

Even emergency parachutes may have steering toggles but, if not, you can still steer to a degree by pulling on either riser above the shoulder. Ideally steer into wind, especially when landing.

Emergency parachutes have a rapid deploy system, but the landing may be hard. The advice should be to keep the feet and knees together with the knees bent, and NOT to try to avoid falling over on landing. If they can remember to turn their feet at an angle to the direction they are travelling and, as they reach the ground, should allow themselves to roll to the ground from feet, along the legs, around their back and onto the other side whilst keeping their elbows in; this will help to avoid injury.

If there is any wind the canopy will remain inflated and try to drag the individual across the ground. The only effective way to collapse the canopy is to grab the lower set of parachute lines and pull them towards you. This will pull the lower part of the canopy towards you and spill the air out of it. Keep pulling in the canopy until you can lay on it to prevent it from reinflating. Once the canopy is under control the harness can be released – do not forget the chest strap before the leg straps!

(ii) Other system failures & responses

Instrument failures

ASI failures – these are not uncommon. They may be due to a kinked tube or blocked static or pitot tube – usually caused by water or insects. The ASI may under read or read zero. Remember to fly the glider by attitude, be aware of symptoms of the stall, too fast on the approach is better than too slow but allow plenty of room ahead. Continue any launch to a sensible height to give time to assess the situation and then land as soon as safe to do so and resolve the problem.

GPS failures

Religiously following the GPS without maintaining an awareness of location will create an issue if the GPS fails. See chapter 17b for 'uncertain of position' procedures.

Control surface failures and Mid-air collisions

Remember: FLY the glider, assess what has happened, make a plan.

If the glider is 'falling out of the sky' a bail-out will clearly be the only option. Otherwise pause and try to analyse what is happening. There have been circumstances when a failed trimmer has been mistaken for loss of elevator control.

A rudder failure may cause the rudder to be locked over to one side. Airbrakes jammed open, or worse still a single airbrake jammed open will require an emergency landing in the middle of the biggest landing space available. Think if a mayday call is possible/helpful. Do not forget that a call on 121.5mHz will get a response.

Personal Locator Beacon

Personal locator beacons (PLB) are relatively low cost distress radio beacons that help to detect the location of the PLB while in distress. Personal locator beacons now feature GPS using the dedicated 406MHz frequency. Operated by the pilot in an emergency, a PLB transmits the precise GPS location to the global network of search and rescue satellites. Owners of PLBs are reminded of the need to register and maintain the PLB.

Sailplane Air Operations requires the carriage of a PLB or ELT (emergency locator transmitter) when flying over water or over land areas where search and rescue would be especially difficult, such as remote mountainous areas.

Open canopy on launch

Unlike airbrakes, an open or opening canopy is immediately apparent and highly alarming. If an alarmed glider pilot becomes distracted from their first priority to fly the glider, then a tug upset may follow if on aerotow, or a stall off a winch launch.

In the event of a canopy opening or partially opening **on aerotow**:

- If not at a safe height, continue to maintain position behind the tug, even with the canopy open.
- When, or if at a safe height, release immediately, slow down and if possible, sort the canopy out.

On a winch launch:

- Continue the launch. Do NOT release immediately otherwise you will be giving yourself a second, unnecessary emergency.
- Lower the nose to the normal attitude, fly the glider and, if possible, sort the canopy out.
- Prioritise flying the glider and land.

REMEMBER – the further you are away from the ground, the more time you have to deal with the problem!

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3 PREPARATION FOR FLIGHT

SPL syllabus: Exercise 3 Preparation for Flight			
(i)	**Pre-flight briefings**	**(v)**	**Pre-flight external and internal checks**
(ii)	**Required documents checked and on board as required**	**(vi)**	**Verifying in-limits mass and balance**
(iii)	**Equipment required for the intended flight**	**(vii)**	**Harness, seat or rudder pedal adjustments**
(iv)	**Ground handling, rigging including connection of control surfaces, movements, tow out, parking and security**	**(viii)**	**Pre-launch checks**

INTRODUCTION

Flight safety is always of paramount importance, but it is sobering to look at how many accident reports include failure of adequate preparation prior to the flight as contributory factors. Distractions and/or hurried processes are common. The objective is that the trainee should not only understand the process, but carry it out with diligence, in a calm, unhurried environment. It may be helpful to introduce the concept of a 'sterile environment' i.e. no-one is allowed to interrupt or distract an individual whilst undertaking key functions such as rigging or pre-flight checks. Making cultural changes like this take a concerted effort of both education and repeated re-enforcement.

The individual

Gliding requires full concentration, so it is essential that an individual is mentally and physically fit to fly. Learning and instructing can be even more stressful. The CAA IMSAFE checklist, (also on the BGA website) can help judge whether you should be flying on a given day. Do not put other people at risk by ignoring the signs that you are not in a fit condition to fly.

The instructor needs the appropriate valid instructor rating and to comply with the current medical and recency requirements. Ensure the trainee is aware of the medical requirements to fly solo.

Briefings

There is a legal obligation to brief any passenger – trainee or otherwise, to cover normal and emergency procedures. (CAA Sailplane rulebook SAO.OP.110)

As a minimum this covers:

- straps
- emergency canopy opening
- parachute; oxygen dispensing equipment and any other emergency equipment provided for individual passenger use.

From an instructing perspective, a well-planned and prepared flight should cover a pre-flight briefing to include the aims of the flight, as well as key instructions such as handover procedure *'I have control/ you have control'* etc, and TEM discussion.

Glider preparation and documentation

There are certain legalities contained in BGA and CAA operational procedures that apply. As the pilot in command (PIC) you are responsible for ensuring the glider complies with these.

- All clubs are required to keep logs/flight-time sheets as an accurate record of the club's flying operations.
- The glider must comply with the relevant airworthiness requirements and have appropriate insurance.

Up to date information about documentation to be carried can be found in the CAA s Annex II, Sailplane Rulebook section *Air Operations*, specifically SAO.GEN.130 and SAO.GEN.155. The regulations allow for documents be retained at the aerodrome or operating site for flights: (1) intending to remain within the sight of the aerodrome or operating site; or (2) remaining within a distance or area determined by the CAA. (This is currently considered to be the UK.)

If flying out of glide range, an up-to-date chart clearly marked with controlled and regulated airspace must be carried in the aircraft.

If the glider has been rigged that day, independent rigging checks must be carried out and documented in the DI book. This must include positive control checks.

The daily inspection (DI) must be carried out diligently, by an experienced and trained individual. By the time they complete their bronze certificate or SPL, the trainee is required to be able to undertake a DI. It is logical that by the time they go solo they should have been trained to do this. After all, as the pilot in charge of an aircraft, they are responsible for ensuring the aircraft is safe to fly. There is no requirement to be a qualified pilot to be trained to do a DI.

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However, exactly when you and the club are happy to sign off an individual after appropriate training, will depend on their background and previous experience. As example, engineers might be expected to develop the skills more quickly than youngsters with relatively little experience.

It is helpful if the club teaches a specific system DI process, so that trainees do not get confused by different systems taught by different instructors. Using the pre-take mnemonic is common, but not mandatory. Although a generic system can be used, the Flight Manual should be checked for any specific requirements for that aircraft.

The objectives of the DI are:

1. to ensure the aircraft is correctly rigged and serviceable
2. to identify and document defects
3. to comply with the maintenance schedule.

Examples of what might constitute a defect include:

- Actual failure: cracked, broken or deformed materials e.g. glass/carbon fibre, wood, plastic or metal.)
- Deterioration (e.g. rotten wood, brittle fabric, rusty steel) and/or excessive wear, looseness or lack of lubrication.
- Incorrect assembly, wrong adjustment or actual loss of a particular part.

Diligence in reporting defects is important. Having a robust system in place to identify and act on defect reporting is an essential part of the safety culture.

The Daily Inspection (DI) book

BGA laws and rules state that:

'All gliders operated from BGA club sites shall be inspected before flying on each day and that…(they) must be inspected by club approved persons who must sign that the glider is serviceable before it is flown on that day.'

The BGA strongly recommend that details of work done, and defects found should be recorded in the aircrafts' DI book. On completion of a Daily Inspection, the person carrying out the inspection must complete and sign the (DI) book, signifying that the task has been completely and correctly carried out and the aircraft is 'Serviceable' (S) or 'Unserviceable' (U/S) Any minor defects must also be entered in the DI book.

If a defect or condition is found that has rendered the glider not fit for flight, then an 'Unserviceable' (U/S) entry must be recorded in the DI Book.

Fuller details of the recommended procedure for DI can be found in Chapter J.

Before the glider is parked at the front of the launch queue, make sure the trainee can get comfortably seated and strapped in. They need to be able to adjust the rudder pedals as required and easily be able to reach all the controls, including the cable release. Is a seat back required or better removed? Common issues are ergonomic problems such as not being able to get full extension of the airbrakes.

Note: Energy absorbing cushions under pilots are essential unless the pilot cannot fit with them. Any cushions or packing behind the pilots must be non-compressible. Compressible cushions are potentially dangerous, because:

- *If the packing compresses during the initial take-off acceleration of a winch launch, the pilot may slide backwards and be unable to reach the release or other controls. Instinctively, the pilot may try to stop themself from sliding backwards by pulling hard on the stick. The moment the glider becomes airborne it will pitch up rapidly and there is a very real danger of it stalling and flicking.*
- *in the event of a heavy landing, they increase the likelihood of the pilot sustaining serious injuries.*

Walk round checks

The BGA recommends a walk round check before flying. This is because some time may have passed since the DI and rig check and things change - for instance damage may have occurred during towing out or the glider may have been interfered with by unwitting individuals whilst left unsupervised. Better to pick up a problem before you pull on-line, than miss something because you do not want to hold everyone up. If the trainee is not trained in a culture where these checks are routine, they will not build it into their own routine as a solo pilot.

ABCDE checks:

Airframe - Look for anything unusual or that may have happened since the DI. Include: soft tyres, damaged trailing edges or control surfaces etc. no signs of damage.

Ballast – has the previous pilot put ballast in? Remember water ballast in the tail. Check that the pilot can meet the ballast limits.

Controls – all still connected and moving in the correct sense – you probably can't see the elevator once you are sat in the glider.

Dollies - check the tail and wing dollies have been removed.

Environment – a last look at the sky/wind for weather changes that may affect the launch or early stages of flight. (e.g. low cloud.) and any other potential issues affecting the launch.

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Pre-flight checks

Pre-flight checks are often the first piece of 'homework' we give to trainees. Learning them gives an early sense of achievement and builds the concept that safety matters. They should be thorough but concise and undertaken without distraction. If interrupted, go back to the beginning. A recent review of accidents/incidents showed more than half involved aircraft on an instructional flight and of those a significant number involved failure to adequately check canopy or brakes

Controls: Once **both** pilots are strapped in, move each individual control slowly and smoothly to the limit of its travel, to check full and free movement.

Ballast: Check that the glider will be flown within the placarded weight limits. (For early solo or conversion flights ensure the pilot(s) are at least 13kg/30lbs over it.)

Check should also include water ballast if appropriate; is the CoG still within limits? Is the glider within other loading limitations?

Straps: Ensure lap strap is over the pelvis and as tight as possible and shoulder straps are pulled down. Check for a 5th strap. The trainee's check should include checking the rear seat pilot is properly strapped in.

Instruments: Check set the instruments to zero or as appropriate. Check they are reading correctly and that the glass faces are not cracked or broken.

Check the correct operation of any electrically powered instruments and on as required. Check radio on as required to correct frequency.

Encourage the trainee to always make a mental note of the panel position of critical instruments like the ASI. So, they identify quickly in the event of a launch failure.

Flaps: Identify whether fitted. If fitted, set for take-off.

Trim: When setting the trim, take account of the type of launch and conditions.

For a winch launch the trim lever should be set for approach speed - usually a little forward of neutral. Further forward in strong wind conditions.

For aerotow, set for anticipated aerotow speed. These initial settings can only be estimates of what is required, so re-trimming may be necessary later.

Discourage trainees in the early stages of training from trying to re-trim shortly after take-off as this can lead to Pilot Induced Oscillations.

Brakes - Checked on both sides, above and below the wing making sure they close together. Locking is critical, make sure that the over-centre lock is engaged.

Eventualities

As a minimum:

- Hand on the yellow knob to release immediately if the pilot is unable to keep the wings level.
- Procedure in the event of a launch failure: in particular the brief to lower the nose to the recovery attitude and wait for the nominated speed.
- A look round for any last interruptions or potential complications to the launch (wind changes/personnel in the launch area etc

It is NOT the time for a re-brief, so keep it short and to the point.

Canopy

Canopy closed and locked including a physical check with upward pressure on the canopy **frame.** Close the DV panels before take-off. In a two-seater both pilots should verbally confirm that their *'canopy is closed and locked.'*

Note: Interpreting the weight and balance can be complex, so explaining the weight placard for the glider is best done as part of the pre-flight briefing, rather than whilst sat in the glider about to launch. After a few flights, the trainee should be encouraged to read and interpret the placard weight limitations and remind themselves of key the speed limitations before the launch

Be vigilant when a trainee first flies solo, as they may need ballast that was not needed when flying dual. It can be challenging to keep concentrating to check that the pre-flight checks are done thoroughly when you are on the 16th flight of the day but taking off with an open canopy or worse could be the consequence of not monitoring it properly.

TEM

Threats:	**Mitigation:**
Distraction	Interruptions during rigging, DIs and pre-flight checks are unacceptable. If interrupted, go back to the start and repeat the checks.
Errors:	
Incorrect and ballast	Check trainees' understanding of weight and balance placard, ensure ballast appropriately fitted or removed

Ground handling

A significant part of the insurance we pay is due to ground handling accidents. In our enthusiasm to get our trainees airtime, it is easy to overlook the importance of the ground handling aspects. A dedicated teaching session is extremely worthwhile. Using aspiring instructors to undertake this (properly trained in what to deliver) can be a useful exercise for both parties. A ground-handling progress card, such as the example on the BGA website, is useful to ensure all areas are covered. Written information such as club handbooks, or

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better still videos, help ensure a consistent and thorough approach.

Key areas:

- General airfield safety – including winch cable and hardware hazards, aerotow rope hazards.
- Moving aircraft by hand: where to push, pull or lift, which wing to hold – who is steering and 'changing wing' drill.
- Canopies – how to handle, fragility, how to open, close and lock. How to keep clean and where cleaning equipment is kept.
- How to do positive checks.
- Batteries – charging and **safely installing** in the glider
- Parking gliders – which wing down, orientation to wind and picketing methods.
- Towing gliders - who can drive the vehicles, procedures, hazards etc – (especially down slopes) and lookout.
- Hooking on gliders - weak links checks, which hook to use etc.
- Lookout and signals for the launch - who can shout 'stop' and why, what to do – or not do.
- Wing running how to run the wing, hazards, e.g. wing tip loads.
- Retrieving cables safely.
- Powered aircraft safety issues – incl. propellors.
- What to do in an emergency.

Most clubs should and do have policies covering most of the areas above, so it is beyond the scope of this manual to cover them in further detail.

Fuller details about general aspects of ground handling can be found in chapter I.

4 – INITIAL AIR EXPERIENCE

SPL syllabus: Exercise 4 Initial air experience

(i) Area familiarisation

(ii) Lookout procedures

INTRODUCTION

The objective of a trainee's first flight is to familiarise them with being in the air, with the area around the airfield, and to draw their attention to safety and lookout procedures. The instructor also has to analyse the reactions of the student.

There may be subtle differences in how this exercise is conducted, depending on whether it is a first flight for a trainee who is committed to learning to glide, or for a member of the public taking a gliding experience with no fixed intention of carrying on with the syllabus. The key points about safety and familiarisation are the same in either case, but the theory briefing component will be different for a member of public having a First Flight. See the 'First Flights' section of Chapter F – Supervision. The rest of this chapter assumes we are dealing with a trainee on the first step of their training programme.

Most people are a bit apprehensive before their first flight, however much they want to learn to fly. If they seem nervous, let them know that is perfectly normal and that if they are uncomfortable in the air and want to land, they should simply let you know. Explain that most people take a while to adapt to the sensations of being airborne – varying G forces in particular – and that they will almost certainly get used to it. A first flight should be carried out in benign weather and should be quite short. As well as learning to find the airfield and to look out properly, they should enjoy it.

THEORY BRIEFING

The briefing points to cover are:

- How to find the airfield from the air.
- The need for lookout.
- The correct technique for lookout.
- The protocol for changing aircraft control.

Area Familiarisation

The first flight will be local to the airfield and part of its purpose is to enable the trainee to locate and identify the airfield from the air. The glider needs to remain within easy gliding distance of the airfield throughout this flight and this is the first introduction for the trainee to the situational awareness skills needed in all their flying. The wind strength and direction may make a difference to what is 'easy gliding distance.'

A chart or image of an aerial view of the airfield and surrounding area is useful for the trainee to examine before take-off. The instructor can use this to point out local features, readily visible from the air, which will be used to help the pilots orientate themselves in flight.

If there are particular hazards near the site, such as nearby airspace, or terrain that causes curl-over in certain winds, – these should be pointed out and guidance given on how to deal with them e.g. 'Stay this side of the motorway and you know you are clear of airspace' or similar. The trainee will understand such information better later in their training, so this briefing is likely to be repeated more than once as they progress.

Lookout

Lookout is of paramount importance. Pilots need to understand and learn the practical skill of how to carry it out effectively.

The need for lookout may seem so obvious as not to need explanation but bear in mind that most people new to the sport have no concept of how close gliders sometimes fly to each other. Whilst it is good to be able to point out gliders in the distance in various directions, it is absolutely *vital* to make sure the vicinity immediately around you is clear **before** manoeuvring, and to continuously monitor gliders flying nearby.

Emphasise the significant threat if a glider remains in the same position in the canopy, even if it may be at some distance – this means it is on a direct collision course with you. Explain that such a glider may seem small and distant until it very rapidly 'blossoms' to full size as the collision is imminent.

There are blind spots behind and under the glider, and pilots must avoid flying in another glider's blind spots.

The technique for effective lookout is something that must be learned and practised. A rapid scan with no pauses will miss objects; the trainee must learn to pause and focus during the scan before moving on. They need to be able to do an effective scan quickly, and this takes a lot of practice. The scan cycle will be introduced more formally at Exercise 7, Straight Flying, and training on electronic conspicuity will also be given, but right from the first flight the emphasis must be on scanning the whole field of view, pausing from time to time to focus on the horizon and look above and below it.

There is more guidance available on lookout in Chapter D.

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Transfer of Control

The protocol for transferring control should be described: 'I have control' 'You have control.' and vice versa. It is important to know which of you is flying the glider. The instruction to 'follow through' indicates that you are flying but you want them to feel what you are doing. Explain that they should lightly hold the stick. Stress that when you have given them control, you are *not* interfering with the controls – and make sure you don't (unless it is an emergency and you don't have time to say 'I have control' first). Also explain that they must release the controls immediately whenever you say 'I have control' – this habit should be formed early in training.

AIR-EXERCISE BRIEFING

Immediately before flight, remind the trainee of the key points to be covered: landmarks to help find the airfield, lookout procedures, and control handover.

If the trainee has not already been introduced to *Threat and Error Management* (TEM) this is a good opportunity. See Chapter B The table below shows the considerations for Exercise 4.

TEM

Threats:	**Mitigation:**
Collision	Lookout!
Adverse student reaction	Monitoring by instructor
	Cutting flight short if necessary
	Guarding controls
Errors:	
Getting out of gliding range or losing sight of the airfield	Familiarisation with local landmarks
Confusion over who is flying	Precise control handover

The points in the TEM table about adverse student reaction are very important but are for the instructor to consider privately. If this is the first time someone has flown in a glider, neither they nor you can tell how they may react, and you must monitor their behaviour and be ready to take control or curtail the flight if necessary. If they are nervous, or start feeling ill, or they may be unable to respond to instructions. They may move the controls clumsily or inappropriately. If the instructor projects an air of calm, cheerful competence, the student is more likely to relax.

If the flight is to include another exercise, such as Exercise 5, Effects of Controls, this would be briefed at this point.

THE AIR EXERCISE

Once airborne, start with the lookout procedure. Remind them how to do it and check that their head and shoulders move as they scan the whole field of view. You will need to remind them from time to time during the flight, that they need to be keeping a good lookout all the time, as well as every time they manoeuvre the glider.

To help you monitor the student's lookout, it helps to ask now and then, how many aircraft they can see. This helps you assess whether they can spot gliders well enough. Being able to pick out a white aircraft against a cloudy sky is a skill that improves with practice. At every appropriate point, emphasise the dangers that were briefed: gliders that are close to you and gliders on a collision course.

Do not let the trainee start a manoeuvre without looking out first. Take control to prevent the manoeuvre and ask them if they know why you did.

During the flight, point out the local landmarks that were briefed, and how they help you locate the airfield. Note the landmarks that keep you out of airspace or other danger areas, if applicable. Try asking the trainee at if they can point to the airfield, to start developing their situational awareness. If there is any noticeable wind you can point out that you are keeping the glider comfortably upwind and never letting it drift too far downwind.

During the flight, monitor your trainee's behaviour and whether they are enjoying the flight and absorbing the lesson.

DE-BRIEFING

After their first glider flight your student may be excited and want to chat about how wonderful it was – obviously, this is to be encouraged.

The lesson points to check are that they can describe the landmarks that help them orientate themselves in the air, that they can describe the procedure for lookout, and that they understand the importance of maintaining a good lookout. If they did well, tell them so, but explain that they will get steadily better at lookout and situational awareness with more practice.

COMMON DIFFICULTIES

Forgetting to maintain the lookout while flying. Beginners need frequent reminders.

Airsickness. Many people feel queasy at first, especially in turbulence or thermalling (avoid prolonged thermalling on a first flight) but most of them acclimatise after a few flights.

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5 – EFFECTS OF CONTROLS

SPL Exercise 5: Effects of controls			
(i)	**Look-out procedures- see chapter d**	(v)	**Relationship between attitude and speed**
(ii)	**Use of visual references**	(vi)	**A. Effect of flaps (if available)**
(iii)	**Primary effects when laterally level and when banked**		**B. Effect of airbrakes/spoilers**
(iv)	**Reference attitude and effect of elevator**		**C. Effect of undercarriage (if retractable)**

INTRODUCTION

These exercises introduce the trainee to the three primary controls, their names, location on the airframe, and their effects.

Skills taught in the first few lessons set the scene for the trainees' future flying career. Flying faults that develop in the early stages of training can be difficult to rectify later.

Whilst part of Exercise 5, it is recognised that the effect of airbrakes, flaps and retractable undercarriages are likely to be covered some while after those of elevator, aileron and rudder. Therefore, they are covered in separate sections of this chapter.

INSTRUCTING CONSIDERATIONS

As an instructor it is important that you understand the following teaching points and some of their implications for all demonstrations and exercises:

Trainee '*follow through*'

- the trainee **must use the right hand** with the stick held in a light grip between thumb and fingers. Check on the first flight, whether your trainee is right or left-handed and advise them as necessary. Many trainees' idea of a *light grip on the controls* is either so light that they usually let go of the stick the moment it moves, or occasionally so rigid that you find it difficult to move the stick at all.
- in following through, the trainee learns how far to move the control, at what rate, and in what direction, but NOT the forces involved.

You have control/I have control

The importance of the words *You have control/I have control* cannot be over-emphasised. Right from the start it is vital that trainees establish the habit of releasing the controls when asked to do so. It is equally important that the instructor does not keep the hand on the controls whilst the trainee is on the controls, unless and until the instructor needs to take control again. The instructor should 'guard' the stick as necessary to be able to take control instantly, in some situations.

When you use the words *You have control*, the trainee should answer *I have control* (exactly those words). When you know they have control, take your hands and feet off, unless you have specified something else, e.g. *You use the ailerons while I coordinate with the rudder*. Similarly, when you say *I have control*, make sure the trainee replies *You have control*, and then lets go. In rare cases where the trainee seems determined to hang on regardless, an established form of words and the related automatic actions can get the message through where other methods do not.

The instructor interfering with the controls, either covertly or overtly, when the trainee has been told *You have control,* is at best, a waste of their time and money, and at worst, downright dangerous. They gain the wrong impression of the pressure that needs to be applied to the controls, and/or a false idea of what the glider does in certain circumstances. Years later, when you are not around to help, your previous 'assistance' could kill them. If you find you tend to interfere with the controls, fold your arms, except of course when close to the ground or other gliders.

Clear demonstrations

While you do not want to upset your trainee, most of the demonstrations in this chapter should not be done too gently. The movement of the stick should be 'clean' and 'obvious'. If you demonstrate something using tiny movements of the controls, your trainee may not make any connection between what you did (or said you did) and the glider's response.

Avoid obscuring the effect you are trying to demonstrate by inadvertently adding other movements, particularly in rough air.

Keeping in range

As obvious as it may sound, it is easy to fly out of range of the airfield while demonstrating something or monitoring trainee practice. Stay within gliding range, and organise demonstrations and trainee practice so that, as height is lost, you manoeuvre progressively back towards the airfield.

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THEORY BRIEFING

The Theory/Classroom Briefing for Effects of Controls should include:

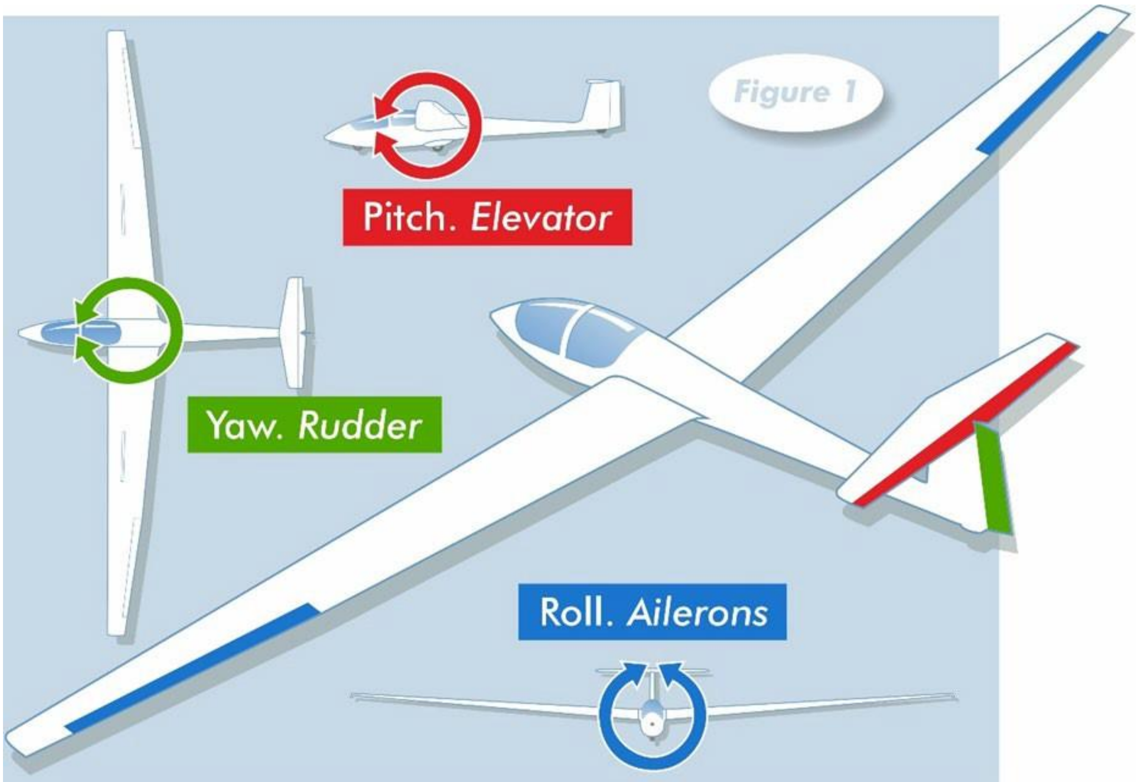
- an introduction to how an aerofoil works
- introduction to the terminology and concept of axes and the rotation around them by pitching, rolling and yawing
- how the elevator, ailerons and rudder achieve this.

It is prudent to mention that the elevator is usually the most responsive and sensitive of the controls and that the force required to operate all the controls vary with speed and glider type.

Elevator – When the elevator is moved down by moving the stick forward, the increase in lift at the tail lowers the nose, reduces the angle of attack of the wings, and hence the lift, and as a result the glider will fly faster. Moving the stick back reverses the effect, but only up to the point where the wing stalls.

Ailerons – the ailerons move in opposite directions. Moving the stick sideways will cause one aileron to go down, hence increasing the lift on that wing. The other aileron goes up simultaneously reducing lift on that wing. This causes the glider to roll. Whilst the stick is held to one side the aircraft will continue to roll further until the stick is brought back to the centre.

Rudder – the rudders effect is to counter adverse yaw and keep the aircraft flying accurately into the airflow. i.e. increasing lift on one wing will increase drag on that wing and hence cause a yawing movement. Using the rudder can counteract this force. The yaw string enables the pilot to assess the amount of yaw.



PRIMARY EFFECTS OF CONTROLS

AIR EXERCISE BRIEFINGS

AIR EXERCISE BRIEFINGS

Note: Demonstrating effects of controls in very rough air will be of no benefit to the trainee because they will not be able to detect the move you are demonstrating, if the controls are twitching about just trying to keep the glider level.

- Prior to the flight, confirm that the trainee has had the appropriate long briefing and ask some questions to check their understanding.
- The trainee must understand the control handover i.e. 'I HAVE CONTROL' 'YOU HAVE CONTROL' and 'FOLLOW ME THROUGH' and what is expected of them.
- Remind them what pitch, roll and yaw are, which controls affect them and how they operate those controls.

↑ Contents

TEM

Threats:	**Mitigation:**
Collision	Maintain thorough Lookout
Errors:	
Running out of height for appropriate circuit	Monitor height & position

The Flying

Before flight:

- ensure the trainee is correctly strapped in, comfortable and can move the controls fully without straining. Sometimes, poor progress in flying can be traced to poor seating and restricted control movement especially with very short or tall individuals.
- Ensure they hold the controls correctly, not too tight a grip or so loose that when following through they let go and that they have feet properly on the rudder pedals.

Remind the trainee that being in the air requires a good lookout and that they should be always helping you with that.

The demonstrations should be un-hurried, with clear positive movements and say the patter just ahead of the movement so the trainee can see action and reaction. Give the trainee time to notice the effects under consideration and repeat the demonstration if they appear unsure.

Adopt normal gliding attitude whilst pointing in the most useful direction (normally into wind). Considering the height available, start the exercises you can comfortably fit in, taking care to maximise time for each exercise.

For each of these exercises ask the trainee to follow through for the demonstration.

PRIMARY EFFECTS OF CONTROLS

Elevator

MANOEUVRE DEMONSTRATION

Elevator – Settle into the normal gliding attitude and trim the glider accurately.

Ask them to note where they see the horizon relative to the nose of the glider: this is the normal gliding attitude. It remains constant.

Move the stick forward to show a definite change of attitude and speed. Point out that the glider is in a new attitude and that the airspeed has increased. You may notice that the airflow over the glider gets noisier.

Then raise the nose above the normal attitude pointing out that there is less ground in view, it is quieter and the speed decreases.

Return to the normal attitude, pointing out that it is the normal attitude, and that the speed has returned to its previous value.

TRAINEE ATTEMPT

Handover control to the trainee. Make sure they confirm that they ‘have control’

Prompt them to move the stick forward to the desired attitude.

Then prompt them to move it back to return to the normal attitude. They may try this movement several times.

Ensure that you formally take back control and they confirm ‘you have control’ when they let go of the stick.

PRIMARY EFFECTS OF CONTROLS

Ailerons

MANOEUVRE DEMONSTRATION

Ailerons – Remind the trainee that the lookout must be thorough. First, look away from the proposed direction of turn, then as far round in the intended direction as possible. Ask them if they see any other aircraft. When certain that it is clear in the direction of the turn, the trainee should look back over the nose.

Show the trainee the normal picture with the wings level. It is possible to detect when the wings are level without having to look down each wing, by noting that the cockpit edge is symmetrical with the horizon. Demonstrate this by banking the glider both left and right.

Describe the movement of the stick to the right or left whilst rolling the glider to a bank angle of 20 to 30 degrees, (Use the rudder to eliminate adverse yaw, because you are only trying to show the bank angle). The aircraft will continue to roll until the stick is ‘centralised’ - normally slightly beyond the aileron neutral position, at which point the glider stops rolling, stays at the new bank angle, and continues to turn. A slight backward pressure to the stick is required to stop the nose from going down. This introduces the need for coordinated use of the elevator with the ailerons.

Now demonstrate how to return the glider to wings level. Lookout first to check no other aircraft are in the vicinity, then roll the wings level and explain that back pressure on the stick has to be relaxed when the wings are level. Point out that you have returned to the normal attitude.

TRAINEE ATTEMPT

Hand control back to the trainee.

Ensure they do a lookout before manoeuvring the glider. Let the trainee use the ailerons, turning two or three times each

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way, while you operate the rudder to maintain balanced flight. Make sure the formal handover is correct.

It is important that the trainee appreciates and understands that the glider will roll, and continue to do so, if the ailerons are not neutral. Allow limited practice at rolling into a turn, centralizing the stick to maintain the bank, then rolling out and centralising the stick to keep the wings level.

The use of outside references, looking over the nose, to check what is happening needs emphasising to avoid complications later in training. You as instructor should make sure the glider is properly trimmed, so there is no residual pressure on the stick when wings level flight is regained.

PRIMARY EFFECTS OF CONTROLS

Rudder – demonstration only

MANOEUVRE DEMONSTRATION

This exercise demonstrates to the trainee that the rudder is a yaw control: it does not turn the glider, i.e. with the wings held level, the rudder only swings the nose left or right and when the rudder input is removed the glider resumes its original heading. **The rudder is a yaw control** *(rudder left, yaw left, rudder right, yaw right).*

Remind the trainee to maintain a good lookout whilst manoeuvring the glider.

Identify an object directly up or downwind and fly directly toward it so the trainee can clearly see what you are demonstrating. The trainee should follow through lightly on the rudder, but with hands off the stick. This helps avoid any confusion as you will have to use the other controls to prevent the glider gradually rolling/pitching.

Apply rudder but keep the wings of the glider level using the ailerons, so that the glider's track remains along the chosen line. Draw attention to the fact that the glider is flying sideways but still moving in the same direction of travel – **not the direction it is pointing**. This may not be immediately obvious to the trainee.

Now centralise the rudder and allow the nose to swing back to the original heading. This shows the trainee that the rudder yaws the glider but does not turn it. This is a demonstration exercise only and it is not necessary for the trainee to try it.

DE-BRIEFING

In the debrief you will need to elicit responses from the trainee. To ensure that the main objects of the lesson have been learned. In this case they are: -

- Lookout.
- Handing over control 'you have control, I have control.'
- All attitude references (pitch and lateral) are outside the cockpit.
- The effects of the use of all the controls have been achieved.

COMMON DIFFICULTIES

Good lookout must be encouraged from the start, because rectifying lack of lookout later is very difficult, especially if the trainee is only concentrating directly ahead. It slows progress early on, but as muscle memory improves, when carrying out the lookout cycle, and confidence in the aircraft grows, a better and safer pilot will be the result.

The use of the controls by a trainee, can vary between overconfident, or too timid. Timid pilots need encouraging whilst over-confident ones need encouraging to use the controls more gently.

Some trainees may hold the controls too tight in the mistaken belief, that if you hold the controls very still the aircraft will not move. An explanation that the air is always in motion and job of the pilot is to guide the aircraft through it like sailor guiding a boat on an ever- moving sea, is a useful analogy. It sometimes helps to demonstrate that the glider will fly well hands off and the pilot is there to guide it in the required direction.

Stiff legs, due to tension, can be detected in the effect of the rudder exercise, because you will find the rudder extremely hard to move.

Ensure that left-handed trainees are using the correct hand on the stick, it will cause major problems later in training if not caught early.

Over-controlling can be lessened by encouraging trainees to fly with their forearm resting lightly on their thigh. Stick movement can then be made using wrist and/or forearm movements. Using the entire arm can lead to coarse and jerky movements. In this respect it is important that their seating position is correct before they take-off.

Hang-glider or weight-shift micro-light pilots who take up gliding come to it with an in-built set of control responses which are exactly the opposite of those needed to fly a conventional aircraft. To turn left, for example, a hang-glider pilot swings the control bar to the right, and to dive they ease it back. in an emergency, such as a cable-break, or any other occasion when the workload is unusually high, they may revert to their previous habitual response. The only way to replace the initially learned responses is by rigorous re-training.

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5B – EFFECT OF CONTROLS - AIRBRAKES & SPOILERS

INTRODUCTION

The aim of this exercise is to demonstrate the effect of opening and closing the airbrakes on the rate of descent, the attitude and airspeed of the glider.

- Effect of opening and closing airbrakes/spoilers on air speed.
- Changing sink rates on opening brakes/spoilers.
- Forces required at different speeds.
- Selecting the right lever.

THEORY BRIEFING

Airbrakes

The primary effect of airbrakes is to increase the drag on the aircraft. The amount of drag can be varied by the pilot, by adjusting the extent to which the airbrakes are extended. The effect is two-fold by adding drag and reducing lift. As an example, a K13 at 55kts has a glide ratio of 25:1, and with full airbrake deployed, this becomes 6:1, giving good approach control, enabling steeper approaches and shorter landing runs.

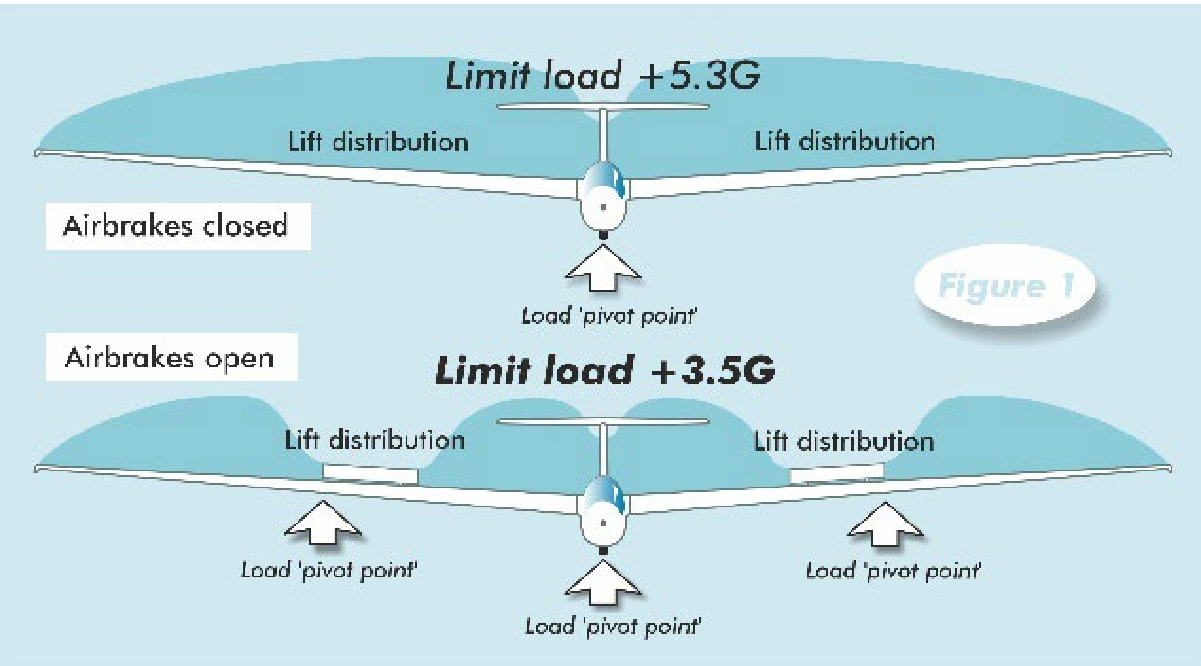
The drag is also speed sensitive, increasing as the square of the speed and this causes the glide angle to reduce considerably further with increased speed.

Trainees often mistakenly believe that you can control the speed on the approach by pulling more brake. It needs to be explained that the primary purpose of airbrakes is to control the rate of descent.

However, extending the airbrakes, spoilers or any other approach control device, will have the effect of changing the trim of the glider and the increase in drag will start reducing the airspeed. Therefore, the nose of the glider will need to be lowered to maintain speed, but the change of trim may be nose up or down. Therefore, any change in the airbrake setting will require a nose up or down adjustment to compensate.

The loss of lift when deploying airbrakes will increase the stalling speed, a consideration when choosing the minimum approach speed, or in the case of a balloon landing when airspeed may be low. At increased speed when operating the airbrakes, the forces on the lever can be quite high, sometimes sucking out violently once they are unlocked. Due to the positioning of the airbrake lever, it may not be possible to exert enough force to close them, so speed may have to be reduced to do so (a problem when landing in rough air with a strong wind to contend with).

An important aspect of opening airbrakes when pulling G is that the limits reduce from 5.3G to 3.5G for most gliders (those in the Utility class) due to the lift distribution curve on the wing being disrupted. A greater proportion of the lift is developed outboard placing greater strain on the wing structure. See figure 1.



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Spoilers

Spoilers, as the name implies reduce the lift, but do not produce as much drag as the usual airbrakes. They are definitely non speed limiting and the significant trim changes vary according to the design of the glider, some but not all, are spring loaded and close if the operating lever is released.

Other Approach Devices

Some gliders employ extreme flap deflection to increase drag. Some also have 'Top Spoilers' that are linked to the flap and lift ahead of the flap on the top surface when approach settings are used. This type of brake can be very powerful indeed. Many gliders have an approach setting for their flaps and also use conventional airbrakes. On some of these the flaps alone create considerable drag. An important point to remember if needing to reduce brake on approach, even with the brakes closed performance may be very poor.

They are very uncommon now, but many early glass gliders featured a tail parachute. Typically, these produce lots of drag, but as the only way to reduce that is to jettison the parachute, great care should be taken with their use.

Wheel brake

In some gliders, the wheel brake is operated by extending the airbrake fully, rather than having a separate control. In these cases, landing with full airbrake is not advised because if any yaw is present a ground loop may result.

AIR EXERCISE BRIEFINGS

The air exercise briefing should emphasise the safety requirements for the flight, as well as brief reminder of the main effect of airbrakes on rate of descent, as well as the effects on airspeed and trim.

TEM

Threat	**Mitigation**
Collision	Keep good lookout
Descending into traffic	Do not 'fall' into circuit
Error	
Running out of height	Monitor height & position

MANOEUVRE DEMONSTRATION

The demonstrations for this section are all upper air exercises. Approach control/reference point demonstrations are part of Chapter 12.

Trim the aircraft for the approach speed, relax on the stick and open the airbrakes, drawing the trainee's attention to any attitude/speed change, the increased sink (variometer) and any airframe buffet.

Then close the airbrakes and notice the attitude/speed change and reduced sink rate. Note that it takes time for the variometer to settle to the new value.

Next, demonstrate a simulated approach (trainee lightly on the stick) showing that a nose down attitude is necessary to maintain approach speed. And when closing the airbrakes show that a further adjustment is required to prevent speed increasing.

TRAINEE ATTEMPTS

Having demonstrated all the aspects above, whilst you maintain approach speed, get the trainee to open and close the airbrakes over the full range of movement and then lock them. This introduces the trainee to the need to maintain the attitude as the brakes are open or closed.

The trainee should then trim to approach speed, then open and close the airbrakes whilst maintaining the speed and finally locking the airbrakes closed. Encouraging progressive rather than sudden and large movements with the airbrake lever makes speed control easier to achieve. Draw attention to the changes of trim in addition to the changes in attitude.

A further exercise for the trainee is to open and close the airbrakes at higher speeds emphasising the need for care in opening them and the amount of force required to close them.

DE-BRIEFING

Highlight the parts of the exercise that went well and point out what should be included in their next flight, put an indication of that in their logbook and when appropriate an entry in the trainee's training record.

COMMON DIFFICULTIES

The main difficulty is that the Trainee will not be able to control the attitude as they open and close the brakes.

Considerable amounts of height can be lost demonstrating and practicing these exercises. An aerotow launch or thermals can be very helpful.

When operating the airbrakes, the glider will be out of trim making speed control more difficult. Some trainees require considerable practice before they are ready to use airbrakes on the approach.

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5A – EFFECT OF CONTROLS - FLAPS

INTRODUCTION

The trainee will need time to learn to fly the glider in a coordinated manner before being introduced to the effects produced by the use of flaps. In most cases this will be a post solo exercise since most two seat training aircraft are unflapped. Therefore, whilst this section is contained under the umbrella title of effect of controls this section must be given to trainees prior to transitioning on to a flapped aircraft which require an increased skill level to fly successfully.

Ideally training in a two-seat glider with flaps is given prior to conversion to a flapped single seat glider.

It is imperative that the instructor understands the flap characteristics of the aircraft being demonstrated and if a type conversion to a flapped single seater is planned, also the aircraft being converted to.

Read the flight manual of the aircraft being flown, learning on the job can be disastrous.

This chapter covers:

- Flap operation in both performance modification and in the landing configuration.
- Attitude changes.
- Speed monitoring for flap operation/changing.
- Maintaining approach speeds with high drag settings.
- Control effectiveness changes on take-off or landing roll.

THEORY BRIEFING

Aerofoil sections are generally a compromise between thermal flying and handling in landing configuration and the need to fly faster between thermals to achieve long distance flights in the best soaring conditions of the day.

To improve performance in all phases of flight flapped aircraft were developed. The most common type is the simple flap consisting of a moveable section of the wing which can be moved by the pilot from about minus ten degrees to plus forty degrees. This allows the pilot to alter the camber of the wing to increase the efficiency of the wing over a broader range. A few aircraft such as the Blanik use a fowler flap which also increases the area of the wing by having the flap extending rearwards from the wing. The simple flap is more appropriate for sailplanes and less complicated to manufacture and is most prevalent today.

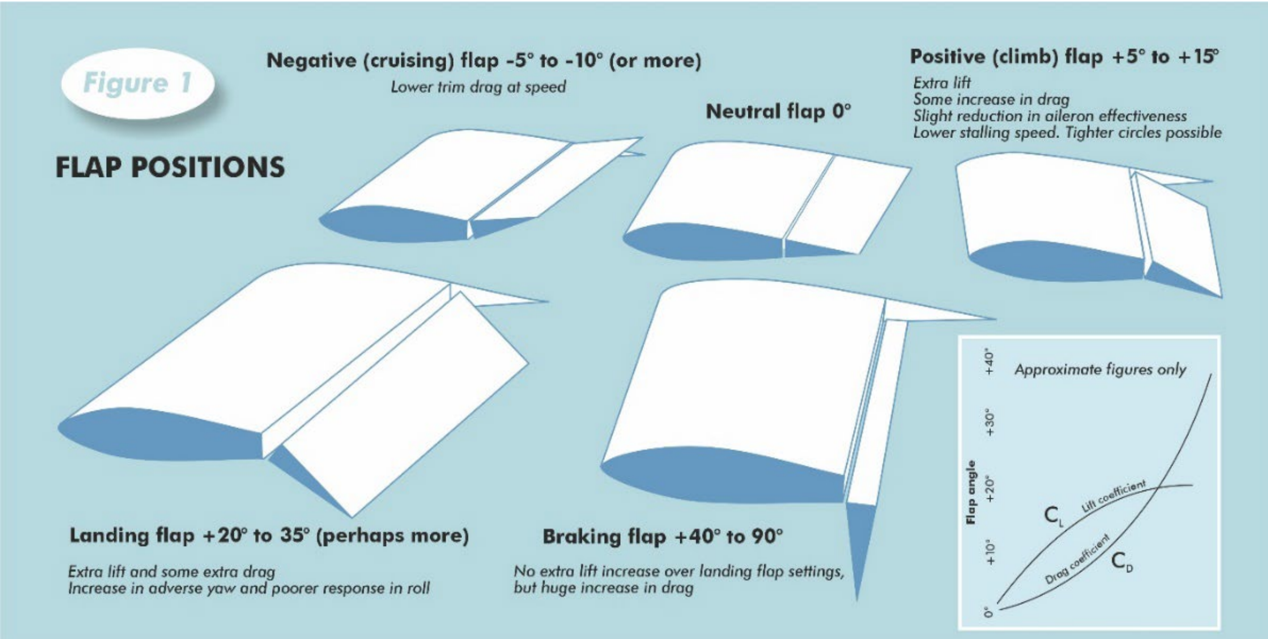
Small positive flap settings give lift increases with small drag increases. As positive flap deflections are increased the increased lift gets less and the drag increases noticeably. See the Cl and Cd graphs in figure 1.

Changes in flap settings cause trim changes altering both attitude and flight path. The more positive the setting the bigger the differences and speed control needs to be more related to airspeed than attitude i.e. similar to use of airbrakes.

Cruise/climb flap.

Cruise flap, often referred to as negative flap reduces drag and allows faster glide speed with little or no performance or handling penalty. **(The aircraft flight manual gives speed/flap setting limits)**

Climb Flap. Small amounts of positive flap (between +5° and +10°), reduce the stalling speed slightly depending upon the aerofoil section typically by about 2kts. With accurate speed control, climb flap allows slightly tighter turns in thermals and sometimes they give a slightly better minimum sink rate, useful when ridge soaring or in wave, but only with accurate speed control. It also allows slightly lower approach speeds.



Threat and Error Management

Threats:	Mitigation:
Collision	Maintain lookout
Errors:	
Running out of height for appropriate circuit	Monitor height & position
Inadequate speed on approach due to attitude change with flaps	Monitor ASI on approach

Even when used in small amounts the main drawback of positive flap is a slight deterioration in the handling. Adverse yaw increases, and rudder and aileron coordination are more difficult. Tip stalling and wing rocking can be irritating side effects. The roll rate is worse especially in larger gliders. Just to add insult to injury the glider will spin more readily.

Cruise/climb flap only has a beneficial effect on performance if used correctly.

Landing Flap

Landing flap is an extension of cruse/climb flap typically between +20 to +90 degrees depending on the glider type.

Landing flap produces a large amount of drag and can reduce the stalling speed by 3 or 4kts, allowing steeper approaches, slower touch-down speeds and shorter landing runs. The forward view on the approach is improved by the change in camber of the aerofoil giving the glider a markedly nose down attitude compared to normal flight. This gives a big difference between the glider's attitude and flight path therefore there is a tendency for the pilot to unconsciously raise the nose to a more familiar attitude with corresponding reduction in airspeed – **monitoring the airspeed using the ASI is paramount,** especially as the drawbacks encountered in handling in cruise/climb flap are increased markedly, increasing the tendency to drop a wing or spin on the approach. Limiting speeds with landing flap deployed can be surprisingly slow so accurate speed control is essential. The aircraft flight manual speeds must be adhered to.

Additional Considerations

The cockpit ergonomics vary considerably and flap, airbrake, trim, and undercarriage levers, are in different places on each aircraft. This coupled with cable release location can be a problem in nil wind take offs, when aileron control may be reduced if positive flap is needed to get the glider airborne before the Tug. The initial ground run may require negative flap to start with, for adequate aileron control, until sufficient speed has been reached to change to positive flap.

Check the flight manual for the specific glider for recommended flap settings for both aerotow and winch launching.

Any inattention whilst changing the flap setting may result in the cable having to be released to prevent an accident. The application of positive flap may cause a sudden increase in height dependent on the speed at the time of changing from negative to positive flap.

The Flying

AIR EXERCISE BRIEFINGS

Having carried out the ground briefing, the air exercise briefings will be limited to what is practicable on the day.

The take-off (aerotow) briefing should include flap settings for the ground run and initial take off emphasising the problems of changing flap settings whilst managing this difficult part of the flight. If speed is too high when changing from negative flap to positive there is a danger of the glider getting too high just off the ground and causing problems for the tug.

Briefing for winch take-off is easier and first positive flap setting may be appropriate so that, in the case of a launch failure, flap setting will not necessary need changing for landing. In nil wind, aileron control on a long ground run should be mentioned and zero flap setting can be more appropriate with the penalty of a longer ground run. This will depend on how powerful the winch is and therefore briefed accordingly.

Approach control exercises should be done carefully, and the briefing should contain speed limits necessary for full and landing flap configurations, also emphasis on aileron control problems causing wing drop on round out and landing run should be included.

MANOEUVRE DEMONSTRATION & LESSON

The demonstration of take-off and landing should be carried out by the instructor particularly explaining any flap movements that are necessary at the appropriate time. For the first lesson, do the launch yourself and use it as a demonstration.

Upper air demonstrations are not required but the opportunity should be taken to explore the characteristics of changing flaps setting, with regard to changes in speed and trim. When at height, get the trainee to carry out flap changes with nominated speed limits. Prompt the trainee to change speed and monitor the change in attitude and speed in various flap settings. They can also investigate the roll response in different flap settings at low speed.

Flaps must be appropriately set in the circuit. Types with modest landing flap deflections can be flown in that setting all the way from the high key area to landing. Types with large landing flap deflections cannot be operated that way. Application of the landing flap setting will normally be appropriate on early finals, or at the earliest, on the base leg. On the first flight, do the landing as a demonstration.

Approach demonstrations should use a reference point well into the field and the effect of reducing flap shown at such a (safe) height that, the effect of losing lift can be demonstrated more effectively than during upper air exercises, and recovery to appropriate speeds can be carried out safely. These demonstrations are more difficult in strong winds with significant wind gradient.

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When you are happy with progress, get the trainee to do an approach and landing with the reference point well into the field. Do not be afraid to take control if the approach is unstable as errors near the ground with reduced aileron control will be difficult to rectify.

Follow this with take-off training where aileron control may be a problem and changing from negative flap to positive at a crucial part of the will cause the highest workload. Unfortunately, single seat gliders have various ergonomic layouts and cannot be taught in advance so ensuring that the trainee is coping with the high workloads caused by flap changing is the best you can do.

DE-BRIEFING

Concentrate on any major problems and suggest any further practice necessary. Make a note in the trainee's logbook. As always, end on a high, pointing out the good parts and give some further encouragement.

COMMON DIFFICULTIES

Unfortunately, flapped two-seaters frequently have flap systems with significantly different characteristics to those of the aircraft to which the trainee intends to convert.

Not reading the flight manual!

It is a good idea for the trainee to share experience with other sensible/experienced pilots who have flown the glider. Lack of information and awareness of potential difficulties causes unprepared flight and there is enough evidence that poor preparation for flight, particularly type conversions, results in accidents.

5C – EFFECTS OF CONTROLS RETRACTABLE UNDERCARRIAGE

INTRODUCTION

Whilst most training two seat gliders usually have fixed undercarriages, most single seat gliders have retractable undercarriages. In the absence of a two-seater with a retractable undercarriage this exercise can be accomplished by a managed conversion to a single seater. (Chapter G)

THEORY BRIEFING

Retracting the undercarriage reduces drag and improves the performance of the aircraft. Most retractable undercarriages in gliders are manually operated, but a few are now being produced with electrical retraction.

Most manual undercarriages are straight forward and it's obvious how they work, but some have unusual movements of the handle which may not be obvious.

Electrical undercarriages can be complicated, and it is vital to understand not only the retraction and extension processes, but any emergency extension procedure that may be required if the normal procedure fails.

Read the flight manual of the aircraft thoroughly, learning on the job can be expensive!

The undercarriage should not be raised whilst launching. When aerotowing, distraction from flying the aircraft may result in a tug upset, with the associated serious hazard to the tug pilot.

AIR EXERCISE BRIEFING AND EXERCISE

Explain the mechanism and explain that as an upper air exercise they will practice raising and lowering the undercarriage several times. Remind them to avoid the distraction that the exercise generates and to always keep a good lookout. The pilot must properly conduct their pre-circuit checks to ensure the wheel is down for landing.

If conversion to a pilots first retractable undercarriage type is imminent, it can be useful for the trainee to try the undercarriage on the ground with the aircrafts fuselage securely supported on its fuselage rigging/trailer dolly. It is recommended that the pilot wears their parachute, sits on the required cushions, straps in and closes the canopy to ensure they can operate the undercarriage in the confines of the cockpit. Remind pilots that some undercarriages are forward for down and some work in the opposite direction – always check against the signage in the glider.

TEM

Threats:	**Mitigation:**
Collision	Maintain thorough Lookout
Errors:	
Running out of height for appropriate circuit	Monitor height & position
Failing to lower or lock the undercarriage at the end of flight	Conduct appropriate pre-circuit checks.

DE-BRIEFING

Discuss any problems that may have occurred and take the opportunity to remind the trainee when they should not retract the undercarriage and when it should be extended immediately before entering the circuit.

COMMON DIFFICULTIES

Not reading the flight manual and hence not understanding how the undercarriage will cause most problems, particularly with the more complex arrangements.

Whilst the trainee may be in the habit of conducting their WULF check, long familiarity with fixed wheel aircraft may result in them overlooking the need to lower the undercarriage.

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6 - COORDINATED ROLLING TO AND FROM MODERATE ANGLES OF BANK

SPL syllabus Exercise 6: Coordinated rolling to and from moderate angles of bank

(i) Look-out procedures

(ii) Further effects of aileron (adverse yaw) and rudder (roll)

(iii) Coordination of controls

(iv) Rolling to and from moderate angles of bank and return to straight flight

INTRODUCTION

All flying accuracy relies on good, coordinated flight, including straight flight, take offs, turns, and landings. Coordinated flying coupled with a good lookout starts from these first exercises and subsequent encouraging monitoring.

THEORY BRIEFING

Further effect of ailerons - aileron drag

This briefing may be helped by the use of a model. Include an explanation of basic aerodynamics to include the idea that increasing lift also increases drag, and conversely reducing lift will reduce drag.

Relate this to the motion of the ailerons i.e. moving the stick to the left raises the aileron on the left wing, effectively reducing the camber and therefore reducing the lift on that side. Whilst the aileron on the right wing goes down increasing the camber and hence increasing lift on the right side. The down going aileron creates increased drag on the right wing.

This effect causes adverse yaw, causing the nose of the glider to move the 'wrong way' to the direction of the applied bank. This can be corrected by applying rudder in co-ordination with aileron input. i.e. '**stick right rudder right – stick left rudder left.**'

Rudder – induced roll

If the rudder is applied on its own e.g. right rudder, the nose will yaw to the right. The left wing moves forward relative to the other wing, therefore generating more lift causing the glider to bank i.e. roll to the right.

AIR EXERCISE BRIEFINGS

These are upper air exercises. Remind the pupil about the secondary effects of the ailerons i.e. adverse yaw and secondary effect of the rudder i.e. roll. Check they understand the theory. Encourage and reinforce good lookout throughout the exercises.

TEM

Threats:	**Mitigation:**
Collision	Maintain thorough Lookout
Errors:	
Running out of height for appropriate circuit	Monitor height & position

EFFECTS OF CONTROLS

Secondary effect of ailerons

MANOEUVRE DEMONSTRATIONS & LESSONS

ADVERSE YAW AND COORDINATION - Demonstrating adverse yaw shows the trainee the secondary effect of aileron and why we need to use the rudder. Have the trainee follow through on both stick and rudder.

- *Have a good look out, particularly in the direction of stick movement then look over the nose.*
- *I am going to use the ailerons without using any rudder, I want you to tell me which way the nose moves first.*
- *Look what happens when I move the stick to the left without using any rudder*
- *Which way did the nose move? I wanted to go to the left/right, but what happened first?*

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Your trainee may be surprised, even puzzled, that the nose of the glider swung the wrong way initially. Most trainees will benefit from a second demonstration. Tell them what the effect is called and, briefly, why it occurs. Then demonstrate how coordinated use of the ailerons and rudder overcomes adverse yaw. Reinforce coordinated use of the rudder by making two or three turns and reversals without altering the heading by more than 20° or 30°.

The trainee should try two or three turns and reversals. The exact amount of rudder for accurate coordination is a matter of practice. Reference to the yaw string helps, though this is something else which the trainee may fixate on and forget everything else. The purpose of the air exercise is to give the trainee some practice in moving the stick and rudder together rather than independently, to achieve coordinated flight. It is also useful in teaching the trainee to recover from a banked attitude, which implies a turn, back to straight flight, this in turn makes it easier to teach turns in subsequent sections. Make sure prior to the flight that the nature of the exercise is understood, and that this is preparation for coordinated straight flight.

Remind the trainee that the first priority is always a good lookout before making any manoeuvre in flight. Refresh the trainee with the salient parts of each further effect of controls to be demonstrated, finishing with the statement. **Coordinated flight is achieved by using stick and rudder together.** Also impress on the student that the initial lookout before an exercise is to check that it is clear to proceed, and throughout the exercise the scan cycle is continued because things change quickly in the air.

EFFECTS OF CONTROLS

Secondary effect of rudder

MANOEUVRE DEMONSTRATIONS & LESSONS

Roll from rudder alone

In this part of the exercise having looked out again tell the trainee to look ahead and tell you what happens when you apply only rudder. Say 'I am moving the rudder to the left/right, tell me what happens to the bank angle.' Again, do it several times in both directions until the trainee appreciates what has happened.

EFFECTS OF CONTROLS

Exercise – rolling about a heading

MANOEUVRE DEMONSTRATIONS & TRAINEE ATTEMPT

Co-ordination

Demonstrate that if both controls are moved together the secondary effects of controls can be balanced.

Ask the trainee to identify a point straight ahead and follow through lightly on the controls. Apply stick and rudder together from one side to the other reasonably quickly and ask the trainee to tell you what happens to the position of the nose (It should not move).

If you demonstrate moving the controls out of sync, then ask them what happened to the nose position this time. (The nose should swing from side to side).

The stick and rudder should be used together as a final demonstration, repeating the coordinated part of the exercise. The trainee should practice the coordination exercise, with prompting as necessary.

MANOEUVRE DEMONSTRATIONS & LESSONS

Recovering to straight flight from moderate bank angles

Patter the recovery from a moderate banked turn (20 -30 degrees) and then recover to straight flight, then repeat in the opposite direction and back to straight flight, with the trainee following through.

DE-BRIEFING

Reinforce the point of the exercises and check your pupils understanding. Comment positively on good practice and give suggestions for improvement.

COMMON DIFFICULTIES

The major difficulty is usually over-zealous use of the stick compared to the rudder.

Tense legs will result in lack of movement of the rudder. When the trainee is 'following through' you will feel this because you will have difficulty moving the rudder.

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7 - STRAIGHT FLYING

SPL Syllabus Exercise 7: Straight Flying			
(i)	**Lookout procedures**	**(v)**	**Control of pitch, including use of trim**
(ii)	**Maintaining straight flight**	**(vi)**	**Lateral level, direction and balance and trim**
(iii)	**Flight at critically high airspeeds**	**(vii)**	**Airspeed: monitoring and control**
(iv)	**Demonstration of inherent longitudinal stability**		

INTRODUCTION

New instructors soon discover that flying straight is often trickier than turning. The ability to fly in a straight line accurately, impacts on the launch, circuit, approach and the landing. It involves the lookout scan cycle whilst trying to fly straight in varying weather conditions.

THEORY BRIEFING

Lookout Procedures

The trainee should already have been briefed on Lookout. See Chapter D. Do not allow concentration on the exercises to compromise the trainees' lookout. This is a good time to quiz the trainee's understanding of the lookout scan cycle and to re-emphasise that it should be a continuous part of the flying process.

Maintaining Straight Flight

To maintain straight flight, a pilot has to be able to detect deviations from the intended path as early as possible. Small frequent corrections should be made to keep the desired heading. Each correction will need coordinated input of aileron and rudder. Elevator input to maintain the appropriate gliding attitude may also be needed, especially if the glider has not been correctly trimmed.

Detecting changes to the flight path will be both visual i.e. the nose is moving away from a point identified on the horizon, and/or a wing is seen to go down, and/or physical e.g. a wing is felt to be pushed up. Being able to detect both these aspects is essential. If the aircraft appears to be level but the nose is gently traversing the horizon, there must be a small amount of bank present. This is corrected by the application of a tiny amount of aileron and rudder in the opposite direction to the direction that the nose is moving to roll the aircraft level.

Conversely, trainees often tend to 'over control' the glider early on and 'stir the pudding' rather than accept small movements of the air which do not cause a permanent displacement to the heading. They may need encouraging to 'just let the glider fly itself.'

Despite the trainee's best efforts, hands, feet and head can get 'out of sync'. Brief the trainee to bring all the controls back to neutral, wait for the glider to settle and then correct the heading with co-ordinated controls.

Inherent longitudinal stability

Gliders are designed to be stable in pitch – a combination of the effect of the tailplane being set at a different angle of attack to the main wings, combined with finesse from the trim tab. This should form part of a wider briefing on basic aerodynamics.

Control of pitch & use of trim

Attitude should be the prime reference for speed, and only glancing at the ASI to check after any disturbance has settled. The ASI only shows what the speed was, if attitude changes are still in progress.

Flying in trim is a good habit to acquire early in a pilots training. The instructor should check from time-to-time check that the trainee is trimming and re-trimming when appropriate.

The advantages of trimming:

- easier control of speed
- more attention can be paid to other important activities, such as airmanship
- easier to maintain attitude whilst thermalling, resulting in more accurate circles
- greater safety when speed is a critical, such as when in the circuit.

For those reasons, introduce trimming as soon as the trainee has successfully mastered the use of the elevator, and begun to appreciate the relationship between attitude and speed.

There are different types of trimmer, aerodynamic and spring and the pilot needs to be aware of the positioning and mechanism for a particular glider before flight.

The pilot should select the attitude to give the required speed, then keep that attitude constant whilst moving the trim lever to remove the load on the stick. Going faster requires a push load which is removed by moving the trim forward and vice versa. As soon as the load on the stick goes away, relax the hand, check the speed, then if required make further small adjustments. It is important to keep the attitude constant whilst trimming, no matter if the stick wants to move, so that the point at which the load on the stick disappears is apparent.

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Airspeed monitoring and control

The trainee should learn to monitor the airspeed indicator and, as soon as possible, be required to fly within specified airspeed limits. A steady airspeed monitoring is achieved by ensuring that the attitude of the aircraft is correct, then checking the ASI for confirmation. The frequency of monitoring is increased at more critical parts of the flight, such as on a winch launch or on the final turn and approach to landing. If the airspeed varies too much then the trim may be wrongly set, or the attitude is being allowed to vary. Watching the ASI too much and following the changes means the trainee is spending too much time with head in the cockpit.

Lateral Level direction and Balance and trim

The trainee needs to be able to determine whether the glider is in coordinated flight. The main glider imbalance detector is the yaw string. It must be correctly positioned (usually in the most sensitive area of the canopy) and readily observable to the pilot. It is very sensitive at indicating small errors.

Flight at critically high airspeeds

The pupil should understand the basic meanings of the flight limitation placard, including:

Va - the max manoeuvring Speed (VA) of an aircraft is an airspeed limitation determined by the aircraft designer. At speeds exceeding the manoeuvring speed, full deflection of any flight control surface can result in damage to the aircraft structure.

Vne – Velocity never exceed is the manufacturers designated speed at which structural failure or flutter may occur and must literally never be exceeded. Explain what Va and Vne mean and why they are important.

As speed is increased significantly, the controls become stiffer to operate, but small forward movement of the stick can quickly cause overspeed if close to Vne. If the forward trim is not sufficient to maintain the high speed, then releasing the stick may cause large vertical acceleration.

Straight flight - correcting for drift

Since flying straight cannot always be conducted up or down wind, it is necessary to explain that even in a cross wind, the aircraft should always be flying straight with balanced controls, with respect to the air. See figure 1 below. However, flight relative to the ground (track), will appear to the pilot as travelling sideways. This sends mixed messages to the trainee pilot; the tendency then is to keep adjusting the flight path rather than heading more into wind to make good the required track. The following diagrams help to demonstrate the problem. This is most noticeable when hill soaring in a medium to strong wind.

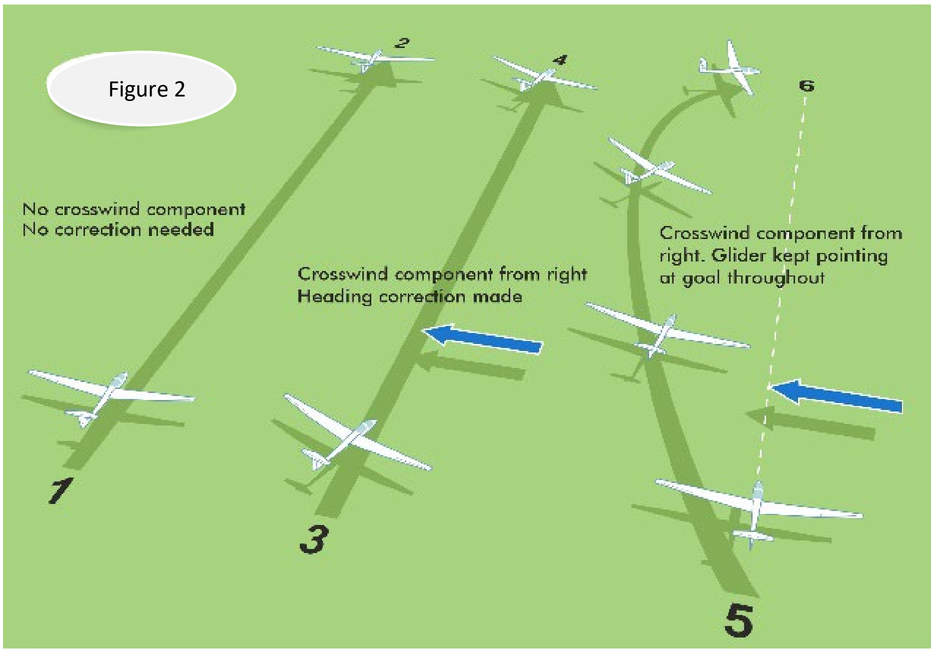
MAINTAINING STRAIGHT FLIGHT

Lookout and maintaining straight flight

AIR EXERCISE BRIEFINGS

The elements to this section of training may take several flights to complete and is weather dependant. Attempting to teach straight flight or trimming in rough air is likely to fail and result in a disheartened trainee.

If it is intended to teach trimming make sure that with the trainee in the glider, they operate the trim system to become familiar with it, before flight. This is particularly important with spring trims operated via a stick mounted trigger or any system that puts a significant load on the operating lever when unlocked.



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Remind the trainee that the glider should always be flown in trim for steady phases of flight i.e.

- continuous turning (thermalling)
- flying slowly in lift, or faster in sink
- in the circuit or on the approach
- anywhere where the speed will remain constant for more than a short time.

The exception is that the trim is set in advance for a winch or motor launch or during the initial stages of an aerotow.

TEM

Threats:	Mitigation:
Collision	Maintain thorough Lookout
Trainee mishandling at high speed	Progressive approach to exercise
Errors:	
Running out of height for appropriate circuit	Monitor height & position

MANOEUVRE DEMONSTRATION & LESSON

Remind the trainee to use the lookout scan cycle throughout these exercises, as always. Having launched, settle the aircraft into the required gliding attitude and trim. Ask the trainee to follow through and then demonstrate the control movements required to keep the glider flying straight using all three controls.

Then ask the trainee to fly the glider to a fixed point on the horizon, preferably directly up or downwind, using all three controls observing the control movements and prompting where necessary. Continue with the practice until a measure of accuracy is achieved.

MAINTAINING STRAIGHT FLIGHT

Control of pitch and use of trim.

MANOEUVRE DEMONSTRATION

With the trainee following through, fly the glider, at a steady attitude and point out that as long as the attitude is steady, the speed will be steady. Repeat this for a number of different attitudes. Explain that the trim enables the pilot to maintain that attitude without having to keep forward or backward pressure on the stick. Make it clear that attitude is the prime reference for speed control and only glances at the ASI for confirmation of the speed are required. Point out that the ASI only shows what the speed was, if the attitude is still changing.

TRAINEE ATTEMPT

Ask the student to try changing the attitude to select a new speed and wait for the speed to settle at that attitude. Re-practice with for different attitudes.

Use of Trim

Hand control to the trainee.

- Ask them to maintain the attitude but warn them that you are going to alter the trim. Ask them in which direction they are having to apply pressure to the stick.
- Now ask the trainee to use the trim lever to reduce the stick load to zero and then to check whether they have trimmed correctly or not release the stick.

Be on your guard! Some gliders will pitch quite violently if the trim lever is not close to the correct position. If necessary, ask the trainee to return to the initial attitude and re-trim

- repeat the exercise by moving the trimmer fully backwards while the trainee maintains the attitude. Get them to re-trim again

Repeat the exercise for various speeds, say 50kt and 60kt. Tell the trainee that from now on, whenever the glider is in steady flight, whether straight or turning, they should always fly the glider in trim. Make sure they do so.

TRAINEE ATTEMPT

MAINTAINING STRAIGHT FLIGHT

Airspeed monitoring and control

A demonstration is not necessary, so the trainee should fly the exercise. Ask them to fly the glider in the normal attitude and to read off the airspeed aloud so that you can check they is looking at the correct instrument. Ask them to Fly at a set speed (e.g.50kt) and then to lower the nose to the position which they estimate will result in 60kt. After allowing the glider to accelerate, ask the trainee to check the ASI to see if they have succeeded in finding the correct attitude/air speed combination. If it is not very close to what you asked for, ask them to adjust the attitude and try again.

Emphasise the importance of attitude (and lookout) to avoid the trainee becoming fixated on the ASI, before continuing with the next demonstration.

'Chasing' the ASI, and the importance of attitude

This demonstration is useful if you think the trainee is over correcting the attitude because they are following the ASI rather than flying by attitude.

From the 'normal attitude.' take control and move the stick smoothly forward, and keep moving it forward until the ASI reads, say, 60kt (or some value between 10kt and 20kt above the glider's 'normal' speed). Hold the stick in that position. The speed will eventually go beyond 60kt. Talk through the demonstration so that the trainee understands why this is happening and draw their attention to the time it took for the glider to accelerate.

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Now smoothly raise the nose until 60kt is again indicated. Hold whatever attitude the glider happens to be in at that point. (Don't pull up too quickly as the glider will be well nose up by the time the speed has fallen to 60kt, and the only way you will then avoid a fairly vigorous stall is to make a recovery under reduced G). The speed will bleed off to well below 60kt. Move the stick forward again to prevent the glider stalling.

Emphasise that the only way to control the glider is by setting the attitude and waiting for the speed to stabilise. If it does not stabilise at the required speed, re-adjust the attitude. Hand back control to the trainee so that he can practice attitude/speed control.

MAINTAINING STRAIGHT FLIGHT

Lateral level direction balance and trim

MANOEUVRE DEMONSTRATION

This exercise is best done straight up or down wind to avoid the potentially confusing issue of track and heading differences.

Trim the glider to the required attitude. Point out that the glider is flying straight towards some obvious landmark because the wings are level. Apply a small amount of bank and point out to the trainee that the glider is now turning. Then, bank slightly back the other way to turn the glider back to the original heading and level the wings.

TRAINEE ATTEMPT

Pass control to the trainee and ask them to continue to fly towards the significant landmark. If, as is likely, air movements tips them slightly and they begin to wander, then give them a little time to spot the error themselves, then prompt them to correct it if they haven't. If the air is smooth and no error develops then briefly take over and introduce a deliberate slight change of direction for the trainee to correct.

MAINTAINING STRAIGHT FLIGHT

Straight flight - correcting for drift

Track v. heading

MANOEUVRE DEMONSTRATION & LESSON

For obvious reasons, this exercise is best conducted on a reasonably windy day. First fly directly into wind. Identify a clear landmark or line feature and the demonstrate that the track of the glider is straight in the direction that it is pointing. Then point the nose of glider at 90 degrees to the wind at another obvious aiming point or feature. The glider will drift sideways in relation to the landmark. Therefore, the nose has to be pointed a little into wind to maintain the track in the required direction. This is called correcting for drift. Point out that you can identify the fact that you are heading directly at your aiming point by the fact that it remains in the same place in the canopy. If there is a local ridge, this is an excellent exercise to conduct whilst ridge soaring.

Ask the trainee to repeat the first two parts of your demonstration. They may need some help in assessing what the wind direction is initially. It is likely that they will need a few tries to apply the correct heading change to accurately counter drift.

MAINTAINING STRAIGHT FLIGHT

Inherent longitudinal stability

MANOEUVRE DEMONSTRATION/LESSON

New trainees frequently struggle with pitch control. They tend to overcontrol and become frustrated.

Trim the glider out in reasonably smooth air, and then release the stick, best glide speed will be OK. Remove your hands from the controls and make it clear to the trainee that neither of you are at that point flying the glider, but none the less, the speed is steady and the glider flies well without help!

Longitudinal stability can be further demonstrated by:

- Setting the attitude in straight flight, for a steady speed – (say 50kts but as a minimum best L/D for the glider) and trim.
- Lower the nose to attain a steady speed of 10kts higher than the trimmed for speed e.g. 60kts but leave the trim.
- Release the stick and observe the glider's response. The glider should initially pitch up (static stability) to an attitude higher than the datum attitude but then perform a series of 'damped oscillations' before settling back at the trimmed speed; this demonstrates positive (dynamic) pitch stability.

MAINTAINING STRAIGHT FLIGHT

Flight at critically high airspeeds

MANOEUVRE DEMONSTRATION &LESSON

Compared to most light aircraft, gliders are aerodynamically very 'clean' and usually have much lighter control in pitch. It is easy to go fast and important that appropriate caution and handling are exercised when at speed. Satisfactory completion of this exercise will prepare them for handling the recovery from the various spin and spiral dive exercises. Ask the trainee to follow through on the controls and speed the glider up to Va pointing out the sensitivity of the elevator and very modest movements you are making.

Ask the trainee to repeat the exercise, holding Va for 10 – 15 seconds before slowing smoothly to normal speed. If the trainees handling is not appropriate, repeat the exercise until they get the feel for it.

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When their handling is good enough repeat the exercise going up to about halfway between Va and Vne. Again, repeat until they demonstrate satisfactory handling.

DE-BRIEFING

Reinforce key messages such as the need to fly in trim and the importance of understanding the flight speed limitations on the placard and check there understanding. Always give the opportunity for the trainee to reflect on the flight and ask questions.

ADVICE TO INSTRUCTORS

Trimming as an exercise is sometimes taught, fully or partially learnt, but then neglected.

If the trainee is having difficulty with speed control, check whether the glider is being flown in trim or not. Repeat the trimming exercises if necessary. Re-enforce the message about always flying in trim.

COMMON DIFFICULTIES

The commonest difficulty is the rudder not being moved sufficiently with the stick movement, sometimes due to tense legs opposing the movement.

Over-controlling. Some trainees may overcontrol and swing from side to side about the point they are aiming at. A demonstration showing how less movement and more patience will help.

Trainees often have trouble how to recognise deviations from the proposed path, especially if they have never flown before. To help with this get the trainee to select an aiming point in the distance.

Trainees may find trimming difficult if they alter the trim before adjusting the attitude. The correct order is:

(1) adjust the glider's attitude and allow the speed to stabilise

(2) trim

(3) check that the trim is set correctly

(4) re-trim if necessary.

Trainees may find it difficult to maintain a steady attitude with one hand whilst adjusting the trimmer with the other.

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8 - TURNING

SPL Syllabus: Exercise 8 Turning			
(i)	Lookout procedures	(vi)	Faults in the turn (slipping, skidding & speed control)
(ii)	Demonstration & correction of adverse yaw -see Chapter 6	(vii)	Maintaining appropriate look-out procedures
(iii)	Entry to turn (medium turns)	(viii)	Turns on to selected headings and use of compass
(iv)	Stabilised turns	(ix)	Use of instruments (ball indicator or slip string) for precision
(v)	Exiting turns		

INTRODUCTION

The ability to roll the glider quickly and efficiently into well-controlled turns is fundamental to basic flying confidence. Since gliders spend much of their time in circling flight, failure to develop turning skills inhibits the development of a successful soaring pilot. In addition, stalling and spinning accidents are often associated with poorly coordinated turns.

Experienced glider pilots with hundreds of hours often appear on soaring and/or cross-country courses, only to find that their major problem is poor turning technique. Their instructors taught them to 'circuit standard', but not to the higher standard required for rapid progress into soaring and cross country flying.

Analysing And Correcting Turning Difficulties

Turning requires skill in coordinating all three controls together, and needs repeated practice, combined with the ability to recognise mistakes, their causes, and what to do about them. The instructor's job is to provide both the handling practice and the necessary help in recognising and correcting poor coordination. Practice whilst thermalling is of tremendous value, providing extra time on the controls, and the basis to become a good soaring pilot.

The trainee will not recognise a poorly coordinated turn entry unless they look over the glider's nose as it enters the turn and exits the turn. The view over the nose provides continuous information about:

- the attitude, and therefore the speed
- the direction and rate of yaw
- the direction and rate of roll
- the bank angle
- any slip or skid.

THEORY BRIEFING

Basic Turning

The glider is turned by rolling it so that some of the lift force created by the wings produces the required 'pull' (acceleration) in the direction of the desired turn. Because this 'tilt' reduces the vertical component of lift supporting the glider's weight, an appropriate back pressure is needed on the stick to increase the AoA to make up the difference. This increases both the into-turn component and prevents the nose from dropping.

Key points for the trainee:

Lookout –before entering a turn look both outside and inside the turn to check that the airspace you will be entering is clear and will remain so.

Look over the nose as you start the turn to check the attitude, the roll rate, the angle of bank, and any yaw

Rate of roll is determined by the amount of aileron applied. The larger the stick deflection, the faster the roll rate and the more rudder is required. the greater the bank angle, the faster the rate of turn.

The ailerons are centralised to stop the roll continuing once the desired bank angle has been reached

The rudder the rudder is applied in the direction of the turn. and has two functions:

- to overcome the adverse yaw (aileron drag) created by the ailerons when they are deflected, and
- to keep the nose of the glider pointing into the airflow as the glider changes direction.

The amount of rudder applied is proportional to the aileron input but compared to the stick movement, the rudder movement is relatively large when rolling out of the turn.

During a turn the natural tendency is for the glider's nose to go down. If no action is taken both the rate of descent and the airspeed increase, so back pressure on the stick is required to stop the nose from dropping.

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During a turn, the outer wing traces out a larger diameter circle than the inner wing, so its airspeed is greater and it produces more lift. For this reason, the ailerons almost always need to be slightly 'out of turn' to prevent the bank increasing ('holding off bank').

Continued lookout during the turn is important. Once the roll into the turn is complete, look out again. Set up a regular pattern of looking out for other traffic, then looking over the nose to check the attitude, the instruments, the angle of bank and the yaw string.

After any correction to maintain the bank angle, the ailerons and rudder are returned to their original positions; ailerons approximately central, and the rudder deflection reduced to a small amount in the direction of the turn.

Rolling out of the turn is the reverse of rolling in

- look out to ensure it is clear
- look back over the nose
- apply coordinated aileron and rudder

As the wings come level, centralise the ailerons and rudder and maintain the attitude by reducing the back pressure on the stick.

AIR EXERCISE & 'BY GLIDER' BRIEFINGS

Give the trainee a pre-flight briefing going through the intended exercises as well as the key threat and error check.

TEM

Threats:	**Mitigation:**
Collision	Maintain thorough Lookout
Errors:	
Running out of height for appropriate circuit	Monitor height & position

EXERCISE DEMONSTRATION

The trainee should follow through on the controls.

Going into the turn

- *before turning to (e.g.) the right, look out, first to the left and then round as far as possible in the direction of the intended turn, particularly behind the wing*
- *if it is clear, look back ahead over the nose*
- *roll the glider using aileron and rudder together*
- *as the bank increases, maintain the attitude with a slight backward pressure on the stick.*

When the desired bank angle has been reached, use the ailerons to prevent it increasing any further, and reduce the rudder deflection.

- *the glider is now established in the turn*
- *now, look out again.*

The trainee's initial practice is to copy the demonstration, and establish the routine of when to lookout, when to look over the nose to check the attitude, what to look for, and to practice coordinating the controls.

Staying in the turn

- *notice how the nose moves steadily around the horizon*
- *keep the bank constant, making any corrections with coordinated aileron and rudder*
- *continue to maintain a good lookout, particularly in the direction of the turn and along the horizon.*

Coming out of the turn

- *first check that it is clear to straighten up, especially ahead of and below the higher wing:*
- *take off bank using coordinated aileron and rudder*
- *relax the back pressure to maintain the attitude*
- *when the wings are level, centralise the ailerons and rudder.*
- *re-trim if necessary.*

BASIC TURNING PRACTICE

Turning exercises

If the turn is taught as one continuous demonstration, then the order will obviously be 'going in', 'staying in and lookout', and 'coming out'. However, opportunities for teaching turning often occur when the instructor has, say, established the glider in a thermal, so the order to teach shown below may be the most appropriate.

- **Staying in and look out in the turn.**
- **Coming out.**
- **Going in.**

The order recommended above may seem slightly strange, but trainees usually find continuous turns easier than the going in or coming out phases. It is also easier if they can fly straight and turn reasonably well before they try to join the two together – which is where most of the coordination problems arise. Trainees may learn more easily if they start by restoring the glider from turning flight to straight flight: a state they are hopefully more familiar with. Whatever the order, considerable practice is required.

Slip and skid

The opportunity to point out when the glider is slipping or skidding in a turn, is usually while the trainee is flying. If the trainee seems unsure of what you are talking about then demonstrate what is happening.

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Slip (i.e. under-ruddered turn)

Notice that.

- the yaw string is deflected towards the outside of the turn
- the slip ball is deflected into the turn
- the nose is higher than normal
- there may be a feeling of sliding into the turn.

Correcting slip

- the glider is slipping towards the lower wing, and needs more into-turn rudder
- apply sufficient to straighten the yaw string and/or centre the slip ball
- the bank angle and, indirectly, the attitude, are almost certain to be affected so make the necessary adjustments to keep the bank and attitude constant
- the turn is now balanced and there is no feeling of slipping into the turn.

Skid

- the yaw string is deflected into the turn
- the slip ball is deflected out of the turn
- note that the nose is lower than normal - looks safe, but it is not
- notice that there may be a feeling of skidding and sliding out of the turn.

Correcting skid

- the glider is skidding towards the raised wing, and needs less into-turn rudder
- reduce the amount of rudder to straighten the yaw string and/or centre the slip ball
- keep the bank and attitude constant using the ailerons and elevator respectively
- the turn is now balanced and there is no feeling of skidding out of the turn.

Varying angles of bank at constant speed

Further practice in the kind of coordination needed for thermal centring can be gained by trying to keep the speed constant while varying the bank angle.

Varying rates of roll

High, controlled rates of roll may be needed for thermalling, and for collision avoidance. Asking the trainee to roll quickly into turns will show up any poor coordination.

Turn reversals

Turn reversals improve coordination and use little height. As well as the aileron/rudder coordination required, there is the smooth relaxation and re-application of backward pressure on the stick to keep a constant speed.

Regaining a heading

This is a repeat of the straight glide exercise but includes a gentle turn to regain the original heading. Brief on the following:

- **regaining the heading** by choosing a feature to turn towards, using small angles of bank and coordinated controls
- **rolling the wings level** just before the feature is directly ahead**. (**The need for anticipation when straightening up soon becomes apparent, but the degree will depend on how quickly the glider is rolled wings level.)
- **continuing in straight flight**, using the scan cycle.

For trainee practice prompt rather than demonstrate. Take control, identify a distant ground feature or cloud ahead, and then introduce a heading error. Hand back control to the trainee and ask them to return to the previous heading.

When the trainee can reliably turn onto a heading, then a briefing on use of the compass and turning onto compass headings should be introduced.

DE-BRIEFING

As always - the debriefing should cover the exercises covered in the flight, but lookout is always a priority to either commend or stress the need for improvement if it is poor. Re-iterate any specific faults identified and how to eliminate them or improve. Always end on a high.

COMMON DIFFICULTIES

Failure to lookout before rolling into the turn is extremely dangerous. Emphasise the importance of lookout by taking control immediately and preventing the turn.

Looking down the wing as the glider starts to roll is common, unnecessary, and often results in poor coordination and speed control. If this tendency is established early – it will become a habit that is difficult to correct.

Failure to look out before rolling out of the turn is no less dangerous than failing to look out before rolling in. Same remedy as before.

Very slow rates of roll and/or under-banked turns can be achieved smoothly and with apparent accuracy even if the pilot's coordination is poor or non-existent. Do not accept slow rates of roll, or bank angles of less than 30°. Uncoordinated turns are both inefficient and potentially dangerous. Nervous trainees will require your patience and encouragement to help them overcome this problem.

Bank varying in the turn. In straight flight trainees have difficulty recognising when the wings are not level, and while turning can find it difficult to perceive small changes in the bank angle, which may be partly or wholly the problem. Bank can also vary if the trainee is over-controlling the glider.

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Bank increases in the turn. Ailerons almost always need to be slightly 'out of turn' to prevent the bank increasing ('holding off bank'). If the bank becomes very steep, it may not be possible to check under the raised wing whether it is clear to roll level, or not.

Bank reducing in the turn - may be due to holding off the bank too much, or a thermal core lifting the inner wing. In either case it is necessary to recognise what is happening and then take action to prevent it. As the bank reduces, trainees may attempt to maintain a steady turn rate by ruddering the glider round. Allowing the bank to reduce, and over-ruddering can sometimes be a result of nervousness about steeper turns - look for the trainee leaning out of the turn.

Speed varying - is the result of poor elevator coordination and has several causes:

- the horizon not clearly visible during part or all of the turn
- not appreciating the need to maintain the attitude when rolling into the turn, or when established in it
- not noticing the attitude change by failing to look over the nose during the roll into or out of the turn
- failure to maintain the necessary back pressure on the stick when aileron input is required
- not re-trimming in a continuous turn
- chasing the ASI
- failure to monitor the speed sufficiently often, along with almost any of the other faults.

Guessing with the rudder - indicates that the trainee does not understand what is required, or how it is achieved.

Over-active yaw string. Before assuming 'guessing with the rudder.' try flying the glider yourself. The location of the yaw string on some canopies can make it incredibly over-sensitive. If it is, try moving it to a less critical position. Learning to ignore the yaw string is negative training.

If the attitude remains constant the transition to stronger or weaker lift produces short term changes in speed. It is an advanced technique to maintain constant speed and milk the most energy from these surges. Be satisfied if the trainee is maintaining the attitude. Explain to them why the speed changes even though the attitude remains constant.

Speed and bank increasing in the turn is the start of a spiral dive. To recover, reduce the bank, bring the speed under control, and then resume the turn. The initial cause of the problem may be over-banking, or a failure to correct a sideslip, either of which results in the glider weathercocking. A common reason for unwanted roll is leaving on too much in-turn rudder.

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9 – SLOW FLIGHT & STALLING

SPL Syllabus: Exercise 9a Slow Flight			
(i)	**Safety checks**	**(iii)**	**Controlled flight down to critically high angle of attack (slow air speed)**
(ii)	**Introduction to characteristics of slow flight**		
SPL Exercise 9b Stalling			
(i)	**Safety checks**	**(iv)**	**Recovery when a wing drops**
(ii)	**pre-stall symptoms, recognition and recovery**	**(v)**	**Approach to stall in the approach and in the landing configurations**
(iii)	**Stall symptoms, recognition and recovery in straight flight and in turn**	**(vii)**	**Recognition and recovery from accelerated stalls**

INTRODUCTION

Even though stalling is a benign flight condition, it is still a major contributory factor in gliding accidents: not because the pilots involved did not know the correct recovery action, but because they did not recognise what was happening. This is why the training must strongly emphasise recognition of, and familiarity with, the symptoms of the stall.

Slow Flight, whilst not strictly speaking a stalling exercise, is an important part of stall recognition and hence avoidance. Both this exercise and stalls should be practised often enough to ensure that the trainee's habitual response to slow flight is to move the stick forward. Slow flying may be perceived as a trivial exercise and when conducted correctly is unspectacular, but do not skimp time on either the slow flying or stalling exercises; it is valuable accident prevention.

In addition to teaching our trainees to be safe at first solo and through to licence standard, we should be teaching them to be sufficiently competent and confident to indulge in practice stalls in any type that they subsequently fly. Trainees should keep themselves familiar with stalls and recoveries for the rest of their flying life.

When introducing **slow flying**, make it clear that the exercise is to help the trainee recognise the feel of the glider and control response rates near the stall; not to develop skill in 'slow flying'.

The objective of the slow flying exercise is to:

- **recognise** inadvertent flight at critically low speeds (high angle of attack) and take timely action to avoid a stall.
- avoid inadvertent stalling by developing safe flying habits in all phases of flight.

Stall training progresses from extensions of the Slow Flying exercise on to gentle, wings-level stalls, to accelerated stalls in turns and climbing attitudes.

The aim of stall training is for the trainee to:

- recognise the symptoms of an approaching stall and take timely avoiding action.
- become familiar with the characteristics of the full stall and learn how to recover with minimum loss of height.
- avoid inadvertent stalling by developing safe flying habits in all phases of flight.
- establish an automatic link in the trainee between this symptom and the need for stall recovery action.

Trainees may be apprehensive about stalling, so use these slow flying exercises and a very gentle 'confidence stall' before introducing the further stalling exercises. Everything possible should be done to make the stalling exercises a positive learning experience: otherwise, if they are too anxious, then they will not be learning.

Reduced G and pilot reactions

The 1G we are used to, can reduce when we fly. If we move the stick forward when flying at normal speed or at the stall, as the lift reduces the glider will start to accelerate downwards relative to its previous flightpath and we experience reduced G.

There have been fatal accidents where gliders have dived steeply into the ground. No technical problems seem to have been involved, so there is a strong possibility that the pilots confused the sinking sensation due to reduced G with the stall and/or became disorientated. There have been accidents in two seaters where a low-level launch failure produced enough reduced G to panic an over-sensitive trainee into pushing forward on the stick so hard that the instructor was unable to take over.

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Many trainees dislike reduced or negative G, but rarely this may be accompanied by a sense of panic. Beware of doing stalls with markedly reduced G before you have determined whether the trainee is sensitive to it or not.

In the rare event that a trainee seems over-sensitive to reduced G, inform the CFI. Affected pilots who want to persevere with flying may be helped/de-sensitised by practising dozens of reduced G exercises.

The exercises:

Together with the slow flying exercise, the following are covered in this chapter:

- 4 unaccelerated stalls (often referred to as the ' basic stalls) i.e.
  - Stall without a nose drop (mushing stall)
  - Stall with a nose drop (straight stall)
  - Stall with a wing drop
  - Stall in landing configuration
- 2 further stalling **demonstrations**
  - reduced G is not a reliable symptom of the stall and
  - the lack of the elevator at the stall
- accelerated stall exercises
  - stall in a turn
  - stall speed increases in the turn – demonstration only
  - high speed stall - demonstration only

All except the last 2 demonstrations must be satisfactorily flown before solo, and the last 2 demonstrations before licence standard.

With the exception of winch launch failures, it is unlikely that a pilot will stall inadvertently with the nose held very high, simply because the attitude is so obviously abnormal. **Realistic** training is vital. There is no point in stalling from an attitude which the trainee knows they will not encounter in real life.

A likely and dangerous place for an inadvertent stall is close to the ground. For example, the pilot might under-estimate the wind gradient or unconsciously attempt to stretch the glide. Thermalling low down while trying to select a field often leads to inadvertent stalls, sometimes with fatal results. Turbulence and wind gradient can increase the chances of a stall and delay the recovery. If the strong visual signal of a nose high attitude is absent the pilot is less likely to recognise the onset of the stall. High workload also increases the chances of other symptoms going unnoticed.

To help the pilot avoid stalling in such situations, training should cover not only the deliberate stall exercises - which suggest that the symptoms are fairly obvious and are often continued until the glider is fully stalled – but also those more subtle stall entries where the emphasis is on recognising the symptoms and initiating immediate and appropriate recovery action.

Many training gliders are sufficiently vice free, and their stall so innocuous, that it is difficult to convince trainees of just how hazardous an inadvertent stall can be. This does not prevent their use in providing familiarisation with the symptoms of an approaching stall but severely limits their usefulness in the teaching of certain exercises. Attempting to demonstrate 'Stall in a turn' and 'Stall in a steep turn' in two-seater gliders like the K21, which lack sufficient elevator power, may prove impossible. Attempting and failing to provide an effective demonstration may very well serve only to convince your trainee that, as you cannot make your point, that they are at no risk from stalling. If a more suitable two-seater is available, then use it.

When to teach

Some of the exercises result in attitudes which may alarm trainees or produce disconcerting sensations.

Do not demonstrate the accelerated stalling exercises until the trainee is fairly confident in both stalling and recovering the glider from basic and steeper stalls, including those with wing drop.

If at any stage of a trainee's stall recovery training, they over-control - creating reduced G - the instructor should take the opportunity to give the appropriate demonstration before any wrong ideas are formed i.e. to emphasise what caused the sensation, and the implications of confusing it with the sensations in the stall.

Initially, these exercises should be demonstrated with the trainee's hands and feet **off** the controls. Only invite the trainee to follow through once they know what to expect, and you are certain they are not going to react badly.

Considerable height can be lost during some of these exercises.

NOTE: Most of the exercises in this manual have no recommended patter. In the following exercises, patter is in italics to distinguish between the few key things that should be said, and tips on how to fly the exercise. These exercises are demanding of your handling ability. Never be afraid, if a demonstration fails to work or is unconvincing, to say; *I'm sorry, that didn't work, I'll do it again*.

THEORY BRIEFING

Angle of Attack (AoA) and the stall

In normal flight a glider's wings must produce a lifting force near enough equal to the glider's flying weight. The amount of lift generated depends on the aerofoil (overall shape), wing area, and the speed and angle at which the airflow meets the wing. The angle is called the **Angle of Attack**, **(AoA)** (figure 1), and is measured between the aerofoil **chord line** and the **relative airflow**.

If the glider is in steady, fast straight flight, the AoA will be small, but becomes progressively larger as the glider slows down, or as G increases. There is a **critical angle** for the AoA where the lift coefficient, or C_L reaches a maximum. This is aerofoil specific, but typically about 15°. If the AoA is

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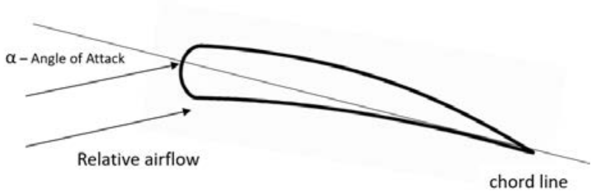
increased further, lift will reduce, often quite sharply, but the drag will continue to rise. Technically, the stall is defined as occurring when the C_L has reached its highest value, regardless of anything the glider is doing at the time. **Fig 1**



Changes occur in the handling and feel of the glider when indulging in 'slow flight' at high angle of attack close to the stall and these can provide useful warning of an impending stall.

The wings of most gliders are designed to stall in a smooth and progressive manner, either through using a different aerofoil section near the tip or building in 'washout' or both. Airflow breakdown begins at the upper surface trailing edge, near the wing root, and spreads forwards and outwards as the AoA increases.

The above features enable many gliders to maintain some aileron control at, and sometimes just beyond, the stall. In general, though, as more of the wing stalls, the ailerons become increasingly sluggish and ineffective.

Secondary effects of rudder inputs at, or just prior to the stall can have much the same effect, except that the glider may roll strongly in the direction of the rudder input.

However, note that aileron input close to the stall **can** result in very rapid roll in the **opposite** direction to the one intended. This is caused by the downward deflected aileron stalling the tip that was supposed to go up.

As the glider slows down there may be a perceptible change in the airflow noise. While usually quieter, it can also be louder or different in character and may sound completely different if there is any significant yaw present. As modern gliders approach the stall any variations in airflow noise may be very subtle.

Separated airflow can produce airframe buffet, and turbulent flow across the static ports can cause the ASI readings to flicker. However, this will only be experienced if the glider is flown at the stalling speed rather than just above it as intended in the slow flight exercise.

Summary of <u>Slow Flight</u> symptoms

Not all the following may be present, or all that obvious:

- The nose is higher than normal.
- The airspeed will be slow.
- Changes in airflow noise.
- Changed effectiveness of ailerons, elevator and/or rudder.
- Unusual control positions for the phase of flight. For example, lots of out-turn aileron or stick further back than usual.

Summary of the <u>Stall</u> symptoms

Not all the following may be present, or all that obvious:

- The nose attitude is higher than normal.
- The airspeed slow or reducing.
- Changes in airflow noise.
- Flickering ASI.
- Airframe buffet
- Changed effectiveness of elevator, ailerons and/or rudder.
- Unusual control positions for the phase of flight. For example, lots of out-turn aileron.
- Higher rate of descent.
- **Inability of the elevator to raise the nose.**

Depending on the glider's elevator authority and/or the rate at which the speed is reduced, the elevator may fail to raise the nose in response to backward movement of the stick, or the nose may drop regardless. **Inability of the elevator to raise the nose or prevent it going down is the most important symptom of a stall.**

Some actions when flying a glider, are learned very early in training and become habitual. For example, to reduce the speed, we raise the nose by moving the stick back. Conversely, if the nose starts to go down, we move the stick back to try and raise it again.

Habits form a major part of our reactions and under pressure it is normal to revert to previously learned patterns, even if the response is completely inappropriate. For example, if the nose drops because the glider has stalled, the 'normal' reaction - using the elevator to raise the nose - will make the situation worse.

There have been a number of accidents and incidents in which the glider has hit the ground at a high rate of descent and the pilots, sometimes very experienced, were convinced that the elevator had become disconnected. In fact, the elevator was connected, but the glider was stalled, and the pilot continued pulling back on the stick. If the pilot(s) had recognised the symptoms of an approaching stall, and taken the correct recovery action, the accident would not have occurred.

Stalling speed

The actual value of the stalling speed of the glider depends on the following factors:

- **Design of the wing**, particularly its size and aerofoil section.
- **Airspeed.**
- **Wing loading**. If the wing loading increases, so too does the stalling speed. The wing loading depends on:
- The **glider's flying weight**, also referred to as the All-Up Weight or AUW.
- **Download** resulting from **cable tension** during a winch launch.

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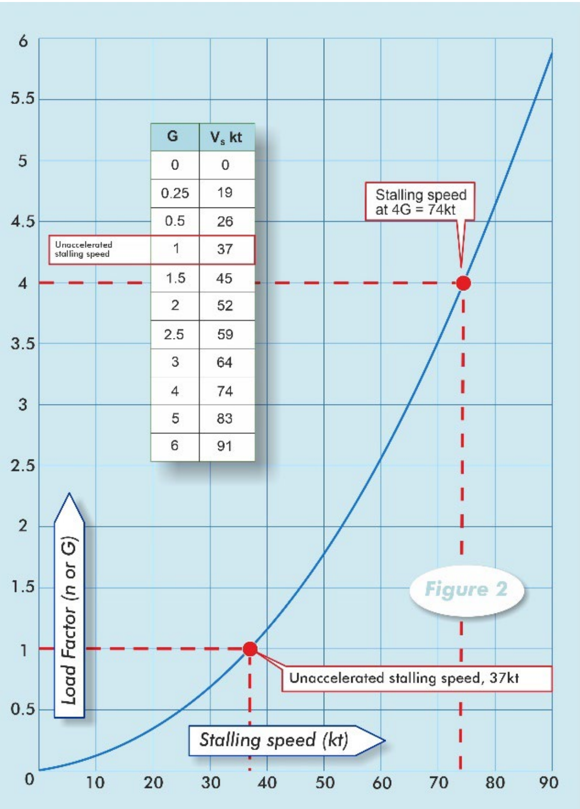
- **contamination.** In unaccelerated flight at a given AUW and with a clean air frame, the stalling speed (V_S) will have a specific value, say 35kt. If the wing is wet or the leading edge covered with bugs, the stalling speed can increase by anything from 1kt to 10kt; possibly more if the airframe is covered with ice. The change in stalling speed is glider/aerofoil dependent, and some gliders are more badly affected than others
- **use of the airbrakes.**
- **increase in G** loading in relation to the glider which alter its effective weight e.g. any change in direction (turning, pulling out from a dive)

Figure 2 below and the inset table show how the stalling speed changes with G for a glider with an unaccelerated stall speed of 37 kts.



G	V_s kt
0	0
0.25	19
0.5	26
1	37
1.5	45
2	52
2.5	59
3	64
4	74
5	83
6	91

Stalls with a wing drop

When one wing reaches the critical angle just before the other, an asymmetric stall occurs, and a wing will drop. Normal stall recovery action will prevent the wing dropping further, and as soon as it has started to take effect, the wings may be levelled with coordinated aileron and rudder. Positive use of the elevator gets the wing flying again very quickly and arrests any tendency for a wing to drop.

When a wing drops at the stall, it is essential to unstall the glider before attempting to level the wings. Once the glider is unstalled, level the wings with coordinated ailerons and rudder.

Do not attempt to use the secondary effect of rudder to restore the wings to the level position. This will introduce yaw which can result in the glider entering a spin, often quite suddenly. The priority must be to unstall the glider by moving the stick forward.

Pilots often over-react when 'unstalling' by pushing the stick hard forward, regardless of whether this is necessary. Considerable height can be lost. The instructor should demonstrate and encourage 'least loss of height' recoveries. The success of this depends on the trainee's understanding and appreciation of the situation, and of the aircraft they are flying. On balance slightly over-reacting is safer than **slightly** under-reacting.

EXERCISE 9a

SLOW FLYING

SLOW FLYING - AIR EXERCISE BRIEFING

Before flying all this exercise include Threat & Error Management and the HASSELL check [Chapter M] in all the pre-flight briefings.

Assess your trainee to check they are not overly anxious.

Carefully check seating positions and straps. It is important that even if an overzealous trainee moves the stick fully forward, you can still reach it. Reduced G combined with loose straps might leave you unable to take control.

Brief the exercises for the flight and remind the trainee of the stall recovery procedure.

TEM

Threats:	**Mitigation:**
Trainee Adverse Reaction	Prepare and brief the trainee appropriately & monitor them carefully
Trainee fails to or overreacts at recovery	Monitor trainee & take over promptly
Collision	Maintain lookout
Errors:	
Running out of height for appropriate circuit	Monitor height & position
Allowing a stall to develop	Be prepared to recover immediately if a stall appears imminent

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SLOW FLYING - MANOEUVRE DEMONSTRATION

Initially, ask the trainee to keep their hands and feet off the controls. Only invite them to follow through once they know what to expect and you are reasonably sure that they will not react badly. Given the risk of accidentally stalling whilst conducting this exercise the trainee should be shown a gentle introductory stall ahead of this exercise. This advice is relevant to all stalling exercises.

The exercise consists of flying just above the 1 G stalling speed, in the region where the aircrafts handling is beginning to change from that at normal speeds, but not actually yet stalled.

The objective of this exercise is to train pilots to **recognise and avoid stalling.** The trainee needs to experience the response and feel of the controls at this crucial point.

- Complete the HASSELL check (some of it can be done prior to take-off)
- Bring the nose slightly above the normal flying attitude.
- Identify the symptoms of slow flight as they occur.
- Note the airspeed.
- Stabilise the glider in this attitude.
- Emphasise that this is the Slow Flying and is very close to the stall.
- Demonstrate the recovery action.

Emphasise that:

- Because the glider is being flown too slowly that it is essential to move the stick forward to recover.
- That flying too slowly is both inefficient and potentially dangerous.

SLOW FLYING - TRAINEE ATTEMPT

The aim is for the trainee to fly just above the 1G stall speed and to:

- identify the symptoms of slow flight
- recognise the impending stall

The trainee needs prolonged experience of the feel of the controls when the glider is too/very close to the stall.

- Complete the HASSELL check.
- The trainee reduces speed very gradually (approximately 1kt/sec) towards the stall. The aim is to try and fly the glider just above the stall while keeping the wings level with coordinated controls.

Emphasise the change in feel of all the controls.

An optional addition to this exercise is to demonstrate a very gentle turn, at a few knots above the stall and have the trainee repeat it. The difference in handing is marked and this is a good lead in to the later 'stall in a turn exercise.'

EXERCISE 9b -STALLING

UNACCELERATED STALLS

AIR EXERCISE BRIEFINGS - for unaccelerated stalls

TEM

Threats:	**Mitigation:**
Trainee adverse reaction	Brief appropriately & monitor trainee
Trainee fails to or overreacts at recovery	Monitor trainee & take over promptly
Collision	Maintain thorough Lookout
Errors:	
Running out of height for an appropriate circuit	Monitor height & position
Allowing a spin to develop at an inappropriate time or height	Be prepared to recover anything that occurs immediately

Brief the exercises for the flight and remind the trainee of the stall recovery procedure.

The aim is to:

- identify the symptoms of the approaching stall.
- recognise the stall itself.
- recover with the **minimum loss of height**, avoiding a secondary stall.

If the pilot either fails to notice or ignores the symptoms, the glider will STALL and:

- begin to descend at a very high rate.
- the nose may drop.
- a wing may drop.

To recover, the AoA MUST be reduced:

- ease forward on the stick (the attitude should be more nose down than the normal gliding attitude).
- regain flying speed.
- return to the required gliding attitude (for that phase of flight).

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The degree of forward stick movement and the time and height taken to unstall the glider depends on the circumstances of the stall. For example:

- A stall without a nose drop - a mushing stall - normally requires more forward stick movement for recovery than if the nose is already dropping.
- Recovery action whilst descending through a wind gradient requires a very much lower nose attitude if flying speed is to be regained. Obviously this should not be demonstrated because the wind gradient occurs very close to the ground

A secondary stall may occur during or after recovery from the first if the recovery is hurried, and if:

- the glider has not been allowed to regain sufficient speed for the next manoeuvre, causing it to stall again, or
- the stick is pulled back too harshly during the return to the required attitude, creating excessive G. The accelerated stall that results may be vicious.

UNACCELERATED STALLS

Stall without a nose drop (Mushing stall)

MUSHING STALL - MANOEUVRE DEMONSTRATION

This is a repeat of exercise 9a, slow flying, but it is continued into a mushing stall.

Demonstrate 1G stalls to cover the symptoms of the approaching stall, the stall itself, and the recovery. Repeat the exercise several times, each demonstration concentrating one symptom of the approaching stall, followed by the stall and recovery.

A full HASSELL check may not be required between every demonstration, but do not forget to monitor height and check regularly that it is still clear below

Initially, ask the trainee to keep their hands and feet off the controls. Only invite them to follow through once they know what to expect and you are reasonably sure that they will not react badly.

Complete the HASSELL check (some of it can be done prior to take-off).

- Bring the nose slightly above the normal flying attitude.
- Identify the 'Symptoms of the Stall' as they occur.
- Note the airspeed at which buffet begins.
- Stabilise the glider in this attitude, with a high rate of descent.
- Emphasise that this is the stall.
- Demonstrate the recovery action.

MUSHING STALL - TRAINEE ATTEMPT

- Complete the HASSELL check.
- The trainee reduces speed very gradually (approximately 1kt/sec) towards the stall. The aim is to try and fly the glider into a mushing stall while keeping the wings level with coordinated controls.

Emphasise;

- the need for coarse aileron and rudder movements.
- that the stick is considerably further back than for normal flying speed, even though the glider's attitude is not dissimilar to 'normal.'
- the rate of descent is high, and a wing may drop.
- Recover from the stall.

UNACCELERATED STALLS

Stall with a nose drop (Straight stall)

STRAIGHT STALL - MANOEUVRE DEMONSTRATION

- HASSELL check
- Lookout.
- Repeat the 1G stall but ensure that the nose drops; to do this, raise the nose above the horizon and hold it there while the glider slows down, then bring the stick further back to induce the stall.

Emphasise that:

- because the glider is stalled the nose drops, despite the stick being held back
- although the nose is dropping it is essential to move the stick forward to recover.
- once unstalled, the recovery from the dive needs to be smooth to avoid a secondary stall.

STRAIGHT STALL - TRAINEE ATTEMPT

Check that you still have sufficient height.

- Lookout.
- The trainee brings the nose up in straight and level flight to about 20 degrees above the horizon and waits for the nose to drop.
- Ease forward on the stick (the aimed for attitude needs to be more nose down than the normal gliding attitude).
- Regain flying speed and return to the required gliding attitude (for that phase of flight.

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Make sure the trainee understands the need to hold the glider in the 20 degrees nose up attitude while it slows down. If they simply pull the stick back steadily until the stall then, depending on the initial airspeed, you may get a much steeper stall than intended. A re-demonstration may be needed.

UNACCELERATED STALLS

Stall with a wing drop

STALL WITH WING DROP - DEMONSTRATION

- HASSELL check.
- Repeat the 1G stall but provoke a wing drop using rudder and demonstrate the recovery.

Emphasise that:

- the wings are levelled with coordinated use of ailerons and rudder, BUT ONLY AFTER the glider is unstalled.

STALL WITH WING DROP - TRAINEE ATTEMPT

Check that you still have sufficient height.

- Lookout.
- You may wish to bring the glider up to the stall and provoke the wing drop, and handover to the student for the recovery.
- Ease forward on the stick (the aimed for attitude needs to be more nose down than the normal gliding attitude).
- The wings are levelled with coordinated use of ailerons and rudder, BUT ONLY AFTER the glider is unstalled
- Regain flying speed and return to the required gliding attitude (for that phase of flight).

UNACCELERATED STALLS

Stalls in Landing Configuration

DEMONSTRATION AND MANOEUVRE

- Complete the HASSELL check including, where appropriate, drawing attention to the limiting speed when landing flap is employed.
- Fly the 1G stall with the airbrakes or spoilers fully open and where appropriate wheel down.
- Note the stall' symptoms and the higher stalling speed.
- Recover from the stall Point out that recovery includes closing the airbrakes or spoilers.

UNACCELERATED STALLS - DE-BRIEFING

Review the symptoms of the approaching stall. Emphasise that only one symptom needs to be recognised for stall avoidance or recovery to be initiated. (There can be some exceptions to this. For example, buffet may not always be associated with an imminent stall.)

Discuss the many different situations where a stall can occur but emphasise that the one thing they have in common is the need to move the stick forward to recover. Review the recovery action, including the degree of stick movement required and the amount of height lost in stalls

FURTHER STALLING DEMONSTRATIONS

LACK OF EFFECT OF ELEVATOR AT THE STALL

Demonstration only

LACK OF EFFECTIVE ELEVATOR - DEMONSTRATION

Complete the HASSELL checks:

Explain that you are going to show how ineffective the elevator is at the stall.

- Dive the glider to 55-60kt. Pull up into a steepish climb and wait for the stall.
- As the nose drops, move the stick fully back and knock it on the back stop two or three times.
- *No matter how hard I pull back on the stick I cannot raise the nose.*
- *The elevator is ineffective.*
- *I must move the stick forward to unstall the glider before I try to raise the nose.*
- Move the stick forward and recover.

DIFFERENCES BETWEEN STALLING AND REDUCED G

Demonstration only

This demonstration is to show the differences between stalling and reduced G. It aims to:

- determine if the trainee is critically/excessively sensitive to reduced G.
- show the trainee that a sinking sensation is an unreliable symptom of the stall.

There is optional extension to the exercise is to push the stick forward when the reduced G is felt, as if one believed the glider was stalled. This aims to demonstrate:

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- how quickly the glider will go into a steep dive if inappropriate stall recovery action is taken.
- how disorientating reduced G can be.

DIFFERENCES BETWEEN REDUCED G and STALLING AIR EXERCISE BRIEFING

A scenario often helps to bring home to trainees the points you are trying to make.

A possible situation: Imagine that for some reason - a severe gust or a sudden forward movement on the stick - the pilot experiences the sensation of reduced G. If they are oversensitive to it, or have not experienced it before, they may feel that the glider is falling away from them and incorrectly deduce that it must be stalled. They may possibly:

- take the stall recovery action i.e. move the stick forward, increasing the sensation of reduced G.
- which will increase their belief that the glider is stalled.

It is hard to believe that under normal circumstances a pilot would continue to keep pushing long enough for the glider to enter a vertical dive, or even inverted flight, but both have happened. Panic and disorientation may set in. Unable to work out what is happening, the pilot then becomes unable to recover from the situation.

DIFFERENCES BETWEEN STALLING AND REDUCED G MANOEUVRE DEMONSTRATION

Conduct the initial demonstration with the trainee off the controls in case of adverse reaction.

Complete the HASSELL Checks.

First stall the glider as a reminder of the stall.

- Dive to 55-60kt.
- Pull up into a moderate climb – about 20-30 degrees.

When stalled:

- *Notice the sensation, low airspeed and ineffective elevator; as the nose drops past the horizon, bang the stick against the back stop to show that the elevator will not raise the nose.*
- *We are stalled.*
- *Stick forward to recover.*
- *Now we will look at reduced G.*
- dive the glider to 55-60kt and then pull up into a moderate climb (as before).
- about 5kt above the stall, push over to create the same sensation as in the stall; do not leave this too late or you will stall when you try to raise the nose.
- *Notice the same sensation, but this time the elevator is effective and air speed OK; demonstrate by raising the nose as it drops past the horizon.*
- *We are not stalled.*
- *Stick back to recover.*

The sensation of reduced G sensation is an unreliable symptom of the stall.

The two demonstrations looked and felt the same but in the first case the glider was stalled and the elevator ineffective, whereas in the second case the glider was not stalled, and the elevator raised the nose as normal.

DE-BRIEFING

Ensure that the trainee understands that reduced G is not a reliable indicator of the stall. If the elevator is effective and the airspeed OK, then the glider is not stalled. Make it clear to them that the sensation of reduced G requires the stick to be moved back not forward when the glider <u>is not</u> stalled.

ACCELERATED STALLS

AIR EXERCISE BRIEFINGS - for accelerated stalls

It is important for trainees to understand that the glider can stall at any speed. For instance, a stall may occur at a speed higher than the normal stalling speed if the glider is turning, the airbrakes are out, the wings are contaminated with rain or ice, the glider is being 'loaded' as in a wire launch or during any manoeuvre where G increases.

The purpose of the demonstrations is to show that:

- the stalling speed is G related.
- the high-speed G related stall may be more dramatic than the 1G stall.
- smooth stall-recovery technique is essential to avoid a pilot-induced secondary stall.

Review the factors which can cause the glider’s stalling speed to increase and establish the relationship between load factor and stalling speed.

ACCELERATED STALLS

Stall in a Turn

STALL IN A TURN - MANOEUVRE DEMONSTRATION

- Complete the HASSELL check.
- Enter a normal, balanced banked turn (30°) and slow gradually towards the stall.
- **Point out the unusual control positions required to maintain the attitude and angle of bank.**
- Note the airspeed at the onset of buffet compared to the unaccelerated stall.
- Continue until the glider is stalled.
- Recover as for 'stall with wing drop.’
- Also note that if the glider is in balanced flight – i.e. the yaw string remains central, the glider does not ‘drop a wing.’

STALL IN A TURN - TRAINEE ATTEMPT

The trainee repeats the manoeuvre as above, i.e.;

- complete the HASSELL check.
- enter a normal banked turn (30°) and slow gradually towards the stall.
- continue until the glider is fully stalled.
- note the airspeed at the onset of buffet compared to the unaccelerated stall
- recover as for 'stall with wing drop.'

ACCELERATED STALLS

Stall Speed Increases in The Turn

Demonstration only

This is a demonstration only in the early stages of training as it involves significant demands on handling. It is a useful exercise for more advanced trainees/check flights to develop their handling skills and stall awareness.

This exercise is to re-enforce the message that stalling speed is not fixed and is independent of attitude. It also demonstrates that the increase in stalling speed is not linear. i.e. the increase in stalling speed at 60 degrees is much more than three times that at 20 degrees. This is particularly relevant in relation to thermalling at steep angles of bank.

MANOEUVRE DEMONSTRATION

Complete the HASSELL check:

- conduct a calibration stall getting the trainee to read the ASI i.e. a 1G stall with wings level.
- enter a balanced turn of about 20° of bank at normal speed.
- maintain balanced flight (not skidding or slipping) and a constant angle of bank.
- gradually slow to the stall buffet whilst maintaining constant bank and balanced flight.
- *Tell me at what speed the glider buffets.*
- the glider buffets but with little or no tendency for the nose to rise. Some gliders may drop a wing at this point. Assuming that this does not happen
- *We can feel the buffet at this higher speed. By relaxing forwards on the stick.*
- relax the back pressure – *the glider recovers.*

Repeat the exercise several times using different angles of bank, but in increments which are obviously different, say 20°, 40° and 60°, as suggested earlier.

TRAINEE ATTEMPTS – ADVANCED TRAINING ONLY

The trainee repeats the manoeuvre as above at each of the speeds.

This is probably the most demanding of the stalling exercises to teach the trainee. Whilst at this stage of their training they should be reasonably good at moderate turns, most find it difficult to hold the bank accurately in steeper turns, particularly as the speed reduces. However, it is worth persisting until they get it right as not only is the increased stall speed instructive, but the unusual control feel is marked, and you should draw it to their attention.

ACCELERATED STALLS

High Speed Stalls

Demonstration only

HIGH SPEED STALL - MANOEUVRE DEMONSTRATION

The intention of this exercise it to ensure the trainee understands that stalling can occur at high speed if the controls are mishandled.

Again, this exercise requires good timing and handling. Get the trainee to fly the pitching manoeuvre first without the stall and when they can do that, tell them when to bring the stick smartly to the back stop. When correctly conducted the trainee will experience a brief period whilst the glider is stalled, and not responding to up elevator. Get the trainee to read the ASI whilst the glider is buffeting.

It is a good idea to precede this exercise by a 'calibration' stall; a normal unaccelerated stall which will establish the 1G buffet and stall speed. It is more of a reminder than anything else.

WARNING! If the speed is in excess of 55kt at the start of the pull-out, do not continue with the exercise. Recover normally and try again at a slower entry speed. If the exercise is performed with any yaw present, then a high-speed spin entry or flick roll will occur.

Complete the HASSELL check:

- *Follow through on the stick.*
- dive to 55 - 60kt and pull up into a fairly steep climb.
- *I am going to completely stall the glider*
- wait for the nose drop and ease the stick forward as in a normal stall recovery.
- *If I recover from the stall normally - but pull back too soon.*
- as soon as the glider stops pitching down, pull the stick to the back stop.
- wait!
- *The glider buffets and stalls at a higher speed - notice the ASI reading.*

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- stick forward to recover, then smoothly back to normal flying attitude.

Point out the circumstances in which a high-speed stall may occur e.g. the recovery after a spin, hurried completion of stall recovery and raising the nose too soon after cable break recovery. The need to recover gently or exercise smooth and accurate control whenever a pull-out manoeuvre is required, especially near the ground.

ACCELERATED STALLS DE-BRIEFING

Remind the trainee about the effect of G on the stall speed. The circumstances in which a high-speed stall may occur e.g. the recovery dive after a spin, hurried completion of stall recovery and raising the nose too soon after cable break recovery. The need to recover gently or exercise smooth and accurate control whenever a pull-out manoeuvre is required, especially near the ground.

COMMON DIFFICULTIES

HASSELL check. Uncertainty about how much of the HASSELL check is required and the appropriate areas of lookout.

Failure to Stall. If you ask the trainee to show you a stall and recovery, they will often begin by raising the nose but fail to continue moving the stick back to maintain the attitude. As the speed reduces the gliders' natural pitch stability gently lowers the nose, often helped by the trainee making a small forward movement of the stick, and soon the speed increases again. The glider has NOT stalled even though the speed may have become very low. This may indicate that the trainee:

- does not appreciate that it is not the initial attitude that causes the stall and so does not attempt to raise the nose or prevent it dropping with back pressure on the stick.
- has not developed the habit of a brisk recovery action.
- is unhappy about ‘stalling’ possibly because of sensitivity to reduced G.

Recovery from the dive can often be:

- too soon, before the glider has accelerated to a safe speed.
- too late, resulting in a greater loss of height and excessive speed.
- too abrupt, bringing the risk of another and more dramatic stall.

Long established pilots often reveal poor skills when handling stalls because they do not practice them. Even if their club requires annual checks, this will not be sufficient to keep them on top of these issues. They should be encouraged to keep in practice stalling their usual glider.

Converting power pilots. Power pilots are apt to push the stick to the front stop for stall recovery. This is rarely necessary in gliders, but a good pre-flight brief and your full attention during the exercises is required.

Occasionally a trainee may react with panic to an alarming change of attitude, or to reduced G. In rare cases they may freeze on the controls. Instructors should make sure that trainees are never flying the glider or even following through, in any situation which they have not previously experienced.

10 - SPINS AND SPIRAL DIVES

SPL Syllabus: Exercise 10 Recognition & Avoidance of Spins & Spiral Dives			
(i)	**Safety checks**	**(vi)**	**Instructor induced distractions during the spin**
(ii)	**Stalling and recovery at the incipient spin stage (stall with un-commanded wing drop to about 45 deg and associated yaw)**	**(vii)**	**Recognition of spiral dives**
(iii)	**Recognition of entry into fully developed spins**	**(viii)**	**Spiral dive recovery**
(iv)	**Recognition of full spins**	**(ix)**	**Differentiation between spins and spiral dives.**
(v)	**Standard spin recovery**		
Note: Consideration of manoeuvre limitations and the need to refer to the sailplane manual and mass and balance calculations.			

INTRODUCTION

The exercises in this section should develop safe flying habits in all phases of flight, to avoid stalling and inadvertent spinning and to learn to safely practise spinning gliders. The trainee should be able to:

- recognise when spins can occur.
- avoid inadvertent spins by developing safe flying habits.
- recognise a spin's characteristics.
- learn and apply the correct recovery action with minimum loss of height.
- recognise the difference between the spin and spiral dive and apply the appropriate recovery action.

Many trainees and established pilots are apprehensive about spinning. However, inadvertent or accidental spins are very dangerous and have killed many pilots, but practice spins are very safe. From 1974 to date the same number of gliders have crashed practising spinning as gliders have been struck by lightning: two! As of 2020 the mortality rate from inadvertent spins is approximately one every 26 months. Whilst better than it has traditionally been, it is still far too high.

For the first demonstration the trainee should not have their hands and feet on the controls. A panicky trainee - who may never have experienced a spin before – may attempt to over-ride the instructor on the controls: when people are scared, they can become incredibly strong. Trainees should only be allowed to follow through on the controls when they are judged to be comfortable with the sensations and have shown no adverse reactions. Initially many trainees find spinning very disorientating, so do not include too many of these exercises in any one flight.

One thing that may help reassure nervous trainees is a discussion of minimum heights during the pre-flight briefing, including consideration of the likely height loss per-turn for the glider in use, etc.

Never demonstrate a spin below a height that does not allow for a comfortable safety margin. Apart from being potentially hazardous, your trainee will be concentrating more on the ground whirling round than listening to you! Nothing will be achieved by spinning excessively low. If spin training is undertaken before the trainee has had any experience of flying the glider at high speed, then the dive recovery itself can be alarming. For this reason, there is merit in teaching them to practise recovering from the dive, before undertaking any spinning exercises.

Most spin training will involve brief spin entries of about a half a turn, with the primary aim of recognising the circumstances in which they can occur and practising the correct recovery action. Continuous spins of two or three turns allow the trainee time to study the spin's characteristics, and distinguish it from a spiral dive, and to give confidence that the recovery action from a stabilised spin is effective.

When intending to demonstrate or practise spinning, it is important that the instructor takes the glider's particular characteristics into account; these have a bearing on the minimum heights for the various exercises. Some gliders spin fast and very nose down; some lose more height per turn; some start behaving differently after they have done more than a few turns. Make sure you understand, can explain and calculate an appropriate height for spinning exercises.

It is not true that a particular glider or type will not spin. It *is* true that some gliders are more reluctant to spin than others, but the 'unspinnable' one may have never been flown in conditions where it would. Remember that the thing we strive so hard to achieve for demonstration purposes is produced effortlessly by pilots who spin in without ever realising what they did.

However, most training gliders are docile. Sometimes both the instructor and trainee will attempt to spin, and fail, and the glider enters a spiral dive instead. Failed spin attempts are opportunities to recognise the ensuing spiral dive, and to practise recovering from it correctly. Recognising that the glider is not spinning is as important as recognising when it is. Applying full opposite rudder or maintaining in-spin rudder with the glider in a spiral dive can result in structural damage or failure. Be careful!

The trainee’s understanding of why the glider spins and also their general confidence is enhanced by the ability to spin the glider successfully. If necessary, initially hand over to the trainee in the spin/spiral dive for them to recover on command. They should progress quickly to flying the whole exercise. Know your two-seater and do not attempt to use an inappropriate type that is excessively reluctant to spin.

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Set up a realistic scenario, but do not go for the actual spin too quickly. Make sure the trainee is as hands-on as possible and encourage them to approach the stall themselves in various attitudes and bank angles. Compare each symptom to normal flight – sound, attitude, control position and loads, string position, buffet, possible wing drop etc. Point out that at this stage simply easing the stick forward will prevent a spin. Once you have demonstrated this, get the trainee to try it. (We are not spinning yet.)

Much of the lesson has now been carried out. The above is the most important bit. The actual spin is almost 'firefighting': '*If you have got to this point, this is what you need to recover and save the situation*.'

Whilst the recovery is key, it is essential for the trainee to feel what it is like whilst entering the spin, as well as practising the recovery. So, whilst the instructor will put it into the spin in the early stages of training, it is desirable that the trainee can handle them from start to finish. The exercises in this section require good handling skills and trainees are unlikely to be able to fly them without good demonstrations, several attempts and some coaching.

Many gliders will recover from a spin simply by releasing the controls. It is possible that the student simply relaxes and that is sufficient for the glider to recover. The K13 will do this, but many gliders will take a long time to recover in this situation and some won't. It is important that as much spin training as possible is done in types that require the full recovery action. Starting on a simulator is a very good, and cheap, way to practise full standard recoveries. The trainee should be made aware of the variations between gliders and that they should be aware of the spin and recovery characteristics of every glider they fly.

Stall/spin avoidance is the main aim of the training. An inadvertent low spin does not give a pilot time to work out what has happened and recover before disaster. It is logically impossible to provide training in inadvertent spins, although the syllabus requires us to attempt to distract the trainee at the point of entry on some entries, so its importance lies in making recognition, and avoidance or recovery, as automatic as possible.

The crucial action is to move the stick forward to unstall the glider EVEN though the nose is dropping or pointing steeply downwards. It is the inability of pilots to take this action when the nose drops unexpectedly which results in stalling and spinning accidents.

Opportunities for continuous full spins may be quite limited, but taking an aircraft to departure is readily possible and provides the really key point of training: to recover at this stage.

Difficulties in demonstrating/teaching these exercises:

Spin recovery often happens so quickly that there is insufficient time for much simultaneous patter. The trick is to lead with the patter and say *stick central*, f*ull opposite rudder, then stick forward* **before** moving the rudder and stick. There is seldom time to refer to the ailerons, but they can be mentioned in flight, between exercises.

Excessive speed can build up after spin recovery if the pull-out from the ensuing dive is either late, or too gentle. Such a recovery will also use considerably more height. Trainees should be taught to recover with significant G to minimise loss of height. Likewise, if the pilot fails to recognise a spiral dive for what it is, and/or does not roll level before pulling out the speed can become very high. At high speeds and/or high G loadings, avoid pulling out and rolling level simultaneously as the resultant loads on the glider can be very high.

The best way to slow down from excessively high speeds may be simply to accept a high G loading, and **NOT** to open the airbrakes.

Opening the airbrakes in this situation creates additional problems [see chapter 5], chief of which is the change in load distribution caused by opening the airbrakes. This reduces the usual airframe limit load from +5.3G (airbrakes closed), to +3.5G when open. (Typical values for most modern gliders). Additionally, they may suck open very forcefully.

A high-speed high G recovery may be an alarming experience occurring as it does seconds after a spin. It will be less so if the trainee is introduced to it first. It may be helpful to teach them to fly up to the likely recovery speed and pull recovery G before spinning. They will find spins less alarming and be less likely to mishandle early spin recovery attempts.

Keeping the above in mind, have your hand just in front of the stick during the trainee's spin recovery to prevent excessive forward stick movement.

Many pilots think they apply full opposite rudder when in fact all they do is centralise it. Encourage the trainee to apply full opposite rudder if the spin is fully developed.

The SFCL syllabus uses the term 'incipient spin.' It is helpful to point out and demonstrate that for the first half of a turn, the spin is generally not fully established, and a simple unstalling of the wings, by pushing the stick forward, is all that is required. At this stage it may be difficult to determine whether a spin or a spiral dive is going to develop, and applying full opposite rudder at the start of a spiral dive is undesirable. Once a spin is fully established the complete standard recovery is required; this typically takes up to one complete turn.

The Exercises

There are several separate exercises in this chapter:

- The spin
- The spiral dive
- The changing effect of rudder at the stall and a further spin avoidance exercise.
- 2 further spinning exercises

Every trainee must fly at least the stall with wing drop and spiral dive pre-solo. Recognitions of full spins and recovery must be achieved prior to SPL licence standard. The further spinning exercises are excellent for further post-licence refresher training.

THEORY BRIEFING

THE SPIN

If the glider stalls asymmetrically due to yaw, air turbulence, non-symmetrical wing profiles or (most commonly) misuse of the controls, one wing will stall before the other and go down. This increases the AoA and its drag, which in turn increase the yaw rate, stalling the wing further. At the same time, the upgoing wing's AoA decreases, making it less likely to stall and reducing its drag. The two effects combined initiate a rotation.

Unless the glider is unstalled, it will rotate automatically (Autorotation); rolling, yawing and pitching simultaneously and describing a steeply descending helical path.

A stall with wing drop can result in a spin if the glider remains stalled, or a spiral dive (discussed below) if it unstalls. The characteristic symptoms of the spin (i.e., those which are obvious without input from the pilot) are:

- a usually nose-down and rapid rotation of the glider (if the spin is unstable the rate of rotation and the pitch attitude may change periodically and significantly).
- low or flickering indicated airspeed (IAS).
- very high rate of descent.
- no increase in G.

Spin Recovery Action

- **Centralise the ailerons** - to reduce the down going wing's AoA.
- **Full opposite rudder** - to reduce the amount of yaw, and indirectly (as a result of roll coupling) to help pitch the nose down.
- **Move the stick progressively forwards until the rotation stops** - to unstall the glider, even though the nose is already pointing downwards.
- **Centralise the rudder immediately the rotation stops (or when the spin changes to a spiral dive)** - to prevent high sideways loads on the fin as the speed increases.
- **Recover from the ensuing dive**.

Any given glider's spin characteristics are related to several factors. The most important one is the CG position. The further aft the CG (i.e. the lower the pilot(s) weight), the easier it is to spin and the harder it is to recover. Conversely, the combination of a heavy trainee and a big instructor may move the CG forward to the point where the elevator lacks the authority to maintain the necessary high AoA. After half a turn the nose drops - even with full back stick - and the glider enters a spiral dive. The 'spinning glider' appears to recover all by itself. This is NOT an indication that it will not spin, simply that conditions were not favourable for it to do so.

Airbrakes can have a stabilising effect on a spin **but may make recovery more difficult. Flaps** and their effects vary from glider to glider. In general, lowering the flaps (thermal or landing) makes the glider more prone to spin, whereas raising them (cruise settings) will tend to discourage it. A good example is the ASW20 which is reluctant to spin with neutral or negative flap, but spins like a top with landing flap and gear down.

Misuse of the rudder at lower speeds produces different and dangerous effects. When close to the ground, misleading visual rewards (an apparent increase in the rate of turn) may lead the pilot to unconsciously over-rudder which can lead to spinning.

Pilots commonly over rudder when under pressure, and low. This is frequently associated with poor speed control. A possible cause is the visual effect of the lower wingtip which describes a forward track over the ground as we get lower, instead of backwards as is usual at height. This effect typically appears when below 300', depending on groundspeed. When observed in peripheral vision it encourages pilots to apply extra rudder to try to remedy the non-existent problem. The result is extra yaw which lowers the nose against the horizon, which in turn encourages the pilot to bring the stick back. So, they end up in an over-ruddered, low, slow turn, EVEN THOUGH THE ATTITUDE LOOKS NORMAL (the string, of course will be deflected well into the turn). Be vigilant for this problem, especially when the pressure is high e.g. in launch failure training.

THE SPIRAL DIVE

The glider rolls towards the dropping wing but instead of stalling and spinning it goes into steeply descending dive with speed and bank increasing. It is possible to go through Va and approach VNE very rapidly and therefore easy to over stress the glider. It is important to stress to the trainee that the stages of the recovery must be done in sequence.

In a spiral dive:

- The speed increases rapidly
- G increases if the stick is held back or moved back.
- The rate of rotation is markedly slower than most spins.
- The controls feel heavy but are effective.

Spiral Dive Recovery

- Relax the backpressure to reduce G.
- Roll the wings level using coordinated ailerons and rudder,
- **then** smoothly recover from the dive, keeping the wings level.

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Key differences between spin and spiral dive	
Spin	**Spiral dive**
Elevator will not raise the nose	Elevator still effective
Rapid rate of rotation	Slower rate of rotation
ASI low or flickering	ASI increasing rapidly
Normal G	G increasing
Very high rate of descent	Bank increasing
Nose down or 'nodding'	Nose down

MINIMUM HEIGHTS FOR SPINNING - CALCULATIONS

Height loss must be carefully taken into consideration before deciding if it is safe to initiate a spin.

Cockpit weight/CG position is a big factor in how gliders behave when spinning. Weather conditions may also be relevant. For instance, a glider may spin very differently if the wings are wet. The minimum safety height for initiating a spin has to include a safety margin which takes some account of these variables. Some gliders reliably recover promptly, but some have characteristics that can delay recovery and incur extra height loss.

In the case of Non-EASA/JAR Compliant Gliders the flight manual should indicate if the glider was designed to EASA or JAR requirements. If it was not, advice should be sought from the manufacturer unless the flight manual is unambiguous regarding any spin recovery delay and loss of height.

All trainees must be trained to calculate the minimum height at which spinning may be initiated.

Fig 1

The **Lowest Point of the Recovery** is defined as the height at which level flight has just been achieved at the bottom of the recovery dive. In other words, the absolute lowest point of the complete spin and recovery manoeuvre. **<u>This is not the height at which recovery action is initiated.</u>** See fig 1 above.

When instructing, selecting the lowest point of the recovery must make allowance for possible, 'unexpected student actions.' The greatest additional loss of height, is likely to result from a sharp pull out of the dive, inducing a flick and spin in the opposite direction. This is likely to consume a further 400ft. Taking this into consideration gives a sensible target lowest point of the recovery of 700ft. AGL. leaving an additional 300ft to avoid terrain and should, following recovery, yield a regained altitude sufficient to re-join the circuit assuming the exercise is conducted close to the airfield.

When deciding on the **Minimum Height to Initiate a Spin Recovery**, guidance should be taken from the glider's flight manual as to height loss per turn. It should also be assumed that it will take between ½ to ¾ of a rotation to move the controls to the recovery position, plus the possibility of a further full rotation before the spin stops. A further 150 to 250ft should then be added for the dive recovery as appropriate to the glider type.

When instructing, when deciding on the **Minimum Height to Initiate a Spin**, consideration should be given to the factors above and the length of the spin required to teach the exercise effectively.

The Calculation:

<u>**Minimum**</u> height to commence the spin =

Ht loss per turn x the number of turns (see flight manual FM)

Plus

The time to initiate the recovery (assume ¾ turn)

Plus

Any delay to recovery (assume at least 1 further turn)

e.g. trainee fails to recover so the instructor takes control

Plus

Recovery from the dive (see FM)

Plus

The 700' minimum ground clearance

<u>**Recommendations:**</u>

When instructing, prior to any spin training a thorough pre-flight brief must be given, including spin recovery actions and clear handover instructions to avoid confusion as to who should be recovering the glider from the spin and any conflict on the controls

Before spinning and preferably before flight the following should be decided upon:

a) minimum height at which **spinning may be initiated**

b) minimum height at which spin **recovery must be initiated**

ADDITIONAL NOTE: TRAINING GLIDERS FOR STALL & SPIN TRAINING

Unfortunately, many of the two seat trainers currently in use do not spin readily. A two-seater so benign that it can be turned with the stick on the back stop can set a dangerously misleading example to its trainees. If we get ourselves into a difficult situation, such as a low final turn, we all tend to revert to what we first learnt (primacy), and the distraction may well result in our behaviour reverting to habits inappropriate to the type flown. It is worth remembering that gliders do not spontaneously stall or spin, consciously or otherwise it is pilots who stall and sometimes spin them.

It is difficult to find training gliders that spin. Even with the better two-seater spin trainers, trainees need to understand that there can be significant difference in spin and recovery characteristics from other gliders that the pilot might fly in the future.

Some training gliders have the facility to ballast the airframe to allow spinning exercises. It this situation the recovery and behaviour may be unusual making it crucial to read and scrupulously follow the flight manual, including the need for accurate weighing of airframe and contents. **The gliders flight manual must be consulted prior to spinning to find out if there are any CoG requirements or <u>special recovery procedures.</u>**

RECOGNITION AND AVOIDANCE OF SPINS

AIR EXERCISE BRIEFINGS

Before all of the flying exercises in this chapter discuss Threat & Error Management, along the lines of the example below, and the HASSELL check in all of the pre-flight briefings.

TEM

Threats:	**Mitigation:**
Trainee Adverse Reaction	Brief appropriately & monitor trainee
Trainee fails to or overreacts at recovery	Monitor trainee & take over promptly
Collision	Maintain thorough lookout
Errors:	
Running out of height for appropriate circuit	Monitor height and position
Allowing a spin to continue at an inappropriate height	Be prepared to recover before safe margins are eroded

For all these exercises remind the trainee of the aim of the exercise and a brief description of the exercise itself. In the early stages of spin training, fly the first demonstration with the trainee's hands and feet off the controls, until you are sure the trainee will not have an adverse reaction.

RECOGNITION AND AVOIDANCE OF SPINS

SPIN FROM UNDER-BANKED OVER-RUDDERED TURN

MANOEUVRE DEMONSTRATION

THIS exercise is almost a repeat of the earlier 'stall with a wing drop' exercise. (Chapter 9.) Here, however, it is related to a scenario in which you have got a little low and/or far away from the site and unintentionally fly slower than usual trying to stretch the glide.

HASSELL check.

Describe the configuration that potentially leads to a spin

- *Notice that the nose is not high - only just above the normal flying attitude.*
- *Check height from the altimeter (for determining height loss afterwards)*
- *We are in a turn with a shallow angle of bank.*
- *The glider doesn't turn quickly enough so you try to bring the nose round faster with the rudder.*
- *This appears to work because the glider looks as if it is turning more quickly.*
- *Not wanting to increase the bank angle, we oppose that by applying opposite aileron.*
- *The nose starts to go down. We try to stop it with the elevator, but even with the stick fully back the nose will not come up. We are now spinning.*
- *Notice the low or flickering ASI reading*
- *Notice the high rate of rotation.*
- *Notice the normal G.*
- *The stick is fully back but not raising the nose.*

To Recover:

- *Centralise the ailerons,*
- *full opposite rudder*
- *stick progressively forward until the spinning stop*
- *.... centralise rudder, recover from the ensuing dive.*

Check the height. Work out the total height loss and estimate the low point.

TRAINEE ATTEMPTS

As with other exercises the spin is best taught in stages and in this case backwards.

- First teach the trainee to recover from the dive,
- then to recover from the spin, holding the glider in a spin,
- then how to enter the spin.

As failures to spin are almost certain to occur, take the opportunity to cover the spiral dive.

In line with the SFCL SPL Syllabus, when the trainee appears to be 'getting the hang of it.' attempt to generate a distraction whilst they are entering a spin. This intention being to give a feel for what it would be like to find oneself unexpectedly spinning and need a recovery from there.

SPIRAL DIVES

Rather than trying to initiate a spiral dive, make use of those occasions when the glider fails to spin and instead enters a spiral dive. Do not delay recovery too long. If the spiral dive does not happen accidentally then demonstrate it deliberately, by not pulling the stick right back at departure.

- *Notice the increasing speed, increasing G, and the lower rate of rotation.*

To recover:

- *Level the wings with coordinated aileron and rudder,*
- ***and then** ease out of the dive keeping the wings level.*

DE-BRIEFING

Draw to the trainee's attention the dangers of uncoordinated turns, particularly low down. When starting to turn, an inadvertent spin is initially masked by the turn and may go unrecognised. If any doubt exists, move the stick forward.

The approach to an inadvertent spin is typically with the nose of the glider below the horizon, not very different from the normal flying attitude. Reinforce the need to move the stick forward even though the nose is pointing steeply downwards. It is the failure of the pilot to move the stick forward when the nose is going down that allows the glider to spin!

Ensure they are clear about spin & spiral dive recognition and recovery actions. Check that the trainee understands that excessive speed can build up quickly after a spin or in a spiral dive and how to deal with that in relation to Maximum Manoeuvring Airspeed, the limit load and use of airbrakes.

RECOGNITION AND AVOIDANCE OF SPINS

CHANGING EFFECT OF THE RUDDER AT THE STALL

(Misuse of the rudder precipitates a spin)

AIR EXERCISE BRIEFING

This exercise shows the trainee the primary and secondary effects of the rudder at the typical cruise speed, and how misuse of the rudder at lower speeds produces different and dangerous effects. This exercise is more one of spin prevention than simple stall avoidance.

Before any of the flying exercises include Threat & Error Management, along the lines of the example shown earlier and the HASSELL check in all of the pre-flight briefings.

Point out to the trainee that at normal airspeeds they will see the expected effects of the controls, but at very low airspeed the effects will be markedly different.

MANOEUVRE DEMONSTRATION

Complete the HASSELL checks. Fly at normal flying speed.

- *Keep your hands and feet clear of the controls.*
- *Notice we are flying at normal flying speed.*
- *I am going to apply full left rudder.*
- *I want you to tell me how much the glider yaws and rolls.*
- apply full left rudder.
- wait for two or three seconds.
- *How much yaw and how much roll was there?* (Figures in the order of 30° yaw and 10° roll or 'lots of yaw and not much roll' are acceptable)'

If the trainee is not sure what happened, repeat the exercise before continuing with the next part.

Then: fly the glider just above the stall. The glider may need to be 'on the buffet' for this to work.

- *Notice that we are now flying near the stall.*
- *I am going to apply full left rudder again.*
- *Tell me how much yaw and roll you see this time*
- apply full left rudder.
- wait.
- *How much yaw and roll?* (70° roll and 15° yaw or 'a lot of roll and not much yaw').
- *Move the Stick centrally forward to unstall the glider* (Centralise the rudder.)

Emphasise that misuse of the controls near the stall makes the glider spin.

ADVICE TO INSTRUCTORS

The reason for asking the trainee to say how much roll and yaw occurs is to make sure that they have seen the effect for themselves, and to ready them for the second part of the exercise. Do not be surprised to find that the first part of the demonstration has to be repeated. This exercise can be a useful, life-enhancing reminder to pilots who tend to over-rudder turns, particularly the final one!

TRAINEE ATTEMPTS

Teach the trainee to fly the demonstration so that they can appreciate the way in which inappropriate use of rudder can cause a spin.

RECOGNITION AND AVOIDANCE OF SPINS

Spin avoidance exercise – How the glider behaves in a stall in the turn in unbalanced flight - Demonstration only

AIR EXERCISE BRIEFING

This exercise demonstrates how the glider behaves in a turn in both balanced and unbalanced flight. It shows the importance of not misusing the rudder i.e. over-ruddering in the turn.

MANOEUVRE DEMONSTRATION

Perform a HASSELL check.

- Put the glider into a balanced turn at a moderate angle of bank at a normal thermalling speed.
- Gently bring the stick back to the point of stall.
- Point out that it is in a balanced slightly stalled turn.
- Notice the nose is just above the horizon, the yaw string is slightly out to the left and the slip ball is slightly to the to the right. The glider should remain
- on the point of stall, although it may eventually drop a wing.

Then demonstrate what happens if you stall the glider in unbalanced flight i.e. an over-ruddered turn.

- Lookout.
- Roll into the turn but leave in too much rudder.
- Notice the nose is now lower on the horizon but the yaw string is out to the right and the slip ball is out to the left.
- Bring the stick back to the stall, the glider will then buffet and rapidly drop a wing and start to depart into the spin.
- To recover, stick centrally forward, roll the wings level and return to the normal gliding attitude.

Point out that the glider departed much more rapidly in an over-ruddered turn.

DE-BRIEFING

Although trained never to use excessive rudder, there can be psychological pressures (such as being low with the final turn still incomplete) to do so. Due to high workload, even the most experienced pilot may find themselves over-ruddering subconsciously in order to get the glider round e.g.; when soaring at low altitude, doing a low circuit turn, or a field landing.

Misuse of the rudder is not only inefficient, but if the glider is at/or near the stall, it can cause it to spin. The only protection is to take care to ensure the glider is being flown accurately, well away from the stall!

RECOGNITION AND AVOIDANCE OF SPINS

SPIN OFF A STEEP OR THERMAL TURN

AIR EXERCISE BRIEFING

For this exercise to work the speed and steep angle of bank must be steady. The spin entry is likely to be far more dramatic than from an unaccelerated flight condition.

It is necessary to pull back on the stick and hold it back as the wing drops and the rudder is applied. This is realistic since the majority of spins are triggered by misuse of the elevator.

SPIN OFF A STEEP TURN – MANOEUVRE DEMO

Spin training may have concentrated on the spin from an under-banked turn. The purpose of this demonstration is to show that the glider will spin from a well-banked, unbalanced turn at airspeeds normally considered to be safe.

Complete the HASSELL check.

Describe and demonstrate a scenario in which an attempt is made to soar low down, in a narrow thermal. The speed should be well above the normal 1G stalling speed.

- Turn with 45° of bank and at a speed a few kts above the accelerated stall speed for that bank angle.
- *Notice the speed is X kt, well above the normal stalling speed.*
- *The nose looks to be safely below the horizon.*
- Gradually increase the rudder in the direction of the turn, whilst at the same time maintaining the attitude with the elevator, and the bank angle with the ailerons. In some types it works better if you do not use the ailerons against the final wing drop but do get the stick hard back as the nose goes down.
- The glider spins. Initiate the recovery.

Note: the outcome i.e. the glider will spin if a turn is tightened with insufficient speed for the new angle of bank, especially if it is over ruddered at this may also be demonstrated.

SPIN OFF A STEEP TURN – TRAINEE ATTEMPT

This exercise is demanding of the trainee's handling. You may need to start by coaching them to turn accurately at 45° of bank first, then again to use all three controls at once at the appropriate rate to maintain the attitude as long as possible as the glider stalls and ultimately departs into a spin.

DE-BRIEFING

Emphasise that the glider will spin from an unbalanced turn at speeds well in excess of the unaccelerated 1G stall speed. Discuss how inaccurate flying helped initiate the spin. Point out that some of the more usual symptoms, such as a nose high attitude, sloppy controls, and buffet, were not present.

RECOGNITION AND AVOIDANCE OF SPINS

STALL AND SPIN OFF A SIMULATED FAILED WINCH LAUNCH

Demonstration only – EXCEPT FOR PART 3

AIR EXERCISE BRIEFING

This exercise shows that during reduced G the glider will fly at below the normal stalling speed, and that turning before the glider has accelerated to a safe speed after a launch failure can cause the glider to spin. It also demonstrates that after a push-over manoeuvre the airspeed can be less than the attitude might suggest.

Unfortunately, spins from turns commenced after a winch launch failure are a not uncommon scenario and can have fatal consequence.

Discuss the recovery action in the event of a winch launch failure:

- The attitude required to regain approach speed.
- Avoidance of turns or use of airbrakes until approach speed is reached.
- The desirability of landing straight ahead if possible.

There are 3 parts to the exercise:

1. A slow recovery from a winch launch failure leading to a mushed stall

2. A slow recovery from a winch launch failure followed by an attempt to turn with inadequate speed despite ‘normal attitude’, leading to a stall with wing drop or spin.

3. A upper air demonstration of the correct recovery after a failed winch launch i.e. waiting for the nominated approach speed. The trainee then attempts this last part demonstrating the correct push over and pause for the nominated speed to be achieved.

STALL OFF A FAILED WINCH LAUNCH - MANOEUVRE DEMONSTRATION

Remind the trainee of what the normal attitude looks like (typically 50kt).

<u>Exercise part one</u>

Complete the HASSELL check.

Describe a winch launch failure where the nose is lowered to the normal gliding attitude. If the speed decays to below the normal 1G speed during the push-over, then the glider will mush-stall when held in the normal attitude.

- Increase the speed to 70kt. Raise the nose to the attitude appropriate for a winch launch.
- Briefly maintain this attitude and say; *The launch has failed.*
- Positively lower the nose to the normal attitude and then pull back on the stick to maintain the attitude.
- If the timing is right then the glider will settle into a mushing stall.
- If possible, maintain the stall for a few seconds, and then recover in the normal way.

<u>Exercise, part two</u>

Complete the HASSELL check, noting your height at the start of the exercise.

Describe a winch launch failure where the nose is lowered after the failure, but a turn is begun before the glider has had time to accelerate to a safe speed.

- Increase speed to 70kt. Raise the nose to the attitude appropriate for a winch launch.
- Briefly maintain this attitude and say; *The launch has failed,* positively lower the nose to the normal airbrakes closed approach attitude, hold that attitude and immediately commence a coordinated turn.
- The glider instantly stalls, and if the controls remain deflected, as for the intended turn, the wing may drop.
- Bring the stick back to attempt to maintain the attitude and use aileron against the wing drop. (Ie. behave as a panicking pilot would.)
- If possible, allow a spin to develop.
- Recover using stall, spin or spiral dive recovery as appropriate.

Establish how much height has been lost and relate this to a low-level cable break and any wind gradient delaying acceleration to a safe speed.

<u>Exercise, part three</u>

Complete the HASSELL check.

- Describe a winch launch failure that occurs during the full climb.
- Dive the glider to about 70kt and then pull up smoothly into a 45° nose up attitude.
- Assume that the launch has failed.
- Lower the nose to the recovery attitude (below the approach attitude).
- Check the ASI and <u>wait</u> for the airspeed to increase to the nominated approach speed; adjust the attitude to hold the desired airspeed
- Ask the question; ‘Can I land ahead?’
- Do not turn or open the airbrakes until approach speed is attained.
- Release the cable.

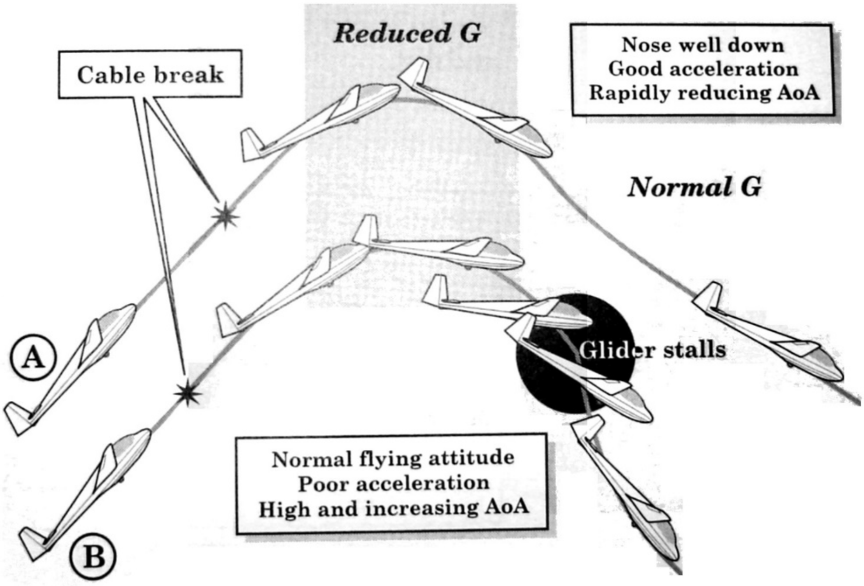
<u>TRAINEE ATTEMPTS</u>

The trainee should ONLY practise part three of the exercise: the correct recovery.

- Explain that you will give them control at the point of winch launch failure.

- Increase speed sufficiently to allow a rotation into the winch launch attitude, then raise the nose to that attitude.
- Briefly maintain this attitude and then say *You have control.*
- The trainee should push over to the recovery attitude and wait for the nominated airspeed (at least 55kts) before adjusting the attitude and manoeuvring.

Before attempting any manoeuvre after a launch failure, the glider must have a safe airspeed. This will require a more nose down attitude than the normal approach attitude (the recovery attitude). This is necessary to avoid a stall on recovery because speed decays rapidly following a launch failure.



Emphasise that attitude itself is not necessarily an adequate indicator of speed. Although the nose was lowered as the aircraft approached the stall, insufficient time was allowed for the glider to regain flying speed. You need to use the reduced G 'window' caused by pushing over to get the glider into a nose down attitude in which it will gather speed quickly. See Figure 2.

For parts one and two of this exercise the airspeed at the peak of the pushover should be below the 1G stall speed but above the 0.5G stall speed. For example, the speed at the peak of the pushover for a glider with a normal 1G stalling speed of 36kt, would be approximately 32kt.

DE-BRIEFING

Ensure that the trainee understands the significance of G on stalling speed and that the normal attitude does not on its own mean that speed is sufficient to manoeuvre. Make sure that they have grasped the importance of checking the ASI before manoeuvring, especially in the event of a launch failure.

COMMON DIFFICULTIES

No habitual response i.e. the trainee has not yet developed the HABIT of making an immediate spin recovery, nor making an immediate dive recovery once the spin has stopped.

Uncertainty about the extent of HASSELL check required, and where in the sky to check for others.

Sickness, disorientation or excessive fright. The exercise will often need to be discontinued and resumed another day.

Lack of understanding of the placard limits - especially manoeuvring speed, the speed above which control movements can damage the glider.

Fails to make the glider enter a spin. This often results from the trainee's misconception that spinning is something that happens quickly. As a result, there is usually a rushed attempt to stall and provoke the spin, followed by a rushed recovery, usually before the glider has done anything very much.

Fails to maintain the spin. Usually due to failure to keep the stick back. This assumes that the glider is a type which can normally be stabilised in a spin.

Extreme forward CG location - i.e. TRAINEE is near the maximum cockpit weight.

Recovery problems. The trainee:

- confuses spin and spiral dive and takes inappropriate recovery action.
- fails to use full opposite rudder.
- inappropriate forward movement of the stick - usually too much, too fast.
- fails to recognise when the spin has stopped.
- continues with spin recovery instead of dive recovery.
- lack of immediate or efficient dive recovery even though the end of spinning has been recognised. The trainee may never previously have encountered such an attitude.
- either keeps the stick too far forward or continues to push the stick forward after rotation has stopped. Trainees often hate the negative G that ensues. Tell those who have trouble with this to bring the elevator neutral as well as the rudder immediately the rotation stops. This also significantly reduces the subsequent height loss.
- fails to centralise the rudder.
- keeps the nose below the horizon after recovery. Speed remains high. Raising the nose would regain some of the lost height

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11a WINCH LAUNCH

SPL Syllabus: Exercise 11a Winch Launch			
(i)	**Signals or communication before and during launch**	**(v)**	**Crosswind take-off**
(ii)	**Use of the launch equipment**	**(vi)**	**Safe and adequate profile of winch launch and limitations**
(iii)	**Pre-take-off checks**	**(vii)**	**Release procedures**
(iv)	**Into wind take-off**	**(viii)**	**Launch failure procedures, simulated during the winch launch**

INTRODUCTION

Winch launching is the most popular glider launch method in the UK with about 150,000 conducted annually. It is a safe means of launching gliders providing the inherent risks are thoroughly understood and mitigated. During early training, the instructor will carry out all the risk mitigation, however the trainee must be taught the risks, to enable their own TEM before solo launches.

The BGA has worked extensively to understand the risks associated with winch launching and educate the members; and this has greatly reduced accident rates. Even so, wing tips still touch the ground during the ground run. The success in getting pilots to have the hand on the release is not always matched by the willingness to actually pull the release when unable to keep the wings level. It is essential the release is pulled as soon as the pilot cannot maintain the correct picture ahead. That is usually before the wing has dropped markedly, well before it touches the ground.

See the on-line video below for the potential consequences.

https://members.gliding.co.uk/wp-content/uploads/sites/3/2015/04/cartwheel_6.mp4

Do not assume that trainees will obtain all the required information by 'osmosis.' Make sure they are aware of the reasons for the BGA rules and operational guidance. That guidance is regularly updated and should be referred to as part of the training process. The new trainee must read the 'Safe Winching' information, and review **with an instructor** during training and most definitely before solo.

https://members.gliding.co.uk/bga-safety-management/safe-winching/

Many clubs operate professionally constructed winches. These modern winches are capable of promptly providing power - considerably more than that needed. It is essential winch drivers deliver power at an appropriate rate. Excessive acceleration makes it difficult for trainees, (and instructors) to keep up with the process. Excessive acceleration may initiate undesirable pitch and yaw moments to the glider.

Clubs are also moving away from steel cables to polymer-based materials. These 'Synthetic' cables have significant advantages over steel. Whichever cable their club uses, both instructors and trainees need to be aware of the significant characteristics of their system.

Winch launching requires a team of people who are competent in the various roles required. Competency requires training and monitoring to ensure the whole process is conducted safely. It is not appropriate for anyone to perform any of the operation(s) in the launch process without close supervision unless they have been trained and 'signed off '.

Winch cables must always be regarded as 'live.' They may move at any moment without warning. Expect the cable to disappear towards the winch without warning. A grass cutter or any vehicle or aircraft crossing a cable can pick it up and move it just as quickly as the winch. Always educate trainees to handle cable so that it will pull out of their fingers if it is moved unexpectedly, rather than wrap around them. Do not get between the parachute and winch and do not loiter in front of gliders after hooking on.

ADVICE TO INSTRUCTORS

Takeover

Things happen quickly when winch launching. **Take over early** if at any stage the launch profile is incorrect, recovery of a failure is inappropriate, or the trainee turns the wrong way. Take over and complete the launch or recovery and landing. Debrief after getting out of the glider.

Do not be tempted to begin winch launch training until the trainee can at least achieve a reasonably straight glide and coordinated turns. It is usually preferable to wait until they have begun to master how to land the glider.

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WINCH LAUNCHING - THEORY BRIEFING

Winch launching overview

Whilst we teach winch launching from the 'top down' i.e. initially allowing the trainee to take control on the upper part of the launch first, it is important to fully brief the whole winch operation. The primary consideration for any launch is that it is conducted safely. Achieving the maximum height is a secondary consideration, but excessively steep rates of climb do not contribute to achieving a greater launch height.

The trainee must understand that whatever the glider characteristics a smoothly controlled rate of rotation consistent with the speed increase is essential for safety. The ability to comfortably recover safely in the event of a launch failure is also a key consideration.

The mechanics of the winch launch are straightforward and can be considered about each axis of the glider in order to anticipate the likely consequences, once the cable is taut and glider accelerating.

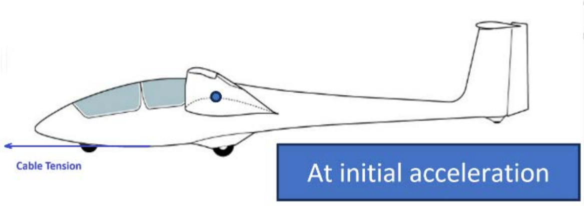
Lateral axis (Pitch)

The glider stalls when the angle of attack reaches a critical angle, and the lift available at that angle of attack depends upon the speed. The path followed by the glider depends upon the balance of that lift and the glider's weight and cable tension. If the lift is enough to exceed them (as a vector sum), then the surplus will cause upward acceleration and a reduction in the angle of attack relative to the air. If it isn't, there will be a downward acceleration and an increase in angle of attack which reinforces any stall. Put very simply: if we rotate more rapidly, we pull more G, increasing the stall speed. For example, A glider with a 1g stalling speed of 34 knots will stall at about 50 knots during rotation on a winch launch if the rotation rate is 20° per second. The stall speed will be about 45 knots if the rotation rate is 15° per second.

A low airspeed and a high rotation rate can arise from a too rapid rotation at low airspeed, or from a rotation with an airspeed that was initially adequate, but which reduces during the latter part of the rotation. Therefore, there must be sufficient airspeed to allow the glider to climb and, additionally, the rate of rotation must be smooth and gradual, so that the increase in angle of attack is small. See Figure 4

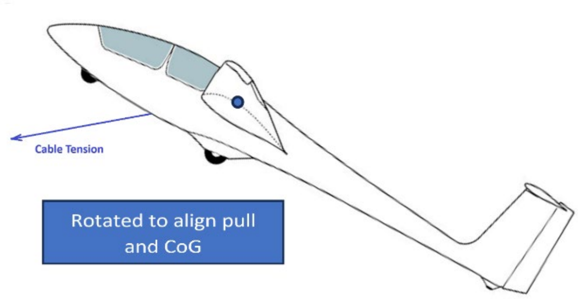
With the glider on the ground, the glider's CoG will be above the line of the cable. Therefore, the pull on the hook will tend to rotate the glider around the CoG i.e. the nose will want to rise.

Figure 1.



Once the wings produce sufficient lift, the glider lifts off the ground and it becomes free to rotate in pitch. As the speed increases the glider, having lifted off, will start to climb. I**f the pilot does not prevent** the nose from rising, the force from the cable will continue to rotate the glider, rapidly increasing the angle of attack i.e. effectively auto-rotating and increasing the risk of a stall.

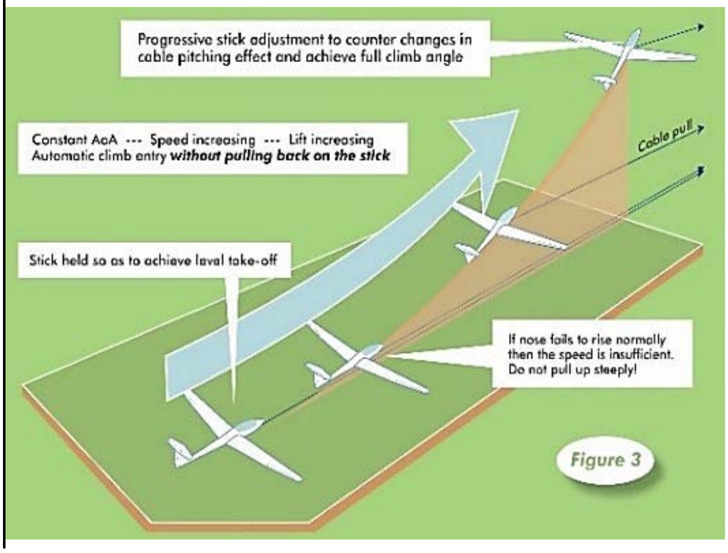
Figure 2



The correct procedure is to start with the elevator slightly forward of neutral. As the 'all out 'is given, and the glider accelerates, use the elevator to balance the glider on the mainwheel and then maintain the glider at or close to the take-off attitude for the initial part of the launch. Provided there is continued acceleration and sufficient airspeed (not less than 50kts or 1.5.x stall speed of the glider, and increasing), the pilot can allow the glider to transition smoothly and progressively into the climb, if anything, the pilot must be ready to move the stick forwards to control a smooth rotation, if the nose tends to rise rapidly.

There must be no abrupt changes of attitude as these entail corresponding changes of angle of attack. If correctly trimmed, no back pressure is needed to achieve the rotation.

The importance of speed monitoring throughout the launch must be stressed. Slow speeds at low level are unsafe. Feeling the acceleration of the glider is equally important. the ASI lags (because of the glider's inertia) and if no acceleration is felt as the glider is lifting off, the launch should be abandoned, whatever the ASI says.



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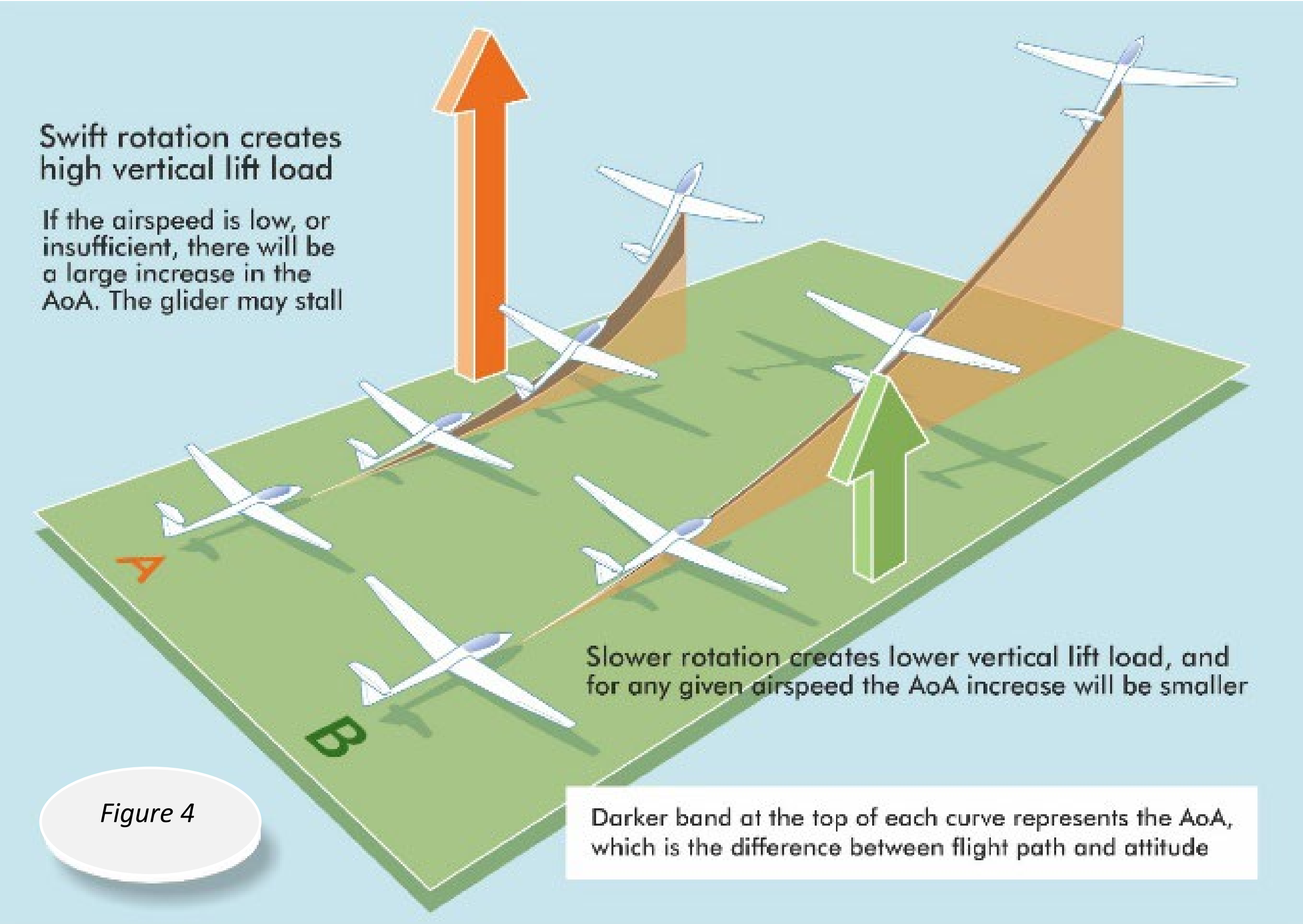

Figure 4

It is important to allow the nose of the glider to climb gradually see fig 3.

Pilots are often concerned about exceeding max winch speeds at the lower part of the launch. However, because the cable is pulling longitudinally to the direction of travel, the stress on the airframe will not be excessive.

The max winch speeds only become relevant in the upper parts of the launch. There is no record of an accident resulting from too high an airspeed on a winch launch.

Longitudinal axis (Roll)

Wing drop recognition: pilots vary considerably in their ability to recognise when the wings are not level, or even when a wing tip is dragging on the ground. Failure to recognise and react promptly to a significant wing drop can be fatal. Therefore, wing drop recognition must be taught from the outset.

The correct position of the horizon to maintain the wings clear of the ground can be described in a variety of ways. It is straightforward on a flat airfield with a distant horizon, but many are not like that, so illustrate to the trainee what the view ahead should look like at the start of the winch run, by sitting the trainee in the glider and getting a wing tip holder to vary the position. Contrast this view with what it looks like if a helper holds the wing tip slightly above the ground.

To maintain wings level at low speed on the ground, full deflection may be required. However, the trainee will often only apply the amount of aileron deflection that would be appropriate to correct similar small errors in bank angle when in flight. Brief them before their first attempts and monitor closely. Emphasise that if the wings cannot be held level the pilot must release before the wingtip touches the ground.

Vertical axis (Yaw)

The glider should always be lined up with the launching cable. However, even when it is, it may yaw as it accelerates. Several factors (see figure 5) cause this:

- An offset release hook.
- The lie of the cable on the ground.
- The wing-tip holder holding back.
- Crosswind.

Many gliders have their winch hooks offset from their centreline. So, when the cable applies its pull, there is a force trying to rotate the glider away from the hook offset. (i.e. Hook offset to left – glider swings to right.)

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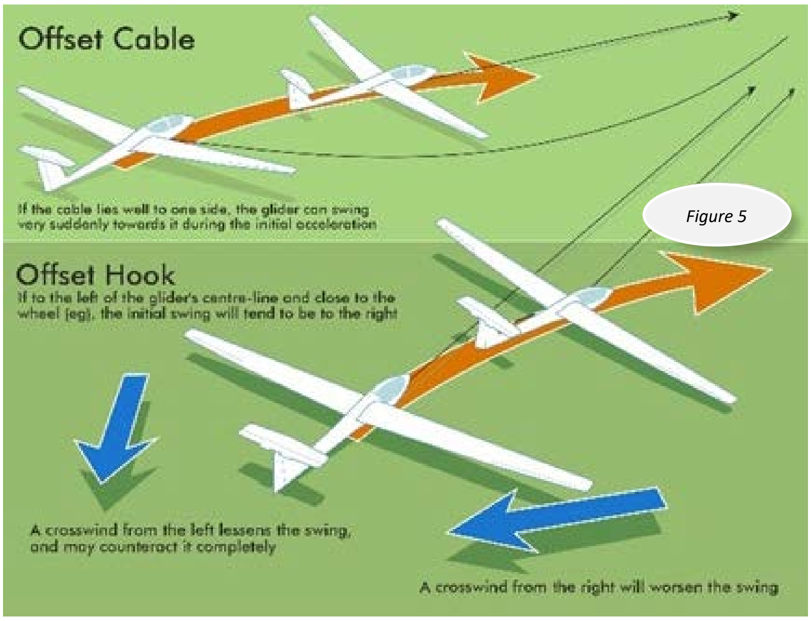

Figure 5

Field layout

The instructor in charge, together with the winch driver, will consider the positioning of both the winch and launch point. Whilst achieving the best height is important, safety is more important.

Consideration must be given to the fall of cable from all stages of the launch, including in the event of a cable break. The pilots must also be aware of where the cable will fall. At sites with limited space or directional options 'laying off' is often required.

Wind conditions may change throughout the day. This can have a significant effect on the safety of the set up.

Landing or taking off into a low sun is hazardous but may be avoided by a small change in the operating direction. There can be significant 'inertia' when it comes to changing the launch set up, particularly if it is late in the flying day. However, safety is important so do not continue when you should not; make the change.

Immediately before getting into the glider at the launch point, assess the wind direction and strength, cable pull-out route and the direction in which the glider is pointing. Do not try to launch with any tail wind component.

If a wing goes down and the pilot releases, there may be a significant heading change as the glider rolls to a stop. Therefore, the launch area must be clear of obstructions in a 45-degree angle either side of the nose for a reasonable distance.

Although the elements of cable, parachute, shock rope, weak link and release rings are common to all clubs, there are innumerable local variations. Trainees and visitors must be made aware of these differences. For example, some clubs will use a coloured hose over the strop cable to identify the weak link, others do not. Trainees should be trained to look at the actual weak link to see its colour.

Cables are often drawn out towards a point alongside the glider rather than directly at it. To minimise the likelihood of the glider swinging as it accelerates, the cable should be pulled in line with the glider. A simple technique to teach ground crew is to pull the cable right across to level with the further wingtip and then drop the end back in front of the glider's nose.

Signalling

Inadequately trained ground crew present a significant safety hazard. Brief the trainee on these ground signals, 'Take Up Slack,' 'All Out' and 'Stop.' They need to understand when they are to be given, who gives them, how they are given and any local methods or variations.

The 'STOP' signal can be given by anybody, including the wing-tip holder if the glider is significantly out of balance. The wing-tip holder must be properly trained to keep the wings level as long as possible and to avoid pulling the wing back as they run the wing. Discuss when and how to signal 'Too Fast' whilst launching. It should only be required in the upper half of the launch. Encourage your trainees to observe the launches taking place prior to theirs. It may provide useful information for planning the launch, such as any yaw and possible reasons, cloud base above launch height, lay off required etc.

Preflight checks

Use the same pre-flight checks; a walk around, A-B-C-D-E & C-B-S-I-F-T-B-E-C for winch launches, as any other launch. Complete the external pre-flight checks. Do not launch if the wings are contaminated with rain, snow. Any increase in stalling speed as a result is unacceptable.

Before getting into the glider, check seat backs are in, if necessary, and locked in position. Avoid using packing between the pilot and seat back, but if it is unavoidable DO NOT use any compressible material. This is important due to the high acceleration involved during take-off. Check for any ballast fitted.

C-B-S-I-F-T-B-E-C has some winch specific considerations. The **T**rim is set for the required approach speed, usually somewhat forward of neutral (nose down) in anticipation of a launch failure. The factors involved in estimating how to set it include the glider type, the cockpit load and desired recovery speed. The position will also depend on the wind speed and combined weight of the pilots. If the glider has

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flaps, they may need to be set differently to that required for aerotowing; always check the Flight Manual.

Ensure the straps are secure and tight, and that all the controls, including the cable release can still be comfortably reached, without risk of it slipping from the grasp in the event of having to pull it.

The Eventualities check is particularly important. Ensure that there are no obstacles in the launch area or anywhere we might end up if we drop a wing and release. Check V_W, the maximum permitted launch speed.

Make a final check of wind speed and direction and consider the launch failure options thoroughly.

Consider:

- how much landing area is ahead
- the headwind component
- any crosswind component
- potential alternative landing directions

Nominate a minimum manoeuvring speed to be adopted in the event of a launch failure. Finally, before closing the canopy and accepting the cable, check for traffic in the circuit. Ask for the cable to be attached, **checking the correct weak link and hook are used**. Once the release is closed keep your hand on the release. If there is a delay between attaching the cable and take up slack, or you hear a 'Stop' signal, pull the release.

Flying the launch profile

During 'take up slack' monitor the rate at which the parachute moves away from the glider, if the speed is excessive pull the release before the rope goes tight to avoid a snatch.

As 'all out' is signalled, look ahead and use aileron as required (possibly full aileron) to keep the wings level, rudder to point the glider along the cable and elevator to balance on the main wheel if possible.

As the glider accelerates it should leave the ground in a level attitude. Maintain the glider at or close to the take-off attitude. Do not attempt to raise the nose. Monitor the ASI and its trend, as you see the airspeed increasing through the safe minimum (around 50kts on most gliders) and feel continuing acceleration. allow the glider to transition smoothly and steadily towards the full climb attitude. This phase should typically take about 5 seconds.

At this point minimum speed is more important than maximum winch launch speed. It is common for the maximum launch speed to be exceeded; do not allow this to be rapidly reduced. i.e. do not pull back. At this point of the launch 'overspeeding' carries no risk because the cable is pulling longitudinally to the direction of travel. In contrast, changing the angle of attack sharply is dangerous.

Once the full climb is reached, monitor both the climb and bank angles by looking at the wingtips. Look forward to see the position of the horizon relative to the edges of the canopy. If it is not symmetrical use coordinated control to roll so a straight flight path is maintained. This will need to be modified if lay-off is required.

Glance at the ASI and again note both the speed and its trend. As the glider gains height, the cable pull direction relative to the glider will increasingly try to pull the nose down. The wings are now not only supporting the weight of the glider but opposing the considerable cable tension. Considerably more back pressure than the trainee is used to applying in normal flight, is needed on most types to maintain the climb attitude.

The back pressure needed increases steadily as the glider climbs towards to the top of the launch. The load on the airframe, the wings and tail in particular increase considerably above normal at the top of the launch. The speed should be maintained at the target ideal speed, i.e. between maximum winch speed and the minimum for the glider and conditions.

If speed is reducing, reduce back pressure, if this does not yield an increase in speed abandon the launch.

Provided there is sufficient airspeed the glider can be held in a climb of up to 45° (check by glancing at the wingtip). **Do not exceed this climb angle because a safe recovery from a launch failure may not be possible at steeper angles, particularly if there is a wind gradient.**

If the full climb angle has already been reached and the speed is increasing towards maximum, signal 'too fast.' This should be done by relaxing the back pressure and yawing the aircraft positively left and right whilst keeping the wings level. – so the winch driver observes a clear signal.

If the speed does not reduce, pull the release.

Inevitably, despite considerable back pressure on the stick, the nose will be pulled down – the horizon moves up the edge of the canopy and may become visible over the nose. At this point release is imminent.

Release Procedures.

At the top of the launch one of the following will happen:

- a feeling of deceleration when the driver cuts the power which may be accompanied by a reduction in airspeed and in the noise transmitted up the cable from the winch. When this occurs, the nose should be lowered to the normal attitude and the released pulled. If the pilot times the lowering of the nose well when the driver cuts the power, then the aerodynamic drag and weight of the cable often causes a gentle back release, minimising the stress on the hook.
- If the winch driver fails to cut the power, lower the nose to reduce tension in the cable and pull the release.
- If the pilot does not release in time, and power remains on, the glider will overfly the winch resulting in a back release accompanied by a bang! This is best avoided.
- If the launch is too slow, too fast or if cloud is encountered, it may be necessary to release the cable early. In these cases, it is safer to release the cable under tension before lowering the nose to reduce the probability of the glider encountering the parachute or cable.

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Crosswind launching

Any crosswind will tend to swing the glider into wind during the ground run. It is good practice to consider these factors before accepting the cable. Apart from the glider no longer going in the right direction swing encourages wing drop.

It is usual for the downwind wing of most gliders to be held at the start of the ground run, to reduce the probability of weathercocking.

Some thought about the launch point set up may also reduce the cable lie problem. If the cable lies to the left of a glider with the hook offset to the left the swing will probably be minimal. It the cable is laid on the right it will be much more significant, particularly if the glider has a nosewheel and the strop pulls around that. For nosewheel gliders, if the cable is laid on the opposite side to the hook offset it should be fed under the glider behind the nosewheel before being attached.

At the start of the ground run the pilot should be ready to apply into wind aileron and opposite rudder to prevent the weathercock effect of the wind on the fin. When launching in a crosswind, it is normal to 'lay off' in order to limit how far downwind the cable will be dropped if it breaks. This is accomplished with the into wind wing low, the yaw string centred. i.e. balanced flight in the upwind direction. Point out that even with the yaw string centred the glider will not feel as though it is in coordinated flight due to the external force from the cable. The lay off should not be introduced until in the full climb. The maximum acceptable crosswind component depends on the glider type. Gliders which sit tail-down and have tailskids are generally more susceptible to crosswinds, particularly on hard surfaces.

WINCH LAUNCHING - EXERCISES

(i) SIGNALS OR COMMUNICATION BEFORE AND DURING LAUNCH

AIR EXERCISE BRIEFING

Only the 'Too Fast' signal is employed in the air and in practice that is likely to be practised on an opportunity basis, so repeated briefings may be required until such an opportunity occurs.

When the opportunity arises demonstrate and patter giving the signal. Point out that the nose should be lowered slightly to reduce the stresses on the airframe and that the aircraft should then be yawed each way whilst keeping the wings level and finally the nose raised slightly to continue the climb.

TEM

Threats:	Mitigation:
A trainee may fail to signal when required.	Monitor closely & take over early rather than late.
Errors:	
A poorly conducted signal may result in the glider being re-directed left or right.	Monitor closely with particular regard to maintaining the correct bank angle.
A poorly conducted signal may fail to get the message across.	Monitor conduct of the signal and if inadequate take over and demonstrate.

MANOEUVRE LESSON

When the opportunity arises allow the trainee to practice the signal. It may be necessary to prompt them to give the signal. Ensure the signal is given clearly and that the trainee resumes the climb appropriately afterwards. They must abandon the launch if it remains too fast.

DE-BRIEFING

Reinforce the correct indication for the signal. Explain how to correct any error/improve.

(ii) USE OF THE LAUNCH EQUIPMENT

Ground briefing to include:

- Field layout, cable and parachute and cable runs
- strops and weak links
- release rings
- key safety aspects

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(iii) PRE-TAKE-OFF CHECKS

EXERCISE BRIEFINGS and DEMONSTRATION

Demonstrate and ensure the trainee understands how to perform the following checks:

Walk-around check – Airframe
Ballast
Controls
Dollies
Environment

Cockpit checks - CBSIFTBEC

Explain there may be variations due to the glider or conditions.

Consider and agree: -

- Maximum winch launch speeds – placard, weak link colour.
- Minimum safe speed to begin the rotation phase.
- Minimum recovery speed following a launch failure for the current conditions, before deciding if landing ahead is possible or manoeuvring / air brake operation.
- Who will fly the launch failure.

Note: Eventualities **must** include the reminders **that if wings level cannot be maintained, we must release immediately.** Also, the speed following launch failure recovery. Finally, to Land ahead if safe and sensible and if not the appropriate direction of turn. Make certain there are no obstructions ahead, and that the wing is clear of the other cables / parachutes.

TEM

Threats:	**Mitigation:**
Errors or omissions in the checks may result in taking off with an inadequately prepared glider	Carefully monitor the conduct of the checks
Helpers & spectators may interrupt the checks.	Encourage third parties not to interrupt. When they do, be very careful the check has been correctly completed. If necessary, start again.
Errors:	
As instructor after hearing the trainees checks many times it can be hard to remain attentive to their conduct.	Take sufficient breaks to maintain your concentration.
Failing to allow for changing conditions.	Stay alert for changes, even on ‘benign’ days.

LESSON & DEBRIEF

Allow the trainee to undertake the checks from an early stage, so they understand their own responsibility for them on subsequent flights. Try to ensure that the trainee running through the Eventualities involves thinking them through, not simply reciting the usual words or assuming they are the same as the previous flight. As these practice checks will precede real flights it is not appropriate to leave the de-brief until later. Question, discuss and correct issues as they arise.

(iv), (v) & (vi) INTO & CROSS WIND TAKE-OFF AND SAFE AND ADEQUATE PROFILE OF WINCH LAUNCH AND LIMITATIONS

Before learning to launch, the trainee needs to be able to control the glider in harmonised flight. They will usually be flying the circuit approach and landings. Before allowing them to progress to flying the take-off, take them through the safe winch program materials on the BGA Website, explaining why the profile is flown the way it is. Knowledge of the consequences of getting it wrong early in the launch will hopefully make our trainees suitably cautious.

EXERCISE BRIEFINGS and DEMONSTRATION

Winch launch take-offs happen too quickly for the instructor to patter everything of significance and even if they could, no trainee could ever retain that information. Many demonstrations will be required, particularly in different conditions: maybe a change in crosswind, different take-off directions etc. These will result in variations in the briefings.

Winch launches should be taught from the top down. Once the trainee is handling the upper stages of the launch, they can attempt the take-off and the critical rotation into the climb.

Remind the trainee of the most significant points of the take-off, in particular those you want them to learn on that flight.

TEM

Threats:	**Mitigation:**
Cable falling onto things or people, on or off the airfield.	Consider the set up carefully to minimise risk.
Errors:	
Underestimating the risk.	Take care and try to arrange a margin in your airfield set-up.
Failing to allow for changing conditions.	Stay alert for changes, even on ‘benign’ days.

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MANOEUVRE DEMONSTRATION

Focus initially on how to achieve the correct and safe launch profile. Demonstrate a full launch, with the trainee following through on the controls, while you patter, to cover the points above. On subsequent launches allow the trainee to take control late in the climb, to maintain it and finally release. Once they can maintain direction attitude / speed & any lay off, progressively give them control earlier in the launch.

Flying the launch profile

Ensure the following key points are re-enforced.

- Ensure the hand remains on the yellow knob to release immediately if necessary.
- When 'all out' is signalled, look ahead and use aileron as required (possibly full aileron) to keep the wings level, and rudder to steer. Balance on the main wheel if possible.
- Monitor the ASI frequently.
- As the glider accelerates it will leave the ground in a level attitude, the last part to leave the ground should be the main wheel.
- Do not attempt to raise the nose and use the elevator to maintain the glider at or close to the take-off attitude. Monitor the ASI and its trend.
- Only once the minimum ***speed for rotation*** has been reached and is increasing, allow the glider to transition smoothly and steadily to the full climb attitude.
- Monitor both the climb and bank angles by looking at the wing tips.
- If the full climb angle has already been reached and the speed is still increasing towards maximum signal 'too fast.'

TRAINEE ATTEMPTS

After the initial demonstration, the trainee should only be allowed to take control once the glider is established in the full climb, and at a steady speed. If the trainee is ready, has been briefed correctly and has seen a number of effective demonstrations they should handle the top third or so of the launch without too much difficulty. Only the load on the stick at this stage of the launch will be new to them.

Once the top third is being flown OK the whole launch from the top of the rotation should also follow with few difficulties. In subsequent flights the trainee can take-over at a progressively earlier stage

The take-off and rotation however need to be handled carefully. Much is happening quickly and if anything is not as it should be do not hesitate to take over. Wasting time prompting here may result in an accident!

Be extra alert during the take-off, initial climb, and following any launch failure. Hover your right hand behind the stick ready to take over if the trainee tries to climb too steeply. Have your left hand on the release, and if possible, also lying over the airbrake lever to prevent the brakes being inadvertently or deliberately opened at the wrong moment. Be prepared to release immediately during the ground run if a wing threatens to or actually touches the ground. Be ready to prevent any or excessive forward stick movement if there is a low-level failure.

On or close to the ground, the effect of a prompt on the trainee's conduct of the launch is unpredictable. **If a potentially hazardous situation develops do not prompt, take control.**

In the event of an unacceptably rapid pitch-up after take-off, taking over immediately and doing something about it safeguards the situation and reinforces to the trainee the severity of the situation. Debrief it later! If your hand is hovering just behind the stick (not actually touching it), then taking control will come naturally and quickly.

The ASI must be monitored frequently. Sometimes a questioning de-brief will indicate that whilst the launch may well have been flown correctly, the trainee had little, or no idea of the speeds involved. The ability to monitor the airspeed effectively during these busy seconds will only come with practice. Initially you, as the instructor, must do it for the trainee and, as ever, be ready to take control.

Crosswind launches

Trainees often struggle to maintain an appropriate or steady lay off. Demonstration of appropriate response to various crosswinds will address the former. Often insufficient reference to the wingtips once in the climb aggravates the problem.

Remind the trainee that the layoff should not be introduced until in the full climb.

DE-BRIEFING

Given the brevity of a normal take-off, it can be challenging for an instructor to spot every point worthy of mention, and to do so would overload the trainee. Pick one or two key points to emphasis.

(vii) RELEASE PROCEDURES

AIR EXERCISE BRIEFING

The trainee will have seen several demonstrations of the release procedure before they do it themselves. This exercise is normally combined with the trainee flying the upper part of the full climb.

TEM

Threats:	**Mitigation:**
Collision	Maintain thorough Lookout
Errors:	
The trainee may release under tension causing cable issues at the winch.	Brief and demonstrate the correct procedure carefully.

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The Flying

MANOEUVRE DEMONSTRATION

It is not necessary to devote a complete launch just to a demonstration of the release. It should be incorporated in the teaching of the upper part of the launch. Point out to the trainee that the end of the launch is imminent and release as required.

Once the cut in power by the winch driver is felt, the pilot lowers the nose to the normal attitude and, if the cable does not immediately back release, they should pull the release.

If no cut in power is felt, the pilot must decide when they are at the appropriate position to release, then lower the nose definitely and immediately (before the cable comes tight again) pull the release. The sequence is always 'lower the nose, then pull [the release].'

TRAINEE ATTEMPT

Assuming the trainee is appropriately handling the upper part of the launch then they are ready to release, initially when instructed and as they gain experience, when they see fit.

DE-BRIEFING

Only the timing of the release presents any difficulty and if that is not correct then advise as required.

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WINCH LAUNCH FAILURES

INTRODUCTION

Any instructor teaching winch launch failures must obviously be current at the exercise themselves. If the site is difficult or restricted the TEM pre-planning must be thorough and the instructor must be ready to take over if the trainee deviates from what has been determined as the safe plan.

Advice to inexperienced, recently qualified instructors is to make the launch failures you teach initially very straightforward: obviously land ahead or obviously no room ahead. Remember that an important part of the training is to convince the trainee that they can easily handle these situations themselves. This object is defeated if the instructor has to take back control because the manoeuvring required is so difficult. The situation should at all times be comfortably within the instructor's control, not pushing *their* limits.

At large sites cable break options are usually plentiful and easy, but we should be teaching trainees to deal with launch failures at any site. A concentrated session of training is advisable just before solo and regular refresher training later. The trainee may have managed comparable tasks, e.g. stall recovery, circuit planning etc., but the workload during a launch failure/cable break may be too high for them. If you are not demonstrating, then be prepared to take over. Taking over and turning the exercise into a demonstration is safer than prompting.

Airfield set up

The winch run should always have overlapping options in the event of a launch failure. i.e. there should be sufficient height to safely turn before there is too much height to land ahead.

The land ahead option should not require anything other than full airbrake to accomplish, once approach speed has been reached. Whilst it may be possible to get in using full brake / side slip / energy dump combinations, if the winch run has been set up correctly in those situations, turning is likely to be simpler and have a better outcome.

Be aware of light / zero wind conditions, the rate of climb is markedly lower, and landing distance is longer. The glider will fly a very considerable distance in ground effect as during the ultralow failure demonstration.

Be cautious of wind changes during the day. While you are focusing on instructing it may have changed and eroded the margins for safe cable break options.

When judging the point at which to initiate a simulated cable break (by pulling the release) in launch failure training, consider using distance along the winch run rather than the altimeter. Pulling the release in the first ⅓ of the run should give a comfortable land ahead option, and anything over ½ way an abbreviated circuit. Between those two there may or may not be room to land ahead, depending on the airfield and the strength of the wind.

Given the rather poor view of the airfield ahead from the back of a typical two-seater climbing steeply, inevitably, we will pull the release at the wrong time on occasions. It is particularly important to fly the launch failure we have, not the one we wanted.

Ongoing Launch Failure Training

Launch failure training does not stop once the exercises have been signed off. Pre- and post-solo trainees need to be checked frequently with a range of launch failures. Also, experienced pilots should prove they can handle launch failures safely, preferably at least once a year.

When to teach

This is a particularly important part of Winch Launch training, and a thorough classroom briefing is required. Trainees not only need to know what to do, but why they should do it. Once the trainee can fly the launch profile consistently in different wind strengths and directions and perform the approach and landing well, they are ready to handle the additional pressure of launch failures.

i.e. the trainee should be able to

- Judge the circuit, to put the final turn in about the right place.
- Achieve a stable approach (Speed, centre line & descent rate.)
- Do a fully held off landing.

Teach trainees to expect a launch failure and be surprised when they reach the top of the launch. For example, during Eventualities, using words such as '*When the launch fails I will* ….'. Rather than; '*If the launch fails I will…*'.

A number of launch failure causes need to be considered. Depending on the type of failure there will be different noises and or sensations. It is important for the trainee to recognise the reduction in (power) airspeed, rather than reacting to a loud bang, which will not always occur. Simulated and real cable breaks tend to be sharp and obvious. Winch failures often die away gradually. It is important that trainees experience both varieties.

Start by demonstrating and practising launch failures as an upper air exercise.

Then, demonstrate launch failures at different heights before they are practised by the trainee. Begin with the low launch failure and a land ahead first. Then the high launch failure with a mini-circuit, followed by the **Ultra-low-level failure which should be done as a demonstration only**.

Trainees need to be taught to consider the minimum safe speed/height combination for launch and launch failure options and nominate the approach/recovery speed before taking off for every flight.

Typical demonstrations of launch failure, with the instructor pulling the release, provide inputs which will not be present in actual launch failures. It is possible for the trainee to feel the instructor start to pull the release before the cable comes off the hook. Failures initiated by the winch driver are often preferable. Some of these should consist of a slow reduction in power. The weak link failing or a cable break very close to the glider can feel similar to pulling the release, but most failures are rather more subtle.

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Simulated failures at early stages of the launch, where there is a risk of flying into the cable parachute, should always be initiated by the winch. Higher up, there is the drawback that the winch driver may not be able to judge the height accurately, giving a simulated failure not at the height the instructor wanted. This drawback must be balanced against the advantages just described

The introduction of Polymer based cables for glider launching has much improved reliability, but they still fail occasionally. When they do fail it is usually with little or no noise. A winch running out of fuel during launch, would give progressive deceleration.

LAUNCH FAILURE PROCEDURES, SIMULATED DURING THE WINCH LAUNCH - THEORY BRIEFING

After any launch failure the objective is to avoid stalling, maintain as much energy as possible and land safely. To that end it is important that our trainees respond to any failure however it presents. Treating a poor or 'unusual' launch as a failed launch is the safe option.

Following any launch failure:

- Lower the nose to an appropriate recovery attitude, while checking the ASI.
- Wait until the approach speed has been achieved.
- Plan a safe approach and landing.
- Monitor airspeed.
- Fly the approach and landing accurately (keeping the string in the middle).

Recovery

Except for the very lowest of failures, this will require the nose to be promptly lowered to the appropriate attitude for the phase of flight, which reduces the angle of attack.

The degree of stick movement will depend on the attitude of the glider at the time. Immediately after take-off, before the nose has been allowed to come up at all, little or no forward movement will be appropriate. From the full climb a positive movement forward is needed and will need to be held until the glider has accelerated to the appropriate speed. A reduction in G will accompany the significant pitch attitude changes from 'nose up' to the recovery attitude, which will be below the normal approach attitude for the day.

A push-over at zero G is ideal; the glider will not stall at this loading and it provides a 'window' in which to achieve the nose-down recovery attitude, from which the glider will easily accelerate to an appropriate flying speed even if the airspeed is very low when the normal 1G force returns.

It is important to consider the wind gradient: on windy days, the launch may have been given a boost in energy as the glider climbed into faster moving air. Unfortunately, that will be lost again when descending. Whatever the phase of flight, lowering the nose to the appropriate recovery attitude should not be delayed. Typically, we set a minimum approach speed and a target +5kts higher.

The recovery attitude enables safe airspeed to be recovered as quickly as possible. Once this is done, the aim is to maintain an appropriate airspeed for the phase of flight. It will take time for the glider to accelerate, and the pilot **must wait for the speed** to reach the correct value. Once the target airspeed has been reached in the recovery attitude, speed will increase beyond the target, **so make a correction to the attitude to steady the speed**, this will change the picture ahead. Once the glider is maintaining approach speed the correct picture over the nose can be seen and the possibility of landing ahead judged. **See figure 6 below**

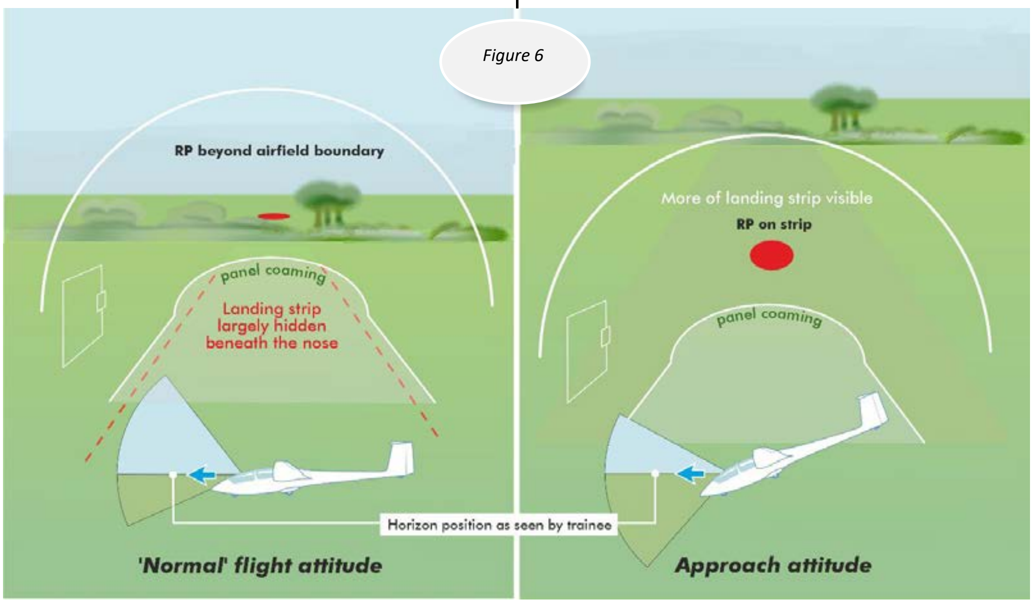
Planning and judgement

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

The first question is 'Can I land ahead'? If the nose is not lowered sufficiently after a launch failure at anything more than a few hundred feet, the airfield perspective will look wrong, and there won't appear to be sufficient room to land ahead (figure 6). The trainee will conclude 'No' to the question and almost certainly turn. Given the initial attitude and speed, giving a high angle of attack, a spin is highly likely.

The correct answer to the question is only apparent once the nose has been lowered to the approach attitude. If the answer to 'Can I land ahead?' is then 'Yes', do so!

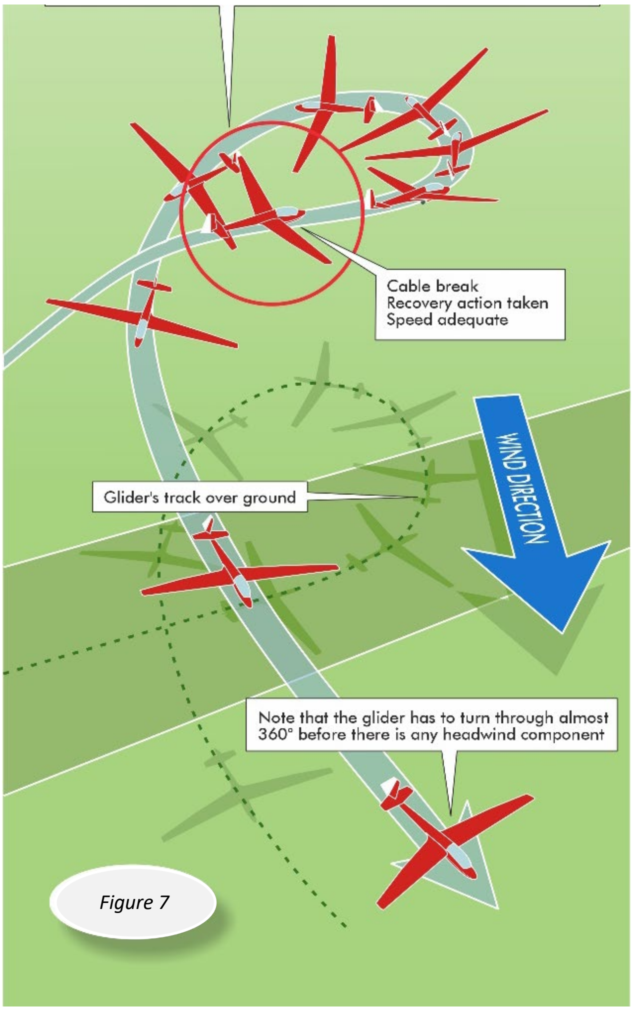
Figure 6

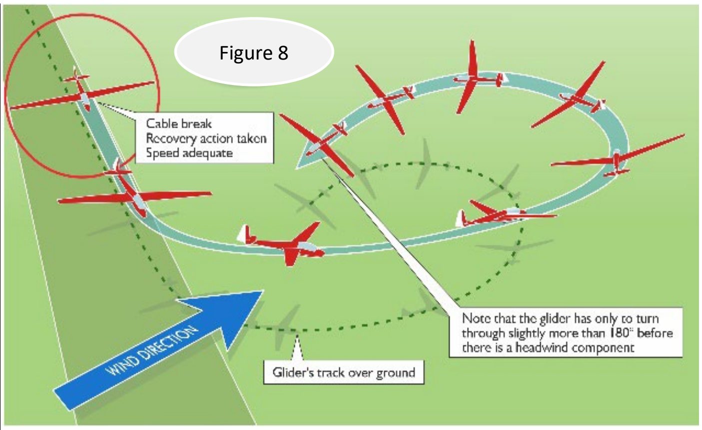


At small or restricted sites, 'Is there enough space to land ahead?', can be a tricky question, as the answer 'No' may occur at modest height. If this is the case then assuming that height is modest for turning, then the next question would be 'Do I have to land directly ahead?' Would a small change of direction make more space available, by, say, taking advantage of any crosswind or a corner of the airfield.

If it is impossible to land ahead, then, whilst maintaining the target speed, commence the turn in the direction decided before take-off, i.e. based on any crosswind component, the airfield layout, and terrain. In most cases an upwind turn is not the best decision (figure 7.) The glider has to turn through more than 360° to get back into wind. If the cross wind is strong and the break is at an awkward height, it may be impossible to return to the site.

A downwind turn first is best (figure 8), unless it takes the glider over the lee slope at a hill site, say, or is inadvisable for other reasons which are peculiar to the site. Those reasons apart, turning downwind offers more options, and the angle through which the glider has to turn is smaller.





- if you decide to turn, be aware that your airspeed may be less than the apparent ground speed when travelling downwind. The illusion is strong when relatively close to the ground and may tempt you to slow down. Monitor the airspeed closely.
- If, after turning 270°, you are below your normal final turn height, level the wings and land as soon as it is safe to do so. Do not continue an already low turn simply for the convenience of landing into wind.
- Depending on the circumstances, the circle can be extended into a more or less truncated circuit. The decision to turn in is then the same as the one to be made when running out of height in the circuit. The final turn should normally be completed at the same height as any other final turn. At restricted sites, a lower-than-normal final turn may be unavoidable.
- Off-field landing: Do not exclude this possibility at restricted sites, or elsewhere, especially when other choices might involve a very low final turn. An off-field landing might be a good option at some hill sites.
- The 'S' turn involves a fair amount of manoeuvring, often at low altitude and even on narrow strips is seldom appropriate. It can lose you more height than a straightforward circle but if poorly executed, the glider can arrive higher and nearer the upwind end of the airfield than it would with a straight-ahead approach using airbrakes.

Cable release

After a launch failure has occurred, the drogue chute and a length of cable very occasionally remain attached to the glider. If significant it normally pulls itself out of the back-release, if not it does not matter. **The priority is to fly the glider.**

For straight ahead launch failures, the strop/cable is extremely unlikely to cause a problem even if it does not back release. So:

- Fly the glider
- Action the plan i.e. focus on landing safely.
- If a turn is required - pull the release.

The club's standard operating procedures should have considered and mitigated the risks of where cables and strops are likely to fall in the event of emergency procedures such as launch failures.

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WINCH LAUNCH FAILURE EXERCISES

WINCH LAUNCH FAILURES

AIR EXERCISE BRIEFING

Remind the trainee of the theory involved and explain what you will demonstrate, and which points you particularly want them to observe. Brief one exercise at a time: Upper Air Exercise, Straight Ahead failure, Failure requiring a short circuit and finally a demonstration of an ultra-low-level failure. Things happen quickly in these exercises, and a thorough briefing is essential if the trainee is to get the most from them.

In summary the correct sequence is:

- unless close to the ground, lower the nose to the recovery attitude (below the approach attitude)
- wait until the approach speed is attained
- is it possible to land straight ahead?
- check the airspeed again
- if it is not possible to land ahead, select alternatives
- release the cable (only if time permits).
- continue to monitor the airspeed
- do not turn or open the airbrakes until approach speed is attained.

TEM

Threats:	Mitigation:
Collision	Maintain thorough Lookout
Errors:	
Not lowering the nose promptly to recovery attitude	Monitor adequate response/takeover
Running out of height for appropriate circuit	Monitor height & position

WINCH LAUNCH FAILURES

Upper air exercise

MANOEUVRE DEMONSTRATION

The intention is to simulate a launch failure in the full climb.

After the HASSELL check,

- Increase speed to about 70kt and then pull up smoothly into a 45° nose up attitude.
- immediately state that the launch has failed (do not say ‘Bang’ or pull the release).
- lower the nose to the recovery attitude (below the approach attitude)
- wait for the airspeed to increase to the nominated approach speed.
- Ask the question: ‘Can I land ahead?’

TRAINEE ATTEMPTS

Allow the trainee to fly the exercise until they can push over at the appropriate rate, to the appropriate extent and then wait while the nominated speed is attained. They should ask the question: ‘Can I Land Ahead?’ Get them to repeat the exercise until they can do the whole thing smoothly.

DE-BRIEFING

The exercise is not difficult and after a few attempts trainees usually get it right. Take the opportunity to reinforce their understanding of launch failures generally and the important pre-decision on landing options.

WINCH LAUNCH FAILURES

Straight ahead launch failure

MANOEUVRE DEMONSTRATION

Fly the manoeuvre from a height where a straight-ahead landing is clearly the only option. Be careful to concentrate on the key and safety critical points. Stress that, whilst time must not be wasted, there is plenty of time to conduct the change of attitude, and take the time to assess whether there is room to land straight ahead safely.

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TRAINEE ATTEMPT

Try to repeat the conditions of the demonstration accurately so that the trainee sees the same picture post failure. Monitor them carefully to ensure that they respond appropriately. Ensure they do not start to turn before they have waited for the nominated speed and allowed time to ask the question; Can I land Ahead?' Monitor speed and accuracy of flight carefully. If either of these is noticeably in error, take over and fly the rest of the exercise. Do not hand the glider back to them. Re-brief for another attempt when back on the ground.

DE-BRIEFING

If the exercise was not flown well then point out the errors in the order they occurred. This can form the briefing for a further immediate attempt if that is possible.

If the exercise has been well conducted, say so. However, point out that even then they will have to repeat it several times under a range of weather conditions and on all the available launch directions.

WINCH LAUNCH FAILURES

Launch failure requiring a modified circuit

MANOEUVRE DEMONSTRATION

Fly the manoeuvre, being careful to concentrate on the key and safety critical points. Stress maintenance of safe speed all the way down, once it has been regained after the failure.

Sometimes on a practice 'go round' launch failure, the cable will have been released too early. Thus, having adopted the recovery attitude and achieved the required speed, on asking the question; 'Can I land ahead?' the answer will actually be 'Yes.'

If this is the case then that is what you must do, even if you are at a safe height to do a short circuit. Turning when you do not need to is teaching the trainee to do something potentially dangerous. Instead apologise the exercise did not go to plan and repeat it with appropriate modification.

TRAINEE ATTEMPTS

In the early stages of cable break exercises, tell them exactly what you are planning and what you expect them to see and do. If the upper air exercise has been conducted thoroughly, they should only require a few attempts to handle this exercise.

DE-BRIEFING

Whilst there is plenty of time to conduct this manoeuvre, trainees often do not find that to be the case. Rushing the procedure is common and should be discouraged. Strict adherence to the correct procedure including waiting while the speed recovers and only after that making the decision.

WINCH LAUNCH FAILURES

Ultra-low level launch failure

This exercise is a demonstration only, as there is insufficient time to recover any mistakes made by the trainee. However, trainees will benefit from practice on a simulator, if available. There is a simulation video on the BGA website under Instructor Resources.

A thorough briefing is essential so that the trainee understands the issues. It will need to be demonstrated more than once to reinforce the key points.

Response time is limited, so if you lower the nose dramatically too close to the ground, a potentially serious heavy landing will ensue.

Conversely, if you have enough speed to start the transition and the launch fails, you have a lot of energy - if you just hold the take-off attitude you will be climbing. You need to adopt an appropriate attitude i.e. you may have to lower the nose slightly to stop the glider climbing any further - think ballooned landings! The technique is essentially the same.

DEMONSTRATION

The exercise must not be simulated by pulling the release. Talk to the winch driver and ensure that they understand what is to be done and that they have been trained in this exercise. Be aware of light / zero wind conditions. The glider will fly a very considerably distance in ground effect during the ultra-low failure demonstration. Be aware that although you have asked for an ultra-low launch failure, it may not be at the planned height – deal with the one you get – not the one you asked for.

If the power has been cut just after the glider has left the ground, it will not yet have transitioned into the climb and may well be doing less than the minimum speed for transition i.e. 1.5 x the unaccelerated stalling speed for the glider. Carefully lower the nose (if necessary) to the appropriate attitude. DO NOT open the airbrakes; wait for the glider to land. If it has already gone through the minimum speed for the transition, still adopt the same attitude, but it may be possible to very carefully open a small amount of airbrake.

The cable must not be moved after the glider has stopped, until it has been confirmed from the glider or launch point that the glider is safely clear. At the conclusion of this exercise the glider is likely to be close to the cable, possibly over it.

Fly the manoeuvre, being careful to concentrate on the key and safety critical points. In particular, stress the lack of urgency to open the brakes.

DE-BRIEFING

Debrief the exercise with reference to what went well and what did not. Point out **what you did not do**: in particular not 'pushing the stick forward.' Probably, any forward movement was small or possibly non-existent. Discuss if and when you opened the airbrakes, and the caution with which they were opened.

COMMON DIFFICULTIES

Too abrupt a transition into the climb. This may mean that the trainee has never had a decent demonstration of what it should look like in the prevailing conditions. Do not be afraid to re-demonstrate if prompts or descriptions do not work. This part of the launch is over too quickly to give you an opportunity of correcting the fault in flight, and if the trainee climbs too abruptly, both of you are at risk!

Fish-tailing up the launch is usually caused by a failure to apply sufficient (or any) rudder to counteract the adverse yaw which results from small aileron inputs. The trainee may also be nervously bracing himself against the rudder pedals and finding the rudder 'very heavy.'

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

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

Releasing under tension at the top of the launch, can cause time-wasting breaks and tangles, particularly if it is a winch using piano wire. Releasing under tension does not offer any significant height gain and increases wear on the hook.

Does not use sufficient aileron to keep the wings level whilst still on the ground. Stress the importance of keeping the wings level and the need for full aileron promptly applied. Stress the need to release before the wing touches the ground.

Tries to take-off too soon. This should be strongly discouraged as it can lead to very swift rotation into the climb at the worst possible moment. Watch out for this if the ground run is longer or faster than usual, and/or the ground is very rough. Get the trainee to run the glider on the mainwheel, not the mainwheel and the tailskid/wheel. Lack of headwind lengthens the ground run and can induce this problem.

Veers off to one side during the climb. The trainee needs a reference point to help keep the line of the launch.

The trainee rushes the launch failure recovery resulting either in excessive negative G or does not take the time to let the speed recover or starts to turn prematurely. More practice at the Upper Air exercise to give them confidence is required.

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11b - AEROTOW

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

INTRODUCTION

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

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

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

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

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

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

Before sending someone solo on aerotow, they must be given control when the glider is out of position and banked relative to the tug and be able to demonstrate their ability to recover to the normal tow position. It is insufficient to simply position the glider off to one side and then hand back to the trainee to correct. The acceptable displacement depends on the controllability of the tug and the angle of the rope. Ensure the rope is an adequate length. The longer the rope, the more scope there is to allow a trainee to get out of position.

Converting solo pilots

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

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

SAFETY & TUG UPSETS

Responsibilities

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

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

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

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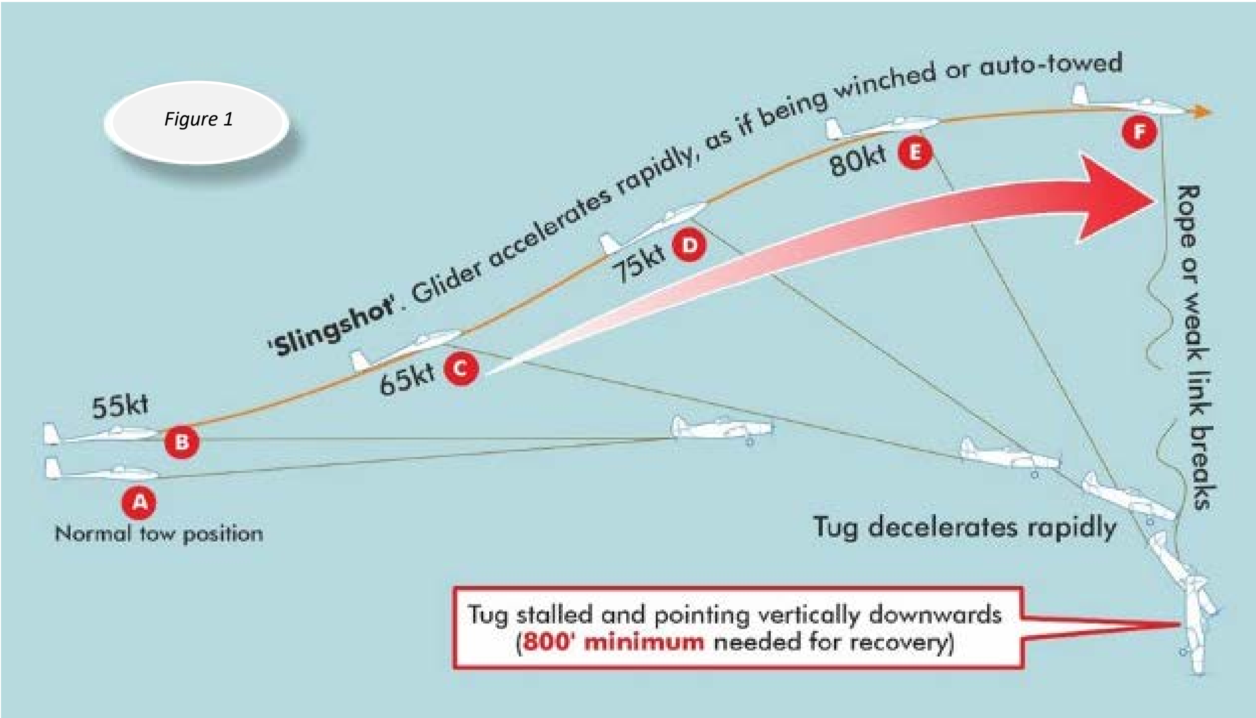
combination. Higher up, the glider pilot can help, but this must not distract from the primary task of maintaining the correct position behind the tug. Up to 1,000' agl the release knob should be held, albeit in a fashion where turbulence is unlikely to cause unintentional release. As already noted,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

The problem

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

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



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

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

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

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

Tug Upset Prevention

When things have gone wrong, the pilot <u>must</u> release immediately if:

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

The following factors increase the probability of upset:

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

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

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

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

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

AEROTOW THEORY BRIEFING

SIGNALS & COMMUNICATION

Ground signals

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

Airborne signals

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

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

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

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

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

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

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

PRE-TAKE-OFF CHECKS & GROUND OPERATION

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

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

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

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

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

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

TAKE-OFF

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

Initial Acceleration The vertical position of the tug in the canopy as the rope goes tight gives a good approximation to the correct vertical position on tow for most gliders. Until the glider becomes airborne, the rudder is used to steer the glider, and the wings are maintained level with aileron control. As the acceleration is modest, the controls will be relatively ineffective for several seconds, particularly with modest headwinds. Full control deflections may well be required. Trainees are often reluctant or find it difficult to use full control deflections: it is something they will not have needed to do when handling the aircraft at normal speeds aloft. Stay directly behind the tug using the rudder control.

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

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

Aerotow in a Crosswind

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

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

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

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

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

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

Once the tug is airborne it should climb and simultaneously accelerate. Continue to keep the tug in the same position in the canopy. There will be an increase in airspeed if the combination climbs through a wind gradient and that effect will be more marked if the tug has been 'held down.'

If the glider gets low in relation to the tug, a hurried climb to get back 'into position' can lead to the glider accelerating up through the wind gradient into a 'slingshot' and send the tug straight into the ground (see earlier section on 'tug upsets').

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

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

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

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

ON TOW

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

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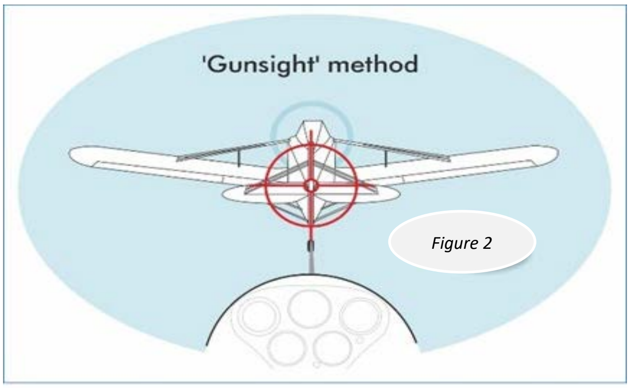

Figure 2

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

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

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

Vertical Positioning Behind the Tug

If the glider is above the slipstream, it is said to be in the 'normal tow' position. If below the slipstream it is called the 'low tow' position. In the normal tow the glider is positioned just far enough above the slipstream to keep the glider clear, making allowance for rough air and the fact that the pilot will rarely maintain position perfectly.

Limit - High

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

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

Limit – Low

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

Lateral Positioning Behind the Tug

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

The force required to keep a glider 'out of position' laterally only exists if the tug and glider's angles of bank differ, so to maintain or return to the correct lateral position, simply keep the glider's wings at the same angle of bank as the tug's, and the force in the rope will do the rest.

Limit-Left/Right

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

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

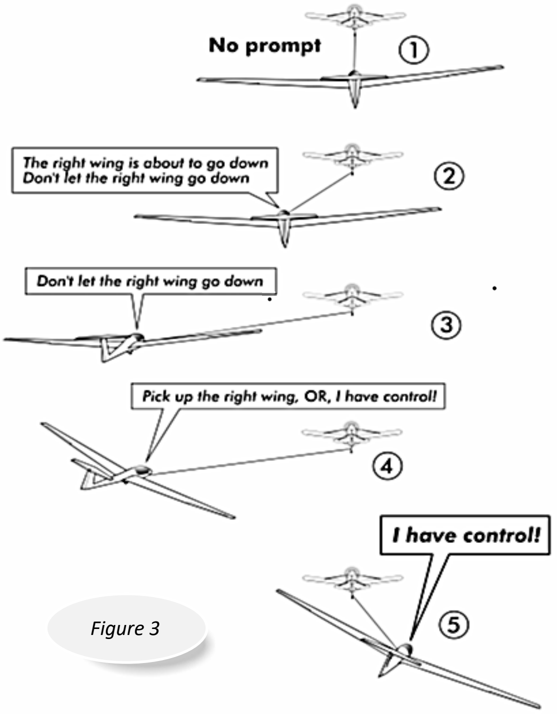

Figure 3

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

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

Slack Rope

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

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

Turning

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

Lookout?

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

OUT OF POSITION

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

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

RELEASING

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

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

The release procedure is:

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

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

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

DESCENDING ON TOW

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

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

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

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

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AEROTOW AIR EXERCISES

TEACHING CONSIDERATIONS

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

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

(i) SIGNALS OR COMMUNICATION BEFORE AND DURING LAUNCH

AIR EXERCISE BRIEFING

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

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

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

TEM

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

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

TRAINEE ATTEMPTS

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

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

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

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

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

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

DE-BRIEFING

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

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

EXERCISE BRIEFING, DEMONSTRATION & LESSON

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

In specific relation to aerotowing, consider and agree:

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

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

TEM

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

DE-BRIEFING

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

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

AIR EXERCISE BRIEFINGS

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

TEM

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

MANOEUVRE DEMONSTRATION

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

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

Before the rope tightens, check that it is still clear ahead and that there is no conflicting traffic. If there is, release immediately. Otherwise, as movement commences get a little ahead of things by pattering what you know is about to happen and follow that with any oddities of the launch. (e.g. '*I'm needing full left rudder to keep straight.*') Point out what you are doing to keep the wings level and glider running on its mainwheel. In practice there is not time to patter everything that is happening, but over a number of take-offs it should be possible to cover all aspects.

DE-BRIEFING

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

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

EXERCISE BRIEFING

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

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

Teach aerotow in the following sequence:

- Normal position
- Vertical positioning
- Lateral positioning

TEM

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

MANOEUVRE DEMONSTRATION

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

Vertical Positioning Behind the Tug.

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

The position in which the tug appears in the canopy, once noted, becomes the glider's attitude datum (see figure 2). By using elevator to keep the tug stationary at this datum (like a gunsight), the glider's position relative to the tug will remain stable.

- if the tug’s position on the canopy rises, the glider is descending relative to the tug.
- if the tug moves down the canopy, the glider is climbing relative to the tug.
- if the glider is a little high, the tug will appear lower down the canopy, below the datum position.

Lowering the nose gently returns the tug to the datum position. Then hold the tug in the datum position using the elevator. The result is a progressive reduction in the glider's rate of descent, reaching zero as it arrives back in the normal tow position.

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

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

Lateral Positioning Behind the Tug

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

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

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

TRAINEE ATTEMPTS

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

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

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

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

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

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

TRAINEE PRACTICE WITH PROMPTS

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

DE-BRIEFING

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

RELEASING

AIR EXERCISE BRIEFING

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

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

TEM

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

MANOEUVRE DEMONSTRATION

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

TRAINEE ATTEMPT

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

DE-BRIEFING

De-brief their performance as appropriate.

OUT OF POSITION ON TOW AND RECOVERY

AIR EXERCISE BRIEFINGS

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

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

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

TEM

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

OUT OF POSITION MANOEUVRE DEMONSTRATION

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

TRAINEE ATTEMPTS

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

DE-BRIEFING

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

DESCENDING ON TOW

AIR EXERCISE BRIEFINGS

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

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

TEM

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

DESCENDING ON TOW MANOEUVRE DEMONSTRATION

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

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

TRAINEE ATTEMPT

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

DE-BRIEFING

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

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COMMON DIFFICULTIES

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

- If the glider begins to move out to the left – '*The right wing is about to go down, don't let the right wing go down'* (because of the roll resulting from the yaw caused by the rope tension).
- When out to the left and as the wings come parallel – '*Don't let the right wing go down.'*
- If the right wing is allowed to go down despite the previous prompt, then say '*Pick up the right wing'* It is important to specify **which** wing.

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

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

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

PIO's resulting from successive over-large corrective movements. Remind the trainee to use the tug as their attitude reference and only use sufficient control movement to make the tug appear in the normal place in the canopy. PIOs cannot happen if the controls are held still.

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

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

If this is an issue consider the following exercise:

Adverse Yaw on Tow

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

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

Tends to rise above tug soon after take-off. Take over immediately, there is no time for prompting. Explain that (at least) until the tug climbs away, the combination is still accelerating, so the glider will rise unless it is prevented from doing so. The strength of this tendency will depend largely on the accuracy of the trim setting.

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

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

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AEROTOW LAUNCH FAILURES

Introduction

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

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

THEORY BRIEFING

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

Possible reasons for launch failure during the climb are:

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

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

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

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

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

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

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

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

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

Most serious aerotow launch failure accidents result from turning back to the airfield with insufficient height. Given that the climb rate of the combination usually exceeds the glider's normal sink rate by a factor of at least two, then theoretically the glider could immediately do a 180° turn and arrive back on site. Unfortunately, this fails to work in the following circumstances:

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

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

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

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

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

AIR EXERCISE BRIEFINGS

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

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

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

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

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

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

TEM

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

MANOEUVRE DEMONSTRATION

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

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

Throughout, emphasise the need to maintain a safe speed.

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

MANOEUVRE LESSON

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

DE-BRIEFING

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

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11d CAR LAUNCH

SPL Syllabus Exercise 11d: Car Launch			
(i)	Signals or communication before and during launch	(v)	Crosswind take-off
(ii)	Use of the launch equipment	(vi)	Safe and adequate profile of car launch and limitations
(iii)	Pre-take-off checks	(vii)	Release procedures
(iv)	Into wind take-of	(viii)	Launch failure procedures, simulated during the car launch

INTRODUCTION

Car launching was very much more popular in the past than it is today. But in the UK, at the time of writing, only one club still routinely car launches. Car launching shares most of its characteristics with winch launching and therefore much of the process is identical to Chapter 11a Winch Launch. However, there are some important differences which this chapter will highlight. **Therefore, please read chapter 11a first and then note the additional points provided in this chapter.**

Car launching can be conducted in two different ways. The simplest involves a powerful vehicle pulling a length of cable attached to the glider. The launch is usually conducted on a runway to provide the vehicle with a suitably smooth and lengthy surface. If the glider is to get more than 1,000 ft on its launch, without a significant headwind, well over a kilometre of runway is required.

The second method involves feeding the launching cable around a large stationary pulley situated at the upwind end of the runway. The car sets out from near the pulley heading towards the glider to conduct the launch. This makes much better use of the available runway length at the expense of some added complexity. It can also provide a very quick turn-around as the car delivers its end of the cable to the launch point for the next glider to launch and then returns to the pulley, attaches the other cable end there and is ready for the next launch.

As with winch launching it is a safe means of launching gliders providing the inherent risks are thoroughly understood and mitigated. During early training the instructor will carry out all risk mitigation, however the trainee, must be taught the risks, to enable their own TEM before solo launches.

The BGA have worked extensively to understand the risks associated with winch launching, inform its members and this has greatly reduced accident rates. All of that guidance also applies to Car launching. New trainees must be shown how to access the 'Safe Winching' information and review it **with an instructor** during training and most definitely before solo.

https://members.gliding.co.uk/bga-safety-management/safe-winching/

Traditionally, as Car launches are normally conducted off runways, the launching cable usually consists of hard spring steel wire, commonly referred to as 'Piano Wire,' to resist the inevitable abrasion. However, as with Winch launching, clubs are moving away from steel cables to polymer-based materials. These 'Synthetic' cables have significant advantages over steel. Notably, much improved reliability. Piano Wire, unfortunately, suffers with work hardening in use and is prone to breakage. Also, if it forms a loop when it falls to earth after a launch, then as the loop tightens on the next launch it will form a kink and promptly fail.

Car launching requires a team of people who are competent in the various roles required. Competency requires training and monitoring to ensure the whole process is conducted safely. It is not appropriate for anyone to perform any of the operation(s) in the launch process without close supervision unless they have been trained and 'signed off.'

The elements of; cable, parachute, strop, weak link and release rings are common to winching. But trainees should be trained in the local procedures.

Launching cables must always be regarded as 'Live,' they may move at any moment without warning. Expect the cable to disappear without warning. Any vehicle or aircraft crossing a cable can pick it up and move it suddenly. Always educate trainees to handle cable so that it will pull out of their fingers, do not get between the parachute and launch vehicle and do not loiter in front of gliders after hooking on.

THEORY BRIEFING

Signals or communication before and during launch

The verbal commands are the same as winch launching but especially if the launch is a direct tow rather than a reverse pully, it can be very difficult for the driver to watch visual signals as they drive the vehicle. Therefore, a robust radio system is preferable, so that any emergency signals can be clearly heard.

Use of the Launch Equipment The instructor in charge at the commencement of flying should, consider with the car driver the positioning of both the launch run and launch point. Whilst achieving the best height is important, safety is more important. Consideration must be given to the fall of cable from all stages of the launch.

A full launch is simple to anticipate as the car will normally use power to pull the cable supported by the parachute downwards. However, in the case of a cable break, that will not be possible. Consideration needs to be given to where it may land, also where 'strops' may fall following a weak link break. If another glider, or aircraft has landed downwind of the launch run cable may fall on them.

In a cross-wind at sites with limited space or directional options 'laying off' is often required.

Pre-Take-Off Checks

These are as per winch launching but note the following.

Use the same a walk around, A-B-C-D-E for car launches, as any other launch.

C-B-S-I-F-T-B-E-C has some car specific considerations. Set the **T**rim for the required approach speed, usually somewhat forward of neutral (nose down) in anticipation of a launch failure. If the glider has flaps, they may need to be set differently to that required for aerotowing.

As always, the **E**ventualities check is particularly important. Ensure that there are no obstacles in the launch area or anywhere the glider might end up if a wing drops, and the glider departs left or right. Check the circuit is clear of traffic. Also make a final check of wind speed and direction and consider the launch failure options appropriate to the glider type, site and weather thoroughly.

Into & Cross Wind Take-Off

If the pilot/trainee is used to a normal winch launch, care needs to be taken. Whilst the two launch methods are very similar the differences through take off and rotation into the climb are substantial and require great care in their handling. A winch pilot 'programmed' for significantly more initial acceleration may well attempt to pull the glider off the ground early. They may also rotate into the climb at their usual (winch launch) rate, rather than as appropriate for the more subtle acceleration.

The mechanics of the car launch are straight forward and can be considered about each axis of the glider in order to anticipate the likely consequences once the cable is taught and glider accelerating.

Lateral axis (pitch) - With the glider on the ground the pull on the hook will tend to rotate the glider around the gliders CoG which will be above the line of the cable. This effect is usually less marked than on a typical winch launch but can still be significant.

Longitudinal axis (Roll) – **the slower acceleration on a car launch may make a wing drop more likely.** Pilots vary considerably in their ability to recognise when the wings are not level, or indeed when a wing tip is dragging on the ground. Failure to recognise and react promptly to a significant wing drop can be fatal. Therefore, wing drop recognition must be taught from the outset, as per normal winch launch procedures.

Car launch profile and limitations.

if your trainee is Winch Launch trained or current, do stress that the ground run and transition to full climb may be MUCH slower than with a modern winch. The tow car engine is having to accelerate the tow car as well as the glider, so is working much harder than a winch engine. Careful airspeed monitoring is vital.

It is only practical to employ a vehicle with an automatic gearbox. Despite that it is common to get a power reduction as the gear changes in the early part of the launch. This may well be during rotation, just when you don't want it.

It is important to start the launch directly in line with the launch cable with little or no bow in it.

As with a winch launch, the glider should not be allowed to rotate up into the transition to full climb until the pilot is able to recover without stalling the glider or hitting the ground. It is important that the ASI is monitored as that speed is increasing as the glider is pitched up into the full climb.

This is normally 1.5 times the 'normal stall speed.' More speed may be required in windy or turbulent conditions so an alternative 'rule of thumb' is the minimum approach speed for the day.

As the acceleration is slower this may take longer to achieve than on a normal winch launch.

The glider will not autorotate into the climb as in a winch launch so the transition into the full climb must be flown by the pilot.

If the aircraft fails to reach "recovery speed" then the nose needs to be carefully raised into the climb as long as the ASI indicates that the airspeed is increasing until you reach "recovery/approach" speed when the climb may be continued into the full climb attitude.

This is because, once the car reaches full speed, which may be below "recovery/approach" speed, it cannot provide any more acceleration, so you need to use the sling shot effect to provide the increase in airspeed required. **Note – this is completely the opposite to a winch launch.**

This requirement will be more pronounced in light wind conditions.

The normal climb attitude is slightly less than for a winch launch at 40 degrees.

Stick action for too fast or too slow:

Too fast – reduce the angle of climb to slow down. Radio the tow car if still too fast.

Too slow – carefully increase the angle of climb to increase speed. If you have reached your minimum speed you **must release immediately and not wait until you reach a safe height. it may be too late !!.**

Release procedures

At the top of the launch as the car runs out off runway space it will slow down, and the nose of the glider will go down. Relax the back pressure and select an attitude to place the nose on or just below the horizon. The cable will probably back release as you do. Don't forget to double pull the release to make sure.

As per a normal winch launch, back release is the preferred option, but an emergency or inadequate launch profile may require the release to be pulled as per a winch launch.

Launch failures

Launch failure procedures need to be clearly understood as per winch launching. The options from the glider pilot's perspective are likely to be very similar to those from a winch launch failure. In the event of a launch failure the driver will immediately exit the runway via a predefined route.

AIR EXERCISE BRIEFINGS

Car launch take-offs usually happen slower than typical winch launches but still too quickly for any instructor to patter everything of significance and even if they could, no trainee could ever retain that information. Many demonstrations will be required, particularly if conditions, a change in crosswind, different take-off directions etc. These will result in variations in the briefings.

Remind the trainee of the most significant points of the take-off and transition.

TEM

Threats:	**Mitigation:**
Errors, omissions or distractions to the checks resulting in taking off with an inadequately prepared glider	Carefully monitor the conduct of the checks
Helpers & spectators may interrupt the checks.	Discourage interruptions. If they do, be careful the check has been correctly completed. If necessary, start again.
Errors:	
As instructor, after hearing the trainees checks many times it can be hard to remain attentive.	Take sufficient breaks to maintain your concentration.
Failing to allow for changing conditions.	Stay alert for changes, even on 'benign' days.
The trainee may make sudden and inappropriate inputs.	Monitor closely and take over, do not prompt.
Allowing the trainee too much scope for making errors.	Monitor closely and take over well before you get to your limits.
The trainee may release under tension causing cable issues at the car.	Brief and demonstrate the correct procedure carefully.

MANOEUVRE DEMONSTRATION

Conduct the launch as accurately as you can concentrating the limited time to talk on the items you are teaching on that particular flight.

As it is impossible to alter the pace of the launch and much happens quickly, multiple demonstrations are needed to cover all the features and give the trainee time to absorb the volume of information. Given that no two launches are quite the same and conditions vary, patter what you are doing and what you are monitoring on each demonstration, explaining any unusual features later.

MANOEUVRE LESSON

It is not appropriate to start teaching the launch procedure until the trainee's handling skills are good enough that they are attempting the landings. After a thorough briefing, explain that you will hand them control towards the top of the launch i.e. once fully established in the climb, and gradually hand over lower down as they are managing the upper part. Once they are manging the full climb competently, allow them to do the initial take-off, including the critical rotation into the climb.

Before the trainee attempts a take-off, they should be taught to recognise the 'wings level' position from the forward picture and when it is approaching acceptable limits. Confirm their ability to comply with the requirement: 'If I cannot keep the wings level, I will release before the wing tip touches the ground.'

Emphasise that the cable must be released before this point is reached if aileron input is not arresting the wing drop.

Pre-solo, the trainee should demonstrate that they recognise whilst looking ahead when the wings are not level, and releases the cable with the wing tip still safely clear of the ground. Ensure they understand the significant risk involved and that it does not diminish with experience.

Be extra alert during the take-off, initial climb, and following any launch failure. Hover your right hand behind the stick ready to take over if the trainee tries to climb too steeply. Have your left hand on the release, but once the glider is airborne, move your hand to behind the airbrake lever to prevent the brakes being inadvertently or deliberately opened at the wrong moment. Be ready to prevent any or excessive forward stick movement if there is a low-level failure. Also, be prepared to release immediately during the ground run if a wing threatens to or actually touches the ground.

On or close to the ground, the effect of a prompt on the trainee's conduct of the launch is unpredictable. If a potentially hazardous situation develops do not prompt, take control. In the event of an unacceptably rapid pitch-up after take-off, taking over immediately and doing something about it safeguards the situation and reinforces to the trainee the severity of the situation. Debrief it later! If your hand is hovering just behind the stick (not actually touch it), then taking control will come naturally and quickly.

As the glider leaves the ground, the pilot should maintain the normal take off attitude. A forward stick movement may be required to stop the nose from rising. Monitor the ASI and its trend. Only once the minimum recovery speed has been reached and is rotate the glider smoothly and steadily into the full climb attitude. When ***winch launching*** this usually takes more than five seconds from lift off to a 45° climb. When **car launching**, because acceleration is usually comparatively modest, longer period will commonly be appropriate. This later point is particularly important if you or your trainee are winch launch current.

Once in the full climb, minimum speed is more important than the maximum launch speed (V_W). If the maximum launch speed is about to be or is exceeded, do not allow this to be rapidly reduced i.e. do not pull back sharply. At this point of the launch being 'overspeed' carries no risk.

Monitor both the climb and bank angles by looking at the wing tips, look forward to see the position of the horizon relative to the edges of the canopy. Unless lay off is being applied, if it is not symmetrical use coordinated control to roll so a straight flight path is maintained. Glance at the ASI and again note both the speed and its trend. Note the progress along the airfield as height is gained or more importantly, not!

Crosswind launches As for winch launches the maximum acceptable crosswind component depends on the glider type. Gliders which sit tail-down and have tail-skids are generally more susceptible to crosswinds, particularly on hard surfaces. It is usual for the downwind wing of most gliders to be held at the start of the ground run, to reduce the probability of weathercocking.

DE-BRIEFING

Following your demonstrations debriefing will still be required, in particular to cover any unusual things that occurred. Given the brevity of a normal take-off it can be challenging for an instructor to spot every point worthy of mention, but fortunately a significant number of launches are usually required for a trainee to get to solo standard and normally they will be able to take off satisfactorily well before all the other pre-solo exercises have been completed. Sometimes a questioning de-brief will indicate that whilst the launch may well have been flown correctly, the trainee had little or no idea of the speeds involved. They must understand safe speeds for transition and the importance of monitoring the ASI

LAUNCH FAILURES

Simulated and real cable breaks tend to be sharp and obvious. Car failures often die away gradually. It is important that trainees experience this type of power failure.

Trainees need to be taught to consider the minimum safe speed/height combination for launch and launch failure options and nominate the approach/recovery speed before taking off for every flight. They must also be completely conversant with the following:

- unless close to the ground, lower the nose to the recovery attitude (below the approach attitude.)
- be patient, do not turn, open the airbrakes or make decisions until the approach speed is attained
- check the airspeed
- is it possible to land straight ahead?
- check the airspeed again
- if it is not possible to land ahead, select alternatives
- release the cable (only if time permits.)

COMMON DIFFICULTIES

Too abrupt or gentle a transition into the climb. This may be due to a failure to monitor the ASI. Re-demonstrate if prompts or descriptions do not work. This part of the launch is over too quickly to give you an opportunity of correcting the fault in flight, and if the trainee climbs too abruptly, he is putting both of you at risk!

Not monitoring the ASI in the early climb leading to over rotation into the climb at below a safe airspeed.

Poor directional control, wing dropping on ground run. The most likely reason is that the trainee has not yet learned how large the control movements at low speeds need to be. The problem is aggravated by the fact that on the ground the rudder is steering the glider as well as counteracting aileron drag. Release immediately if a wing goes down on the ground run.

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Does not use sufficient aileron to keep the wings level on the ground run. Stress the importance of keeping the wings level and the need for full aileron promptly applied.

Tries to take-off too soon. This should be strongly discouraged as it can lead to very swift rotation into the climb at the worst possible moment. Converting Winch Launch pilots are prone to this. Watch out for this if the ground run is longer or faster than usual, and/or the ground is very rough. Get the trainee to run the glider on the mainwheel, not the mainwheel and the tail-skid/wheel. Lack of headwind lengthens the ground run and can also induce this problem.

Winch converts:

Getting the increase and reduce speed corrections with the elevator the wrong way around.

Veers off to one side during the climb. The trainee needs a reference point to help keep the line of the launch.

The trainee rushes the launch failure recovery resulting in excessive negative G and either does not take the time to let the speed recover or starts to turn prematurely. More practice at the Upper Air exercise (Chapter 11a) to settle them down and convince them that they can handle launch failures is required

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11c Self-Launch

SPL Syllabus: Ex 11c: Self-launch			
(i)	**Review of the flight manual for the sailplane used**	**(xi)**	**Abandoned take-off**
(ii)	**Engine extending and retraction procedures**	**(xii)**	**Maximum performance (short field and obstacle clearance) take-off**
(iii)	**Engine starting and safety precautions**	**(xiii)**	**Short field take-off, soft field procedure or techniques and performance calculations**
(iv)	**Pre-take-off checks**	**(xiv)**	**In-flight retraction of engine and engine cooling**
(v)	**In flight engine start checks**	**(xv)**	**Propeller drag**
(vi)	**Noise abatement procedures**	**(xvi)**	**Effects of reduction and increase of power**
(vii)	**Checks during and after take off**	**(xvii)**	**Pitch nose-up tendency in case of engine shutdown (in case of over-wing propeller installation)**
(viii)	**Into wind take-off**	**(xviii)**	**Approach with extended retractable engine inoperative (may be simulated by extended airbrakes)**
(ix)	**Crosswind take-off**	**(xix)**	**Decision process and reasons to terminate the soaring flight and to switch to powered flight**
(x)	**Power failures and procedures including partial power loss**	**(xx)**	**Decision process and reasons for not starting the engine and to end the flight as a non-powered sailplane**

INTRODUCTION

A self-launching sailplane (SLS) is a traditional sailplane, but with an engine or motor which allows it to take off using its own power. This is distinct from a sailplane with an engine for sustaining flight only, where additional training is not required under SFCL. However, a pilot converting from a pure glider to a powered one of any kind should be advised of the safety considerations laid out here, most of which apply to sustainers as well as self-launchers.

Under SFCL a self-launching sailplane may be flown without SLS privileges provided it is launched by aerotow, winch, or bungee. This chapter describes the training for adding self-launch as a launch method.

SFCL.155 specifies that the training for self-launch must include a minimum of five launches in dual flight instruction, and five solo launches in the SLS, under supervision. The dual flight instruction may be conducted in TMGs.

Instructors conducting flying training for self-launch should ideally be qualified and experienced with self-launching themselves. To carry out the dual training element in a TMG they must hold SFCL.315 (a)(4) TMG instructing privileges. Exceptionally, a two-seater SLS may be available, in which case the FI(S) must have completed as PIC at least 30 self-launches as well as meet the associated recency requirements and be familiar with the glider type in question. The solo self-launch flying requirement must be supervised by an FI(S) with a minimum of 30 self-launches as PIC.

Whilst the ‘trainee’ in this case is likely to be an experienced glider pilot, converting to a self-launcher is a significantly different type of flying. This is particularly true if the SLS is an old design with complicated controls, or one that loses a lot of height during engine starts.

THEORY BRIEFING

There is a great deal of variation between different SLS types, and the flight manual (FM) must always be the principal reference.

Self-launching sailplanes, like powered aircraft, have varied take-off performance. In addition, take-offs may be undertaken from less than perfect sites – short runaways, grass or undulating strips, obstructions in the direction of launch etc. This may make their use subject to additional risks over and above normal gliding operations. It is important that pilots fully understand the limitations in performance and put in place appropriate mitigations.

Care should be taken when operating within mixed operations on an airfield, to avoid conflicting traffic and to avoid picking up a winch cable on take-off.

Various types of powerplant are used in SLS’s;

- Traditional combustion engine within the fuselage and retractable over-wing propeller (many types).
- Jet engine that extends and retracts vertically from the fuselage (e.g. Jet Shark).
- Combustion engine with retractable forward mounted propeller (e.g. Stemme).
- Electric motor with folding nose mounted propeller (e.g. Silent 2 Electro).
- Electric with engine within fuselage and retractable over-wing propeller (e.g. Antares).

Traditional combustion engine

Usually, the engine and pylon are housed within the fuselage for when it is in ‘glide mode,’ but the engine is able to extend, start and produce enough thrust to take off and climb.

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Typically, the engine is a 2-stroke engine that produces around 40-80hp with a 2 bladed propeller.

Another popular engine used in gliders is a Wankel Rotary engine, which produces similar power with a 2 bladed propeller.

Electric with nose mounted propeller

These are totally reliant on electrical power, needing large capacity batteries to be able to operate. The electric motor powers a small propeller attached to the nose of the glider. The propeller blades fold neatly up against the fuselage to reduce drag when not in use.

There is very little noticeable pitch change with power changes.

Electric Pylon

Much like the traditional combustion powerplant, the engine and propeller are stowed within the fuselage, which can extend, start and produce thrust. This design is completely electric, relying on large batteries.

CONSIDERATIONS OF OPERATING A SELF-LAUNCHING SAILPLANE

A self-launching sailplane will be considerably heavier than a non-engine version of the same type. The weight increase may be as much as 100kg. This weight increase is the equivalent of carrying permanent water ballast and results in:

- higher stall speed.
- higher approach speed needed.
- longer landing distance.
- longer take off run.
- higher speeds for thermalling/higher radius of turn.

However, sailplane designs vary considerably and some, such as the Silent 2 Electro, are very much lighter than more traditional gliders.

Centre of Gravity versus Engine Thrust Line

More consideration of the aircraft's handling is needed with a self-launching sailplane under power.

All self-launching sailplanes produce thrust that acts in relation to the centre of gravity of the sailplane. Those that use a propellor raised out of the fuselage, create forward thrust that acts well above the centre of gravity which generates a significant nose down pitching moment under power. This nose down pitching moment needs to be countered with a marked nose up stick position, most flight manuals also recommending full nose up trim during self-launch. It is important that the stick is held fully back to reduce the risk of the sailplane pitching forward on to its nose during taxiing and the early stages of the ground run. Keeping the stick back on the initial part of the ground run maintains the tailwheel on the ground maximising directional control.

Note: The higher the resistance of the runway surface, the more likely the nose is to pitch down, i.e. taking off on grass will produce more of a tendency to pitch down than taking off on tarmac.

Although the thrust line is much lower for sailplanes that use nose mounted propellers, they are still susceptible to pitching forward at high power settings and risking a prop strike if the pilot is unable to keep the tail on the ground during taxiing and the early part of the take-off run.

AIR EXERCISE BRIEFINGS

Training to fly self-launchers is unusual because the dual training requirement will most commonly be carried out in a TMG which will have different handling characteristics to the SLS that the trainee will go on to fly and complete their supervised solo flights in. The dual flights should aim to establish principles that will be the same in the trainee's SLS and should focus on engine handling and take off techniques; they are not learning how to fly a TMG. Before the supervised solo launches a comparison of cockpit layout and controls must be made and it will be helpful for the instructor to supervise 'touch drills' with the trainee sitting in the SLS cockpit.

TEM

Threats:	Mitigation:
Engine failure after take-off	Plan ahead with local landing fields; maintain safe airspeed
Partial engine failure after take-off	Maintain safe airspeed; treat as engine failure if low
Airborne engine start fails	Always be within reach of a landable field; careful TEM in advance
Errors:	
Unsuitable take-off run	Calculate required runway length, including surface and headwind considerations
Insufficient airspeed during the initial climb	Monitor airspeed closely
Attempting airborne engine start too low	Have a pre-determined minimum height for engine start
Failure to control the aircraft with over-wing propeller deployed but not operating	Practise this configuration if the flight manual permits

(i) Review of the flight manual for the sailplane used

Both the instructor and trainee must have read and understood the FM with special attention to:

- CoG and ballast considerations
- Daily Inspection and maintenance requirements
- Fuelling/recharging
- Cockpit and control layout
- Any other specific safety requirements or procedures.

(ii) Engine extending and retraction procedures

Modern SLS types may have straightforward mechanisms for deploying the engine. In the case of front mounted electric-powered propellers it is usually just a case of switching on the

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power unit and turning a knob. However, older types often have complex procedures involving multiple controls in the cockpit that must be operated in a particular sequence.

In all cases, the flight manual is the primary reference. The instructor will not necessarily have flown the glider type themselves, so the trainee will need to be able to demonstrate the procedures with touch drills.

(iii) Engine starting and safety precautions

This training can be provided using a TMG because the considerations are the same for all engine starts. The pilot's seating position and view will be different, but the precautions needed with propellers are the same. Before starting the engine, it is **vital** that you make sure no one is near the propeller. Shouting 'CLEAR PROP' and waiting a few seconds is essential. There are blind spots with all gliders. You may not be able to see the person that has their head next to the propeller.

Consider the effect of the prop wash. Are you parked in front of open canopies? Your prop wash may cause issues to others, so check it is clear behind before you start.

(iv) Pre-take-off checks

Consult the flight manual and use the manufacturer's checklist where provided. Give consideration to where you undertake checks in relation to active traffic on the airfield.

If a TMG is being used the checklist will be different from the glider's. Nevertheless, the trainee should be shown how to follow it: the principles will be very similar and the habit of following a checklist which is quite different from that in a pure glider must be established.

Similarities to and differences between the specific SLS checklist and a pure glider should be considered. For example, both the TMG and SLS may have a steerable tailwheel, which means checking rudder operation is done while taxiing rather than when stationary. This taxiing check will be completely new to a pure glider pilot.

Positions of switches for fuel, power etc will be different but the principle of setting them appropriately is the same.

It should be pointed out to the trainee that gliders with nose mounted propellers taxiing on rough ground/grass have a significant risk of a prop strike. Therefore, towing the glider behind a vehicle may be safer than taxiing under its own power. If taxiing, they should consider using a wing walker to keep the wings level.

(v) In-flight engine start checks

The flight manual for the SLS should be consulted for the procedure.

The basic principles can be demonstrated in a TMG by stopping the engine during flight and then restarting it.

In the SLS consideration must be given to how much height will be lost during engine start in-flight. Some types must be dive started and the speeds used for starting the engine and then changing to a climb profile may be critical. By contrast, starting an electric motor with a forward propeller may result in no height loss at all.

Emphasise that there must always be a safe landing option should the engine fail to start.

(vi) Noise abatement procedures

This will probably be an unfamiliar concept to pure glider pilots who are not used to having full control of their climb-out path and have never had to consider the effect of engine noise on inhabited areas below.

Follow noise abatement procedures in place at the operating site. Information about local sensitive areas should be easily available and pilots should be careful to avoid them, particularly during climb out. Electric self-launchers are significantly quieter. Jets are usually extremely noisy.

(vii) Checks during and after take-off

These should be performed as per the Flight Manual**.**

The checks in a TMG will probably be different from the SLS ones but with the same key features:

- Normal checks for other traffic plus required radio calls must be completed.
- It must be established before starting that the runway is long enough, considering the surface and headwind.
- If flaps are fitted, they must be set correctly.
- The throttle must be opened smoothly to full power.
- The pilot must check that full power is achieved and abort the take-off if not.
- An abort point must be selected, where the take-off will be abandoned if the aircraft is not airborne.
- Crosswind limits must be considered and the pilot must self-brief to abort the take-off if a straight ground run cannot be maintained.
- The airspeed to be achieved after take-off and before climbing must be noted.

Differences in procedures between the TMG and SLS should be identified and discussed.

(viii) Into wind take-off

Demonstrate the take-off in the TMG (or two-seater SLS) before expecting the trainee to attempt it. The trim should be set as specified in the flight manual. With a pylon-mounted propellor this will be close to or at full nose-up, whereas for a nose-mounted propellor it is likely to be much as for aerotow.

There will be differences in the view, control movements and so on between a TMG and the SLS. The common features should be pointed out.

In the SLS the take-off and initial climb will be similar to that for aerotow – except that the pilot operates the throttle. Deciding where to position the elevators at the beginning of the ground run will be dependent on the thrust line. With a pylon-mounted propellor this will always be fully up. Not only does this counter the nose down pitching moment but with a nose wheel, it lifts the nose wheel off the ground at the earliest opportunity whereas with a tailwheel, it maintains the maximum tailwheel force on the ground allowing better directional control in the early stages of the take-off run. For a nose mounted propellor the stick should remain fully back initially before relaxing the back pressure and allowing the tailwheel to lift slightly.

If the TMG has a tailwheel the take-off attitude should be very similar to that in the SLS: the tail wheel just 'skipping' along the ground. If the SLS has a nose mounted propeller, point out the dangers of a prop strike if the tail is allowed to rise much. Particular care must be taken on uneven surfaces.

With a propellor aircraft there are turning tendencies caused by the rotation of the propellor which need to be considered. The first is slipstream effect where the airflow corkscrews back from the propellor and works as a sideways force primarily on the fin of a sailplane. The second is torque effect which tries to roll the aircraft in the opposite direction to the propellor. The third is p factor; when the glider is flying at a positive angle of attack, the downgoing blade is at a greater angle of attack than the upgoing blade, the result of which is more lift from the downgoing blade. All these effects work to make the aircraft turn in the opposite direction to the propellor's rotation. Therefore, if the propellor rotates to the right as looked at in the direction of flight, the glider will want to turn left.

In an SLS, the launch should be abandoned if the wings cannot be kept level, just as it would be on aerotow. The launch should also be abandoned if the glider cannot be kept straight. Most such gliders have wing wheels, and the take-off run can be started with a wing down instead of using a wing runner. Many pilots prefer this as the wing comes up when they gain aileron control. The condition of the runway surface should be taken into account, and whether the wing is likely to catch on soft or uneven ground or in grass.

Follow the flight manual procedures for use of flaps – again, this is likely to be the same as for aerotow.

Glider pilots who do not fly powered aircraft may be unfamiliar with powered take-off profiles. After the glider leaves the ground, it needs to be held in a suitable attitude while the airspeed increases to the correct climbing speed. This is extremely important in SLS such as the Silent Electro which will lose airspeed rapidly if the attitude is allowed to remain in, or increase above, the slightly nose-up take off attitude.

In the case of self-launchers with a nose mounted propeller the pilot may be keeping the tail on the ground or only just off it during the ground run, and a small but positive adjustment of attitude may be needed immediately after lift-off to achieve a safe attitude during the acceleration phase.

(ix) Crosswind take-off

Crosswind considerations must be discussed with the trainee. Crosswind take-offs can be practised in a TMG, paying attention to use of rudder to keep straight and prevent weathercocking, and the need to track along the runway once airborne, by crabbing into wind.

For their early SLS launches, the trainee should not attempt take-off in significant crosswinds (the flight manual may specify limits) and it may be safer to use a wing runner than to start wing down.

If the SLS pilot is to start with the wing down in a crosswind, they must consider which wing should be on the ground. Having the downwind wing down will tend to keep the wing on the ground and prevent or reduce the tendency for weathercocking. Bear in mind that it will take much longer for the wings to level, meaning the wing will be dragging along the ground at a high speed which may lead to an uncontrolled turn and will also have a negative impact on take-off distance.

Having the upwind wing on the ground means that the pilot can usually level the wings very quickly and take-off performance is improved. But there is more of a tendency for weathercocking and the wings may 'swap' abruptly early on before aileron authority is achieved, which could result in an uncontrolled turn.

Once again, follow the advice in the FM.

(x) Power failures and procedures including partial power loss

Power failures after take-off can be simulated in a TMG exactly as for aerotow failures if the propeller is nose mounted. The trainee should be taught to nominate a minimum height for attempting a turn back to the airfield, and to pick a field ahead if below that height, adopting the appropriate airspeed (as specified in the FM) immediately.

With an over-wing propeller the extra drag of a deployed but stopped engine means that there is probably no safe turn back option below normal circuit height. The situation can be simulated in a TMG by closing the throttle and using airbrakes or spoilers – but only at a safe height! This should fully convince the trainee of the wisdom of not turning. The trainee should also be briefed that a power failure in a sailplane with an over-wing engine will result in a significant nose up pitch (because the trim is close to fully nose up AND the nose down thrust vector has been removed), which must be controlled immediately.

A partial engine failure may still allow a reduced rate of climb or the ability to maintain level flight. Monitoring airspeed is vital. If some rate of climb is still possible, you may be able to achieve sufficient height to glide back to an airfield. However, the possibility of a subsequent total engine failure should be considered, with allowance for the extra drag of the extended engine. When below the pre-determined turn back height for the type, the safest option is to treat the partial failure as a complete failure and pick a field ahead to land in. The partial power of the engine gives a little more time to pick the best landing area.

Partial engine failures can be practised in a TMG. The exercise should involve reducing the power to find the setting at which straight and level flight can be maintained but there is no climb. The trainee can reproduce this exercise, at height, when flying the SLS solo. This will enable them to become accustomed to the feel, noise, and handling of the SLS in a partial power failure. One of the risks of partial power failure is that it may be gradual and therefore not noticed, so the pilot needs to be familiar with the symptoms and able to recognise them.

(xi) Abandoned take-off

As when aerotowing, an abort point should be nominated before take-off.

The instructor should demonstrate an aborted take-off in the two-seater and give the trainee practice, briefing that at a certain point the 'abort take-off' command will be given, and the trainee should close the throttle and bring the aircraft to a controlled stop, using wheel-brakes as appropriate.

Cutting the power quickly may not be as easy or as intuitive in the SLS as in a TMG. In electrically powered sailplanes with

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a rotary knob throttle, the pilot should give particular thought to the process for abandoning a take-off, as twisting a knob is less easy than simply pulling a throttle lever backwards.

Pilots should always complete a comprehensive self-brief for the take-off and any eventualities.

(xii) Maximum performance (short field and obstacle clearance) take-off

Follow the flight manual procedure. This may include holding the aircraft on the wheel brake as the throttle is opened, to minimise the ground run. The manual should specify the 'best angle of climb' speed, which is lower than the 'best rate of climb' speed normally used.

A short field and obstacle clearance take-off can be demonstrated and practised in a TMG, noting any differences in the airspeeds to be used.

(xiii) Short field take-off, soft field procedure or techniques and performance calculations

Follow the FM procedure and performance calculations. This may include selecting neutral or positive flap (if fitted) as soon as aileron control is achieved, to minimise the take-off run and get the airborne at the lowest possible airspeed. In a TMG there is no significant difference between this and the previous exercise.

(xiv) In-flight retraction of engine and engine cooling

A demonstration of engine shutdown in flight can be done in a TMG but will be significantly different from the process in the SLS. The SLS flight manual will describe the procedure and touch drills can be done on the ground.

The process can take a significant amount of time, as the propeller is slowed, stopped, and its position adjusted to park it, or allow it to be retracted into the fuselage. For over-wing propellers there is a significant amount of extra drag – and hence height loss – whilst the engine has stopped and before the propeller is retracted. Trainees practising engine shutdown should do it at a comfortable height!

Pilots of self launchers with piston engines must take care to keep temperatures within limits. Appropriate use must be made of cowl flaps and the time spent in both the high power/ low airspeed and low power/ high airspeed regimes should be minimised. The SLS may have an engine management system with software monitoring engine temperatures and power, and the trainee must be familiar with the settings and messages of their installation.

(xv) Propeller drag

This item should be covered in discussion with the trainee.

The extra drag of a stopped propeller has already been stressed. A windmilling propeller creates more drag than a stationary one. On sailplanes with a front mounted propeller the drag is very much less than if the propeller is over-wing. The effects can be experienced at a safe height when flying the SLS.

(xvi) Effects of reduction and increase of power

There may be significant pitch changes when power is increased or reduced. This will vary depending on how the engine is mounted. To some extent the effect can be demonstrated in a TMG but this is something the trainee should be briefed to try when flying their SLS, at height. Smooth throttle handling is the key.

Prolonged idle running a piston engine using a 2-stroke system may deprive the engine of much of its oil lubrication. Care must be taken when practising handling with the engine a low power settings.

(xvii) Pitch nose-up tendency in case of engine shutdown (in case of over-wing propeller installation)

In an over-wing propeller installation, shutting down the engine can create a nose-up pitching tendency because the propeller's thrust is now no longer a downward force, relative to the centre of gravity. However, this will be minimal if the engine is at idle.

(xviii) Approach with extended retractable engine inoperative (may be simulated by extended airbrakes)

The flight manual must be consulted because landing with the engine extended may be prohibited – in which case flying a circuit with extended airbrakes is a reasonable simulation; this can also be practised in a TMG. With a stationary pylon-mounted propeller the extra drag will be comparable to flying with full airbrake. The handling and stability of the glider may also be affected. The trainee should be advised to study the flight manual and explore the effects at altitude.

(xix) Decision process and reasons to terminate the soaring flight and to switch to powered flight

This item requires thorough discussion with the SLS trainee. There have been many accidents caused by poor decisions about when it is safe to try to start the engine.

For over-wing engines that extend from the fuselage the height loss in airborne starting can be considerable. Consult the flight manual for guidance, and the new SLS pilot must determine their typical height loss by experimentation at altitude. TMG practice may not be especially useful because the process is so dissimilar. On electric systems with front mounted propellers, the height loss is negligible.

The pilot must bear in mind that the engine may not start immediately. This is especially true of piston and jet engines, but electric motors can also fail. An airborne start must never be attempted when a safe landing cannot be made in the event the engine fails to start. It is imperative that the pilot calculates the minimum height at which an engine start can safely be attempted and sticks to that. Below that height they have ruled out using the engine.

When attempting an engine start, the pilot must be in a position where they could land with the engine extended if necessary. The workload in such a situation will be extremely high and the pilot must mentally prepare for the eventuality with TEM beforehand, e.g. '**When** the engine fails to start, I will….' Flying the glider accurately and maintaining safe airspeed are the top priorities. Plan A should be to land in the chosen field, and the engine starting successfully is a happy bonus. Only if there is plenty of height to spare should the pilot check for a reason for non-starting and attempt another start.

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(xx) Decision process and reasons for not starting the engine and to end the flight as a non-powered sailplane

If the pilot's minimum height for engine start has been reached then, if soaring away is not possible, a conventional field landing should be flown. Workload increases significantly when faced with a field landing and to add to that workload by adding a further complex task of starting the engine can lead to a breakdown in a pilot's basic handling skills; this can lead to a loss of control/low-level spin. Accident statistics demonstrate that, in the heat of the moment, pilots may ignore this advice and take significant risks, to avoid the inconvenience of a land-out.

The field landing will obviously be very much simpler when the glider is configured normally, without a stationary engine deployed.

If there is an airfield within gliding range, the pilot of a self-launcher with over-wing engine should bear in mind that a conventional landing followed by a self-launch may be a safer and less stressful exercise than a low engine deployment with the possibility of engine failure. Deciding in advance to choose the landing option would give them more height available to try to soar away.

MANOEUVRE LESSON & DE-BRIEFING

The minimum number of training flights and supervised solo flights as per SFCL.155 must be achieved including all the items detailed above.

As specified in AMC1 SFCL.155(a)(2), at the end of the training, the candidate should be able to demonstrate:

- a self-launch
- appropriate actions in the event of engine failures
- the decision processes referred to in sections (xix) and (xx) above.

Following satisfactory completion of training, the instructor should sign the pilot's logbook/logbook signature card to indicate that the self-launch method has been added. .

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12 – CIRCUIT, APPROACH AND LANDING

SPL Syllabus: Exercise Circuit approach and Landing			
(i)	**Procedures for rejoining the circuit**	**(vi)**	**Visualisation of an aiming point (the reference point)**
(ii)	**Collision avoidance, lookout techniques, and procedures**	**(vii)**	**Approach control and use of airbrakes**
(iii)	**Pre-landing checks, circuit procedures, downwind and base leg**	**(viii)**	**Normal and crosswind approach and landing**
(iv)	**Effect of wind and windshear on approach and touchdown speeds**	**(ix)**	**Short landing procedures and techniques**
(v)	**Use of flaps (if applicable)**		

INTRODUCTION

A circuit, approach and landing will be flown on every flight. There are many reasons cited for flying a circuit all of which are valid. In power flying, a circuit ensures an orderly pattern of traffic flying visually around an airfield. This is also true for gliders, however, there are other more fundamental and practical reasons for us doing so.

- It enables us to remain within easy gliding range of our chosen landing area.
- It allows us to remain visual with the chosen landing area.
- Most importantly, it enables us to position the final turn such that we can use the correct approach control technique to achieve a safe landing in the chosen landing area.
  In other words, it allows us to arrive:
  - at the final turn in the right place;
  - at a safe height and speed; and
  - with safe alternatives available.

The chapter is divided into three parts, circuit planning, approach control, and landing. These are distinct exercises for the trainee to master and each should be taught separately.

The exercises completed by the trainee up to this point of the syllabus have been focussed on fundamental flying skills, that is, handling the glider. This is the first exercise where we will be expecting the trainee to exercise judgement, and this will increase their workload significantly. It is important that before commencing this exercise, that they have demonstrated proficiency in:

- Adequate lookout techniques.
- Use of coordinated controls.
- Coordinated turning and rolling out in a nominated direction.
- Achieving and maintaining a straight glide towards a nominated feature.

By the time the trainee comes to this stage of their training, they will have seen their instructors fly many circuits, approaches, and landings, and so in teaching this exercise, you are building on what they have already experienced.

THEORY BRIEFING

CIRCUIT PLANNING

Prior to joining the circuit, the pilot should be building good situational awareness of other traffic using good lookout techniques, utilising FLARM and listening actively on the radio. As soon as you realise you need to land, identify the wind strength and direction (windsock) and choose a suitable landing area. Position yourself upwind of the airfield in such a position that you can turn and roll out on a downwind track as you fly through the high key area. Once committed to the circuit, the pre-landing/circuit checks should be completed prior to starting the circuit – this is to manage the workload and ensure the focus is on the main task of flying the circuit.

The recommended pre-circuit check is **WULF.**

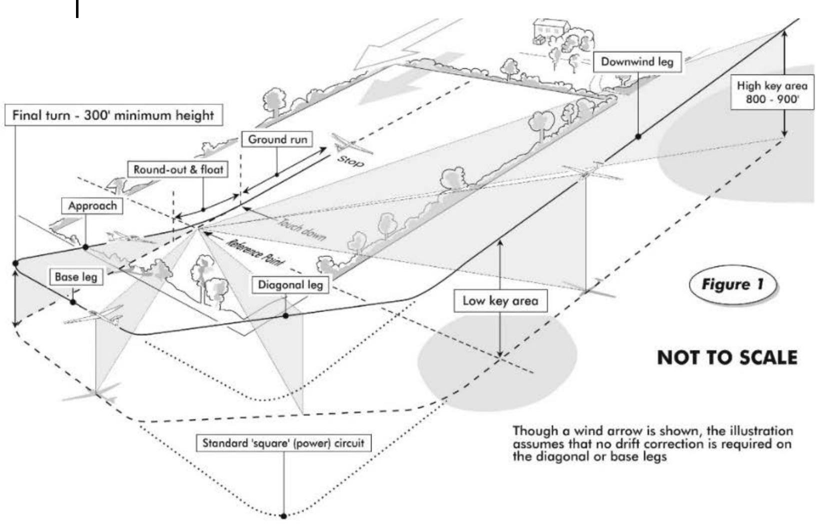
W Water ballast released.

U Undercarriage down

L Loose articles stowed and straps secure.

F Decide appropriate flap setting for approach & landing.

The circuit should be planned back from where we intend to land and stop the glider. Figure 1 shows a normal circuit with a high key area located upwind and to the planned circuit side of the landing area, a low-key area abeam the landing area and reference point.



In the high key area the glider should be approximately 700-900 feet and in the low key area around 500-700 feet; note that these are approximations as height should be judged primarily from the visual picture; trainees should be taught to disregard the altimeter once they have started the circuit and to use the angle to the reference point as their primary reference for judging correct position. Most gliders in still air, sink at around 200 feet per minute and their groundspeed once in the circuit is around 60 kts – thus to lose 200ft, high key should be positioned approximately 1nm upwind of the low-key position. This should give adequate time for the pilot to assess their progress and position relative to their chosen landing area and make appropriate corrections; shorter or non-existent downwind legs make this task much harder.

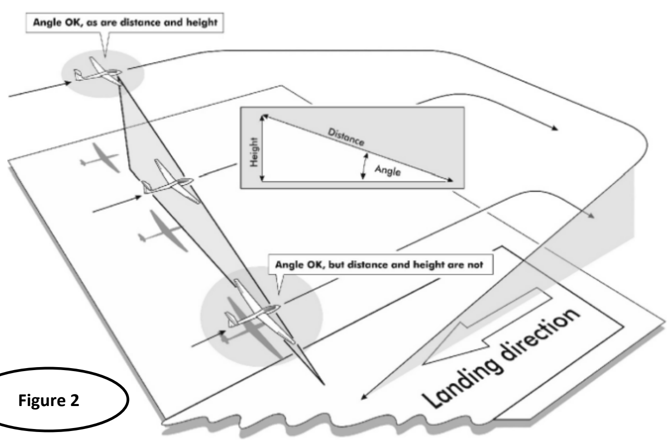


Figure 2

An effective lookout must be maintained throughout the circuit. It is very easy to become fixated on the landing area/reference point and so pilots must be vigilant in ensuring they maintain an appropriate scan outside the circuit and across the airfield to look for traffic on wider or opposing circuits. As they get closer to the natural funnel of the final approach, the risk of collision increases markedly; FLARM at this stage can be ineffective at as it will alarm off stationary gliders/aircraft on the ground close to the approach path.

A sensible speed should be flown for the conditions – for most gliders use best L/D, which, in many cases, will be very close to a normal approach speed; it is recommended to set and re-trim for the nominated approach speed as you approach low key as this will reduce tasks when the workload naturally increases in the latter part of the circuit.

In the early stages of training trainees will take a while to trim, so this process may need to start earlier on downwind leg, or even before high key.

Reference Point (RP)

The reference point is best described as the point on the ground at which on a steady approach, we would hit the ground if we failed to round out. It is selected based on where we want to land and stop the glider and therefore its position is affected by the strength of the wind and the steepness of the approach.

It might be easily defined by a recognisable point on the ground that the pilot can fly directly towards, as an area to the side of a ground feature, or it might just be a less defined area of grass to make the approach to. The more clearly defined, the easier it is to fly an accurate approach towards it.

As the glider progresses downwind, the pilot must continually monitor the chosen landing area to ensure it remains both unobstructed and within gliding range. It is essential that alternative landing options are constantly assessed in case the primary landing area becomes obstructed or other factors such as heavy sink are encountered; this ensures the circuit can be immediately adjusted and a safe approach and landing completed.

Spacing in the circuit is based upon the strength of the wind and the expected steepness of the approach. Ideally, the angle to the reference point should be similar to or just slightly shallower than the intended approach. Care must be taken to ensure that other parameters remain safe. If too high, care must be taken to ensure the circuit is not excessively wide; in this situation the angle would look fine (see Fig 2) but the spacing is not. Conversely, you can be too low, but the angle looks okay; in this case you may be too close, however, the greater issue here is that you may not have sufficient height to execute a safe turn onto the approach.

Awareness of height is important and learning to judge height above the ground without relying on the altimeter is a skill that needs to be taught to trainees. One simple technique is to observe how much fine detail can be seen on ground features. With trees, above around 1000 ft and at close range, very little detail can be seen, whereas once you descend below that height, finer detail will start to appear which becomes more apparent, as you get lower, with individual large branches starting to appear around 500 ft. Similar effects can be seen with other ground features.

Diagonal and Base Legs

As the glider passes low key it will start to fly away from the RP/landing area. At this point, the glider is turned onto the diagonal leg. The turn should be about 45 degrees but is flexible. The diagonal and base legs are used to make sure the final turn happens in the correct place. Continue to assess the angle to the reference point and make any adjustments necessary. If the angle is too shallow or decreasing then turn in a bit more; if too steep, a smaller turn or even widening out the diagonal leg will take you further back from the landing area. Airbrakes can be used at any time to correct a situation resulting from excess height.

Effect of Wind

The wind can have a significant effect on the circuit and rarely blows exactly down the runway. A strong wind increases the ground speed as you fly downwind, thus reducing the time available to assess and make adjustments. A cross wind will either work to slacken or tighten your circuit (see Fig 3, next page).

Whilst flying downwind the glider's heading must be adjusted such that you follow the correct downwind track; a slackening crosswind will drift the glider away from the circuit requiring the nose of the glider to be pointed in towards the airfield, whereas a tightening wind will drift the glider towards the airfield requiring a heading correction away from the airfield. This latter condition leads to potentially losing sight of the landing area/RP much earlier as you pass Low key.

As you turn onto the diagonal leg the effect of crosswind changes. The slackening crosswind may produce a headwind component on the diagonal leg and a definite headwind component on the base leg. This increase in headwind

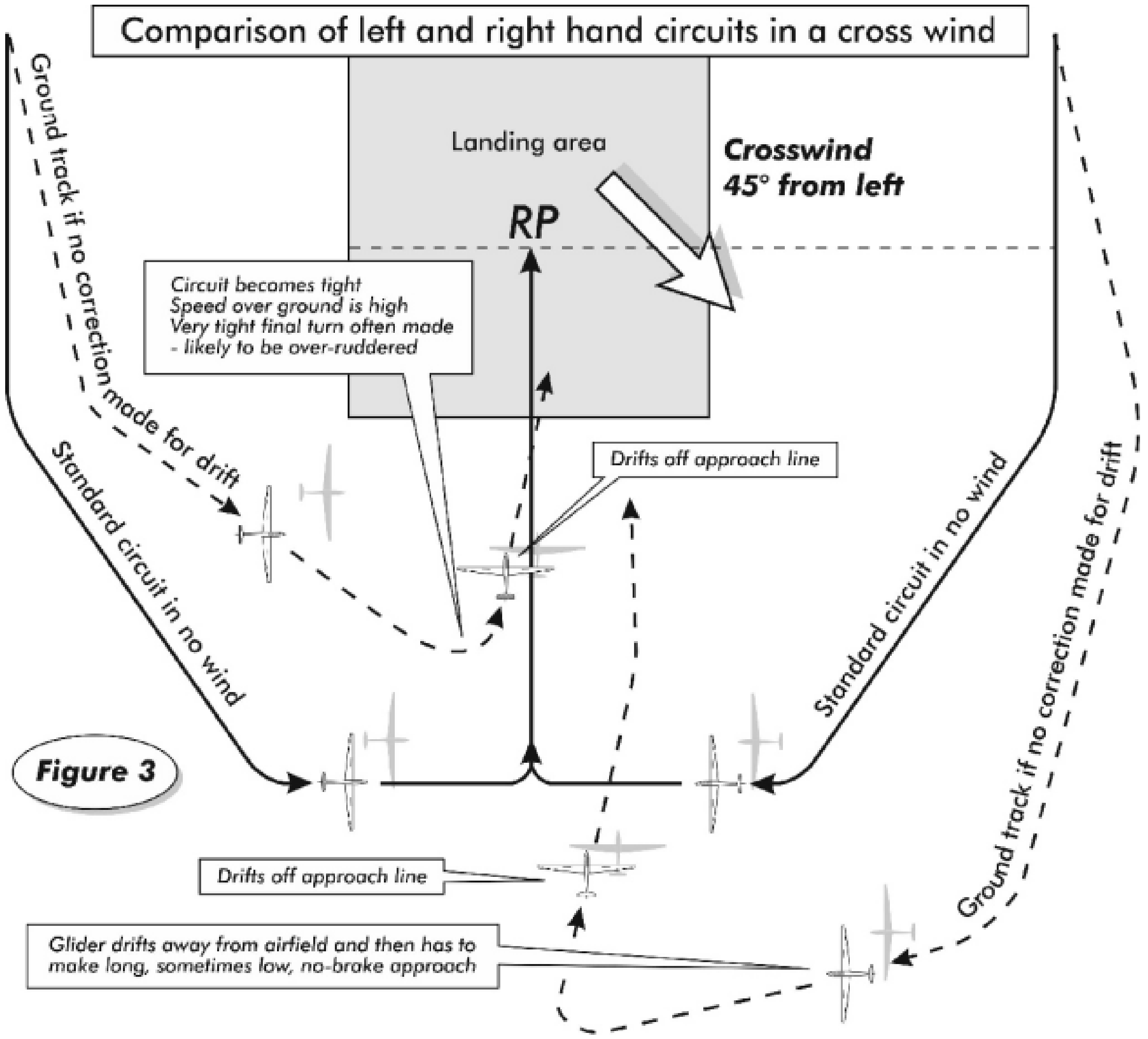


Figure 3

component reduces groundspeed and therefore increases the time taken to fly to the final turn point. With a tightening wind turns immediately into a tailwind component which continues to tighten the diagonal and base legs, increases groundspeed and reduces the time taken to reach the final turn point. This can be a significant threat as it can lead to not anticipating where the final turn needs to start such that a dangerously high angle of bank is used, risking an accelerated stall/loss of control. The effect of crosswinds can, of course, be anticipated by good situational awareness. If required, a tighter downwind leg can be flown with a slackening wind whereas a tightening crosswind can clearly be countered by a wider downwind leg to give a sensible available time for the diagonal/base legs; REMEMBER, the diagonal and base legs are where you make your final adjustments to ensure the final turn happens in the correct place.

Generally speaking, a circuit on the downwind side is usually preferable. The corrections for drift give you a better view because you crab towards the landing field not away. The headwind component on the base leg makes that part of the circuit less rushed, and the final turn position is easier to judge because there is less risk of overshooting it.

APPROACH CONTROL

The descent path of the glider during the final approach is adjusted using the airbrakes (or spoilers). Once opened, the airbrakes significantly increase the descent angle, or put another way, reduces the glide angle. As an example, an

ASK21 typically has a best glide of around 34:1 which reduces to around 8:1 with full airbrakes; the increase in drag and increase in glidepath makes it easier to fly an accurate approach to the RP.

The variation in glide angle between zero and full airbrake is referred to as the approach funnel. Trying to fly an approach in the bottom of the approach funnel, i.e. close to the 'no brake' line, is high risk, as it is difficult to judge and leaves no margin if an undershoot develops. The aim is to fly the approach in the upper part of the approach funnel, looking to use half to two thirds of the airbrake's effectiveness. If overshooting, the airbrakes can be extended further to increase the glide path angle. If undershooting, the airbrake can either be reduced slightly for a minor undershoot or be put away and fly to a steeper angle before extending them again and re-establishing a corrected glide path.

To add to the complexity of approach control, the strength of the headwind component directly affects the achieved glide performance (Figure 4). Thus, the half/two-thirds effective airbrake approach angle is constantly different as the wind strength differs on almost every approach.

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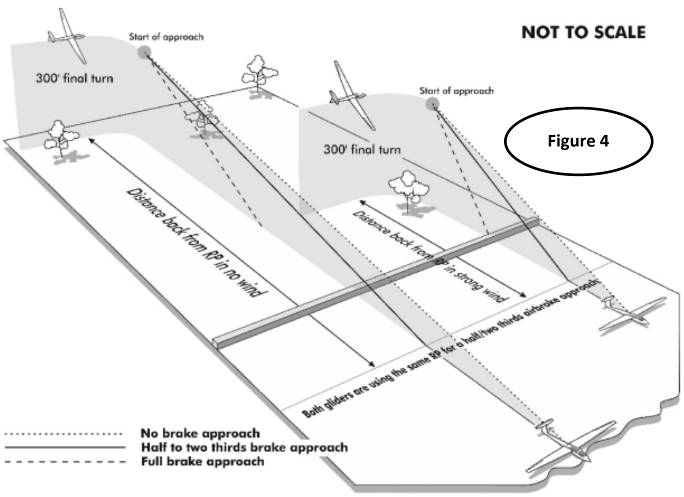


The final approach starts when we roll out of the final turn at a sensible height for the conditions and preferably no lower than approximately 300ft. The final turn should occur far enough back from the landing area that the glider can be flown towards the RP and into the ideal part of the approach funnel. Correct alignment of the final approach track should be established taking into account any crosswind and then, as the correct descent path is reached, the airbrakes should be smoothly opened to the half/two-thirds position and checked visually, the attitude adjusted to maintain approach speed, the glider's trajectory allowed to stabilise and then assess any movement of the RP. A continuous scan should then occur: **Alignment – Attitude – Airspeed – Reference Point**. Any deviations should be quickly assessed and corrected and the scan continued until approaching the flare.

The most common method of coping with a crosswind is the crab technique where the nose of the glider is pointed into wind such that the glider **TRACKS** down the final approach course in balance (yaw string centred). This is maintained until the flare when the glider is aligned with the direction of travel using the rudder.

<u>Use of Flaps</u>

If flaps are fitted, their setting will also affect the glide angle; the more positive the setting increases the wing camber, leading to greater lift, greater drag, a lower stalling speed and a lower nose attitude; the latter giving the pilot a better view of the RP and landing area. The most positive setting is usually known as landing flap and will allow the lowest approach speed and shortest landing distance but often leads to a reduction in roll response. Therefore, landing flap may not always be the most appropriate setting in gusty conditions. During the pre-circuit checks, **F** should be a consideration of what flap setting will be used and not a cue to set them; this should be done at an appropriate time prior to intercepting the final approach path.

<u>Determination of Approach Speed</u>

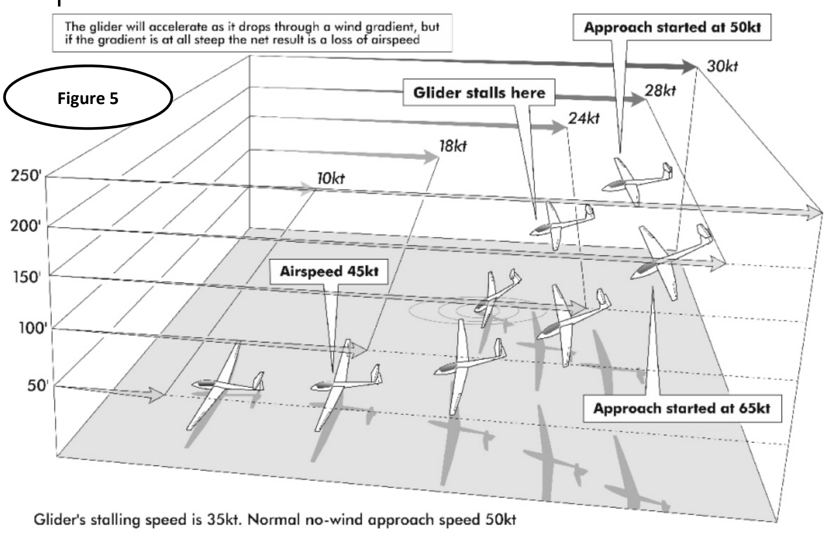
Approach speed in any aircraft is primarily determined by weight, landing configuration and wind conditions. It is based on a reference speed which is 1.3 times the 1g stall speed; this gives a base line approach speed which can then be corrected for wind and other factors. In most sailplanes this figure is worked out by the manufacturer at MAXIMUM WEIGHT without water ballast and is depicted on the ASI with a Yellow Triangle. However, it is important that the flight manual is referred to for type-specific advice.

Pilots are often confused about what speed to use on the approach and what they are trying to achieve. At best this confusion leads to slow progress for trainees and at worse causes accidents either during training or post solo. It is vital trainees are briefed on approach speeds and the effects of wind gradients prior to attempting to teach approach control or landing. They must understand the following:

- **Landing speed** – The speed the glider touches down at, normally close to the 1g stall speed for a fully held off landing.
- **Speed required for a round out** – The minimum speed the glider can achieve a round out on level ground with clean wings. This information is in the flight manual and often quoted as the minimum approach speed or marked on the ASI with a yellow triangle, however the flight manual should still be consulted for any special conditions. Provided we have this speed or more we will be able to achieve a round out irrespective of the wind speed.
- **Approach speed** – If approaching into a headwind there will usually be a wind gradient down the approach, which will act to rob airspeed from the glider. For this reason we add extra speed for the approach in excess of minimum approach speed. It is normal for this 'extra' speed to decay in the last 50 to 75ft of the approach. Provided we have our minimum or yellow triangle speed for the round out then we will be OK.

When deciding how much extra speed is required, use minimum approach speed + half the headwind component. Additional speed may need to be added for turbulence/gusts, wing contamination or landing up slope. It is normal practice in the case of gusts to add the 'gust factor,' so for gusts of 10kts **above the steady wind speed you** would add 10kts. However, unless your airfield is equipped with an accurate anemometer, these calculations can only be based off a 'best guess,' and in the situation of an airfield experiencing rough rotor conditions, the wind affecting the glider pilot is changing constantly.

Be aware, that if the result of the pilot's approach speed calculation is exceeding 70-75kts (40-50% over a 50kt yellow triangle speed), it is likely to be excessive at the majority of airfields. High approach speeds bring about a significantly



Glider's stalling speed is 35kt. Normal no-wind approach speed 50kt increased rate of descent from which the flare needs to be anticipated and actioned earlier than from a normal approach. Pilots often believe they must maintain all this extra approach speed down to the point of flare leading to them either diving through the wind gradient resulting in an increased rate of descent and a late sharp flare, or they start reducing the airbrake setting in the last 50ft. Both these habits lead to excessive speed for the flare and the result is ballooned/bounced landings, under shooting, PIO, a long float, or all the above.

In summary:

- Determine minimum approach speed (Yellow triangle/aircraft flight manual).
- Nominate **minimum acceptable** approach speed (minimum approach speed + allowance for contamination/runway upslope.
- Nominate **target** approach speed (wind corrections including gusts/turbulence as required).
- Do not carry excessive speed!

Strong Winds and Wind Gradient

The wind tends to increase with height. In strong wind conditions this increase in wind speed can be significant and therefore the approach needs to be flown at a much steeper angle to allow for the decrease in groundspeed and increase in approach speed. As you descend through the wind gradient the wind component reduces which will lead to a decrease in IAS (Figure5).

If a sensible approach speed has been selected there will be a safe margin above the minimum acceptable approach speed for you to take corrective action and recover the airspeed; this might require a lowering of the attitude along with a reduction of airbrake.

If the wind is gusty then we should have chosen an approach speed that adds a gust factor as previously described and which keeps the glider above the minimum acceptable approach speed. You will experience IAS variations above and below the selected approach speed. Trying to correct the speed by reacting to every gust invariably leads to destabilising the approach, the constant attitude and airbrake changes will make it impossible to fly the approach accurately to the RP. Gusts, by their nature are exactly that, momentary changes in wind speed; maintain the selected attitude and accept any variations in IAS caused by gusts and allow the speed to recover. REMEMBER – this is WHY we added a gust factor, to keep us above the minimum acceptable approach speed. If you arrive at the flare with an IAS above the minimum acceptable approach speed you should have enough energy to flare!

In certain conditions, windshear can be experienced where the wind speed or direction can change suddenly leading to an instant change in airspeed. In essence, windshear can be viewed as the most extreme gusts where a sensible choice of approach speed is most important. But note that windshear conditions can be extremely dangerous for any aircraft when close to the ground. If experiencing a marked loss of airspeed on approach, the airbrakes should be fully closed and the nose lowered if there is enough height to do so; the action of closing the airbrakes will, in isolation, restore energy/speed sufficient to flare the glider.

LANDING

As the glider approaches the reference point the rate of descent needs to be arrested such that the glider transitions smoothly to level flight just above the ground; this is commonly known as the ‘round-out’ or the ‘flare.’ The exact point at which the flare starts is dependent on the steepness of the approach path and the approach speed as these factors can vary the rate of descent considerably. The greater the rate of descent, the earlier the round-out should be initiated. To judge when to commence the flare, the pilot must transfer their focus from the reference point and look towards the end of the runway. This allows them to judge closure with the ground, continue tracking in the required direction, and achieve the correct landing attitude.

From the start of the flare the airspeed will be reducing and therefore the attitude needs to be adjusted by a continuous nose up elevator input to maintain level flight just above the ground. If landing up a slope, a slightly higher approach speed should be used as the glider needs to be flared more to achieve level flight along the upslope. Commonly called the ‘hold off’, this is maintained until the glider reaches the correct landing attitude when the attitude should be held and the glider will sink on to the ground; the aim is to touchdown on the tailwheel/skid and the mainwheel at the same time; this will occur shortly before the stick reaches the back stop. This is referred to as a ‘fully held-off landing.’

Pilots sometimes mistakenly say that the glider is being stalled onto the ground. Whilst the airspeed is decreasing and the symptoms of the approaching stall are evident; the glider actually sinks onto the ground before stalling speed is reached. To stall, the glider would need to reach the stalling angle of the wing, commonly around 15 degrees. Few gliders sit with the tail and mainwheel on the ground with the wings close to an angle of 15 degrees.

If a crosswind is present, once transitioned into the ‘hold off’ the pilot should align the glider with a smooth rudder input and maintain the wings level using ailerons. If this alignment is done too early the glider may start to drift downwind before it has landed; in this case the into wind wing may need to be lowered slightly to stop the drift.

Once on the ground, the glider should be maintained straight with the rudder, with the wings level and the stick smoothly moved fully back until the glider has stopped; this latter action will keep the tail firmly on the ground aiding directional control, and also for gliders with nose wheels such as ASK21s, keep as much weight off the nosewheel until the lowest possible airspeed. Wheel brake should be used as required to bring the glider to a safe stop.

Short Landing Procedures

Short landing procedures are a requirement of the SPL syllabus and link accurate approach and landing techniques with the practicalities of field landings.

If the landing area is restricted due to size, an RP is initially planned about one-third of the distance into the area. Once a stable approach has been established, the amount of airbrake can be increased to bring the RP safely back towards the boundary of the available landing area, thus maximising the landing distance available. Once the glider is on the ground, the wheel brake is used to bring it to a halt in the shortest possible distance, minimising the risk of hitting an unseen obstruction.

The Flying

AIR EXERCISE BRIEFINGS

The three elements of Ex 12 should be taught as separate lessons and will be covered as such below. As with all flying exercises, once a level of proficiency has been achieved, the elements should be combined appropriately. NEVER attempt to teach both approach control and landing together – there is too much information to take in.

Nothing in Ex 12 will be a new experience for the trainee as they will have seen every element on every flight they have completed to this point. You are building on an existing level of knowledge from the start. Do not assume, however, that they understand what has been happening thus far. Remember this is a judgement exercise and it is highly likely that, although they may have been flying parts of the circuit, the instructor will almost certainly have been making the judgement calls and directing the trainee with significant prompting.

CIRCUIT PLANNING

AIM: To fly a safe circuit resulting in a final turn at an appropriate height and position.

Check that the trainee has received a thorough ground briefing and understands the concepts of circuit planning and judgement and what they are trying to achieve.

TEM

Threats:	**Management:**
Collision	Maintain thorough lookout scan
Errors:	
Running out of height for appropriate circuit	Monitor height & position
Not recognising effect of wind or a changing wind.	Consider effect of wind prior to commencing circuit

MANOEUVRE DEMONSTRATION

In demonstrating and practising circuits at this stage, conditions need to be as ideal as possible. Strong winds and/or significant crosswinds should be avoided.

For the initial demonstration, the trainee should be watching and not following through on the controls or flying the glider.

Set the glider up in a suitable position, upwind of both the airfield and the high key position. Explain what you are doing, how you are assessing the wind, selecting your landing area/RP, and assessing other landing options in case your chosen area becomes obstructed.

Assess the wind and its effect on the circuit.

Agree a target and minimum acceptable approach speed (this might already have been done prior to launch).

Complete the pre-circuit checks – WULF (recommended).

Join the circuit at high key pointing downwind. Fly the circuit such that it reflects the 'ideal' circuit with regards to height, distance out and angles to the reference point. Describe where you are looking and that you are assessing your height/distance/angle from the reference point whilst emphasising your lookout scan, especially outside the circuit and across at the opposing circuit. (You should not assume every aircraft will be flying the same pattern.). As you reach low key, point out that you are now level with the reference point and that you have set and re-trimmed for the approach speed. This is a convenient point to identify the airbrake lever and place your left hand on it (so there is no scrabbling for it later and possibly confusing it with the gear retraction lever).

The turn onto the diagonal leg should be made shortly after passing the low-key area. The diagonal leg should be used to ensure the height/angle/distance to the RP remains satisfactory. If the angle appears to be shallowing off the diagonal leg can be adjusted in towards the airfield; conversely, if the angle appears to be too steep the diagonal leg can be adjusted slightly away from the airfield. The attitude/airspeed should now be monitored every few seconds. Continue to emphasise an effective lookout scan especially outside of the circuit, on the opposite circuit, and further out on the approach track.

The base leg should be flown to ensure the final turn occurs to allow the correct approach control technique to be used as described in the next section. Height/angle/distance assessment and attitude/airspeed monitoring continues and the base leg can be adjusted to tighten or slacken the circuit as on the diagonal leg. Airbrake can be used effectively but with care at any stage on the diagonal and base legs if too high, however, a good circuit demonstration with good positioning should not require this.

The turn onto the final approach should be anticipated such that a normal banked turn can be made to roll out aligned with the selected approach track.

Emphasise effective lookout approaching the final turn.

Now just fly the approach and landing without further patter; you have completed the circuit demonstration at this point, so do not distract from it by describing other exercises.

If you manage to demonstrate the 'perfect' circuit as per this manual/the Student Pilot Manual – fantastic – the student now has a model to follow. However, achieving the 'perfect' circuit every time is highly unlikely. You MUST NOT attempt to fly the 'perfect' circuit where the conditions result in either a cramped final turn or, more dangerously, far too low, or too far out; this would not be flying by example. You MUST ensure you fly making corrections appropriate to the conditions, describing WHAT is happening and WHY you are doing something. For example, you might encounter lift as you fly downwind putting you high on your diagonal/base leg; the correct action in this case may be to widen out your circuit, possibly combined with using airbrake to lose height to correct to a more appropriate height. Conversely, you may encounter sink and find yourself running out of height such that you have to turn in early and land further up the airfield than originally planned. In cases like these where conditions require corrections to be made, it is absolutely ESSENTIAL that an instructor demonstrates the CORRECT action to achieve a SAFE outcome. In the subsequent debrief you should reflect on what has just occurred, assess what the trainee understood by asking them what they remember and explain your decisions and actions. You have just demonstrated good situational awareness and decision making, the very competencies your trainee needs to develop to successfully fly this exercise.

If you assess that your demonstration strayed too far from the 'perfect' circuit, it is essential another demonstration be flown; consider whether this should be delayed to a time when conditions become more appropriate.

THE ZIG-ZAG CIRCUIT DEMONSTRATION

The Zig-Zag circuit is not a type of circuit; it is a tool for the instructor to assess the trainee's judgement and should be flown after the trainee has had a few attempts at the circuit themselves It is intended to show what it looks like if the glider is either too close or too far away for the height available and should be used to assess the trainee's judgement. (Fig 6).

Position the glider about 900ft in the High key area; point out that the height/distance/angle is correct.

Fly in towards the airfield. Point out that the height/distance/angle relationship is wrong and the glider is **TOO CLOSE** and not too high.

Turn the glider so that you widen out the circuit. Point out to the trainee that the angle is reducing and the distance increasing; ask the trainee to judge when the glider achieves the correct height/distance/angle. If height permits, continue to widen out the circuit beyond the ideal and highlight that the glider is **TOO FAR OUT** for the height available.

Demonstrate that the correct action in this situation is to turn back in positively to immediately correct the error and to try and rejoin the correct profile; ask the trainee to judge when the height/distance/angle looks correct. If getting too low, demonstrate the correct action by cutting the circuit short and land further up the airfield. The risk here is the **ERROR** of becoming too low or too far out.

Care MUST be taken to ensure the Zig-Zag circuit demonstration does not result in a dangerous situation or an inadvertent land-out. It can be a challenging exercise to fly in one attempt, especially in a conventional glider and a TMG is ideal to use if one is available. It may be better to split the demonstration into two parts; ensure the elements are not rushed and the training objectives of assessing the trainee's judgement are achieved. A light wind day makes the demonstration easier to fly and gives the trainee more time for assessing changes of angle.

MANOEUVRE LESSON

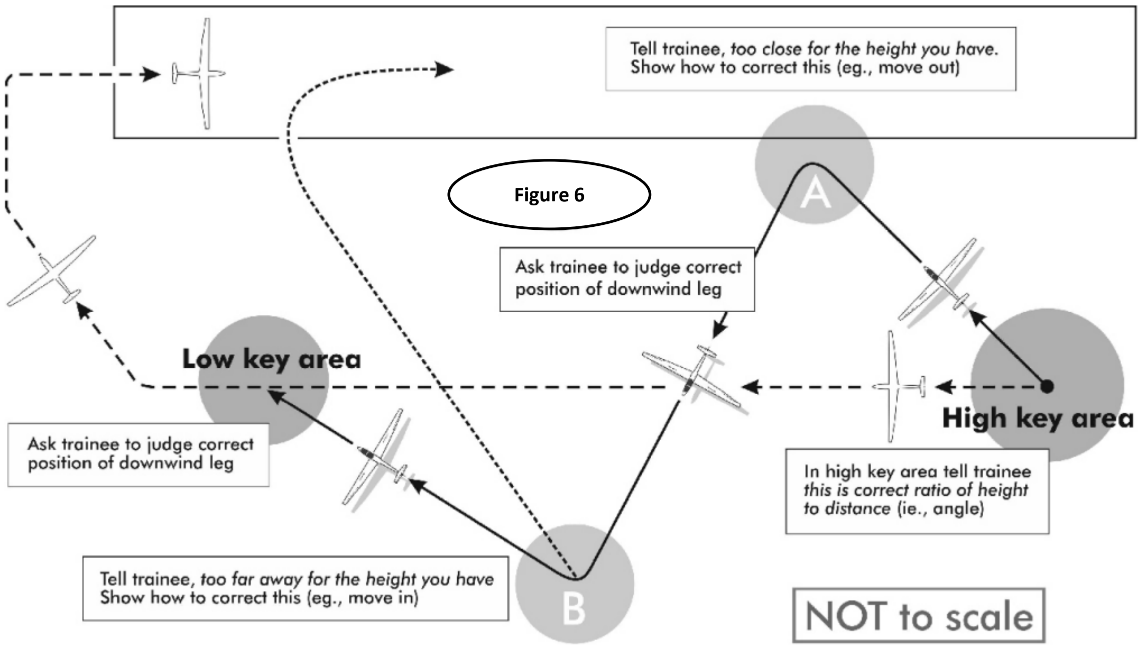
The trainee should try to fly a standard circuit as demonstrated. Make it clear in the exercise briefing that one of the main training objectives of circuit planning is for them to assess the conditions, to recognise when the height/distance/angle is not correct, and to make suitable corrections. Once in the air, prompts need to be minimised. Allow them to recognise any deviations and to make appropriate corrections; constant prompting around the circuit by the instructor is distracting and means that the instructor is ultimately making the decisions. Clearly you need to intervene at an appropriate moment and at an appropriate level, but if they are doing okay, leave them alone.

Initial trainee attempts are likely to see a deterioration of flying accuracy due to the increased workload so you may need to remind them to fly the glider. It is likely they will be able to replicate the correct height/angle/distance, especially immediately after your demonstration. An indirect prompt such as *"What do you think of your angle and distance?"* can help compare their perception to your own. If they recognise it is wrong but not doing anything about it, you need to encourage the decision making by asking *"What are you going to do about it?"*

As they progress you will need to introduce various unusual or awkward circuit situations to allow them to develop their judgement and decision-making skills.

Such situations could consist of:

- arriving at high key lower or higher than usual.
- commencing the circuit from too close in.
- being too low or too far out to reach the high key area.
- encountering sink resulting in running out of height (simulated by using the airbrakes).



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To check that the trainee is not over-reliant on the altimeter, fly an exercise with the altimeter covered up.

It is essential that the trainee can deal with any of these scenarios. Whilst it is great to have one who can fly a model circuit time and time again, it does not prove their ability to recognise and respond correctly to deviations.

A TMG is useful for covering the early demonstrations and trainee attempts at circuit planning. A flight of 30 – 45 minutes can provide some consistency without having to wait until the next glider flight. The circuit only needs to be flown until the final turn has been completed then the instructor can take-over, perform a go-around and reposition for another attempt. To ensure the trainee is not overloaded, an initial TMG session could include the instructor demo, some trainee practice, finishing with the zig-zag circuit demo which can be broken down into two parts to prevent it being rushed. A second TMG session could be used to look at awkward circuit scenarios. Practice on a simulator can also be helpful – and very cost-effective – provided the setup provides a sufficiently wide field of view.

Whilst allowing the trainee scope to make errors, identify and correct them, you must ensure they do not take you beyond your ability to recover the situation. It is very easy to let them get too far out of position and as you progress beyond Low key, you have little excess height and time to sort out significant errors, especially if the airfield you fly from has fewer or restricted landing options.

Most importantly, You MUST ensure that if the trainee makes any safety error at a CRITICAL stage of the circuit, you MUST:

- TAKE CONTROL and recover safe flight path.
- DO NOT hand control back to the trainee.

DE-BRIEFING

It is important that you establish what the trainee saw and how they corrected errors, even if the outcome was successful. They may not make adjustments in the same way you, as an experienced pilot would, but the overall outcome may be a safe approach. This is a good opportunity to discuss their decision making. If their decisions led to instructor intervention, then it is important they understand why.

Ensure you praise positive examples whilst being constructive when highlighting examples of poor decision making. If it is clear the trainee does not understand what they are trying to achieve, ensure they are re-briefed and re-taught.

COMMON DIFFICULTIES

Trainees often recognise their position in the circuit is incorrect but then fail to take any action to correct it. A suitable direct question to gauge their assessment and what they need to do about it might be appropriate at this stage but keep any questioning as brief as possible.

The trainee may have a tendency towards cramping their circuit. Certain gliding sites have local conditions which often lend themselves to tight circuits which the trainee often sees as the normal, especially if their instructors set the wrong example by flying tighter circuits normally. It is imperative that trainees have any tendency towards cramped circuits corrected.

It is possible that the trainee's standard of flying may deteriorate when they start circuit planning. Do not forget that they are now having to exercise judgement and make decisions which will increase their workload. Be patient with them. If necessary, break the exercise down into bite-sized chunks by flying the glider yourself so they can concentrate on the decision making and reintroduce them to the handling when they have a bit more capacity. If they require frequent prompts or you are having to take control it is likely that circuit planning has been introduced too early.

Some trainees may have the ability to vocalise their thoughts and decisions. If they can it might help you work out what is happening, but do not insist on them doing so as it may overload them.

Some upper air exercises immediately prior to joining the circuit can overload or disorientate the trainee during their early attempts at circuit planning.

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12b – APPROACH CONTROL EXERCISES

APPROACH CONTROL AIR EXERCISE BRIEFINGS

The aim of the approach control lesson is to teach the trainee how to fly a safe approach using the correct technique to enable a safe landing in a chosen area.

DO NOT try and teach approach control and landing at the same time.

The first element is to cover the effects and use of airbrakes (and spoilers). The trainee will have seen them being used but it is important that they not only know HOW they affect the handling and performance of the glider, but also how they are used to adjust the approach path whilst maintaining approach speed.

Point out that the **descent path** is controlled by the **airbrakes.** The **approach speed** is controlled by the **elevator** with reference to the **attitude and airspeed.**

The effect the airbrake has on the glider's natural stability is dependent on the position of the airbrake on the wing and this affects the change in the wing's centre of pressure as the airbrakes are opened and closed. With airflow over the wings, the airbrakes will open easily (suck out) once unlocked; the higher the speed or angle of attack they are unlocked, the greater the tendency to open suddenly. Different glider types have different responses but that the effect on airspeed, attitude and trim is minor and easily controlled.

The approach funnel and reference point technique should be recapped, highlighting the objective of a half to two-thirds airbrake approach. Stress the importance of establishing and maintaining the correct final approach track **alignment** and then, once the angle to the RP looks correct, smoothly opening the airbrakes (encourage a quick glance to see how much airbrake is actually extended), adjusting the **attitude** to maintain the **airspeed** and assessing any movement of the **RP.** This establishes a suitable scan (**Alignment – Attitude – Airspeed – Reference Point)** all the way down the approach until the flare.

Assessing overshoot and undershoot by movement of the RP in the canopy can only be done if the **attitude and airspeed are stable**.

The appropriate technique to correct both situations should be discussed. The **primary method to recover from an undershoot is to close the airbrakes**, fly towards the RP until a steeper angle is seen and then re-establish a half/two-thirds airbrake approach. Only when a small undershoot is apparent is it acceptable to reduce the airbrake setting slightly to make a correction. Constant reduction in the airbrake setting, however, can lead to a **shallowing approach** where the glider is dropping lower and lower in the approach funnel; this is a **hazardous situation** which must be avoided.

Reassure the trainee that it is very rare for any glider pilot to get the correct approach angle/airbrake setting correct at the first attempt and it is absolutely normal to have to make some correction on most approaches.

TEM

Threats:	**Mitigation:**
Collision	Maintain thorough lookout during all phases of the circuit and approach
Errors:	
Shallowing approach due to incorrect technique during undershoot scenario.	Ensure correct technique used
Instructor failing to take control in time	When trainee makes an error at a critical stage of flight, the instructor MUST take control

AIRBRAKE DEMONSTRATION + LESSON

Upper air exercise

<u>**THREAT**</u> **– This lesson leads to a large loss of height.** Check you have sufficient height before starting and monitor the height loss and distance from the airfield.

The first element of the lesson is to **demonstrate** the **effect** of the airbrakes.

Trim the glider for the **approach speed** and then release and guard the stick. Slowly open the airbrakes to between half and two-thirds. Draw attention to:

- Any change in attitude and speed that occur.
- The increased rate of descent.

Now open the airbrakes fully and draw attention to any changes to the same points above.

Whilst continuing to guard the stick, smoothly close and lock the airbrakes, again drawing attention to:

- Changes in attitude and airspeed.
- The reduction in sink rate.

The second element of the lesson is for the trainee to learn **how** to operate the airbrakes whilst maintaining a **constant airspeed**. Trim the glider for the **approach speed**. Get the trainee to **follow through** and slowly open the airbrakes to around half to two-thirds whilst **adjusting the attitude** if required to **maintain** the approach speed. Get them to glance

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at the airbrakes to see how far they are extended and then back to the **attitude and airspeed**. Open the airbrakes fully maintaining the approach speed and then whilst continuing to maintain the approach speed, smoothly close and lock the airbrakes.

The instructor should continue to fly the glider at the approach speed whilst the trainee opens and operates the airbrakes over their entire range including closing and locking them. Draw the trainee's attention to:

- Any tendency for the airbrakes to suck out.
- The force to move the airbrake lever comparing the air loads to those on the ground.
- The force required to lock the airbrakes.

The trainee should then practice flying the glider, maintaining the approach speed whilst unlocking the airbrakes and operating them smoothly over their full range. They should also be able to close and lock the brakes. Allow the trainee sufficient practice to achieve **proficiency** in all elements of this exercise as this is a basic but essential skill before moving on to the next stage.

One final exercise for the trainee to practice is for them to accelerate the glider towards maximum manoeuvring speed (Va) and then smoothly open the airbrakes fully to experience the operating forces.

AIRBRAKE LESSON DEBRIEFING

Remind the trainee that:

- the **descent path** is controlled by the **airbrakes.** The **approach speed** is controlled by the **elevator**
- the effect of the glider's airspeed on the airbrake operating forces and the need to keep one's hand on the operating lever to prevent the airbrakes from extending beyond the desired position.
- they must perform an adequate scan to fly and maintain the nominated airspeed.

Discuss any difficulties experienced in unlocking, locking, or operating the airbrakes. If so, their reach may be compromised by an incorrect seating position.

<u>Advice to Instructors</u>

The airbrake demonstration and lesson use large amounts of height. You may need several flights to allow the trainee to achieve the correct level of proficiency. If the trainee does not master this skill, they will struggle later on.

APPROACH CONTROL LESSON

The approach control lesson comprises the following elements:

- Revision of the use of airbrake (required if not completed directly before).
- Demonstration of a normal approach.
- Demonstration of the undershoot and overshoot and how to correct to a normal half to two-thirds airbrake approach.
- Trainee practice.

During the demonstrations and initial trainee practice, the instructor should fly the glider and arrange for the final turn to occur slightly higher and slightly further back from the RP than normal (an extra 200ft will suffice). **Note:** appreciation of approach angle can be more difficult if the glider is a lot further back than normal – you need enough time to highlight the teaching points.

<u>Demonstration of a Normal Approach</u>

Roll out of the final turn **aligned** with the final approach maintaining the correct **attitude and airspeed.** Continue to fly towards the RP until intercepting the half to two-thirds airbrake approach path. Example patter could be:

- 'I'm going to demonstrate a normal approach to you – please follow through.'
- '**Aligned** with the approach track, maintaining XX knots.'
- 'Two-thirds airbrake - **NOW -** glance at them.'
- 'Note where the reference point is in your canopy – it isn't moving.'
- **'Alignment – attitude – airspeed – reference point.'**

<u>Demonstration of an Overshoot</u>

Establish on a normal two-thirds airbrake approach before reducing the airbrake setting to **establish a clear overshoot**. Then increase the airbrake to return to a normal approach. Example patter could be:

- 'I'm going to demonstrate an overshoot and how to recover to a normal approach – please follow through.'
- 'Settled on a normal approach I will now reduce the airbrake - adjust the **attitude - airspeed** about right.'
- 'How is the reference point moving?'
- 'This is an **overshoot.'**
- 'I'm now increasing the airbrake to correct the glidepath – glance at them.'
- '**Alignment – attitude – airspeed – reference point.**'

If the use of full airbrake still results in overshooting the RP, the approach should continue to be flown at the correct **attitude and airspeed,** accepting that the original RP will be overflown resulting in a longer landing; a dive towards the RP allowing the airspeed to increase is not the acceptable technique.

<u>Demonstration of an Undershoot</u>

Roll out of the final turn **aligned** with the final approach maintaining the correct **attitude and airspeed** but **before** intercepting the half to two-thirds airbrake normal approach path, open the airbrakes fully **establishing a clear undershoot**. Then close the airbrakes and fly back on to the normal approach path (if sufficient height, this can be repeated once more), with half to two-thirds airbrake extended. Example patter could be:

- 'I'm now going to demonstrate an undershoot and how to recover to a normal approach – please follow through.'
- 'Before I reach the correct approach angle I'm going to open the airbrakes – glance at them – **attitude – airspeed** about right.'
- 'How is the reference point moving?'
- 'This is an **undershoot.'**

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- 'Closing the airbrakes – glance at them – **attitude – airspeed** about right – fly in towards the correct angle.'
- 'That looks about right – reselecting the airbrake – glance at them – **alignment – attitude – airspeed** about right – **reference point.'**

It is possible to combine the overshoot/undershoot demonstrations into one approach but be aware that the trainee may not recognise what is happening for some time, which can lead to a rushed or ineffective demonstration. For the undershoot demonstration, choose an RP well into the field to cater for the possibility of landing short (TEM) which, if it happens, can be used in the debrief to reinforce the threat from undershooting.

For the initial trainee attempts, start the final approach at about the same height/distance out used in the demonstrations to give them time to assess.

- For the initial attempts, the instructor should fly the glider and **align** it on to the final approach track before handing control to the trainee.
- Initially, the emphasis will be on the trainee using the correct technique **(alignment – attitude – airspeed**) rather than focussing on flying to an accurate RP.
- The trainee should be able to recognise and make an appropriate correction to the approach path – accuracy will come with practice.
- If the glider drifts away from the final approach track, correct this first before the glidepath – **alignment – attitude – airspeed – RP.**
- Try and avoid making big corrections as you approach the flare.
- Whilst it may be necessary to prompt the trainee during their early efforts, be aware this can be hazardous. When the trainee is working at their capacity, a sudden prompt might elicit an unexpected and irrecoverable situation. It is often best to say **'I HAVE CONTROL'** and **take over.**
- If the approach is not reasonably under control by 100ft, **take control.**

If the trainee makes an error at a critical stage of flight the instructor <u>must</u> take control – and do not hand it back.

DEBRIEFING

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- Alignment of the approach track and corrections.
- Accuracy of attitude and speed control.
- Assessment of undershoot/overshoot.
- Correction of undershoot/overshoot and achievement of acceptable approach path.
- Wind gradient effects on approach speed control.

A simple way to think about it:

- On approach the target speed should be maintained.
- If overshooting, increase airbrake and **accept** the reference area may be overflown.
- If undershooting, put the brakes away **FULLY** and fly on until a two-third airbrake approach can be achieved.
- It is absolutely **normal** to misjudge the required approach angle initially and it is **okay** to have to make corrections.

REMEDIAL EXERCISES

Both of the following exercises are intended to show the importance of maintaining a constant airspeed when flying to a reference point. These demonstrations should only be shown to the trainee if it is felt they do not understand the need for a constant airspeed to be flown. The trainee **should NOT** follow through on the controls.

<u>Exercise 1 – The Overshoot</u>

- Choose an RP close to the downwind boundary of the landing area and make the final turn slightly higher and further back than normal.
- Open the airbrakes in the normal position but only use a small amount (maximum one-quarter).
- Maintain the RP in the same position in the canopy by gradually lowering the nose – do not alter the airbrake setting.
- Emphasise that the picture looks right with the RP static but that we are **failing to monitor** the airspeed.
- The airspeed will increase, slowly at first. Once it has increased by 15 to 20kts, **'realise'** that the airspeed is too high and adjust the attitude to slow down to the **correct airspeed** whilst increasing the airbrake setting. The result will be an overshoot and a long landing.

<u>Exercise 2 – the Undershoot</u>

- Identify a RP that is well into the field with a safe undershoot – you will almost certainly land in it.
- Select a slightly higher approach speed. If it is a 55kt approach day, use 60kts.
- At the appropriate time set up an undershoot by using full airbrake and maintain the RP in a constant position – comment that the RP picture looks okay but emphasise that we are **failing** to monitor the airspeed.
- The airspeed will slowly decrease. After losing a **maximum** of 10kts, **'realise'** that the airspeed is **too low.** If you are at a safe height (above 200ft) and over a safe landing area, lower the nose to retrieve the speed you've lost, but leave the airbrakes open and deliberately land short of your chosen RP.

<u>THREAT</u> – DO NOT allow the glider to get low and slow in this exercise. If you mistime the exercise discontinue it immediately – close the brakes and accelerate to a safe speed.

<u>NOTE</u> Both these exercises demonstrate the need to maintain a constant airspeed when using the RP technique.

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COMMON DIFFICULTIES

Trainee has issues flying and maintaining the approach ground track alignment. This could be an indication that they are getting over-loaded, or the root cause might be as fundamental as they cannot fly in a straight line. Don't be afraid to revisit the basic training exercises such as the Straight Glide if required.

Adjusting the airbrakes too frequently. The trainee needs to understand they should make an adjustment and let the glider settle before assessing whether a correction is needed. A re-brief on the effects of the airbrakes might be useful and/or a re-demonstration of the use of airbrakes whilst at height.

Closing the airbrakes in the final stages of the approach. Unless the airspeed is decaying unacceptably and there is insufficient height to lower the nose, ensure the trainee maintains the appropriate airbrake setting as they commence the flare until they have landed.

Opening the airbrakes as soon as they roll out on final approach – the 'going into land' lever. Reinforce that they must assess whether they have reached the correct approach path angle **before** they open the airbrakes. They may, of course, need to open the airbrakes immediately as they have cramped their circuit/base leg and is the correct decision – it is important that circuit planning is discussed to ensure the final turn is positioned correctly for the conditions.

Be aware of the power pilot converting to gliding easing the airbrakes in gradually to maintain a constant approach picture. This is a standard technique in powered aircraft but, of course, can lead to a shallowing approach in a glider.

The trainee may tend to drift laterally towards obstructions or the edge of the landing area. This is usually caused by the trainee not looking directly where the RP is, but at a feature or obstruction to one side. Ensure they are **aligned** with a suitable RP well clear of any obstructions and that they are looking at where they want the glider to go.

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Ex 12 – LANDING EXERCISE

DO NOT try and teach approach control and landing at the same time.

LANDING EXERCISE BRIEFING

AIM: To teach the trainee how to land a glider.

Under normal conditions the flare starts about 20 feet above the ground, but this will depend on the steepness of the approach and the descent rate. The objective is to transition smoothly from the approach to flying parallel with the ground just a couple of feet up.

When it is time to begin the flare, stop adjusting the airbrake and look away from the RP towards the far end of the landing area and the distant horizon. This helps judge the glider's height and closure with the ground and also allows accurate adjustment of the attitude. During the flare, the pilot should concentrate only on the attitude and flight path.

Smoothly move the stick rearwards to arrest your descent until the glider is flying parallel with the ground. Use the elevator to slowly raise the nose until the glider is in the correct landing attitude then allow the glider to settle onto the ground.

Once on the ground:

- Keep the glider running straight by using the rudder.
- Maintain the wings level with the ailerons for as long as possible.
- Progressively bring the stick all the way back.
- Select full airbrake.
- Apply the wheel brake gently if required.

<u>Landing with a Crosswind</u>

To maintain the correct ground track on the approach the nose of the glider needs to be pointed towards the wind (crabbed) – this may position the RP to the downwind side of the canopy rather than being directly over the nose. The desire to point the glider directly at the RP and therefore be out of balance needs to be resisted – the glider must continue to track in coordinated flight until after the flare has commenced.

- As the nose rises towards the landing attitude, use the rudder to point the glider in the direction of landing.
- Remember – the further effect of rudder will roll the glider in the same direction – prevent this roll by maintaining the wings level with opposing aileron.
- As the glider slows it will want to yaw (weathercock) into the wind – initially maintain and then increase the rudder input as the glider slows.
- Keep the wings level for as long as possible.

TEM

Threats:	**Mitigation:**
Unexpected trainee action	Avoid unnecessary prompting. Take control early
Errors:	
Lots of trainee errors	Guard the controls effectively. Take control early

LANDING DEMONSTRATION

Ensure you are flying the glider from early on the approach. Example patter could be:

- *'Alignment – attitude – airspeed – RP all good.'*
- *'Continuing towards the RP.'*
- *'Approaching the flare.'*
- *'LOOKING UP – <u>NOW</u> – FLARING – <u>NOW</u>'*
- *'Smooth round out – and maintaining THIS height – nose rising to – this attitude.'*
  *(*If landing with a crosswind – *'Rudder to point the glider – keep the wings level.')*
- *'Touchdown – keep the stick coming back – full airbrake – keep straight with rudder – wings level with aileron.'*
- *'Wheel brake gently if required.'*

TRAINEE PRACTICE

Allow the trainee to land the glider. Prompting key points such as 'Look up -now, flare – now' might be appropriate for initial efforts but the trainee will have seen quite a few landings by this stage and so will have a reasonable idea of the flare height.

Instructors **must** guard the controls carefully but **must not** interfere with the controls. Either the trainee has control or the instructor has control. Be ready for any eventuality:

- Right hand in front of the stick to prevent any sudden forward movement.
- Feet close to or very gently on the rudder pedals, left hand close to or behind the airbrake lever to prevent a sudden opening.

If there is any doubt – **TAKE CONTROL IMMEDIATELY!**

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COMMON ERRORS

Early Flare

An early flare is either caused by a lack of height awareness from the trainee or an element of 'ground shyness.' The trainee's response will indicate their awareness of the initial error. If they are making a reasonable correction, a direct prompt such as 'Hold everything still, let the glider sink – continue to flare' might be appropriate.

If there is either no response or an incorrect one – **TAKE CONTROL IMMEDIATELY!**

Late Flare

A late flare is usually caused by not looking up from the RP towards the end of the landing area – **ask** the trainee in the debrief where they were looking.

A late or even no flare leaves very little time for the instructor to react so **TAKE CONTROL IMMEDIATELY!**

Ballooned flare/landing

A sudden, snatched, or late flare, or even a bounce, can lead to a ballooned landing. These may arise quite naturally during pre-solo training, but it is important that a trainee knows how to recover from them before being sent solo. They can be practised in a simulator prior to attempting it in a glider. Recovery actions should be prompt and focus on the glider's attitude and the severity of the trajectory.

- Smoothly adjust the attitude to stop the glider climbing and reduce the airbrake setting.
- As the glider sinks towards the ground, continue the flare and land.
- If the balloon is more severe, **promptly** adjust the attitude to stop the glider climbing, and **close the airbrakes.**
- Set an **appropriate** attitude to maintain the glider's energy and then re-flare the glider. The airbrakes should remain closed until in the hold off where they can be 'cracked open' gently to prevent the glider floating. With the airbrakes closed the glider is more sensitive in pitch so beware of the possibility of over-controlling and pilot-induced-oscillation.

To set up a 'balloon' practice, use a low airbrake setting and a speed about 10kts higher than normal. Carry out a flare with a 'normal' stick input and this will produce an adequate balloon without bringing the nose up too high.

Instructors should TAKE CONTROL IMMEDIATELY if the trainee fails to respond correctly or overreacts in some way.

DE-BRIEFING

Early trainee attempts at landing are unlikely to be perfect. Points to look out for:

- Are they using the correct technique?
- Do they recognise their errors and are they correcting them without instructor intervention?
- Are they looking in the right place?

Finesse will come with practice. If the outcome will be safe, let them get on with it and debrief them appropriately.

COMMON DIFFICULTIES

Trainees landing the glider and then forgetting or failing to continue to control the glider on the ground run – remind them that they may need full control input as the ailerons and rudder lose their effectiveness.

Once the glider has touched down, relaxing the back pressure on the stick – remind them to keep the stick fully back until the glider has stopped.

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13 – FIRST SOLO FLIGHT

SPL Syllabus: Exercise 13 1st Solo Flight			
(i)	**instructors briefing including limitations**	**(i)**	**Effects of the centre of gravity (CoG) on controllability of sailplane**
(ii)	**Awareness of the local area and restrictions**	**(iv)**	**Observation of flight and debriefing by instructor**
(iii)	**Use of required equipment**		

INTRODUCTION

At first sight the decision to send a trainee off on a first solo looks to be a tricky one. It isn't, because if you aren't sure, don't do it. Nevertheless, solo flying is an important step for trainees and once they are ready it shouldn't be delayed for too long. Done at the right time, it is a great boost to their confidence.

Particularly with the advent of part SFCL, first solo is not the finish of training or supervision. Of course, there will be a "pat on the back" after the event, before continuing the training syllabus.

The issue of when a trainee can, or should be sent solo, may be influenced by local club rules about who can authorise it. BGA rules allow any FI(s) who has completed the probation requirements to send someone solo, but advice inexperienced instructors often consult the nearest experienced instructor and may ask them to conduct the pre-solo check flight.

When the pilot is getting close to the stage of going solo, check that they are aware of, and meet the medical requirements in place at the time, in order to fly solo. Even a Pilot Medical Declaration cannot be processed instantaneously, so tell them to get it completed well before they need it for a solo flight. If the trainee is under 18, it is wise for the club to have a system in place for ensuring parental agreement for the trainee to do their first solo.

Before solo, the trainee's performance must have satisfactorily completed and been signed off for exercises 1-12 of the SFCL syllabus, with the exception of the solo spin. This means they will have the following essential minimum skills and knowledge:

- **basic rules of the air and good lookout** - a pre-solo quiz covering local airspace and the rules of the air is available from the BGA website under 'Bronze'.
- **speed and directional control** - should be good, particularly on approach.
- **circuit planning** - especially recognising getting low in the circuit and understand the need to turn in early if necessary.
- **approach control** - able to recognise and correct for an undershoot.
- **stalling** - must be able to recognise all types of stall and make consistent least height loss recoveries, including stall with a wing drop
- **spinning** – if the club does not have a spin-trainer glider it may be reasonable to send someone solo without having done a full spin in a glider. They must have been very thoroughly trained in stall training up to and including stall with a wing drop and spin avoidance. In the absence of real spinning, simulator training is better than no full spin training.

*If spin training **is** available locally then they should be to recognise a spin, take the correct recovery action, and recover with minimum loss of height. If a spin does not develop (a common occurrence), the trainee should be able to recognise and recover correctly from the ensuing spiral dive*.

- **satisfactory take-off and launch** - including a clean take-off avoiding PIOs. On the winch; adopting the correct climb attitudes at the correct moments. On aerotow: recovering from being 'out of position.'
- **launch failures** - satisfactorily handled by the trainee without any 'help' at all from the instructor.
- **finally** - you will have done some sort of check flights on the day and be confident that the trainee's performance is satisfactory. Ideally this will include some of the following:
    - a cable-break.
    - some stalls.
    - a single, low-pressure circuit during which you said and did nothing; just let the trainee get on with it. You want them to be relaxed and to repeat a simple uneventful solo circuit.

To establish all these points, you may have to rely on either the training card, a detailed syllabus sheet, and/or log-book entries, otherwise check flights can go on for ever.

If the conditions are not suitable for a first solo, wait until they are. Do not take a risk.

ADVICE TO INSTRUCTORS

If you haven't personally assessed the trainee's progress over a reasonably long period of time, and don't trust implicitly the judgement of the instructors who have flown with them and said they are OK, then it will take at least four launches for you to check through the essential exercises. If this is likely to be the case, it may be better to ask another instructor more familiar with the trainee's overall progress and who has flown with them recently, to consider sending them solo.

BRIEFING POINTS

Do not advertise to other individuals at the launch point that a first solo is imminent – a crowd of well-wishers will not help.

Check that the trainee answers satisfactorily the following:

- *Are you happy to go off on your own?*
- *What is your weight and are you at least thirty pounds above the minimum placard weight? If not, carry ballast - that will stop the elevator from being too twitchy.*
- *What approach speed is appropriate for today's conditions?* Encourage the trainee to specify an exact speed.
- *What will you do if the cable breaks at X feet?*
- *What will you do if you get low in the circuit?*
- *Soar if you can (or don't) but make sure you can see and are within gliding range of the airfield at all times.*
- *Any questions?*
- *Now, go and do another flight just like the last one.*

Briefing points:

Explain that with a lower weight and the CG further aft the glider will feel different when flown solo. The controls will feel lighter, and the minimum sink speed will be lower. The launch is likely to be higher.

Remind trainees about to go solo that in any two-seater, the rear cockpit is now their responsibility, even though there will not be anyone in it. i.e.

- check the straps are done up
- any lose items such as surplus cushions/parachute are removed.
- the rear canopy is locked shut and DV panel closed.

Keep an eye on the progress of the first flight but do not fret – you know they will be all right. If winching, pay particular attention to the launch and note the transition to full climb and the height achieved. If aerotowing, watch out for PIO's or other wobbles.

Note the circuit; was it too high/low or too close/far out or just right, and how it was handled. Check that the approach and the use of airbrakes was smooth, and that the flight ended with a good landing.

DE-BRIEFING

Well done! Any questions? Now I'd like you to go and do another one - if appropriate.

If the first solo was satisfactory then it is often helpful to do another flight straight away to build confidence. Give the minimum briefing, i. e. Did everything go well? Any issues or questions?

De-brief any significant points you noticed. If for any reason you feel that trainee should not do a second solo, then don't say so yet - just don't offer one. Say that you would like to do a long debrief on the day's flying so far. Go and have a cup of tea.

COMMON DIFFICULTIES

Circuit too close - being extra careful.

Ballooned landings. Good trainees may have learnt so fast that they never experience or even see a ballooned or heavy landing. This is very difficult for them if they are solo when they first encounter one. The fact that most two-seaters' elevator forces and general handling are lighter when the glider is flown solo, may contribute to ballooning.

Other (social) problems. All the trainee's mates (or 'relations') will want to rush around them both before and immediately after the flight. This is very distracting, sometimes misinforms and may stop the trainee from absorbing even the shortest of briefings.

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14 – ADVANCED TURNING

SPL Syllabus: Exercise 14 Advanced Turning	
(i)	**Steep turns (45° or more)**
(ii)	**Stalling and spin avoidance in the turn and recovery**
(iii)	**Recoveries from unusual attitudes, including spiral dives**

INTRODUCTION

Once the trainee has mastered co-ordination at moderate angles of bank to a reasonable standard, introduce the skills needed to maintain steep turns, as are needed for thermalling. Ideally the stalling and spinning exercises will have been completed, so that spin avoidance can be concentrated on here.

THEORY BRIEFING

The stalling speed of the glider increases in the turn and that this increase is non-linear: at small bank angles it is negligible but as the bank increases beyond 45° or so, it becomes significant. To turn tightly, we must have the speed to do it.

The wing has to produce more LIFT to counter the increase in weight due to the load factor. There is consequently, an increase in the stalling speed. The speed to maintain the turn should be increased in proportion - see the table below.

The formula for calculating the increase in stalling speed is:

$$\sqrt{n} \times VS$$

where n is the load factor (same as G) and VS is the normal unaccelerated stalling speed.

Table of typical stalling speeds at given angles of bank

Bank angle °	G loading (n)	Stall speed kts
0	1.00	36
10	1.02	36
20	1.06	37
30	1.15	39
40	1.31	41
45	1.41	43
50	1.56	45
60	2.00	51
70	2.92	62
80	5.75	86

The radius of turn is related to both the airspeed and the angle of bank. A steeper turn at the same airspeed will result in a smaller turn radius. It may not be so immediately obvious that allowing the airspeed to increase will widen out your turn. This is important when thermalling with others – if you are being “caught up” by a glider behind you in the thermal turn, then increasing airspeed will make it more likely they will disappear from view as they come close to your tail or even cut inside you. To ‘get away’ you must increase the bank.

Up to this point in the training, the trainee has been taught that at the required angle of bank, return the controls to neutral. However, at steeper angles of bank, most gliders will require a little out-aileron to maintain the bank and considerably more up elevator than the trainee will be used to. This outer wing is moving faster in a steep turn, and hence producing more lift, which tends to increase the bank if not “held off” with out of turn aileron. If you are over-ruddering at the same time then the controls will be crossed, with the stick well back as you reduce the airspeed. If the glider is allowed to reach the stall it will roll in and depart with very little warning.

AIR EXERCISE BRIEFINGS

The aims of the exercise are to teach trainees to fly steep turns accurately, with good lookout and situational awareness, and secondly to ensure they understand the potential threats from mishandling. A busy thermal is one of the main situations where someone whose lookout is sub-standard and whose handling is not instinctively accurate will come to grief, endangering others as well.

TEM

Threats:	**Mitigation:**
Collision	Lookout
Spin or spiral dive	HASSLL check first
Violent “flick” entry	String in middle, especially > 50°
Errors:	
Stalling in turn	Monitor airspeed
Running out of height for appropriate circuit	Monitor height & position

Brief the trainee, that you will be practising more steeply than they have probably been used to i.e. aiming for 45 degrees. They should reach a standard where they can maintain attitude (and hence airspeed) and bank angle and fly without slip or skid, i.e. with the string in the middle.

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It is common for trainees to overestimate the angle they are at. Conveniently, it is easy to judge the angle by picking any instrument with screws at the four corners. When you are at 45° the diagonal will be parallel to the horizon.

More elevator input is required to maintain the correct pitch attitude at higher angles of bank and out of turn aileron will be needed in steeper turns to maintain the bank.

MANOEUVRE DEMONSTRATION

For part (i) of the exercise you should demonstrate a steep turn – usually starting at 45° is good.

The speed to maintain the turn must be increased as the bank angle is increased. However, it is easier to stabilise the required speed before rolling into the turn, so demonstrate this, and the new attitude taken up by the glider.

Then:

- Look out for other traffic, especially in the direction of the intended turn.
- Look back over the nose.
- Roll the glider to 45° bank. Point out that the diagonal screws on the instruments are now level with the horizon.
- Point out that considerable up elevator is needed to maintain the correct pitch attitude.
- Out of turn aileron will be needed as the angle of bank increases, to maintain that angle of bank.
- If the nose is allowed to drop the speed will build up rapidly.
- If the speed is excessive, first reduce the angle of bank with aileron and rudder, then reduce the speed with the elevator. When the speed is correct, increase the angle of bank again.

Demonstrate that the rate of roll can be varied, by moving the controls more quickly. There are situations where a rapid roll is essential.

For part (ii) of the exercise, allow the glider to come close to departure and demonstrate that the stall can be avoided by simply relaxing forward on the stick (or moving the stick slightly forward if fully trimmed).

Demonstrate the different effects of over-ruddering (skid) and under-ruddering (slip). In the latter case, you will add a little "top" rudder (i.e. out of turn rudder), and the string will be slightly out of the turn. Allow the trainee to feel that the glider is more "comfortable" like this, and contrast with how it feels if you change to bottom rudder. If you attempt to stall with even a small amount of sideslip, the nose will have to be high before the stall, and the glider gives plenty of warning.

TRAINEE ATTEMPTS

Allow the trainee to practice each part of the exercise, over several flights if necessary.

Depending on your trainee, you may choose to start with "easy" turns, at about 30° of bank, and build up gradually to steep turns. You should re-demonstrate if you want them to try very steep turns, at say 60°. Draw attention to the G force they will feel (2G at 60° of bank).

When they can maintain a turn at a given angle of bank, get them to vary the bank angle during the turn.

For the stalling parts of the exercise, it is important that trainees feel for themselves how the glider behaves when it is very close to the stall.

DE-BRIEFING

The debriefing should emphasise the importance of lookout and situational awareness. The trainee's understanding of how stalling speed increases in a turn should be checked, along with their appreciation of the effect of slip or skid, and how to recover if the glider is near the stall.

This is a challenging exercise for the trainee and, if they have found it hard going, they should be reassured that that is normal, because it requires a high degree of co-ordination skills, whilst still maintaining a really good lookout. Remind them that mastering these skills will make them a much better thermal pilot, which is a reward worth striving for.

COMMON DIFFICULTIES

Failure to lookout before rolling into the turn is extremely dangerous. Take control to prevent this happening. In a thermalling situation the pilot must check it is safe before every change of bank angle. This requires a lot of practice. Aim to bring your trainee to the point where they *cannot* move the controls without looking out first.

Bank increases in the turn and the ailerons need to be slightly "out of turn" to prevent the bank increasing.

Varying the bank angle whilst maintaining airspeed takes patient practice and may produce basic co-ordination errors.

If the trainee is having trouble maintaining the airspeed they may be focusing on the ASI instead of the horizon. Covering the ASI can work wonders.

Bear in mind, and point out to the trainee, that in a thermal, the airspeed will vary as the glider moves through differing rates of lift. This can be ignored if you are just trying to perfect turns, or it can be used to help you centre better. They should fly by attitude.

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15a THERMALLING

SPL Syllabus: Exercise 15a Thermalling			
(i)	Lookout procedures	(v)	Flying safely in proximity to other sailplanes
(ii)	Detection and recognition of a thermal	(vi)	Centring in thermals
(iii)	Use of audio soaring instruments	(vii)	Leaving thermals
(iv)	Joining a thermal and giving way	(viii)	Considerations of use of oxygen

INTRODUCTION

Our objective is not simply to train safe, competent pilots, but to produce good soaring pilots. On two-seater training flights good soaring opportunities are sufficiently rare that they should be taken, even if it means dropping previously briefed exercises from the flight.

Using a thermal poses no great risk but joining and sharing a thermal with other gliders certainly does. Some inexperienced pilots who are overconfident and unimaginative (two qualities which often seem to be welded together) will enter thermals in any way they think convenient, which usually means straight in anywhere, regardless. This direct injection method hugely increases the likelihood of a mid-air collision and needs firmly discouraging right from the start. Other trainees and some solo pilots may be understandably nervous about entering already occupied thermals. A discussion of why the rules 'are as they are' is helpful, but they are largely common sense. Even most birds know to thermal in the same direction as each other. Teaching a safe way of entering the thermal will encourage them and help keep all of us safer

Rules of thermalling need to be explained in a ground briefing early on in the training. Make sure trainees know and understand the rules about joining, sharing, and leaving thermals (see box below).

Thermalling Rules

Joining a thermal

(1) Gliders already established in a thermal have the right of way

(2) All pilots shall circle in the same direction as any glider(s) already established in the area of lift

(3) If there are gliders thermalling in opposite directions, the joining gliders shall turn in the same direction as the nearest glider (least vertical separation)

(4) The entry to the turn should be planned so as to keep constant visual contact with all other aircraft at or near the planned entry height

(5) The entry shall be flown at a tangent to the circle such that no aircraft already turning will be required to manoeuvre to avoid the joining aircraft

Sharing a thermal

(6) Pilots shall adhere to the principle of see and be seen

(7) When at a similar level to another aircraft, never turn inside, point at, or ahead of it, unless you intend to overtake and can guarantee safe separation

(8) If, in your judgement, you cannot guarantee adequate separation, leave the thermal

(9) Look out for other aircraft joining or converging in height

Leaving a thermal

(10) Look outside the turn and behind before straightening up

(11) Do not manoeuvre sharply unless clear of all other aircraft.

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THERMALLING - THEORY BRIEFING

(i) Lookout

However good a trainee pilot's situational awareness on the ground, in the air it is likely to be poor initially. It is not unusual for the instructor to be aware of a potential collision risk long before the trainee realises there is a problem.

Assuming the trainee can fly reasonably well and keep a good lookout, emphasise any points that give clues to imminent collision For example, there is a high collision risk if another aircraft stays in the same position in your canopy; it is coming directly towards you. If no avoiding action is taken it will suddenly appear much bigger just before impact.

The basics that they learned in the first turning exercises – i.e. looking both outside and inside the turn – are especially important when entering or leaving the thermal or when adjusting the turn radius. The potential for getting into blind spots is significant.

The commonest scenario being when a glider (B) is above and behind another glider (A) – glider A cannot see glider B because it is directly behind. Glider B cannot see glider A because one cannot see through the floor of the cockpit. So, avoid getting into this situation in the first place.

(ii) & (iii) Detecting thermals and use of audio

In the early stages of training, finding a thermal often involves reading the sky and looking under appropriate clouds. As you approach a thermal, the air is often increasingly turbulent or 'bubbling' and there may be increased sink ahead of the thermal. This is followed by a sensation of lift in the 'seat of your pants' and an indication of lift on the vario (ideally an audio indication, as well as a mechanical) which lags a second or so behind actually finding the lift. The side of the thermal air which is rising most strongly will tend to push the glider away from the thermal. The pilot needs to be holding lightly on the stick to feel this movement and then turn towards the rising wing.

On other days, take the opportunity to explain other ways of identifying thermal such as thermal sources on blue days - hotspots/triggers/ridges/birds or other gliders.

An audio vario is highly recommended even in a training glider. It significantly reduces time with the 'head in the cockpit' instead of looking out.

(iv) Joining a thermal and giving way

Thermalling rules dictate the entry should be planned to:

- keep constant visual contact with all other aircraft at or near entry height, and
- the entry should be flown such that no other aircraft will be required to manoeuvre to avoid the joining aircraft.

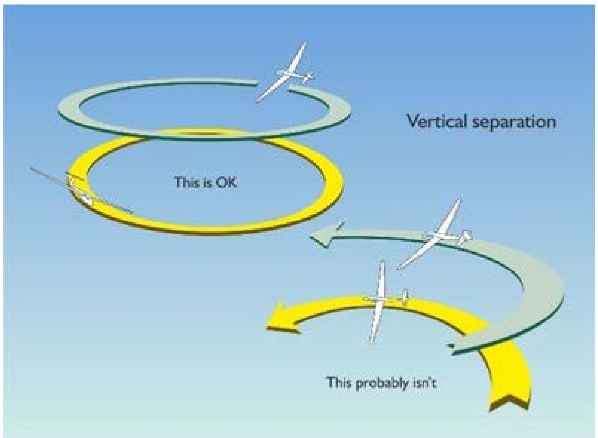
Good lookout is vital. If a pilot is going to share a thermal with other gliders, they must be able to keep the attitude steady at the same time as moving their head to look round. Inexperienced pilots may be very poor at this. Lookout should not be detrimental to the flying. Is there any point in knowing everyone's position, being in exactly the right position, and then spinning down through the whole lot?

A couple of points:

- If you are not sure that what you are about to do is safe, don't do it; better to be saying 'I could have done it', rather than 'I wish I hadn't'.
- Aggressive thermalling in gaggles is nearly always to the detriment of everyone's ability to utilise the thermal and is often dangerous.

How to join an occupied thermal safely

If you enter with sufficient **vertical separation** between you, all that is required is to circle in the same direction as everyone else, and position yourself such that they can maintain visual contact i.e. if possible, on the opposite side if the thermal to any glider at a similar height. See below: **fig 1**



Where relevant, the vertical separation between your glider and the closest should be at least 100'. At that vertical separation, if you are both flying 15m gliders and are steeply banked, one above the other (figure 1), the nominal separation between your nearest wingtips will be just 65 ft, which is close!

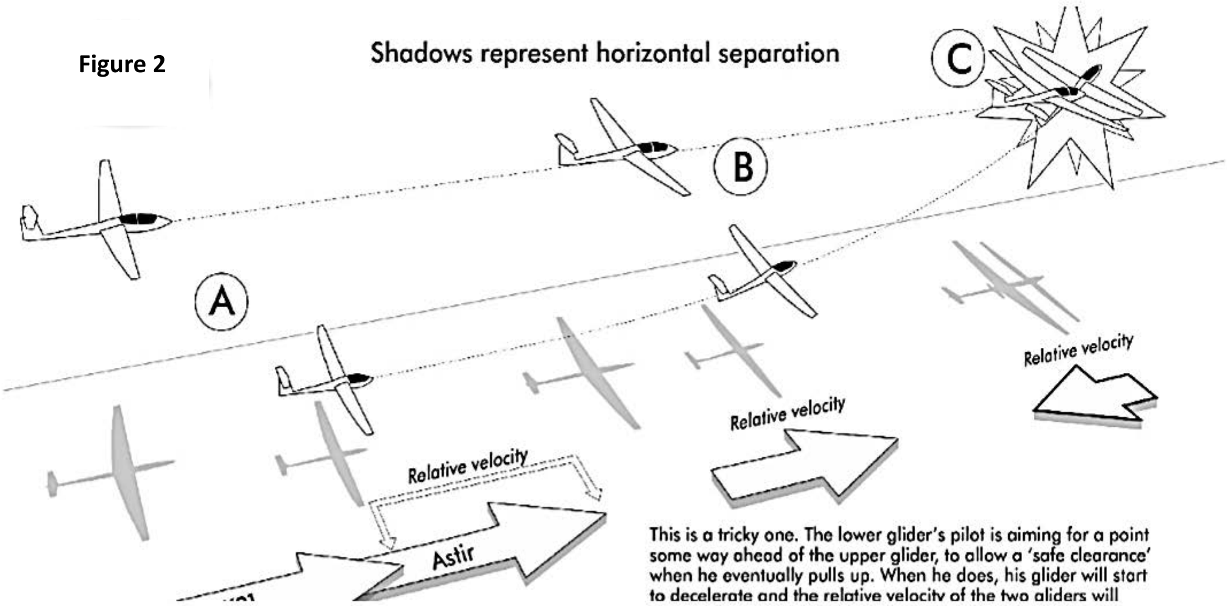
If you join a thermal with two gliders already in it that are circling in opposite directions, you may find yourself forced to join somewhere in between. The thermalling rules require you circle in the same direction as the nearest glider, vertically speaking. In practice, it may be better to continue to the next thermal, if practicable, unless there is plenty of vertical separation.

When you are approaching a thermal, you can only estimate your eventual vertical separation from already established gliders, because you do not know exactly what the air in between is going to be doing.

Low performance gliders are more affected by the ups and downs of the air, so it is harder to guess where you will arrive. With more efficient gliders the problem is not so much the air movements as proper management of the pull-up into lift.

Converting speed into height can be risky in certain situations. See fig 2 next page. As you pull up, your speed will decrease dramatically, but the other pilots speed does not change. Therefore, the gap between you can close very quickly leading to a risk of collision.

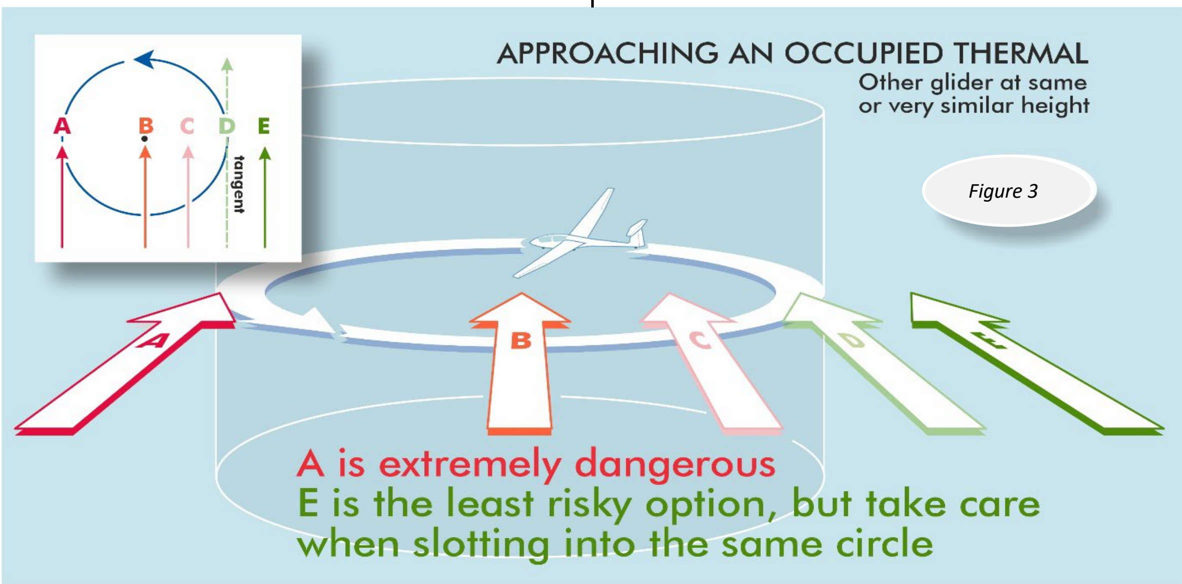
Figure 2



Trainees are often nervous about how to join a thermal so taking time to explain it in a proper briefing will add to both their safety and everyone else's.

When joining a thermal the horizontal line which you take is important. The following comments assume there is ONE other glider there already, and that you will be joining at the same height as them. Broadly speaking there are five possible ways to join, three of which ask for trouble (see figure 3 below):

- Approach A creates a risk of meeting the other glider head-on at very high speed. You may both be doing only 50kt, but head-on your closing speed will be double that.
- Heading towards the centre of the other glider's circle, as indicated by approach B, will lead to two overlapping circles and hence a risk of collision.
- entry via C is a subtle variation on B, with the centres of the overlapping circles much closer together. This increases the area of potential risk, and there will also be longer periods where one glider is out of sight of the other. Blind spots are high risk in thermals.
- option D may look reasonable. But it is difficult to arrive at exactly the right moment, in the right position on the opposite side of the other glider's circle. This ideal join can be and is done by many pilots, but not every time, despite their best intentions. In practice, you either arrive too soon, or too late.
- approach E avoids the above problems by allowing the joining glider to follow an adjustable and spiralling path (figure 3, A to C) into the 'correct position'



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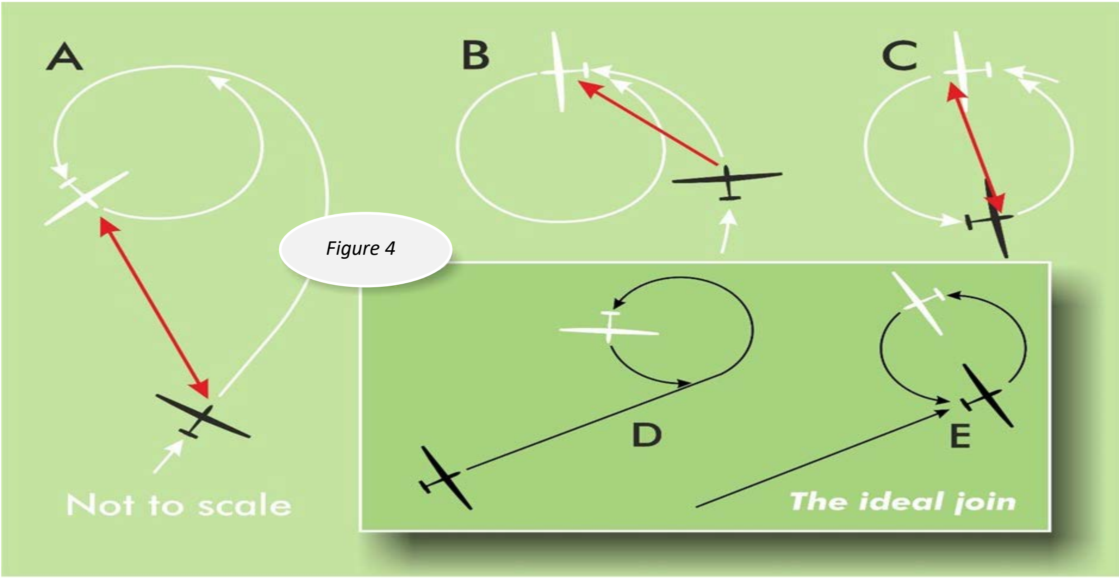

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Figure 4 shows how spiralling in ought to work. If you are not in the 'correct' position, you can continue turning outside the other glider's circle until you are. Nevertheless, spiralling in to match circles, speeds, and stay in the correct position, is difficult to do well.

Do not concentrate exclusively on the glider(s) you are trying to avoid as you could easily hit somebody for whom you haven't been looking. If your trainee seems over-anxious about joining other gliders in a thermal, probably best for you to do it initially. Alternatively, if the option is there, go and find an unoccupied thermal.

(v) Flying safely in proximity to other aircraft

Horizontal separation

Assuming you are joining a thermal with one other glider in it at a similar height, the correct position is on the opposite side of the circle to the established glider. If you are both circling at the same rate with the same centre, the two gliders will remain stationary in relation to each other.

Maintaining position.

In order to maintain station on the opposite side of the circle you need to match the angle of bank and approximate speed of the other glider.

If the other glider is catching you up, the natural inclination is to try to accelerate, but this does not work. It can actually have the opposite effect because it increases the radius of your turn. The correct technique is to increase the angle of bank and tighten the turn and the gap will open up again. If you do not do this and the other glider comes up behind you, such that you lose sight of the other glider, check under the upper wing, open the turn and leave the thermal.

If you are more steeply banked than the other glider, **you will catch the other glider up**. This may be frustrating, but getting in the blind spot is dangerous. Overtaking on the inside when you will both get into each other's blind spot is dangerous. So, the correct response is to decrease the angle of bank to open up the turn, to increase the distance between you and the other glider again.

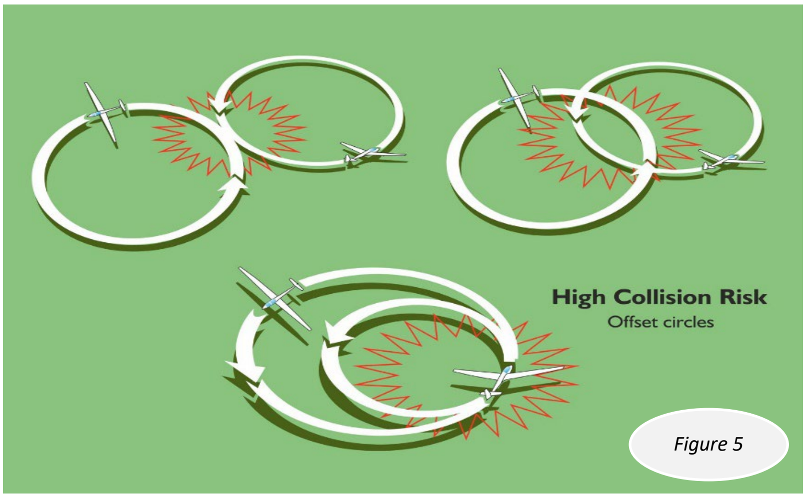

Figure 5

Overlapping turns and offset circles both carry a high collision risk.

If there is not sufficient vertical separation, persisting with this type of thermal pattern is poor airmanship and dangerous.

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(vi) Centring in thermals

To be able to centre a thermal, the trainee needs to be able:

- to make co-ordinated turns at a steady angle of bank, **and**
- be able to change that angle,
- all whilst maintaining a steady attitude/speed, **and**
- keeping a good lookout.

This is not an easy task, but in an ideal world we would find a nice large steady thermal to let the pupil practice these skills without worrying overly much about centring the thermal to start with – preferably away from other gliders. Taking control intermittently to re-centre is acceptable, indeed usually inevitable, at this stage.

Once their turns are reasonable, they need to understand how they move the centre of the turn to stay in the best lift.

There are a number of techniques that can be used to centre a thermal.

Using 'landmarks':

This technique requires the pilot to make a mental map in their head of the turning circle. On the turn ask the trainee to make a note of where the strongest lift in the turn is, in relation to a ground feature.

The next time they come round the turn as them to decrease the angle of bank as they come round towards that feature, in order to move the turning circle in that direction. Count to three moderately slowly (about 2 secs) and then tighten the turn again. Spatial awareness of the thermal is a key skill, and using ground features such that they build up a mental picture may help this skill. Be careful to ensure that a good lookout for other gliders is maintained throughout.

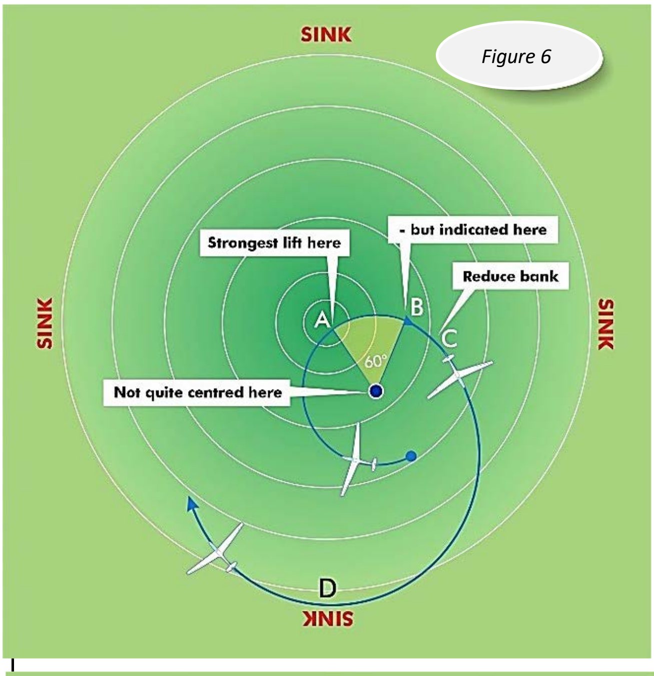
Some instructors prefer the next technique which is basically 'Less lift: reduce the bank and 'increase the bank' as the lift improves. Figures 6 and 7 show how the technique works.

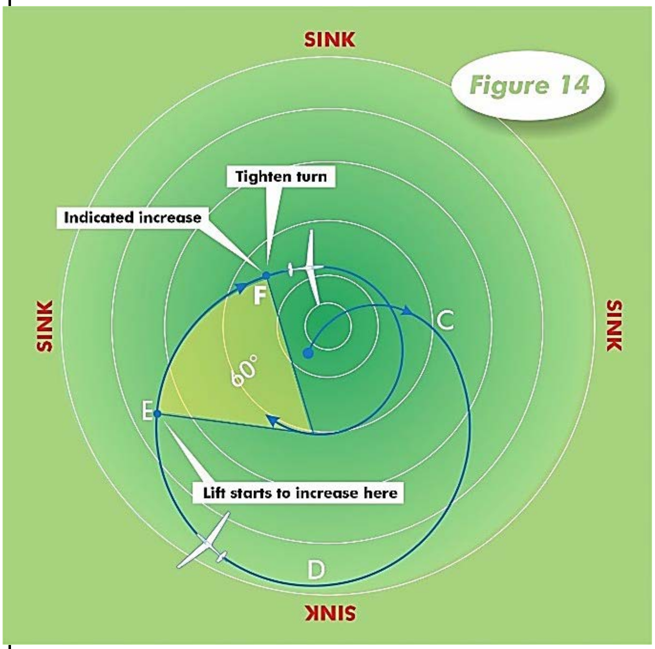
To understand thermal centring using this method we need to know two figures:

- the time taken for a complete 360° turn in a thermal - this is about 25 seconds
- the variometer's 'lag'. Variometers respond to changes in the glider's height, but this does not occur instantly. Variometers themselves also have small lags in their response. As a result, any lift or sink indication is likely to be about 3 seconds out of date. This is unhelpful, particularly when attempting to centre and means that any reading relates to roughly 1/6th of a turn, or 60°.

Therefore, it is important that you do not straighten up when the variometer indicates maximum lift, as by then the glider is already well into the core. Straightening out at this point may well fly you out of the lift (figure 6.)

The recommended method is when the variometer indicates maximum lift continue to fly a properly banked thermal turn (aim for about 40 degrees) Then, when, less lift is indicated reduce the bank and increase the bank again as the lift improves. Figures 6 and 7 show how the technique works.





The lift core is at A. Variometer lag means that the strongest lift is not indicated until point B. If the pilot then straightens up C), the glider will be heading almost directly away from the core. The mistake has already been made, so whatever method of counting the pilot uses to decide when to turn again at, say, D, the situation will be worse than it was before.

Rather than straightening up shortly after the strongest lift has been indicated on the variometer, the pilot should reduce the bank by, say, 15° at C, and continue the turn. As the indicated lift begins to increase at F, the pilot tightens the turn and should now be closer to the centre.

Tightening on the surge

Many experienced cross-country pilots use a third method – tightening in the strongest lift. As you come round the turn again, relax the bank as you feel the lift increasing – a bit like surfing a wave. Once trainee get better at feeling the surge as

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they come into increasing lift, they can be encouraged to 'tighten on the surge' and then relax the bank as they feel the lift decreasing again.

Hints and tips

1. Unless they can fly well banked, accurate turns at constant speeds, none of these techniques will work. Concentrate on getting the basics right.

2. Making more than one correction per turn complicates both procedures and rarely works.

3. Maintaining lookout in the early stages is essential. If they get into the bad habit of failing to look out early on, it is difficult to break the habit again.

(vii) Leaving a thermal is usually straightforward. Look under the upper wing, gradually straighten up and fly away. Two points to watch out for:

- As you leave make sure you are not going to conflict with someone who is about to join (i.e. look outside the turn and behind before straightening up and do not manoeuvre sharply.)

- Do not manoeuvre violently when leaving; this includes precipitous dives to gain speed before hitting the sink.

(viii) Considerations for use of oxygen

Supplementary oxygen should be used in gliders above 10,000 ft. This is unlikely to occur in thermal flying in the UK, but relevant when flying in hotter climates such as S Africa or in wave.

You need to explain the basic principles of relative movement, and how things will look from your trainee's point of view, by using models, or your hands, or by drawing what happens in various scenarios. The BGA 'Managing Flying Risk' document includes, in its 'Safe Thermal Soaring' section, a link to an excellent 3-minute video on 'thermalling with others'. This is well worth showing to your trainees. If you happen to be very good at joining thermals but have never analysed exactly what it is that you do, then you will need to give it some thought if you want to be of any help to trainees.

Once the trainee has achieved some proficiency at frequently altering the angle of bank whilst maintaining a reasonably constant speed in the turbulent air of a thermal, it is important to give them a good ground briefing on how to centre the thermal using your preferred technique. It can then be demonstrated as an air exercise.

Stage 1

The trainee (who could be at any stage from early pre-solo to advanced solo) flies the glider in the thermal and simply responds to the instructor's prompts to increase or reduce the bank.

Accurate speed control is important and should be kept at around that required for the 40° banked turn used in the centre of the thermal.

Most trainees will allow the speed to reduce as bank is reduced and to increase as bank increases. These speed changes counteract any changes in the radius of turn that the changes in angle of bank are intended to produce. Frequent prompts, and if necessary, re-demonstration, are required to control this tendency.

Early pilots have a tendency to look down the wing when thermalling, which makes attitude control more difficult for them. The airspeed is of course related to the attitude and in general the key point to stress is to maintain the correct attitude, even if the airspeed varies slightly as the glider turns in a gusty thermal. At all times, the co-ordination must be accurate, with no tendency to over-rudder.

The trainee should be encouraged right from the start to keep a very good lookout while thermalling, even when they are not sharing the thermal. The habit has to be learned and practised. The instruments must be glanced at from time to time, but the principal guides are the attitude over the nose and the sound of the vario, neither of which requires 'head in cockpit.'

Stage 2

The instructor begins to withdraw by not prompting to increase/reduce the bank - leaving only the hint that the rate of climb is increasing/reducing. In other words, acting as a sort of audio-variometer. A little later even these prompts can be withdrawn, and the trainee should be able to soar successfully unaided. Prompts should still be made if the trainee is not responding correctly to changes in lift or if lookout or speed control are inadequate.

POST FLIGHT DEBRIEF

Lookout is paramount and allowing the pupil to fail to look out properly, risks this practice becoming embedded. A common early fault is poor speed control and may be due to failure to monitor the attitude of the glider, especially whilst looking out and or due to looking down the wing persistently. Errors in maintaining adequate separation should be addressed by reference to appropriate diagrams

COMMON DIFFICULTIES

Poor lookout It is essential to embed the habit of good lookout from the start of their training: look both ways before entering a thermal, maintaining lookout including above and behind, and lookout before leaving.

Lack of awareness of other gliders – they may see them but do not anticipate their actions.

Poor speed control. If the speed is varying, they will not be able to centre a turn.

Indecisiveness entering a thermal and ending up flying straight through it

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15B – RIDGE FLYING

SPL syllabus: Exercise 15B Ridge flying			
(i)	**Look-out procedures**	**(iv)**	**Speed control**
(ii)	**Practical application of ridge flying rules**	**(v)**	**Wind shear**
(iii)	**Optimisation of flight path**	**(vi)**	**Consideration for change of turn radius with the same indicated airspeed at different altitudes**

INTRODUCTION

Ridge flying can be exhilarating but it can have many traps for the unwary. There have been many accidents on hill sites and some of those have been caused by ignorance and/or inadequate briefing. This section aims to address those issues.

THEORY BRIEFING

Lookout Procedures – maintenance of a good lookout on a ridge is essential, so the trainee must have been briefed fully on the scan cycle. Whilst ridge flying, the trainee can get fixated on the following aspects, to the detriment of a wider lookout.

- fixation on the aircraft that is closest and obviously is no danger to the glider, instead of looking for other conflicting traffic and avoiding flying into an untenable situation with no escape path.
- watching the ASI or other instruments to the detriment of all else.

Spatial awareness is important when ridge flying to avoid conflict with other traffic. Flarm is helpful and the trainee should understand how to use it, but it will never be a substitute for good lookout.

Practical application of ridge flying rules –All pilots must be fully aware of the rules of the air as they apply to gliding including ridge soaring. These are found in UK SERA and the Rules of the Air 2015 which are helpfully summarised in the CAA publication CAP1535 Skyway Code under the section 'Essential Rules of the Air'. The provision that allows for gliders to undertake hill-soaring can be found in a CAA ORS4 exemption – the link is in the 'Skyway Code.'

Key points to remember:

a) The pilot nominated PIC is responsible for the safe operation of the flight, whether they are on the controls or not.

b) The aircraft shall not be flown in such a manner that would endanger either people or property.

c) Low flying – the CAA have made a relaxation of the 500ft rule to allow hill/ridge soaring provided b, above is complied with.

d) Do not intentionally fly close to other aircraft so as to cause a collision hazard.

e) If approaching another aircraft head on, such that there is a risk of collision, both aircraft shall turn right to avoid each other – effectively this means that the glider with the hill on its right has 'right of way' as it may not be possible for it to turn into the hill.

f) When overtaking, a sailplane may pass to the left or right of the aircraft being overtaken but the aircraft with right of way remains the same.

Local Rules

Generally these have been developed over many years and modified over time to ensure that pilots remain safe. Below are the types of rules to be expected, the details will vary from site to site.

- All turns to be made away from the ridge.
- Minimum height to circle in thermal over the top of the ridge.
- Minimum height to leave the ridge for a safe landing.
- Maximum number of aircraft on the ridge (weather dependent.)
- no-go areas (defined by previous accidents/incidents.)
- Action to be taken if ridge suddenly stops working (landing many aircraft safely.)

Optimisation of flight path

We need to consider the types of hill geography that may be encountered, because although the basic positioning on the ridge is similar for all ridge types, implementing the rules of the air may be different.

For any type of hill, positioning is important, the best lift being in front of the hill face. Trainees often have problems noticing position when busy with controlling the aircraft, lookout etc. Moving too far behind the hill can result in heavy sink unless adequate height is maintained and this can result in having to turn downwind and possibly land out.

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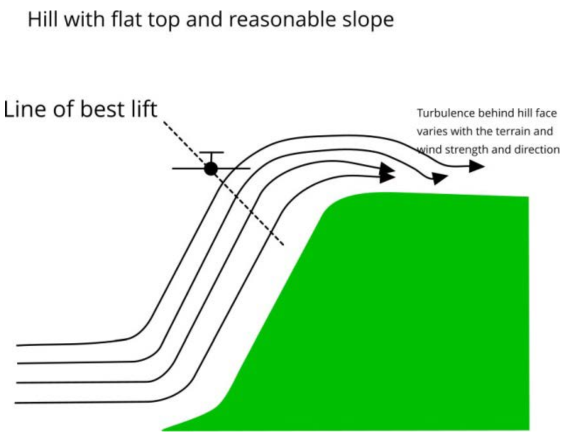
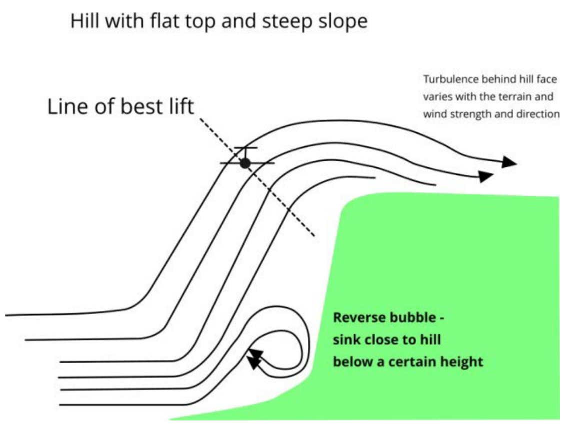
TYPES OF RIDGES

Flat top ridge:

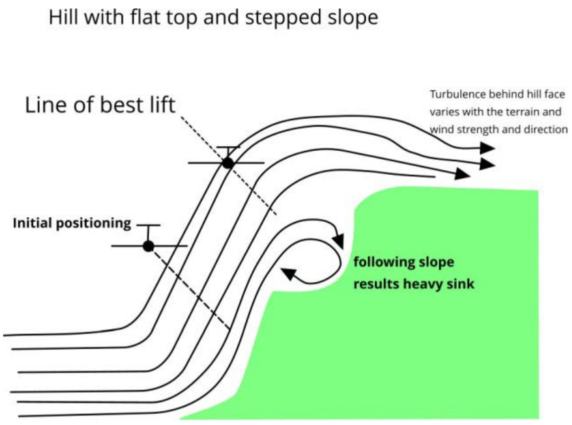


Often hilltop sites are located here. Wind strength and direction play an important part here, since the amount of, and position of, turbulence will vary from day to day. Returning low to the ridge will have the same problems as flying from the bottom of the hill (see later), with the added risk of being unable to climb high enough to land at the top, especially if the wind is dropping in strength.

Steep ridge:



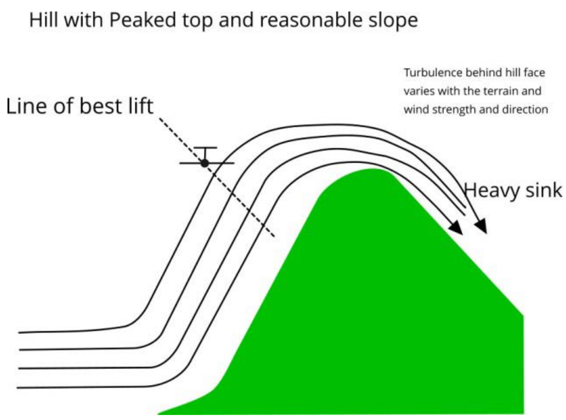
In this situation entering from a bottom of hill site or returning low to the hill, the bottom of the hill may not produce any lift as a reverse bubble can form so the main airflow can then take up a shallower profile. Flying further away from the hill may produce some lift but it may be weak and possibly turbulent.



When there is a discontinuity or 'step' in the slope of the ridge there is likely to be an area of sink or turbulence similar to the reverse bubble on the bottom of a steep ridge. It is therefore necessary to carry on climbing in front of the lower part of the ridge, if possible, until high enough to drop back onto the higher part of the ridge, again local knowledge is important, if it is not a local ridge take great care.

Peaked ridge:

Positioning on ridges of every type to maximise lift are similar. The main variations are dependent on whether the ridge is local to the gliding site (where local rules apply) or encountered during cross country flight.



Most hill bottom sites are located within reach of the hill. As you can see from the previous diagrams there may be a no-go height at the bottom of the hill caused by a reverse flow bubble of air and sink as the air tries to streamline itself over the ridge by creating a vortex parallel to the ridge. All approaches to the hill below hilltop height should be made with adequate speed because the air close to the surface will be slower due to friction (similar to wind gradient when landing). Entry must be above the minimum height (set by the gliding club). This is set as a minimum height to carry out a safe landing back at the site if no lift is encountered. This applies to both top and bottom of hill sites.

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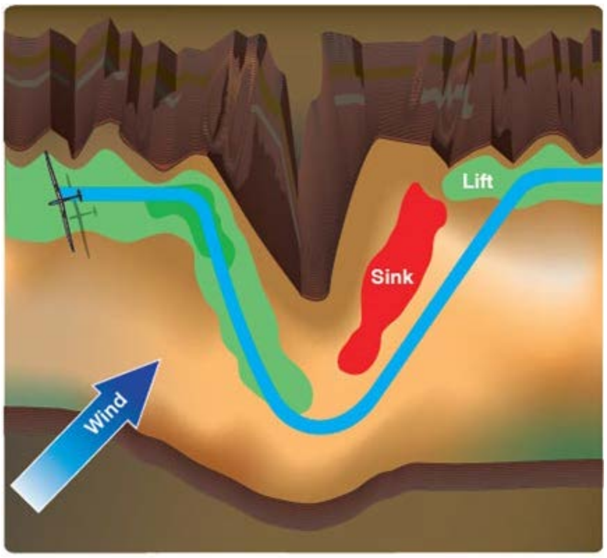
Long ridges with alignment variations:



This covers ridges which change direction and those that have re-entrant areas or bowls. The main difficulties here are: -

- Changes in lift/sink along the ridge
- Turbulence at sharp direction changes
- And finding a safe route to drop back on to secondary ridges
- Turbulence at direction changes

Speed control - In weak conditions there is a balance between flying slow enough to climb and maintaining enough speed to have adequate control. Lack of co-ordination at slow speed is a recipe for a stall or spin.

Speed control is very important flying below hilltop as horizon information will be taken (sub-consciously) from the hill profile, which can vary and flying along below a rising hill profile can result in inadvertent loss of speed. Co-ordinated flight and speed monitoring must be observed at all times especially when flying below hilltop height (e.g. string in the middle or ball centred.)

Turn radius changes with height Mountain flying has its own challenges and one important one is turning close to the slope. Remember that at higher altitudes, indicated airspeed can be very different to true airspeed. The rate of turn is governed by bank angle and true airspeed, which means that turning near a slope, may result in a greater radius of turn at the indicated airspeed than usual. If a tighter turn is essential for e.g. collision avoidance a steeper bank angle required for the radius of turn needed. This in turn will require more airspeed so care is needed not to stall and spin the glider.

Weather considerations The overall airmass conditions, coupled with local micro-climatic effects, will change the expectations for ridge lift.

Upper air directional wind shear can also cap ridge lift and create turbulence.

Thermals moving across the hill will affect the strength of hill lift, either augmenting or reducing it. Therefore, in light winds with thermals low down, it is important to maintain a position which will allow a safe exit from the hill. Constant manoeuvring in such conditions requires skill and care. Sufficient height to be gained to allow transition from hill soaring to thermal flying.

Hills facing into sun often trigger thermals but beware climbing in a thermal that drifts behind the hill such that there is not sufficient height to push back through the curl-over in the lee of the hill.

Windy days, can also be good wave days. Beware: if the wave is 'out of sync' with the hill, it can completely cancel out the ridge lift, even at low levels. Additionally, it can create additional turbulence on the hill. The conditions on the ridge can change very suddenly if the wave system shifts.

Quite subtle changes in the strength or direction of the wind can significantly alter the nature and position of the lift. Local pilots will often be able to advise what the wind strength is required to make the local ridge work, noting that stronger wind is needed if the wind is not blowing directly onto the hill

Orographic cloud can give a false impression of position on the ridge due to cloud formation and apparent flow rate obscuring true ground speed, especially when flying above the cloud. When flying from hilltop sites care and foresight with respect to orographic cloud formation is necessary for a safe landing on top. It can form very suddenly especially on winter days. Do not be tempted to continue flying in poor visibility, or very close to cloud based on a ridge.

Avoiding Conflict with Other traffic.

It is impossible to itemise all the situations that may be encountered whilst hill flying, but these are a few important things to be considered.

- Overtaking – whilst legally gliders can overtake on either side how practical is it? Obviously overtaking on the hill side of a glider when below hill height is dangerous. **Above hill height,** it may only be possible if the hill profile allows it. The glider being overtaken should only ever turn away from the hill, so you should either pass on the inside or give a very wide berth on the outside.
- Overtaking on the outside has its own dangers; you must give enough room for the other glider to turn and enable you to take avoiding action. In weak conditions this may mean loss of height which it may not be possible to regain. If the other glider is having to deal with head on traffic and you are too close, the result does not bear thinking about.
- Head on traffic – manoeuvring early to indicate intent early, can avoid the confliction. Alternatively, turn back along the ridge to reposition and avoid the situation.
- Being 'in the right' is no solution if the other pilot has not seen you. It is no good being 'dead right'!
- Flying over the top of other gliders with minimum clearance is not good airmanship: if they hit a strong patch of lift, heights can change very quickly.
- When sharing a ridge with paragliders or hang-gliders spatial awareness gets even more critical. These aircraft have much slower speeds, especially into wind, but they can turn tightly. Always give them a wide berth. For preference, pass in front/up wind of them. Do not fly close over the top of paragliders as the turbulence of the gliders air flow can cause a collapse of their canopy

Use of electronic collision avoidance systems. - (e.g. FLARM). When flying with paragliders on a ridge, multiple indications can be really confusing since they change direction very quickly. There can be a big difference between heading and track so locating conflicting traffic. Multiple aircraft in the same direction can be confusing so maintaining a good visual lookout is vital. In poor visibility these devices are useful but cannot be totally relied on.

It is necessary to carry out detailed training in the use of these devices, but as always, they can be an extra distraction from flying the aircraft and physical lookout raises the workload of the trainee.

Remember:

AVIATE NAVIGATE COMMUNICATE

The latest innovation of 'LED flashers' may be a helpful safety addition especially when ridge flying.

AIR EXERCISE BRIEFINGS

A lecture room briefing for the site, whether for local trainees or visitors should cover:

- the geography of the local ridge (where lift may be contacted depending on wind direction and any other pertinent information) and where curl over/heavy sink may be encountered.)
- local ridge rules (including max number of gliders if appropriate.)
- minimum height to leave the ridge for a safe landing.
- landing procedures (+ possibly recommended minimum approach speed.)
- possible weather changes that may affect the outcome of the flight. These may include expected lift strength in light winds, turbulence etc Possibility of lowering cloud base and poor visibility should be considered, including low sun and misting canopy, together with the possibility of orographic cloud.

Emphasise the need for a good lookout all the time, a collision on a ridge is, often, fatal.

For early ridge flying, trainees will be learning to fly the glider in a co-ordinated manner, trying to trim properly, and carry out turning manoeuvres. They should know the 'local ridge rules' before their first attempts at flying on the ridge.

TEM

Threats:	**Mitigation:**
Collision	Maintain thorough Lookout and avoid confliction by taking action early
Errors:	
Running out of height, leaving ridge too late, or heavy sink in circuit.	Monitor height & position
Staying too long on the ridge in marginal weather conditions	Call off the flight early as a training point

MANOEUVRE DEMONSTRATION & LESSON

If the trainee is at an early stage in training, first get established on the ridge and properly trim the aircraft. Then demonstrate how to keep position on the ridge, (a good time to demonstrate the difference between heading and track over the ground, and how important lookout is). Then if conditions allow, hand over control to the trainee and monitor progress.

When appropriate, demonstrate the avoidance of conflict with other traffic and how the rules of the air are applied on the ridge.

Let the student fly, with prompts as needed in the early stages. Monitor progress and if the trainee is finding things difficult take over control and leave the ridge. Always maintain a good lookout yourself as well as encouraging your student to look out– you have overall responsibility for the flight and the potential collision risk remains high on a ridge.

DE-BRIEFING

Ridge flying is an excellent opportunity for 'stick time' - practicing co-ordination in the turns etc, but the workload may be high so emphasise the good points and be constructive with a maximum of two or three points to improve at most. Getting used to flying in rough conditions, pays dividends when the air calms down.

COMMON DIFFICULTIES

Poor position on the ridge, pre-occupied with flying the aircraft.

Poor lookout .

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15C – WAVE FLYING

SPL Syllabus: Exercise 15C Wave Flying			
(i)	Look-out procedures	(iii)	Speed limitations with increasing height
(ii)	Considerations and techniques for wave access and exit	(iv)	Considerations for use of oxygen

INTRODUCTION

For BGA clubs situated in Scotland, Wales and Northern England useful wave is common. However, for the other clubs it can be quite unusual. This makes picking up wave flying techniques difficult compared to the ongoing thermal practice that most trainees enjoy. The range of knowledge of trainees is likely to be very wide, depending on the frequency of wave flying at their club. This must be allowed for if they are to be appropriately briefed, not only to complete exercise 15C, but to subsequently wave fly effectively and safely.

THEORY BRIEFING

What conditions are required for wave to form?

In brief, wind over hills can form wave. However, that alone will not necessarily produce usable wave. Bigger hills and stronger wind usually produce better wave, but the other important factor is the state of the atmosphere. Orographic Lee Wave (the correct terminology) requires an unstable layer at low level, a stable layer above and an unstable layer above that. There should be wind increasing with altitude and little change in direction.

Wave is common, but usually too weak, high or localised to be of any use for soaring. It may interfere with thermal conditions or suppress ridge lift, making the ridge unsoarable. Wave has its downside.

A wave may be set off in the lee of a slope, but the topography downwind may cancel out useful wave further downwind. Conversely, it may boost subsequent waves. Very often, the waves downwind of the original source are better than the primary. Where wave systems from different sources converge, interference patterns will be formed. When the characteristic long lenticular clouds are present, a satellite picture will show the wave patterns, which can stretch across very large areas.

Innumerable smaller factors, the shape of the triggering hill, the depth of the various layers, etc. affect the wave. It is a complex subject as yet to be fully documented. Figure 1 gives a 'General Arrangement' of wave.

How to soar in wave?

Unlike the meteorology behind wave, the principle of soaring in wave is straightforward. Find the line of rising air and fly along it. When conditions are good and the wave is marked by smooth lenticular clouds it is simple. However, sometimes very good wave can occur in blue skies and with no visual clue

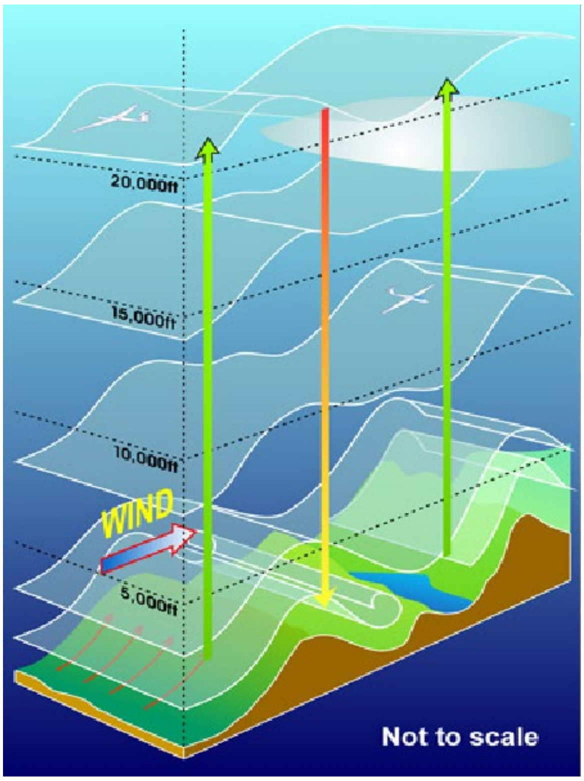

Figure 1. Wave – Typical Arrangement.

to its position, so soaring it is more challenging. Even more commonly, the wave clouds can be ragged, with gaps and changes of direction, depending on the terrain. Disappointingly, most usable wave is not suitable for high climbs or travelling great distance, but it can still provide interesting soaring.

Although often referred to as 'standing wave,' the lift is rarely completely static. Usually, the position of the best lift moves a little, slowly over time and occasionally it can move quite quickly. Sometimes, having climbed in good wave, it weakens and dissipates leaving one to slowly sink back to low level.

What can we do in wave?

Most Gold & Diamond height climbs are achieved in wave and, as the wave is often better when there is no thermal interference, it can provide some good, albeit cold winter soaring. If the wave bars are long, it is possible to cover great distances, sometimes at considerable speed. Waves often re-occur a number of times downwind of their trigger (i.e. propagated wave), so having gained height it is possible to jump between wave bars to progress up or downwind.

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How to get into wave?

The simplest way to start a wave flight is to aerotow to the front of a lenticular cloud in an active wave system. Most UK sites do not often see too many obvious, well organised wave systems, so frequently we have to fight our way up through weak and often broken lift to get into the wave proper.

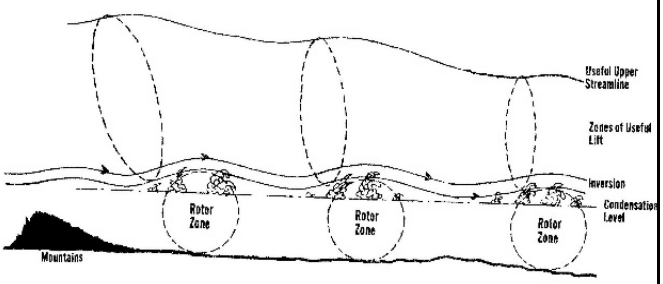

Figure 2. Wave Cross Section.

If it is too rough to aerotow, you are airborne when the wave starts, there is no tug available, or you are just too mean to pay for an aerotow, then hard work, cunning and above all patience, can be employed instead. It is rewarding when you then succeed.

Occasionally, you can transfer directly from ridge lift to wave, but more commonly from ridge lift, to thermal to wave. Ridges provide a useful 'Base of Operations' that you can keep returning to, to climb up and try again, which is useful, as many attempts to get into wave fail.

If the ridge is working better (or much worse) than you think it ought to, then suspect wave, even if it doesn't look like it. Even if the ridge isn’t unusually good, always keep wave in mind, particularly if the forecast suggest conditions are favourable.

Whilst airborne, monitor the situation: what does the sky look like? If it is full of lenticulars, that’s great. However, often there will be a poorly defined pattern, and it may not be visible at all. Observation over a period of time may reveal a stationary sunny or bright patch on the ground and frequently, that will be in the lee of high ground. On cloudy days, the appearance of a wave ‘slot,’ or clear gap in the overcast, may be an indication of wave setting up.

Whilst assessing the situation, try to gain the maximum height. Height is everything when wave hunting, the higher you are the further you can search and normally the higher you meet wave the easier it is to climb further. Much of the time when useful wave is present, it is above the height that we can climb to using ridge and thermal. However, the height that usable wave comes down to fluctuates and possible entry points move around and come and go. If you get a good height, then try a straight glide to any likely looking gap upwind of a cloud. With luck you may fly into the beginnings of wave lift at the edge of the cloud. In the absence of clouds, push into wind, but on most attempts you will be disappointed.

It can be an extremely difficult and frustrating process to get started, particularly if inexperienced. Often just a few pilots get into wave and frequently their entries are closely spaced in both time and position and then no one gets in for ages, if at all. Encouragingly however, some pilots succeed much more frequently than others, so evidently it is not entirely down to chance. With practice, persistence and patience, we can get better at getting into wave.

Successful attempts are often preceded by having found a thermal significantly stronger and rougher than the rest. These are commonly found just behind the up going wave, where the unstable thermic air and wave flow meet at the inversion.

If you get into the bottom of a wave system, then the first bit of the climb is critical. Initial climb rates are often poor and the lift is not necessarily smooth. This is an area where the thermals and wave are mixed. Be patient and stick with it, even if only climbing very slowly. If good lift is above, it should improve and smooth out as you climb.

Often, having taken a thermal at the edge of the cloud you will have drifted back under it because it is held in place by the wave system. That is a good sign, and you can move forward again and hopefully find another strong wave induced/boosted thermal. Use it, if possible, if not just pull up in it and then continue forward to the edge of the cloud. Keep a good lookout for all the other gliders playing the same game!

If you push out into the clear and find lift, fine, but if you don’t find it in the first few hundred metres then you probably aren't going to. But you can look back at the front edge of the cloud and return to the waviest looking bit; that may or may not prove to be useful.

It is important whilst flying in wave, to be certain of the wind direction. If as is usual the wind gets stronger with height, then even a modest error regarding its direction can result in significant cross wind movement or even drifting downwind rather than progressing into wind.

The sharp edge to the lenticular cloud observed from the ground is not usually like that when you are there. Often the edge of the main cloud is rather ragged, being fed by growing wisps that form in front of the main cloud and as with isolated wisps forming lower down. Even the tiniest and most transient cloud wisp is valuable information. It is best to keep moving around the windward edge of them. Normally, as you do this another will form into wind from you, and another, and so on. You can sometimes see a pattern forming as the wisps line up. It is easy to linger too long, particularly if the wind is brisk and end up engulfed in cloud. This is extremely dangerous and must be avoided. Disorientation in cloud happens very quickly and a small deviation from heading directly into wind will track you back into the cloud towards the sinking air, and the cloud can sometimes be thousands of feet deep. Wet or iced up wings add to the danger. Usually, once you are above cloud, the wave pattern can be seen much more clearly.

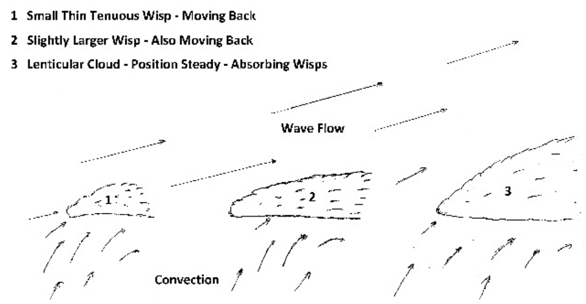

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Figure 3. Wave Wisps in Section.

If it is blue, with no cloud to guide you, a moving map snail trail provides a reference in space which is very useful because wave lift, in the short term, is fixed in space. As the areas of lift low down are often small and difficult to stay in, it is very useful to be able to fly back to them accurately and it also helps to be able to turn reliably back along a track when establishing a beat. As you discover better lift you can modify where you go back to.

Moving map displays can also provide a good measure of wind strength and direction, enabling progress back into wind to be made efficiently. They are usually essential if there is any airspace to be negotiated.

Safety issues are associated with wave flying

Oxygen: Regulations (UK Sailplanes Rulebook AMC1 SAO.OP.150) state that, oxygen should be used above 10,000ft When the pilot-in-command cannot determine how the lack of oxygen might affect the persons on board.

The **symptoms** of hypoxia such as headache, or fatigue may be insignificant or non-existent, so consequently the pilot is unaware of them. But the **effects** such as confusion, euphoria, inability to concentrate, impaired decision-making, impaired psychomotor performance, and eventually loss of consciousness are dangerous and potentially devastating.

Make sure you are familiar with the equipment, that it is functioning properly and adequately filled **and use it!**

Cold: Even in summer it will be cold at height and particularly so under cloud. In winter it can be very cold from the ground up! At higher altitudes very, very cold indeed. It is important to dress appropriately. Sufficient layers, multiple warm socks and boots, and warm gloves. Extreme cold impairs concentration, and shivering increases the need for oxygen.

Turbulence: Wave lift is noted for its smoothness, but wave systems often feature a turbulent 'rotor' structure under its crests. In the mountains and strong winds significant, sometimes severe, turbulence can occur which may or may not be marked by cloud. Aerotowing through it is very challenging and encountering it at more than manoeuvring speed is inadvisable. The wave system may create rotor over the airfield with very significant turbulence and an entirely different wind direction on the descent and approach.

True Air Speed: TAS is always higher than IAS (indicated air speed) and the difference is significant at high altitude. To avoid the possibility of flutter, gliders have a reduced (indicated) VNE with altitude. This is detailed in the Flight Manual and should be placarded in the aircraft.

Being blown downwind: wind increases significantly with height in wave, so may necessitate flying in windspeeds above those that we are accustomed to: 60 kts plus can be encountered. A rough estimate is that true airspeed increases by about 2% per 1,000ft. Therefore at 10,000ft, TAS will be 20% greater than indicated airspeed (IAS) caution is required moving downwind. You may have taken hours travelling 20 miles into wind, repeatedly climbing as you go, but getting back may take just 10 minutes. Be cautious on a downwind run, many sites in the UK are only minutes flying time from the sea!

Unlandable territory: Climbing in wave implies there is hilly or mountainous terrain upwind. Having gained significant height, the next step may be to jump forward and climb again. However, if you push forward, fail to climb you may find yourself low over hostile terrain. If you are pushing forward through sink, things can go wrong quickly. It is important to think ahead and make sure that you have sensible landing options.

Look out: Above cloud, some of the joys of wave flying are unlimited visibility and brilliant sunshine. Despite that, effective look out is an issue. Smooth lift, bright sunshine and the steady tone of the audio variometer can be quite soporific, lowering one's guard. It can also be quite difficult to spot gliders approaching as white gliders do not stand out well against gleaming white cloud. The best lift tends to be confined to a fairly narrow band, so it is not surprising that we encounter other gliders despite the huge volume of operating space.

FLARM is very useful given the limitations of our lookout, but it has limitations. FLARM indicates the direction of the threat relative to the glider's track, not its heading. In a strong wind there can be a big difference. See Figure 4 and the example below. Consciously look in the direction of track.

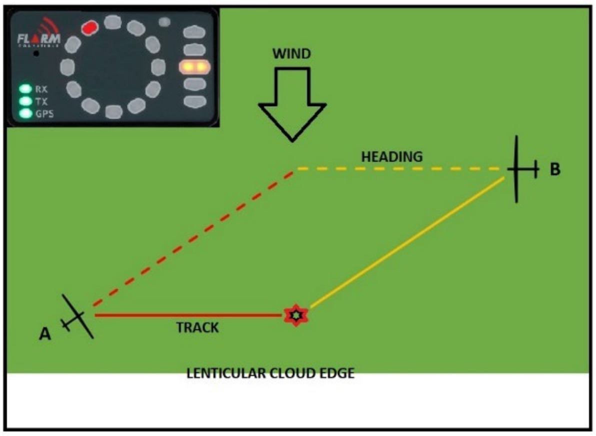

Figure 4 FLARM and Crosswinds.

Example: You are in glider A in Figure 4 soaring along a lenticular cloud in a brisk wind and therefore crabbing into wind. On collision course is glider B. This is further out from the cloud edge but tracking back towards it by heading parallel to it. Seen from your cockpit the glider you will hit is to the right of your heading. However, if the collision actually occurred, it would come from the left of the glider's track and the FLARM would appear as illustrated. Unfortunately, if you only look to the left of your heading, you will not see the impending collision. You must look left of your track.

Airspace: In the UK we are limited to FL100 without a transponder. However, the BGA negotiated a number of non-transponder areas above FL100 and up to FL195 in parts of Wales and the West Midlands, much of Northern England and all of Scotland. These are detailed as exceptions in the UK AIP under ENR 1.1 and 5.2 and there are various local Letters of Agreement. There are also wave boxes permitting even higher flight when enabled. Make sure you understand what you can do and where before you take off. Whilst these exemptions are very useful, Class A airspace exists within them making reliable and accurate navigation vital.

Daylight: Know the time of sunset. At height, it can still be bright after the sun has set on the ground. However, even with a 10 kt descent rate, it takes 20 minutes to lose 20,000 feet. Start the descent in good time.

Operation above cloud: Whilst it is possible to operate above 8/8ths cloud with moving map equipment, it is highly imprudent. The cloud base below you may have reduced since you climbed, perhaps to below the height of the hills. A descent through cloud is challenging even with the right instruments and experience – without these it is suicidal. Operating above partial cloud cover may be safe enough, but it is essential that a clear way down to a safe landing area is always available. If high in wave the reducing size of a gap may well be because you are getting higher above it. Or it may be that the airmass is getting damper and the gap is closing!

AIR EXERCISE & BY GLIDER BRIEFINGS

The intention of this lesson is to give the trainee experience of wave soaring and to practice the manoeuvring, decision making and required airmanship.

As with other exercises wave soaring is best taught in bite size chunks. However, exactly how this is done will vary considerably and we can only demonstrate dealing with the conditions that prevail. Teach them the various parts, getting into wave, climbing in wave, travelling in wave and exiting wave. This combined with a proper briefing covering the wider aspects of wave, will serve them well when they encounter other conditions.

Describe how you envisage the flight being conducted, along with likely variations if conditions do not prove as anticipated. Discuss how much flying you anticipate the trainee doing and what if any demonstrations you anticipate flying.

Draw attention to any local issues if they exist. Include advice on how to deal with particular issues you anticipate encountering.

Aerotowing into Wave:

If at a site where wave conditions allow, take the trainee through your thinking on where and how high to go and involve them in the tug pilot briefing. This briefing should be two-way, as, assuming the tug pilot has already flown that day, they will hopefully know where the wave is.

Remind the trainee of:

- the implications of aerotowing in strong wind/wave conditions, particularly rotor turbulence.
- The variometer as a method of spotting suitable release conditions.
- The importance of lookout, and specific issues of lookout in the wave environment.

Soaring into wave:

If planning to try to climb directly off a ridge into wave, brief the trainee how to best use the usual ridge soaring techniques to get as high as possible and push forward where the lift is best. With luck a seamless transition from ridge lift into the wave will occur.

If you do not have a ridge, but it is possible to stay aloft in thermal, then thermalling into wave, the most difficult method of entry, can be attempted. If the trainee is to do the flying in this exercise, they will have to be competent at thermalling.

If operating close to cloud, either vertically or horizontally ensure the lookout is good.

Not every wave flight will involve all aspects of wave soaring, so obviously we need to restrict pre-flight briefings to those aspects we expect to encounter. As before any flying exercise the instructor should discuss Threat & Error Management, along the lines of the following. There is a wider discussion of TEM in chapter B.

TEM

Threats:	**Mitigation:**
Collision	Maintain thorough lookout
Failure of Navigational equipment.	Monitor performance of equipment and have back up plan
Failure of oxygen equipment	Understand your equipment and monitor its performance.
Errors:	
Running out of height for appropriate circuit.	Monitor height & position.
Climbing too high without oxygen.	Carry & use Oxygen equipment above 10kft.
Being blown downwind	Use appropriate navigational equipment and maintain awareness.
Inadvertent penetration of airspace	Use appropriate navigational equipment with current airspace files.
Over speeding at altitude.	Monitor airspeed against table of speed restrictions at altitude.

AIRBORNE MANOEUVRE LESSON

When attempting to instruct the various techniques of wave flying considerable doubt will inevitably exist in the mind of the instructor as to what will be possible in the forthcoming flight, particularly as many of us (instructors) may be inexperienced at instructing in wave techniques. This is probable if the club is not one of the dozen or so in the UK frequently favoured by wave.

If you are confident that you can aerotow with your trainee directly onto wave then, depending on your understanding of their knowledge, you can brief for the launch, tow, initial & subsequent climbing, moving around in the wave and ultimately exit and recovery from the wave.

How much of the handling the trainee can manage will depend upon the skills they have. It is quite likely to be a windy day so even if they are already solo, or even licensed, they may not be up to the aerotow, particularly if you encounter rotor. Guide them as required to get established in the climb. If they were brought up in a thermalling environment they may fail to appreciate the significance of turning into wind whenever lift is encountered, or the importance of staying on the windward side of forming cloud.

Soaring in wave: If there is wave cloud then point out how to track along it, whilst keeping a focused lookout for gliders flying in the opposite direction. Draw the trainee's attention to maintaining station in lift and how to keep track of wind strength and direction, particularly in the absence of cloud.

Demonstrate how to conduct a logical search for better lift.

If possible, demonstrate how to tackle a transition to the next wave bar upwind. If you have climbed well above cloud, then the lift ahead is likely to be over the next lenticular cloud and given a strong wind and sink falling into it is easy. As you set out forwards, monitor your progress relative to the top of the cloud ahead.

If uncertain about pushing directly forward to the next climb, without penetrating cloud or falling out of the bottom of the system, track along the lift until you have either gained more height or found an area of weak lift and move forward from there. The weak lift should be behind the weaker sink. An extension of this idea which is to keep going until you effectively travel off the end of the system, go forward and then move back into the system having, hopefully, evaded the sink altogether. This may make progress into wind possible if the glider has limited performance.

Exiting wave: If you are only a few miles from home and in clear air a few thousand feet up, then safely getting home will not be a challenge. Conversely if you and your trainee are 20 miles upwind at 20,000 ft with an increasingly large amount of cloud below and airspace to be evaded, it requires more consideration.

Key points:

- It takes time to get down from height so make sure your trainee can make a good estimate of how long it is likely to take. If it is sunset at height then it may be really dark when they get home, particularly if cloud obscures the western horizon.
- A really swift descent has risks due to taking a very cold airframe into moister air e.g. forming a layer of ice on the airframe and canopy; it may also damage the gel coat of the wings if the airframe temperature changes rapidly.
- Encourage them to stay clear of cloud on your return and leave a little time in hand allow any condensation or ice issues to clear and to assess conditions at home before landing.

The obvious way of descending is to open the airbrakes and speed up. However, trainee may not appreciate the alternative is to achieve a good rate of descent by flying into the down of the wave.

Do not undertake a good descent but in doing so neglect to get home first. i.e. keep plenty of height in hand until close to home to allow for any navigational uncertainties or to outmanoeuvre any inconveniently placed cloud.

DE-BRIEFING

It is important that the trainee is encouraged to understand as much of the decision making as possible. A two-way discussion on how that went will be helpful, as will discussion of associated aspects of wave that may not have been encountered on the flight.

COMMON DIFFICULTIES

Trainees may find aerotowing difficult if conditions are windier than they are accustomed to or if rotor is encountered.

Trainees inexperienced in thermalling may well struggle with the characteristically tight and rough thermals associated with those squeezed close to the upgoing wave.

Some trainees struggle to keep track of the wind direction and may well require both assistance and reminders to do so effectively. Further, they may well require similar assistance and encouragement to progress into wind without wandering off.

Trainees and some experienced pilots struggle to navigate whilst at considerable height and are prone to being 'blown' backwards out of the lift.

The very bright conditions well above cloud can result in time and the need to be back on the ground in daylight being overlooked.

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16 - Out-Landings

SPL syllabus: Exercise 16 Out-Landings			
(i)	**Gliding range**	**(vi)**	**Circuit and approach procedures**
(ii)	**Restart procedures (only for self-launching and self-sustaining sailplanes)**	**(vii)**	**Actions after landing**
(iii)	**Decision process to not start the engine and to outland**	**(viii)**	**Determination of wind direction**
(iv)	**Selection of landing area**	**(ix)**	**Selection of landing direction**
(v)	**Circuit judgement and key positions**	**(x)**	**Considerations for landing at high slope landing sites**

INTRODUCTION

The most important message is that a good field landing is something that starts long before it is necessary. The whole flight needs to be conducted so that a good field landing can be made – and doing so, helps makes a cross-country flight much less stressful.

THEORY

Flying cross country safely

Flying a glider means that there is no guarantee of staying airborne. Even if the glider has an engine, it may not start. So, it is important to need to have at least one safe landing option available. At the right time of year, in the flatlands, there are plenty of landable fields in range in the direction of travel. In areas of inhospitable terrain, such as the mountains, (or even the flatlands when the crops are well developed) it might mean planning the route to stay in safe glide range of known landable places.

What does safe glide range mean? It means that even if we fly through reasonably foreseeable sink, we will get to our landing area with enough height to do a safe landing. A reasonable estimate might be half the best glide angle of the glider to the required arrival height – so 20:1 for a 40:1 glider – ***plus*** an allowance for wind. The circuit height needed will depend on experience and where you intend to land. More height may be required to fit in with traffic at an airfield, or to inspect an unknown field. Beware the 'arrival height' given by nav computers – they assume the full performance of the glider at the appropriate speed for the McReady setting in use.

In inhospitable areas, once you have got down to the minimum height for a safe glide (so, for example, when your glide angle to the circuit height above the field reduces to your previously chosen 20:1), you need to make a decision to fly towards the landing option and land if you can't find lift.

In more hospitable areas, with good landing options, tactics will vary with height.

- Above, say, 2500' AGL, it is enough to have landable fields ahead.
- Between, say, 1500' and 2500' AGL, you must be able to identify specific landable areas in safe gliding range.
- Below, say 1500' AGL choose a specific field, and local soar that or land. Do not give up that field unless another has been selected.
- At, say, 1000' AGL make a decision to land and stick to it.

The actual heights chosen will vary with conditions and the glider being flown.

Field Selection

Teach Wind + the six S's as a mnemonic for use in the air: Size, slope, surface, surroundings (or sticks) and stock. Inexperienced cross-country pilots should study the BGA's field selection videos before going cross-country. It is also useful as a revision for more experienced pilots at the start of the season.

Wind: It is essential to know what the wind direction is locally. The pilot should have a good idea of what the surface wind is from the forecast, and what it was at the point of take-off. However, in some areas, particularly the mountains, local effects may be significant. The nav computer may give the wind at soaring height, and movement of the cloud shadows will also indicate the local wind. Typically, the surface wind is backed by up to 30 degrees and is approximately half the strength of the boundary layer winds. Landing into wind has a significant effect on the size of the field that is required. It is easy to become disoriented with respect to wind direction, so it may help to teach the trainee to know where it is in relation to the position of the sun, for example.

Size: A big field is good and gives more margin for error. You cannot land in a field that is not big enough, no matter how good it looks from any other point of view. Even a field full of crop is preferable to one that is too small, especially if it has obstructions on the approach. Beware thinking that it is a large field simply because it is the biggest field in the area. Particularly in hilly areas the field may be smaller than in the flatlands.

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Slope: Slope can be quite difficult to see from the air and requires inspection from the side of the field (another reason to get there with a reasonable amount of height). If you can see the slope from higher up it may be so steep that it is difficult to land in. A flat field is very helpful. With any significant slope landing uphill is essential (and requires extra speed).

Fields that run parallel to rivers or railway lines are likely to be flatter.

Surface: Attention needs to be paid to any crop and its height. If there is no crop, there is a significant difference between a recently ploughed field and one that has been tilled. If there are tramlines in the field (from a tractor) landing across them you will probably lose the undercarriage doors, at least. In addition, look for things on the surface of the field, such as drains, fences and wires.

There's a very good video of how crops develop during the year which should be studied (fieldselection.co.uk). More can be learned by looking at the crops in fields on the way to the airfield.

Ensure your trainee is aware that a cropped field can be a good landing option at the right time of year, but a bad one at other times – it is all dependent on the height and density of the crop. If you can see the soil through the crop, then the crop is probably short enough to land in.

Shape: A square field can give more landing options that a long thin one. Landing across the diagonal also increases the landing run but beware ruts/tramlines etc.

Surroundings (or 'Sticks'): Obstacles on the approach significantly affect the landing distance available. Worse, many obstacles are difficult to see – often fields have telephone or power wires along their edge, and these can be hard to see until the last minute. Likewise, pilots have been known not to notice smaller trees within their wingspan. Brief your trainee that they should assume there will be obstacles, and land well into the field.

Stock: Fields with stock in should be avoided if possible – they are moving targets which might get in your way when landing and could be a problem when you are on the ground.

These are all factors that are used in choosing a field, but what if they can't all be met? It is worth discussing with your trainee the priorities amongst them, and what trade-offs can be made.

Estimating height

Few people can judge heights with any accuracy, and even then, it is very dependent on known features. The advice should be to use all the methods that are available for estimating height.

The recommendation is to fly cross country with the altimeter set to QNH. Discourage pilots from leaving their altimeter set to the departure airfield QFE – it is not very helpful 100km away. The QNH is needed as a reference for airspace and in talking to Air Traffic (or the standard pressure setting if high enough). From map study prior to the flight, pilots should also have an idea of the height of the ground in the area they are flying in, so the altimeter will give a reasonably good idea of height AGL, by subtracting the height of the ground from the altimeter reading.

Most modern navigation computers have a digital model of the terrain and so can display height AGL. This is very useful and usually reasonably accurate.

Lastly, those can be checked against how low the glider appears to be visually.

Landing / engine start decision height

Encourage pilots to have a decision height below which they commit to land, or in the case of a Self-Sustaining Sailplane (Turbo'), attempt an engine start. This is to mitigate three potential problems:

- the first is that by continuing to search for lift in the vain hope that it will be found, you end up too low to fly a safe circuit.
- even if lift is subsequently found, if that lift does not turn out to be reliable, the glider can be drifted away from the safe landing. Thermalling very low, has its own dangers as well.
- Lastly, in the case of a glider with a turbo, the glider engine may take time to start and generate thrust or not start at all. The minimum height for an engine start needs to be such that if the start fails, a safe landing can still be made.

There is often a time when a pilot is trying to find lift or circling in weak lift with a specific field chosen. At this point, if the pilot has capacity, they can evaluate other fields to see if there are better choices or look for fields downwind which can be alternatives. This is good but emphasise that they should not give their chosen field up unless confident that the alternative is appropriate.

Flying a glider with a turbo can reduce the need for field landings. However, it can increase the workload and risk if things do not go to plan. The details vary with the engine type.

Gliders with a two-stroke engine need to accelerate to start and will lose height in the process. The picture to the field is going to look different after the dive if it does not start. Additionally, if the engine does not start and is left erected, the glide performance will have decreased significantly. Jets and FES gliders are better in this regard – not needing much height to start and not giving extra drag if the start is unsuccessful. The distraction caused by a failed start could easily lead to the typical stall/spin accident that is too common in field landings. Further height will be expended for a second start attempt, if the first one fails.

A partially failed engine i.e. not running at full power, can be dangerous, and pilots are best advised to shut down the engine and land in their chosen field if that happens. The risk being that partial power merely moves them to somewhere without a good landing option.

Accordingly, the decision height for a turbo can or should be higher than for a pure glider. If the pilot of a glider with a turbo finds themselves below their decision height, it may be better to land rather than attempt an engine start.

Having a turbo makes little to no difference as to how the flight should be conducted – the reliability of turbos is such

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that the pilot should assume that the engine will not start and be pleased when it does!

Flying the field landing

Prior to the decision to land, an initial set of pre-circuit checks can be made. The BGA recommend WULF which is at least a partial set of things to think about. Water should be jettisoned in plenty of time – there is a better chance of climbing without it and landing with water on uses a longer landing run. The cockpit can be tidied, and straps tightened. Consider the altimeter setting that is in use and decide on an approach speed and flap setting for the conditions and field.

Whilst searching for lift in the vicinity of the field, there should have been an opportunity to inspect it, and perhaps rethink the field choice if there is a better option. If not, then the inspection needs to be done during the circuit, but that is really leaving it too late.

In the event of arriving in the vicinity of the field lower than is desirable, then the circuit should be intercepted at the appropriate height, rather than trying to fly a complete but low circuit.

Once the decision to land has been made, the wheel should be lowered. Using the landing decision as a trigger for the wheel can be effective, especially if backed up by a check downwind and on final. That is particularly true if the circuit has been intercepted, so the normal trigger for lowering the wheel has not happened.

Ideally a full circuit should be flown. This needs to start in the high key area, the normal distance upwind and to one side of the field. That area is likely to be two or three fields upwind of the intended landing area – a common mistake is to start at the upwind end of the chosen field, not realising that the field is much shorter than one's home airfield. But the circuit should look very much like the circuit that is flown at the home airfield in terms of size and shape.

The landing area chosen should, by preference, be well into the field. If the field is too small for this to be practical, then extra attention should be paid to the possibility of obstacles on the approach. Remember that once on the ground, the stopping distance in a soft field is likely to be less than on a smooth, hard, airfield. Also, that given a choice between hitting an obstacle at the near hedge whilst in the air, and running into the far hedge on the ground, the latter is better. If necessary, a deliberate ground loop can be an emergency solution to avoid running into the far hedge or other obstacle.

Aids can be used to help start the circuit at the appropriate height AGL, but once started the primary means of guidance is the distance and angle to the landing area. Avoid cramping the circuit (a common mistake) and do not get fixated on the landing area – pay particular attention to speed control, and attitude during turns. A normal half to two-thirds airbrake approach leads to a shorter landing than a shallow approach.

Once on the ground, stop as quickly as is practical – that reduces the risk of finding an unseen ditch, hole or post in the field.

After landing

This should include:

- After landing on an airfield or strip, move the glider off the runway.
- Find the owner of the field and tell them (with apologies, not arrogance).
- Contact the home club and crew.
- If you land in a field, you can contact (Distress and Diversion) D&D by phone in case the landing is reported as a crash. They are happy to be made aware. 01489 612691.
- Put a notice to put in the canopy stating the pilot is uninjured, a give a mobile phone number to contact them (whilst out looking for the owner).

TEM

Threats:	**Mitigation:**
Few good fields (terrain – crop)	Make routing decisions based on landing options early
Unseen obstacle or poor surface	Make as good as an inspection as you can make. Pick a big field and land well in.

Errors:	
Trying too hard to stay airborne – not making field choice early enough	Choose field earlier & do not lose sigh/track of it
Excessively focussed on the field leading to loss of speed control	Fly a proper circuit and look back over the nose in the final turn.

OUTLANDING AIR EXERCISE

Practical teaching of field selection and field landings is best done in a Motor Glider, by an appropriately qualified instructor. Ideally, it should be done when there are a reasonable number of fields with crops in, rather than every field being landable.

Whilst it can be done on the same sortie as the navigation exercises, in practice this means that both exercises are compromised due to lack of time. Better split the task up into two or even three sorties.

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Remember safety is the key priority. That means:

- When making an approach you, as instructor need to be confident that you have good options should the engine not respond when you open the throttle for the go-around. That means that you might reject fields chosen by the student that would otherwise be acceptable.
- BGA guidance is that you do not descend below 500’ AGL. That is primarily because the risk caused by an engine issue lower than that goes up significantly, but it also helps you comply with the low flying rules. However, the downside to this is that you can only say that the trainee has got the aircraft to a reasonable final approach position.

It is better for the trainee if they do their circuit with the field on the side that they are sitting, if they are in a side-by-side motorglider. However, this might compromise the desire to do the circuit on the downwind side of the field.

AIR-EXERCISE BRIEFING

Explain the plan for the flight e.g. familiarisation with handling the motorglider first, followed by a demonstration and then trainee field selection. Before you launch, agree how you will both identify the fields that you are looking at. You need to be very specific – ‘*the green one*’ rarely works. So, it’s ‘*the field at 1 o’clock, about 2 km away, oblong running left to right with a triangular shaped wood in the top right corner*’, for example.

AIR EXERCISE

The process might be as follows:

- At a reasonable height after take-off, let the trainee fly to get used to the handling of the motorglider. Explain the differences with a normal glider, and the controls that they will use. For some motorgliders, the airbrakes may be less effective than they are used to, for example.
- Climb to around 2000’ AGL and set the power for a glider-like descent (~150 fpm) at a nominated speed. Teach the process of looking for landable areas, then specific fields, and the decision heights associated with them. Demonstrate a field selection then fly a well-spaced circuit around that field (with the field on the student’s side of the aircraft), resulting in what would have been a final turn at greater than 300’ AGL.
- Then climb back above 2000’ AGL and let the trainee have a go. Look for sensible field choices, decision making at the right heights, and a good circuit.

COMMON DIFFICULTIES

Losing orientation and getting the wind wrong.

Starting the circuit at the upwind end of the field chosen, not the normal distance upwind.

Cramping the circuit, particularly by turning towards the field from a slight close high key area, whilst heading upwind.

Leaving the landing decision late and being too low.

Being fixated on the landing area and not looking over the nose during turns and consequently losing speed control.

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17a – FLIGHT PLANNING

SPL syllabus: Exercise 17a Flight Planning			
(i)	**Weather forecast and actuals**	**(vii)**	**ICAO flight plan where required**
(ii)	**Notices to aviation (NOTAMs) and airspace considerations**	**(viii)**	**Mass and performance**
(iii)	**Map selection and preparation**	**(ix)**	**Mass and balance**
(iv)	**Route planning**	**(x)**	**Alternate aerodromes and landing areas**
(v)	**Radio frequencies (if applicable)**	**(xi)**	**Safety altitudes**
(vi)	**Pre-flight administrative procedure, including preparation of additional required equipment, as applicable (e.g. life vest, personal locator beacon)**		

INTRODUCTION

With the complexity of today's airspace, the threat of litigation and the possible loss of one's license from airspace violations, modern GPS based moving maps with airspace warnings are all but essential. Every cross-country glider pilot should be strongly encouraged to use a moving map of some sort, with up-to-date airspace, as their primary navigation tool.

However, pilots also need to be able to navigate should that system fail. We need to teach them the process for planning and executing a flight as well as the detailed knowledge and skills required to do it.

A pilot's approach to navigation will vary depending on equipment capability, but for our purposes we should consider the typical equipment used by an early cross-country pilot – a moving map GPS – perhaps an Oudie or phone app – supplemented by a paper chart.

Additionally, pilots should develop the skills to use the radio on cross-country flights – see chapter K Radiotelephony

To complete the training course for an SPL pilots will be expected to demonstrate the required skills in practice.

Part SFCL breaks these skills down into 3 areas:

- 17a - Flight planning (important pre-flight preparation and study)
- 17b - In flight navigation
- 17 c - Cross-country techniques

THEORY

Airspace

The airspace structure in the UK is complex. There is both permanent airspace and temporary airspace – the latter usually notified via a NOTAM.

The definitive resource containing all the information you'll ever need, is the Aeronautical Information Package (AIP), found on the AIS (Aeronautical Information Service) website.

The AIP covers airspace classifications, altimeter setting procedures, details of all danger, prohibited and restricted areas, details of parachute dropping sites, charts of airspace and gliding wave boxes, etc. It is worth delving into, but the CAA Skyway Code is much easier to digest. Available at: https://www.caa.co.uk/publication/download/16110 There is information on the edges of the 1:500,000 chart.

Trainees should understand the main classes of airspace i.e. A, D, E and G. Classes B and F are not currently used in the UK

A – Not available to gliders other than under the terms of a specific Letter of Agreement (LOA).

D – The most common Controlled Airspace at low level. Gliders can enter with a clearance, but unless you are in an area that is used to dealing with gliders you may have difficulty. Brize Norton is an example.

E – Effectively uncontrolled airspace (Class G-like) for VFR gliders, controlled airspace for IFR gliders. So, no communication with ATC required if VFR. ***Gliders are unlikely to be able to obtain an IFR clearance***.

G – Free for all, see and avoid (ideally supported with EC)

Further information is available on CAA websites

The most practical ways to teach airspace and its numerous classifications is to use a 1:500,000 chart as a study aid. It is important to make sure that the airspace data that you and your trainee are using is current or make it clear that you are using an out-of-date map.

It can be used as material to test a trainee's knowledge, by getting them to identify different map symbols and then asking five main questions:

- What does the symbol/area denote?
- Can we fly in it?
- How can we find out if it is active or not?
- How high is the top or bottom of the area?
- On what altimeter setting? QNH? QFE?

Figure 1 above provides a couple of examples:

Question	Answer
What is symbol with the red diagonal lines?	A restricted area (co-incident with a MATZ)
Can we fly in it?	Read the note on the edge of the chart for R313. We find that we can telephone Waddington before we go or call on 119.500 to obtain information as to whether we can fly through it or not.
How high is the area?	9.5 means 9,500' above sea level (QNH), not above ground. When R313 is not active it reverts to a standard MATZ.
What is the circular symbol with red dots around Wickenby?	An ATZ.
What is the ATZ's radius and how high does it go?	1.5NM and 2000' on Wickenby's QFE.
Can we fly in it?	At the very least we must speak to the airfield. For some permission is a requirement; see Laws and Rules.

Vertical navigation – (altimetry)

For a fuller explanation of vertical navigation – refer the trainee to Bronze and Beyond. But a few key points:

When flying, there is a potentially confusing choice of reference levels for altimeter settings. The three in general use (see the grid following and Figure 5) are all important, helping a pilot understand height above ground, or the airfield height in relation to airspace or separation from other aircraft.

Abbreviation	Reference	Correct terminology
QFE	Airfield	Height
QNH	Sea Level	Altitude
SPS	Standard Pressure Setting (1013.2 hPa)	Flight Level

Pressure settings

We should teach trainees to fly on QNH whilst cross-country or using the standard pressure setting if above the transition altitude and close to airspace (most nav' systems will allow a box showing Flight Level which avoids having to make changes in altimeter setting).

They have the option of changing back to QFE when they get back to the airfield or remaining on QNH. There are pros and cons:

- Staying on QNH means that you do not have to switch altimeter settings. However, airfield elevation needs to be considered for final glide calculations (a nav system will do this automatically) and the circuit.
- Switching to QFE makes the circuit simpler, but they must remember to do it (perhaps an addition to the pre-circuit checks).

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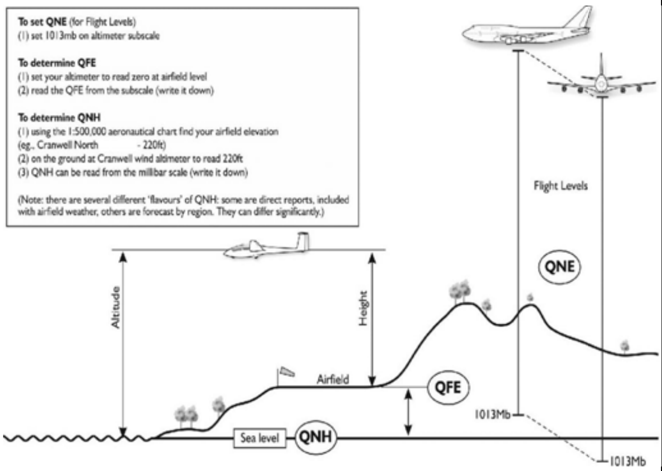
Each part of the country has an altitude above which Flight Levels are used. This is called the Transition Altitude. For much of country it is 3000 feet, but for areas close to a TMA or CTA it tends to be higher – often 6000 feet. In practical terms, glider pilots do not need to worry about the Transition Altitude, other than to be clear when to look at which Flight Level they are at, rather than altitude, if the base of local airspace is defined as a Flight Level.

From a practical point of view, trainees must be able to manipulate and understand the altimeter subscale to help them keep clear of relevant airspace. Some simple rules which can help keep pilots out of trouble, especially with airways.

Flight Levels effectively go up (i.e. in relation to the ground) as atmospheric pressure increases, and down when it decreases. If you leave your altimeter on QNH on a day when the pressure is 1013 or higher, your indicated altimeter reading will still be below the airway. So, when climbing on a low-pressure day, set 1013 early if underneath airspace defined by flight levels. If you insist on leaving it on QFE on a low-pressure day, having taken off from a high airfield, it is possible for an airway to easily be more than 2000’ lower than your altimeter indicates. Watch out!

With many modern nav systems it is possible to have a nav-box which shows Flight Level – this might be a good strategy to discuss with the trainee. It is in any case important that the trainee knows what the primary altimeter is set to and changes it when appropriate.



Flight Planning - Practical Considerations

To reach SPL standard, pilots must be able to self-brief. To achieve this, it is helpful to have a systematic approach to planning a cross-country flight. This should include the following items:

(i) Weather forecast and actuals Demonstrate to them a practical process for weather briefing – perhaps starting with the big picture and working down to the detail. For example:

- current weather radar picture
- winds - current and forecast on the ground and at likely flying heights
- the synoptic picture
- the soaring forecast (cloud base, cloud cover, thermal activity)
- significant weather forecast (as we acclimatise to the flying conditions, it is all too easy to overlook a gradually deteriorating situation.)

There are multiple sources of information: paid and unpaid. For gliding RASP is free, and SkySight and TopMeteo good paid options. Windy.com can provide a lot of useful information. The Met Office publish useful synoptic charts and weather radar. Encourage the trainee to develop their own process.

By looking at a fairly wide area, a sensible choice can be made of route later. If the trainee aspires to become a successful x-country pilot encourage them to understands tephigrams which will give them a greater insight into understanding the forecast.

(ii) Notices to Aviation (NOTAMs) and airspace considerations It is important to check that the airspace information that you are using is current. The pilot should know where the airspace files in the GPS have come from, what they include, and what date they were valid. There may be subsequent changes (perhaps NOTAMed), and the pilot must be aware of these changes/additions.

NOTAMs are notices issued by the CAA to inform airspace users about aeronautical facilities, services, procedures and hazards designed or changes to airspace – temporary or otherwise. The challenge is to sift through much irrelevant information to find the important points. These are the things that will affect the conduct of the proposed flight (for example the imposition of a temporary restricted area – RA(T)) or might affect our route planning.

There is no single, best, source of NOTAMs. Each has its own advantages and disadvantages.

The official source is the AIS website nats.aero/ais. You will need to login, but it is free to register. A NOTAM decode is also available on the AIS site. It primarily uses a 'text only' presentation that is particularly difficult to interpret and easy to misread. Use of the AIS web site is logged, and being able to prove that you have received an official briefing at a particular time may be helpful but using a visualisation system is helpful. There are several unofficial, systems offering graphical representations. However, should you choose to use another source the pilot will be responsible for an infringement if it is on AIS website and omitted by an unofficial provider. Whichever you use - take care.

Before you start to rely on them, you need to be familiar with the software and any quirks it has, and how to set it up. These systems include:

- SkyDemon. A good source of NOTAMs, which presents complex NOTAMs well. It requires a paid subscription.
- SPINE (Soaring Pilots’ Intelligent NOTAM Editor). A PC based system which gives a graphical NOTAM representation.
- The NOTAM tab on the Airspace Select website, which can provide an overview (and provide airspace files for complex RA(T)s which are planned).
- NOTAM Info – a website giving a good overview of NOTAMs but has been known to miss important ones.
- It is important to understand that the times given in NOTAMs are UTC (so add an hour to get local time (BST) in the summer).

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All NOTAM systems have a delay between NOTAM publication and them appearing on the site. You can call the AIS information line on 0500 354 802 to find out about things that have appeared since you checked or had not made it into the data. This lists all major Temporary Restricted Areas, Airspace Upgrades, and emergency restrictions on flying, e.g. due to an accident or incident.

(iii) Map selection and preparation

It is a legal requirement to carry suitable and current charts for navigation. Whilst these can be electronic, a backup is needed, and it makes sense for this to be a paper aeronautical chart. When planning the route, it may be easier to check the airspace en-route on a paper chart. This can be particularly important given that many early-stage pilots are flying with low-cost devices with small screens which may not be adequate for a good appreciation of airspace and may not be dependable.

For the GPS moving map system it is important to have a current airspace file. Some systems can automatically update, but it is not always clear what the valid date of the airspace file is. In that event, it is better to download a known file from, for example, Airspace Select. The user can customise the airspace shown on the GPS, to some degree (for example, the height to which airspace is shown) and to include Letters of Agreement that give access to otherwise disallowed airspace. Also, it is possible to select airspace representations that show the level of blocks of airspace on the map, which can be very useful.

In the UK there are basically two aeronautical charts to choose from:

- The CAA 1:500,000 which is good for longer cross countries and works well in conjunction with a GPS.
- The CAA 1:250,000 shows a higher level of detail and might be useful for shorter cross countries in hilly terrain. It is important to note that it does not show airspace above 5,000 ft / FL 55, so needs to be used with care, if at all.

It is important that the map is folded appropriately. A glider cockpit in the air is no place to re-fold a map.

(iv) Route planning

A suitable route can be chosen based on the skills and desires of the pilot, taking into consideration the weather, notams and airspace considerations. Other factors to consider are the airspace (ATZ, Class D), terrain in mountainous areas, the state of land out fields, the availability of other land out options, and relevant frequencies (if any) at these sites. Do not task under low airspace ceilings (< 4,000 ft AGL), or just upwind of 'forbidden' airspace as wind-drift when thermalling will inevitably push the pilot into it.

Particularly for early-stage pilots, the route should be eminently achievable given their likely slow cross-country speed.

It is very disappointing for a trainee to complete a badge flight and find when it is not valid after you/they realise they have not followed the rules for claiming the flight. The FAI sporting rules do change from time to time to encompass changing glider performance and GPS recording technology. The Sporting Code is available online and gives the detail of what is required for badge flights. Issues to watch out for include:

- The allowed length of start and finish lines
- The reduction in task length caused using 'barrels' or 'thistles' at turn points
- The reduction in task length caused by the difference in start and finish height

The route should be marked on the map with an indelible marker (if you use a coated map, the marker can be removed with white spirit). See Figure 6. As the electronic map will give the pilot the range to a TP (and bearing), it is useful to mark range marks (every 10 kms) from the next TP thus giving the pilot an instant 'where are they' on the map. Turn points should be left clear (put a clear circle around a TP. Highlight possible land out sites / airfields and ensure radio frequencies are on the chart (and readable). The wind should be marked on the map. Relevant NOTAMs should be marked on the map and if close to track significant airspace highlighted.

Once the route has been planned, and the map marked up, it needs to be studied, so that the trainee knows what their route, safety, land out and airfield bolthole airfields are. Particular reference should be taken to the 'big feature' navigational features – large / distinctive towns, lakes / rivers /canals, motorways crossing route, large woods, etc (either side of the route as the pilot will take the best energy line) – these will greatly assist in locating oneself and lead to accurate navigation. Particular attention should be paid to airspace positions and levels, and NOTAMs.

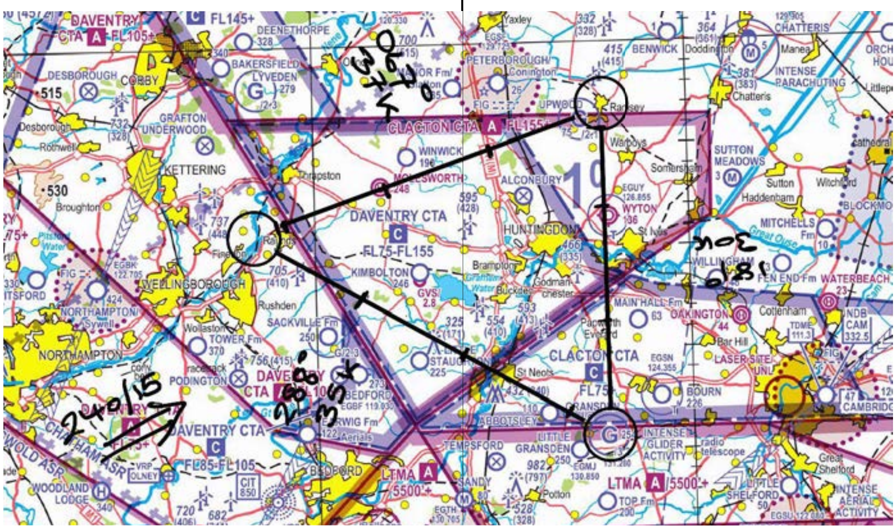

Figure 6

(v) Radio frequencies (if applicable)

The pilot does not need a FRTOL licence to use the standard gliding channels but strictly speaking a licence is required to communicate with using other frequencies e.g. to contact some aerodromes, AIS etc. Whilst it is worth encouraging pilots to get a FRTOL, remind them that in some situations it is better to communicate as needed even without a licence – e.g. when needing to land out at an aerodrome etc. The pilot should ensure that they have up to date radio frequencies to hand in to communicate with airfields or air traffic as required.

Sources for these include:

- NATS Frequency Reference Cards
- Airfield frequencies in electronic data such as airspace files (ASSelect), and the Airfield and Land out package from Paul Ruskin (ruskin.me.uk/gliding-data)
- Frequencies programmed into a radio are a little more difficult to manage and care needs to be taken to ensure that they are current.

Particularly for early flights, it is sensible to have the frequencies likely to be needed written on a single planning piece of paper along with relevant NOTAMs, or even better on the chart.

(vi) Pre-flight administrative procedure, including preparation of additional required equipment, as applicable (e.g. life jacket, personal locator beacon)

Trailer and retrieve. Before the flight sort out the retrieve equipment and arrangements. Make sure trailer is serviceable, and crew or pilot knows how to de-rig and what additional equipment they may need to bring – trestles, de-rigging tools etc.

Also consider what other equipment is required, for example:

- Sunglasses/ suncream / lip cream.
- a hat (long flights in sunshine will cause problems if you do not have one – avoid large brims that prevent adequate lookout such as baseball style caps).
- drinking water.
- pee bag system / other suitable arrangements.
- food & sweets to suck to keep mouth moist.
- a survival blanket (easy and small to carry).
- a warm coat in case of land out.
- a personal locator beacon. That normally needs to be registered, and the battery checked in line with the instructions.

Ensure the item are all properly stowed – no loose items in the cockpit.

(vii) ICAO flight plan where required

An ICAO flight plan is a legal requirement if the flight crosses an international frontier – so, unlikely to be needed in the UK, but might be if flying in, say, the Alps.

There are various ways to file these online, and the flight plan will need to be activated via a Flight Information Service once airborne and closed before landing.

(viii) Mass and performance

Mass and performance are not generally an issue with gliders, albeit the use of water ballast is appropriate for some gliders in some conditions. That is unlikely to be the case with early-stage cross countries though. Always refer to the flight manual.

(ix) Mass and balance

The consideration of mass and balance (Centre of Gravity) are a normal part of our pre-flight checks that are conducted ahead of every flight.

(x) Alternate aerodromes and landing areas

It is possible to fly cross-country making use of known land out areas or places. This is not necessary in much of the UK for much of the year, but in inhospitable areas such as mountainous terrain, over large, wooded areas, or over small field areas (Devon, The Dales, moors etc) it can be a necessary discipline.

In that case it is necessary to know where the available landing places are, and to stay at a safe glide angle to those places. In the event of descent to that limiting glide angle, the action taken should be to immediately fly towards the safe landing place.

(xi) Safety altitudes

The concept of a safety altitude is an altitude above which there is no possibility of hitting terrain or an obstacle on it. That can be very useful in powered flight, particularly in poor visibility or IMC – it is less useful in a glider which will usually be remaining VMC or at least clear of cloud.

17b – IN-FLIGHT NAVIGATION

SPL syllabus Exercise 17b: In-Flight Navigation.			
(i)	**Maintaining track and re-routing considerations**	**(v)**	**Uncertainty of position procedure**
(ii)	**Use of radio and phraseology (if applicable)**	**(vi)**	**Lost procedure**
(iii)	**In-flight planning**	**(vii)**	**Use of additional equipment where required**
(iv)	**Procedures for transiting regulated airspace or ATC liaison where required**	**(viii)**	**Joining, arrival and circuit procedures at remote aerodromes**

INTRODUCTION

As discussed in the previous section of this chapter, given the complexity of today's airspace, the use of GPS based moving maps with electronic airspace warnings are essential. It will be very helpful if their training is conducted using the same type, or at least, very similar equipment.

THEORY

(i) Maintaining track and re-routing considerations

Correcting for drift: drift is the effect the wind has on a glider's track. The difference between track and heading is greatest when the wind is at right angles to the heading. The effect on the glider's ground speed is greatest when the glider is heading either directly into wind, or downwind.

Pilots flying their first few cross countries are unlikely to be doing so in strong winds. However, even moderate winds can result in significant drift, especially if a lot of time is spent thermalling.

Figure 1 (opposite) shows how a crosswind affects a glider's track over the ground. In addition to causing the glider to track downwind relative to its heading, whilst thermalling, the glider will drift even further downwind. That means that for the periods that we are gliding between thermals, we need to make a bigger offset for drift than if we did not have to stop to climb. If we spend 50% of the time thermalling, the offset is roughly twice as much.

Therefore, when flying crosswind, if there is a choice whether to route upwind or downwind of the route heading, routing upwind is preferable. Otherwise we will end up further off track than we need to be.

(ii) Use of radio and phraseology (if applicable)

Cross-country glider pilots should be strongly encouraged to get and use a FRTOL (R/T licence). However, a FRTOL) is not a requirement for cross-country flying or to use gliding frequencies (details from Laws and Rules). Using the radio can cause a significant increase in a pilot's workload. A FRTOL, however, enables a pilot to communicate with airfields, and potentially access some additional airspace. Calls to airfields when passing close by, can improve everyone's situation awareness and safety. (See chapter K).

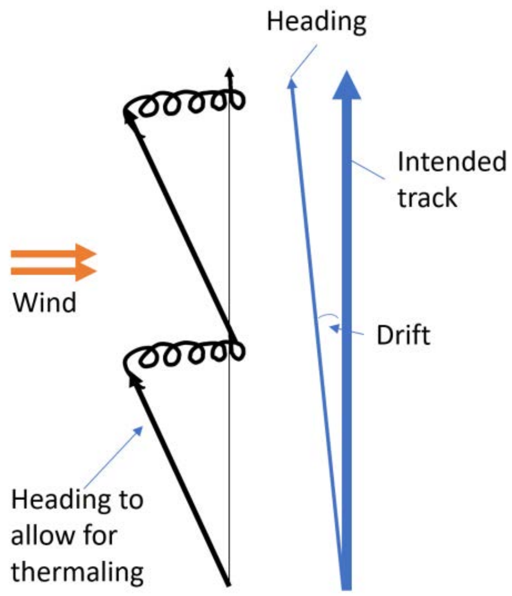

Figure 1. Heading and Track

Occasional, unlicensed calls made to achieve safe outcomes have not been known to cause complaint, especially if done with a degree of competence.

(iii) In-flight planning

The pre-flight planning should have been done thoroughly, but it is possible that we will need to adapt to changing circumstances for example, because of the weather. So, it may be necessary to divert to an airfield enroute, unexpectedly. In that event, making sure we have all the information we need to hand, prior to getting there, is essential.

This information can be written on the map or alternatively may be available in the nav system if the pilot knows how to access it easily.

In the event of such a diversion we need to be able to make a reasonable estimate of the track and distance to be flown, and the effect of wind to achieve that new track. Easy when using a GPS, but more difficult when flying using purely a chart. This can be practiced on the ground.

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(iv) Procedures for transiting regulated airspace or ATC liaison where required

There are several circumstances during a cross-country flight where use of the radio is something between helpful and essential.

- To enable you to use an airfield as a land out option safely.
- To liaise with ATC when in the vicinity of an airfield with, for example, an instrument approach to improve the situational awareness of you, other pilots, and ATC, and thus everyone's safety.
- To gain permission to enter or cross controlled airspace.

The last of these is probably the least often used by glider pilots. However, there are pieces of controlled airspace (typically Class D) that are not heavily used, and where, with the appropriate techniques, a clearance to enter or cross should be easily obtained.

(v) Uncertainty of position procedure

Reading a map is not difficult but it does require practice.

If you don't know where you are, (assuming you are uncertain of your position due to a GPS failure) and you flounder on hoping, perhaps, that some voice from above will tell you the way, then you will probably stay lost or worse still, infringe airspace.

If it is possible that you have strayed into airspace – follow the lost procedure (next section vi)

If you are confident you are clear of airspace, try to find some lift to "park up" in whilst you work out your position. You should look at the world and fit that to the map, rather than try to fit the map to the world.

If you are well clear of controlled airspace:

- Guestimate where you might be from your last known position and the general direction of travel
- Look around for a prominent landmark e.g. a lake, a large town, hills etc.
- Note a clear, secondary feature and its relation to the first.
- Use the compass or sun's position to help orientate yourself. Look at the map and attempt to locate the first feature at approximately the right distance from your last known position.
- Still looking at the map say (e.g.), *if that is Northampton I'm looking at, then I should be able to see a motorway to the West of the town, and a large u-shaped reservoir to the North* - one of these could be your secondary feature. What you can see will depend on the visibility, your altitude, and the direction you are looking from.
- If the features are visible, and in their correct relation, make further checks to be sure. For example, there should be a river and several small lakes to the south of the town.
- If none of the features check out in relation to each other or the map, look out at the features once again (or choose different ones), and then go back to the map and attempt to make another identification, following through the steps as before.

It is very easy to fail to keep a thorough lookout whilst trying to re-establish one's position. Keep a good lookout.

(vi) Lost procedure

If you really are lost, there is help available, if you call for it, on 121.500 – the Distress and Diversion frequency (D&D). Do not be shy about using it – especially if you may be in or near airspace. That it is what it is there for. The controllers are well used to fumbling radio calls and welcome the training. Right from the first transmission, a call for help demonstrates that a pilot is being mature about their problem. Best of all is the fixing service; given nothing more than your transmissions, they have the technology to work out where you are. 'London Centre' is their call sign. Call and tell them that you are lost and need assistance. They will ask you to make long transmissions (just repeat your callsign a few times asking for a fix), so that they can use their triangulation system to fix you – they can give you your position relative to a town / city, to an airfield, or to GPS coordinates. Position fixes should be obtainable down to and about 3,000 feet outside the London TMA.

(vii) Use of additional equipment where required

Cross-country gliders should carry Flarm. The trainee should understand how to use Flarm, in particular:

- what the various warnings mean
- have an understanding that Flarm displays directional information relative to track, not heading, and when that might be important.

The later point can be significant in strong winds. It is also possible that the trainee will fly a glider with a transponder, in which case they also need to be familiar with its use.

(viii) Joining, arrival and circuit procedures at remote aerodromes

The trainee should be familiar with the likely joining and circuit procedures at any airfield they plan to land at, and the standard procedures for unplanned airfields. Most airfields provide very useful information online, that should be studied in advance. Standard procedures are well covered of this in the BGA FRTOL course and trainees should be encouraged to do the course even if they do not choose to do the test at the end to get the licence.

TEACHING CONSIDERATIONS

Equipment

A moving map with a good-sized screen mounted securely in the glider can be enough to provide navigation and airspace information. This requires a good fixed or mobile battery supply more than sufficient for the planned flight and possibly a duplicated battery system. Nonetheless, a backup should be carried and used in the event of fault or uncertainty.

Less capable systems (such as a phone running one or other glider navigation package) can be used, but they may require a more substantial use of a complementary paper chart.

Non-moving-map GPSs can provide good navigation information, but require more care in their use, particularly if a direct-to is chosen to a diversion, that potentially routes through airspace.

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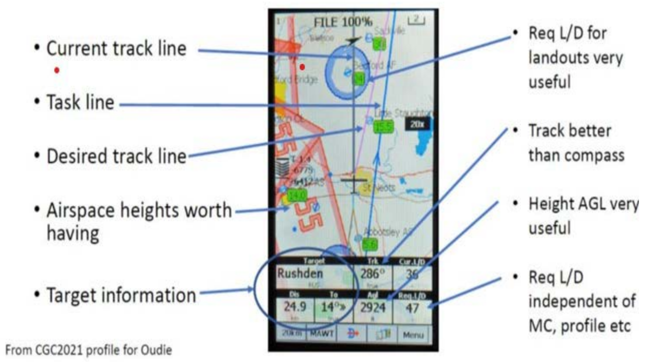
The trainee should understand how to navigate using a paper map and compass – that being the ultimate backup to a GPS system failure. But cross-country navigation by map and compass alone should be strongly discouraged in any situation where proximity to airspace could be a concern.

If possible, it is good to use the navigation system that the trainee will use when they start going cross-country, so encourage them to research and choose one. Learning to use a moving map GPS is mostly about managing the kit, rather than the flying, so most of it should be done on the ground, or possibly in a good simulator.

They should know how to:

- load current airspace and waypoints (and know what they have got).
- make sure that the nav' system is set up to show relevant airspace, and alert if they get close.
- load NOTAMs if appropriate.
- find airfield and radio details (from the nav system, from a Frequency Reference Card, etc).
- load a task with appropriate turning-point zone settings for a cross-country badge flight.
- fly the task, whilst understanding their diversion and land-out options as they pass appropriate choices.
- make a diversion choice, select a go-to in the nav system, then fly there.

You can give advice as to a suitable simple setup for the moving map, for example that shown in Figure 2



A properly marked and folded map is essential in addition to the moving map, especially if it is relatively difficult to get airspace information from the nav' system.

Flying with just paper map and compass.

The backup to the normal use of moving map GPS is 'Pilotage' navigating using the map and comparing it with the features on the ground to establish your position.

We know what track we want, and what our drift is likely to be. So, making allowance for wind, we pick a point on the horizon and head towards it. We compare map and ground features to work out where we are. As we move along our task, the features we choose will change.

If we know where we are, we work map to ground, maintaining at least three known "fixes" which change as we move along the track **figure 3.**

At the position shown by the orange triangle in Figure 3, we should be able to see:

- Grafham water in our 1 o'clock - a large body of water with its major axis along our track.
- Little Staughton airfield just left of our nose an airfield with lots of solar panels.
- St Neots close in our 9 o'clock.
.
- Railway across track.
- Lakes across track.
- Major road across track on far side of town.

If lost, we work ground to map i.e. look for features we can see on the ground and find several distinguishing characteristics and compare them with the map. For example, in Figure 5 below)

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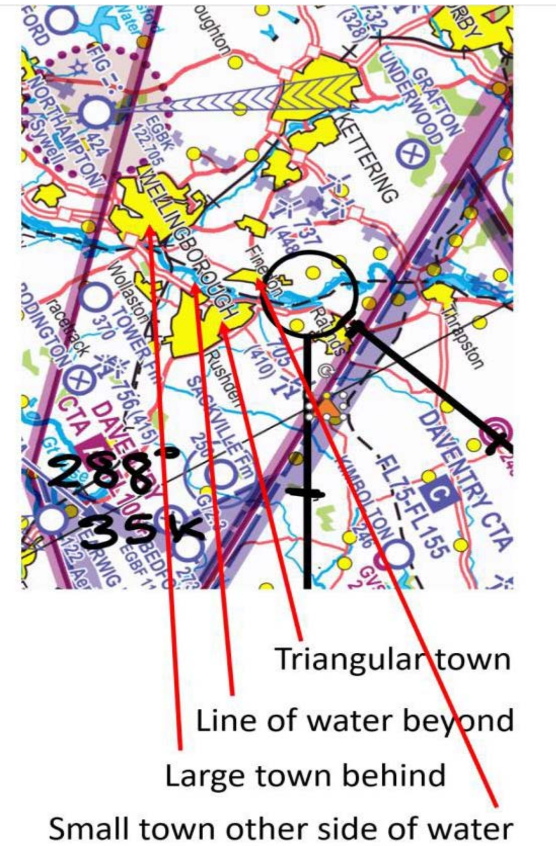

Working ground to map, we look for features we can see on the ground and find several distinguishing characteristics and compare them with the map. For example, in Figure 5, we can look at what's ahead and identify things which we can see on the map in Figure 6. In this way we can fix our position.

We should demonstrate, where possible, the effects of visibility and height. As we get lower, we can see less far, small features may seem significant but may not be on the map. As atmospheric visibility decreases, we also see less far, so we have fewer clues to work with. Navigation in poor VFR conditions can be very difficult.

Visibility can be much worse into sun, and that cloud shadows often obscure ground features.

In the air the trainee should be taught about how to fly using this setup.

- Looking only occasionally at the map – and picking a feature in the distance and flying towards that, making suitable allowance for drift.
- Looking out thoroughly before and after looking in at either GPS or paper map. Ensure the trainee keeps the 'look-in' time to a minimum.
- Making use of the paper map to give better situational awareness than some moving maps provide and to review airspace on track.
- Carrying out nav tasks early in the cruise after leaving a thermal, but ensure they know where to go (heading or feature) before they leave the climb.

Track/heading or north up?

The question of how to orientate the map or moving map is the subject of much debate. There are pros and cons of each method. Explain what they are and allow trainees to make the decision. Pros and cons are:

Heading up: The world and the map correspond, which is very useful when identifying features and, on a portrait, orientated moving map, you can see furthest in the direction you are going which is better than seeing what's behind you.

But on a paper map, the writing may not be horizontal and figuring out the actual heading can be more difficult (though can be helped by a compass rose).

Our ability to recognise familiar patterns or shapes of features, is compromised and when thermalling the device is of limited use.

North up: you can read the text on a paper map easily and it is relatively easy to identify north.

But you have to rotate features in your mind to compare them with what's out the window.

17C - CROSS-COUNTRY TECHNIQUES

SPL Syllabus: Exercise 17c Cross-country Techniques	
(i)	**Lookout procedures**
(ii)	**Maximising potential cross-country performance**
(iii)	**Risk reduction and threat reaction**

INTRODUCTION

Flying cross country is an aspiration of many early pilots, but they often need help to develop the confidence to go and do it themselves.

Proper and thorough briefing and training is an important step towards increasing their confidence, together with some gentle encouragement.

As always, they need to be properly prepared.

Lookout Procedures

If the trainee pilot is having to navigate as well as soar, their workload has increased substantially compared to just soaring locally. Consequently, they may neglect their lookout. Hopefully, lookout will have been re-enforced so often in their basic training, that it is second nature but sadly this is often not the case.

Flying cross-country often involves thermalling with other gliders, which is a higher risk situation, particularly when joining or leaving a thermal. Avoid flying in other gliders blind spots.

The risk increases when close to cloud base.

Flying along a "street" is another point of potential conflict with traffic in the opposing direction. Because the glider in a head on situation remains in a constant position in the canopy, it is harder to see. This, combined with a high closing speed, is a very high-risk situation that all pilots should be aware of. Again, it is worse close to cloud-base.

Flarm is a valuable aid to look out, but not a substitute. The pilot must be familiar with using it.

Remind trainees to:

- carry out a thorough lookout before and after any head in cockpit time (for example, looking at or making changes to the nav system or map).
- incorporate any traffic display into their scan to add to their situational awareness of other traffic.

Maximising potential cross-country performance

Whole books are written on the topic of maximising potential cross-country performance, so the question is what you can sensibly teach a new cross-country pilot for their early cross-country flights.

Usual advice for first cross-country flights is to 'get high and stay high' For those looking to start increasing their performance, a discussion around the following topics might be useful:

- Sensible choice of operating band – typically between close to cloud-base and about halfway between that and the ground. Any lower than that and they risk becoming disconnected from the clouds.
- Sensible thermal selection – not always stopping to climb when high, not pushing on when low.
- Discussion about when to leave a thermal. E.g. setting a minimum rate of climb to accept provided the sky ahead still looks reliable.
- How to estimate range and height-loss to the next climb.
- Routing – selection of best energy line – how far off track to go and in which direction. Most early x-country pilots simply look for the next cloud rather than a line of energy. Looking further ahead for the best line of energy will be new to them. Up to 20 degrees of track, adds very little to the overall distance to travel down a leg. But this is an exponential curve – so by the time you are 60 degrees off track you would double the length off the track if you stayed 'permanently' on that line. Remind them, that is 20 degrees either side of the track – not twenty degrees either side of where the glider is pointing at the time.
- On a crosswind leg, if there is a choice of routes, take the upwind route – whilst you are upwind of the track, every time you stop to thermal you will be drifting back towards the original track line rather than drifting further downwind.
- Looking at clouds – signs of new clouds rather than decaying clouds.
- Search patterns under clouds and tips for where they might find the best lifts – up wind/ sunny edge, steps in the cloud base etc.
- When near to cloud base, the route ahead can be difficult to see, but looking at the cloud shadows on the ground will give you a good indication.
- What to do in blue conditions. Good potential thermal sources. Task up / down wind direction. If flying up or down wind and finding only sink, consider deviating crosswind to escape the possibility of a 'sink street.' Look for haze caps at inversion level.
- Speeds to fly for given conditions and glider performance. The speeds to fly are based on Macready theory, as are final glide calculations. Following the 'speed-to-fly' command is usually counter-productive, due to the lag in the vario, the pilot's reaction to the vario and the time it takes for the glider to accelerate.

Block speeds often work better e.g. in a medium performance glider 60 kts between thermal in weaker conditions, 70 kts in good conditions and 80 on a good day – adding another 10 kts when carrying water.

- Final glides. Must include a discussion of the risks and safety margins. For more competitive performance, discuss the use of final glide calculations/calculators and adding the appropriate arrival heights/safety margin.

An explanation of MacCready theory can be found at the end of this chapter for completeness.

Outlandings

Outlanding considerations are covered in Chapter 16, but it is worth thinking about reasons why people might increase the chances of landing out:

- Poor thermalling
- Impatience
- Flying into poor conditions instead of having a plan B such as 'parking up' or deviating from route
- Poor task setting
- Weather forecast incorrect
- Fatigue/lack of concentration
- Instrument problems – leaks in vario's etc
- Out of practice.

Practising

Flying with a cross-country coach in a two -seater is ideal but not always available. Ultimately, getting better requires practice and some key cross-country skills can and should be practised locally even when the weather is not suitable for tasking e.g.

- Thermal centring
- Entering thermals and getting straight into the core.
- Good thermal discipline when flying with other gliders.
- Gaining familiarity with the navigation instruments and logger.
- Starts and final glides
- Staying airborne in weaker conditions – nearly every long-distance flight has a difficult patch, so encourage them not to only fly on weaker days and work at staying airborne locally.

Proper preparation will increase their confidence and thus willingness to go cross-country. This includes

- Improving interpretations of weather forecasts and understanding tephigrams.
- Familiarity with checking Notams
- Field landing practice in a motor glider
- Trailer preparation – a job to do in the winter.

Risk reduction and threat reaction

Flying cross country carries a statistically great risk than local soaring – only partly due to the risks associated with field landings.

Consider factors such as:

- Poor preparation
- Fatigue or dehydration
- Inexperience
- Lack of currency
- Difficult terrain/poor field selection
- Technical issues

There are several things a pilot can do to reduce risk:

- Preparation starts well before the day. Having kit fully prepared and ready for use/potential tasks planned in advance/research circuit/landing procedures for potential airfields en-route etc
- Allow plenty of time to prepare for the flight. Some pilots find checklists help with personal and glider preparation.
- Conscientious lookout
- Manage the flight so that there are always landable options available – see the chapter on field landings. That means a change in approach as the glider gets lower, with the exact details dependent on the number and quality of the available fields. In extremis, in otherwise unlandable areas, that means always staying within safe gliding range of a known good option.

MACCREADY THEORY

MacCready theory is a gliding strategy that tells a pilot the optimal speed to fly between sources of lift (e.g. thermals) to maximize average cross-country speed. The theory balances the trade-off between flying faster and losing altitude more quickly versus flying slower to conserve altitude.

The key takeaway is that the pilot's speed **depends on the strength of the *next* thermal they expect to encounter,** not on the thermal they just left. Therefore, this depends on how good the pilot is at judging conditions ahead. However, during a final glide you are not expecting to have to climb again so in this case, the calculation **does** depend on the climb rate of the last climb.

Adjusting your flight based on conditions

The MacCready setting—the expected climb rate—determines the strategy. Put simply:

- **Strong thermals (high MacCready setting):** If a pilot anticipates strong lift, they should fly faster between thermals. Higher speed is more costly in attitude altitude quickly, but is compensated for by reaching the next climb more quickly so the time is made up by the faster climb rate.
- **Weak thermals (low MacCready setting):** If thermals are weak or fading, the pilot should fly more conservatively, at a slower speed. This minimizes the rate of descent and conserves precious altitude, since regaining it will take more time in weak lift.

However, the obvious risk is that you do not reach the next climb and therefore land out – i.e. game over, or more

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subtly, the climbs are weaker lower down and you have fewer choices of climbs, so you end up having to take a weaker climb instead.

While fundamentally sound, MacCready theory has some practical limitations.

- **Idealized flight path.** The basic theory assumes an ideal "sawtooth" flight path of straight glides and circling climbs. The pattern of rise and sink does not follow such as fixed formula.
- **Wind effects.** The basic theory ignores wind effects, though adjustments can be made. For example, a pilot should fly faster into a headwind and slower with a tailwind during a final glide to a destination.

How it works

The principles of MacCready theory are used in modern flight computers, which automate the speed-to-fly calculations based on the pilot's input of the expected thermal strength.

The usual practice is to set the MacCready at half the expected rate of climb in the next thermal (this is **the average over the whole climb** from including the time to centre the thermal and the last turn when you wish you had left a turn earlier!)

If setting the MacCready to the achieved rate of climb in the last thermal, turn it back again for the final glide until you are sure you are gaining on glide and 'comfortably in.'

Older gliders may still have a **MacCready Ring**, a rotating scale fitted around a glider's variometer (an instrument that shows the vertical speed).

The pilot estimates the average rate of climb they expect in the next thermal. They rotate the ring to align this estimated climb rate with an index mark. The variometer's needle will then point to the optimal cruising speed to fly in the current airmass.

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