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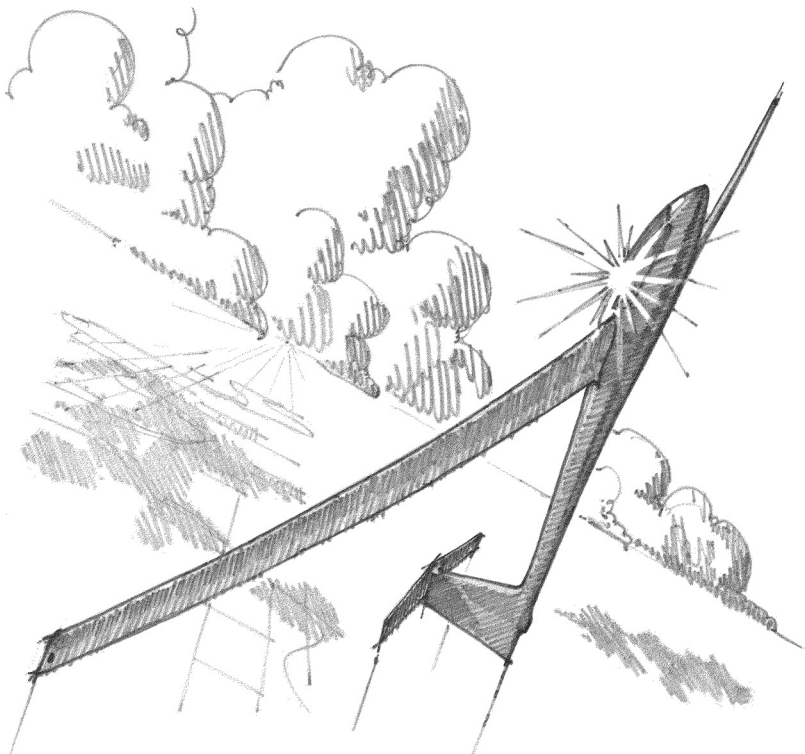

and learn to fly gliders

the official soaring instruction manual
of the Soaring Association of Canada

Edition 10

SOARING ASSOCIATION OF CANADA

L'Association canadienne de vol à voile

SOAR

and

learn to fly gliders

Edition 10

approved by the SAC

Flight Training & Safety Committee

Ce manuel est aussi disponible en français

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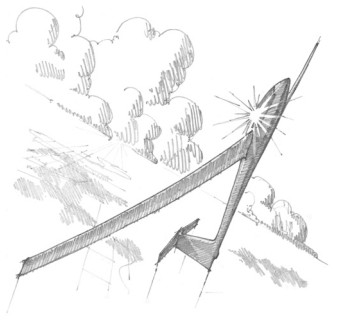

Edition 10

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ACKNOWLEDGEMENTS

FLYING TRAINING manuals are the distillation of many years' work by people in many countries, and they are no longer the effort of just one or two. However, I would like to acknowledge the contributions of the OSTIV Training and Safety Panel (TSP), chaired from 1998 to 2004 by Sakari Havbrandt (Sweden) and prior to that by Bill Scull (UK) since its inception in the early 1980s. The TSP's detailed look at various training exercises and methods over the years has given us useful updates to this manual. Indeed, without the international input from the regular exchange of ideas, the methods that we use could otherwise become stale and outdated.

I would further acknowledge the ideas and comments from several Canadian pilots, in particular Dan Cook and Gabriel Duford, who provided very useful and independent checks of the manual and its contents. To Tony Burton, many thanks for painstaking attention to the design and layout of this new edition, text details, graphics improvements, and additional comment on content.

Examinations of accidents to gliders provide us with 'Safety Bulletins'. Related training exercises have been amended accordingly in this and previous revisions in the hope that pilots trained with these materials will become aware of the pitfalls to avoid, and will have been trained to the latest standards.

OSTIV is the Organisation Scientifique et Technique Internationale du Vol à Voile. It has three technical panels: the Sailplane Development Panel (SDP), the Metorological Panel, and the Training & Safety Panel. Among other tasks, the SDP is responsible for the development of the international airworthiness standards for gliders (CS-22, was JAR-22). OSTIV publishes a journal, ***Technical Soaring***, together with the Soaring Society of America.

Ian Oldaker
chairman, OSTIV TSP
January 2007

Edition 10 of the "SOAR manual has been updated to reflect user observations and what has been learned since the last edition. We have corrected inconsistencies for alignment with our other training documents and it reflects safety improvements from lessons learned such as the importance of safety culture and the understanding of human factors. Again, working with the international organization of the Training & Safety Panel of OSTIV has been a great help with identifying better training.

Dan Cook, Chairman SAC Flight Training & Safety committee
August 2023

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FOREWORD

THE ART OF SOARING

THE FASCINATION OF FLYING has been with us for hundreds of years, but it is only within the last century that we have learned to fly. It is now so commonplace that we often take it for granted. If we can leave behind the bustle and pressures of modern life, the joys of soaring are not far away.

Flying in gliders, or sailplanes, as the high-performance models are called, has to be experienced to be appreciated. It is possible because the rising currents of air that support the glider enable it to fly at high speeds and to travel great distances. The record for distance now exceeds 3000 kilometres, and average speeds exceeding 100 km/h are commonplace in competitions.

> ***" I had never seen a sailplane close up before until I arrived at the gliderport. My experiences had been at the local airport watching and occasionally riding in a small powered aircraft. I only considered gliding as a possibly inexpensive introduction to my ultimate goal of a private power pilot licence. Twenty minutes later I was on an entirely different path! Just watch how a glider lands; nothing in the flying world swoops down so gracefully, runs along just above the ground seemingly forever, and then gently surrenders to the earth. Even birds just seem to arrive by comparison. I was hooked. I eventually also obtained my other licence, but if I had to choose between the two, there would be no hesitation. First and foremost, I will always be a glider pilot."***

The modern sailplane uses advanced composite materials and special construction techniques, though many venerable wooden and fabric-covered gliders are still flying; in fact, some excellent two-seat trainers were made of these materials in the recent past.

Gliders are carried aloft by thermals in most areas of the country. In mountainous areas in Alberta and BC, mountain lee waves can provide lift to over 30,000 feet, and ridge lift is to be found whenever the wind blows against a hillside. When the sun heats the ground, producing bubbles of hot air, they continually rise from the ground to form "thermals". They allow a glider to ascend at speeds exceeding 10 knots (1000 ft/min) at times. The glider pilot must circle within the thermal to make best use of the conditions, because the surrounding air will be descending! Having gained sufficient height, the pilot will set off to look for the next thermal, either to remain aloft locally or as part of an intended cross-country flight. Unfortunately, thermal soaring is practiced only in the summer, whereas ridge and mountain wave flying are possible almost all year. Surprisingly, wave flights are sometimes made from frozen lakes during the otherwise unsoarable winter months.

Most clubs offer glider pilot training. Club members can become instructors through the Soaring Association of Canada approved instructor training courses endorsed by Transport Canada, the licensing authority. People with the necessary aptitude will often learn to fly

gliders in one summer and, on passing a written exam, go for their Glider Pilot Licence. Next, they will work to increase their skills over many years of pleasant flying. A power pilot similarly can obtain a glider pilot licence quite easily, following a conversion course at one of the many Canadian clubs.

Read this book before and during your training to be a glider pilot. Read it now and review the different chapters frequently. Read other gliding books and take every opportunity to talk about gliding with your instructor and other pilots.

On the field, learning opportunities are all around you. Question your instructor on what any pilot is doing and how any situation is being handled. Closely watch the performance of other pilots and develop a critical outlook.

Prior to each of your flights, your instructor will first discuss and explain the exercises to be flown. Up in the air he or she will reinforce the explanations with demonstrations, after which you will practice the maneuvers. Full understanding may not come immediately but talking it over, if possible, in the air so that you can try again immediately, will speed your learning. Before you go solo, the instructor is "pilot-in-command" and, during your training, he or she will progressively hand over the reins for decision-making to you. However, while flying dual with you, your instructor has the final say at all times. To many of us, learning to fly is an entirely new experience, so don't be slow to ask questions; communication is a two-way street.

Having learned to control a glider you can now learn to fly well and efficiently and make the glider do what you want it to do. Learning never stops. Avoid long intervals between flights otherwise you run the risk of forgetting what you learned on one flight before you take the next one.

Going solo for the first time is a truly exciting experience. It is the point at which you will have completed the early part of your training. It is fun to fly – fly often and enjoy it! The next stages are to work up to the licensing standard of the Soaring Association of Canada, and then to becoming a truly competent soaring pilot. Having obtained your glider pilot licence, how would you progress? How do you know what to do, what are the next challenges? There are local and national competitions, but well before this level of flying there are a series of international FAI badges that a pilot can obtain. These provide a measure of the pilot's abilities, and they recognize the achievement of progressively more difficult tasks. These badges begin with the FAI Silver badge that requires a distance flight of 50 kilometres, a gain of height of 1000 metres, and a duration flight of five hours.

However, there is a preliminary badge to this, the "Bronze" badge, administered by your club and described in Appendix A, earned following the extra skills needed for the Silver and higher badges such as how to carry out off-field landings.

Advanced accomplishments allow pilots to add "Diamonds" to their FAI badges, or to obtain recognition for flights exceeding 1000 kilometres! These badges advertise what level you have achieved and provide a means of gauging how you are progressing relative to other pilots. Badges are not for everyone of course, and you can enjoy the sport for its pure pleasure of flying and the joy of escaping this turbulent world for a few hours for a personal discussion with nature as you chase that elusive next thermal.

ABOUT THIS MANUAL

Learning to fly is a fascinating activity and has different appeals. While many people will approach flying from a technical point of view, there are many who regard flying as esoterically enjoyable, an activity that does not need technology. Despite this, the pilot must learn the appropriate mechanical skills and knowledge. These are the necessary means to an end, and increasingly the pilot will be able to appreciate the endless variations of the soaring environment, and to fly with inspiration and finesse rather than purely mechanical sequences or procedures. To enable you to become a competent pilot with a good understanding of the principals of flight, this manual has some basic explanations of the theory of flight. These are given in the chapters where the knowledge will be used, rather than in one chapter alone. The detailed theory of flight will be given at a ground school course, run by clubs, often during the winters.

The technical content of this manual is designed to give you a basic insight into how the glider flies and how it responds to the pilot's control inputs, without delving too deeply into the subject. Don't panic if you don't understand the explanations fully; this will undoubtedly come later, especially when you attend a ground school course, and after you have taken a few flights.

The chapters are generally written to first give a brief explanation of the maneuvers to be taught, and why and how the glider responds to the controls. This is followed by a more detailed discussion and explanation of the theory, which would be of interest to the more technically inclined people and to those who have a need for a deeper understanding. In fact, the glider's response is often very complicated, and people have written whole books on the subject. But this is a book about how to fly, and therefore we have attempted to keep the technical content within reasonable limits.

The instructor will demonstrate the maneuver in the air, after which you will be asked to practice it, so the manual explains how to fly the maneuver, and how it feels from the pilot's point of view. Other points to remember, for example about safety considerations, are included.

It is true to say that flying can be terribly unforgiving of the foolish. And nothing concentrates the mind so much as knowing that you are one or two minutes away from an off-field landing, and that you have no motor to climb away. Hence making the right decisions

becomes a paramount requirement. Decision-making and pilot judgement, which includes how an individual's personality governs their decision-making, are recognized now as a very necessary part of flying training. Therefore, the training curriculum includes Pilot Decision-Making (PDM) and Judgement Training.

Although you may feel that in everyday life you can make the needed decisions, it is true to say that when flying, decision-making takes on a whole new meaning. Therefore, the subject is covered fully in its own section and appendix and will be taught throughout your flying training.

Human Factors has become an important part of pilot training, as we realize that our performance, from an aircraft-handling perspective and about decision-making, is critical to maintaining a high level of safety throughout all our flying activities. Handling skills and knowledge of how aircraft fly, how to plan flights, the weather and so on, and knowing the aviation regulations is not enough. We need to understand how we as humans operate in and respond to stimuli and our environment, what affects how we think and make decisions; in fact we should have a good understanding of human factors and their ultimate effect on the safety of our operations. Appendix D discusses these factors in more detail.

The manual is divided into five chapters. Chapter 1 deals with the introductions to flying gliders and what you need to consider to prepare for flying. The early lessons are covered in Chapter 2. The following chapters cover more of the basics plus advanced topics, reaching up to soaring and cross-country flying.

During your practical flight training your instructor will give you Preparatory Ground Instruction (PGI), usually within 48 hours of each flight lesson(s). This is the theory you should have before the lesson to understand the context and outcomes. Ideally you would be attending ground school before or concurrently with your flight lessons, but this training is often given by clubs in the off-season months to prepare you for the Transport Canada written GLIDE exam. Most gliding students start their practical training before their ground school attendance. In addition, before each flight you will also receive a preflight briefing from your instructor about the aim of the lesson and any safety or human factors relevant to the lesson. Annex G contains a list of stages that will be used to make up your lessons. One or more stages may be included in a lesson depending on several factors, soaring weather being a major factor. Each of the stages in annex G has a QR code which will take you to the PGI for that stage so you may prepare for your next lesson the day or two before. An instructor will take a few minutes to review the material with you and answer questions before the flight. Following the lesson, you will receive a post flight debriefing. This is the opportunity to discuss with your instructor what you did right and what you can improve on. It is important to understand what you need to do to improve a skill, technique, or procedure before the next flight. Ask questions when you do not understand.

Becoming a competent glider pilot is your entry into a fascinating world of flying motorless aircraft that depends on nature and your skills to keep aloft. We hope that this book will help you achieve the goals you set yourself, and that your flying will include the right mixture of technical and artistic or aesthetic enjoyment.

The ASK-21 is a popular modern 2-place training glider, here at the Cu Nim Gliding Club.

CHAPTER 1 – PREPARATION FOR FLYING

IMPORTANT POINTS TO CONSIDER

S GLIDING FOR YOU? It may seem strange to start a book about learning to fly gliders with this question. Maybe you first asked, can I learn to fly? The answer here is almost certainly yes (you are, after all, reading this manual). However, you should know at the start that learning to fly gliders is a time-consuming activity. You will be asked to help fellow student pilots in handling gliders on the ground, and in launching them, and so on. Some additional information may be of help.

Some clubs teach student pilots during set courses lasting a few weeks; most teach whenever there is flying going on at the club. Instructors are club members who volunteer their time, so the instruction is free. You will of course be paying for the launch, either by aerotow or by winch, and the glider-flying fee. These costs are reasonable, as the glider consumes no fuel other than that needed for the launch.

The minimum age to obtain a Student Pilot Permit (which is required before you can fly solo) is 14. At 16 you can obtain your licence; this requires passing the Transport Canada glider pilot exam and flight tests at your club. Some clubs may suggest that you take an aviation medical exam.

The best time to learn to fly is when you are in your late teens and early twenties, while you are still in the prime of your learning years, though many pilots learn later in life. Beyond about sixty we can take a longer time to learn, we slow down and gradually become less able to handle sudden emergencies, so flight training this late is inadvisable. If you have concerns, try some flights with an experienced instructor and seek their advice whether pilot training would be a good idea for you.

You will be expected to help around the club with moving gliders and launching them, and with other jobs involving physical activity, so you will need to be reasonably healthy. You should not fly if you are taking over-the-counter drugs such as antihistamines that can cause drowsiness and upset a person's judgement and concentration. If you are taking a prescribed medication, find out from your doctor if it is compatible with flying. Pilots with colds are susceptible to breaking their ear drums if their nasal passages are blocked, so don't fly with a cold. The changing air pressure easily damages eardrums as you descend from a flight, though the effects will be less for a low tow and immediate descent. The pain can be extreme, and this will distract you from flying the glider. If one of the remedies to unblock your Eustachian tubes has been taken, it will also have partially blocked your ability to think decisively! Clearly, it is unwise to fly with a cold. Never fly when you are feeling unwell, even if you have taken ASA to lessen the feeling.

Reasonably good eyesight is needed for safety to see other aircraft in the air so you can avoid them. Glasses may be worn in most cases, but if a person has poor depth perception

or poor peripheral vision they will likely have extra difficulty with learning how to fly the circuit and to land. In some cases, these problems cannot be overcome, and the person will be unable to learn to fly. Discuss any possible problems with the club's Chief Flying Instructor (CFI) early on.

People who are physically disabled are often very mobile and able overcome their limitations. In many cases flying will be possible if, for example, the glider has a hand control for the rudder installed. However, any mechanical device or modification to an aircraft must be type-approved by Transport Canada, and the process requires a rigorous, time-consuming, and usually costly effort. The aspiring disabled pilot should first fly with a knowledgeable and experienced instructor who can assess the situation and determine the potential problem areas. One or two clubs do offer programs for the disabled; ask the CFI for details.

Pilots who are outside the range of average weights can be difficult to accommodate in gliders. In such cases discuss the situation with the club CFI. If you are a light-weight you can carry ballast, but there is a strict limit to how heavy you can be for a given training glider. Short pilots can have problems reaching all the controls adequately. Cushions may be used, but they must be firm to avoid inadvertent squashing and loosening of the lap belt and/or shoulder straps.

You are the best person to know your capabilities and whether you are fit to fly. If you have doubts and ask the question of yourself, you are probably unfit to fly. In this case stay on the ground and assist the other members as they prepare to get off the ground or, if you must fly, find a fellow member who will act as a safety pilot to go with you.

PILOT DECISION-MAKING

Pilot decision-making, or PDM as it has come to be known, is an important part of learning to become a good pilot. Making decisions is an everyday thing to us all, done even without thinking. However, it seems that when we get into an aircraft the common sense that we have learned to use on the ground escapes us, or we think it is inappropriate, or we simply do not know how to apply decision making in the air.

It is because flying is learned often when we are older that a conscious effort is required to ***think ahead and to make decisions***. It doesn't help either that because we are flying in the wide open sky, we often get the feeling that we do not need to make quick decisions. This is far from the truth of course as any wrong or late decision can be terribly unforgiving. Therefore, this training has been devised to assist us in developing a technique or method to plan ahead so that we can make those necessary decisions in good time.

The main purpose of this judgement training, therefore, is to add decision-making skills to our learning of the usual curriculum which includes mechanical or flying skills, the acquisition of the needed aviation knowledge and long-term flight planning techniques, and so

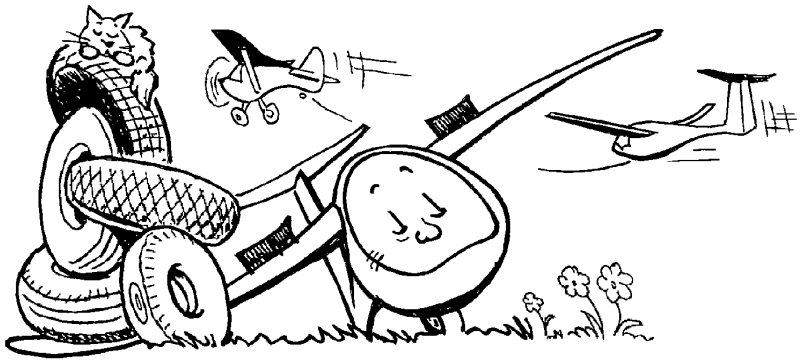
on. You will be taught how to become an all round and superior pilot by gaining the skill to make the right decisions, particularly when time is at a real premium, for example when landing.

This subject cannot be taught quickly; it has to be learned and practised often. It will appear in many flights at different times, but learn the basics now. Chapters 2 & 3 explain the process. It may appear a bit daunting at first, but it is surprisingly simple. As your training progresses re-read the manual to review the decision-making technique, it will be increasingly easy to use, especially if you practise the technique often.

GROUND & AIR OPERATIONS – GENERAL

In this section we talk about the way gliders are handled on the ground and how they have to be launched. They have to be pushed and pulled by hand and sometimes by vehicle. Getting gliders and their pilots ready is a team effort, and launching them requires the coordination of several people who know the signals and commands. Pilots depend on others to help get airborne, and this includes getting the gliders ready at the start of the day and moving them after landing. Move them always with safety in mind. Good ground operations are necessary to ensure the safety of pilots and bystanders. Points to watch for and learn early are:

- All aircraft get a daily inspection (DI) and positive control checks; you will be taught how to do it early in your training.
- Prior to each flight, pilots will perform a walk-around inspection of the glider to ensure that, for example, removable panels are secure or no damage has been sustained during the previous landing.
- Handle gliders ***carefully***, use lifting handles if provided, and never push on control surfaces. Be sure there are enough people available to help as ground handlers when gliders are moved.
- Park gliders well clear of take-off and landing areas, with the into-wind wing tied down or weighted. Leave air brakes out and any tail dolly off. Some pilots will leave their into-wind wing high, with the tail being prevented from moving sideways. But watch for a change in wind direction that could cause unwanted lift to be developed on this wing.
- When moving a glider, hold the windward wing low to prevent the wind from overturning the aircraft. Car tow ropes should be at least one wingspan long. Open car windows so that you can hear instructions. In high winds use extra people.
- Cars must be parked well clear of the flight line; there is no excuse for a glider bumping into a car! It has happened.
- Be aware of all aircraft movements. Remember that gliders are silent. Keep children under control, and keep dogs tied up.
- After landing stay with the glider until retrieve help arrives. After retrieve, the glider must be parked as above or the pilot must remain with the glider until the next pilot takes over. Gliders must never be left unattended on the flight line. They have been known to be blown over by a sudden gust due to a thermal departing from an adjacent field!



Park gliders well clear

- Canopies are fragile and must be handled carefully. Always close and lock a canopy when the glider is to be unattended. Hold it by the frame, not on the perspex, as finger marks will attract dust that cause scratches. These are an annoyance particularly when flying towards the sun.
- No confusion should exist as to who is holding the glider's wing. Use the words ***"my wing"*** when you wish to take hold of the wing or are asked to do so, and ***"your wing"*** when you wish the person at the other wing tip to take hold of it. Acknowledge that you have taken hold (when asked) by saying "my wing".
- When moving gliders around, also only use the words **STOP** and **GO**. The word "Whoa" sounds like "go", and "Okay" can mean either "yes" or "no", or anything else, so don't to use ambiguous words.
- Remove knots from tow ropes before flying. Be sure that the rope is inspected and has the correct weak link and release ring for your glider's hook mechanism.
- Winch launching cables are fitted with a weak link, parachute, length of larger rope and release rings. These should all be thoroughly checked prior to each launch by the person who will hook up, and shown to the pilot before doing so.
- Parachutes are used in most clubs. It should be put on and removed outside the glider. As with the glider, the parachute must be given a daily inspection.

GROUND & AIR SIGNALS – AEROTOWING

Although the signalling system will appear simple at first sight, don't assume that you have seen all of it. There are emergency signals and procedures that must be learned before a new person can safely help with the launch. To ensure you are taught it all, ask to have the ground signals and procedures demonstrated, and any special club rules explained. Practice them under supervision the first times that you run the wing.

It is usual to have two signallers, one who runs the glider wing and who initiates the signals; the other stands ahead and to one side of the towplane, and visible to the towpilot, who repeats the signals. This person normally stands on the inactive side of the runway. It is the ***glider pilot*** who is responsible for ensuring the take-off is safe. However, the pilot has to

rely on the signallers to ensure that the circuit is clear of any approaching aircraft during the initial part of the take-off. While the cockpit check is being done, the wing runner is responsible for searching for traffic ***above and behind*** which would make an immediate take-off hazardous. He or she should also check that the air brakes (spoilers) are closed and locked, and that the tail dolly (used by many gliders) has been removed.

The repeat signaller is responsible for repeating the signals given by the wing runner, for continual monitoring of the circuit for air traffic, and for halting the take-off should the situation demand. More specifically during signalling, the wing runner should look ahead for traffic, and the repeat signaller should look towards the final leg of the circuit. If either signaller sees a possible conflict with the pending take-off, they are to stop the take-off by giving the **STOP** signal (see next page).

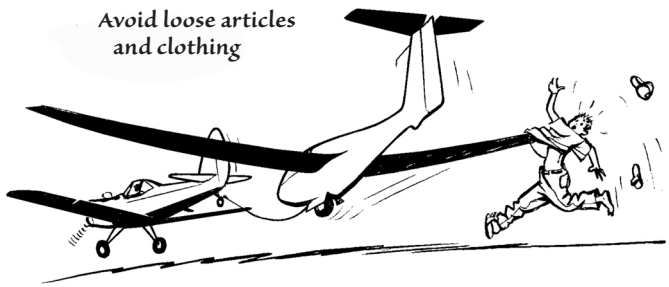
At some clubs the repeat signaller for the towpilot is not used. Note also that when initiating the take-off, some pilots will call, ***"Take up slack"*** when they give the thumbs-up signal, and will again call, ***"all out"*** when the rope is tight. Know the system in use at your club.

Take-off imminent When ready, the pilot will ask the wing runner, ***"All clear above and behind?"*** If clear, the wing runner replies, ***"All clear above and behind".*** As a double check, visually confirm that the tail dolly has been removed and reply to the pilot ***"check canopy and air brakes locked"?*** The wing is then raised, which is the signal to all that a take-off is imminent. Do not raise the wing if the circuit or take-off run is not clear. The same applies if the glider pilot appears to have any problems – for example, air brakes accidentally left open.

Take up slack The pilot will initiate the take-off by giving a clear thumbs-up signal as a visual command. The wing runner then waves their free arm in a 180 degree arc from side to side in front of the body below shoulder height. The repeat signaller repeats for the towpilot who taxies forward until the rope is tight. At any time the pilot has a safety concern, they can pull the release to stop the launch.

Running the wing The wing runner holds the wing lightly, being sure ***not to push or pull*** which might start the glider swinging. When taking off directly into wind the wings are held level. In a crosswind the into-wind wing should be held slightly low. At some clubs or with some aircraft other considerations may dictate that both signallers stand on a particular side of the runway irrespective of wind direction. Avoid loose articles and clothing that may catch on the wing, and run with the wing as far as possible. Wearing proper footware will help to avoid a tripping hazard. See also SAC wing runner training ***www.sac.ca /docs***.

Emergency stop The emergency signal used at gliding clubs in Canada should be directed to the pilots concerned. It is shout ***"STOP"*** and raise both hands above the head, with the palms facing forward; the arms are usually held motionless. There is also the international aviation signal for stop that omits the shout but includes wag the upraised arms slightly from side to side – the speed of the arm movement indicates the urgency for the stop. Remember both these signals because power pilots visiting a gliding club know the latter.



If the signal is given at any time by any person, the wing runner, repeat signaller, or nearby competent person must shout ***"STOP"*** and raise both hands above the head, with the palms facing forward; the arms may or may not be waved from side to side. This signal must be repeated by the towpilot's signaller (if he or she is not initiating the stop) and the glider pilot immediately should pull the release handle. The towpilot will immediately stop the towplane. The signal can and should be given to other power aircraft pilots, as appropriate. The air brakes not being closed and locked by the glider pilot or the tail dolly still being on the glider are examples of situations that must be carefully watched for prior to giving the ***all out*** signal. The wing runner, having noticed either of these conditions, must halt the take-off by shouting ***"STOP"*** and signalling the STOP signal at the same time.

Concept of the sterile cockpit

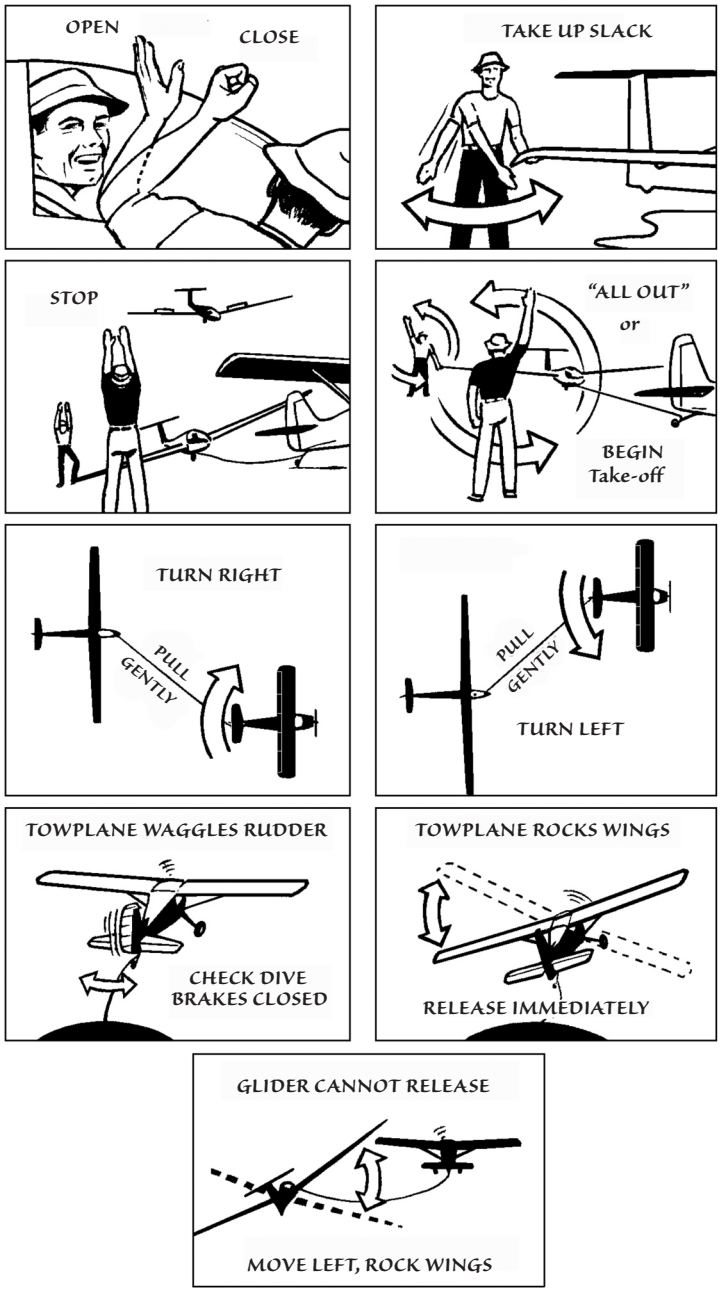
One of the major challenges in the take-off and landing phase of flight is the concept that distractions have taken away the pilot's attention from flying the glider at critical times where 100% of concentration needs to be on flying the glider. The pilot should put away any loose items such as maps, cameras, electronic devices in the cockpit that may move, fall down, or otherwise distract their attention. Reaching down for a fallen pencil, opening an air vent, or trying to close a canopy that pops open has been distracting enough to cause accidents. The glider pilot should have all the non-critical adjustments made before the take-off until release or the landing from the High Key area to stopping on the runway. This includes any non-critical discussion with passengers or on the radio.

Should a canopy open in the take-off phase the first response, as in any emergency, is to ***"fly the glider"*** and not lose control of the glider by the distraction. The next consideration is to pull release and land on the remaining runway ahead. Most often this will be the case as a bump or skid after lift-off has loosened a miss-latched, or forgotten to lock, canopy by mid-field. If landing is not possible if the remaining runway is too short to land on, then complete a tow for a circuit understanding the longer you are flying the greater the risk of losing the canopy completely or creating a towplane upset situation. The glider will fly with a missing canopy. At no time should the pilot's attention be diverted from flying to closing the canopy or trying to hold it closed until at a safe altitude, free of the towplane, and before the landing phase.

Wing runner presentation

https://www.sac.ca/index.php/en/documents-en/safety-and-training/resources-for-new-pilots/527-wing-runner-training/file

Standard signals given in glider operations



Note: These signals are often used in conjuction with, or in lieu of radio calls.

GROUND & AIR SIGNALS – WINCH LAUNCHING

A winch launching is very exciting, and the first few times you are launched by cable you will experience one of the thrills of the sport. It is widespread in Europe where towplane noise and the high cost of aerotow make winch launching more attractive. In North America we tend to have mostly aerotow operations which are popular for the versatility they offer. With the increase in cost of aviation gasoline however, the possibility of winching is being discussed by more clubs as an alternative to aerotowing.

Winch launching is used by only a few Canadian clubs, and their members continually talk of the speed and efficiency of this launch method. If you have joined one of these clubs ask to have the ground signals demonstrated, and any local club procedures explained to you. There are four methods of signalling to the winch operator which have been adopted and perfected over the years. The signals are given:

- by a painted paddle (eg. 0.6m diameter *"Day-Glo")* or similar signalling system,
- by a high intensity lamp or lamps controlled with a flashing timer system,
- by telephone, or
- by radio between the pilot and winch, making the launch process very simple.

The wing runner usually relays signals to a nearby signaller (or controller) who in turn signals to the winch. In some operations the signaller initiates all signals independent of the wing runner.

Take-off imminent

When ready, the pilot will ask the wing runner, ***"All clear above and behind?"*** If the approaches to either end of the field are clear, the wheel dolly has been removed, the wing runner replies ***"All clear above and behind"*** and as a double check, ***"canopy and air brakes locked"?*** The wing is then raised, and this is a warning to all that a take-off is imminent. Do not raise the wing if the circuit or take-off run is not clear. The same applies if the glider appears to have any problems, for example air brakes left open, or the cable being over-run by the glider. As in the aerotow, at any time the pilot has a safety concern, they can pull the release to stop the launch.

Take up slack

The pilot will initiate the take-off by giving a clear thumbs-up signal as a visual command. The wing runner then waves the free arm in a 180 degree arc from side to side in front of the body below shoulder height. The launch controller repeats the signal as follows:

- the launch controller will repeat the signal with the paddle,
- the launch controller relays the signal to the winch with a series of slow light flashes, or
- the launch controller repeats, ***"Take Up Slack"*** continuously over the telephone or by radio.

When the wing runner sees that the cable is tight he or she will give the "All Out" signal which is to wave the free arm in a full circle in front of the body. The launch controller then repeats this for the winch operator as below; the signals are continued until the glider wing is released:

- the controller will repeat the circling signal with the paddle,
- the controller will give a series of fast light flashes, and/or
- the controller will repeat the words ***"All Out"*** continuously by telephone or by radio until the take-off starts.

Running the wing

While the runner is running the wing the controller will continue signalling to the winch driver. At the same time the controller must monitor the take-off and, if there is any doubt about the safety of the take-off, the controller must shout ***"STOP"*** and signal STOP to the winch operator.

Emergency stop

The wing runner, launch controller or any nearby competent person shouts ***"STOP"*** and raises both hands above the head and with palms facing forward, the arms are usually held motionless, the same as for aerotowing. Some pilots may wave the arms from side to side, as in the international signal for STOP, in which the speed of the hand movement indicates the urgency for the stop. The signal is repeated by the launch controller (if he or she is not initiating the stop) and the glider pilot must pull the release immediately. The winch operator will stop the winch as soon as possible. The repeat signaller will:

- hold the paddle motionless over the head,
- give a steady white light signal, or
- repeat continuously the word ***"STOP"*** over the telephone or by radio, until the winch stops.

Some emergency situations which must be carefully watched for are: the cable becoming caught by the wheel or axle if the glider is snatched during the initial tightening of the cable, or air brakes appearing to be open (i.e. are not seen to be closed and locked) at any time during the launch.

Air signals to winch operator

If during the launch the airspeed departs from the recommended speed, the pilot should call by radio or signal to the winch if the speed is increasing towards the placard limit and/or is too fast. If the speed is too low and is decreasing (the winch operator has not recognized the low speed or responded immediately to a radio call to increase speed), the pilot should release.

Too fast The pilot first must lower the nose; this will reduce the loads on the cable and hence on the glider's wings, particularly at the top of the launch when the cable pulls more downwards on the belly or cg hook. Loads caused by gusts can become significant if the glider's speed is already high, and the weak link could break. The signal

for "Too-Fast" is to yaw alternately left and right using firm rudder movements while keeping the wings level. This is continued until the winch operator reacts or until excessive speed makes it necessary to pull the release. The pilot should lower the nose slightly during signalling, to reduce the angle of attack and hence the load on the glider's wings. See also the note below about the new winches.

The "Too-Fast" signal should be relayed to the winch operator during the early part of the glider's climb, as the operator may not be able to see the glider clearly due to the slope of the ground or due to heat haze. Therefore, using telephone or radio, the launch controller should continue to relay the "Too-Fast" signal until the winch operator responds and can easily see the signal themselves as the glider climbs into view.

Too slow The minimum recommended speed for modern gliders is often set at a minimum of $\mathbf{1.5V_{stall@1g}}$ (unless otherwise stated in the Aircraft Flight Manual) to ensure that the glider will develop sufficient lift and that there is a margin to allow for turbulence. If the speed is too low during any part of the climb, and it seems that the winch is not increasing speed, the glider pilot must already be lowering the glider's nose in response to the low speed. The "Too-Slow" signal therefore, is this lowering of the nose. It is usually readily seen by the winch operator. If on the other hand, the speed should approach the lower limit, the pilot must release and lower the nose quickly to the recovery attitude in order to accelerate to the calculated approach speed (height permitting) to carry out a recovery and landing. The pilot must assume that a cable break or winch engine failure has occurred.

New winches

There are some very powerful winches on the market that require a different piloting technique to maintain speeds within the recommended limits during a launch. These winches use either diesel or gasoline engines, or electric motors, and more often feature computer control to maintain correct cable tension for the type of glider. Using the latest synthetic cables, cable breaks are virtually unheard of while good launches are almost guaranteed depending, of course, on the pilot "getting it right"! Altitudes based on 60% of cable length used are achievable with simpler operator training . Using a second smaller recovery winch, a launch every six minutes may be achieved.

Terminology

The terminology for the launching signals has been chosen carefully. ***"Take up Slack"*** is three words; ***"All Out"***, two words; and "Stop" is one word. Each command is quite different from the other two. Even if there is confusion about what command was given because it was difficult to hear, remember the ***number*** of words. Don't use different terms or variations as this would remove this useful backup.

CHAPTER 2 – THE EARLY LESSONS

FIRST FLIGHTS

Familiarization flights
When you visit a club for the first time, it is most likely to find out about the sport and to take a first flight. This will be with an instructor or experienced pilot who will be pleased to share their enthusiasm with you and to tell you about the club's operation. The flight will be geared to your enjoyment, and will depend on your previous experience. If you take up the sport and have not flown before, you will be called a beginning or "ab-initio" student – if you have a power licence your flying in gliders will be a type of conversion course.

Ab-initio student
The instructor will help you to be seated comfortably usually in the front seat of the glider for maximum visibility and comfort, and will explain briefly the instrument panel, and how the controls function. He or she will ensure also that you can easily reach and operate the controls. As the flight begins, the pilot will usually ask you to keep your hands and feet off the controls, so that you can enjoy and get used to the view as you take off and climb. You will notice the general lack of noise and vibration.

Your pilot will explain the highlights of the flight, and will point out the location of the airfield, towns, and other features to help with navigation in future flights. You may be asked to pull the release handle to let go of the towrope when the normal release height is reached. Once in free flight, the instructor may allow you to briefly handle the controls and to follow through as he or she flies the glider. You will probably notice that only small movements are needed to control the glider.

Power pilot
You may wonder about the lack of a motor; however, gliders land at slower speeds and are far easier to land consistently on the same spot using their powerful air brakes. Take a few seconds to become familiar with the controls such as the tow hook or winch cable release handle, airbrake lever, and wheel brake if fitted. You will notice fewer and different instruments. For example, the variometer (a sensitive rate of climb indicator) will usually have an audio output added to it. The airspeed indicator is usually a 1½-revolution unit, with the low speed end expanded. Flight directors linked to a GPS unit are increasingly used for navigation and flight recording.

Your instructor may allow you to follow through on the take-off and tow. If you are launched by winch, the instructor will do the complete launch before letting you fly; the climb attitude is very unusual! The handling of the glider will likely surprise you; roll rates are slow due to the long wings, and you will have to use the stick and rudder together to maintain well coordinated flight. Any application of roll will produce a strong adverse yaw, so insufficient rudder application when banking (perhaps not noticeable in power flight) will have the nose swinging from side to side as you roll from one side to the other. Once banked and

in a turn, the amount of rudder needs to be reduced and only a small amount applied in the turn direction, to prevent any skid.

The glider is more often flown closer to its stall speed than is typical for power aircraft, and therefore its control response is slower. Do not watch the instruments as much as one may in a power aircraft – we need to keep a very good lookout at all times, and must control the speed by controlling the ***pitch attitude,*** not by chasing the lagging airspeed indicator! We gain height in gliders first by circling at slow speeds in thermals, often with other gliders, so accurate flying and good lookouts are very important. Practice turns often on every flight while converting to gliders. Precise turns will also come in handy in turbulence conditions when approaching to land in a small field, when even a small aileron correction without rudder will cause a nose swing.

You will notice the smaller circuit pattern and the critical need to assess the effects of the wind and sink rate throughout the circuit as height steadily decreases. You'll need to vary the circuit pattern to account for the wind so that you can land on the chosen spot each time. The instructor may allow you to follow through during the approach. The flare and the hold-off prior to touchdown are closer to the ground and more nose-level than in a powered aircraft, though the glider is still landed at minimum energy. Your pilot will do a normal held-off landing, though this is not a fully stalled landing. Continue to fly the glider as it rolls to a stop on its single wheel. One wing tip will then settle to the ground – this may feel strange if you are in a high wing glider.

In your training in gliders, there will be many areas that likely were not covered in your power flying instruction. Keeping straight on the ground in crosswinds, flying slowly and accurately in thermals, selecting fields for a cross-country off-field landing, spin avoidance as well as full spins and other exercises are some of the items to be learned. Learn them well, and you will be well on your way to becoming a competent and safe glider pilot.

FIRST INSTRUCTIONAL SESSIONS

Getting ready

This is where your real lessons begin. The sun can be harsh under the canopy of the glider so make it a habit to wear sunglasses and a hat (but not a baseball cap because it restricts your view ahead and above). Wear suitable clothes such as a light jacket; it gets colder with height at about 2-3°C per thousand feet. In the fall, carry an extra sweater and warm footwear – feet are the first things to get cold on a glider flight. A visit to the toilet and having adequate but not excessive food and water before getting into the glider are good ideas. If the flight is only going to last a few minutes (for example in the evening) these preparations are not so urgent, but in the middle of the day, the above three items are essential.

However, before you go flying you will be doing several things, prompted by checklists, to ensure that the glider you will fly is ready to go. Equally important – is your own warm body up to the task? There's a checklist for that too … Your Personal Checklist.

I AM SAFE

I **Illness** Obviously no one should fly when ill, but there many more subtle indications that the pilot does not feel well and should not fly. For example, a pilot with a headache would be unable to concentrate fully on the flying. Being congested can lead to damaged eardrums and further infections; the pilot should consider carefully whether or not to fly.

A **Alimentation** Blood sugar levels should be maintained even more rigorously when flying than when on the ground. Low blood sugar can cause serious loss of concentration or even unconsciousness. Food poisoning is bad news for flying (most cases of incapacitation in flight are caused by gastrointestinal upsets). Water is essential for us to function properly, and in the heat of summer dehydration can rear its ugly head. Water must be available to a pilot during a long flight, but adequate water intake while waiting to fly is equally important.

M **Medication** Consider very carefully if you should be flying when you are taking any form of medication. Is it safe – why are you on the drug in the first place? Your doctor must tell you if the medication is flight-safe.

S **Stress** It is very important to remove all sources of stress before flying. Gliding is a very relaxing sport under most situations, but it can be adversely impacted if you come with pre-stress, such as ground-based worries or arguments with people. Emotional stress is distracting and can lead to mistakes and make flying dangerous. You probably should not fly – the safest option. Getting ready for flying in a stressful environment is not the best way to get a student ready for learning!

A **Alcohol** Alcohol and flying do not mix. Any amount of alcohol will affect coordination, and the effects multiply at higher altitudes. The regulation of twelve hours minimum abstinence from drinking before flying applies only to modest amounts of drink. The after-effects of a mild hangover can be felt longer than we expect and will have equally dangerous effects on one's flying abilities until the body liquid and chemical balance is back to normal. Cannabis can also impair for prolonged periods of time and must be abstained from 28 days prior to flying.

F **Fatigue & Familiarity** Being tired is not a good state to be in when flying. Beware of this trap and come for flight already well rested. Hypoxia, dehydration and cold or heat will compound this effect. The pilot should also be familiar and current on the type of glider they intend to fly and the maneuvers anticipated. All pilots are at higher risk flying an unfamiliar type despite their level of accumulated experience.

E **Emotion** Long term emotional stresses can have a profound effect on your judgement and decision-making ability – do not underestimate the effect. The death of a family member, depression, or divorce, for example, require a break from flying. Seek assistance as necessary and resume flying only after a period of recovery. This can take a few weeks to months.

In summary, if you cannot honestly say *I am Safe*, then do not fly.

Pre-flight and cockpit checks

Before getting into the glider, there are also some essential checks of the glider needed, so your lessons start with those.

A Daily Inspection (DI) will be done by someone in the club at the start of the day's flying. This should include a Positive Control Check (PCC) to confirm the controls are correctly connected and operating and a Critical Assembly Check (CAC) if the glider had been recently assembled. The glider is now at the flight line and you are ready to fly. You will be instructed how to do these checks as part of your flying training. Before you fly, a second safety check called a "walk-around inspection" must be done. It is possible that some damage may have occurred on the previous flight – hitting a runway marker for example (it has happened) or a hard landing. Look for things such as: all inspection panels in place, the controls are connected properly, and there are no obvious defects visible (e.g. skid/tailwheel damage, loose rivets, delaminated fibreglass, binding at aileron gaps or cracks near landing gear or air brake boxes). See that the tail dolly has been removed. With your instructor you should also check several other things:

- Before getting into the glider ensure that the take-off area is clear. Remove any obstacles, or move the glider to a better position.

- Is your clothing comfortable when you are seated, and is it suitable for the weather.

- Is the total weight of you and the instructor within the required limits? Install ballast weights if needed. If you are light, it is necessary to carry extra ballast to keep the center of gravity ahead of the aft limit; in fact, this last item should be automatic if you are a light person. Adjust the rudder pedals.

- As necessary, tell the towpilot your desired tow speed, release area, and altitude. Tow tickets or an App may be used at your club. Discuss with the towpilot any procedures you will use to deal with mitigating any changes to weather, equipment, or normal tow operations, such as the planned training exercises.

- If winch launching, ensure that there are no vehicles or people where the cable will fall after you release it at the top of the launch.

- Check that the weak link is serviceable and correct for the glider.

- Make a mental note of the wind direction and speed.

- Discuss and choose suitable options for what you should do in the event that the launch is interrupted. The launch could be prematurely ended by a rope or cable break, by the towpilot signalling to the glider pilots to release perhaps because of engine problems, by the winch failing or by the glider pilot who may decide to release if the speed is outside the limits. Decide now what you would do if you were still low down. You will most probably have to land in an unfamiliar spot on the runway ahead. Discuss and decide now the options for different heights and situations with the instructor.

Vital action checklists

The next checks to cover are the flight checks, sometimes called VITAL ACTION checklists. All points in these flight checklists are important and must be performed with care. To aid this, the checks have been formed into easily remembered words or phrases. Do these checks systematically so that you know that you have covered everything. If disturbed, start again from the beginning so that no check is accidentally omitted.

Pre-takeoff Checklist

CISTRSC-O (Sisters CO)

C	**Controls**	Check for freedom of movement over the full operating range. Are loose objects stored so they cannot get jammed in controls.
I	**Instruments**	Set Altimeter[1], check instruments, radio, yaw string free.
S	**Straps**	Tighten lap strap first, then shoulder straps. Can you still get full forward movement of control stick to mechanical stop?
T	**Trim and Ballast**	Trim function. If any ballast is in the glider, are pilot weight(s) within limits?
R	**Release**	Check it now for within reach after straps done up and freedom of movement and return to the closed position[2]. Have the rope connected only after you have completed all items of this checklist.
S	**Spoilers & Flaps**	Open spoilers/air brakes, check for freedom of movement and symmetry, then close and lock. Visually confirm open then closed on wing. Set flaps for take-off.
C	**Canopy**	Close and lock; then check physically, by pushing up on the frame, that it is locked. Is the yaw string free?
O	**Options[3]**	Here you must consider your options for the wind speed and wind direction if the launch is interrupted – a rope break, for example.

Notes:

1. Set the altimeter to the mandatory altimeter setting which is the height above mean sea level, not to zero (ground level). Set the altimeter to the field elevation if you do not have the current altimeter setting. For local flights only, the altimeter may be set at the airfield elevation.

2. Learn the type of release ring for your glider, and ask the assistant to show you the ring before you allow it to be attached. Never attach a rope or cable to an empty glider, and have it attached only when you complete the "O – Options" item of this checklist. The release should be tested under tension with the tow rope before the first flight of the day if it was not tested during the Daily Inspection (DI). Then verify again that the runway is clear.

3. The ***Options*** item is a reminder to review now what to do if you have to release the tow rope; for example, if you get out of position, are not airborne by a certain point, if the canopy opens, if you feel the glider is not responding correctly, a person or vehicle enters the take-off area. Also if the launch is interrupted (by an engine failure/emergency release by towplane /winch or cable/rope break) at a low height above the ground. It includes assessment of obstacles and any landable areas on or immediately adjacent to the airfield. Also assess wind speed and direction and how it will impact on your decision making. What do you anticipate you will need to do for crosswinds, an approach speed or directions to turn. A mnemonic to assist in this assessment is "are you ready to **WROLL**" (Wind, Release, Obstacles, Landable areas, Launch interruptions). You will develop these skills as your practical training progresses and your instructor will help you step by step as you progress from basic glider handling to dealing with contingencies.

After all checks are complete, verify again that the runway ***and the immediate area into which you will be flying after take-off***, are clear of obstructions and other potential traffic; this is your responsibility as pilot. Check the windsock for any changes, and call out to the wing runner, "All clear above and behind?" If you get the correct response, begin the take-off with the thumbs-up signal.

If you have ***the least doubt*** about the safety of the take-off, immediately release the tow rope and shout "STOP".

Release from aerotow

Pre-release check. At the release altitude the towplane should level wings and fly straight ahead in a normal climb:

S **Suitable** Confirm release area (height and distance from field OK, do not release if unsuitable – radio call to towplane)

S **Scan** Clear of traffic.

R **Release** Pull once when glider is pointed at towplane (soft release), visually confirm & say "rope gone" out loud. Psychologically, this will help you to remember to make sure the tow rope is disconnected from the glider before turning and confirms to your instructor who may not be able to see the rope.

Post release check The towplane should have turned left 90 degrees:

T	**Turn**	Right about 90 degrees (except when ridge flying).
T	**Trim**	Retrim after flying level for a few seconds while slowing to best L/D.
T	**Towplane**	Locate and confirm clear of towplane and other traffic, let the tow pilot know you have released by radio if they did not immediately turn left.
A	**Airfield**	Locate.
G	**Gear**	Put the gear up and visually check pictogram of the gear handle position is correct.

Checklist prior to performing stalls, rapid height-loss exercises, and aerobatics

It is important to carry out thorough checks before you do stalls, spins, or any other exercise that can lose height rapidly. The mnemonic is:

CALL

C	**Cockpit**	No loose articles, straps tight, canopy locked, side vents closed,
A	**Altitude**	Must be sufficient to recover above a specified minimum,
L	**Location**	Not over built-up areas such as subdivisions, towns, or an open assembly of people, or circuit patterns at the airfield,
L	**Lookout**	Make sure no other aircraft are close to you, either at the same altitude or more particularly below, by doing clearing well-banked **S**-turns. Make radio call to advise air traffic of air work planned.

Note: Steep linked turns (**S**–turns) changing direction by 90 degrees one way and back again 90 degrees, looking also below and behind are best, and should be done thoroughly.

Pre-landing checklist

Start the SWAFTS checklist before entering the downwind leg. As a new student pilot you may need some extra time to go over each item thoroughly, but aim eventually to go through this checklist quickly and efficiently.

Now fly the downwind leg at the best glide speed as a minimum if not stated otherwise in the Pilot's Operating Handbook. You should feel distinctly uncomfortable if your speed drops below this as your height reduces to about 800 feet above ground. See also the sections on flying the circuit in Chapters 3 and 4.

SWAFTS

S **Straps** Tighten up ready for landing as they may have become loose during the flight.

W **Wheel and Water** Lower the wheel and listen to the sound and difference in control feel and look at the gear lever with respect to its pictorial symbol or label to confirm the correct position of the wheel – that it is in the 'wheel-down' position and that it is locked down. Dump any water ballast.

A **Airspeed** Observe or estimate the wind direction and speed by looking at the wind sock (though this is not easy!) or smoke, etc., then calculate the appropriate approach speed; at Goal 2, increase to the calculated approach speed and re-trim as necessary (is the airspeed below the maximum for lowering the flaps?). Do not use flaps if the wind shear calls for an airspeed higher than the maximum flap speed.

F **Flaps** Check that the flaps are set correctly for the downwind leg, and later for the approach as required.

T **Traffic** Check for other aircraft in the circuit pattern or joining midfield, including power aircraft, check also for traffic on the ground and activity at the launch point. Make your radio call for downwind.

S **Spoilers (Air brakes)** Unlock, check that you are holding the correct handle, visually check they do open, then close and be ready to use them.

If you inadvertently grab the flap handle and don't notice (this can happen), then as you pull it and watch the air brakes, they will not open … Surprise! Close the flaps, and then switch your hand to the correct lever or handle, and again check the air brakes by looking at them on the wings. This should be done efficiently but quickly so that you may concentrate on the upcoming circuit and landing. Remember the aerodynamic feeling of this control.

the instructor through the student's eyes

PILOT DECISION–MAKING or JUDGEMENT TRAINING

Introduction

Pilot decision-making (PDM), is an important part of learning to become a pilot. While it would seem that we consider different options and then make decisions all our lives, for example whether to drive through the blizzard late at night or wait until the next morning, such careful weighing of choices seems to elude many of us when flying. This is particularly so when we are under the added stress of a difficult situation.

The purpose of judgement training is to add decision-making skills to the pilot's learning of the usual curriculum. This includes mechanical or flying skills, the acquisition of the needed aviation knowledge and long term flight planning techniques. By adding the skill to assess the situation, to consider options and, based on predictions of what will happen, to make good decisions particularly when time is at a real premium, you will have a good chance of becoming a ***superior pilot***. Though this sounds dry and uninteresting, learning the technique as it applies to flying is important, and it could save the day during some flight that you might make in the future. Is it worth the effort? Of course it is.

Benefits

The decision-making technique is surprisingly simple to learn. One of the benefits will be less stress on pilots especially when under a bit of extra pressure such as when faced with a low circuit and awkward approach. Therefore this will lead to safer pilots who will be thinking things through by considering different options and their consequences. These better pilots will then enjoy their flying more. While it may sound presumptuous to suggest that you can't make decisions, learning this decision-making process will enable you to evaluate options rapidly and then make the most logical, hence safe, decision. Not only will this achieve safer piloting but could help make your everyday decisions easier too.

A benefit that may be more difficult to perceive is that by using this technique you will acquire flying experience more rapidly than a person who is less focussed, and who flies around just for fun. The focussed pilot will be able to predict from previous experience what is likely to occur next, and hence to make the right choices more quickly and easily. Try to emulate this type of pilot and learn the technique; then you will be a safer pilot who will enjoy flying more, knowing what will happen next.

The 4–Step technique for making flight decisions

The technique is derived from Adaptive Management techniques that are used in making business decisions, and the technique serves our purposes very well.

1. The first step is to assess or to **See** the **Situation** as it exists now.
2. Next the pilot must evaluate and rate his or her **Options**.
3. Based on a predicted outcome the pilot must **Act** on one option.
4. This leads to a new situation, so the pilot must Repeat the steps, then **Re-assess** the developing (new) situation.

These four steps give us the easy to remember acronym – **S O A R!**

Learning the technique
Your instructor will start you early in your flying training with an introduction to the technique that you will be taught.

Starting with the first step, on an early flight you will be shown how to assess and to see your current ***Situation***. For example, on the descent towards the circuit entry area you will be asked to assess where you are relative to the club runway. How far are you from the club, what is your height above the ground, are you in an area of lift or sink and is it safe to continue what I am now doing?

As you begin to acquire some flying experience, so that you can predict what is likely to happen next, including what the aircraft might do, start to develop ***Options***.

A very important part of this process is to predict the outcome of each option. For example you are flying along … you have several alternatives: the first is to continue going straight, the second is to turn left or to turn right, or to decrease the speed, etc. Why turn left? … well there is a good looking cloud that way and you ***predict*** lift.

Acting on the best option
Which option should be chosen? Choose the option based on the perceived benefit to you, and on the objectives for the flight. These could be immediate or longer term, but safety must take precedence. In fact, a safety concern should often veto what might otherwise appear to be an acceptable option.

The question then, is: "What is the best option?" To decide, consider your goals, keeping ***play it safe*** foremost in your mind. Having chosen the option that provides the best benefit, you now have to Act.

A word of caution – when choosing which option to act on, be more cautious than the experienced pilot. As a low time pilot you may have the skills to do the basic flying, but you will not yet have acquired the judgement skills and anticipation skills that will be developed more fully by experience. There is nothing better than experience to teach judgement and anticipation skills, so fly often.

Repeating the process
The fourth step is a very important part of this process, and it is to ***Repeat*** the four steps. In this step you will be taught to see and assess the developing new situation. During this re-assessment, compare the results of your earlier decision to the predictions for that option. This builds up your experience. By analyzing and comparing earlier predictions, it becomes easier to make better predictions in the future.

In the above example, if you had predicted that the turn would take you to lift, but all you See is strong sink, (if you are very low) you must act fast to evaluate new Options, predict what will happen with each, then choose the best and Act on it! Then Repeat and Re-assess.

You have just read in a few short lines an example of repeating the **SOAR** steps, although it took two pages to describe them. Experienced pilots know they must make decisions in the air sometimes as fast as you read the above paragraph! By practicing the technique on each flight you too will acquire the ability to make quick and well thought out decisions that are based on all your flying experience.

Discussion
Other factors that must be considered over the different steps of this process are now discussed more fully.

The SITUATION – The 1st Step

Besides the important part of seeing the situation from the perspective of where and what the aircraft is doing, you must consider other longer term factors. These are important and are:

the ***Pilot***, the ***Environment***, and the ***Aircraft***.

First, the **pilot.** You may be tired after a rough four-hour flight, so make some allowances by deliberately saying, "I will begin to plan for my landing early. I will allow lots of time to think the situation through" and "I will think ahead and consider my safest options". Understanding yourself and your limitations as a pilot is a key item that we neglect too often in our flying. Remind yourself that as you get older your reflexes get slower, and your tolerance to heat and altitude, and to lack of food and water also gets lower. You must admit this, though you feel it goes against your ***macho*** image!

This leads to the second area to see and assess.

The **environment** is the weather, the wind, its direction (particularly when landing!), the temperature (too hot or cold and we don't function at our best), and the terrain (lots or little to land in, or we may still be at our comfortable home airfield). All pilots must assess these factors before they can make good decisions. We need to know if the wind has increased since take-off (stronger wind gradient?), to recognize that the selected landing area is tricky because the topography suggests that the ground has a slope to it, or there are trees on the approach, etc. A little extra time to think through and to plan the landing pattern will pay off. Too often we take it for granted that the same old circuit pattern, late decisions, and same speed will do. Accident statistics show they won't.

The third part of seeing and assessing the current situation is to think about the **aircraft** itself. We forget that this one has stiff or ineffective brakes, or that it is slow to roll compared to our own. We fly different types at times, to take a passenger, for example.

The aircraft factor should help us assess the total situation, "What is my condition? What is the environment doing? What can I expect the aircraft to do in response to my control inputs?" All this is in addition to the Situation as seen earlier by the pilot; height, speed, position relative to runway, other traffic, pilot fatigue, and our ability to make good and safe decisions.

OPTIONS – 2nd Step

After a few flights you will start to gain experience, giving you more ability to predict what will happen next. For example, you will know how you react to certain inputs such as the sensations of stalling, or what the aircraft will do next. You will develop local knowledge, such as where there is likely to be lift, or even to develop an ability to predict what the instructor's reaction will be to your flying!

Using this experience, try to predict what will happen for each **Option** you might choose. Each prediction must include an estimate of the benefit of choosing that option. These options are of course strongly geared to the objective for the flight.

The goal could be short term; for example it might be simply to stay up, or long term such as trying to maximize the speed around a triangle. Other objectives could be to avoid an outlanding, or perhaps to look good (in front of your peers) or better, to play it safe. As mentioned earlier, the option giving you the safest outcome should guide all your choices.

ACTING – the 3rd Step

Having chosen the option that provides the best benefit, you now have to **ACT**. You have been taught the flying skills to do this; however, as a low time pilot you must be more cautious than the experienced. If you are a high time pilot, remember that your reflexes slow down with age – what you might have got away with when younger will be ready to catch you out now! An example here is the older pilot who is very relaxed and makes late decisions about a cross-country outlanding. A strongly competitive pilot also can make this type of error. Late decision-making too often ends in disaster. So you **Act** on the chosen option. This immediately leads to a new situation, and this gets us to the fourth step in this process.

REPEATING the Process – the 4th Step

When we repeat the fourth step we should be examining the developing new situation. We must compare the results of our decision, to our predictions for that chosen option. This builds up our experience that then makes it easier to make more accurate future predictions.

Examples of situations to review

Several situations are presented in Appendix C. They have been chosen to illustrate typical situations that will confront you as an early pilot, learning the ropes. Examples are also given for the more experienced pilot who has become a bit complacent perhaps – thinking he or she can handle the developing situation. Review these and try to imagine yourself in similar situations. Review them later on during your training when they will mean more to you, when you will be able to relate more to the examples.

You could also make up unique flight situations, and think through the four step process as you imagine a typical flight. It is much easier to correct mistakes in your mind and when you are on the ground, than to get caught out in the air. This very powerful visualization technique is used today by athletes in many sports, so why not by us for our sport!

Human factors

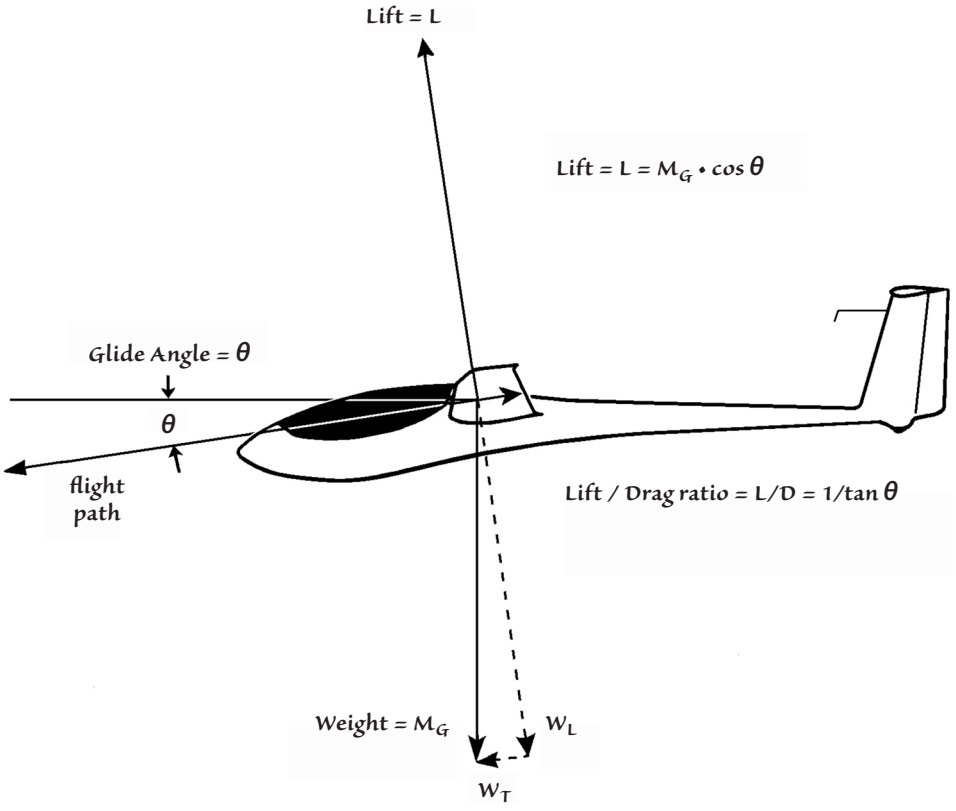
PDM and the SOAR technique that has been discussed here have been introduced to deal with many Human Factors that are critical to a pilot's situational awareness and judgement. See more on human factors in Appendix D. In stressful situations pilots have fallen victim to fixation, or tunnel vision, which has led them to indecision or ***paralysis of action***. This has often occurred when a control input did not give the desired response, or when a situation deteriorated faster than expected. Similarly, as many of you have been taught in defensive driving courses, it is best to have reviewed mentally what can go wrong and have predetermined some possible courses of action. It is not possible to have every situation identified but many articles have been written on this subject and, combined with the SOAR technique, you can be better prepared for the surprises.

A poor decision is better than no decision and a planned response is usually better than the first thing that does come to mind. Half the battle is knowing the risk areas and how you personally react to higher stress situations. If you do not do well when surprised, get better prepared and trained. Along with PDM there is Crew Resource Management (CRM). You are not alone up there if you have a radio. CRM includes other pilots, instructors, air traffic control (ATC) or Flight Information Centers (FIC) that are available to assist you if the situation allows. When in doubt, talk to someone.

All pilots are encouraged to conduct risk management. Even if a risk is assessed as low, you may still wish to mitigate it. For example, in the aerotow after release in absence of a standard procedure, discuss and be clear on what procedure(s) will be used. See also Threat Error Management Annex D Human Factors.

The high performance (L/D of 45 to 1) Duo Discus two-seat sailplane is used for cross-country training and passenger flights in Invermere, BC.

FORCES ON A GLIDER IN A STRAIGHT GLIDE



The weight may be considered as a force opposite to the lift (L), called $\mathbf{W_L}$, plus a force opposite to the Drag (D), called $\mathbf{W_T}$. Combined they give the Resultant Force = Weight = $\mathbf{M_G}$

The force propelling the glider forward is the force $\mathbf{W_T}$

Hence equivalent thrust = $\mathbf{W_T = M_G \cdot \sin\theta}$

[How can gliders fly without propulsion | The most complete explanation - YouTube]

CHAPTER 3 – THE BASIC LESSONS

CONTROL EFFECTS

How does a glider fly?
In this technological age, we benefit immensely as new glider designs and construction techniques give us faster and sleeker gliders; they are able to glide at extremely flat glide angles. How does a glider fly? What propels it forward?

The diagram on the facing page shows how the lift developed by the wings is inclined forward slightly. This is because the lift is developed at right angles to the direction of travel, and the glider is gliding ***down*** slightly, as shown. The weight of the glider is illustrated as a single force through the center of gravity (cg) acting vertically down. The weight can be shown as two components, one opposite to the lift, W_L, and the other at right angles, W_T. Taken together, these two components equal the total weight, W. The smaller component of the weight W_T, or thrust, is the force that propels the glider forward, and it equals the drag of the glider, D. You can see that if the glider is inclined more nose down, the component of the weight in the direction of travel increases, and the glider will therefore fly faster. In fact, it will accelerate until the drag equals the new value of the thrust, W_T.

The angle of the glide is the angle θ. The tangent of the angle is the ratio of the drag divided by the lift, in this case W_T/W_L. More conveniently, the inverse is called the L/D or the lift/drag ratio of the glider. This ratio is a maximum at just one speed, the speed for best glide angle (maximum L/D).

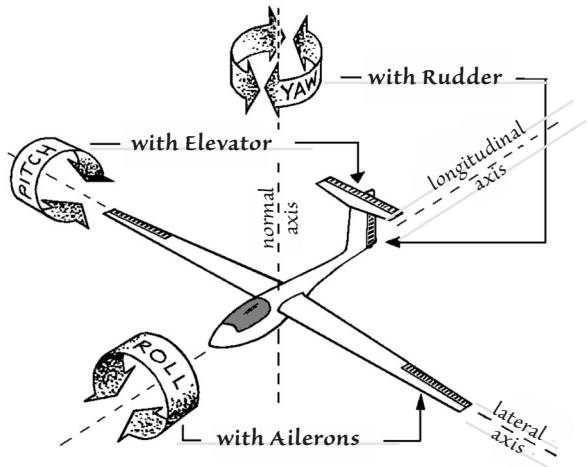
Introduction to the lesson
Some aspects of the first flying lesson may have been covered during your introductory flight, but it is a good idea to start here in any case. These first lessons will give you a good foundation upon which to base your later flying, so they consist of some careful explanations followed by practice (by you) to sense how the glider responds to control inputs. Some parts of these lessons may not be easy to grasp at first. Don't let this worry you, as there are many opportunities to learn these and other aspects of the art of soaring during your training to become a glider pilot.

In general, a glider's response is proportional to how much you move the controls and the glider's speed. In a glider that is flying relatively slowly, you can move the controls quite enthusiastically and the response will be fairly restrained. However, don't move the stick forward or backward too vigorously as you will likely surprise yourself; some gliders are very responsive to such a movement.

In your early lessons, you will learn the effects of the controls. This may seem rudimentary to those with aeromodelling and similar experience, but in the air things can look quite different and you need to experience the feel of the controls and the glider's responses to their use.

The movements of an aircraft

An aircraft can move in six ways; there are three rotary motions, and three translational motions or speeds. The rotary motions are PITCH, YAW, and ROLL, which act around the axes illustrated here. The three translations are vertical speed, lateral speed, and longitudinal speed. In addition to these rotational movements, aircraft have a number of attitudes: climbing, descending, level, and banked.



Effects of controls

Moving the control stick forward or backward operates the ELEVATOR. This produces a PITCHING motion around the LATERAL axis of the aircraft. The long term effect of moving the elevator to a new position is to change the longitudinal speed (or airspeed) and hence the vertical speed (or sink rate) of the glider.

Moving the control column sideways operates the AILERONS, producing a ROLLING movement around the LONGITUDINAL axis.

Pressing one of the foot pedals moves the RUDDER. This produces a YAWING movement around the NORMAL axis of the glider. It is important to remember that the rudder is usually used to control yaw so that the glider does not slip or skid. This is fully discussed under ***"Method of making a good medium turn"***.

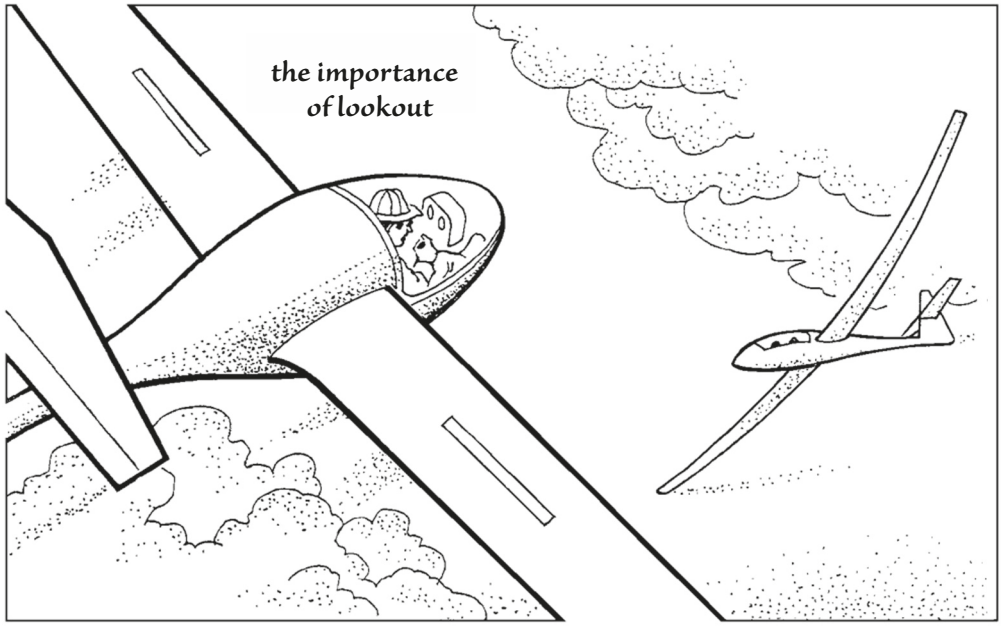
General considerations

Take time to become settled in for these first lessons; a comfortable sitting position will allow you to concentrate on the instruction. Make sure you can move the stick over its full range, and adjust the rudder pedals so that you can easily apply full deflection without fully extending your leg. Except at very slow speeds and in rough air, control movements should be relatively gentle; hold the control stick lightly in the fingers, though in rough air you will need to hold on more firmly. In fact, the instructor may refer to moving the controls as "applying pressure" to or reducing the pressure on the control stick or rudder pedals.

When moving the controls, look well ahead at the horizon, and see how the glider's nose moves as the controls are operated. The instructor will discuss these things with you and will first demonstrate an effect before you try it yourself.

The importance of lookout

Before doing any air exercises, especially those involving turns, it is vital to look around for other aircraft. As well gliders often fly much closer together than other aircraft, for example when thermalling, which makes keeping a good lookout even more important. Searching to both sides of the glider is necessary for the pilot to continuously keep a good lookout.



If you wish to turn right, for example, we can use a sector scanning technique. Start the lookout by focusing on the ***left*** wing tip, then look behind the wing concentrating mainly on the horizon where other aircraft will be at the same height as you. While looking behind the glider wing, keep your eyes fixed on a point for a second or two. Then anything moving in a very narrow cone of view will be seen. Now scan around to the front, pausing the scan every 20 degrees or so, looking along but also above and below the horizon, until you are looking to the front. Now take a good look above and below the horizon to the front for any aircraft. Then look to the right side and again focus on the wing tip, then look behind the wing (mainly along the horizon) and then scan to the front every 20 degrees also checking above and below the horizon. Scan well above the nose, and if all is clear look ahead over the nose to a point on the horizon, then initiate the turn.

Why do we search to both sides before starting a turn? Light aircraft typically fly at twice our speed and commercial or military traffic much faster, and an overtaking aircraft could come from the ***other*** side, that is from the side opposite to your turn. Therefore, make sure both sides are clear, and if the exercise will involve more than normal losses of height such as in stalling, also search ahead and below using the **CALL** checklist given earlier. In the sector scan technique, first look at the wing tips to correct for "empty field myopia", a condition where one's eyes focus at only about 1-1½ metres when at rest or when looking at a featureless area of the sky. The 20 degrees limit mentioned above is the field of view for the human eye to detect an object that is not moving – and an aircraft on a collision course will not appear to be moving! Pausing in the scan rate is to address limitations on our brain's ability to detect and process images while moving one's head or eyes.

Wear good quality sunglasses to correct for the blinding effect created by such strong light conditions and with little detail in the field of view.

Flying demonstrations

For these first lessons, the instructor will demonstrate each effect of the controls before letting you try it. Ideally the flight will be done under calm conditions so the movements of the glider will be from use of the controls; not the glider's response to any air turbulence, which can be confusing. Notice the amount of control movement during each demonstration; note that you will be unable to feel the amount of force or pressure needed to move the controls. When the instructor gives you control, acknowledge that you have control, then apply the same control deflection, and see the effects.

During these early exercises, look well ahead at a point on the horizon otherwise it will be difficult to gauge the glider's response and the attitude to which it moves, Once you stop moving the controls, you can direct your attention to other matters. Most gliders are stable and will fly ***hands off*** without changing attitude rapidly. This will allow you to relax a bit – you don't need to concentrate all your efforts on the flying only!

Your instructor will be exercising ***airmanship***, that is, keeping a good lookout and planning the flight to get back to the club at the right height prior to starting the landing pattern. Help in this task; you will eventually be expected to do this all for yourself, using the pilot decision-making technique, so start practicing now. Remember that the instructor is there to answer your questions at any time.

When **PITCHING**, the nose of the glider is raised or lowered relative to the horizon by small backward or forward movements of the control column. Look ahead over the nose and notice how much ground you can see. Move the stick forward, the nose pitches down, you can see more ground ahead and the speed increases – nose up, and you will obviously see less ahead and the airspeed decreases. LISTEN also – as the airspeed decreases, so does the sound of the airflow. The glider will fly at a certain airspeed for each pitch attitude.

The elevator controls pitch and therefore the angle of attack (the angle at which the chord line of the wing meets the airflow), and for each angle of attack, the glider has a corresponding pitch attitude and airspeed. To maintain a constant airspeed therefore, ***maintain a constant attitude***, and the glider will settle down to a constant speed. To alter speed, first change the attitude and hold it constant. Keep watching ahead, to maintain the view ahead constant and to look out for other aircraft. Now wait for the glider to adjust to the new speed that corresponds to that attitude.

Gliders are fitted with elevator trim devices such as a trim tab or a spring system in the control linkage to the elevator. These help the pilot fly at a selected airspeed without having to hold a constant pressure on the control stick. To trim the glider, maintain a constant attitude to fly at the selected airspeed, and then remove any stick force by adjusting the trim lever.

To turn, the glider is **ROLLED** into a banked attitude by using the ailerons and at the same time applying some rudder in the direction of the turn. The rudder is used to prevent ***adverse yaw*** (this is explained in more detail later), just remember that the ailerons and rudder are used together to start all turns. Judge the amount of bank by the angle made

between the top of the instrument panel (or sides of the cockpit) and the horizon. So long as the ailerons are deflected, the glider will continue to roll; the bank angle will continue to increase. This means that when the desired angle of bank has been reached the stick must be moved back towards the center. At the same time, centralize the rudder. To level the wings, roll the opposite way, applying rudder at the same time, and just before the wings again become level with the horizon, centralize the stick and rudder pedals again.

To **YAW** the glider, press one of the rudder pedals and notice the nose swing across the horizon. Now centralize the pedals again and you will notice the nose will tend to move back. During this maneuver the "yaw string", the wool tuft taped to the center line on the outside of the canopy, will be blown to the same side as the yawing motion, indicating that the glider is skidding sideways through the air. The ball in a slip indicator will move in the opposite direction to the yaw.

The rudder is mainly used to ***prevent*** the glider from slipping or skidding, by controlling any yaw. As explained above, it is usually applied simultaneously with the ailerons during rolling into and out of turns and during rolling maneuvers. In other words, it is used to control the aircraft so that it flies with the airflow straight along the body or longitudinal axis of the glider. This is indicated by the yaw string being straight up the canopy, or the ball in a slip indicator being in the center.

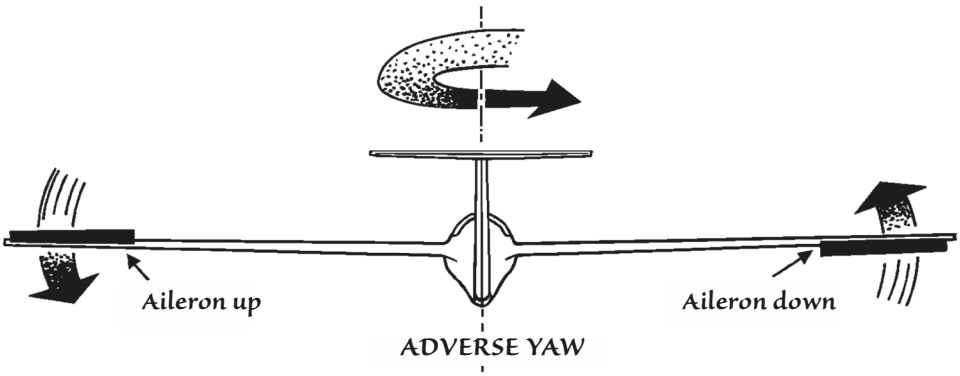
AILERON DRAG, GENTLE TURNS & STRAIGHT FLIGHT

We progress now to some more fundamentals of how an aircraft flies, how it responds to the movements of the ailerons, and how to make gentle turns – flying straight is actually one of the more difficult things to do well.

Aileron drag
Ailerons have two effects, they roll the glider, but at the same time they cause an undesired yaw opposite to the direction of the roll. Rolling into a turn to the left, as below, the aileron on the right wing will go down increasing the angle of attack of that portion of the wing. This produces more lift and more drag, and the extra lift causes the wing to rise. On the left wing the aileron will go up decreasing the angle of attack, producing less lift and drag. The increased drag on the right or outer wing of the turn and the corresponding decreased drag on the inner wing produce an imbalance of drag that will swing the glider's nose to the right, away from the intended direction of the turn. This effect, ADVERSE YAW, is caused by aileron drag and is prevented by using the rudder.

Air Exercise – Aileron drag and correction of adverse yaw

Your instructor will demonstrate aileron drag and the resulting adverse yaw by rolling the aircraft with ailerons, while she or he keeps the rudder centered. Notice that the nose initially swings in the opposite direction to that of the roll. The greater the rate of roll the



greater will be the amount of adverse yaw. The instructor will then demonstrate correctly coordinated rolling of the glider, first one way and then the other, using ailerons and rudder together. As aileron drag is produced only when the ailerons are deflected (when rolling), the rudder is needed primarily during aileron deflection.

Gentle turns

To turn an aircraft it is necessary to bank it in the desired direction of the turn, so that part of the lift of the wings is inclined inward. To initiate a turn, first perform a good look-out, then if the area is clear of other aircraft, roll the glider in the desired direction and simultaneously apply rudder in the same direction to overcome adverse yaw. If the rudder correction is accurate, the yaw string will remain pointing straight back, or the ball will stay in the center, showing that you are flying without slip or skid. Once the desired angle of bank is reached, stop the rolling of the glider by bringing the stick back towards the center, and because the aileron drag is no longer there, also centralize the rudder. In a continuous turn the angle of bank is kept constant by coordinated use of the controls.

The following exercise is designed to give you practice at this coordination. Continuous turns are not generally taught until you learn to make medium turns as discussed later in this chapter.

Air Exercise – Gentle turns towards a horizon reference point

A good speed to fly for this and many of the other exercises in this manual is the speed for the best L/D speed, which is about 45-50 knots in modern two-seaters. For this exercise, look at an object on the horizon and fly towards it.

The instructor will first demonstrate how to correctly roll into and out of gentle turns by doing a series of linked turns, so that the glider will essentially fly towards this one reference point. This is a very good exercise to practice aileron and rudder coordination. To judge how well you are doing, watch the yaw string to see how close to the center you can keep it.

As you roll into a banked attitude to make a continuous turn look well ahead to judge your attitude relative to the horizon. Keep your angle of bank constant by coordinated use of ailerons and rudder, and try to keep the pitch attitude constant (by using the

elevator); this will maintain a constant airspeed. Listening to the airflow noise also helps you to maintain a constant speed … and keep looking out for other aircraft.

Straight flight
To fly straight in a glider is not an easy exercise to do well because even a very slight angle of bank is sufficient to make the glider begin to turn towards the lower wing. To get back on course a gentle turn in the reverse direction will be needed. Making a whole series of small corrective turns towards the point that you have chosen is, in fact, the best way to fly straight in a glider.

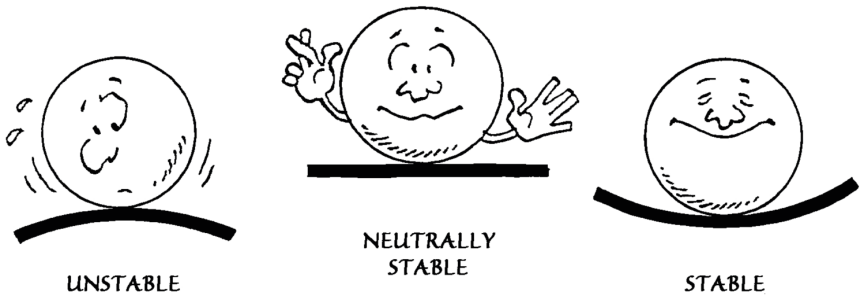
Air Exercise – Straight flight

Choose a point (upwind) on the horizon and fly towards it. As you deviate from your intended course turn back to it by using small angles of bank for your turns. You will notice that only very small, properly coordinated turns are needed to fly straight. If the glider will not fly straight it is often because one wing is slightly low. Sometimes this is because of turbulence, or you may have allowed one wing to drop a small amount. As you become more proficient, select a point across the wind so that as you fly towards it you will be ***crabbing*** over the ground. Not an easy exercise, but one you will find yourself doing increasingly as you fly cross-country, when you are able to do long glides between thermals, or an even longer final glide to home. As you descend to lower heights the visual effect of the wind will be much more noticeable.

STABILITY & FURTHER EFFECT OF CONTROLS

Introduction
Most small aircraft have built-in stability – if you disturb them from their flight path, they will tend to return to that flight path. Training gliders are generally quite stable and will resist the pilot's attempts to make the glider bank quickly, for example. The main points on stability are covered here to give you a general understanding of the subject and to know how this stability affects the glider's feel while being flown. Some situations that are unstable are discussed later.

Why is stability important? First, it would be very tiring to fly a glider that is unstable, apart from the twitchy feeling it would give. You will sometimes be bounced around by some turbulence, and a stable glider will be more pleasant to fly because it adjusts to the varying updrafts and downdrafts without the pilot needing to intervene. An unstable glider, on the other hand, will require constant control inputs. This is particularly noticeable in thermalling, when a well-designed glider is a joy to fly and you can often fly "hands-off" for some time while you drink or eat your snack – an important consideration on long flights. A knowledge of the forms of stability will aid you in your flying, to help give you a feeling of when and by how much you will need to make corrections. This knowledge will help improve your ability to fly slowly, and to make good take-offs and landings.



Stability

Any object may be in an unstable, neutrally stable, or stable state. The ball resting on top of a dome is ***unstable*** because immediately it is disturbed it will continue to roll, and will not return to its original position. The ball on the level surface is said to be ***neutrally stable***. If disturbed it will not try to return to its original position; it will eventually settle at a new position. The ball in the hollow is ***stable***, because even if it is disturbed it will return to its original position.

Types and combinations of stability

Any aircraft may be statically stable or unstable, dynamically stable or unstable, or neutrally stable. When a glider is disturbed in its flight path, it will tend to return to its original path if it is ***statically stable***, but it will continue to show a divergence from its path if it is ***statically unstable***. When the glider is ***dynamically stable***, it will gradually damp out any oscillations to bring it back to its original flight path, but these oscillations will tend to increase in magnitude if the aircraft is ***dynamically unstable***. A glider is said to be ***neutrally stable*** if, when disturbed, there is no inherent tendency to return to its original flight path nor is there a tendency to damp any oscillations that will neither increase nor decrease in amplitude.

Forms of stability

The forms of stability, in relation to the three axes of the aircraft, are Longitudinal Stability, Lateral Stability, and Directional Stability

- ***Longitudinal stability*** is the stability about the lateral axis, involves movement about this axis, and is the resistance to pitching motions of the aircraft. This stability is affected by the cg position and design features such as the elevator and trim systems. An aircraft unstable in this respect tends to continue a nose-up motion until it stalls, or a nose-down motion into a steep drive. Modern sailplanes are much more longitudinally stable than many older gliders.

- ***Lateral stability*** is the stability about the longitudinal axis. It involves movement about this axis, and is the tendency of the aircraft to bank or unbank its wings once disturbed. An aircraft which is laterally unstable would tend to continue to roll. In glider design, dihedral is most often used to provide lateral stability.

- ***Directional (weathercocking) stability*** is the stability about the normal axis. An aircraft with good directional stability, if disturbed, will try to correct any slip or skid (yaw) by flying head-on into the airflow, without slip or skid. The keel surfaces (vertical stabilizer, rudder and fuselage sides) give an aircraft this stability.

The concept of directional stability is an oversimplification because an aircraft will not move in each of the three planes independently. The yaw, roll and pitching motions are linked, and lead to what is known as ***spiral instability***. Different gliders vary considerably in their spiral instability. This instability is easily controlled by the pilot, otherwise it would be tiring to fly for long. This stability is discussed more under ***"Further Effects of Bank"*** later in this section.

When a glider is properly trimmed, and when it is flown with hands and feet off the controls, it will continue to fly steadily on its own; because it is inherently stable. As you can see from the different forms of stability, most gliders are designed in such a way that they will try to fly straight, with no slip or skid, and at a constant airspeed; and they will most often try to return to this condition. This holds true also for well-designed gliders when turning; when properly trimmed, they will maintain a constant speed and bank angle in a turn with little pilot input.

Air Exercise – Stability

Your instructor will first trim the glider to fly hands off, at a constant airspeed. Notice that when disturbed with a very small forward or backward movement of the stick, the glider will return to its original trimmed attitude and speed after only one or two oscillations. You can try larger disturbances to investigate how stable your glider is, and how quickly its longitudinal stability will return it to its original speed.

Weathercocking or directional stability is most easily seen by looking at an object on the horizon and noticing how the nose yaws to the side of this object as a small amount of rudder deflection is applied. The rudder has to be centred again straight away (to avoid any further effects, but see later), and the nose watched to see it yaw back again. This yawing motion is, of course, caused by the effect of the keel surfaces trying to remove the skid, or slight sideways movement through the air.

Lateral stability is not easy to see. It is difficult to get a pure rolling motion without aileron drag; also there is an aerodynamic coupling between yaw and roll which produces the spiral type of motion mentioned earlier.

Further effects of rudder

Although the rudder is normally used to control or prevent adverse or unwanted yaw when turning, it may be used as a primary control input to produce yaw. When the rudder is used to produce a yawing movement, with the ailerons being held in their central position, the glider will soon begin to bank. This banking starts because during the yawing movement one wing advances faster than the other thus generating more lift. If the rudder is now kept held to that side, an outward skid begins to develop. The dihedral of the wings (which gives the aircraft its lateral stability) now produces a larger angle of attack on the

outer or higher wing, and therefore more lift is developed by this wing than by the inner wing. The rolling of the glider therefore continues to a steeper angle of bank. This is known as the "further effect of rudder".

This effect can be useful when the glider is moving slowly, for example at the start of the take-off run when the ailerons are not yet very effective. But if flying very near the stall speed, using the ailerons could increase an already high angle of attack on the lower wing. This could cause the wing to stall over the aileron, which could then initiate a spin. This is an undesirable situation for any pilot to get into, most notably when on the final turn before landing, when an adequate speed must be maintained! So, if a wing drops when flying slowly, first lower the nose to pick up a bit of speed, then use coordinated control inputs to level the wings in the normal manner.

Air Exercise – Further effects of rudder

Fly at the normal speed at which you practice air exercises and apply rudder one way while holding the ailerons centred. Only a small rudder deflection is needed to begin the banking tendency. Keep the pitch attitude constant by usual use of the elevator. Try banking first one way, then the other finishing with the wings level. On some gliders the airspeed indicator will not correctly show the speed while the glider is skidding, hence speed control during this exercise must be by normal reference to the horizon and the glider's pitch attitude relative to it.

During this exercise you may notice that the glider's motions feel rather strange. This is an unusual situation for the glider as it is normally flown in a coordinated fashion. When flown as above with even a small amount of skid, the sensation is one of sliding to one side. If an exaggerated amount of rudder is used this sensation can be quite strong. Later in your flying you will be reacting to this "seat of the pants" sensation to correct what you feel, without the need to use any instrument or even the yaw string to tell you that the glider is slipping or skidding.

Further effect of bank

Let us return to thinking about banking, in the demonstration of the "further effect of bank", sometimes called the "secondary effect of ailerons". It is ***not*** aileron drag, which was covered in the previous section of this chapter.

Imagine that we roll to a banked attitude, and that we use the rudder correctly to prevent adverse yaw, but then return the ailerons and rudder to their neutral or central positions once we are banked. The glider will begin to slip inward as the increased drag on the upper, faster moving wing yaws the glider away from the direction of the bank. As the aircraft slips the directional or weathercocking stability will try to remove this slip by yawing the glider towards the lower wingtip. It is this yaw that is called the further effect of bank. It is only indirectly due to the ailerons used to bank the glider. Again, it has nothing to do with aileron drag.

This exercise will demonstrate the fact that to fly a continuous turn correctly, all controls have to be used, and that if left to their own devices most types of glider will eventually

go into a spiral dive with both airspeed and angle of bank increasing. This is because of the aircraft's inherent spiral instability. However the speed and bank are easily controlled normally.

Air Exercise – Further effect of bank

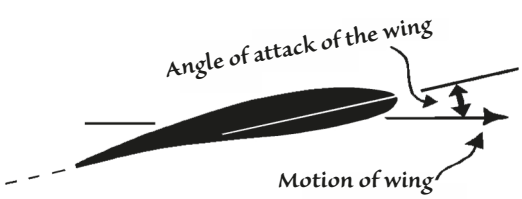
This is best done in very calm air because small amounts of turbulence can disturb the glider sufficiently to make the demonstration difficult to see well. The instructor will roll to an angle of bank of about 20 degrees and will then centre both the rudder and control stick, and then will allow the glider to fly hands off, to let the glider fly by itself. In most trainers in calm air the further effects of aileron described above will then be seen. Notice initially this yaw towards the upper wing tip. As the speed increases, the angle of bank increases and the glider will tend to yaw more towards the lower wing. Recovery is made by rolling out of the turn with ailerons, using the rudder to prevent adverse yaw in the normal way.

SLOW FLYING, GENTLE STALLS & RECOVERY

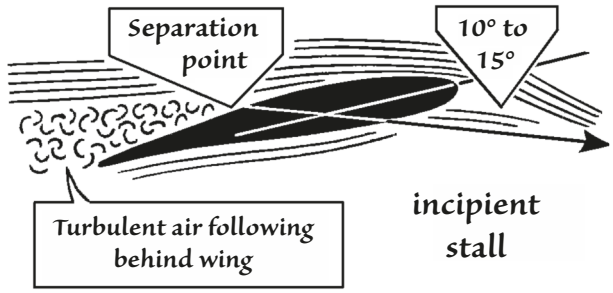
This lesson deals with the first type of flying situation where a recovery action is required. Because we fly gliders slowly much of the time and therefore at speeds close to the stall, we need to know how to prevent a stall and to recover easily from a stall, by lowering the nose, and then returning to level flight.

The stall and its indicators

For a glider to fly, the wing must produce lift equal to the load it must support. The lift produced by the wing depends upon the speed of the airflow past it, and the angle at which it is held to this airflow. When the aircraft is flying at normal speeds, this "angle of attack", is quite small. As the airspeed is decreased, the angle of attack correspondingly increases. At a certain point, the airflow over the wing, instead of adhering smoothly to the wing, begins to become turbulent and to separate from the top surface, resulting in a loss of lift and an increase in drag. The nose will now pitch down, or drop, even if the pilot applies increased back pressure to the control stick. This is the stall. There is nothing particularly strange about stalling an aircraft and the recovery technique is simple. When we fly slowly, we constantly try to remain aware of the stall indicators so as to avoid this condition. Then if we inadvertently stall, we can recover quickly and correctly.



The wing will always stall at the same angle between the chord line of the wing and the airflow, i.e. at the critical angle of attack. For most airfoils this angle is 15-20 degrees. Don't confuse the angle of attack with the angle at which the glider is flying in relation to the horizon (the glide angle), and don't confuse the angle of attack with the angle of incidence – the built-in angle between the wing chord and the longitudinal axis of the aircraft. Whenever the angle of attack exceeds the critical angle the glider will stall, regardless of its attitude or airspeed.

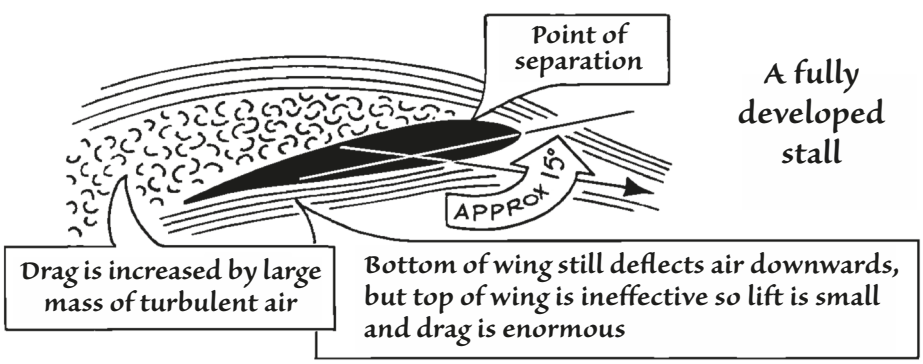


The speed at which the stall occurs depends on the load being carried by the wings; if the load is increased, the stall speed becomes higher. The weight at which a two-seat glider is flown does not usually vary a great deal, so in straight and level flight the stall speed will be more or less the same. If, however, the glider is being flown in a turn or in the recovery from a dive, the wings will have to carry an extra load due to the added g-force applied, and this will increase the stall speed. The indicators of the approach to a stall are:

- If the control stick is held further back than normal for any length of time, the glider will slow down and eventually it will stall; this can occur even if the nose is not above the horizon;
- An absence of noise, accompanied by a slower-than-normal airspeed;
- Ineffectiveness of the controls, i.e., the stick, even though it is being held back, will not raise the nose; also the ailerons will feel sloppy;
- An increased rate of descent and eventual nose drop, even if there is increasing backward movement of the stick;
- A buffeting or shuddering of the glider or the controls before and at the stall.

The recovery from a stall

All that is required to recover from a stall is to reduce the angle of attack until it is less than the angle at which the airflow becomes turbulent or breaks away from the top surface of the wings. That is, reduce the angle of attack to less than the 15-degree stall angle. Simply lowering the nose does this. This will happen automatically to some extent because, at the stall, the nose pitches down and the glider descends into a new flight path. The pilot must assist the reduction of the angle of attack, however, by moving the stick from its rearward position towards the centre. The recovery from the resultant shallow dive must be made in the normal way. Sometimes, if the glider is not flying straight, or has one wing lower than the other when the stall occurs, or if the air is gusty when the stall occurs, the glider may roll at the same time as the nose pitches down. This is sometimes



referred to as one wing dropping. If this happens, recover from the stall as above, by lowering the nose. Then when speed has been regained, level the wings in the normal way by the coordinated use of the stick and rudder.

At the stall, using the ailerons to level the wings before lowering the nose may be quite ineffective, or even have the opposite effect to that desired! This is because if you lower the aileron on the down-going wing you will, in effect, increase the angle of attack of that part of the wing. Hence, because it is already stalled, any residual lift it may be producing is further reduced and the glider will continue to roll. Therefore, do not use the ailerons to level the wings until normal airspeed has been regained and the ailerons have become fully effective again.

Air Exercise – Slow flying

First your instructor will demonstrate some slow flying to you as you follow through; the instructor will point out the indicators of the approach to the stall as the glider is flown progressively more slowly. Then you will be asked to watch for and to point out these indicators yourself, as you try some slow flying.

You will find that keeping the wings level is quite possible using the ailerons and rudder in the normal coordinated way, as you "mush" along at a high angle of attack. If one wing begins to drop rapidly, it is because it has stalled and you should lower the nose immediately to recover from this stall. If you do not start quickly, you may find the glider begin to rotate and begin what could develop into a spin. This is covered in detail later; this is easily preventable before the rotation starts by promptly lowering the nose to reduce the angle of attack and to recover to normal flying speed. As the speed increases above the stall speed, level the wings in the normal fashion and return to the normal gliding attitude, as before.

During slow flight, the glider will be, and will feel, distinctly nose high and the controls will feel ineffective, particularly the ailerons. In fact, it may feel uncomfortable to fly the aircraft this slowly. You will be holding extra back pressure on the stick, and after a while this too will feel uncomfortable. Nevertheless, it is important to increase your ability to react correctly to a stall and perhaps a wing drop (lower the nose). A few minutes each flight spent flying slowly will greatly improve your skill and confidence, and incidentally your ability to make good landings.

Air Exercise – Gentle stalls and recovery

To become familiar with the signs of an approaching stall, you don't need to do a stall! But you need to practice correct stall recoveries so you can regain straight-and-level flight with minimum loss of height. Before the stall exercise, use the **CALL** checklist, and really make sure no other gliders are around by doing a thorough search when you do the ***L – Lookout*** part of the check. Clearing **S**-turns are perhaps the most efficient for doing this search.

To stall the aircraft, keep reducing speed slowly. Note the indicators of the coming stall as the speed falls off. If the glider just flies at a high angle of attack and a high sink rate (look at the variometer), reduce your speed a little more rapidly, with the nose a little higher to produce an actual stall.

In normal flight the glider should not stall inadvertently unless the pilot has been inattentive and slowed without realizing it. A situation such as flying slowly on approach, especially when trying to stretch the glide, can lead you into trouble as you can be distracted from flying the glider by the desire to reach the field. In this situation, pilots can all too easily allow the airspeed to drop below the stall. Prevention is the answer here. If a stall does occur, an immediate recovery must be made. To recover from a stall, gently but firmly reduce the angle of attack by lowering the nose to unstall the wings, then immediately:

- Look ahead at the horizon to establish a reference (you may need to look up, as the horizon will be somewhat above its usual position relative to the front edge of the cockpit),
- Check the airspeed indicator that you are increasing above the stall speed, then
- Pull out of the dive. Note the height you lost in the recovery.

If one wing should stall first, that wing will begin to drop, and the glider could begin to rotate about its longitudinal axis. If allowed to develop, an incipient spin could start and, depending on the glider and its cg, this could be followed by a full spin. To avoid this situation, quickly start the recovery actions by lowering the nose. This will promptly unstall the wing and it will now produce lift again and further rotation will stop also immediately.

Complete the recovery in the normal way; level the wings with coordinated use of the stick and rudder once speed has been regained, and return to the normal gliding attitude by firmly pulling out of the dive. We used to say “ease” out of the dive, and this was enough for the older, low performance two-seater gliders. A balance between being too gentle and too firm will come with experience.

MEDIUM TURNS & BASIC SOARING

Introduction

To fly efficiently a glider pilot must learn how to make an accurate turn without thinking about it. The next series of lessons, therefore, will teach you some of the basic soaring skills. We progress in this lesson to the medium turn, and then teach how to use turns at medium angles of bank to get into and to stay in the centre of a thermal. Early flights will concentrate on basic turns but your instructor may take the opportunity suddenly to ask for a more continuous turn as you fly into an area of lift. You are soaring!

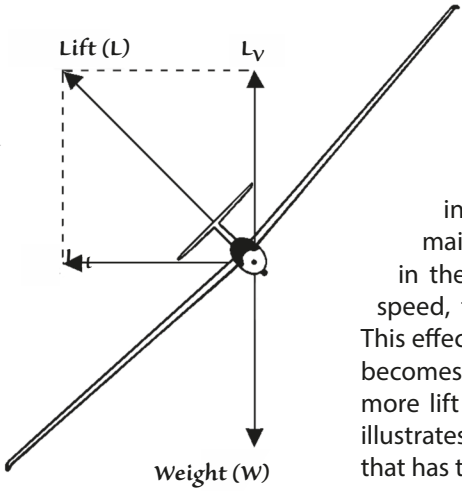
Definition of an accurate turn

An accurate turn is a change in direction at a constant turning rate and constant speed at a constant angle of bank, with no slip or skid.

Forces involved in a turn

To make an aircraft turn it is necessary to provide a force in the intended direction of the turn. Do this by banking the aircraft so that the lift, which acts at right angles to the aircraft’s wings, will be inclined inwards such that part of this lift will provide the necessary turning force. In the diagram below the vertical component of lift L_V will equal

the glider's weight **W**, while the horizontal component of lift L_H, or the centripetal force, will provide the necessary force to accelerate the glider towards the centre of the circle it is making. The greater the force L_H, the smaller will be the radius of turn. Hence, if it is desired to turn sharply, the angle of bank must be greater than when turning gently.



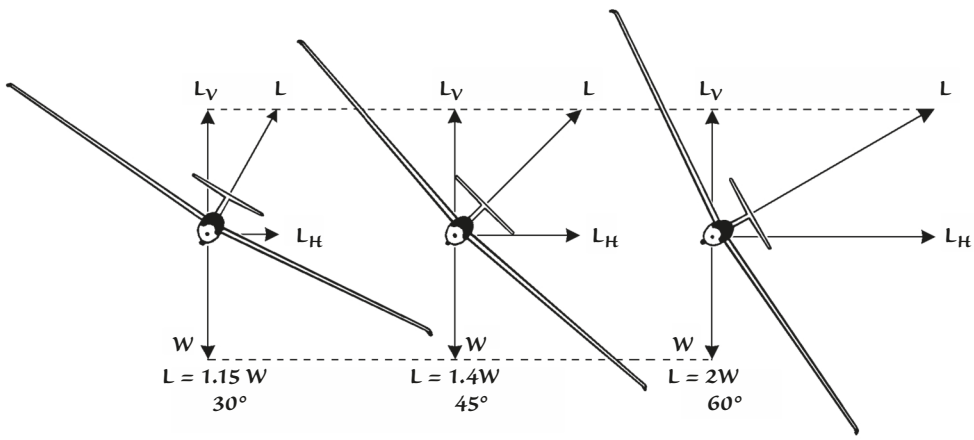
Since the Lift **L** must be sufficient both to support the aircraft and to provide the inward centripetal force, L_H , it must also be greater than that in straight flight.

Above a bank angle of about 60 degrees the increase in lift becomes very great. This increase will be achieved mainly by increasing the airspeed and by some increase in the angle of attack. Unless the pilot increases the airspeed, the angle of attack may approach that of the stall. This effect is not pronounced in medium and gentle turns, but becomes more important as the turn steepens. Therefore, for more lift in turns, increase the airspeed. The diagram below illustrates (by the length of the lift arrow **L**) the increased lift that has to be generated as the angle of bank is increased.

Functions of controls in a turn

Remember that each control has a definite function in a turn, and the amount of control input will depend on the speed of entry to the turn, the angle of bank that you will reach and the design of the glider itself. In all conventional aircraft the following functions apply:

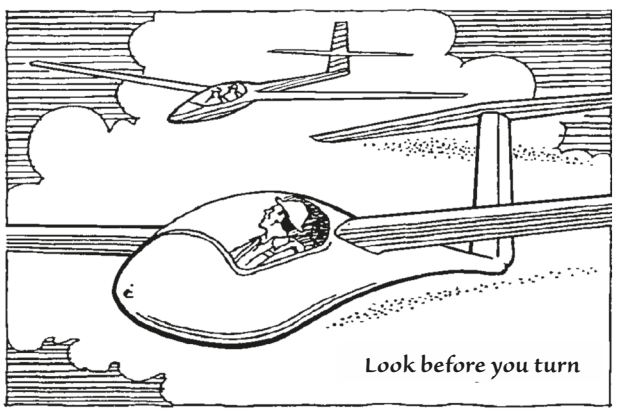
- The **Ailerons** (in conjunction with the rudder) control the angle of bank;
- The **Rudder** is used to prevent adverse yaw that would otherwise occur during the entry to and exit from the turn. During the turn it is used in conjunction with the ailerons, to correct any slip or skid; and
- The **Elevator** controls the angle of attack of the wings, hence the glider's pitch attitude in the turn, and therefore the airspeed.



To enter a turn, first increase speed as needed for the turn, then use the stick and rudder together to roll into the turn. Once the turn has started, the faster moving outer wing produces more lift than the inner wing. This means that you will have to prevent the overbanking caused by this extra lift of one wing. For small angles of bank and in well-designed gliders this effect is small. The outer wing also has more drag than the inner wing and this means that a small amount of rudder is required to counteract this effect. This is normal. This counteracts the extra drag of the faster moving upper wing, which would otherwise lead to a slight slipping of the glider. Remember that the rudder is mainly used just to correct for any slip or skid once the turn has been established. The elevator is used during the turn to keep the nose from dropping due to decreased lift sweeping in a steady path around the horizon, thus keeping the airspeed constant.

Method of making a good medium turn

The fully trained pilot coordinates the movements of the three controls so that he or she smoothly rolls into the turn, stays in, and rolls out again. It is difficult to do this well, but accuracy is the basis of efficient thermalling, so making accurate turns should be a prime goal in your early flying. With practice such turns are soon achieved.



Equally important is keeping a good lookout. A collision is more dire than a bit of sloppy flying. Look in both directions before turning and always keep looking for other gliders, particularly along the horizon and in the turn direction. The instructor's view from his seat is often restricted by the wings and your head and shoulders, so a good lookout is vital. Remember that gliders can be above and below, when you are close to others in a thermal, when ridge soaring and when "dolphining" with others on a competition or cross-country task. Circling gliders attract other gliders to their location.

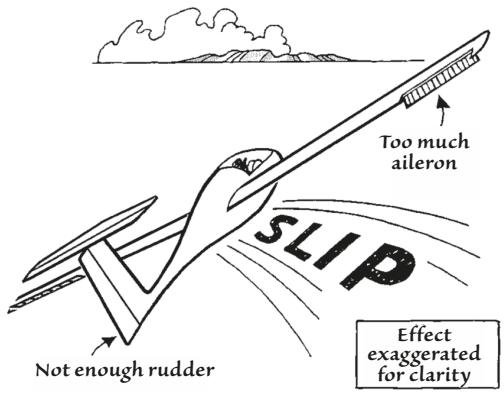
All these situations are made more hazardous if a wide-brimmed hat or cap is worn. They restrict the pilot's view, especially above – they should be left on the ground. By all means use a hat but remember that unrestricted visibility is very important!

***Air Exercise* – Medium turns**

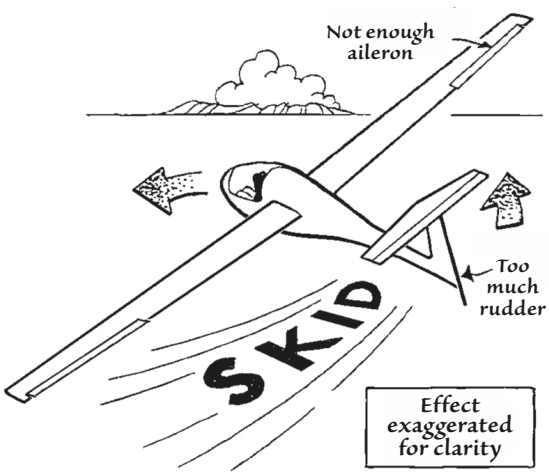
Rolling in Before you start, have a good look for other aircraft. Then make sure the glider is flying in a level attitude and at a steady safe speed. So, increase speed slightly now, before entering the turn. As an alternative, it is possible also to deliberately increase the speed as the glider banks into the turn; this is more difficult to do well, and requires a deliberate nose-down action as the roll into the turn is started. Complete your scan, then look ahead over the nose of the glider to the

horizon, then roll into the turn with firm aileron control inputs to a bank of about 30 degrees, using the rudder as needed to prevent adverse yaw. If you see the nose initially yaw away from the turn direction, you have not used enough rudder, and vice versa.

When you reach the desired bank, prevent a further increase by reducing the aileron and rudder deflections – in fact a small amount of 'opposite' aileron may be needed once you are established in a continuous turn. When you centre the stick, also centre the rudder as there is no longer any aileron drag. Look ahead in the direction of the turn along the horizon



Staying in Judge your bank angle by looking over the nose at the horizon (or by judging its position by reference to the surroundings) and prevent any tendency for the bank to become too steep. You will find that a small amount of rudder will be necessary in the direction of the turn to keep the yaw string straight (or ball centred). Too much rudder and the glider will skid; too little rudder and the glider will slip.



To help keep your angle of bank constant, keep looking at the horizon and try to judge the angle that for example, the instrument panel makes with it. If continuing to circle, retrim the glider to take back pressur off the stick and reduce workload.

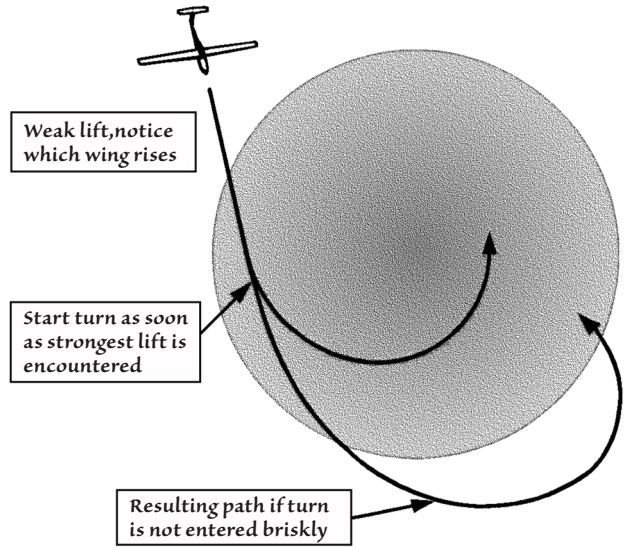
As was discussed earlier, you will find that to keep the speed constant and therefore to maintain the attitude of the glider constant, a small amount of back pressure will be required on the stick. In some gliders you are able to remove this pressure by using the trim, as discussed earlier in this chapter.

Rolling out Look around for other aircraft, particularly under the high wing. To level the wings look ahead over the nose of the glider to the horizon, roll out of the turn, simultaneously using the rudder to prevent adverse yaw. Relaxing the back pressure on the stick (or forward pressure if previously trimmed to stay in the turn) will be needed to prevent the nose from rising as the wings level. Re-trim the glider if it was trimmed to stay in the turn.

Thermalling – entering and centering techniques

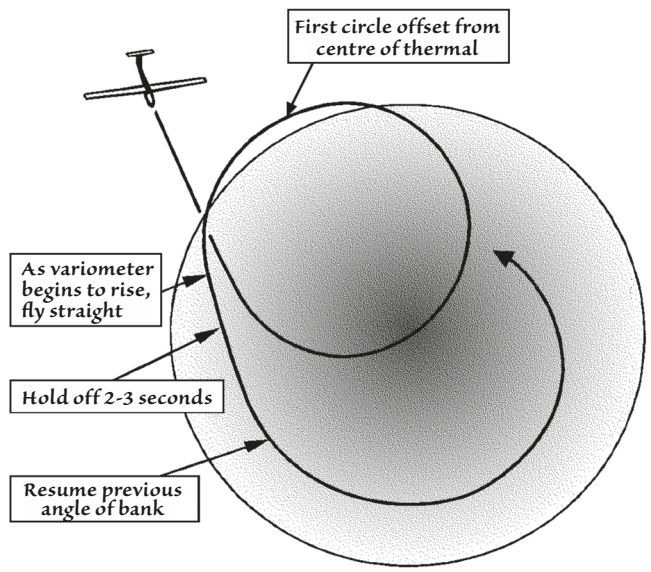
Imagine you are flying straight and level on a day with thermals. If you do nothing, the aircraft will neatly steer itself between the thermals, because one wing will usually be lift-

ed first, tilting the glider from the stronger lift. So, to steer into the thermal, carefully note which wing tends to rise as you encounter it and look around both sides for any other aircraft – only then initiate a turn towards the rising wing. Now make some mental note of a reference point below that will help you to visualize the general location of the thermal.



Because of the normal delay in a variometer's response, it may take 2 or 3 seconds for it to begin indicating lift. If you start the turn only when you see the strongest reading, you may already have flown through the strongest lift. Therefore, start the turn ahead of the maximum reading. Roll into the turn briskly or your path will take you out of the thermal again.

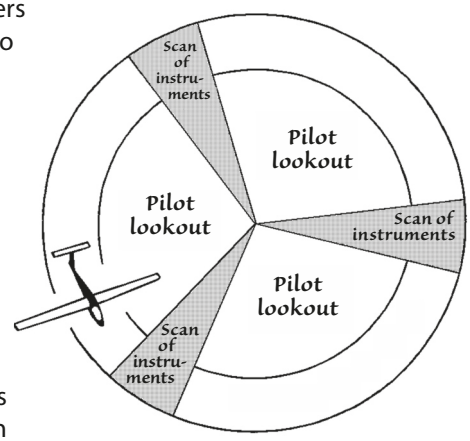
If your first circle is offset from the centre of the thermal, as in this diagram, you will notice a high variometer reading on one side of your circle and a lower reading opposite.



One thermal centering method shown here is simple to use and needs only medium turns to perform. As you continue to circle, wait until the variometer reading begins to rise, and then level the wings to fly straight into the area of better lift. Hold the straight course for 2 to 3 seconds; with experience you will be able to judge better how long to wait before resuming your previous agle of bank. It's easy to draw the diagram, but much less easy to see the thermal in flight (though it is easier to feel it in the seat of your pants as you enter). Constant looking out at ground or cloud references will help you visualize where the strong lift is, and to choose the direction in which to fly.

Collision avoidance while thermalling

The importance of keeping an adequate lookout while you are thermalling cannot be overstressed. An excellent way to do this is to imagine your circle divided into three segments as in the diagram, and divide the time of each segment into a short period for scanning the instruments, and a longer period for looking out. In this way you will get a good idea of the lift distribution in the thermal, and you will be able to keep an adequate eye on the other gliders who are flying either in the thermal with you, or who may come to join at any time. Remember that a circling glider most often shows where the lift is, in which case other gliders will want to come and join you!



A typical circle at medium angles of bank will take about 30 seconds to complete. An instrument scan will use 1 to 2 seconds, leaving 8 to 10 seconds for each lookout. This should be your goal for a minimum lookout period. This system lets you locate the best lift in the circle and allows a good search for any other aircraft, particularly in potential blind spots.

Blind spots are usually behind and also above you, in the area hidden by a peak on a cap or hat, therefore peaked hats are not approved. Use a hat that comes down over the forehead to protect you from the sun, but still allows adequate vision above.

Joining a thermal with other gliders

To enter a thermal with other gliders already circling in it; enter at a different height, circle in the same direction, and try to keep the other glider(s) always in view. If there is one other glider in the thermal try to keep it on the opposite side of the thermal, in line with your wing tip. If you must enter at the same height, do so initially outside the other glider's circle. Then slowly tighten your turn to enter the same circle, keeping the other glider in sight. Should more gliders join you, position yourself so the other pilots can see you easily. Leave the thermal immediately if you lose sight of a nearby glider and believe it is close behind.

Never assume that the other pilot has either seen you or will take avoiding action. Never deliberately fly closely under or over another glider, the pilot may not see you. Remember too that turbulence can quickly reduce any vertical separation.

See and be seen at all times.

Ridge soaring

Ridge lift is present along most hills, cliffs, and mountains whenever the wind blows against them. By flying parallel to a suitable ridge a glider can be kept airborne so long as the wind keeps blowing. In days past, many sites were hill sites, and the gliders were launched by winch, or more often by bungee, to join the others already airborne. When viewed from

the ground it often looked like a giant aquarium with the many colours and sometimes transparency of the gliders' wings adding to the spectacle. It was like an aerial ballet – one glider after the other, all turning at the same point, only to retrace their paths on the way back. It was a delight to the eye. Gliding was a true spectator sport with people often taking picnics for the day just to watch the action.

It is still possible to find hill sites but they are more used today for the start of a long, often world-record-breaking distance flight. It is on mountain ridges such as those in Pennsylvania that some truly spectacular distance flights have been made. Ridge soaring in Canada is confined to a few sites only, a typical one being in the Fraser River valley at Hope, BC where the mountains rise about 5000 feet above the valley floor.

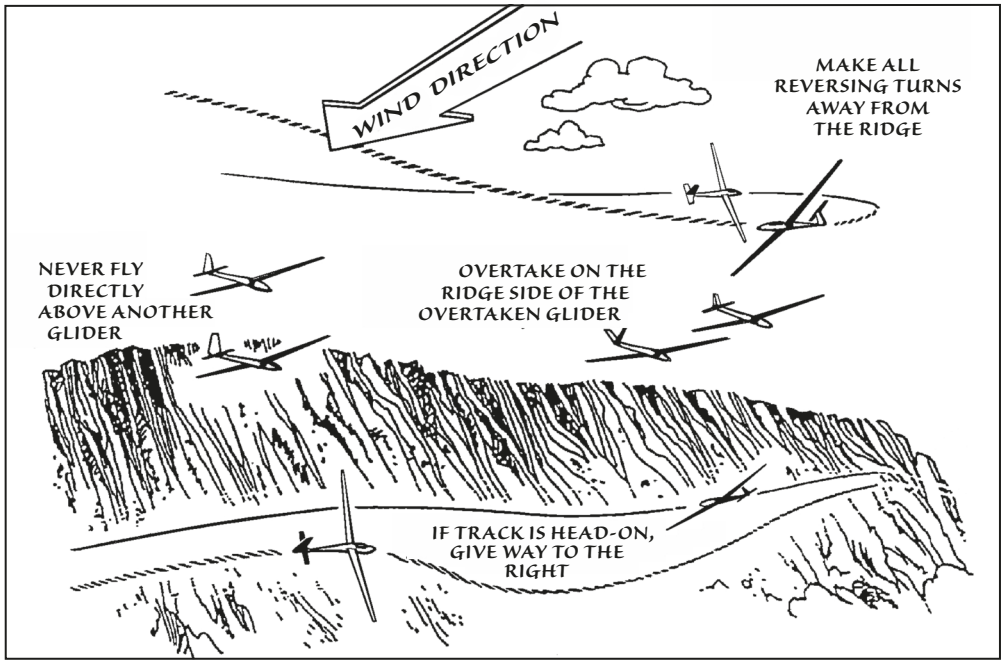
The question is sometimes asked, do ballet dancers collide? Do fish collide in an aquarium? Do ridge soaring gliders collide? Rarely, yes, but not nearly as often as one might think by the numbers flying together. How do they do it? They know the choreography, the rules of the slopes, and they obey them. Slope soaring is like a dance – everyone knows the next step and where the other person is going to go (as in line dancing!). The basis of the slope soaring rules, therefore, are self-discipline, courtesy, no surprises, and allowing the other pilot to know what you are likely to do.

But first, how do we organize ourselves on the slope to make best use of the lift? The technique is to fly parallel to the slope, crabbing into the wind slightly to prevent being blown into the hillside. At the end of the ridge or when the lift diminishes, the glider is turned away from the hill to reverse direction and to then fly back into the band of lift. The closer to the slope the more reserve of speed will be required to allow for turbulence and/or sudden changes of direction caused by the topography. This is very important to remember as the winds close to a slope are quite unlike the turbulence in open spaces, such as over flat land even when in a rough thermal. Besides which, the pilot in the thermal has a good amount of height to recover from an inadvertent stall or spin. Not so the pilot close to a ridge! So when the wind is anything over about 15 knots, increase your speed to at least 10 knots above the minimum sink speed and more if it appears more turbulent than normal.

These are the techniques to use when you are the only glider on the ridge. What about when there are others present?

The general ***"Rules of the Ridge"*** illustrated opposite are followed almost everywhere. However, local ridge rules are often used to account for special hazards, so make sure you know these. The standard rules apply such as when meeting head on; both gliders are to alter course to the right. And when turning on a slope, always turn away from the slope. When slope soaring, the glider with the slope on its right has the right to stay in the lift on the slope. The approaching glider with the slope on its left must give way by turning out to the right, away from the hill.

When two gliders are on a converging course, the glider on the right has the right of way. The glider pilot who sees another glider on his or her right must alter course by turning to the right, and then may align his or her glider behind the other glider, for example to stay on the slope.



When on a slope, it is extremely dangerous to fly in circles, or to do steep turns or aerobatics. To ensure a good lookout, it is essential to look at least 100 to 120 degrees behind you before starting a turn. Then when it is clear, start the turn and after about 90 degrees of the turn look to the slope and only complete the turn if no other glider is nearby. If there are several gliders on the slope and the turn cannot be completed with the required separation, fly out from the slope.

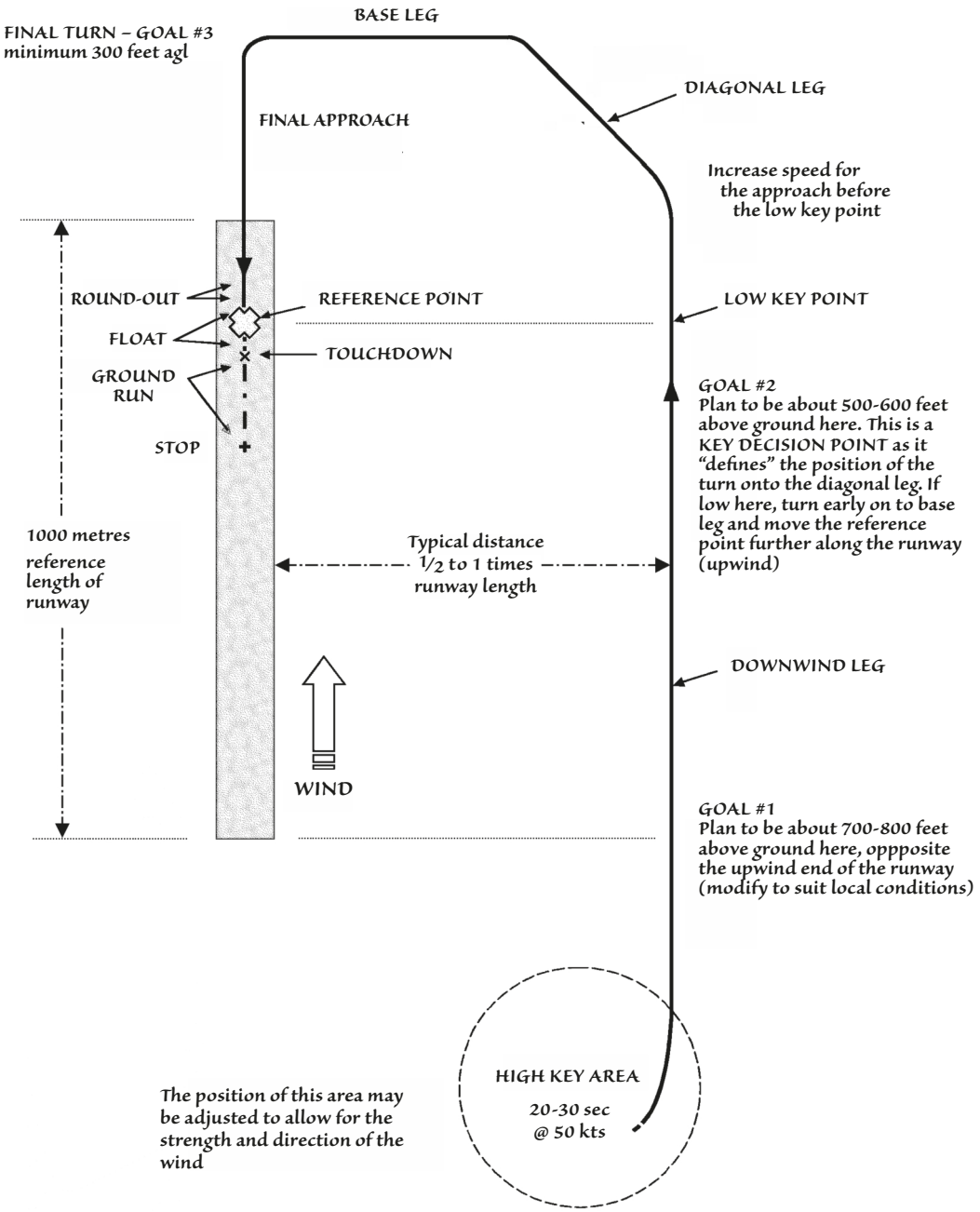
Finally, in a defined slope pattern, it is dangerous to break up the pattern, to turn before the turn point or to cross the path of a glider that is at the turn point. When following another glider at essentially the same height, wait until the one in front turns before starting your own turn, and then leave the slope pattern only at the turning points.

THE STANDARD CIRCUIT PATTERN

A good circuit pattern is a vital prerequisite to making a good landing. Therefore a basic circuit shape has been adopted, primarily as a safety measure, because it allows pilots flying locally to know what to expect as they approach to land. There are two common patterns.

The first and older pattern starts with a crosswind leg, followed by a downwind leg, a base leg and a final approach towards the runway – a basic rectangular pattern. The crosswind leg may be omitted at some gliding sites. The newer pattern uses a diagonal leg (or cut-off) between the downwind and base legs of the pattern. The benefit of the diagonal leg is that the distance and downward angle to the landing area will continually decrease, and the pilot will not lose sight of the reference point, making it a safe pattern for gliders.

THE STANDARD CIRCUIT



In all cases the standard is to fly a left-handed circuit, that is, with all aircraft making left hand turns. Some clubs may adopt a different pattern, perhaps because of the wind direction or because of local topography; and in some cases the towplanes will fly their circuits on the opposite side of the runway to the gliders. So make sure you know what is normal for each runway.

The pattern has three GOALS. Specifying these goals ensures that you will have three points at which to check circuit progress and enable you to anticipate what might happen later, and adjust your flying accordingly, to arrive at the next goal at the right position and height. The standard circuit pattern, shown opposite, is divided into the following parts:

High Key area We use the word "key" to signify that a critical decision is to be made in this area. At the end of each flight, as you descend towards 1000 feet above ground (agl), start your approach to the high key area crosswind or from farther upwind, all the time keeping a good lookout to be aware of other traffic that may be doing the same thing. Modern gliders will fly a long way from 1000' above ground. Your objective should be to maneuver into the high key area as in the circuit diagram above. If approaching crosswind at 50 kts, in approximately 20-30 seconds travel from the runway centerline you will be 500-750m away from the runway for a downwind start from the High Key

Downwind leg and Goal #1 The downwind leg extends parallel to the runway, perhaps half a runway length (500m) or more to the side. This should be sufficient for a good view of the runway and of the circuit pattern ahead. You will see in the circuit diagram that the "REFERENCE POINT" is towards the downwind end of the runway, not at the very end. (See the explanation later under ***Flying the Circuit***.)

The downwind leg is started from the high key area and at about 1000m upwind of the reference point. Your next objective, Goal #1, is to fly the downwind leg so that you will be about opposite the upwind end of the runway at 800 feet agl. For shorter runways, typical of many clubs, the 800-foot height will be somewhat upwind of the runway, and will depend on the strength of the wind. For longer runways often used by winch launch clubs, the 800-foot height may be somewhere along the runway length.

Alternate landing area Now you will be selecting an alternate area on which to land, needed if the usual landing area becomes blocked (see also under ***Flying the Circuit)***.

Low Key point and Goal #2 The goal in the circuit is to be opposite or abeam the reference point, at a minimum of between 500 and 600 feet agl in the downwind leg, as you can see in the circuit diagram. This is the "Low Key Point".

Diagonal leg Having passed the low key point, and before the reference point is obscured by the wing or cockpit structure, the glider is turned (any angle between say 30 and 70 degrees) onto the diagonal leg. This allows you to keep the landing area easily in view as you lose height towards the base leg. At some clubs, topographical or other considerations may mean omitting the diagonal leg, and instead flying an extended downwind leg beyond Goal #2.

Base leg The base leg is typically at right angles to the runway; its length should be at least half the distance from the low key point to the reference point. It is chosen to allow time to adjust your speed, height and position for the final turn. Goal #3 of the circuit is to arrive at the final turn at a safe height to allow time to fly a well-controlled final approach leg.

Final turn and Goal #3 The final turn is usually a 90 degree turn to line up with the runway centre line or a "landing line" that may be to one side of the runway. A landing line is used when a club flies from one edge of the grass for landings and not the centre area or a hard surface runway.

Approach The approach path is flown at an angle to the ground of about 8 degrees (an L/D of about 1:7). Pilots fly down this slope to arrive over the reference point at ground level, and to touch down a small distance beyond. The circuit diagram shows these points. Detailed notes on the circuit, and the approach and landing phases are contained in the later section of this chapter, ***Flying the Circuit***.

Judging positions and heights in the circuit

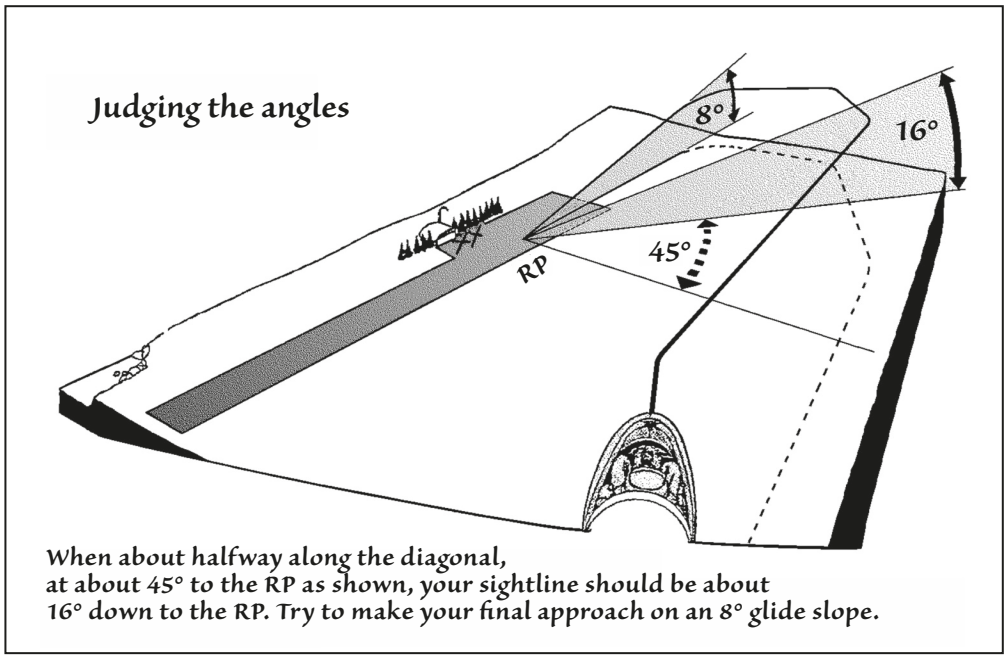
There is no one technique for judging positions in the circuit better than your own eyes and experience to judge the distance and height from the glider to the landing area. The altimeter will be used down to the high key area, as its accuracy is acceptable for this purpose above these heights. On a cross-country flight when the elevation of the ground is known, this is adequate. However, when the elevation of the ground is unknown or when the glider is lower than about 700 feet agl, the altimeter cannot be relied on, so pilots must resort to using their eyes.

As we get quite low, the perspective of ground features and their size is a very good indicator of our height above the ground. This is why we should use our eyes and not the altimeter to judge heights when in the circuit. Besides, we want to be looking for other gliders and towplanes that may also be approaching to land! Using your visual judgement is particularly important for judging the final turn height, which should in any case be no lower than 300 feet agl. As mentioned before, judge your height by reference to the heights of large trees and buildings.

The angle method

This technique to judge the circuit is to combine the distance from the runway with the apparent angle down to the landing area. But beware; our ability at judging angles below **the horizon is poor!** What we want is the correct or an ideal picture or view from the glider. Distance from the landing area will help with our estimation of the height, particularly if we imagine a glide down to the landing area from our current position. It is possible to have the same angle while the distance to the reference point is only a few feet or many feet; the angle is independent of the distance to the landing area. We must combine the ideal picture with the distance in order to obtain the desired height.

At the correct distance, if the angle (or view) is right, then the height must be right. If the distance is correct, but the angle is too small then the height is low. Conversely, if distance is too small and height is correct then the angle will be too large; the glider will be



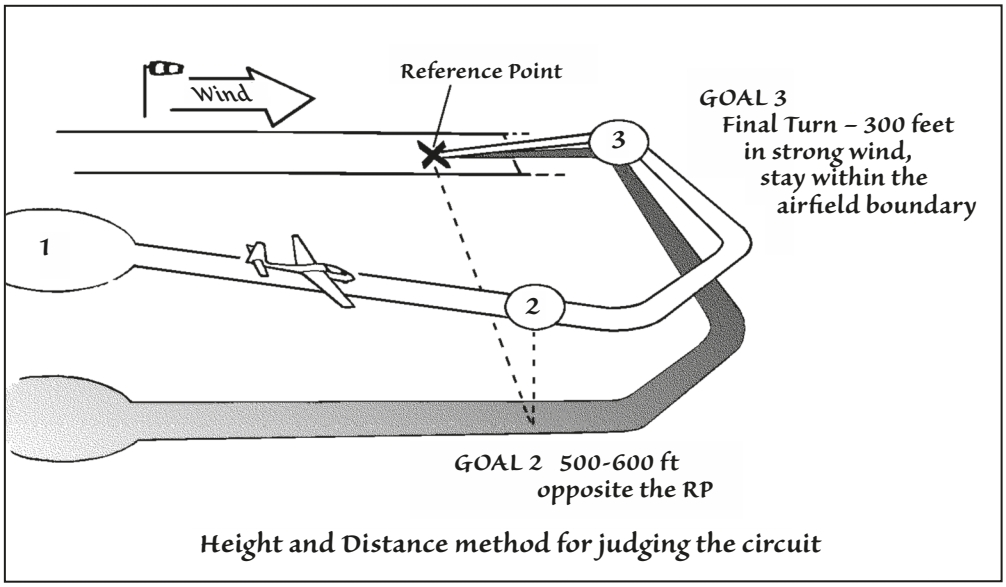
too close to the airfield, and you will likely feel cramped against the runway. The inference is that if any two of these variables is right, then the third must be right. Alternatively, if one is wrong, then at least one other must be wrong.

The two basic angles shown in the figure above will work for most gliders, though there will be exceptions. For example, the glider may have a steeper approach angle than 8 degrees against a typical wind of 10 to 15 knots with the airbrakes closed. Having learned the basic angles, making small changes for different gliders will be no problem. A simple visual aid for judging the angles may be made of wire or card and attached to the instrument panel; while the glider is on the diagonal or base legs with wings level, it would be easy to compare the angles. The pilot would not refer to ground features and does not need to judge the height accurately. Having learned this technique, pilots find it easier to land in strange areas such as a field during a cross-country flight. A third angle of about 30 degrees mid-downwind is sometimes used to confirm the height.

Height & distance method

An alternative judgement technique is to use the height and distance to the landing area as the keys to making a good circuit. The diagram shows the heights and positions for Goals 2 and 3, having started the downwind leg at the right position and height to hit Goal 2 as shown.

If the height was correct at the start of the circuit, chances are that the height will be close to correct later in the circuit. However it is necessary to continuously judge the height and the distance to the landing area (and an alternate landing area) to keep the height under



Height and Distance method for judging the circuit

control. Keep a watchful eye also on your variometer when in the circuit as it will show when you fly into areas of excessive sink or even lift, allowing you to make adjustments when needed.

When flying and judging the circuit it is important to relate the final turn position to the length of the runway and the landing area, not to any geographical feature. This same feature will not be there tomorrow when you are using a different runway!

FLYING THE CIRCUIT AND LANDING

The aim

The overall aim in flying the circuit is to adjust the circuit pattern (your positions and heights) and final approach path so that you can land the glider on a preselected spot. As gliders cannot maintain, let alone gain height in the circuit without losing speed, we always start the circuit with height to spare. On the final approach we use the air brakes (also referred to as spoilers) to steepen the glide angle to approach our preselected reference point and to land slightly beyond.

High Key area

When approaching the high key area, preferably from the upwind direction, start the SWAFTS pre-landing check. Go through the checklist efficiently to allow time to concentrate on planning and flying the circuit. As a new pilot you will find this gives you plenty of time to concentrate on the circuit and be able to fly a good circuit pattern. In gliders we have only one chance to get the circuit and landing correct; we can't go around and try again!

Adjust your height as you approach the high key area so as to reach Goal #1 at the right height and position. If you are far too high, leave the immediate area to look for lift or to lose height. If still slightly high when you reach the high key area, fly the downwind leg further out to the side, or if low, immediately start the downwind leg. Decide early on your reference point. This may be a mark on the runway, or a distinctive marking such as a dark patch on the field nearby and in line with the chosen point on the runway.

Only turn in the same direction as the turns to be made in the circuit when approaching or in the high key area, but always try to limit turning in the high key area so as to minimize conflicts with others. At all times keep a good lookout above, below and along the horizon for other gliders that may also be flying towards or already in this area to join the circuit. Assess when to leave on the downwind leg, to reach Goal #1 at the 800-foot height. Plan to fly the circuit initially at the best L/D speed, or 45 knots minimum whichever is higher. Local factors such as mountains may dictate higher speeds for example due to wind shears.

Downwind leg

Keep looking at your chosen runway reference point as you fly along the downwind leg but avoid the tendency to fly towards it, in effect shortening your potential base leg. Using another Reference point ahead near the horizon to fly towards on your downwind leg can help with the tendency to not fly parallel. Make major adjustments to your circuit pattern and height early, when you have the time available and height to spare.

As you fly the downwind, look for any drift caused by the wind. If the wind is not straight down the runway the glider will tend to drift either towards the runway or away from it. If so, crab the glider towards or away from the runway to make the track over the ground parallel to the runway direction. If the drift is away from the runway you will have a slight headwind on the diagonal and base legs, so keep the downwind leg closer to the runway, and angle the glider's nose towards the runway. You may feel that the glider is skidding, but this is an illusion created by the drift over the ground, making it more of a challenge to keep the glider flying straight and with the yaw string straight! Keep a good lookout for others, possibly joining the circuit in front of you and to either side. Also check for aircraft on downwind below you by lowering a wing for a second or two. Collision risk increases when flying straight lines.

If the wind is drifting you towards the runway, you will have a tailwind on the diagonal and base legs, so angle away from the runway on your downwind. Avoid being too close – if you are, the final part of the circuit will be cramped. As you approach the low key point, your view of the runway may become restricted by the glider structure, so keep well aware of the need to turn onto the diagonal leg while you can still see your reference point. Your final turn will be made with a wind component behind you, requiring a well-judged final turn so as to line up with your chosen landing line. In fact, some clubs will change the circuit direction to keep the diagonal and base legs into wind, which also allows you a better view of the runway as you fly the circuit because you will be angled slightly towards the runway.

Alternate landing area

As you fly the downwind leg also select your alternate landing area well before the need arises. This is not usually a problem on a wide airfield or where there are several available

runways, but when the landing space is narrow (e.g. on a single runway), where will you land if the usual landing area is blocked? This could occur if a glider ahead of you is not moved off the landing area soon enough, or a vehicle or person moves across suddenly. Several gliders may have to approach essentially simultaneously. The problem could occur later on a cross-country flight after you select a field and at the last moment you decide it has too many obstacles in your way. You have a greater chance for success if you already have an alternate landing area in mind! Your objective is now to arrive opposite your chosen reference point at a minimum height of 500 feet above ground, Goal #2.

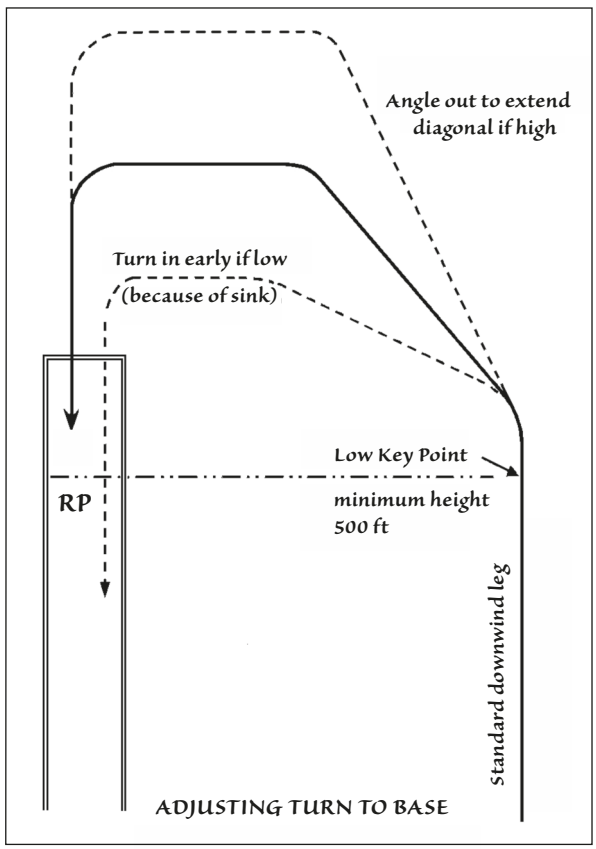
Increase speed

Your last altimeter height reference should be at Goal #2. From now on judge your height by looking out at ground features. At this point, increase speed to your preselected approach speed. Re-trim the glider and maintain this speed to your landing and check the airspeed indicator more often to ensure you maintain a constant speed.

It is not so easy to use the glider's pitch attitude to control speed when close to the ground, for example, because of the changed perspective at low heights, and because of flying through the wind gradient. Now concentrate on the turn onto the diagonal leg. The reference point on the runway should be the point of attention, of course, as you plan the angle of the diagonal, and where to position the base leg and final turn.

The diagonal and base legs

The glider should be at a height from which an easy approach may be made to the landing area from any point along the diagonal or base legs. This gives some flexibility to allow for other gliders also landing and for unexpected sink or wind gradients that may have been unanticipated. In strong winds the base leg should be flown closer to the runway, and the glider crabbed (coordinated turn slightly into wind) to avoid being drifted further downwind. If you still find yourself too high or low at Goal #2, the diagonal and base legs can be adjusted as shown.



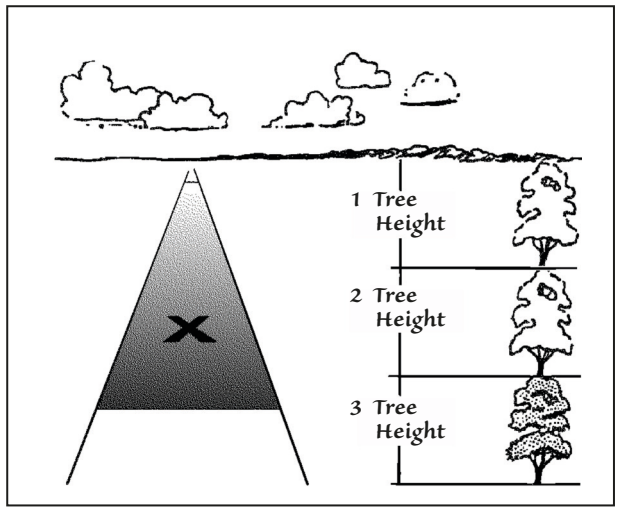
Too low at Goal #2

The first consideration must be to maintain an adequate airspeed, and to make your final turn at a safe height. It is much better in these circumstances to fly an ab-

breviated circuit than to fly the final part of the pattern at too low a height. See also later in ***Running out of Height in the Circuit***. If at any time you feel you might not reach your reference point, ensure your air brakes are closed.

Too high at Goal #2
If you find yourself too high, plan to angle your diagonal out a bit further away from the runway, starting your base leg further from the runway and using air brakes as required. Judgement is needed to decide when to turn onto the diagonal and whether or not to use the air brakes.

Final turn and approach
The height for the final turn can be judged conveniently by reference to buildings and trees. In fact the final turn should be completed at a height equivalent to at least three large trees or tall buildings such as the club hangar, and higher on windy days. This is Goal #3. Soon you should be able to judge this height by reference to typical ground features and not the altimeter, to meet this goal. This figure shows how to judge the height using this technique. Provided the final turn is not made dangerously low, the exact height here is not critical, and will be varied for different winds and positions of the final turn.



As you fly along the diagonal and base legs, try to imagine the final glide slope. This is the slope that you will intercept; it is the final approach path along which you will glide to the reference point. Having established in space where this turn is to be made, your turn onto final must be well coordinated with adequate airspeed. As you approach the center line of the runway or landing line, judge when to roll into the final turn. This turn should be made initially with brakes closed (as a low time student pilot you can't easily judge whether you are high or low before the final turn, but with more experience you will be able to develop this judgement).

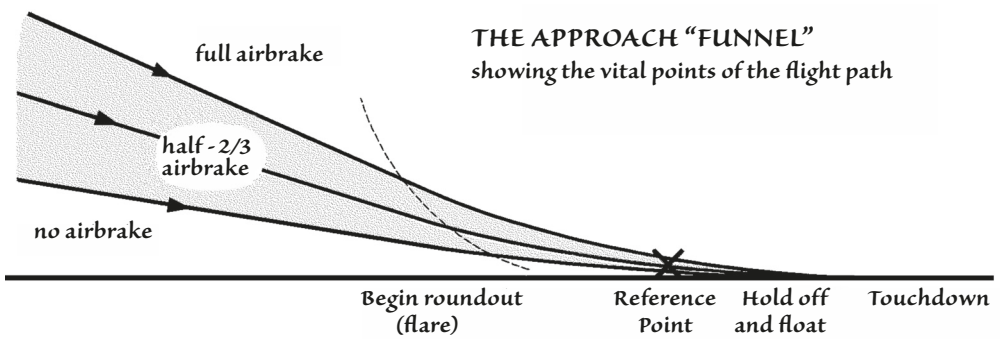
Aim to use a well-banked turn, 30 degrees is about right, as this is safer than a shallow turn: after you achieve some practice you will see that it is easier to make a correctly coordinated turn that is also well banked. It is not so easy to make a properly coordinated turn flying at a shallow angle of bank, particularly when close to the ground where peripheral visual clues are stronger than when higher up; they can be distracting and possibly misleading when low!

If you turned onto your base leg sooner because of strong winds, you can now (almost automatically) fly a steeper approach path as you penetrate against the wind, to land on

the usual landing area. Watch for a stronger wind gradient though under these windier conditions.

After completing the final turn you should visually confirm your reference point, and if necessary re-establish your chosen airspeed. Then stabilize your approach with wings level. It is now important to determine whether you are overshooting, which is the desired condition with the air brakes still closed (see ***Overshooting and Undershooting*** opposite).

It is not as easy to recognize an undershoot as it is to see an overshoot, and if you have opened the air brakes immediately after the final turn, you could lose valuable height before recognizing the situation. Therefore, only start to open the air brakes when you are sure that you will overshoot.



It is quite possible to lose considerable airspeed from an unexpected wind gradient. It will be difficult to regain the higher airspeed quickly, because of the inertia of the glider. To avoid this, we increase our speed before starting the diagonal leg. And it will be doubly important to monitor the airspeed throughout the approach, to make sure we do not lose that important safety factor of adequate airspeed. Once you have established an overshoot condition, a good approach glide path is at an angle to the ground of about 8 degrees. This will mean that the air brakes need to be opened to about half effectiveness (approximately half to three quarters open depending on airbrake effectiveness), permitting considerable freedom to either flatten the glide angle or to steepen it – this should be your aim. It will be possible to vary it from your maximum L/D of anywhere from 30:1 or 20:1 (an angle of 2 or 3 degrees) to a steep final approach path at an L/D of about 5:1 or 4:1 (a glide angle of 11 to 14 degrees).

Although these angles are exaggerated in the diagram above, the steep approach requires you to start the flare sooner and time it very carefully so as not to land tail first or to land heavily because of the high sink rate. You should be adjusting the glide angle, using the air brakes as required, to approach at a steady speed towards the chosen reference point. At the same time, adjust your attitude as required to maintain your airspeed. In exceptional circumstances you might have to sideslip to increase your rate of descent even more. Remember:

Air brakes - - - - control rate of descent
Pitch attitude - - controls airspeed.

Aim now in your training to achieve a high degree of proficiency in speed and glide path control when flying the circuit. This will help you later when converting to higher performance sailplanes.

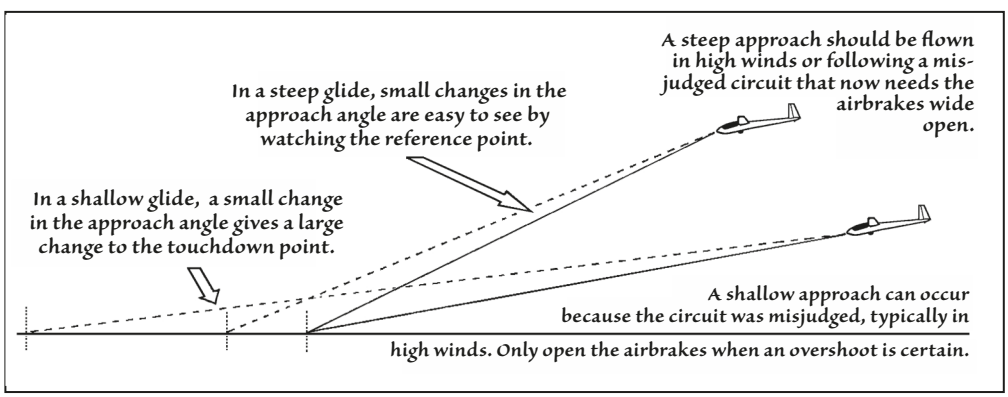
If you find yourself low for some reason when you initially turn onto your final approach and you think you will undershoot the intended reference point, even with the air brakes fully closed, immediately lower the nose to gain some speed. At the higher speed, you will find that the penetration of the glider against the wind will be better, and you will improve the chances of reaching the runway. This is another reason to choose your reference point well into the runway and not just over the boundary fence!

The Reference Point

Essential to making a good approach is to have decided on a reference point early. You will land slightly beyond this point. The reference point is the point that the glider would contact the ground if you did not round out or flare. During a steady descent it is the only point on the ground that should appear stationary with respect to a mark on the canopy. Points below the reference point will appear to descend and to eventually go under the glider. Points above the reference point will rise up the canopy.

Overshooting and undershooting

On final, establish an overshoot as you fly the approach – that is you are going to fly over the reference point and it appears to move down the canopy. Open your air brakes enough to increase your rate of descent (steepen your glide) until the reference point no longer appears to move down. If you then tend to undershoot, close the brakes completely to re-establish an overshoot. Then when the overshoot is recognized, re-open the air brakes enough to prevent the overshoot. When you have adjusted the brakes correctly, the reference point will remain stationary against a mark on the canopy; it will then appear only to be getting larger as you approach it.



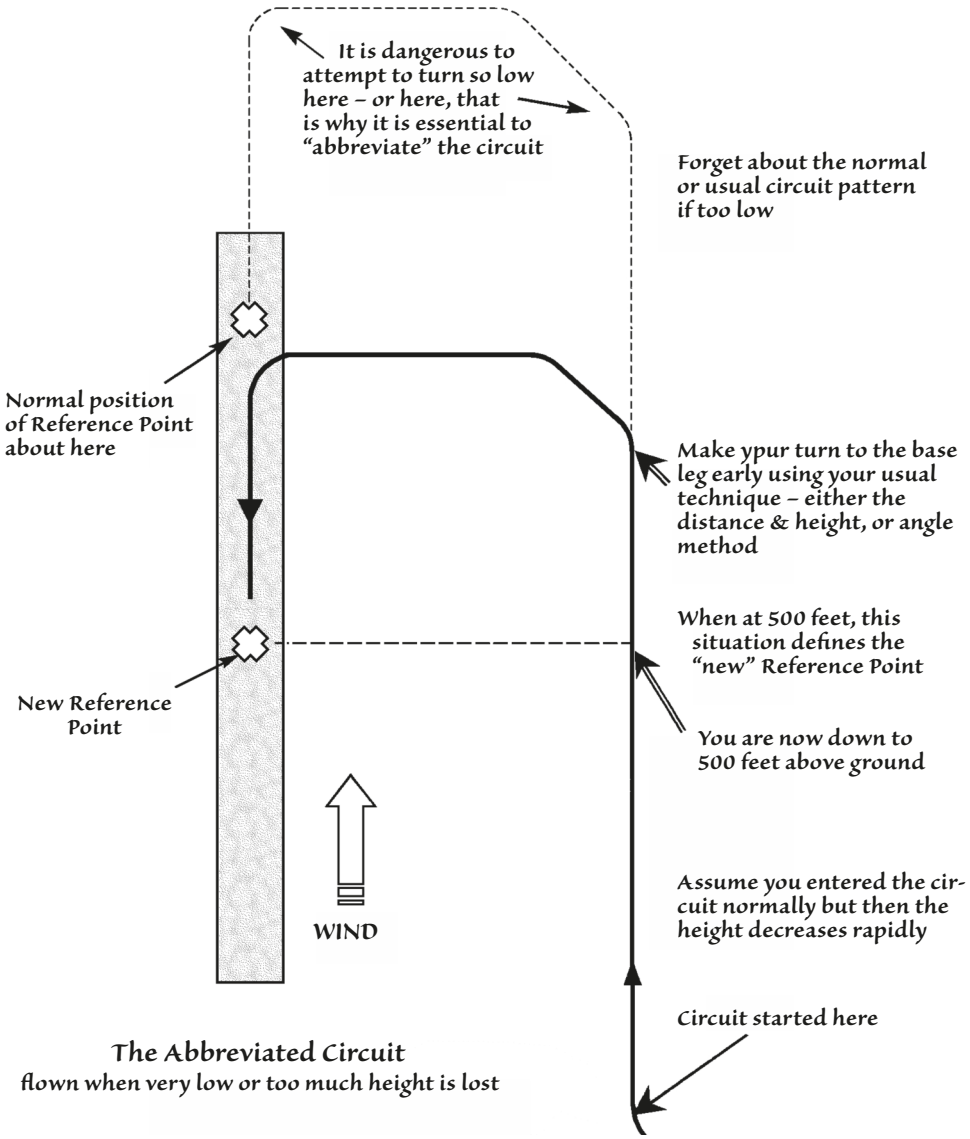
It is easier to judge an overshoot or undershoot from a steep approach than from a low or shallow approach.

Because movement of the air brakes can cause a change in drag that will begin to affect your airspeed and changes pitch will be required, first make gentle adjustments to the brakes so that you only need to make small airspeed corrections. If you encounter heavy

sink on the approach (a possible undershoot), close the brakes and lower the nose to maintain airspeed, the wind gradient is probably beginning to affect you. Never raise the nose in an attempt to stretch your glide. It is better to land one field short with flying speed than to fly into a boundary fence or to stall onto the field. If, however, you have gained a useful increase in airspeed (monitor the ASI frequently on all approaches) and are now covering the ground well, remember to continue to fly the glider. Look ahead to where you are going to avoid hazards like small bushes in the area short of the runway.

Running out of height in the circuit

Sometimes the glider will get too low for a proper circuit, and if the normal pattern is flown, the final turn would probably be made at a dangerously low height. This can and often

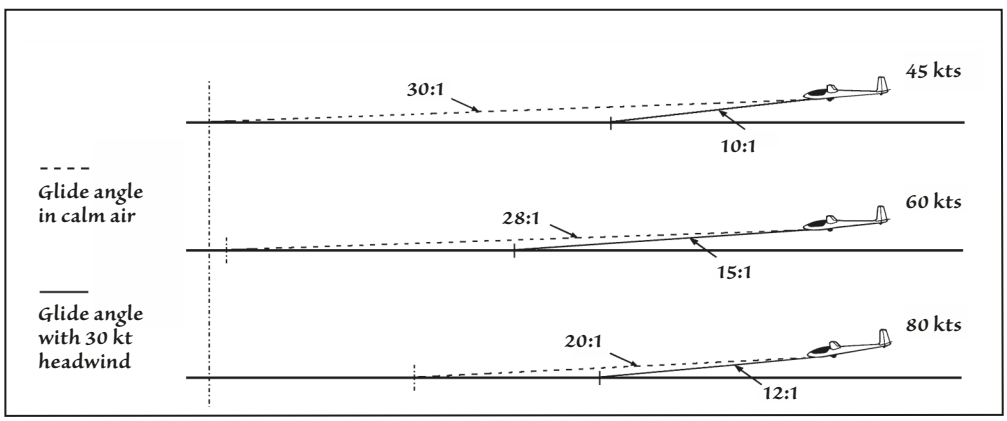


The Abbreviated Circuit
flown when very low or too much height is lost

does lead to a hurried and low final turn, which will end in a poor landing. Even though inexperienced pilots might recognize they are running out of height, there is a magnetic fascination to getting back to the normal landing area – ***this must be resisted.***

You will be taught that when you begin running out of height and you reach the 500 foot level on the downwind leg, this ***defines*** your new reference point that is right now opposite you on the runway. The illustration shows the procedure. Now fly an abbreviated circuit, and disregard any runway downwind of this ***new*** reference point. The ability to recognize that you are low and running out of height is very important when flying cross-country, when you may be making an outlanding into an unfamiliar field. As the ground there will not be at the same elevation as at the club, the altimeter reading cannot be used directly. You will have to refer to ground features as your only sure means of judging heights. So develop your height judgement abilities, and when you reach the magic 500 foot level, discipline yourself to choose the reference point now.

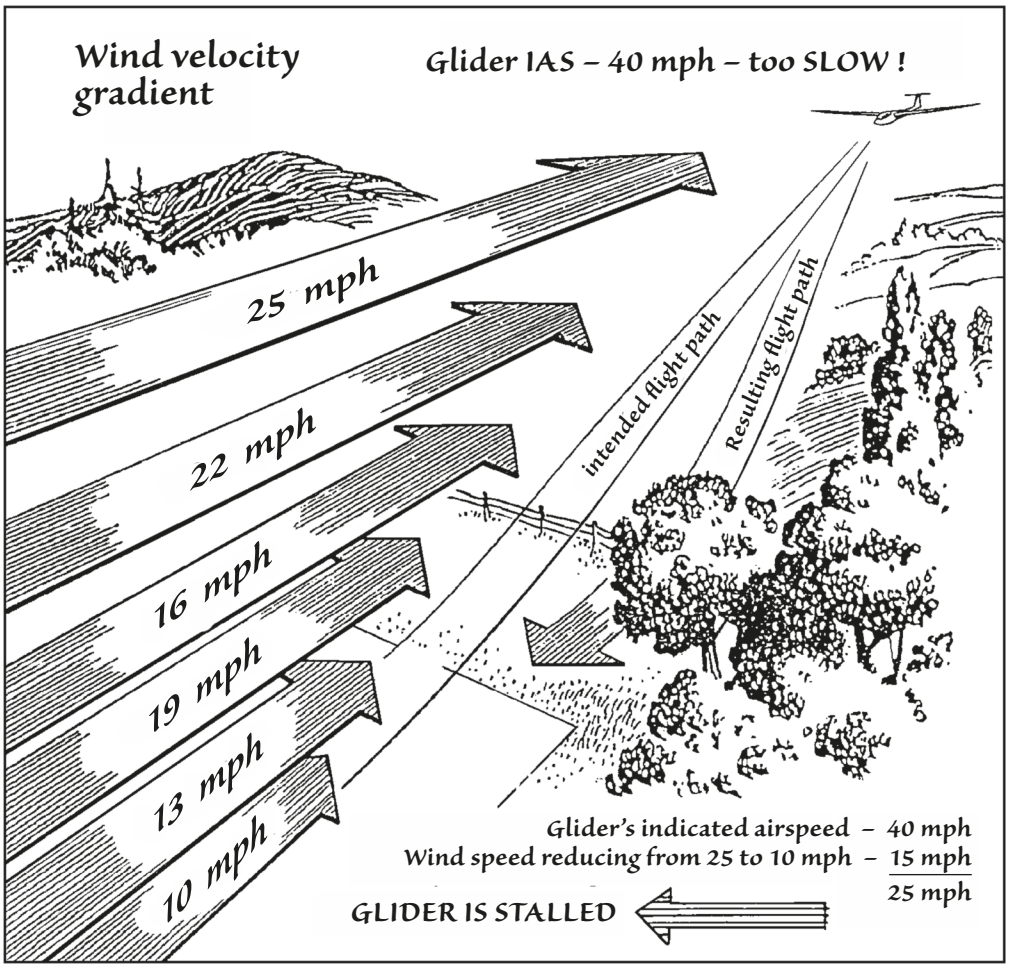
If you are not yet opposite the end of the selected field or runway, again discipline yourself to fly an abbreviated circuit to a safe final turn and landing. In this case you will be eliminating the area of the field (or runway) downwind of the reference point, even if you have a predisposition to land there! Trying to do so one day will land you in trouble as you try to make the final turn too low. Remember that the wind gradient and turbulence this low tend to be stronger.



Effect of the wind on the glide angle over the ground

Winds and the wind gradient

Wind affects a glider's glide angle (L/D) over the ground as illustrated above. This is particularly noticeable in lower performance gliders having a maximum L/D of about 25:1. Even at an angle of 30:1 or about 2 degrees over the ground in still air in a modern two-seater, if this glider is flown at 45 knots, as in this case into a 30 knot headwind, the L/D will deteriorate to about 10:1 as indicated by the solid glide slope line in the diagram above. This could give an unsuspecting pilot an alarming approach if the final turn was started downwind of the airfield boundary. In this case the best speed to fly is about 60 knots, which gives an L/D over the ground of 15:1 against the wind. Note that the ground speed is still only 30 knots, but that the distance flown over the ground is 50% greater.



A second effect of strong winds is the wind gradient. Wind speed decreases progressively nearer to the ground due to surface friction caused by obstructions such as trees and crops. The effect is most marked in a strong wind blowing over uneven ground, or in the evenings when thermal activity ceases and the atmosphere becomes stable. In this case the surface wind can be very light while the wind at treetop height is appreciable.

The effect of a strong wind gradient on a glider approaching to land is to cause a rapid drop in airspeed as you near the flare point. This is particularly noticeable if the airspeed is only marginally higher than the stall speed, when the increase in sink rate (and drop in airspeed) can become alarming.

The airspeed to use for your final approach is critical and must allow for a possible strong wind gradient. The essential point to remember is that extra speed must be established by 500 feet above ground.

Successful flying through wind gradients on final approach demands that we start with adequate airspeed, and are alert to any decreasing airspeed (we must lower the nose),

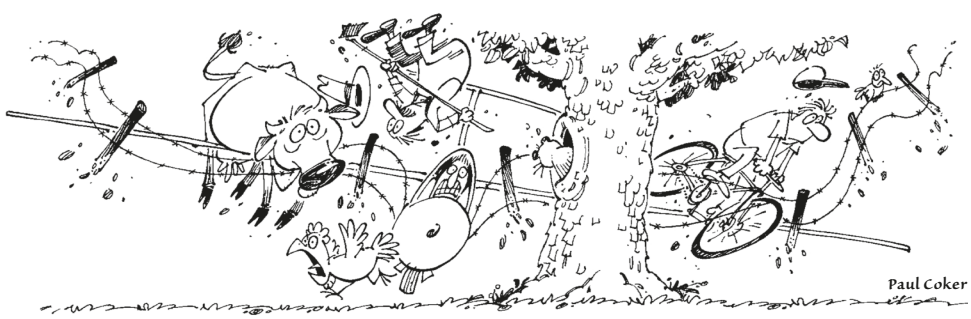
and to an increasing sink rate (close the air brakes or spoilers). In high winds keep plenty of height in reserve until after your final turn, and then use your air brakes to lose excess height. If your airspeed drops and the glider begins to sink rapidly you will have plenty of height in hand and be able to maintain your selected glide path.

The landing

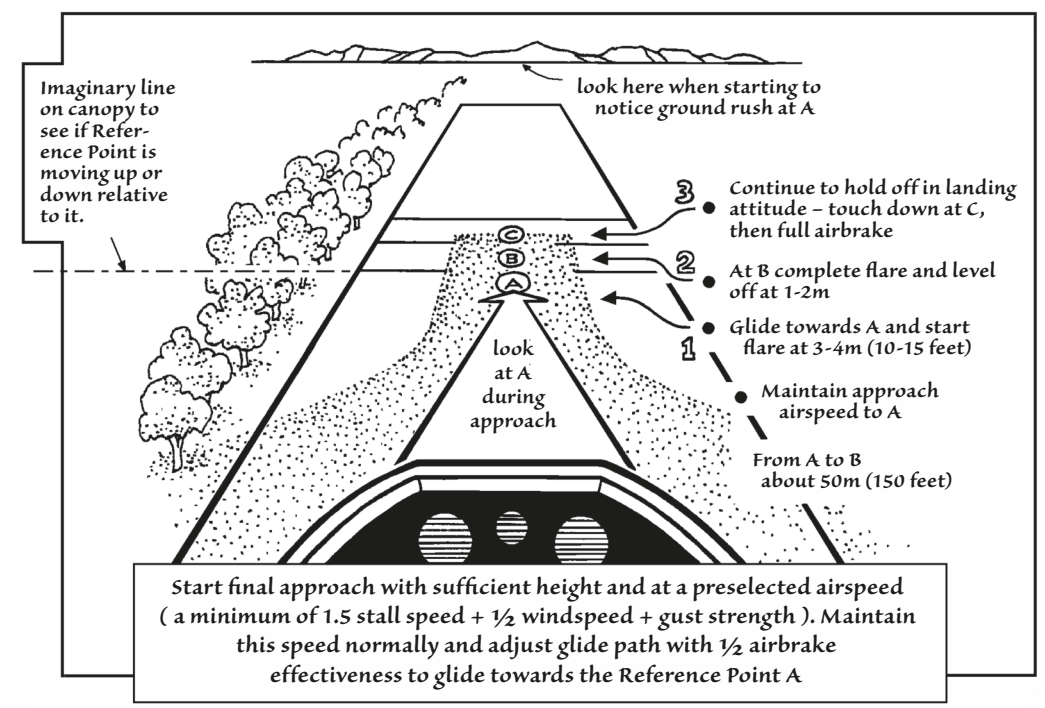
A landing consists of three distinct phases: the flare, hold-off, and the touchdown. Prior to starting the landing phases near the end of the approach phase, adjust or confirm the air brakes are about half their effectiveness at about 10 m (30 ft agl). This will make the glider less pitch sensitive but allow enough drag to prevent floating down the runway. When you are nearly ready to land and to help in judging your height, look well ahead to the far end of the landing area as you descend the last few metres. At a height of 3 to 4 metres (10-15 ft) you will notice the ground start to rush towards you. Now begin to flare (or round out). The flare is a progressive pitching up of the nose to achieve the desired level attitude 1-2 m (3-6 ft) above the ground. Now hold the glider off the ground by progressing towards and then maintaining the landing attitude as the glider slows and try to fly to the end of the runway. This is not possible, of course, because the glider will gradually lose speed until it slowly sinks onto the main wheel and tail wheel (or skid) almost simultaneously.

This is what is known as a held-off landing and it will result in a slow, gentle touchdown, even if the hold-off is a little too high from the ground. Then open the air brakes fully (without activating the brake) after you touch down to prevent a gust from lifting the glider. If you flare and hold off too high, or if you bounce, close the air brakes and lower the nose if it is above the horizon to give you a safe margin of airspeed. Only open the air brakes fully again after landing a second time. This will help keep the glider on the ground. Hold the airbrake opening steady throughout the flare and hold-off. Modulating the air brakes in the round out may start pitch oscillations. Be careful if you touch down with the air brakes fully open. Powerful air brakes require a well-timed flare for the landing, so avoid full-brake landings if possible early in training. On some gliders the wheel brake is operated by the airbrake lever when in the fully open position, and you want to avoid skidding on a locked wheel, for example on wet grass.

This type of landing is sometimes called a ***low-energy*** landing; when the glider touches down it has little (kinetic) energy remaining. In fact, with a proper low energy landing, the glider will not have enough energy to bounce back into the air. If it does bounce, the



… too late, Percy laments the choice and execution of his final …



energy or speed at the touchdown was too high. In this case a new touchdown will have to be made – immediately close the air brakes and lower nose to level if it pitched up. Restart the landing now from the high point after the bounce. If airspeed is good and height allows reopen air brakes a little to make the glider less pitchy. If to low and slow hold the landing attitude and let the glider settle.

In strong gusty conditions, a fully held-off landing is difficult to make. In this case it is acceptable to fly the main wheel onto the ground more firmly at a higher airspeed, and with the glider in a more horizontal than tail-down attitude. After touchdown open the brakes fully and keep the glider's attitude constant to avoid the possibility of taking off again. Keep the nose skid (if you have one) off the ground as long as possible to avoid unnecessary shocks to the aircraft, its instruments and you, but put the glider's nose skid down immediately if necessary to avoid running into a hazard.

Once running on the ground you may use the wheel brake as needed. Keep straight with rudder and keep the wings level as long as possible. If angling off the runway, be extra careful to avoid a swing (from excessive use of the wheel brake) that could develop into a groundloop. Over braking or touching down too fast by moving the stick forward to plant the main wheel on can lead to groundlooping. Center the stick as one wing drops, to avoid damage to the aileron – on some gliders without tip protection the aileron can protrude below the wing's lower surface, and it may be damaged as it contacts the ground first.

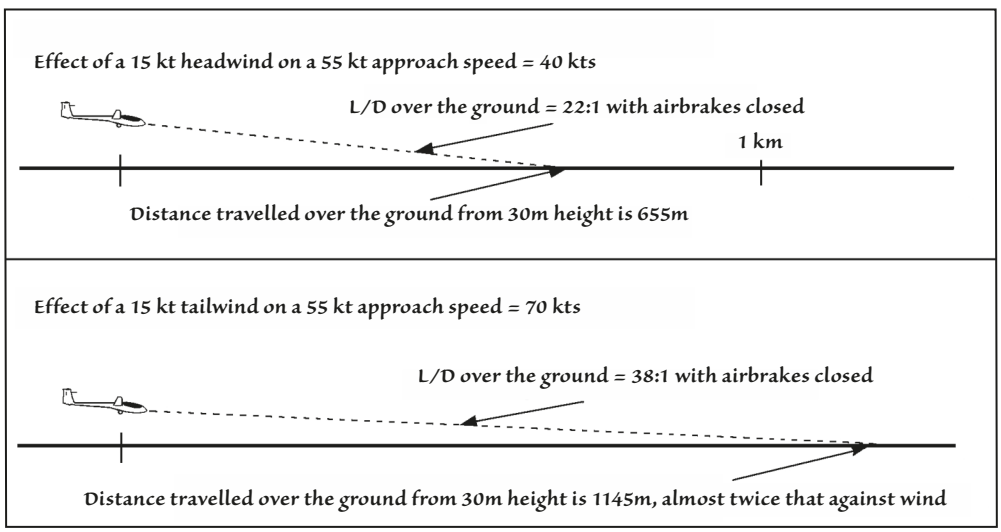
Downwind landings

Occasionally you will find yourself with no option but to land downwind, with the wind behind you. This adds the wind speed to your airspeed to give a much higher ground speed

than for a normal landing that is of course against the wind. Consider a wind speed of 15 knots and an approach speed of say 55 knots:

Ground speed into wind = 55 – 15 = 40 kts.
Ground speed with wind = 55 + 15 = 70 kts.

If you are used to the normal slower ground speed and find that you have to land downwind, don't be surprised by this increased groundspeed and then be tempted to slow down too much! In the above case the groundspeed is 75% greater than normal. Notice too, as shown in the diagram below, that you will cover a far greater distance over the ground, in this case about 73% greater with no air brakes.



A downwind landing may be required, for example, following an interrupted launch or when being caught low with insufficient height to do a full circuit. Having chosen the option to do a downwind landing, choose a reference point on the runway. The position should be chosen to leave you with a comfortable approach path while allowing as much length as possible beyond the reference point.

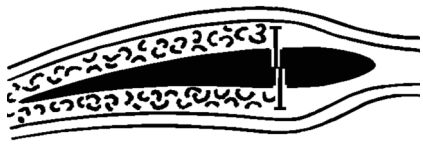
As you turn onto your final approach, control your speed so as not to increase speed – note that your airspeed will increase as you descend through the wind gradient; this is the opposite of the normal situation of penetrating against the wind when the effect of the gradient on the airspeed is to decrease it! During a downwind approach, therefore, it is quite acceptable to fly at the best L/D speed of the glider and not at the usual increased speed required for flying an approach against the wind.

Now establish that you will overshoot, in the same way as for a normal into-wind approach. Be prepared, however, to open the air brakes smartly as otherwise you may have difficulty getting down onto the runway and stopping in time. Carry out a well held-off landing with the wings as level as you can manage, and once running on the wheel, hold the wings level as long as possible and keep straight with the rudder. If the wind is over about 10 knots such a landing is not easy to do well; the wind could swing the glider once it gets hold

of the tail surfaces. To avoid hitting another glider or obstruction, make sure you leave yourself adequate clear space on both sides.

Approach Control Devices

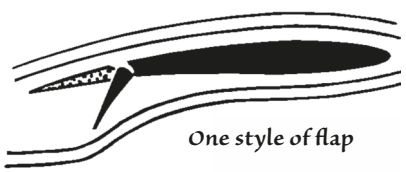
Spoilers Spoilers are hinged plates fitted to the upper surface of the wings, designed to "spoil" the lift, hence increase the sink rate. They increase the drag only slightly and increase the glide angle and stall speed with little effect on airspeed and with a small change in trim.



Air brakes Also called dive brakes, they extend above and below each wing, and can increase the drag substantially while decreasing the lift by a smaller amount. Pitch changes are required to maintain airspeed. In some designs they are on the top surface only but are powerful enough to limit the glider's speed to below the never-exceed speed, V_{ne}, in any dive of up to 60 degrees. The reduced pressure over the top surface of the wings tends to suck out air brakes, and it is important that they are locked before take-off. When opening air brakes in flight, be ready to resist any tendency for them to suck out to their full extent, particularly at high speeds. The normal use of air brakes is for glide approach control, but they can be used to limit speed in a dive, or to lose height rapidly, for example in wave.

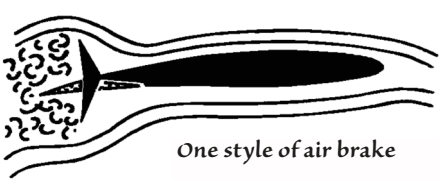
A problem that can occur with air brakes or spoilers, particularly with devices that lock into the wing structure by a mechanical, over-center lock, is that they may open during the take-off run. This can occur without the pilot noticing, especially on a bumpy runway. Therefore, if your take-off run appears exceptionally long, check the air brakes. If they are open, immediately close them gently. If in doubt, release. Keeping a closed fist against the handle on the take off run can help prevent unnoticed opening and keeps hand near release.

Flaps Flaps are fitted to many sailplanes and may be used with a negative setting for high speed cruising, for better thermalling efficiency at low positive settings, and as an approach control at high settings. Flaps lower the stall speed by increasing the lift, at the same time increasing drag. Therefore it is important to remember that raising the flaps from about the 20 degrees position substantially reduces the lift and, as a result, can produce a large increase in the stall speed. Therefore don't raise the flaps when near the ground! On some gliders the maximum flap settings speed limitations may limit the safe approach speed in stronger winds and a lower setting may be more appropriate.



One style of flap

Trailing edge air brakes These are hinged at the rear of the wings and rotate above and below the wing. They can be powerful, particularly if they extend over a large part of the wing span.



One style of air brake

Safety Considerations

Commitment to land

Once in the circuit, you must be committed to land; never attempt to soar even if you apparently fly into lift, as you could conflict with others in the circuit behind you, creating a safety hazard. Also we should mention it is very difficult to use apparent lift so close to the ground – you will lose more height than you will gain, making the remainder of the circuit very hurried and difficult to fly well. Use air brakes to descend if you momentarily gain a bit too much height in the circuit.

Also, never turn your back on the field when low, as you may drift further away and fly into heavy sink, which will result in unnecessary hazards to you if you then attempt to reach the club field, or if you have to attempt a hurried off-field landing.

Lookouts in the circuit area

As you approach the high key area perform a very good lookout to both sides for other gliders also approaching this area. Also there are several points in the circuit where you will be turning when a good lookout is very necessary to avoid a conflict with another glider or towplane. At a busy club there could be a number of gliders approaching or in the circuit together, and some clubs use a circuit for the towplanes opposite to the glider's circuit, so watch this side as well.

When in the high key area maintain your awareness of other gliders approaching the area and look for others already in the circuit ahead. Radio is of course a very good safety device, but it does not remove the need to maintain a very good lookout at this time.

Although we have a basic technique for scanning around the horizon to both sides before making any turns, we also have a real need to look above and below when approaching the high key area. When flying the downwind leg, keep looking above and below in the circuit for other gliders, and keep your eyes on the opposite side of the runway (above your height) for any towplane flying towards the circuit. Before making any turns also search above on the outside of the turn, and below on the inside for other gliders that also may be flying their downwind legs. By keeping aware of the circuits that they may be flying, you will enhance your own safety as you descend and make your turns.

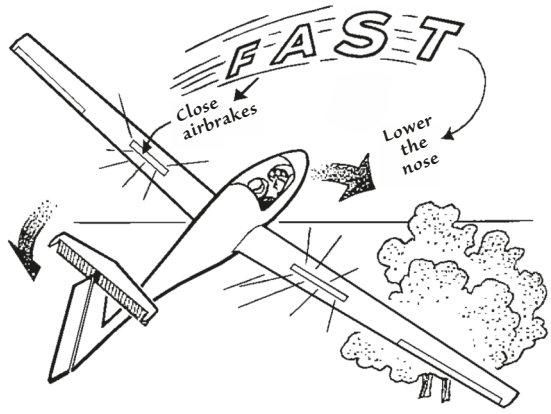
When on the base leg, again search for traffic ahead of you or making an extended final approach. Not many pilots remember to look for a glider making a low final approach – it would not be visible under your upper wing as you make the turn onto final. So look carefully in that direction before starting your turn. Be especially vigilant on the base leg if you have to fly the circuit opposite to the normal one. In this situation, you could conflict with another glider near the final turn, or if you didn't see it, both gliders could turn onto final and be in each other's blind spot!

Too slow in the final turn

Pilots can sometimes inadvertently lose airspeed during their final turn, particularly if they are distracted in some way. In this case, when it becomes apparent that the speed has deteriorated too much, immediately go through the recovery actions. The consequence is

the same as taught earlier, but includes closing the air brakes, because these will often be in use during the approach. The recovery actions are:

- Lower the nose and close the air brakes,
- Look ahead to the horizon,
- Check the airspeed, then
- Recover to the normal approach attitude.

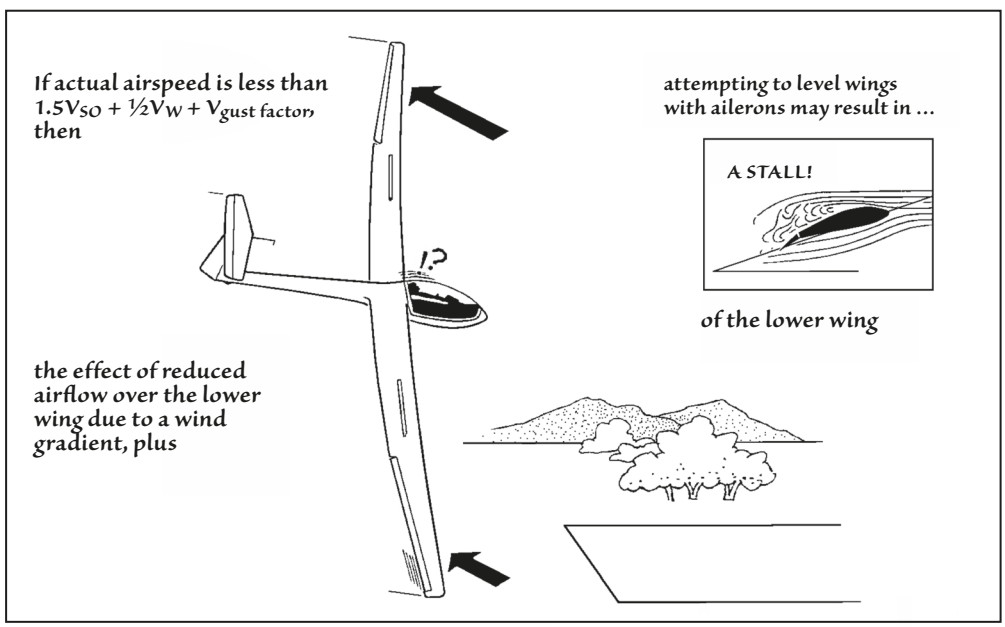


It is very important during this recovery to look up to remain aware of the horizon's location; you don't want to fly into the ground too early!

Banking in a wind gradient

In strong wind gradients the wings (when they are banked) will be flying in different wind speeds, giving a different airspeed over each wing. This effect is most marked close to the ground where the gradient is strongest.

For this reason it is wise to avoid turning so close to the ground that the wings will be across this wind gradient. In such a case the upper wing will be in the stronger wind and will be developing more lift, and the lower wing less lift; the glider will tend to overbank quite strongly, and attempts to prevent this with corrective aileron deflection could induce the wing with down aileron, i.e. the lower wing, to stall. This is shown in the figure below. Instead aim to achieve a well-banked turn at an adequate height and with sufficient speed for all your final turns.



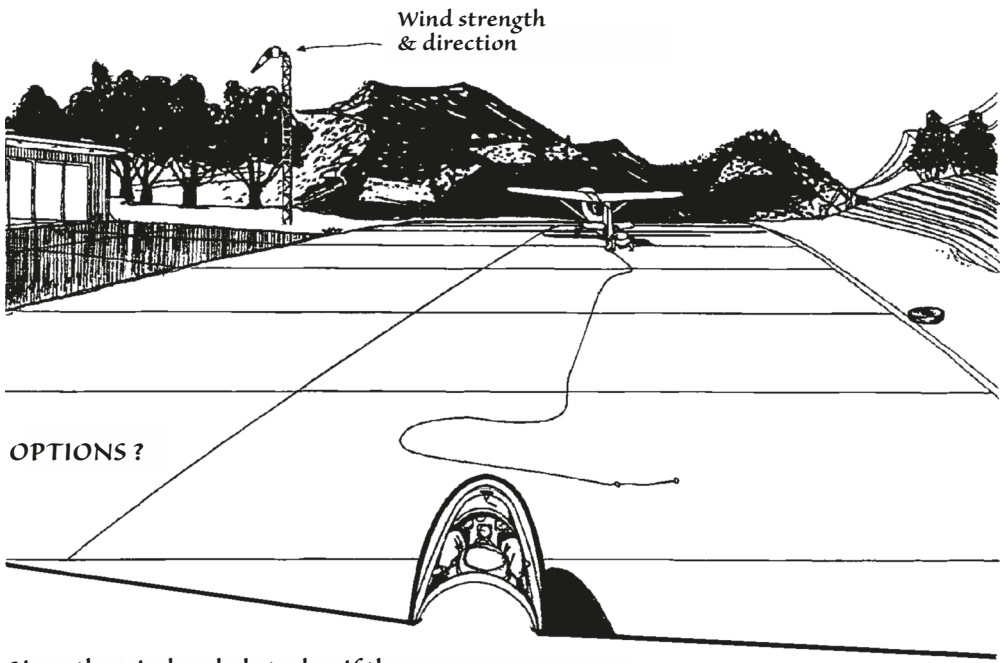
TAKE-OFF, AEROTOWING, and EMERGENCY PROCEDURES

Introduction

Before any take-off is started the first considerations must be, are you and your copilot and the aircraft absolutely ready for a safe flight, and is the weather and the flying environment also within your capabilities?

These questions may seem strange to mention here, but it hardly needs pointing out that once started on the flight and you are climbing behind the towplane, there is no chance to put things right. For example, you would have to return to the field and land to retrieve your water supply for a long flight or to remove the tail dolly, then start the flight again!

Think about it, and also plan ahead for the unforeseen emergency during the early part of the tow, as the pilot is doing in the illustration below. He or she will not be surprised because, if the launch should be abandoned prematurely (for example, the towplane pilot might release the rope, or the rope could be broken by a sudden snatch), the options have been thought about already, and decision heights have been reviewed mentally. With two pilots they should go through the options together. There should be a conscious decision about which pilot has control, particularly for the early part of the flight when the second pilot is a student doing an early take-off. Now review again the pre-takeoff checklist and the accompanying notes.



Given the wind and obstacles, if the towpilot has to release me … or the towrope breaks out there … or maybe there … what will be my course of action? … which way will I turn? … where will I land?

The take-off and aerotow

Make sure the glider is properly lined up, and there are no obstructions in front of you. After getting comfortably seated and strapped in, go through the **CISTRSC-O** checklist:

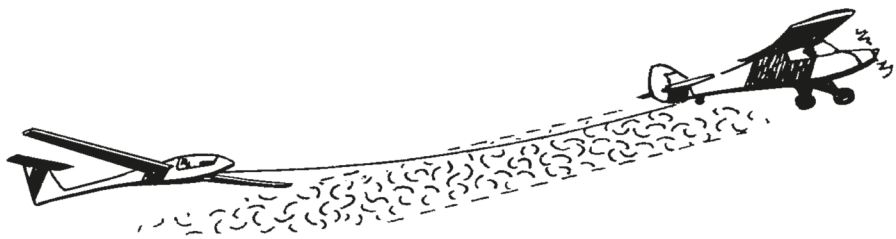
- **C** Controls,
- **I** Instruments,
- **S** Straps,
- **T** Trim and Ballast,
- **R** Release,
- **S** Spoilers and Flaps,
- **C** Canopy, and
- **O** Options.

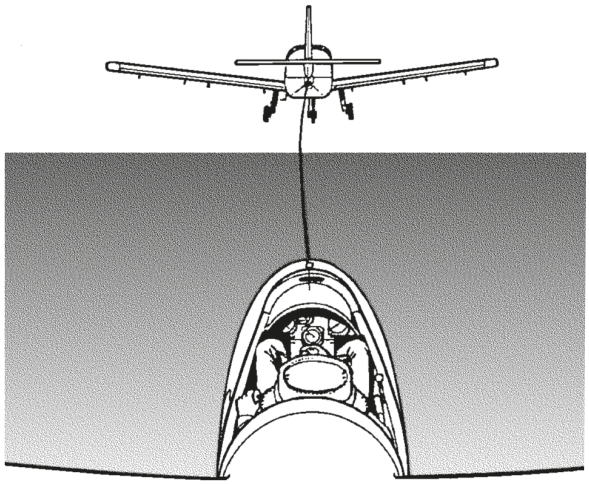
When ready to go and you have been given the ***"All clear above and behind"*** signal by the wing runner, they will give the "Take up slack" signal and remind you to ***"check canopy and air brakes locked"***, then run and release the wing as you gather speed. Until you have sufficient airspeed you will need to use fairly coarse movements of the controls to keep the wings level and the glider in the correct attitude, running on the main wheel. If you have difficulty keeping the wings level and there is a possibility that a wing tip might touch the ground, or you lose directional control, release immediately. This is very important and will help prevent a possible ground loop and damage to the glider.

As the aircraft picks up speed, the controls will become more effective, and the glider will lift off at the right speed. This usually occurs before the towplane takes off. Try now to keep no higher than about 6 feet above the ground. This will prevent the possibility of pulling up on the towplane's tail, making it difficult for the towpilot to take off smoothly; they may even release the rope from their end if you get too high and you begin to upset the towplane! This situation is discussed more fully at the end of this section.

High tow position for aerotowing

The aerotow method described here is for the high-tow position – just above the slipstream of the towplane. Most clubs in Canada use this method. The glider normally will be physically below the towplane, but above it's slipstream. When the glider first takes off and is held level just above the ground, the glider will be higher than the towplane for the correct high tow position. Then, as the towplane lifts off, adjust your height to just below the towplane by moving down slightly relative to the towplane. You will remain above the slipstream created by the towplane. As you continue to climb, the best method to maintain your vertical position behind the towplane is to keep it in the center of an imaginary sight on the canopy ahead of you.





Glider pilot's view of towplane in high tow position
Clear sky between the horizon and the wheels of the tug

This position is seen when the towplane's wheels are 1 to 2m above the horizon (or imaginary horizon if you can't see it). In mountainous terrain the horizon is often below the tops of the mountains. Even over flat country the horizon won't be clearly defined or visible if the air is hazy. Notice the towplane's position relative to the yaw string attachment point for the glider you are training in. Then adjust the height of the glider behind the towplane using this "aiming point" on the canopy of the glider, keeping the towplane in the center of this sight.

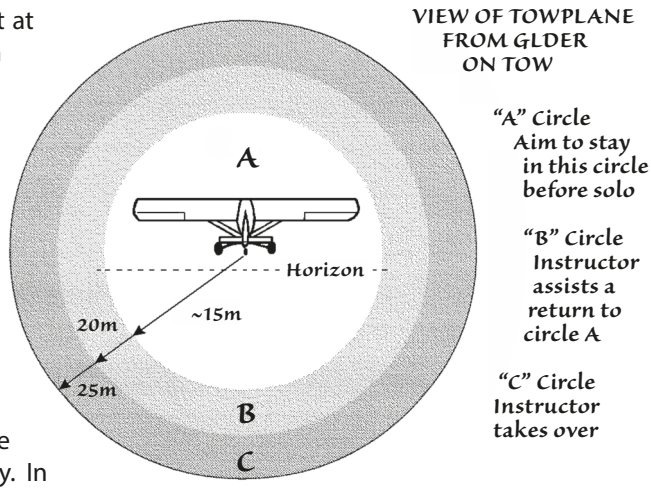
The illustration on the next page shows such an imaginary sight and it is illustrated with some circles to show you how far you can allow the towplane to deviate from the ideal position. In fact, the towplane pilot is always trying to keep a steady climb, and although the towplane appears to move around it is usually the glider that is moving relative to the towplane.

A question sometimes asked is, "how would you establish the correct position of the sight on the front of the canopy, for example when flying behind a new and maybe more powerful towplane?" In this case you will have to notice the position of the towplane when you and the towplane first start to climb out from the runway, when you still have the view of the ground and the topography ahead, to give a good idea of where the horizon would be. Then you will be able to adjust the glider's ideal position to give the most comfortable view of the towplane. Set the sight in this position. Using references such as where the towplane's elevator intersects the wing struts or undercarriage legs is not so easy, and in turbulent conditions can lead to large vertical movements of the glider as the glider pilot tries to correct for every small deviation.

During straight climbing, maintain your position directly behind the towplane by normal use of the controls. The aim during the tow is to keep the towplane in the central circle ***A*** as in this diagram by maneuvering the glider as necessary. To begin with you will need assistance to keep it within circle ***B***, while the instructor will take over if it strays into ***C***.

Looking again at this diagram, if the towplane were to suddenly ascend, it would move up into circle ***B*** or ***C***. You have done nothing to get out of position; it's not your fault! How should you now move the glider to get back into the correct position?

Using the concept of the imaginary sight on the canopy, imagine the circles of the diagram fixed on the canopy, that is, using the circles as the sight. Now try to keep the



towplane in the center of the sight at all times. In this example, as soon as the towplane begins to rise, merely adjust the attitude of the glider to keep the towplane in the center of the imaginary sight. The glider will climb a bit faster now, so as the glider returns to the correct vertical position relative to the towplane you will be adjusting the glider's pitch attitude automatically to maintain the correct height position. This is an effective technique that is mastered quickly. In the previous paragraph, we started by assuming the towplane had climbed rapidly into circle ***B***. This technique is equally effective in returning the glider to the correct vertical position in relation to the towplane.

Should you start weaving from side to side, efforts to stop these oscillations often lead beginners into worse trouble. The problem starts because the pilot lets one wing drop slightly and does not immediately recognize this, then the glider starts to turn away from the towplane and the lower wing drops even further. As the glider drifts more laterally the tow rope tightens and yaws the glider inducing a roll towards the towplane. By the time the pilot reacts, it is not easy to make the needed correction without help from the instructor.

The easiest way to prevent these oscillations is to keep the wings parallel to those of the towplane. If one wing does start to drop, make a small banking movement, as in a correctly coordinated turn, to return into line, directly behind the towplane. Return to level wings about halfway back towards the correct position behind the towplane and drift into position. If you hold the bank until in the correct position you will have to then momentarily turn the other way just before reaching the central position before leveling the wings; otherwise the weaving may start again. Anticipation is the key to staying in position.

While on tow, turns will normally be made with moderate angles of bank. When the towplane gradually starts to bank, wait a couple of seconds before banking the glider to an angle of bank identical to that of the towplane. Keep your vertical position as before, but now you will need to point the glider's nose more towards the outer tip or even beyond the tip of the towplane's wing in steeper turns. To help you do this, assume that the sight on the canopy is moved slightly to that side. This is to assist you to keep flying the same radius of turn as the towplane, the ideal situation. In this way you should be able to keep in the correct position behind the towplane.

High tow versus low tow position

The instructor will first demonstrate the low tow position. This position is sometimes used

for long tows, for example for cross-country tows, and you should become familiar with it. Having advised the towpilot beforehand, you will be asked to follow through with the instructor during the above demonstration. At about 1000 feet height above ground on normal tow, check for other aircraft, and make sure that the glider is in good vertical and lateral position directly behind the towplane. Then, move smoothly down through the wake, without deviation to one side or the other.

If the glider is held in a good position directly behind the towplane during the transition to low tow position, the effect of the propeller slipstream will be minimal. It may cause a mild vibration of the glider, which is not objectionable. As the glider descends below the slipstream, the vibration will stop; you are now in the low tow position. The glider will appear to be very low but this is normal for the low tow position.

If you do move out slightly to one side during this maneuver, the glider will tend to roll towards the towplane as one wing only moves through the downwash (or down-going slipstream). This is not a problem and can be handled normally. Later in your training you may be asked to do a variation of this maneuver yourself, to improve your abilities to handle the glider on tow. First move out to one side of the slipstream while in the high tow position. Then descend to low tow, keeping out to the side. While in low tow position move across to the other side of the slipstream before again climbing back to high tow. You will most likely avoid the slipstream throughout the maneuver and you will gain valuable experience. This maneuver to demonstrate control is called “boxing the wake”.

To keep in the correct position while in low tow, sight the towplane through reference points or the imaginary sight that you choose on your canopy. While climbing, the towplane will appear much higher than if you are in low tow when flying straight and level. Some countries, such as Australia, use low tow for all aerotows, but in Canada high tow is normal for the climb; low tow is usually confined to cross-country towing or if a descent on tow was required. In this case, the glider is only slightly below the towplane because both aircraft will be flying level. The glider is often easier to handle for long periods in this position as it is more relaxing for the pilots; also the glider is in a more stable position.

Before releasing, it is usual practice to return to the high tow position. It is of course perfectly acceptable to release in low tow if care is taken to turn right smartly to avoid the swinging towrope.

Towplane upset

There are certain conditions during the early part of the take-off and tow when it is possible for the glider to inadvertently lift the tail of the towplane. If the glider simply gets too high this may not be enough to cause an upset. However, a combination of factors can lead to a rapidly diverging situation where the upward climbing movement of the glider is very rapid and is known as the “slingshot effect”. The towpilot has little warning and usually cannot react in time to save the situation.

An upset can occur when there are several factors combining to create difficulties for the pilots. For example, if there is a strong wind and the towplane climbs steeply immedi-

ately after leaving the ground, the towplane will enter the wind gradient and climb even more rapidly. It could then leave the glider very low relative to the towplane. This will require the glider pilot to react quickly and to climb steeply too. If the glider has a belly hook or is being towed by the cg hook, the pull of the rope could create a strong nose-up pitching moment, compounding the problem. If the towplane is powerful and there is a strong wind gradient into which the two aircraft are climbing, the nose-up pitching of the glider may not be controllable by the glider pilot. This leads to a divergent situation, and the towplane can be upset in less than two seconds.

However, accidents of this type are extremely rare because pilots anticipate it might occur and are careful to avoid aggravating the situation. Nevertheless, the following additional factors should be understood because, in combination, they could cause an accident.

Gliders with tow hooks under the belly or with cg hooks only, are susceptible to a nose-up tendency especially when being towed faster than normal. The older types of glider such as the 2-33 can be affected, particularly when being accelerated. Think of these types when being winch launched; they require full forward stick position initially, and yet the glider still rotates rapidly into a steep climbing attitude as it is accelerated.

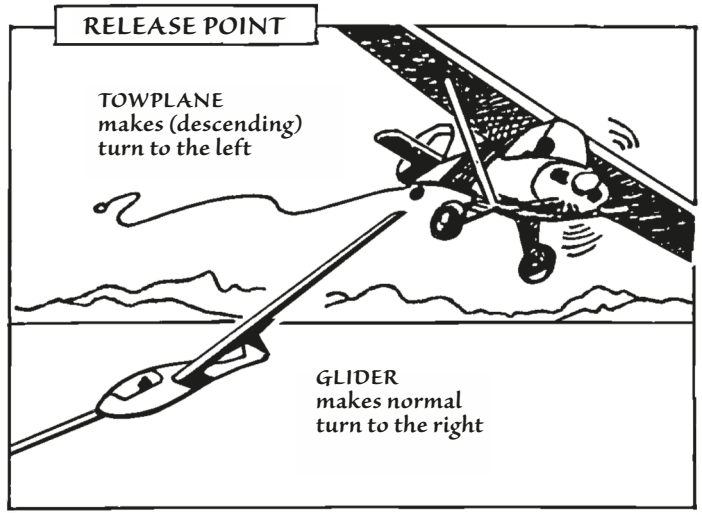
Rope length is important, as the time taken for a slingshot action to upset the towplane varies with the square of the rope length. A length of 60 metres gives four times the time of a 30 metre rope.

An upset can occur also when turbulence causes the initial disturbance to start the glider climbing rapidly. Gliders loaded with water ballast can have their center of gravity higher than normal (due to wing flexing), and if they also have a cg hook, the pitch-up force from the pull of the towrope may exceed the elevator's authority and it will be insufficient to prevent the start of a slingshot type of upset.

Unfortunately, the strength of the weak link in the towrope is insufficient to provide protection to the towplane pilot from a slingshot accident. Adequate training is required in all cases and, when you have limited experience with aerotowing or with flying a particular glider, an extra dual checkflight is strongly recommended, especially under windy and turbulent conditions. The tow pilot will likely release you if your actions may upset the towplane, particularly at lower altitudes where recovery of the towplane is unlikely.

Releasing from tow

When you have reached the release altitude (usually 2000 feet above ground) and before releasing, complete the pre-release check followed by a post release check as described earlier. Do you have height and distance to make the field? Many student solos claim they were not comfortable with the release area. Don't release unless you are sure. Scan the horizon for other aircraft, particularly to the right, the direction in which you will be turning. If clear to your right look back at the towrope, pull the release, and visually check that the rope releases and falls clear of the glider. Now initiate a turn to the right. This turn indicates to the towpilot that you have released. At the same time it is usual to adjust your speed to that for the following lesson. Often this will be a speed reduction.

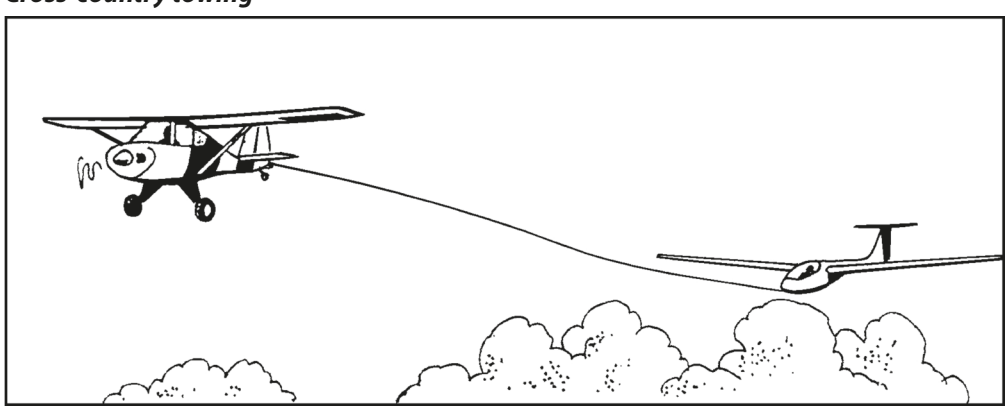


No attempt should be made to gain height by climbing just before or after release. This is a "soft release" to not add stress to the equipment and avoid putting you in the embarrassing situation that you cannot release. The rope also can become knotted when it releases from the hook. If the release fails, a habit of climbing after release could lead to a towplane upset! As part of your post-release checklist, if the towplane does not turn away after your release, advise them by radio that the glider has been released.

The objective of the glider turning to the right after release is to quickly get clear of the towplane's slipstream and the dangling rope, but also to move to the side so that the towpilot can see you and increase separation. The towpilot will not descend until they have assured themselves that the glider is free. The turn should be about 90 degrees, though if in a thermal, you may wish to continue circling. However, if you do this make sure that the towplane is clear and is descending as you circle around during your first complete turn as the towplane may also continue to climb to cool the engine or may not realize glider has released.

After the rope has been released and you have turned away, re-trim at the speed for the air exercise, and make sure you know where you are in relation to the club's field and any other traffic. Raise the gear if retractable now that you are off tow by confirming the handle position in the gear pictogram. Your flight should be flown in relation to the field and the circuit you will be flying unless you are now climbing.

Cross-country towing



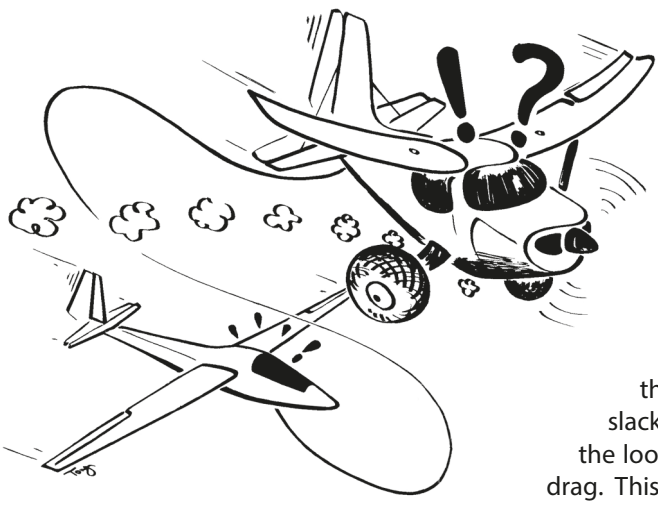
Most tows are made to gain height, but you may become involved in a cross-country tow. The low-tow position is most often used, and you may prefer to use a longer towrope than usual. This will help reduce your workload, particularly in rough air. It is easier to keep in position on a long flight when in low tow, when any tendency to go too high is immediately obvious as you encounter the slipstream.

Be careful to observe the glider's maximum aerotow speed and to make sure that you and your towpilot are absolutely agreed on signals to be used for normal and emergency situations. Have alternate landing areas selected ahead of time if flying over inhospitable terrain, and above all, plan ahead. In cool weather dress warmly. Cold pilots don't function well; cold can be as debilitating as alcohol.

Either during or usually at the end of the flight you may wish to descend while still on tow. If the descent is done gradually by the towplane, there will be no problem for the glider pilot. In a rapid descent the glider will tend to overtake the towplane – this may be avoided by using the air brakes and/or yawing slightly to increase the drag to keep the towrope tight. Descending in the low-tow position is best, and edging into the towplane's slipstream a bit with air brakes open as needed will help create the necessary increase in drag. Since, without special instruments, it is impossible to maintain the correct flying position unless the towplane is visible, it follows that the towplane must not fly into cloud – if it does so, release immediately.

Slack in the towrope

During the tow, control actions of the glider and towplane or air turbulence can sometimes contribute to slack in the towrope. It is important that you can handle the glider so that when the rope snaps tight again it does not break, or the sudden pull does not damage either aircraft, especially for older gliders that may be less robust than the modern sailplane.



If the glider first flies outside the towplane during a turn and then rapidly turns into position, or climbs too high then dives and gains speed, slack in the rope can occur. Rough air could cause the towplane to descend rapidly before it pulls up, slowing itself but not the glider. This often causes slack to occur in the towrope. To control such slack, yawing the glider (away from the loop in the rope) will create extra drag. This is the first and easiest technique to use. If a small loop does form, the pull of the rope will yaw the glider back into line as the rope retightens. Air brakes also may be used sparingly as they can create too much drag and break the weak link but

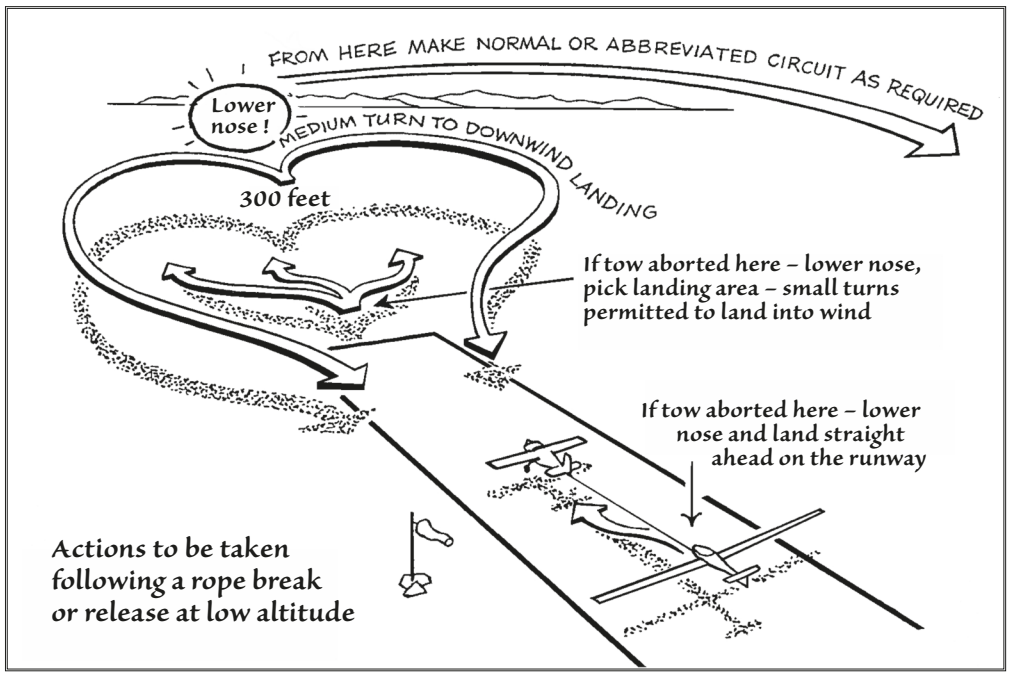
yawing the glider is a better way of handling small amounts of slack when aerotowing. If a large loop occurs in the rope to one side of the glider, first yaw away from the rope; this often takes out much of the slack. Then as the rope snaps tight, lower the nose slightly and point it towards the towplane as the rope becomes taut again to prevent stresses that may cause a rope break. You may have to smartly climb back into position too, as this maneuver may have put you low with respect to the towplane.

In very rough air (e.g. in a rotor when wave flying) it will take all an experienced pilot's resources (air brakes, full control deflections) not only to keep in position but also to keep the rope continuously tight. As slack in the rope rapidly re-tightens, the pilot can try to equalize the speeds of the two aircraft by lowering the glider's nose. At the same time, if the glider is pointing away from the towplane, the sideways pull on the nose of the glider and on the tail of the towplane will cause both aircraft to yaw into line. This will help reduce any sudden shocks on the rope and aircraft. However, as stated before, if at any time the glider pilot loses sight of the towplane the glider pilot should release!

Failed launch procedures

It is possible that the towplane pilot might have to release the glider due to a malfunctioning motor for example, or for the weak link on the rope to break. Should either occur low down during the early part of the tow, an emergency situation can develop. Procedures to handle such emergencies must be learned and practised; this is particularly important because a launch failure at lower altitudes does not leave much time to sort things out.

The best course of action is to ***pre-plan*** your response to a low-level release or rope break. In fact, having noted the wind speed and direction during the pre-takeoff checks, now is the ideal time to decide whether or not you would attempt a downwind landing under the



prevailing conditions. The techniques to follow for a downwind landing are given earlier in this chapter on the ***Circuit and Landing***. So, for all heights during the initial part of your take-off and tow, have a plan of action worked out before you actually begin the take-off.

If the rope should break or the towpilot release the rope at a height of less than 300 feet above ground you should normally follow an automatic plan to land straight ahead. It is dangerous to attempt to turn around to land on the runway when very low, so your first choice should be this automatic reaction. Then use your Pilot Decision-Making abilities, as reviewed below, to make a safe landing.

When there is a significant crosswind, a useful practice is for the towplane pilot to bear off to the downwind side of the runway center line after take-off, then to angle into wind. If a rope break occurs or the towplane pilot releases the glider low down, a turn back towards the runway (this may be a left turn) will incur minimum height loss because a turn of 180 degrees or slightly less gets the glider immediately back to the runway center line. Another benefit is that the glider pilot does not waste any time deciding which way to turn at this critical time. Also, a turn into a crosswind may help line up the glider with the runway during a turn for a downwind landing. At higher altitudes if a modified circuit is more appropriate, a turn with the wind is better so that the base leg will be into wind. Another available runway may modify this practice. Your instructor will introduce you to any local modifications to the circuit and towing patterns as part of your flight training.

Remember that if the towplane fails or begins malfunctioning, your speed at the wave-off or release may have decreased to below normal without you having noticed it!

Time for pilot decision-making

Before you do anything else, if you should find yourself suddenly without the towrope attached, for whatever reason, your first essential action must be to lower the nose to below the normal approach attitude, to regain approach speed for the current wind conditions – if very low, the nose will have to be less nose-down. Now you have a bit more time to assess the ***Situation***. What is the height, speed and the position of the glider relative to the runway, and what is the wind direction and speed? Even if you had planned ahead, the situation may be slightly different. Next consider your ***Options*** and predict what will happen with each option, because you will choose one of them. For example, what will happen if you start an immediate turn? Is there a possible landing area to the side and what is its surface like? What would happen if the turn were to be continued? Would it be safe to land on the runway? Choose the safest option and ***Act*** quickly, as there is not much time for hesitation.

Now ***Repeat*** the process by re-assessing the developing new situation. Was your prediction accurate? Is there still sufficient height to continue the turn, for example, and is the speed still safe for the conditions? If not, immediately act to correct it, and assess new options. Then act on the safest option, and repeat the process.

Notice that the automatic reaction to a low-level emergency can be modified safely by good judgement. The PDM or pilot decision-making technique, using the mnemonic ***SOAR***, is shown being used above, by safely modifying the normal automatic reaction

to this emergency. Appendix C shows further examples that are analysed with the PDM technique.

To help us when time is at a real premium, we need some other good habits. A good one to use at low heights is to keep your left hand close to (but not holding for aerotow) the release knob. This can be close to the airbrake handle as well, in which case you can close the air brakes promptly if a bit of rough ground allows them to pop open – keep the back of the hand or fist against the handle, not around it. Now, if a rope break occurs when low or you are signalled to release immediately – this is another possibility – you can pull the release handle without delay because your hand is very close to the handle.

In summary then, if the glider is released or the rope breaks very low down, follow these actions:

- lower nose immediately, to regain and maintain a safe approach speed,
- pull release to let go of any rope,
- plan to land straight ahead, or slightly to either side in a suitable field or area,
- make no turns except to adjust into wind,

At some point above 300 feet you can decide when it may be possible to return to the runway with either a downwind landing or a very abbreviated circuit. At this point you can deliberately remove your hand from the area of the release handle.

Again, if the rope breaks, lower the nose to keep up your approach speed, pull the release handle to drop any rope still attached, and turn initially so that you are flying across the wind. Now assess the situation – can you land downwind on the field? – wind less than 10 knots, and no hazards on the runway? – can an abbreviated circuit be flown or must an off-field landing be made? Don't wait, make your decision, act, and concentrate on landing. If landing downwind on the field, land as soon as possible well clear of hazards. Keep the wings absolutely level as long as possible to prevent a swing and possibly a ground loop (caused by the weather-cocking tendency of the glider).

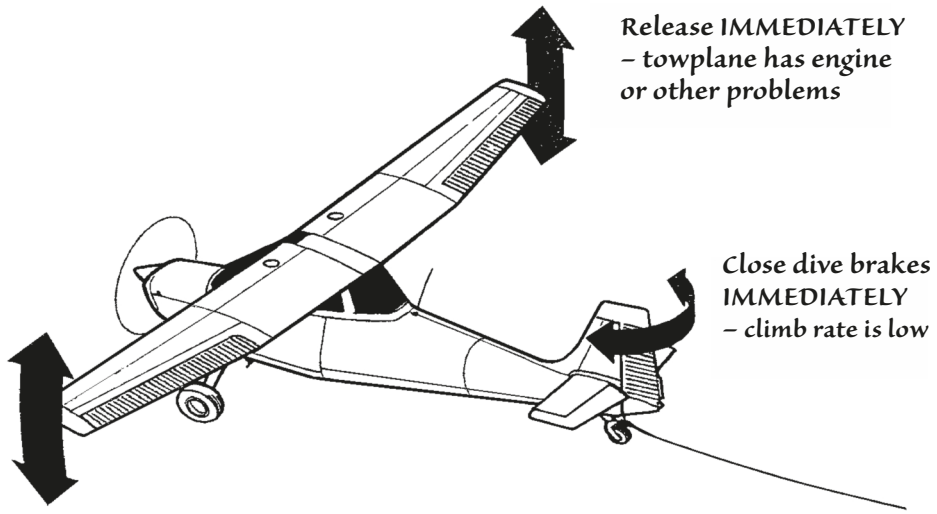
Emergency towplane procedures

Three main emergency air signals are necessary between the glider and the towpilots. The visual signals take precedence over radio calls that may also be used. These are:

- When the towpilot waggles the wings steadily in a rolling motion, this is an order to the glider pilot to release immediately – this ***must*** be complied with at once. [Radio Call: "Release, release, release."]
- The towpilot waggles the rudder as a signal to the glider pilot that the climb rate is low and that the glider pilot ***must*** immediately check that the air brakes are closed and locked. [Radio Call: "spoilers-spoilers-spoilers", (airbrakes).] This rudder signal may also indicate something else is visibly wrong with the glider if airbrakes are not open, such as a second tow rope is hanging from the main rope at the glider end.
- When the glider pilot cannot release, position the glider to the side, normally to the left of the towplane, and waggle the wings in a rolling motion. This is a

signal for the towplane pilot to release the rope at his end. Having given the signal, return to the usual towing position. If necessary, repeat the signal.
[Radio Call: "Towplane XX, Glider XX cannot release."]

There are other signals used, for example to signal the towpilot to turn or to change speed, but these are not emergency signals. Because they are not standardized in Canada, learn the signals used by the local club. Most gliders and towplanes are radio equipped and these requirements can be sorted out by verbal communications (CRM).



Failure of sailplane release
When the sailplane pilot has signalled to the tow pilot that they cannot release, the tow-pilot will return to the airfield at the same altitude and will release the rope from the towplane end. Should it then release from the glider it will (one hopes) fall near the airfield. If not, try pulling the release handle again. However, ***do not*** assume that the rope has fallen free. You should now plan a circuit to land back at the field remembering that the rope will possibly be trailing 20 metres below you. Your final approach should be higher by at least this margin so that the rope will remain clear of all people and objects.

Failure of sailplane and towplane releases
Such an occurrence is very unlikely indeed, but you should consider the possibility. Having signalled that you cannot release it will soon become apparent that the towplane release will not function, when the towpilot returns to and tries to release you over the airfield. Now you will have to do a formation landing. This is easier than it might appear at first. However, it should not be taken lightly because such a landing does require some skill. The towpilot will fly a wide circuit, and will make a power-on approach. They will try to maintain a low descent rate so that you will be able to keep the towrope tight by careful use of the air brakes or spoilers.

If not done already, move to the low-tow position during the approach. This will be at the same height as the towplane, which is higher than during a normal climb. You will be able

to feel the slipstream if you move too high. During the landing you will touch down first or almost at the same time as the towplane. After the towplane has landed keep the rope tight as before, or by using the wheel brake, so that you don't pick up the rope with your wheel. Move to the right of the towplane as you slow to a stop. Since the chance of this ever occurring is so rare, you will not be asked to practise landings on tow. However, your instructor will have you practice descending on tow at altitude as a separate exercise.

WINCH LAUNCHING

Actions prior to take-off

You should by now be familiar with the signals and the cable hook-up procedures given earlier in this chapter. Winching is an exciting launch method that requires discipline to do correctly (therefore safely) every time. Your club may have slightly different procedures to those that follow, and you should become thoroughly familiar with them.

Before getting in the glider, it is good airmanship to do two inspections: first an external inspection or walk-around inspection of the aircraft, and second an ***internal*** inspection of the cockpits. Make sure the glider is properly lined up, and that there are no obstructions that you might hit should you inadvertently swing to one side during your ground run at the start of the take-off. Review the beginning of the section on aerotowing also, because the advice there is equally applicable to winch launching.

During the cockpit check, the ground assistant or wing runner will be checking the cable or wire, parachute and weak link closely, and should show it to you prior to hooking it up to check the release. This allows you to see that the correct ring and weak link for your glider are in use. When checking the release, check both forward releasing and the back release. At the end of the **CISTRSC-O** checks, be careful to go through the ***O – Options*** item with your instructor. Here you will plan what to do if the launch is abandoned prematurely, in other words plan your options, and review your decision heights before you start the take-off.

Prior to asking "All clear above and behind?" check again that there are no obstructions on the runway by searching the area ***ahead*** for hazards and ***above*** for other traffic. When you have asked the wing runner or signaler, "All clear above and behind?" and received the same in answer, the wing runner should also ask you to ***"check canopy locked, check air brakes locked"***. Then you give the ***"Take up Slack"*** signal.

The take-off and initial climb

The winch launch or vehicle launch (2000+ ft rope) has three phases that will occur. The take-off, initial climb below 300 ft agl, and full climb above 300 ft agl. You will have preset the trim during your cockpit check, but with some older gliders you may need to hold forward pressure on the stick to prevent the nose rising too rapidly during the initial acceleration. Keep your left hand on the release handle.

As the ground run starts, keep the wings level with positive use of ailerons, a lot of rudder may be required for a few seconds to keep a straight course aimed at the winch. If you

have difficulty keeping the wings level or if one wing drops to hit the ground, or directional control is lost (more than about 20 degrees off the runway heading), release immediately. The reason is to avoid cartwheeling the glider or groundlooping violently and being damaged, or causing damage by hitting an obstacle such as a person or aircraft nearby. As the airspeed increases, the control movements become less pronounced. Allow the glider to lift off itself – do not deliberately pull back on the stick to lift off early.

Rotation into the full climb

When the airspeed reaches the proper value for the climb, the glider will automatically have assumed a climbing attitude. Continue the climb at no slower than ***50 knots or 1.5V_{SO}***, whichever is higher (V_{SO} is the 1g stall speed). At this speed, it is safe to rotate to the full climbing attitude above 300 ft agl. It is recommended that you rotate to a climb angle of about 40 degrees in ***no less than 6 seconds*** from the launch. The need to limit the rotation rate ***cannot be over-emphasized***. At a slightly higher rotation rate, the stall speed during the rotation could approach your actual speed. Rotating at the recommended rate will keep the stall speed safely below the actual airspeed. Now maintain the airspeed at least 10 knots above the recommended minimum launch speed.

The full climb

The angle of climb will depend upon the glider, its airspeed, and the roughness of the air and to a certain extent the wind speed. If the airspeed is too slow (that is, a minimum of 5 knots above the recommended minimum low speed) it is not advisable to try to improve the climb by additional backward stick pressure; the glider will only mush and apply extra load on the winch. This in turn will make it difficult for the winch to increase speed, unless it is very powerful. See ***Signals during the launch*** opposite.

Therefore, if you find the speed decreasing to a value close to the minimum recommended launch speed, it will have become obvious to the pilot(s) that the winch is having problems or that the operator does not recognize the low speed. In either case, you should be lowering the nose in response to the declining speed, so that the glider will already be at a safe flying attitude if the winch stops entirely. If the winch does not increase the speed immediately, release and carry out the ***Launch Failure*** procedure, given later in this section.

If the airspeed becomes too fast (that is about 5 knots below the maximum speed recommended) do not climb more steeply as this imposes extra loading on the glider (and the cable) especially at the top of the launch, and initially this action might increase the airspeed. In this case, give the ***Too-Fast*** signal.

Before giving the ***Too-Fast*** signal, lower the nose to reduce the loading on the glider. This reduces the stresses on the equipment, particularly the loads on the hook and the bending moment on the wings, which can become very high at the top of the launch. In fact flying at too high a speed is not so much of a problem during the full climb but is considerably more so at the top of the launch.

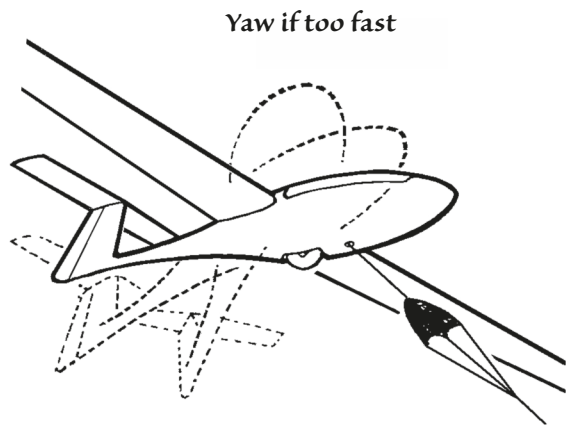
On calm days it would be appropriate to climb at a slightly higher airspeed than on a windy day. On windy days, a slower climb will give a higher launch and less stress on the glider, which is caused by the turbulence that you will fly through.

During the full climb, hold the wings level. The steep nose-up attitude will feel awkward at first and you will have to judge whether you are level by looking out to either side of the cockpit. After you gain experience and become more relaxed, you will be able to use your peripheral vision more easily to judge whether your wings are level.

Signals during the launch

If the airspeed close to the ground becomes excessive, climb gently to several hundred feet, then release. Now follow the ***Launch failure*** procedure.

If the airspeed nears the recommended maximum launch speed during the full climb, signal the winch driver with the ***Too-Fast*** signal – yaw the glider to the left and right with firm rudder movements while keeping the wings level. Continue this signalling until the winch operator reacts or until the excessive speed makes it necessary to pull the release. Lower the nose slightly as you are signalling in order to reduce the angle of attack of the wings and hence the load on the glider's wings and hook system.



The ***Too-Slow*** signal is when the glider pilot must also lower the nose, in this case to reduce the loads on the winch and to maintain the glider's airspeed if the winch does not increase the speed to ***normal*** for the climb. The ***Too-Slow*** signal is to lower the nose as a distinct maneuver. The lowering of the nose is usually quite visible to the winch operator or the launch controller when the glider is rotating into the full-climb attitude. At an earlier point in the launch the glider may not be clearly visible to the winch operator, in which case the signal will be relayed by the launch controller by radio, telephone, or other means to the winch operator who should immediately increase speed.

If, for example, the winch engine should slow and then stop, the glider will be safer than in the full climb attitude because the nose should have been lowered already to the normal gliding attitude. However, you should be careful because, when the winch actually stops, the glider's speed may not yet have reached a safe value for an immediate approach. Therefore, if you find it necessary to release, lower the nose even further to below the normal approach attitude. This is the first step of carrying out a recovery from a failed launch. This lowering of the nose to lower than the normal approach attitude ensures that you will accelerate quickly to an adequate approach speed for the wind conditions. Then complete the recovery by choosing the best option to make a safe landing that you made before making the launch.

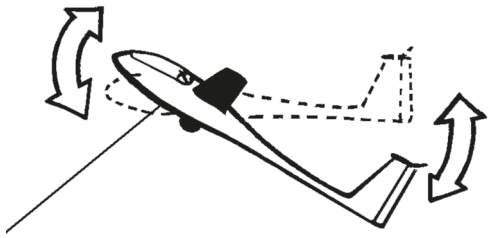
Launching with newer winches

Newer and more powerful winches most of which use computer controlled tensiometers allow a different technique for the climb, by which the pilot will adjust the glider's attitude

to control the speed. Unless your club operates one of these powerful winches, learn the ***Too-Fast*** signal (yawing the glider alternately side to side) and ***Too-Slow*** signal (lowering the nose) at the outset, as this will provide a good foundation for your future flying on different winches.

Porpoising

A pitching motion known as porpoising will occur near the top of the launch sometimes. Rough air, pilot induced control motions, elevator stall, or the elasticity in the cable may contribute to this phenomenon. It is easily stopped by briefly relaxing the back pressure on the stick.



Laying off for drift

If the launch is made out of wind, the windward wing can be kept lowered slightly. This allows the glider to slip towards the wind, giving a straight climb in line with the runway. Under these conditions you will have to look out both sides to judge the track or heading along the runway center line or use a cloud ahead to maintain a constant heading. You will need to hold a constant bank angle to maintain the desired amount of slip, at the same time applying some rudder deflection to maintain a straight track. This is not easy to do well, but practice improves the skill, as is usual in flying.

Releasing

When the glider has lifted the cable to an angle of approximately 80 degrees from the ground, the winch cable will increasingly pull down on the glider, and you may be able to see the horizon over the nose. Now get ready to release. The winch operator will slow or stop the winch as the signal to release. This will reduce the pull on the cable, usually enough that the pilot(s) can feel it. Now lower the nose to a descending attitude and pull the release knob. Then adjust your speed and re-trim as required.

Estimate your launch height by looking at the ground, then, and only then, check against your altimeter. This is good experience for later flying, particularly when you may be going cross-country and cannot rely on your altimeter to tell you your heights above ground.

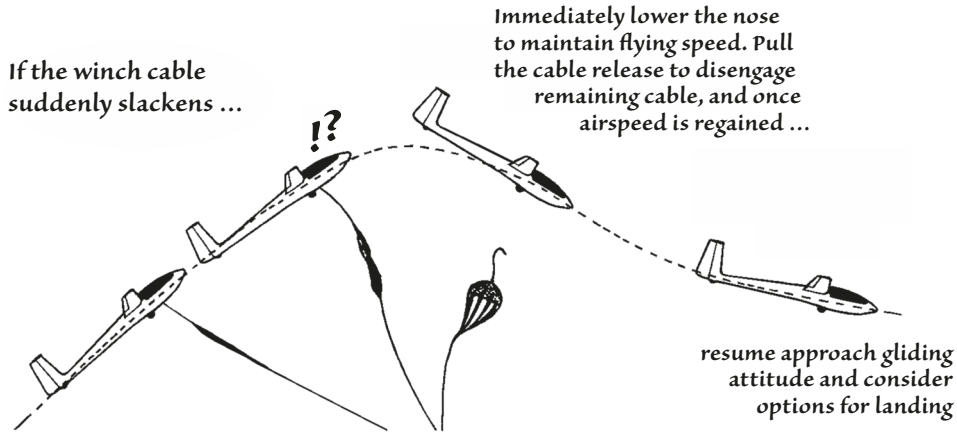
Emergency Procedures

Prior to take-off

If the glider slows down on the ground run, or over-rolls the cable so that there is a possibility of it being picked up by the wheel, pull the release ***immediately***, shout **"STOP"** and keep the stick fully forward. This should prevent a take-off if the winch continues to pull on the cable.

Launch failure – cable break or winch failure

If the cable breaks or the winch motor fails during the launch, you will have to make some quick decisions and to take rapid actions to carry out a smooth landing. Successfully handling such emergencies depends to a great extent on preplanning. Hence, before geting in the glider, go through your cable break procedures for different heights, and be prepared. Then during your pre-takeoff **CISTRSC-O** checks, at the "O – Options" item carefully review the chosen options for different heights.



On any cable break, the air brakes should ***not*** be unlocked and used until the normal approach speed has been reached. A review of wind gradients will be useful here, and will remind you of the value of pre-planning your approach speeds. At very low heights, your climbing attitude will be quite gentle provided you are following the correct launch procedure. If the cable breaks, lower the nose immediately to the approach attitude, or even lower, to pick up your speed again. Then pull the release knob to drop any part of the cable still attached; now consider your options, which at very low heights will be restricted to landing straight ahead.

Be especially careful if below 100 feet, by using a suggested recovery dive angle of about 15 degrees. At intermediate heights between about 150 feet and up to 300 feet, you might have to lose excess height before you land in front of, or alongside the winch. To lose excess height an **S**-turn is usually used. After a cable break immediately lower the nose with a pushover of about zero-g, and then pull the release knob as before. Don't confuse the zero-g sensation with that of a stall as you lower the nose. If you lower the nose quickly enough the glider will hardly lose any airspeed, but you will get that sinking or zero-g feeling! Now assess your height. If you judge that you are high, turn across the wind to the downwind side of the runway if there is an appreciable crosswind (it is vital to pre-plan this during the **CISTRSC-O** checks). You can now judge your final turn back towards the field, to land at the upwind end of the runway. Note your final approach will be more in line with and into the wind.

Once higher, you have more time to make well-judged decisions, so you might be able to consider alternatives by using the **SOAR** steps as described in the section on ***Pilot***

Decision-Making or Judgement Training in Chapter 2. If the cable breaks, again lower the nose immediately to the approach attitude – ***this automatic reaction must still be followed!*** Pull the release knob and now assess the Situation. What are your position and height, and the speed? It is probably not adequate to make an immediate turn, so you will have to wait several seconds before attempting to turn.

If you judge you are a bit too high for an extended **S**-turn, there will usually be sufficient height for an abbreviated rectangular circuit. Alternately, there is the possibility of continuing to fly straight ahead, so as to position yourself for a controlled 180 degree turn to land downwind on the runway. Don't be tempted to try and land at the launch point itself, you may find yourself turning onto final at much too low a height. Someone once said it is better to be safe and land ahead than to make a fool of yourself as you try to impress your friends by crashing the glider at the launch point. Sadly, there is truth in that!

Having assessed the ***Situation***, now work out your ***Options***, and predict the outcome of each. Choose the option offering the safest and best outcome for you, then ***Act***. As you carry out the maneuver that you have chosen, watch to see whether the prediction is coming true. This gives you a changing situation, so ***Repeat*** the steps by first reassessing the new Situation.

The result of using the above Pilot Decision-Making technique is that you should be making a good and safe landing, either alongside the winch, in the field beyond or to the side, or perhaps landing back on your runway. However, the decision-making technique does not mean you can omit pre-planning what to do in the case of a premature cable release or cable break. Do this on the ground before you start the launch process. It is surprising how much extra time this gives you when the emergency occurs! Now review again the rope break procedure for aerotow. Much of what is written there applies here too.

Cable will not release from glider

Though a cable hang-up should never occur and is in any case an extremely rare occurrence, you should know what to do. First, the winch has a guillotine to cut the cable for this type of event, so that when the winch operator suspects a problem with the glider's release, he or she will cut the cable at the winch end.

If the cable will not release, the glider pilot(s) will start a spiralling descent centered on the winch. They will do this at higher speed than normal, as the extra weight of the cable and the banking of the glider will increase its stall speed. When the winch driver cuts the cable, the glider would be flown downwind more, to leave adequate room to land into wind. It must be flown at sufficient speed to allow for the possibility of the cable catching on the ground (the weak link should break), and to allow for the extra weight and drag of the cable if the pilots must land with the cable still attached.

Winch loss of power

A more insidious failure is when the winch loses power but not completely. The slowdown as opposed to a complete stop is more difficult to process. Some pilots may hope the loss is only momentary or an operator error in the hope to save the launch and they will start to lose airspeed getting into mushing stall situation. This can result in a very hard

landing or stall/spin. It is best to treat this, if not a momentary situation, as a launch failure and pull the release. Then lower the nose to the recovery attitude and maintain the appropriate approach speed and land ahead. Be aware the winch rope recovery parachute may inflate in front of the glider at lower altitudes and may have to be avoided.

Just soloed!
Some clubs mark the happy occasion with
the presentation of a wildflower bouquet to the pilot
(and perhaps an impromptu shower)

Yee hah! – along the ridge at Cowley

CHAPTER 4 – ADVANCED MANEUVERS

SIDESLIPS & FURTHER STALLING

Introduction

Sideslips are used to compensate for a crosswind during the approach to land or to lose height rapidly. It is not an easy maneuver to master as there are several methods of initiating the sideslip. However, when you gain some competence at the sideslip, you will find it an extremely useful maneuver. It is sometimes called a forward slip, but this is a variation of the sideslip, and to keep things simple, we will call all such maneuvers by the one name, sideslips. Shallow sideslips are also effective for maneuvering behind the towplane on aerotow for making smaller corrections. This technique is used more often by experienced pilots before they get too far out of position that require coordinated turns. Once you are comfortable with slipping you can use this technique on aerotow.

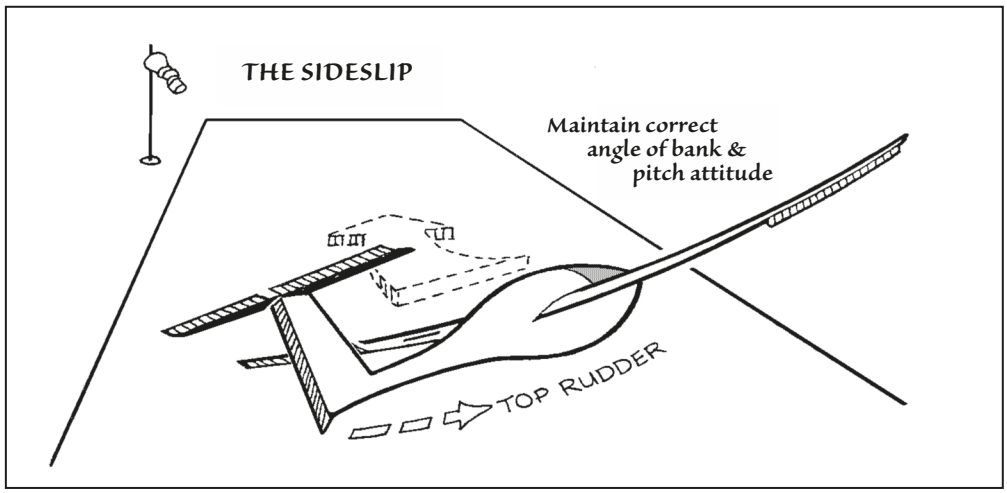
Definition of a sideslip

A sideslip is a maneuver in which the glider is banked, but in which the tendency to turn is prevented by use of the rudder. The glider then slips towards the lower wing, and high rates of descent are possible.

Purposes of the sideslip

The two main purposes of sideslips are first to ***compensate for drift*** while landing in a crosswind, and second to ***increase the rate of descent*** without increasing the forward speed, usually to correct a too-high final approach.

The glider may be sideslipped in straight flight or while turning, when the maneuver gives very high sink rates. This is most useful when coming in to land over tall obstacles such as trees or power lines, when on a cross-country out landing. Try such maneuvers first at a safe height.



Air Exercises – Sideslips

Preparation

The aim of this maneuver is to correct for an overshooting situation when you may have misjudged the circuit and you are too high on the approach to land at the usual spot on the runway. Prior to carrying out this exercise at altitude, look around for other aircraft and make sure you have adequate height bearing in mind your location relative to the club runway and the exercise you will be doing. Now start a coordinated, gentle-to-medium banked turn, and make sure the yaw string is straight.

During this turn, make a mental note of the angle of bank; this is the angle that you will want to maintain in the sideslip. Also note that you are keeping the speed constant by reference to the ***pitch attitude*** of the glider relative to the horizon ahead and this is the attitude you will be maintaining during the sideslip. This is important to remember because the pitot probes of many gliders are sensitive to yaw; that is when the airflow is at an angle to the normal direction, the airspeed indicator will misread because of the reduced dynamic pressure on the pitot. The static ports will also not be normal to the airflow, which will further contribute to errors in the airspeed indicator (ASI) reading. Many ASIs will show a negative speed in a steep sideslip! So, don't refer to the ASI for speed control in a sideslip, use pitch attitude instead.

Entering a sideslip from a turn

The first method of entering a sideslip can now be tried. As you turn, apply top rudder. The glider's nose will yaw towards the upper wing as you apply the rudder. This will make the glider slip towards the lower wing, and the turning will stop. Next you will notice that the glider will try to unbank the wings. This is caused by the further effect of the rudder. It works when banked as well as when level, which was demonstrated in an earlier lesson in Chapter 3. Soon the speed will decrease unless you compensate by correcting the pitch attitude. Your first attempts at the sideslip may be awkward, so center the rudder to coordinate the turn again, and return to a well-controlled turn.

Enter the sideslip again and notice that, to prevent the glider from turning, you are having to control both the angle of bank (with the ailerons) and the amount of slip (with the rudder). Simultaneously you will be maintaining a constant pitch attitude (with the elevator). The controls may appear to be ***crossed***. You will get a distinct feeling of slipping sideways in the seat. Notice your direction of travel is not straight ahead but is at an angle, more towards the lower wing. Remember this angle.

After you have tried a few entries to the sideslip and have recovered again to a well coordinated turn, you are now ready to try flying the sideslip in a specified direction. Again from the turn, watch for a suitable ground reference such as a straight road, and start the sideslip as you turn towards the road. The sideslip should be established with the direction of travel along the road, and the nose of the glider pointing ***up*** from the road at the angle you remembered earlier.

This technique will be used when making your final approach and you realize you are too high. As you make your final turn you can start a sideslip, controlling the direction of travel along the runway centerline.

Entering a sideslip from straight and level

Situations will arise when you will want to sideslip from a straight and level attitude, for example when you are already established on final approach. Here you need to bank the glider and start the yaw at the same time. This is not so easy, hence it is the next method described. In this method the glider should be flown with wings level, parallel to a reference line and preferably in line with the wind. This will avoid illusions caused by drift over the ground. The sideslip is then started with firm control inputs, by banking and by applying top rudder simultaneously. Now maintain the previously remembered angle of bank and pitch attitude, and the technique can be used effectively to smoothly enter a sideslip. Too quick or vigorous application of the controls and the glider will be difficult to handle in this unusual attitude, so be careful until you have the skill to control it well.

To do a reasonable sideslip in some gliders, you will need to apply the rudder first to start, to initiate a good slip. This may be tried in the two-seater. When you have established the skid with wings level, bank the glider now towards the advancing wing to slip. An acceptable sideslip should be produced. Control the pitch attitude and bank in the normal way.

Another technique of entering a sideslip can be used. The glider may be banked first with no rudder deflection (contrary to the normal entry into a turn). This produces adverse yaw, which is what you want in this case. Then almost immediately apply top rudder to start the sideslip. You can see in this technique that the effect of aileron drag will yaw the glider in the desired direction. Hence, as the glider is banked, the glider will yaw and will automatically assume a sideslipping attitude.

To initiate a sideslip using this effect, first choose the desired direction of travel into wind, as before. Roll the glider, and let the aileron drag start the sideslip for you. Now use the rudder to prevent the glider going into a turn, by holding the rudder against the turn. Again, you are in a sideslip. Control the angle of bank and pitch attitude (ie. the speed) as before. You may need to adjust the direction of travel during a sideslip; do this by using more or less rudder, or bank as required. You will notice that the glider will run out of rudder authority first, as the rudder will be against the stops before you have reached the steepest comfortable angle of bank. In this case reduce the angle of bank slightly, to regain good control of the glider.

The angle of bank will determine the rate of descent – the greater the angle, the greater the sink rate. This effect and the effectiveness of the rudder will vary considerably with different gliders – it's an excellent exercise to try when flying a glider for the first time.

Final approach and wind gradients

When using a sideslip to lose height on final approach, it is important to remember that the speed to fly is given in the glider's flight manual or by the formula (if the information is not available):

$$\textbf{Speed to fly on approach} = 1.5V_{\text{stall at 1g}} + \tfrac{1}{2}V_{\text{wind}} + V_{\text{gust factor}}$$

This speed must be established before the diagonal and base legs, and the final turn. During the sideslip, maintain this speed by keeping the pitch attitude constant as the

ASI reading is likely unreliable. The gust factor is the wind speed increase over the steady wind speed.

During the sideslip, bank the glider towards the wind if there is a crosswind. Recover from the sideslip at an adequate height to avoid having to contend with the wind gradient. The lower wing can get into the slower moving wind, hence the glider will be difficult to unbank because the lower aileron will be less effective (it has a lower effective airspeed over it). The effect of lowering the aileron also is to increase the angle of attack of that part of the wing, and if the angle approaches the stall angle, the glider will be very difficult to unbank.

Slipping turns

A variation of the straight sideslip is the slipping turn. It can be used when approaching a field with high obstructions near the downwind boundary, or when a base leg is made too close to the field to allow a normal final turn followed by a sideslip. A slipping turn is basically a normal turn in which the rudder is used to reduce the turn rate. At large bank angles the rudder is fully applied and the turn rate is controlled by the angle of bank only. Sink rates can be much greater than in a straight sideslip.

Recover as for a normal sideslip, but allow ample height to recover after turning onto final approach, as the sink rate can be very high. You may also notice that the force to re-center the rudder is higher than normal because the rudder tends to be held by the airflow against its stops during the sideslip. Practice slipping turns first at altitude before you try one close to the ground. As sink rates can be very high, only do slipping turns initially with an instructor, and use caution when doing them. This is a very useful exercise for exploring the behaviour and characteristics of a new type of glider, before you have to use a slipping turn, or even a straight sideslip, just prior to landing.

Control of drift in a crosswind

Prior to doing this exercise to counteract drift, choose a straight line on the ground, but this time it should be at right angles to the wind. It will readily be seen while flying along the reference line that the aircraft is drifting because of the wind's influence. This drifting may be counteracted by slipping the glider towards the wind. When the maneuver is done correctly, the longitudinal axis of the glider is kept parallel to the ground reference line. This maneuver is most often used to counteract drift when the glider is being landed in a crosswind, as described later in this chapter.

Air Exercise – Sharp stalls and recovery

You have already learned the gentle stall in Chapter 3. The sharp stall is more of an aerobatic maneuver than the gentle stall, and is taught so that you will become familiar with steeper pitch attitudes. You will also become more at ease with the glider when doing other maneuvers that will put you into what are called unusual attitudes. A sharp stall occurs more abruptly and rapidly than a gentle stall. The glider will display more pronounced reactions such as a definite nose drop, and more height will be lost before returning to level flight.

Before carrying out sharp stalls, review the recovery sequence with your instructor. And as you will be losing more height than in gentle stalls, make sure the area is well clear of other aircraft by carefully going through the **CALL** checklist. The glider should be in a wings-level attitude and flying at the normal speed for training maneuvers. To perform a sharp stall, raise the nose to about 30 degrees above the horizon and hold it there. You will eventually need full backward stick movement to hold the nose up. The airspeed will decrease rapidly, and the sound of the airflow will cease; buffeting may or may not be felt.

At the stall the nose will drop sharply even with the stick kept fully back. You will notice a strong dropping sensation, similar to the zero-g feeling that is felt when the glider is ***pushed over***, for example when recovering from a cable break on a winch launch, or from suddenly lowering the nose. Do not confuse these two situations; in a sharp stall, even if the stick is held fully back, the glider will pitch nose down. That is, the glider will respond differently to the controls and it will ***mush*** or fall down, whereas in a pushover the glider will continue to fly under full control albeit at reduced g-loads.

To recover from the stall:

- First immediately lower ***the nose*** as for the gentle stall recovery, to reduce the angle of attack of the wings and to let the glider begin to fly properly again. Do this in spite of the fact that the nose will drop on its own automatically, because if you don't the glider may well remain stalled and continue to descend, now in a nose-down attitude! As you lower the nose, centralize the stick;
- Look ahead or ***up*** at the horizon, to maintain your orientation or sense of where the horizon is; then
- Check the ASI – is speed increasing? and finally,
- Pull out of the resulting dive, levelling the wings if necessary as normal way.

The actions of looking at the horizon and checking the speed are made so that you will be fully aware of the glider's changing attitude and speed throughout this unusual maneuver. It is important to go through these steps on each recovery, so that when an inadvertent stall occurs you will respond automatically and correctly. In this way you will remain fully in control, even if low, when the distraction of the ground close below you can adversely alter your response to recover correctly. You will notice that this recovery technique is identical to that for the gentle stall. Again make a note of the height lost in your stall and recovery. With repeated practice you should be able to recover from an inadvertent stall with little loss of height.

A note of caution

Although sideslips are a method of losing height rapidly when, for example, the circuit has been misjudged, care must be exercised when sideslipping in some modern sailplanes. These gliders may have powerful air brakes so sideslips should not normally be needed on approach. Some are decidedly reluctant and are uncomfortable to put into a slip. Others may even drop a wing rapidly if the air brakes are also open when the slip is started. So, read their flight manuals carefully.

Steep sideslips with full air brakes have caused turbulence over canopies to the extent that the vibration has loosened canopy locks and in a left sideslip the air pressure opened the canopy in flight. If slipping to the right on canopy hinge side, this risk can be reduced. Better still, on modern gliders with powerful air brakes, opening air brakes fully and pitching down steeply in staight flight to gain 10 to 20 kts of airspeed is more effective for rapid hight loss than is slipping. For example, on a very high overshoot situation this technique can be used until back on a normal approach angle of 8 degrees to reference point. At that time the nose can be raised back to the normal approach attitude for the conditions and slow the glider. When the correct approach speed is achieved the air brakes can be reduced to maintain that normal approach angle.

If the air brakes malfunctioned or the pilot is not able to operate them effectively, it is hazardous to attempt to keep the nose of the glider pointed at the Refrence Point as the glider will gain speed rapidly on the approach. In most cases the nose will drop quickly if the air brakes do open suddenly (some gliders pitch up). In the case of no air brake, it would be more appropriate to fly the glider at normal approach speeds for conditions and use the sideslip technique to control the descent and landing as described before in sideslips.

STEEP TURNS, SPIRAL DIVES, & ADVANCED THERMALLING

Steep turns

The steep turn is the next maneuver to master if you are going to become a competent glider pilot able to use the full potential of the glider. These turns take practice to do well; they can be continued for part of a revolution easily enough, but the technique has to be mastered if you wish to do good continuous turns for a full circle or more. In fact steep turns are an extremely good exercise for improving flying ability – and can be considered as almost an aerobatic maneuver. They are used for a variety of purposes, including centering in thermals or changing direction quickly. When making a steep turn, the lift on the wings has to be increased considerably compared to that in straight flight – the stall speed is therefore greater.

Bank angle (°)	g load	Stall speed increase (%)	Typical glider V_{stall} (kts)
0	1.00	0	32
10	1.02	1	32
20	1.06	3	33
30	1.15	7	34
40	1.30	14	37
50	1.56	25	40
60	2.00	41	45
70	2.92	71	55
80	5.75	140	77

The relationship between bank angle, g-load and stall speed

You will see in this table that above an angle of about 50 degrees the g-load and the stall speed increase rapidly. This is because in any turn the wings have to develop more lift, and increasing the angle of attack of the wings is used to generate the extra lift required. In a steep turn, however, this may not be enough as the angle of attack may reach the critical angle of 15 degrees and the wings will stall. For a steep turn, therefore, the speed must be increased before you roll into the turn. Notice from the table that if the glider is banked to 90 degrees there would be no vertical component to the lift. The glider will therefore rapidly lose height as it is impossible to do a continuous turn at a 90 degree bank angle.

A steep turn with more than 45 degrees of bank is rarely used continuously when thermaling. Not only is the sink rate of the glider much higher than it is at shallow angles of bank, but because your airspeed has to be so much higher, the diameter of your turn is larger too. This leaves you often outside the strongest lift, or core of the thermal. Use care when turning at high angles of bank in rough air as the extra g-loading due to a sudden gust has to be added to the g-load of the turn. The total loading must be kept below the glider's design load capability, so use caution when turning at bank angles greater than 60 degrees.

Air Exercise – Method of making a correct steep turn

There are three stages to making a good turn:

Rolling in

Look around well for other aircraft before you start a turn, and concentrate more in the direction of the intended turn. Increase your speed to about 40% above the best L/D speed, look over the nose to the horizon and roll briskly into the turn to an angle of bank of about 45 degrees; on later flights you could increase this to about 60 degrees. As you roll into the turn use the stick and rudder together to maintain a well coordinated entry to the turn. When you have the desired bank angle and back pressure on the stick to prevent the nose from dropping and have centered the rudder/ailerons, look ahead of the glider along the horizon for other aircraft.

Staying in

To stay in the turn use the same technique as for a medium turn. Once again the objective is to maintain a constant angle of bank and a constant pitch attitude (hence constant airspeed) and, while doing this, looking out adequately for other aircraft that may be close by. The glider's controls will have been briefly centered as you reached your desired angle of bank. To keep the glider turning accurately at a constant speed, you will notice you will be applying a definite back pressure to the stick, and this in spite of the already higher airspeed. Re-trim if you are going to stay in the turn. Correct any tendency to overbank, and keep the yaw string, or ball, centered by momentarily looking over the nose to the horizon.

At what appear to be very steep angles you will have to look ***up*** in order to search along the horizon for other aircraft. Keep looking out and try to ***listen*** to your speed. If it increases, you will need to raise the nose a bit to slow down, and vice versa. If the speed seems difficult to control and it wants to increase in spite of ***pulling back on the stick***, briefly reduce the angle of bank, adjust the speed and then roll again back

to your previous angle of bank. And always try to keep the yaw string in the middle! The rate at which the nose sweeps along the horizon should be constant. If it slows or speeds up you are inconsistent with the back pressure on the stick.

Rolling out

Again look around for other aircraft before rolling out of the turn, particularly under the high wing. The recovery from steep turns is similar to that for medium turns: first, look over the nose to the horizon and level the wings with coordinated use of the stick and rudder, and re-establish your normal speed. There will be a tendency for the nose to rise because you will have been holding back pressure on the stick during the turn, unless you had retrimmed. So, relax this as you return to wings level. If you had retrimmed to stay in the turn you will need forward pressure on the stick as you level the wings and then re-trim the glider when your speed has stabilized.

Spiral dives

A spiral dive is a steep diving turn, with the glider in an increasingly nose-down attitude. The airspeed will increase very rapidly. Unlike the spin, a spiral dive is a condition of ***unstalled*** flight. When a spiral dive is performed as a maneuver, the following precautions must be observed:

- Considerable height may be lost, so start at a safe height to allow for recovery with adequate height remaining,
- The airspeed will increase rapidly so care must be taken not to exceed the maximum permissible for the type,
- Recover gently, as a harsh recovery from the spiral dive can produce high loads on the airframe and lead to structural damage and to the pilot blacking out!

Air Exercise – Spiral dive and recovery

First, carry out the **CALL** check. A spiral dive can often be entered inadvertently when doing steep turns, and may be started here by deliberately allowing the speed to build up in a steep turn. If you now try to control the speed by the normal technique of pulling back on the stick, the turn will merely tighten, and the aircraft will continue to descend, now in a steeper spiral dive. Note again that this is a condition of unstalled flight in which the airspeed and g-loads are increasing rapidly. In this case it is important to recover before the speed and g-load become too high. The standard method of recovering from a spiral dive is:

- start to level the wings with coordinated use of the controls, and at the same time,
- reduce the back pressure on the stick momentarily to reduce the g-loading on the aircraft, then
- ease out of the dive.

Remember – any attempt to pull out of the spiral dive by increasing the back pressure on the stick without ***first*** leveling the wings will simply tighten the spiral and the airspeed will continue to increase. The occasions when a pilot will inadvertently enter a spiral dive will probably be when thermalling at medium to steep angles of bank, particularly when get-

ing tired and when the pilot's experience is limited. The speed will appear to be increasing too much, and attempts to slow down in the normal manner won't work. The speed only increases! In such cases the recovery technique is to first level the wings, then get the speed under control, before resuming thermalling.

The benign spiral

A benign spiral is a dynamically stable, uncontrolled (hands-off) descending spiral at a somewhat varying airspeed in maximum drag configuration: air brakes out, and wheel and flaps down (beware of any flap speed limits). It is started from a turn that is properly trimmed, with hands and feet off the controls. A benign spiral may be used when wave flying, to descend rapidly from above cloud if the wave window threatens to close over. Your instructor will demonstrate this when flight time is up and you need to get back to the club.

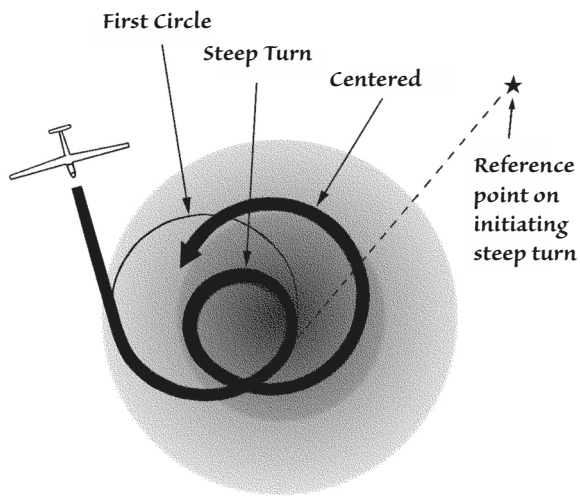
Your instructor will brief you about this maneuver the first time you try it. Start the spiral from a medium turn at about a 30 degree bank angle. Set the trim correctly so that the glider will fly happily by itself hands off for a few seconds. Lower the gear if not fixed then gradually open the air brakes fully and hold them there. Now take your hands and feet off the controls. The glider may oscillate in both airspeed and angle of bank, but generally it will remain in the turn indefinitely at a high sink rate. Each glider type will behave somewhat differently and must be checked to determine its benign spiral characteristics.

Spiral dive out of a spin

An attempt to spin a glider that is reluctant to spin can sometimes produce a rapid entry into a spiral dive. The wing drop can be very similar to the departure from unstalled flight into a spin. This is followed by the nose going down steeply, the glider then can become unstalled so that the speed starts to increase, often quite rapidly. In this case we have to recognize that it is a spiral dive (increasing speed) and it is not a spin (constant speed). Now we can start the spiral dive recovery. This type of entry into a spiral dive is unexpected to the newer pilot – unless you are pre-warned it can be alarming. Your instructor will brief you on what to expect, and will guide and assist as you practice these maneuvers.

An advanced thermal centering technique

Now that you can fly more accurately and have tried a few steep turns, a more effective method of centering than the one learned in Chapter 3 can be tried. This method was developed by Heinz Huth (twice a World Champion), and makes use of a steep turn for less than a complete circle. Your first circle begins where you think the best lift is, but it may not be in the center of the lift. As you fly into the stronger lift, pick a reference point straight ahead, and increase your



angle of bank to that of a steep turn. When your reference point is in line with the lower wing tip, or slightly in front of it, resume your normal angle of bank. You have now done a steep turn for 270 to 300 degrees of a full circle, and will have moved your circle towards the thermal's center.

Practice is needed to be able to maneuver like this, but the results are worth the effort. Again, remember that an adequate lookout is vital to ensure good separation from other aircraft, especially when concentrating on first centering a thermal.

Because a circling glider often marks lift – others will join you, seemingly arriving from any direction or nowhere. Particularly on a marginal day, other gliders may come to join you as your instructor asks you to practice one more turn, even in zero sink!

So – see and be seen at all times.

SPINS

Introduction

Spinning is the subject of much discussion among pilots. It is a challenge to do well and to be able to recover, pointing in a desired direction, for example. It is an exciting maneuver to do, and many enjoy it. The purpose of teaching it, of course, is to enable you to recognize the situations that lead to spins, and to recover from it should you inadvertently start a spin.

Good, efficient flying of thermals demands that we fly close to the stall in well controlled circles. Anyone who is not relaxed about this will not make a good soaring pilot. We should not forget the final turn in the circuit pattern when the pilot's workload is high and distraction could get in the way of allowing the pilot to recognize an impending stall. In this case the pilot's response is usually to pull back further on the stick to try and raise the nose, making the situation even worse. Now the problem is that there is insufficient height to make a recovery. It is very important to be able to recognize the indications of the stall and particularly the situation when close to the ground. This will help to make you a safe pilot, and will allow you to avoid the stall in the first place.

The location of the center of gravity (cg) has an important effect on the spinning characteristics. Most gliders will refuse to spin with the cg at the forward limit but will spin readily if the cg is close to the aft limit. Some gliders will spin quite differently with the cg at the aft limit, though all gliders with a certificate of airworthiness will recover from such a spin. In fact, it is a requirement of the international Airworthiness Requirements (JAR-22/CS-22) that gliders will recover readily when the ***Standard Recovery Procedure*** is employed. All modern gliders should be type-certified to these requirements; however, consult the Aircraft Flight Manual for type-specific procedures.

Situations leading to stalling and spinning

A review of stalls is in order before the spin itself is discussed, because a glider will not spin without first being stalled. A stall occurs when the normally smooth airflow over

the wings breaks up, becomes very turbulent, and separates from the top surface of the wings. This occurs when the angle of attack – the angle at which the airflow meets the wing – exceeds 15 to 20 degrees (remember, the specific angle for each glider type remains constant regardless of airspeed). This causes a serious loss of lift and produces an increase in drag – the wing is stalled. The glider will now lose height until the incident airflow again meets the wing at a smaller angle, so that the wing becomes unstalled and can again produce the required amount of lift.

At the stall there is often a distinct nose-down pitching movement, partly because the center of lift of the wings moves aft, and because of the lift from the tailplane. The tailplane does not stall because of the downwash effect from the main wings and its lower angle of incidence. The pitching down of the nose, therefore, assists the glider to unstall the wings – almost all sailplanes will become unstalled if they are permitted to fly again on their own. But you must assist the so-called nose dropping by lowering the nose (moving the stick forward); this reduces the angle of attack to unstall the wings. You ***must not*** try to prevent the nose from dropping by moving the stick further back. This will only maintain the high angle of attack, and the wings will remain stalled. The indicators of the approach to a stall in straight flight or in a gentle turn are many and should be well remembered:

- The position of the stick is further back than normal, leading to:
- Low airspeed,
- Absence of, or reducing airflow noise,
- Ineffective controls – sloppy aileron control – and the backward position of the stick will not raise the nose,
- The nose may or may not be higher than normal, and
- Buffeting or shuddering of the glider and/or controls.

At the stall the nose drops in spite of the pilot keeping the stick hard back, and one wing may drop first, again in spite of attempts to keep the wings level with the ailerons. There is a rapid loss of height and the airspeed will increase again. The pilot must assist the recovery from the stall however, because some gliders will continue to descend in a very nose-down stall until the back pressure on the stick is reduced to allow the glider to fly again.

At low speeds the glider flies at a high angle of attack and the nose may or may not be higher than normal. For example, with the air brakes open on final approach there is extra drag and the attitude could be close to normal or even slightly nose down. During an approach in windy conditions the airspeed could drop suddenly because of rapid changes in the wind speed (caused by the turbulence and wind gradient). Under these conditions the angle of attack is again high and, when the wind gradient or wind shear is encountered, an even higher angle of attack could occur, leading to a stall.

A high speed stall can occur in a steep turn or when pulling out of a dive. In these cases it is called an accelerated stall. At an angle of bank of 60 degrees the g-load is twice normal and the wings will have to develop twice the lift to maintain the glider in an accurate turn at this angle. The corresponding stall speed is increased over that for straight-and-level flight by the square root of the g-load, in this case 1.414 (see page 39 diagram).

To produce a stall under these conditions the angle of attack has to be increased by moving the elevator fairly vigorously. The indicators are as above but include now the extra g-loads and only slight or no buffeting. The stick will be nearer the rearmost position and the pilot will definitely be pulling back on it. When the glider stalls, further backward movement of the stick cannot tighten the turn any more, and of course the nose cannot be raised. Also at the stall the nose is not necessarily higher than normal; the nose will drop, and there will be a rapid loss of height. At the same time the inner or lower wing will tend to rotate downward rapidly, and this is known as an incipient spin, or departure from normal flight (into a spin). You will notice that the ailerons will be ineffective in rolling the glider and the aerodynamic forces on the ailerons may ***flick*** the stick suddenly to one side, and the feel of the glider will be different. If the stick is maintained on the rear stop, the glider will next go into a full spin.

What is a spin?

A spin is a condition of ***stalled flight*** during which the glider makes a spiralling descent, losing height rapidly. The glider rotates about the three axes simultaneously; it rolls, yaws, and pitches at the same time. As discussed in Chapter 3 under ***Stability***, an aircraft in normal straight flight resists any tendency for turbulence to disturb it. When one wing tends to roll downwards, the angle of attack is increased and the wing develops more lift; at the same time the higher wing produces less lift and therefore it tends to stop rising. This stabilizing effect is known as lateral damping and it is a very strong effect, particularly in gliders with long wings. It is present so long as the glider is rolling and disappears as soon as the rolling ceases. The effect will not level the wings, however, as it is a damping effect only. You can see this strong effect when you try to roll the glider; it will not roll rapidly because of the lateral damping effect of its wings.

Once stalled however, an aircraft becomes unstable because the lateral damping effect is lost; if one wing starts to drop first, it will tend to drop further. This is because the angle of attack (already above the stall angle) is increased even more by the downward motion; the wing stalls more completely. Meanwhile the other wing that is now rising has a smaller angle of attack, so it may be developing some lift relative to the stalled lower wing. The net effect is to allow the glider to roll more towards the lower wing. The stalled glider, therefore, is laterally unstable and undamped. If one wing drops at the stall, the glider will continue to roll. It combines now with the increased drag on the down-going wing and the reduced drag on the upper wing to produce a strong yaw towards the lower wing. This is known as ***autorotation***, a combination of roll and yaw about the cg. Also, at the same time the nose pitches down, and the glider goes into a spin.

The glider can only enter a spin when it is fully stalled. Once unstalled, the glider will stop rotating, and lateral damping will be regained. The glider is again controllable. This means that if one wing starts to drop when the glider is approaching a stall, you should immediately lower the nose to reduce the angle of attack, and you will instantly regain lateral damping and hence control.

General considerations

With the cg close to the aft limit, using the standard recovery sequence will eventually stop a spin but may take longer than normal, and unusual forces may be needed to move

the controls. If it is likely to be close to the aft location, the glider will be sensitive in pitch even at normal speeds, so it is advisable to carry additional ballast. This is a very important consideration for lightweight pilots, who may at the same time be shorter than average. Careful consideration of the pilot's positioning in the seat will be needed to help keep the cg within the safe and legal limits. Always know the location of the cg. Typically, inadvertent spins have occurred in two more common situations. The first is while thermalling when, usually, there is adequate height for recovery. The second is during the final turn onto the approach to a landing. There is no spare height here!

Spinning while thermalling

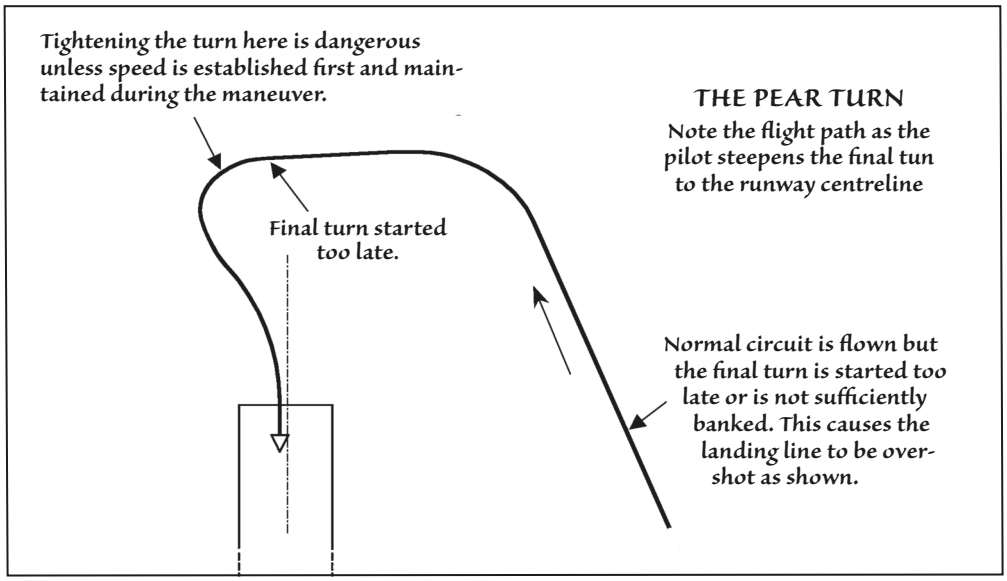
This can occur when the pilot is trying to hold a turn at the normal low thermalling speed, is concentrating on climbing, and allows the speed to fall close to or below the stall speed. A bit of turbulence (vertical gust) can then stall the glider. Because it is already in a bank, the glider can next enter a spin unless quick recovery actions are taken.

Another spin situation occurs when stronger lift is encountered. The pilot's reaction is to tighten the turn into the stronger lift – remember the second method of centering a thermal by tightening the turn? If the speed is marginally above the stall at the medium angle of bank, it will be below the stall speed at the steeper one, particularly if the pilot is pulling back hard on the stick to tighten the turn. During this attempt to increase the bank angle, the attitude of the glider will have appeared quite normal to the pilot who will not have been expecting the glider to be close to the stall speed. In fact, the glider may not give any pre-stall warnings and will drop the inner wing rapidly, then enter a spin above the 1g stall speed. Again, the recovery is normal, either lowering the nose to unstall the wings at the incipient stage or, if the full spin has developed, using the full spin recovery sequence described in the aircraft's flight manual or if no procedure listed then with the standard recovery method described a little later.

Spinning on a final turn

The second more common place where an inadvertent spin can occur is during the final turn onto the approach to a landing. This can be dangerous because of the low height. During a slow final turn when the pilot is otherwise preoccupied with getting onto the field, and is perhaps trying to stretch the glide because the circuit itself is too low, the speed can drop to marginally above the stall speed. The turn may be badly coordinated as the pilot may be using too much rudder input in an attempt to tighten the turn. The pilot may also be tempted to point the nose of the glider at the reference point with more rudder as it may feel comforting, but this skids the glider. The retreating wing stalls and the glider then spins. Turbulence, the wind gradient, or trying to tighten the turn because the glider has overshot the intended landing line, are situations that you should try to avoid or mitigate as they compound the chances for a stall/spin. This latter, tightening of the turn is called the ***pear turn***, illustrated on the next page. These effects can all lead to a stall and wing drop, and can develop rapidly into a spin unless quick recovery actions are taken to unstall the wings to stop the autorotation.

In the pear turn the pilot may attempt to increase the bank to return to the extended centerline of the runway after overshooting the turn. The pilot also attempts to increase the turn rate by pulling back on the stick increasing the angle of attack. If the turn was



started below the 2g stall speed or higher g loads, usually due to distraction, the glider has an accelerated stall and spins.

In a low turn in a wind gradient, if the glider is also flying slowly, a spin can begin rapidly as the inside wing tip can be stalled in this situation. Remember, the lower wing is in the slower moving airflow over the ground, hence will be flying more slowly than the upper wing. The glider will be difficult to unbank without stalling the lower wing even more. Obviously, we don't practice this maneuver close to the ground so we cannot demonstrate this effect. The wind gradient can catch the unwary, so beware of it.

Recognizing the onset of a spin early is very necessary so that you can prevent a full spin developing. Taking action early, automatically, and instinctively, is what we are aiming for. Knowing how the glider reacts at various stages of a spin will increase your confidence to be able to handle any situation. Better still – avoid the low and slow final turn!

Wing-drop stalls and recovery

The wing-drop stall is often called the start of an incipient spin because it has the potential to develop into a full spin. This can be avoided if the glider is recovered quickly from this condition. As the glider is slowed down and stalls, one wing can stall first. As described earlier, this makes the wing drop. If the wings are not immediately unstalled, the glider will start to yaw, the nose will start to go down sharply, and the glider will start to autorotate.

Situations that produce inadvertent spins

Several situations can lead to a glider spinning, and you should be aware of them so that you can avoid the situation in the first place. Also, you will be able to recover quickly if you inadvertently approach one of them. The situations also depend on such factors as the glider's characteristics and the degree of mishandling by the pilot. Typically, inadvertent spins can arise in several situations:

- While attempting to stretch the glide onto the final approach at low heights, the pilot uses an over-ruddered turn at too slow an airspeed, and the glider spins.
- While tightening the turn onto final having flown beyond the landing line (the pear turn).
- While suddenly tightening a turn in a thermal with inadequate airspeed, or making a quick reversal in the circuit, the glider spins.
- While flying too slowly, possibly in turbulent air, when misuse of the rudder at the stall causes a spin.
- A launch failure when, following a winch launch cable break or an aerotow rope break, the pilot attempts a low level turn with the airspeed still too low, and the glider spins.

If you can remember these situations, you will be able to avoid them. This is the first line of defense – a clear case of prevention being better than the cure.

Air Exercises – Wing-drop stall recognition and spin entry

Before this exercise is started, make sure the cg is within the limits shown on the cockpit placard, climb to an adequate height, then carry out a **CALL** check.

To try a wing-drop stall and recovery, first start a gentle turn and then slowly decrease speed. The attitude of the glider will appear to be normal, and the slight raising of the nose to slow down will be almost imperceptible. The glider may not exhibit the pre-stall warnings that you learned in the stall exercise. As it slows, it will tend to increase its angle of bank. The decreasing speed and the slight angle of bank tending to increase, the quieter airflow noise and the gradual moving of the stick rearward are the indications of the approach to a stall/spin. Again, this is difficult to see because the glider's attitude appears quite normal. This is more of a problem close to the ground when the attention of the pilot will likely be on trying to complete a final turn, and is therefore not concentrating on the attitude, or the decreasing speed that can be reduced even more rapidly in strong winds by the wind gradient.

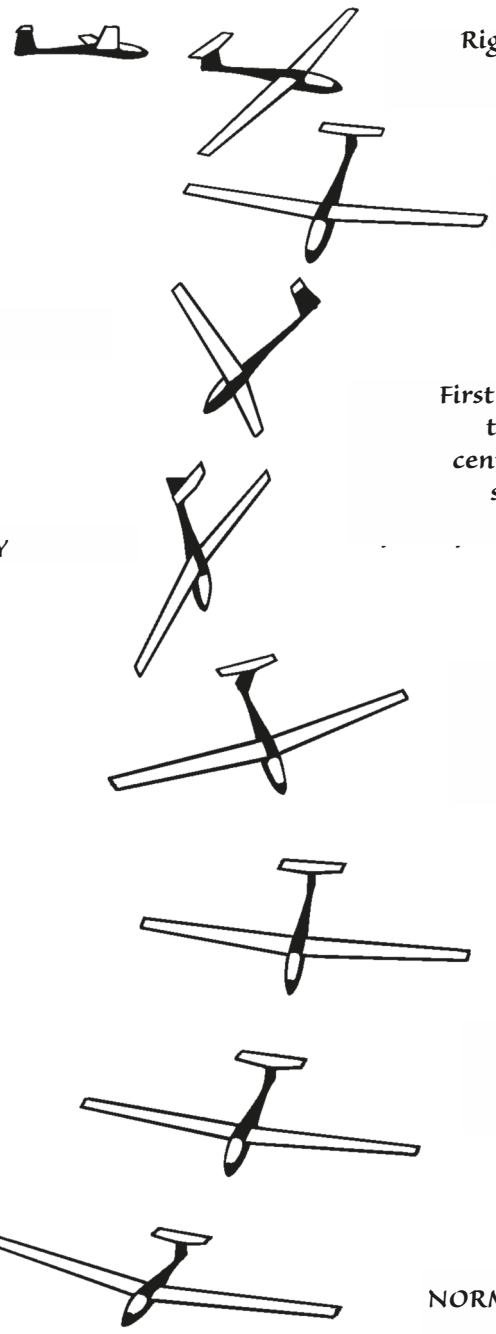
Your instructor will take you through each of the inadvertent spin situations so that you will have an appreciation of what the glider will do. You will also be taught how to avoid and recover from the developing stall and possible spin in each case.

Recovery from the wing-drop stall

At the stall, the lower wing will descend more rapidly and, if recovery is not started immediately, the glider will begin to autorotate. At the same time there may be sufficient extra drag on the lower wing to start the yaw towards that wing. Most likely, a full spin will develop.

To recover from this departure from normal flight, quickly lower the nose to reduce the angle of attack and unstall the wings. Having unstalled the wings, the glider will begin to pick up speed and, because the lift is restored immediately, lateral damping returns and the autorotation stops. Having increased speed sufficiently, return to level flight using the stick and rudder normally.

Glider descending in a full spin and the recovery



This is the same basic recovery technique for a wing drop at a normal, wings-level stall. Do not attempt to raise the down-going wing with ailerons only, you will only increase its angle of attack, which may deepen the stall, and the wing will drop faster. This is particularly important when close to the ground, for example in the wind gradient that can deepen the stall on the lower wing. A full spin will then be the next item on your agenda.

Note that the incipient spin is not a specific point in the entry to a spin, but is the sequence of the wing drop, the developing autorotation and the ensuing yaw towards the lower wing. This all occurs before the glider develops a full spin after 1 to 3 rotations. The start of the spin can be stopped at any point using the above technique. Recovering as early as possible to lose a minimum of height is the name of the game. Remember; the worst point to start a spin is during the final turn before landing, so learn to recognize the indicators that can be produced from a low, slow and shallow turn. Avoid making low and slow final turns whenever you fly – you have no spare height!

Full spin and recovery – general considerations

Before any spin maneuvers are to be carried out, check that the cg is in the right range, and is, if possible, reasonably ahead of the rear limit. If ballast is to be carried make sure it is correctly fastened and that it cannot come loose in flight, even if the glider is put into a reduced or negative-g situation. If your club does not have a glider that can spin readily (some two-seaters are reluctant to spin), the club will likely use a higher performance glider for full spin training. Use the time well, and ask for extra flights to cover the spin if at first you feel uncomfortable with your recoveries. To become a fully competent pilot, it is important to become proficient at spin recognition and recovery; extra time spent now is well worth it.

Spin practice should be started no lower than 3000 feet above ground to allow sufficient altitude for adequate height after recovery. On later flights, when you are more comfortable with spinning, a tow to 4000 feet would be well worthwhile. Repeat the **CALL** check if doing several entries and recoveries in a row.

Also practice recoveries to a known heading; this will give you an added challenge, besides spinning is an enjoyable exercise when done well. Enjoy!

Air Exercise – The full spin and recovery

An inadvertent spin is most likely to develop from a slow turn, not from straight and level flight. Entry from a turn will allow a full spin to develop in most two-seaters and will re-pro¬duce the spin that can occur from the too-slow final turn.

To try a full spin, first climb to a sufficient height, go through the **CALL** check, then start a gentle turn and gradually reduce the airspeed. The glider's attitude will look normal but as the speed reduces further, the controls will feel sloppy, and you will probably have to prevent the glider from overbanking. The stick may be against the back stop before the glider stalls fully, in which case you may have to induce it to spin by adding rudder in the direction of the turn. This reproduces the over-ruddered final turn mentioned above (some gliders will spin without this addition of rudder input.)

As the autorotation starts and the glider yaws towards the lower wing, hold the controls where they are, the stick most likely to one side and against the rear stop, and the rudder to the other side. As already mentioned, in some gliders this will not be needed, as they will spin with the rudder and ailerons more in the center but with the stick fully back. A full spin will normally follow.

A mistake is sometimes made in which the nose of the glider is pulled up more as the stall occurs. This will result in a sharper nose drop and recovery, most likely into a spiral dive, with the speed increasing rapidly. Other gliders that are a bit reluctant to spin will exhibit the wing drop and autorotation but will then go into a spiral dive instead of a spin. Recognizing the rapidly increasing speed will tell you that the glider is not spinning but is in a spiral dive.

Recovery from the spin starts almost immediately after either control is moved from the extreme position. It is imperative; however, that you learn the standard recovery technique because this is needed with many sailplanes, and of course it will work for all gliders. To recover from the full spin:

- first, apply full rudder against the rotation of the spin, and centralize the ailerons (the stick should be all the way back and the rudder must be against the mechanical stop before moving the stick forward),
- then move the stick steadily forward until the rotation stops,
- centralize the rudder, look up and,
- pull out of the dive. To prevent the speed from building up excessively, start a smooth, positive pull-up as soon as rotation stops, increasing the g loading to 3-4 g to minimize height loss. (caution: jerking the stick back can lead to secondary stall and much higher wing loading).

In most cases the glider will start to come out of the spin when the first action is taken, that is to apply rudder against the spin and to centralize the ailerons. In some gliders you will have to reach the third step of moving the stick steadily forward before the glider responds. If the cg is towards the aft limit, the glider will be reluctant to recover, and although the glider is designed to do so eventually, it can be alarming to the pilot not used to the reaction of a glider to a rear cg position! On some gliders the elevator can partially blanket the airflow over the rudder when in a spin, and this is made worse with the elevator down (stick forward). Some V-tail gliders might also be unable to produce full rudder authority when the stick is fully forward. Hence in the recovery sequence you must apply full rudder first against the mechanical stop, followed by moving the stick steadily forward.

As a new glider pilot, practice incipient and full spins often. Start with the early solo ships in the club before progressing to the higher performance sailplanes. These can have awkward spin characteristics, such as oscillatory motions, and it is essential that you master the basic techniques first before trying the higher performance gliders. Becoming competent at recognizing a wing-drop stall and recovering from them will protect you from the inadvertent low down, spin entry. By unstalling the wings the moment that you recognize the developing departure from normal flight, you will recover with little loss of height and you will be able to continue the turn safely. Practice full spins too. They are fun

to do and the more you do them the easier it will be to handle the high performance sailplanes when you move up to them.

Summary
Recall the differences between a spiral dive and a spin; they might appear similar due to their descending, diving nature but there are distinct differences.

A ***spin*** is recognized by the rapid rotation and the low airspeed. It is typically just above the normal stall speed and it remains fairly steady. The rate of rotation and the descent rate also remain steady. The g-load is constant at about 1½ to 2g. The loss of height is about 300 feet per revolution, but it can be greater.

A ***spiral dive***, on the other hand, is recognized by the rapidly increasing airspeed, increasing g load and the steepening nose-down attitude.

During a spin the glider is pointing quite steeply nose down. In the spin and the spiral dive recoveries, also the recovery from a loop, the glider is still pointing steeply nose down and the speed is increasing very rapidly. These are unusual attitudes and because the ground appears to be moving rapidly around the field of view, it can be disorienting to the new pilot. It helps to try and keep the horizon in view. When spinning, you will have to deliberately look up to do this.

During the recovery, the initial effect of stopping the rotation is to make the glider point its nose even further down (lack of centripetal forces from the spinning masses of the glider in front of and behind the center of rotation cause the nose-down effect). You may feel you are pointing vertically down! The speed will build up very rapidly unless the pilots start to pull out of the dive smartly. The g-loads will be noticeable – but the use of terminal airspeed limiting air brakes for speed control in this situation is ***not advised***. Disadvantages include considerably lower g-load available for pull-out, higher cockpit workload, greater height loss during recovery, and difficulty of smooth and timely application. You can often gain back some of the height lost in the recovery by climbing deliberately, then pushing over into the normal gliding attitude as the speed reduces to a more normal value.

TAKE-OFFS AND LANDINGS IN CROSSWINDS

General considerations
Take-offs and landings in crosswinds may be necessary when the best runway is at an angle to the wind, or when there are obstructions on the landing area, which limit the length of run directly into the wind.

When a glider runs along the ground in a crosswind, problems can occur. First, the glider wants to weathercock into wind and second, the wind tends to blow the glider sideways. These effects are not too great as the normal friction between the wheel and the ground will prevent it from moving sideways, and the person on the wing tip can usually prevent the glider from weathercocking at the start of the take-off.

Of more concern in strong winds is the tendency for the wind to lift the wing facing the wind, making ground handling difficult. Refer again to the earlier section on ground handling. Ask club members if you are unsure how to run the wing for example, as during a take-off, or landing for that matter, the effects of crosswinds must be dealt with.

Take-off across the wind

When the wing runner lets go of the wing, the upwind wing will tend to rise. Asking the wing runner to hold the wing below the horizontal should prevent this. When it is released, you should continue to hold the wing slightly low. As the glider will be doing a slight slip through the air it will run straight towards the winch or towplane. If the wind gets under the wing, the take-off can become very difficult and directional control can be lost. You should release the rope or cable and start again.

In a glider with a nose or fixed (non-castering) tail wheel, allowing the glider to run on this wheel will help keep it tracking straight toward the towplane. As the take-off run starts, therefore, prevent the tendency to weathercock into the wind by keeping the nose wheel or tail wheel firmly on the ground until the glider approaches flying speed. As the rudder becomes effective, allow the nose or tail to come off the ground then keep the glider straight using the rudder, plus the wing slightly low towards the wind while running on the main wheel.

With gliders that have a nose or tail skid, lift these skids off the ground as soon as possible, keeping straight with rudder and one wing low. With a nose hook, take advantage of the pull of the towrope by having the towplane line up slightly to the downwind side of the glider. The pull of the rope will help to prevent the glider (and the towplane) weathercocking into wind during the start of the ground run. Finally, allow the glider to take-off into the air cleanly to avoid the possibility of a sideways bounce.

Be prepared to follow the towplane closely after lift-off, in case it turns rapidly into wind. On narrow runways with obstructions down each side you may have to crab the glider into wind after lift-off in order to stay over the runway and not drift over obstructions. On wider runways, once clear of the ground, move into position behind the towplane as usual.

Shortly after leaving the ground, the towpilot may bear off to the downwind side of the runway centerline and then angle into the wind. This gives the glider pilot a safer return to the runway compared to an upwind track should the tow be interrupted for any reason when low to the ground. Know what the practice is at your club, and don't forget that planning ahead is the best motto, for any eventuality.

On a winch launch, once airborne the glider will want to weathercock into wind. If you wish to track straight towards the winch, ***laying off*** for drift will be necessary, and this is covered in detail in Chapter 3 on ***Winch Launching*** in the section ***Full Climb and Release***.

Landing across the wind

When landing across the wind the glider can be positioned correctly by sideslipping or crabbing into the wind. The crabbing method can be used in very strong crosswinds whereas the sideslipping method has the disadvantage that the low wing tip could touch

the ground prior to touchdown. On the other hand, the sideslip method has the advantage when landing across a slope, and in gentle crosswinds when only a little bank is needed.

The aim of doing a proper landing when the wind is blowing across the runway is to transfer the glider cleanly from the air to the ground while it is not drifting over the ground, and while it is under good control. If it should land while drifting, side loads on the wheel or skid could cause damage.

Air Exercise – Crabbing method of landing in a crosswind

Adjust the glider's heading by gentle but coordinated turns to establish the crab angle desired. A common error by pilots is using only rudder to establish a crab angle which skids the glider not changing the ground track. Make smaller coordinated turn adjustments until the glider's path coincides with the centerline of the landing path. Also, adjust the amount of crab with shallow coordinated turns as the glider descends through the wind gradient. Keep the yaw string straight, as the glider should be flying without slip or skid. Hold the glider's heading until you are just off the ground. At this crucial point swing the glider with the rudder, so that you will now be lined up with the direction of travel along the runway. There will be a slight tendency for the glider to bank when this yaw is applied – remember the further effect of rudder? Keep the wings level or slightly wing-down into wind. Once the nose is in line with your direction of travel let the glider touch down. Avoid delaying the touchdown as it will allow the glider to start drifting sideways over the ground.

After touchdown, make sure the glider travels in a straight path using rudder as required and with the into-wind wing slightly down, until you come to a complete stop. Allow the nose or tail wheel to contact the ground to maintain a straight track as you slow. Once on the ground apply full air brakes to minimize the ground roll. To help prevent weather cocking for tail wheel gliders, bring the stick progressively back to hold the tail down and for nose wheel gliders relaxing the elevator to neutral to keep weight on nose wheel on the ground.

Most two-seat trainers have their cg close to or ahead of the wheel. This will tend to reduce the weathercocking tendency once on the ground, due to the large side area of the fuselage ahead of the wheel. The rudder in this case is sufficiently powerful to allow you to keep straight in any but the strongest crosswinds. In addition, the momentum of the glider (with the cg being ahead of the wheel) will tend to keep you straight. However, on sailplanes with the cg behind the wheel, the tendency to swing is accentuated because the momentum effect, which is quite powerful, adds to the weathercocking effect. Any hard braking with the wheel brake will aggravate a swing that must be corrected very quickly, or it will become uncontrollable.

If the sailplane has a nose wheel or fixed tail wheel instead of a skid, keeping the nose or tail firmly on the ground will help to keep the glider straight. Don't use the wheel brake too enthusiastically as you may then lift the tail wheel, losing its steering effect, and any swing could result in a groundloop in which the glider swings around in an uncontrollable circular path.

Air Exercise – The sideslip method of landing in a crosswind

With this technique you will be flying down your final approach in line with the runway, and the glider will be sideslipped just enough to prevent it drifting to either side. The amount of slip or angle of bank will usually be much less than that used to get down quickly, as described at the beginning of this chapter.

As you near the ground and begin a normal flare and hold-off, you may need to reduce the angle of bank slightly to prevent the wing tip touching the ground prematurely. For this reason the sideslipping approach in a crosswind is not favoured by pilots of sailplanes with low or long wings or small dihedral angles (in most trainers there is ample wing clearance). Your landing will be quite normal except the into-wind wing will be slightly low at touchdown, and it should be held in this position as you slow down and stop. Try to keep straight with rudder, and as you come to a stop finally lower the into-wind wing. This is easier said than done because the wind will tend to lift the wing, unless you anticipate this and start to lower the wing early, before you stop rolling. Again, follow the advice above to use a nose or tail wheel to keep straight, and use the wheel brake carefully to avoid a ground loop.

Always allow adequate space on either side of your take-off and landing paths.

Illusions created by drift

At low heights the effect of the wind on the path that the glider makes over the ground can be quite noticeable. When flying upwind (against the wind) for example, the groundspeed can be quite low whereas at the same airspeed and going downwind the groundspeed can be more than doubled. This is obvious when flying at low heights. Flying across a strong wind will make the glider appear to be crabbing, that is, flying with noticeable skid, while the ball and/or the yaw string are in fact centered. Such effects are not very noticeable at high altitudes because the apparent movement over the ground is too slow to be noticed, but become important in circuit flying in a strong wind, when it is essential to maintain speed and to fly well coordinated turns.

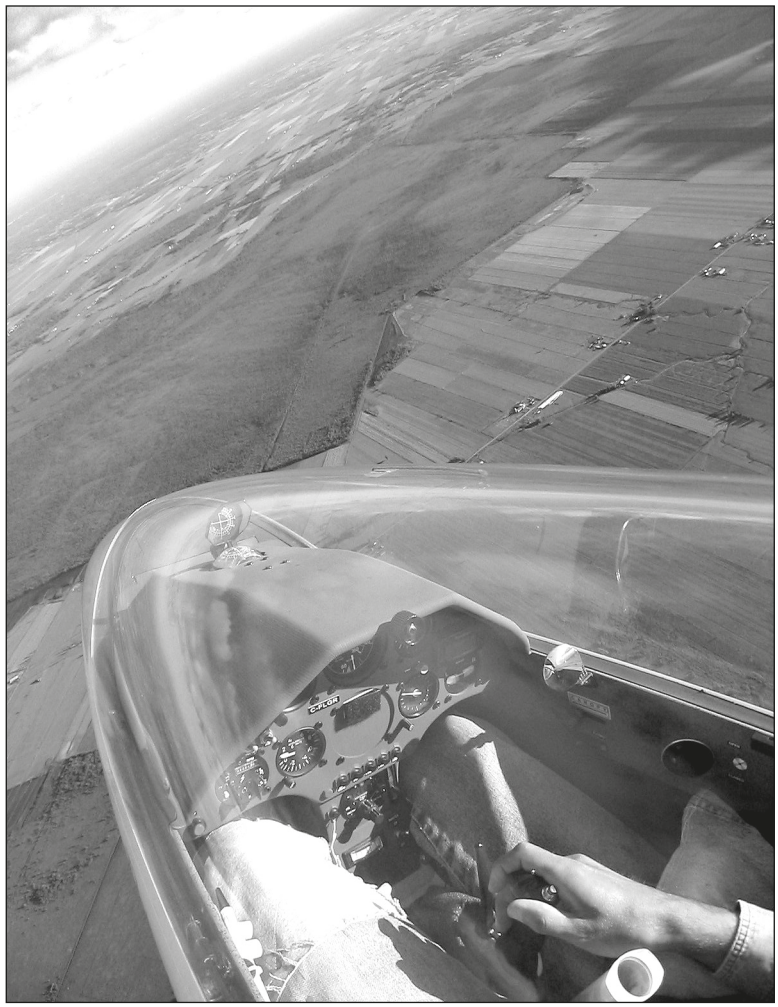
Your turn onto the base leg in a strong wind will probably cover more ground than a similarly banked turn in a light wind, and as you turn you will increasingly appear to be drifting or skidding outward. Starting your turn a little sooner should compensate for the first effect. However, the skid can be an illusion because of your drift over the ground. You may be flying perfectly coordinated, with no slip or skid, but your peripheral vision is translating your drift over the ground into a feeling that the glider itself is skidding through the air. There is a great inclination on the part of pilots to then apply rudder to try and remove the apparent skid, by applying too much rudder towards the wind.

This is dangerous, especially when low and in turbulent air, and could lead to a departure into a spin. Anticipate this illusion created by the drift, and when turning onto your base leg, first make sure you have adequately increased your speed to that for the approach, and check that you are keeping the yaw string straight.

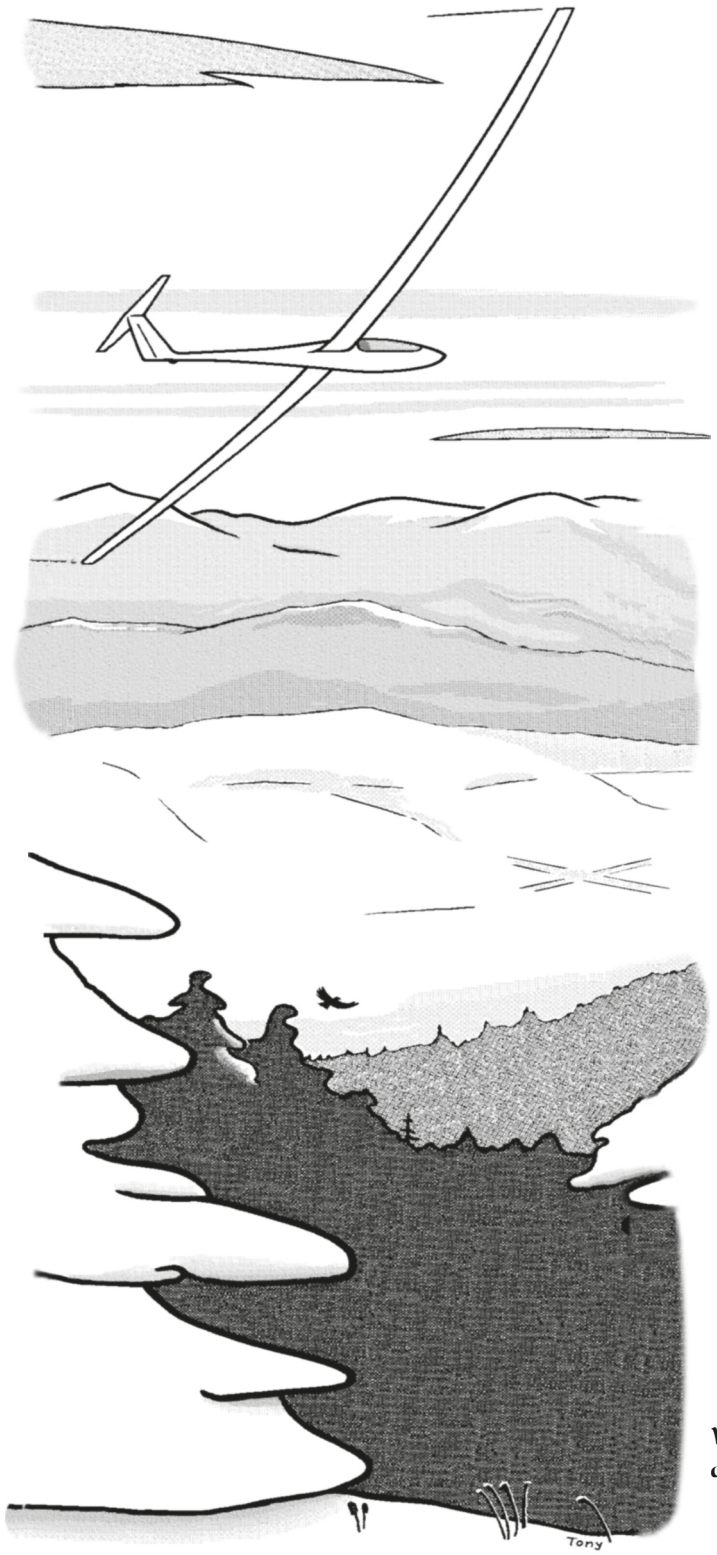
The apparent skid as you crab along the base leg becomes more noticeable as your height decreases, and can lead you into applying too much rudder deflection for your final turn.

Again, the illusion is accentuated in strong winds. Keep your flying well coordinated and with an adequate airspeed, and resist the temptation to apply too much rudder while trying to tighten your final turn. That is how a spin is started, as discussed in the previous section, remember?

Turns with a tail wind component can also be hazardous if not careful, as you will feel you are slipping into the turn and you may subconsciously apply the opposite rudder skidding the glider. Also, you will feel like there is an increase in airspeed and may slow down the glider. Add a pilot distraction that keeps your attention away from the yaw string and the airspeed indicator and you have the potential for stall/spin. In cross winds it is preferable to have your base leg into wind where possible if there is sufficient height. During launch interruptions low to ground where illusions are more noticeable, attention to coordination with yaw string centered and adequate airspeed is critical.



A Discus cross-country somewhere in eastern Canada.



Winter soaring on the ridge

CHAPTER 5 – BEFORE & AFTER FIRST SOLO

PRE-SOLO CONSIDERATIONS

After you have progressed through most of the flying lessons, and you are feeling comfortable with flying under a variety of conditions, and if you know how your club does things and how you are progressing relative to the other students, you should soon expect to be sent solo. Your instructor will ask if there are any maneuvers that you wish to review. We suggest you take a dual flight or two to go over some of the items below, or others of your choice:

- sideslips,
- wing-drop stalls and the various spin avoidance exercises,
- aerotows in rough air,
- winch launching and cable-break and recovery procedures,
- low level rope breaks or release, and of course,
- emergency landing procedure,
- illusions created by drift,
- landing or taking off in stronger cross winds.

Even before the instructor asks you about the above, you should think about any other aspects of your training in which you would like to have additional instruction or review.

Review of emergency flight procedures and signals
Before you go solo you should of course be thoroughly familiar with these procedures and signals. Remember that it is not enough to plan for an emergency when it occurs. Planning ahead should be your motto. Hence be prepared for:

- hazards in your takeoff path,
- cable breaks on aerotow or winch launch,
- air brakes or canopy opening during takeoff,
- other aircraft not seeing you, so keep a good lookout all the time,
- wind gradients and changed conditions waiting for you, particularly after a long flight.

Also review the standard recovery procedures for spins and spiral dives and review the air-to-air emergency signals.

Pre-solo exam
Your club will likely use the SAC-recommended PSTAR exam or have its own pre-solo exam. In either case prepare for it now by discussing points on the different subjects with other pilots, including your instructors. This exam forms part of your licensing and it must be passed before you fly solo.

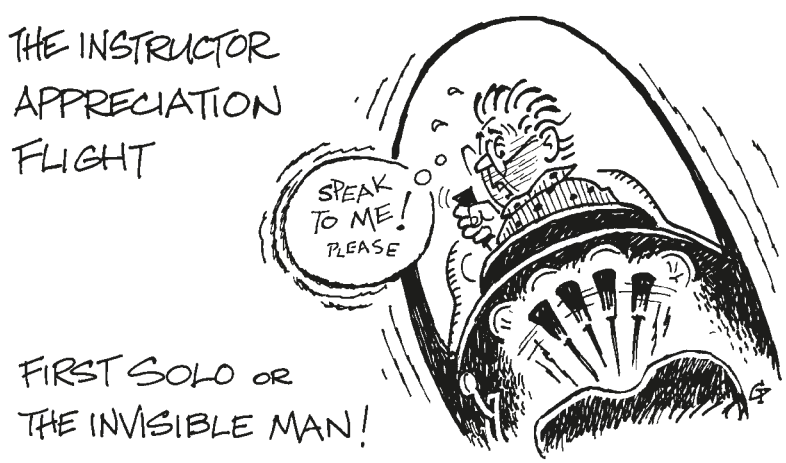
POST-SOLO FLYING

Going solo is without doubt a memorable and thrilling experience, not the least perhaps because you no longer have that voice in the back seat! It is a great confidence builder to fly by yourself; you can begin to put into practice all the things you have been taught. Now is the time you will really begin to learn the art of flying. Don't hesitate to go for a dual flight if anything is troubling you, such as flying for the first time with very strong winds.

To date in your lessons you have had the maneuvers demonstrated, and you have practiced them a bit, but you are not yet a polished pilot. Practice each of the exercises, particularly the ones you feel most need practicing – even if you don't like it at first! Also practice the SOAR technique of pilot decision-making; this is a most useful system that will help make you a superior pilot. If at any time you feel in the least bit unsure of a maneuver get hold of your instructor for a dual flight, or practice it on your dual flight that you now will take for the first flight each day that you go flying.

Soon you may be allowed to fly solo without a dual check ride, particularly if you have been flying regularly. Bear in mind that you haven't yet had your licence check flights and that you are still under the supervision of an instructor who will brief you before each flight, noting any weather conditions to watch or discussing the objectives you have set yourself. During this time a very important objective is for you to learn advanced maneuvers while flying dual, and to improve your skills under more demanding conditions, for example under strong thermal conditions or with high winds. It is during these early solo flights that bad habits can creep in, so another purpose of intermediate dual flights is to help catch and prevent these.

Practice whenever you can, and include such exercises as sideslips, stalls, wing-drop stalls (incipient spins) and of course full spins. As you gain confidence, try to recover from a spin onto a predetermined heading, and include practice of steep turns and medium turns at minimum speeds without the pre-stall buffet. To do this slow down in the turn until the



buffeting starts, then practice circling at a few knots above this speed. Above all, during your pre-licence solo flying have an objective for each flight. Consider the conditions before you take off so that you will have planned your approach speed before the flight, for example. Look at the sky and discuss with others which areas to go searching for the best lift, and don't forget the circuit direction currently in use. Planning for an emergency now will save valuable time when it occurs, for example an unexpected wave-off by the towpilot when at a low height shortly after takeoff.

You should plan to do an excellent circuit with a well controlled final glide and aim to touch down on a preselected spot. Exercises like this make good pilots and add to the challenge and fun of flying. They will help prepare you for your licence check flights during which your various skills will be evaluated.

Post-licence flying

Your licence gives you passenger carrying privileges and you can build some experience, but you will probably be aiming to reach the club intro passenger-carrying stage shortly, so that you can share your joy of gliding with potential students. Before taking intro passengers, you will receive some more dual and likely be trained to fly from the back seat and receive advice on how to handle such familiarization flights. When checked out, make sure your logbook is signed to that effect. This is discussed more in a following section.

As you improve your flying skills during your early solo flying, you should start "badge hunting". There are progressively more difficult requirements for each badge, and displaying a badge is an instantly recognizable sign of your growing achievement level. Have a look at the section on the Bronze badge and consider getting some extra dual instruction to complete some of the requirements for this badge.

All this time don't forget the safety lessons you learned earlier. There is no one constantly looking over your shoulder, so you must rely on yourself to maintain a high standard of airmanship. It is particularly important that you are properly prepared for each new challenge, for example when first going out across country – though you may be reluctant to depart – or when first flying a new, and perhaps more difficult-to-fly sailplane. Build up to it slowly and keep your ears and eyes open for advice. There are always many pilots very willing to share their experiences and to help you to get started on the right foot – there is a lot of difference between your first solo machine and that competition, fibreglass beauty you yearn for. Find a mentor in your club to help you with these next stages.

Even if the weather is unsuitable for flying, probably there will be other pilots talking soaring. Listen and learn from them, you can always pick up some free advice. And there is a lot to be learned from helping others like helping a private owner to rig their ship or going on land out recoveries. They will be very willing to pass on their experiences and advice to those who assist them. Remember you cannot be a loner in gliding. They too will return the favour when you require assistance yourself. Read other soaring books as well as this one again. We tend to forget much of what we first read, but on re-reading many points will become clearer. New ones may occur to you as you re-read this book, because of the flying experiences you now have. FTSC recommends ***Advanced Soaring Made Easy*** as the next book for expanding your gliding knowledge.

Up to this point this book has covered the subjects of the basic licence. A fully competent glider pilot, however, has several more skills to add to his or her inventory. In the following sections of this chapter the subjects of passenger carrying, cross-country flying, conversions to more advanced gliders and so on are covered. It is not expected that all pilots will aspire to competition flying or even cross-country flying. Many of us do, and the many aspects of advanced soaring and competition keep pilots learning for many years. Nevertheless, many pilots enjoy the sport without these skills. However, we hope you will wish to explore the sport to the full. Your CFI will be able to discuss these and other subjects and to offer the right mix of suitable training, appropriate to you. Seek and listen to the advice; that is what they are there for.

PASSENGER CARRYING

Introduction

Carrying passengers is another interesting activity that we can enjoy as glider pilots. Here is a chance to show to friends and members of the public the joy of soaring, and to share with them some of the thrills of the sport. This is not to suggest that we will show them aerobatics, as this is one sure way of turning off most of us! Leaving the ground is bad enough for many people and doing so without a motor is something else. So don't think that you will thrill someone with slick, abrupt maneuvers or steep thermalling turns; you will more likely scare them sufficiently that they will not come near a glider again, and you may have lost a potential member! We need sympathetic pilots to carry passengers. Morning or late afternoon/early evening flights when turbulence is minimal are best for familiarization flights.

General

You must of course possess a valid glider pilot licence; in fact a private pilot licence will not be sufficient because, to carry passengers in a glider, you must have a glider pilot licence. The requirement is met legally in gliders also, by having flown a minimum of five takeoffs and landings in the past six months. In addition to the above, gliding clubs require passenger carrying training and flight checks before they will permit members to carry passengers from the club's airfield.

Experience

In general, it is recommended that all pilots should have a minimum of ten hours of pilot-in-command time in gliders before they carry passengers. This is to ensure that the pilot has absolute command of the aircraft, in other words can demonstrate adequate flying and airmanship skills, and can handle distractions that inevitably occur when flying with a passenger. Many clubs may feel that more experience and other qualifications are necessary, particularly with respect to the conduct of ***introductory*** or ***familiarization*** flights with the general public. Check with your club CFI for the local requirements.

Skill

Aside from a minimum experience requirement, the pilot should demonstrate flying capabilities and judgement skills to an instructor permitted by the club CFI to conduct

passenger-carrying checkouts. The first part of this process will consist initially of a briefing, a flight with the candidate and a debriefing session. The candidate then should fly a minimum of five flights with other club members who hold passenger-carrying privileges, to familiarize him or herself with typical passenger-carrying situations. After these flights, the candidate should fly with an instructor to demonstrate this newly acquired knowledge and to run through a typical flight, from briefing to landing and debriefing. This flight is the final checkflight, after which the passenger-carrying qualification is noted in the logbook.

It is recommended after this point that passenger-carrying privileges should remain valid on the basis of a thirty-day flight currency at the club and an annual general proficiency check flight with an instructor.

A typical flight scenario

A typical flight with a person who has not flown before in either a light aircraft or a glider would differ from a flight with a power pilot who is going for a first glider flight. Of course, you will want to know what kind of experience they have, so some simple questions should suffice. Don't get caught showing an airline pilot what the rudder pedals are for!

Explain to the passenger what to expect on the flight and set him or her at ease by answering any questions they may have. One might typically ask whether the passenger has flown in a small aircraft before, what the passenger weighs, and about the general state of their health (colds, medications, etc.). The pilot should determine in this process that the glider will be properly loaded before the passenger is strapped in. The passenger should be secured in the glider either by you or by some other knowledgeable club member. Make sure this is done properly.

You could and should then brief the passenger on where to put his or her hands, what is permissible to do, and in particular not to touch the controls during the flight. Only instructors may allow the passenger to handle the aircraft in flight. During the takeoff and landing the passenger should not hold onto any of the controls. It is usually best that they hold onto their shoulder straps if they don't know what to do with their hands. It is strongly recommended that the passenger not perform the release of the towrope or cable. There have been several incidents over the years in which the passenger has released the rope at an inconvenient time during the launch, so it is best to avoid this possibility altogether. You may want to mention that when you do pull the release, there will be a noise and that this is normal.

Do not dwell on the topic of airsickness. Generally, if passengers are afraid of this, it will become apparent in their questioning. Otherwise just address the matter at the time by pointing out where the airsickness bag is. Above all assure them that you anticipate they will have no problems; if they do, you will immediately return to the field and land.

A typical first flight for a passenger should probably not exceed half an hour or so. Thermalling should be kept to a minimum, preferably at the beginning of the flight, as most people are not used to the constant circling involved. You should, if possible, use straight-and-level "dolphin" methods to use lift from this point on. Definitely do not use abrupt maneuvers such as steep turns, stalls and aerobatics.

During the flight it is a good idea to point out the landmarks around your airfield, the airfield itself, and other traffic. All of these activities will keep the passenger's head ***out of the cockpit*** and remind them to look ahead to the horizon. This will minimize any onset of airsickness. Keep talking – let your passenger know what you are doing. If the passenger becomes quiet it may indicate the onset of airsickness. If you are an instructor and time permits, an introduction to the effects of the controls and simple turns is a possible activity. It is a good idea during such flights to fly a course that always has the airfield located to one side of the cockpit. That is, fly in a direction that is not directly towards or away from the field but rather parallel to it. This technique will minimize the risk of being too far away from the field to execute a proper circuit if you get distracted and lose height more rapidly than anticipated.

At the end of the flight, mention you will be landing shortly, and perhaps point out how you are judging when to start the circuit. You can verbally go through the prelanding checklist, which will add to the passenger's positive impressions of the flight. Then try to execute as smooth and gentle an approach and landing as is possible under the prevailing weather conditions – for example, avoid sideslips and abrupt turn entries. After landing, help the passenger out of the glider and escort him or her off the active runway (another club member should do this for you if you are staying with the glider). Thank them for flying with you and ask for their impressions of the flight. Some clubs have souvenirs to hand out, such as a DVD and a certificate. These all go towards making the passenger feel special and hopefully one day to join the club.

Alcohol and drugs

Alcohol has the insidious effect of making us feel bolder! We think we can handle something more easily but, as we all know, this is not the case. In flying, any discomfort, nausea and hence airsickness effects are accentuated. Other drugs can have similar effects. Hence, no passengers should be flown where there is a suspicion that they are under the influence of alcohol or any other drugs. A simple question is to ask if the passenger is taking any medication, and if they answer yes, they should not be flying. For example, medication taken to handle epileptic fits may be considered acceptable by some, but this is a clear case where the person should sit on the ground as their friend goes for the flight. Even "ordinary" over-the-counter drugs such as cough medicine have active ingredients that can cause strong dizziness that will adversely affect a passenger's reaction to flying.

Other considerations

Learn about other pressures that are involved in passenger flying. In particular, be very careful about distractions at critical periods during the flight (takeoff, tow, winch climb, the circuit and landing). You may be tempted in two ways; first you may be subtly pressured by the passenger, and second by yourself. In the first case this means no continuous thermalling, no aerobatics, and no extended flights. As for yourself, don't be tempted into doing foolish things, even to the extent of doing a gentle stall to give the passenger their "money's worth". The passenger will appreciate the flight if it is carried out in a thoroughly professional manner, with confidence and good airmanship; in other words, no showing off. However, do enjoy the flight, and the passenger will too.

CROSS-COUNTRY FLYING

Introduction

Cross-country flying in gliders is no doubt a challenge to many pilots, an inspiration to others, and to many others a relaxation from the everyday activities on the ground. To some it is a wonderful release, and a successful flight under indifferent weather conditions can give a fabulous sense of accomplishment. To reach this stage requires a bit of dedication to reach a high standard in all one's flying and to not settle for second best. A good instructor will try to instill a sense of pride in the student's flying by requiring a steadily higher standard. You too can continue this after your first solo flight, to try and improve the accuracy of all your flying, and to learn new and better skills, for example to fly in strong winds and to learn better thermalling techniques, and, for your future cross-country flying, map reading. Learn these latter skills dual with an instructor.

Cross-country flying will require you to recognize and to use lift to best advantage under stressful conditions, such as when low and away from a suitable runway, so practice now to hone your flying skills. Don't concentrate on one aspect only to the detriment of other important points such as pilot decision-making to get back to the field with adequate height; work also to improve your handling and other skills. This will help you to stay in the thermal when needed, for example, without the danger of starting a spin because you allowed the speed to fall too much. You will be keeping a good lookout and instrument scan while improving your handling skills, all at the same time.

Becoming a good soaring pilot takes time, and it may seem you are getting nowhere at times. But remember that we all started with mere gliding when we started training, and that first thermal was surely a thrill! So too, the first time you venture away from the field will be memorable, and the thrill of returning to it with a long final glide is something to talk about. Most of us need help here though, and a small amount of instruction at this time will improve one's confidence measurably.

Attending a flying week at the club or visiting another club to attend a cross-country course are two ways of "breaking the bonds" that keep you close to home. Help from your instructors is not that readily available as they are usually busy with basic training, but seek their help, particularly if the club has a suitable two-seater for cross-country flying. An alternative is to fly along with an experienced pilot as a shepherd who will help you find lift and give advice by radio.

This section of the manual deals with several aspects of cross-country flying, starting with improving your attempts at thermalling or soaring and ending with the off field landing. During your training you probably had some thermalling flights, but the instructor most likely made the decisions then. Now you have your licence and you are improving your abilities; maybe you are eyeing a Bronze badge which is the entry level needed to attend one of the cross-country beginners' clinics offered across the country from time to time. Many clubs use ***"Proving Grounds"*** to build progressive skills. Most pilots who learn cross country soaring stay with gliding as a lifelong sport. Happy soaring, and soft landings!

Looking for lift

The best place to study the lift is from the ground. When preparing for takeoff, study the sky and look for the formation of clouds, and whether other gliders are circling generally under them or more towards the upwind edge, and so on. This will help you locate the lift when you get airborne. Listen to other pilots as they can be an excellent source of daily information, but the private owners may well be up and away before you can ask them, so watch where they first circle after they release from the aerotow or winch launch. You can always try starting with the lift that you flew through during the aerotow, if you noted where it was located! If you are winch launched you can probably do no better than to go to the "house thermal" that is already well known to you. Get to know the areas near the club that are lift sources such as a gravel pit or rocky area. This will help avoid the frustration of searching for lift as you return towards the club and a landing. When in the air, circling gliders most often mark the lift, so go and join them. If possible fly to lift upwind of the club, so if you fail to climb and "get away", you won't have to penetrate against the wind to get home.

When lift is encountered and you decide to try and climb in it, circle and get comfortable with the thermal before trying to center. Watch for other gliders and, after marking where the strongest lift is located, start to center it. The thermal will be drifting with the wind and there will be a tendency for you to fall out of the downwind side of the thermal; so watch for this, always remembering where the club field is and your glider's performance in a straight glide against the wind. If the rate of climb reduces, try moving upwind. Often you will have to move some distance to get into decent lift again.

When we do not encounter lift during the tow we will have to search for it. This can be a case of bumping into it by chance and such a thermal will be as good as any that you may find. However, flying cross-country demands that we develop a sense of where the next lift may be. So try to read the sky and the clouds now, to develop that important ingredient of the good soaring pilot, the ability to locate lift. This will enable you to find lift and to stay up on what appears to be a non-soaring day to others. To help in this there are some "rules":

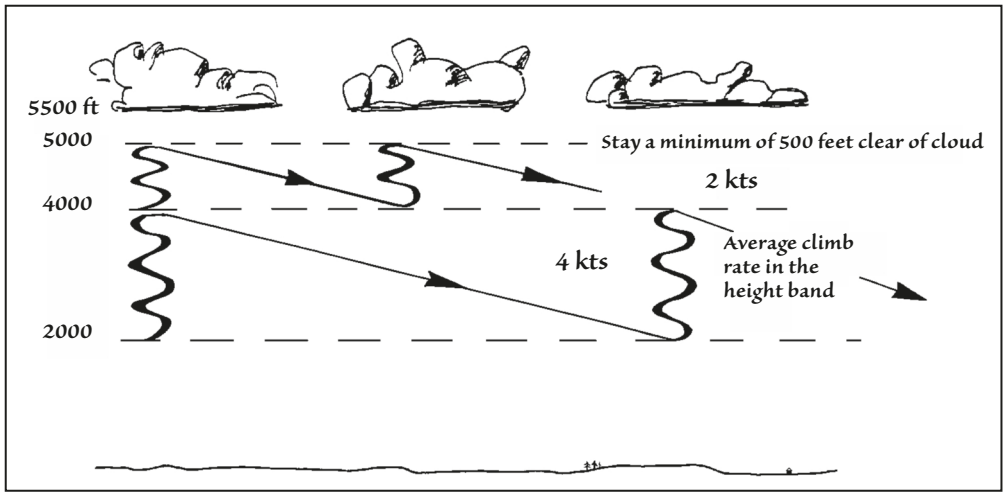
- Choose a cloud and fly towards a definite point below it, and don't let turbulence turn you away from it.
- Make wide circles under the cloud to cover a large search area.
- Thermals get larger as they rise, so lift may begin to vary widely; persevere with searching for the best areas of lift.
- Don't persist in looking for lift for more than one or two turns, watch for the cloud that is dissipating, its lift will stop.
- When you are low, ground clues must be used to locate possible lift since you won't likely intersect the lift forming a cloud high above; this also applies on cloudless days. Learn to recognize these clues, and study the crops and other ground features to look for signs of lift sources, and areas of sink such as swampy ground.

Early encounters with lift

Your early flying will be characterized by lift that is flown into more by luck than by choice. You may be flying locally with no destination in mind other than to return to the club at

the end of an hour. In this case, whether you climb slowly or most efficiently or merely climb to the tops of the thermals and stay high doesn't matter much. However, for efficient cross-country flying one needs to maximize the climb rate, to leave the thermal when the lift starts to drop off, and to study how to improve performance by adopting a positive approach to one's soaring and piloting techniques. Soaring instructors can help a great deal here so seek them out and learn from them, if possible even during your early training, as they will set the tone for your later approach to soaring.

You may find that the rate of climb reduces the closer you get to the clouds. The lift itself may be weakening but it is probably due to the fact that the lift is not so well defined and you are no longer centered in the strongest part. Lower down the glider was being well-banked and you managed to stay in the center more easily as you concentrated purely on the climb. Now that you are higher up, you are (or should be) thinking about navigation and the location of the next likely looking cloud, and this detracts from the task of keeping in the strong lift.



Soaring in different height bands. The new pilot tending to stay high will get poorer climb rates and slower progress cross-country than the experienced pilot who notes that the strong lift does not go to cloudbase on this flight.

The technique to overcome these problems is to fly in the best height band. This is the band of useable lift in which the pilot can maintain a good climb rate relative to the maximum strength of the thermal, and the top of the band is often less than the height just below cloudbase. The lower limit will be based on your experience and your confidence at contacting and climbing in lift low down. During your training you will already have had some good contacts at heights below your release height. Your experience and training at making an outlanding also will influence your decision about the lower limit to your height band.

During our early soaring flights there are temptations that detract from improving soaring skills. These are first, the desire to stay as high as possible and therefore to hang onto every scrap of lift, and second, to stay close to the club. The pilot who stays high will

seldom practice entering a thermal from an area of strong sink, and the skills to quickly center the lift and to start climbing efficiently will not be learned. Pilots who stay close to the club will become very uncomfortable when one day they fly out of range, and now begins to wonder if and how to get back to the field. These pilots will not develop good cross-country skills and their ground speeds will be low. Strive to explore the lower height bands where the lift is often the strongest. While lower down we can study the clouds ahead more easily. For example, lines of cloud (cloud streets) and likely strong clouds can be seen clearly from below whereas if the pilot is close to cloudbase, these features cannot be seen.

When first exploring your abilities at soaring further from the club, you may arrive at the club circuit one day and run into lift – now, do you try to climb away? In this circumstance there are additional "rules" that must be observed:

- don't try to thermal below circuit entry height; this is typically at 800 feet above ground, but could be lower for an experienced pilot,
- once in the circuit, never turn your back on the field, you may drift too far away and not be able to reach the field, and
- aim to land well within the field, not at the down-wind boundary.

These rules are designed to safeguard you from drifting too far downwind to be able to make a proper circuit, and to avoid circuit conflicts. When lift is contacted and a positive climb rate is achieved, you will be above the circuit height and conflicts should no longer occur. However, the likelihood exists that you will drift downwind of the club as you climb. You need to judge when to break off the climb and to penetrate against the wind back towards the circuit.

As your experience increases and you gain confidence you will probably want to explore further afield, and when you fly away from the club, will experience your first exciting moments of wondering whether you'll get home!

Before you do this sort of flying, some extra preparation is suggested. First, a flight plan is needed. This would include accepting the possibility that you might not get back home. This will put you into a healthy frame of mind immediately; you will find yourself much more relaxed, you will enjoy the flight more because you will be less concerned about returning to the club. This relaxation will in fact improve the chances you ***will*** make it back, or if not, will help you make much better decisions for an outlanding.

Part of the flight planning therefore must be to arrange for a retrieve – have the trailer checked and ready to go and connected to the car, crew on standby with car keys in their

pocket or in your car (not in your pocket! – that has happened, even in contests). This may be a bit of a hassle at first but retrieves are a lot of fun, meeting new people, the dinner and wine – cross-country is a shared event, not a solo show.

Learn the rates of climb needed to make progress against different wind strengths. A good rule is to add half the wind speed to the speed for best L/D, for the best penetration against the wind. This works well for lower performance machines, but for higher performance sailplanes try to use a final glide calculator or computer. These should be carried in the glider and used with a local map so that distances to fly can be determined and used. It helps too, to mark distances on the map, such as circles at 5 or 10 kilometre increments from the home field. The advantage of using the calculator is that if you get too low to make it back to the club, an outlanding can be contemplated early rather than when it becomes obvious later when getting very low. It is by making late and hasty decisions, when the club just isn't close enough for the proper circuit entry height, that accidents are most likely.

If we recognize the risk of landing out, the safety of local soaring is improved. During local soaring flights, select one or two local fields that are close to and downwind of the club, and inspect them for suitability for an outlanding. Drive over to them after a flight where you selected them to confirm their suitability. Then later if you do get caught low, the business of selecting a safe field has already been done. Even on a local flight an outlanding is always a possibility. Have this in the back of your mind: ***it is okay to land out close to the club***. It is better to make an unhurried circuit and outlanding, de-rig, and have the glider ready to fly again tomorrow, than to have an accident trying desperately to get back to the airfield and then have to wait perhaps months getting it (and maybe yourself) repaired. This happens!

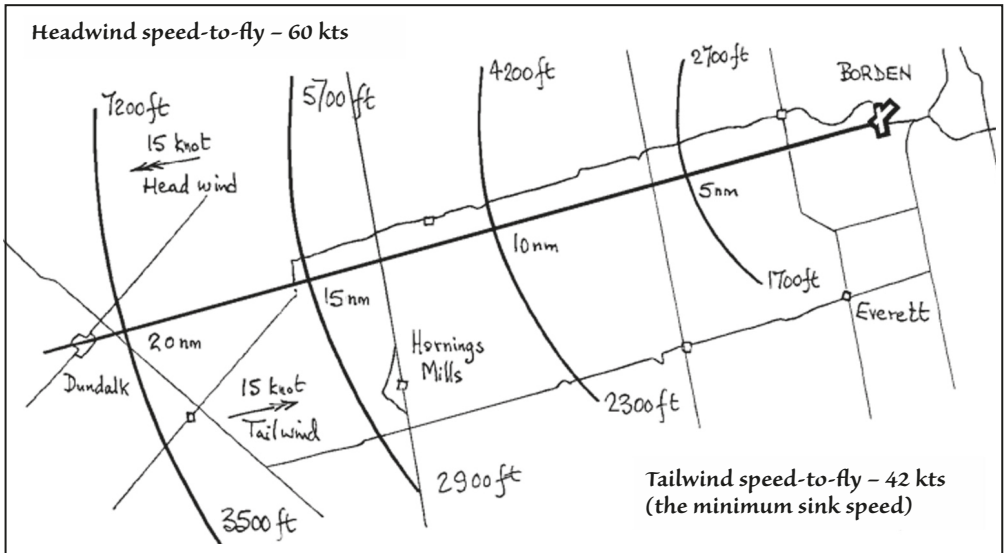
Those who develop confidence at using the lower height bands will be able to achieve faster cross-country speeds, and will feel less exposed to risks when gliding out of range of the club. Good training and practice when flying dual will develop good airmanship, or judgement, as well as soaring competence. So, take a flight with an experienced pilot occasionally, and you will be surprised at how your confidence and abilities will improve.

Building on your abilities

Dolphin flying is one of the more important time-savers in flying cross-country. Consider that one circle in a thermal takes about 25 seconds; at a speed of 60 knots a glider will fly just under half a nautical mile! If the glider can be soared by pulling up in lift rather than circling, the extra distance travelled and resulting time saved can be considerable.

An exercise that you can practice to get used to dolphin soaring is to climb initially in a thermal to a good height and then set off upwind. If you climb too high under the cumulus you will not be able to see the lift areas ahead, so break off the climb at least 500 feet below the bases (besides, it is against the law to get any closer).

The task now is to see how far you can go without circling. You will have to deliberately pull up in the lift, perhaps flying an **S**–pattern in strong lift areas, rather than circling, all the time penetrating upwind. Then increase your speed in the weaker lift and sink, according to the speed-to-fly ring on the variometer. Take along a map also, previously marked with



A method of marking a map for final glide heights and distances from club.

distance circles and heights needed to get back to the start of the circuit, or use the final glide calculator, to determine when you must break off the upwind run to return home. On successive flights reduce the margins progressively, so as to arrive back at the field with sufficient height for the circuit. You can reduce the margin as your confidence in the glider improves.

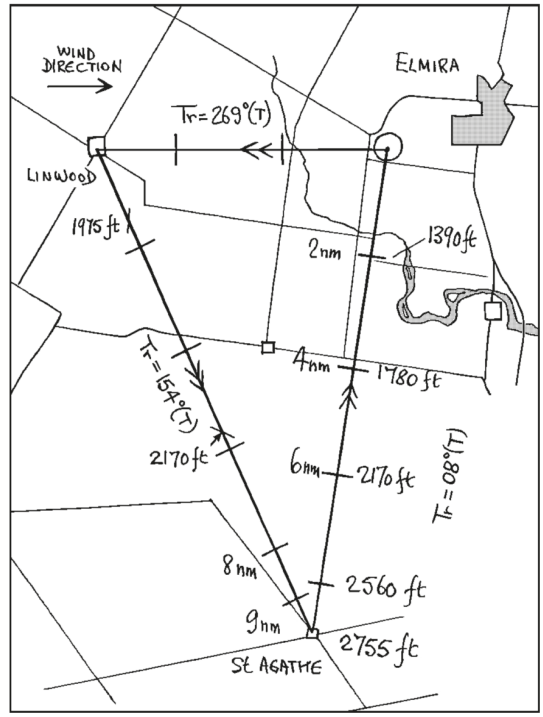
Another exercise you can practice without getting very far from the club is to fly very small triangles, say up to 40 kilometres in length. Not only does this kind of practice make for an interesting flight, it is excellent for developing cross-country flying skills. In this exercise you are never out of gliding range of the club, greatly reducing the chance of an outlanding and therefore the mental stress on the pilot.

For your first attempts, choose small triangles with easily identifiable turnpoints upwind of the club. Turnpoints are point features on the ground such as a road intersection, a prominent structure, or a bridge (one end if it's long). You can use the clubhouse as one turnpoint. Before you fly the triangle, estimate the time that you will need to fly the course, making a rough guess of the average ground speed. Your glider (a 1-26 in this example) will fly about 22 times the height lost when flown at its best L/D speed between thermals. This translates to 22 km for a height loss of 1000 metres, quite a long distance! Looked at this way, traveling a moderate distance in a glider doesn't seem all that daunting, does it?

When you have done a couple of these exercises, evaluate your own performance. Did you make your predicted speed, or did you circle in every bit of lift and thereby lose a lot of time, did you arrive back at the club with height to spare, and so on? You might be able to go around more than once on the same flight, allowing you to compare techniques. For example, try to use only the best lift on a second try, and compare your times. If you climb high enough at the start, try to go around without circling, and use the MacCready ring to set your speeds as you fly through areas of lift and sink. In lift you may be tempted

to circle, but try not to! If you choose the turnpoints well, you will always be within gliding range of your club, and you can break off the task at any time if you get low.

Practicing in this way allows you to see how and what is needed to get your average speeds up to those needed to be able to attempt a larger task. And it's fun to persuade another club pilot to fly the same course. Attending a cross-country clinic helps too, but these exercises can be a lot of fun, and they too will allow you to improve your abilities as a soaring pilot.



A typical small triangle for practicing local cross-country. Choose a triangle essentially upwind of the club. The height needed (plus a 1000 ft circuit margin) to each the club anywhere along the triangle is marked on the route. The height needed for a final glide from the far turnpoint is easily made from a thermal on an average day.

Map reading

Here we enter the arena of the true cross-country pilot, even in a world now dominated by handheld GPS units with moving map displays or flying in sailplanes fitted with GPS navigation and flight director systems. Low-cost GPS devices can be loaded with glide computer freeware for inexpensive devices to learn typical soaring navigation methods, turn points, tasks, etc. So why bother with learning map reading? – because it is a law of nature that all electroic equipment will fail when you need it the most, and even the most reliable GPS is useless after your battery has died. It has been said that GPS is God's gift to pilots only when it is used to confirm what you already know from a sound knowledge of basic navigation. There is no substitute for proper flight planning with a map and a ruler.

Map reading is not difficult but can be frustrating when first attempting to simultaneously thermal while trying to orient the map. The first requirement is to have the map folded correctly so that the area of interest is folded out, and the size of the folded map is not so great as to make flying difficult. This sounds self-evident, but one could forget to do this before takeoff, and then find that refolding the map in the air is virtually impossible! You will likely use a 1:500,000 VFR navigation chart. The folds tend to be awkward for a glider cockpit, and you may wish to redo them.

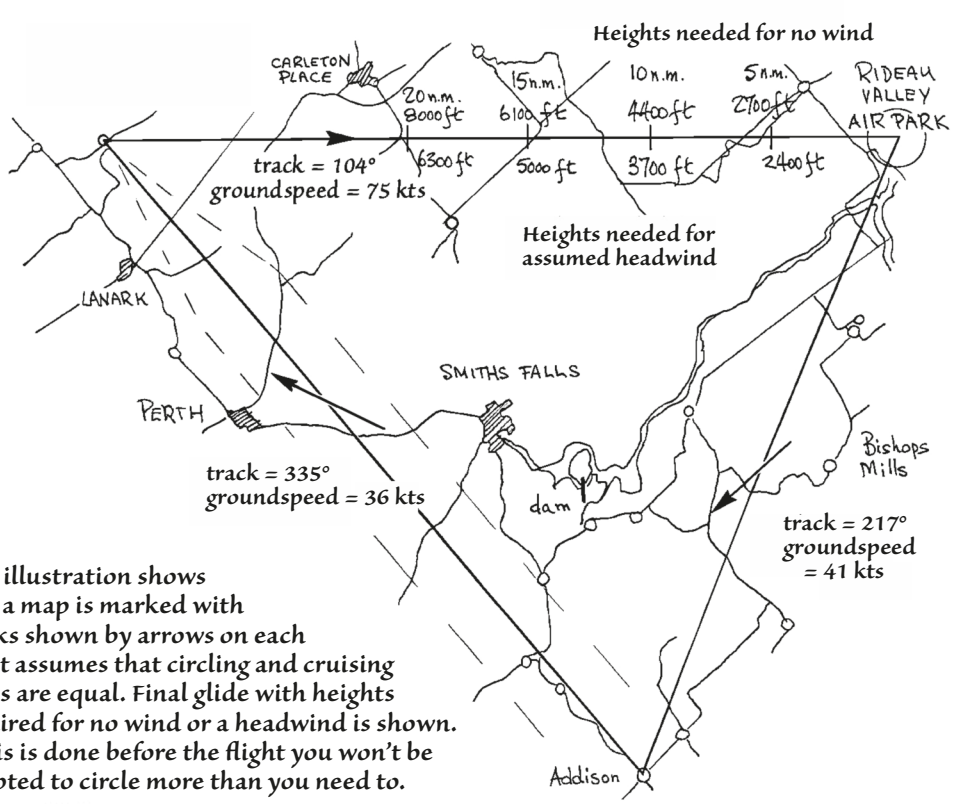
One way to handle such a map is to first open it fully, then to cut off portions that are not part of the "local" soaring area. Then fold it in half, parallel to the bottom edge, so as to leave the desired face of the map outward. Now fold it like a concertina into suitable

sections. This should serve you well for most cross-country flying, as the map can be opened like the pages of a book. With some practice at using the map and flying different courses, you may wish to cover the map with a plastic film, and to fold it differently.

Using an easily erasable pencil, draw the triangle or other course you wish to fly, show the compass courses along each leg, allowing for the predicted winds (though you may not get to this stage until you have been to a clinic), and then add the height and distance numbers for the final glide. The map is now ready for you as it has the minimum vital information on it. An example of such a course as it would appear on the map is in the illustration below.

Studying maps and courses in the winter is time well spent. It saves time later, as you will be already familiar with the areas around the club, features to look for, and you will have a good idea of how far away local towns and other landmarks are.

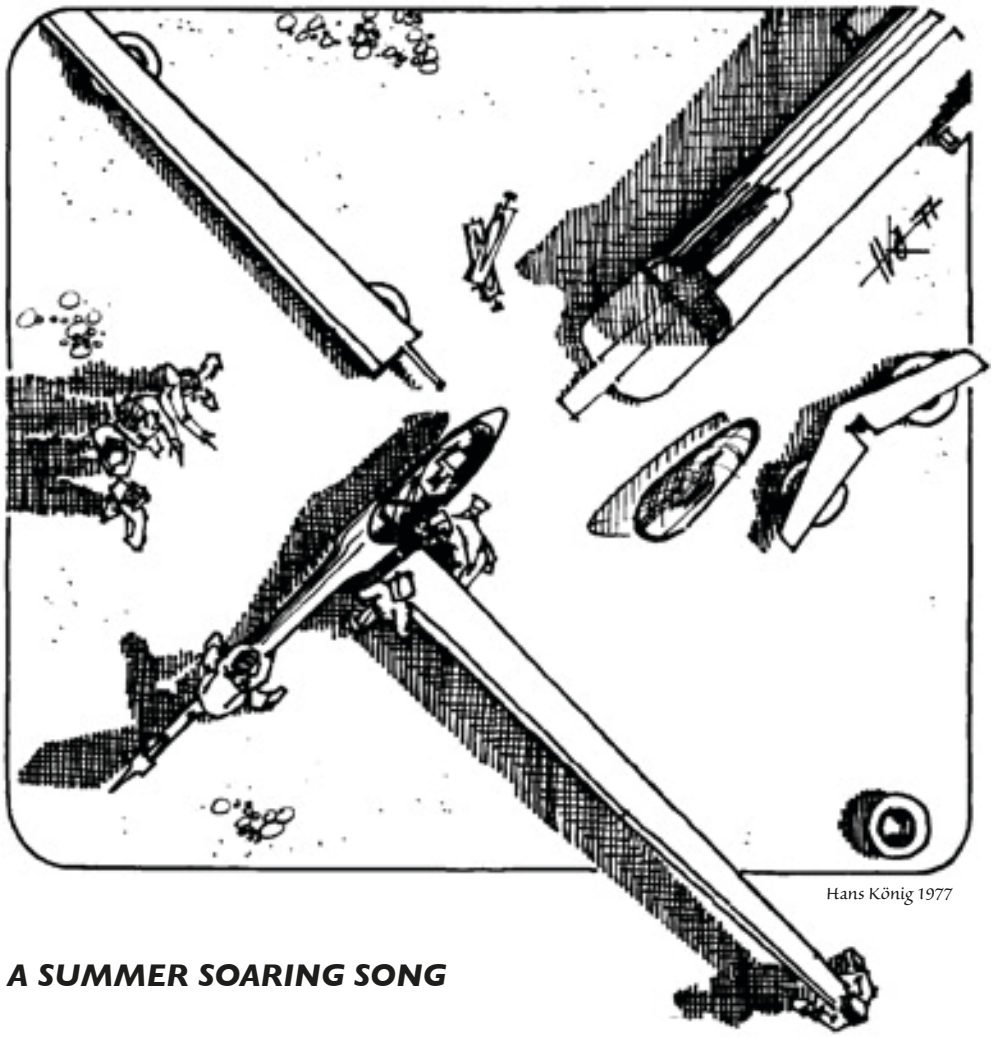
Learn how the features on the map are represented, and then identify how they look from the air when you go flying next. Remember that features are much more difficult to see when in cloud shadow and when the visibility is poor. Also learn the areas of restricted and controlled airspace, and respect them. We are allowed to penetrate certain of these areas and doing so is not difficult, but learn the radio requirements and how to use this airspace. Good airmanship is a prerequisite of course, as we can't always assume the other pilots in the area, who may be under radio control, will see us.



This illustration shows how a map is marked with tracks shown by arrows on each leg. It assumes that circling and cruising times are equal. Final glide with heights required for no wind or a headwind is shown. If this is done before the flight you won't be tempted to circle more than you need to.

Elevations shown on maps are height above mean sea level. As a new glider pilot you may have been used to setting the altimeter at zero when learning to fly, in which case the altimeter was showing height above the club field. This is of no use if the ground where you intend to land is at a different elevation. Therefore, you now will have to get used to setting it at field elevation, and the altimeter will now show your height above sea level. This is important particularly if serious cross-country flying is contemplated. The heights shown on the figures in this chapter are heights above ground, and you will probably mark your final glides and other heights as height above sea level. You will have to practice subtracting the map heights from your altimeter reading to obtain the height above ground. This isn't all that earth shattering, as I trust you will be judging your final heights above ground by reference to trees and other ground features, not by reference to an altimeter.

Now you have some tasks to practice around the club. Try them, and discuss with others your first successes and failures; share as we learn from our experiences.



Hans König 1977

A SUMMER SOARING SONG

Up! up a little
Up a little more!
Too far !!
Forward! … more more …
Again! … some more!

Oh !! … I mean BACK !!
Back on that tip!
Back … now forward a bit!
Okay !! Pin's in !

NEXT WING … (please?)

APPENDIX A

GLIDING BADGES

INTRODUCTION

AS GLIDER PILOTS GAIN EXPERIENCE, there are a series of soaring performance levels that they can work towards. Unlike other aviation pursuits, gliding has had internationally recognized badges from the beginnings of the sport. The historic ones, first earned in bungee launches off hillsides into ridge lift, are the **A**, **B**, and **C** badges. These recognize the basic soaring skills, and each club now awards the introductory **A** badge following the pilot's first solo. The **B** badge requires a five minute sustained height above release height (now usually considered achieved if the flight is over half an hour after release from 2000 feet by aerotow), and the **C** badge requires a pilot to stay up for at least one hour following a release at 2000 feet.

The next badge shown here, the FAI ***Silver badge,*** is rather less easy to achieve as it requires a five hour flight, a cross-country flight of 50 kilometres from both launch point and release, and a gain of height of 1000m (3280 feet) from the lowest point after release. Later, the now experienced soaring pilot can work towards the expert levels of the Gold and Diamond badges. Proof of these flight goals is documented according to FAI rules, and Official Observers are appointed to help with the documentation.

THE BRONZE BADGE

The purpose of the Bronze badge is to foster continued interest and a desire for a pilot to improve their abilities by acquiring additional skills and capabilities beyond the basic Transport Canada Glider Pilot Licence. As the requirements of the Silver badge can take a year or two to complete, the ***Bronze badge*** bridges the gap and provides aspiring pilots with a more easily achievable set of goals and to demonstrate the minimum cross-country skills and knowledge to attempt the Silver distance flight. The badge is available from SAC's National Office.

The badge is the required entry level for the Basic or Beginner's Cross-country Clinics run across the country from time to time (the specific clinic entry requirements may contain extra items not specified for this badge).

It is entirely administered within each club. Become familiar with how the training for it is done by your club. It is an excellent set of tasks to keep up the momentum of new post-solo pilots towards becoming much more competent and skilled. The checklist at the end of this appendix enlarges on the items to be completed.

BRONZE BADGE

Checklist and application

Pilot Name …...…...……

Item	REQUIREMENTS	Date Task Completed	Signed *
1	Glider Pilot Licence		
2	Pilot-in-Command time of 10 hours		
3	Soaring Flight of 2 hours duration – 1st flight		
4	Soaring Flight of 2 hours duration – 2nd flight		
5	Three consecutive spot landings in marked area on club field **		
6	Off-field landings – Field selection exercises – dual		
7	Off-field landings – Circuit planning exercises – dual ***		
8	Map reading exercises on dual flight		
9	Final glide exercise on dual flight		
10	Rigging, de-rigging and trailering; instruction and practice		
11	Cross-country flying requirements; Airspace structure and use; Radio procedures and practices		
12	Basics of advanced instrumentation (Speed-to-fly, TE compensation, Final glide calculator)		

* To be initialled or signed by pilot or instructor as appropriate
** To be accomplished with normal approach & landings
*** Should include landing on an unfamiliar part or different airfield, and practice on how to prevent an overshoot if too high.

Bronze Badge requirements completed .....

Bronze Badge issued and logbook signed .....

The required training at the club may be completed normally after first solo during the time the pilot is working towards their licence. Some items will require time to complete, and these may be done as part of the pilot's recreational flying at the club. It is expected that a number of fun flights can be taken with instructors who are experienced cross-country pilots, to learn the techniques for field landing selection, for example, and to hone those thermalling skills. Much may be learned on such flights, and the experience of gliding can be extended to true soaring and the challenges that this implies. The Bronze badge is awarded on completion of the following requirements:

- Glider pilot licence
- Pilot-in-command time of 10 hours, including:
  2 soaring flights each of 2 hours; and
  3 consecutive, defined spot landings.
- Training beyond licence

Spot landings

The landings are to be made in a space marked on the runway approximately 50m wide by 150m long; the glider is to cross the threshold at a height of 1m minimum, and come to rest before the 150m mark. If the pilot fails one of the three attempts, the series must restart. An instructor certifies successful completion of each landing in the logbook or on the badge checklist, which may be kept in the logbook. Hence the pilot should advise an instructor ahead of time of each attempt. The aim is to make precise normal 8 degree approaches with held-off landings. Planting the glider on the ground after a low and slow approach can lead to ground loops and glider damage. Having to use full air brakes all the way down final because you are consistently too high is also not demonstrating a good level of circuit planning!

Training beyond licence

The following are required to be completed as part of the pilot's training for this badge at the club; these items again are to be certified by the instructor, in the log book or on the badge checklist, as they are completed:

- Off-field landings – field selection exercises
- Off-field landings – circuit planning exercises
- Map reading during dual flight
- Final glide exercise dual
- Rigging/derigging/trailering safety
- Cross-country procedures – club requirements checkout
- Basics of advanced instrumentation (speed-to-fly, total energy compensation, final glide calculator, GPS flight recorder)
- Use of radio – procedures, and its use for advisories and as a safety aid, including its use for cross-country flying, and
- Canadian airspace structure and restrictions.

Off-field landing exercises

These exercises are to be flown dual, and will normally require at least two flights. Field selections should be practiced at different times of year, and the choices the pilot makes

from the air close to the club should be checked on the ground after the flight. The pilot will be asked to plan circuits into the chosen fields as well as identify hazards on the approaches, slopes of the field and so on. You should also demonstrate how to execute overshoot protection by using full airbrake and increased speed to get back onto glideslope or to a fully held-off landing.

Map reading and final glide exercises

Map reading can be practiced at any time. The requirement for the badge includes an ability to mark the map to show typical final glide heights needed to return to the club. The exercise to be flown dual will include a final glide from a distance of about 5 miles, and must show the student can judge his or her glide to arrive at a minimum of 1000 feet above ground, to allow sufficient height for the circuit. Airspace structure and use should be reviewed, and even if you do not use radios at your club as a general rule, its proper use should be learned. For example, it is important to allow other pilots adequate time on the radio frequency, particularly to keep it free for safety purposes.

Rigging, de-rigging and trailering

The requirement can be completed on a non-flying day, and would include some trailer handling. Pilots are encouraged to arrange with an instructor to be taught how to rig and de-rig the glider that they might fly cross-country first. The requirement for independent rigging checks by another pilot is important, and the method of recording this must be included in your instruction. Practice backing up the trailer and making turns, with other pilots providing a lookout. The club instructors will suggest how to set up a suitable practice area. Pilots should become fully conversant too with the hazards of trailering with a glider, particularly if the club owns an open trailer. The center mounting of the trailer axle makes the rear of the trailer swing out in tight turns, with the potential to sideswipe vehicles or obstacles. So talk about the problems of inadequate brakes, wheel nut torque, and poor loading (too much weight behind the axle) that can lead to fish-tailing. Such conditions can and have led to accidents where the glider is damaged. Aerotowing out of a field has several associated hazards and is not recommended; many clubs will restrict tows to approved airfields only. Many farm strips were developed for light powered planes or ultralights and crops/grass close to edges are too tight for safe glider launches.

APPENDIX B
FIELD LANDING NOTES

2000 feet agl

If landing appears likely, fly towards a suitable area that is flat and unobstructed. You will cover more distance if you fly downwind.

By 1500 feet

Pick an area with two or three suitable looking fields. Consider the surrounding terrain:

- Are there hills or tall trees and/or bushy areas to create turbulence?
- Are there power or telephone lines or other similar approach problems? (Your initial assumption should be that there are.)
- Is there a visible slope to the field? Look for streams for clues; if a slope is visible the field normally will be unsuitable, or very difficult to land in.
- Keep the wind direction in mind, remembering the wind and sun direction during the flight.

By 1000-1200 feet

Select the most suitable field, considering the factors below. Having chosen the field, plan the most suitable circuit, and how to get to the ***high key area*** from your present position. Keep in mind that there is often a tendency to keep too close to the field, therefore making a circuit too cramped and difficult to fly. Having looked at the field for obvious obstructions, etc, fly to one side; it is easier to plan a good circuit from a position alongside the field and not directly on top of it, so move to the side, preferably with the sun and wind behind you. Then visualize the circuit as you examine the field for (mnemonic ***SSSLOW***):

S*lope* – No visible downslope is acceptable. A similar upslope would be acceptable if you have a good wheel brake. Look at adjoining fields for slope indications. Any nearby watercourse will be a clue to the orientation of a potential downslope.

S*hading on Surface* – Examine fields (shading from the air is a good clue) in the following order for priority (look for shades by comparing what is on ground with what it looks like in the air for the season you are making the flight):

- ***Summer fallow*** The outlanding motto is: ***"You can't get hurt if you land in dirt."***
- ***Stubble*** – a recently harvested field.
- ***Grass*** – beware of strip grazing indicated by a colour change at an electric fence, which itself will be almost invisible until it is too late. ***Don't cross a change of colour.***
- ***Short crop*** – the surface will appear brown looking from above but slightly green from a low angle.
- ***Ploughed*** – though clear of crop, it could be quite rough depending on the depth of the furrows unless they have been harrowed. If you can't land parallel to the furrows, choose another field.

- ***Tall crops*** **– C**anola, flax, grains, and especially corn can present a large hazard on landing, perhaps causing a groundloop. Consider the season and review the fields en route to the club regularly.
- ***Pasture*** – The surface condition is a complete toss of the dice. If the farmer doesn't put a tractor on it, why would you chance your glider?

Stock (Animals) – Cows are curious and may step on wings, horses bolt, and sheep panic and run in random directions. A single cow is probably a bull! If at all possible, avoid landing in a field having animals on it.

Length of the field – Remember the apparent size of the field is seen relative to the size of surrounding fields. Know the topography of fields in the area in which you are flying. A good field for an outlanding is at least 2000 feet long with relatively unobstructed approaches over which you will fly.

Obstructions – These reduce the usable length of the field by about ten times the height at which you will cross the obstruction. Trees and other obstructions create turbulence downwind for several times their height.

Wind on ground – Assess the wind direction by water surface ripples, smoke, or by cloud shadows (these can be in error) or your drift over the ground. Always plan to land into wind as far as possible, minimizing any crosswind component.

By 800 feet

This is the height at which you will be starting a downwind leg. Position yourself well upwind and to the side, visualizing your home club circuits. Try not to get too close; this is a well-known tendency of pilots on their first outlandings.

Circuit

Plan to be opposite the chosen reference point at 500-600 feet above ground. Select a safe approach speed and plan to use half airbrake opening on the approach. Allow an adequate margin of height over any obstructions. Aim to touch down at minimum speed on rough ground. Try to avoid dropping a wing early, as this will often lead to a groundloop in any crop. Retract flaps early after touchdown, if necessary to avoid damage.

After landing

Secure into-wind wing with tie-downs. If leaving the glider to look for a phone, secure the canopy and take removable and expensive equipment such as clip-on nav-aids with you.

Finally …

Your first concern must now be to notify the landowner that you had to make an unplanned glider landing on his or her field. Ask for permission to move the trailer onto the field or the road next to it, and so on. If you damaged the crop, try to avoid having others tramping on it who may come to help. If the farmer is concerned about crop damage explain you are insured and ask for an estimate of the damages. In all likelihood they will not bother with a claim. However, minimize the damage the retrieve will do by moving the glider to the trailer. The farmer may even assist you with

a farm vehicle. Tip: keep a spare link in your glider to mitigate damaging your release mechanism; better yet, carry your own towrope as part of the landout kit. Ask the farmer for their name and address so that you may send a postcard of thanks or a letter enclosing a photo of the farmer and the glider.

Good luck!

I'm down okay,
but you won't believe what I'm looking at!

APPENDIX C

PILOT DECISION-MAKING

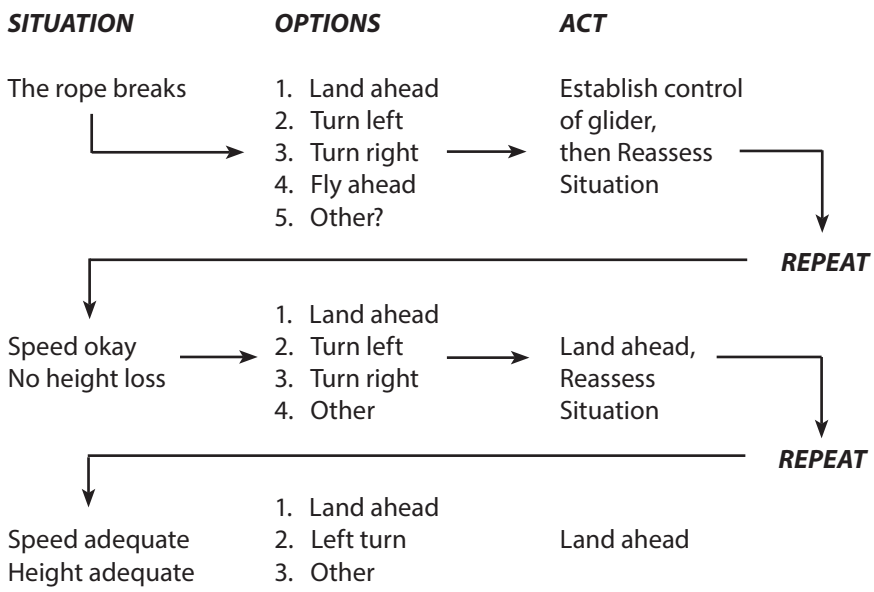
THE SOAR TECHNIQUE

TO ILLUSTRATE the technique in action, a few situations are discussed here. Actually there are many situations which can be assessed using the ***SOAR*** PDM technique, and these go from considering whether you have adequately planned the flight and made all preparations in the first place, to assessing your final glide and upcoming circuit and landing after a five-hour cross-country flight. Situations can require slow, considered thought, such as before the first flight after rigging the glider, to ones that require very fast assessment and action such as being too low to fly the normal circuit pattern. Discuss these with your students throughout their training, as only by going through a variety of situations will they begin to apply the technique to all they do in making flying decisions.

The following two situations are very similar and have been chosen to show how PDM can be used to safely modify what is an almost automatic series of actions following a low level rope break. The last situation is chosen to illustrate that you do not have to be in the air to display good judgement by using PDM, in this case to decide whether or not to fly. Get the student to think about this one!

The first ***Situation*** refers to a low level rope break: we are on an aerotow at about 200 feet, with a light wind. It is landable beyond the airfield? And to the left is a stubble field, to the right a tall crop. The pilot has only a few hours of gliding, and is not too experienced on the glider. The rope breaks … Suddenly the pilot has no more oomph! No more pull … How does this pilot react? What do they see? What do they do? What should they do? Remember the automatic reactions. So, here we go …

Example: ROPE BREAK



S – O – A – R

Remember that a rope break can occur in the steep climb through the wind gradient. This requires the automatic reaction to lower the nose to prevent the speed from dropping rapidly after the break. Also under this heading comes a low level wave-off by the towplane, when the speed could be marginal.

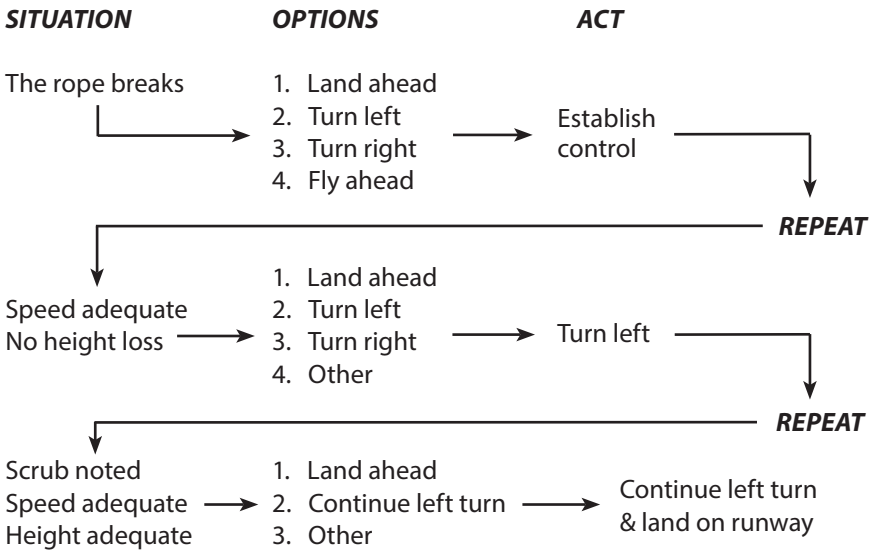
The pilot could have turned left towards the stubble field, but in this case they were a low time pilot and they considered the left turn more dangerous than going straight ahead onto a landable area. Here we are also operating by the rule for a rope break below 300 feet, which is to land straight ahead, with only a brief turn into wind if needed.

For a situation where a landing straight ahead is out of the question, the pilot must still react automatically, but their responses may be modified now by using the SOAR technique, i.e. by good judgement.

The next example shows how this would be done …

Example: ROPE BREAK, WITH AUTOMATIC REACTIONS MODIFIED BY PILOT DECISION-MAKING

The ***Situation***: we are on aerotow at about 200 feet, and there is no wind. It is a hot day, ahead it is unlandable, to the left is a rough scrub area and to the right is a tall crop. The pilot has only a little glider flying time solo, and is not too experienced on the glider.



In this case the pilot saw and knew that landing ahead would end in disaster. So he began the left turn even though the turn would lead towards rough scrub. Note that the pilot ***Sees*** the speed continues to be adequate at each repeat, and the continual repeat of the four-step process led to an acceptable change to the normal rule to ***land ahead***. It has shown a good use of the pilot decision-making technique added on to the basic automatic reactions that you learned for these emergency situations.

Another type of situation that occurs to higher time pilots concerns decision making while enroute on a cross-country flight. The situation could go something like this. The pilot is flying an 18m racing sailplane, and is at a good height above the ground. This would allow for several more minutes before having to land. A few minutes earlier this pilot passed over a small landing strip. Lift has generally ceased because the pilot has had to fly under a large area of cloud to stay on course. But ahead the sun is shining and (perhaps?) promises lift. There are not many suitable fields underneath, but the pilot is under pressure to continue.

Of course we can imagine a student doing the flying on final approach. The instructor, is watching and is following through. The student is slowing down imperceptibly. This is the ***situation*** and the instructor begins to feel uncomfortable with the declining speed. What are the instructor's ***options?*** Say nothing, hoping the student will notice, then increase the speed; say something simple like "watch your speed"; the student might

not really get the message, hence does not act; they do nothing. The speed continues to decline so now the instructor has new options. Says, "Lower the nose to increase speed", which is an instruction to the student; or if the instructor had more time they could ask the student to read the ASI and tell what it reads. This is a better teaching point than simply asking for a speed increase – a command that the student won't necessarily learn from! If the student does not recognize the speed is declining by reading the ASI, and therefore they do not act quickly enough, the instructor's only option might be to take over control and ***act*** to increase the speed.

This and similar situations should be visualized by you, so that when in the heat of the moment you have a situation and therefore options to consider. Also you will have already gone through the process and will be able to act appropriately and to ***repeat*** these four steps using the SOAR technique.

Example: TO FLY OR NOT TO FLY? – THAT IS THE QUESTION

Another question that occurs occasionally could be whether or not to fly at all. The situation could be that our pilot has had a rough week and, though the weather looks great for thermalling, the pilot has a slight headache or maybe a bit of a hangover? Not much of a problem they think, but how about predicting what would happen if he did take off. What is likely to happen to the headache? Is the pilot going to be able to concentrate well? An increasing wind is predicted, and it is strong already. The pilot is tempted to say they can handle things, eh? Okay, so now you as the pilot will reflect to summarize the four steps and see how to use PDM to come to a safe and logical decision:

Situation
The pilot does not feel too hot (rough week); perhaps is suffering from a bit of a hangover. Weather looks good for thermalling, and it is tempting. Wind is predicted to increase, and is already strong.

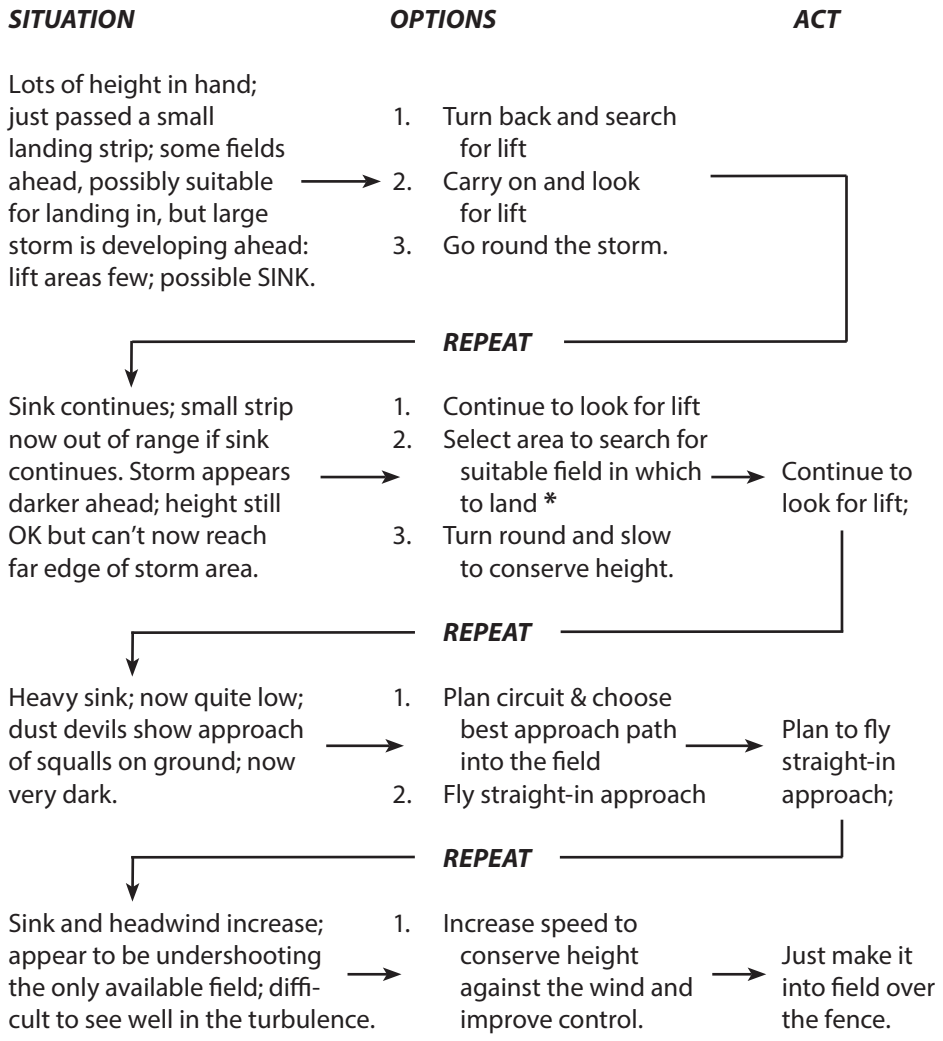
Options
There are only two; to fly or to stay on the ground. The ***predictions*** for the flying option are; the pilot will probably be able to climb away and have a flight of an hour or so. The winds will increase, making good piloting skills and good planning of the circuit prime requirements for the circuit and landing. The headache will get worse due to the altitude and concentration will suffer – and when did this pilot last eat? The pilot will be distracted from ***flying the 'plane.*** Probably they will make a poor circuit and hence a poor landing. With the increasing wind, a serious situation could arise.

If this pilot stays on the ground the ***predictions*** are that they will gradually get to feel better. The pilot can even do some useful by helping around the club and the flight line, and impress on younger pilots that if they don't feel well, it is best to stay on the ground. Any one or two of the first set of predictions alone (the flying option) would suggest that this pilot should not fly. An extreme example perhaps, but it was chosen to illustrate that a person does not have to be in the air to use the **SOAR** technique to reach a good decision.

Below is a situation that you should go through with a pilot who is working up to competition status, when the pressures of cross-country flying can lead to the consequences of pushing on and having to plan a off-field landing late.

Example: CROSS-COUNTRY FLIGHT AND OUTLANDING

The pilot feels that the flight has gone well so far, in fact a few other gliders on the same course are behind, and there is lots of height; however, the second turnpoint has yet to be reached and there is a large area affected by a developing storm ahead.



In this example, the pilot clearly left the decision to land too late. The lure of the sun ahead, a promising lift to allow them to continue in the quest to reach the second turnpoint could have resulted in an accident. They were clearly a pilot who ***pushed their luck***. "It can't happen to me, I can handle it," they say. With luck on the pilot's side, they avoided one this

time. If you look at item 2 in the second block, marked (*), this is the decision that would have been safest and best for this situation.

SUMMARY

Before solo, aim to go through the four-step process without thinking and without being prompted by your instructor.

Approaching your first solo, you may consider to continue thermalling when you might feel it is best to fly towards the club and prepare to land. Are you planning ahead using the ***SOAR*** technique? Consider your options and what might go wrong with your instructor. Other similar exercises to make it more of a challenge, to prepare yourself for later solo flying, might include considering to fly towards a good looking cloud when you should really be flying towards the club, because you are getting too low. Review with your instructor your situation, options, and then act and reassess. Or an exercise could be to practice field selection and circuit planning for an off-field landing when very close to the club.

These are interesting and difficult exercises for a pre-solo pilot, but instructors should suggest these exercises to improve your skills to become a good solo pilot. All pilots have to practice becoming proficient at PDM using the SOAR steps. A few flights practicing these types of exercise with an instructor's advice will greatly improve one's proficiency.

Don't forget that there are many situations that require continuous evaluation; in fact there should be very few occasions when you will not be assessing your options. Sometimes the process will be fairly relaxed, as when you are very high, but don't forget to practice the technique when flying solo, as it will be vital to you under situations that call for rapid decision-making, such as when landing in a strange field. Your pilot decision-making will be based on the predictions for the options that you are evaluating at that moment …

A new cross-country pilot got low with no better option … and avoid an outlanding field that has a tall crop in it. If you caught a wingtip after the flare the glider would groundloop.

APPENDIX D

HUMAN FACTORS

HUMAN FACTORS (HF), is the study of how humans react to and operate within our environment in all senses of this word. The environment is generally understood to mean the air and space in which we live and work. In aviation we describe it more broadly to include the cockpit environment where heat, cold, light conditions and altitude vary, as well as the human environment of the club, of the flight line operation, and so on. Enlarging on these thoughts we see that HF includes how we respond to operating procedures, to the design of the aircraft (cockpits especially), how the body functions and responds to many different stimuli, and how we interact or communicate with, and are influenced by other humans, and how we make decisions.

Ultimately, the safety of our flights comes down to how we as pilots and operators (winches, for example) relate to our equipment, procedures, other people and the environment. HF is a very broad subject, however we need a good basic understanding if we are to become successful soaring pilots. We measure success here through safety and our ability to participate over many years without injury. Soaring is not risk free, and how we understand our ability to function in this relatively new experience that is human flight (last 100 years of human evolution) will increase the enjoyment we can draw from the sport.

Accident statistics from many years show that the greatest risks occur when taking off and landing. This is not surprising of course because the cockpit workload is high in both these phases of flight and the ground is hard if a mistake is made. We add a long flight, and the landing phase is seen to demand the most attention, from the now fatigued pilot.

The top three major areas of concern with respect to serious accidents in gliders worldwide include judgement or decision-making, the stall/spin, and mid-air collisions. The first two can arise from problems with circuit planning, especially when flying cross-country, and when trying to make a safe landing after an emergency during the launch. Inattention and becoming distracted, perhaps by the newer in-cockpit electronics, have been implicated in mid-air collisions. Other areas are poor pre-flight planning and missed items on glider daily inspections (DI). How can we avoid these hazards and reduce the risks?

Humans receive many stimuli on which we base our decisions. We receive data, evaluate or process it, make a decision and then act on that decision. Sound familiar, does it? The mnemonic ***SOAR***, learned earlier in your training, is just that: S for ***See the Situation***, O for what ***Options*** do we have? A for ***Act*** on the best and safest Option, and R for ***Repeat*** the sequence.

When we ***See the Situation*** we are using our sight and other receptors to gather information that tells us how the flight is progressing, what the situation is ***right now***. The data must include physiological inputs:

- ***Sight*** – are other gliders in sight nearby and do we understand the eye's limitations?
- Does this control movement feel and sound right? What do the aircraft's movements and the g forces tell us?
- Is our food and water intake okay?
- How do we feel; hot, cold?

Psychological influences on our performance are very important too:

- Have we just had an argument with a fellow member,
- Are we under some form of general emotional stress, perhaps from job, financial, or family problems, or are we in a good positive mood, able to make sound decisions?

And we must ask how is the glider performing – height, climbing or sinking, and location relative to our goal, and how is the weather changing to affect our flight's safety and progress? We constantly evaluate all inputs so that we can make the best decisions for a safe continuation of the flight.

HF then, is the understanding of the factors that affect our performance as humans from many different but important aspects. HF includes the pilot's attitude, their knowledge, and discipline in making the right decisions. The pilot's attitude plays a pivotal role. A negative or indifferent attitude will not support good judgement and therefore safety. Self-discipline includes everything from the use of checklists to following rules and safe practices. It also includes avoiding temptation to indulge in risky flying behaviour.

Your judgment is the ability to identify usable options and apply experience gained to various situations in order to make good decisions. What do you need to know about yourself with respect to HF? How does your body and mind react to the environment? Do you have left-brain or right-brain dominance and what are your learning styles. This will have an impact on how well you will learn. How would you classify your performance under low- or high intensity situations? This can explain our flight-or-fright response and our ability to react to unusual high risk situations. Knowing how you perform in these situations will determine to what extent you should plan ahead using different options.

Experience has shown that some people perform better in emergencies when they have had similar exposures during their training. Others may have difficulty thinking, or have a tendency to ***freeze*** in some situations. This can be a response to adrenaline and the resulting increase in the heart rate which can cause tunnel vision and an inability to move your own limbs! Learn how to recognize and reduce anxiety. Breath holding, squeezing the stick, or pushing on both rudder pedals are signs of anxiety when flying. If you can notice these, controlling your breathing, or your relaxing hands and feet will help you reduce anxiety.

The brain is a marvellous organ, able to perform many functions. In flight, we gather information continuously; for each decision, we need to assess if the inputs are complete,

useful, and correct. We may interpret some input incorrectly which can lead to a poor decision or the exclusion of available information relative to making a good decision which can cause a loss of situational awareness. A study of how the brain works can take a lifetime, but a basic understanding of the brain's capabilities is important to us. We can remember, concentrate, focus on a task, reason, evaluate and solve problems, but we also may relax, be distracted or forget, and we tend to develop expectations that certain things will happen – this latter factor can lead us into trouble. The brain needs a good environment to function at its best, and only we can provide that. Hydration, hypoxia, blood sugar level, heat or cold stressors will all affect your ability to think and act. Being aware of how we feel and act, and how the brain works to make decisions will go a long way to making you a good and safe pilot.

Human factors is also about risk management. Develop your own ***comfort zone***. This means finding your personal level of satisfaction within the risks in gliding by identifying elements that protect you and make you comfortable. Learn the causes of typical accidents, and how to recognize departures from your usual routine by knowing your limits. Develop your personal discipline to include items such as checklists, weather minimums, personal routines, etc. You need to discipline yourself to take the actions needed to break an accident sequence (the domino effect) or to correct a missed pattern. This is why your instructors will expose you to checklists such as ***I-AM-SAFE, SOAR, CISTRSC-O***, and will explain what to do when one may be interrupted.

Threat Error Management (TEM) is a process to analize risk and plan how to mitigate it. You examine each phase of your flying process and how things should go right, then identify threats (what could go wrong), then for each step identify how that risk could be mitigated. There have been some excellent articles written in *NZ Soaring* on how TEM can be applied to gliding. The bottom line is to learn good flying practices, develop a good attitude towards safety culture, apply consistency, personal discipline, and set and keep high standards in your flying.

TEM1.pdf

TEM2.pdf

TEM3.pdf

Further very good reading on Human Factors is the Transport Canada Publication, ***Human Factors for Aviation***, ***Basic Handbook***, TP 12863 (E) (09/2003)


GLIDER PILOT UNFAIR TO GOD
OH, DAMN I'M GOOD!
PARCELL

APPENDIX E

CONVERSION FACTORS

DISTANCE	**1**	**inch**	**=**	**25.4**	**millimetre (exactly)**
		foot	**=**	**0.3048**	**metre**
		mile (nautical)	**=**	**1852**	**metre (exactly)**
		kilometre	**=**	**3280.84**	**feet**
		mile (statute)	**=**	**5280**	**feet (exactly)**
		mile (statute)	**=**	**1.6093**	**kilometres**
		mile (nautical)	**=**	**1.1508**	**miles (statute)**
SPEED	**1**	**foot/second**	**=**	**0.3048**	**metres/second**
		metre/sec	**=**	**3.6**	**kilometres/hour**
		metre/sec	**=**	**1.9438**	**knots**
		metre/sec	**=**	**2.2369**	**miles/hour**
		mile/hour	**=**	**1.6093**	**kilometres/hour**
		knot	**=**	**1.8520**	**kilometres/hour**
		knot	**=**	**1.1508**	**miles/hour**
		knot	**=**	**101.2686**	**feet/minute**
		mile/hour	**=**	**1.4667**	**feet/second**
PRESSURE	**1**	**atü**	**=**	**15**	**psi (for tire pressure)**
		psi	**=**	**6.8948**	**kilopascals (kPa)**
		atmosphere	**=**	**101.3325**	**kilopascals**
		atmosphere	**=**	**1013.325**	**hectopascals (hPa) or millibars**
		atmosphere	**=**	**29.9213**	**inches Hg (0°C)**
		inch Hg (0°C)	**=**	**33.8639**	**millibars (mb)**
		millibar	**=**	**0.7501**	**millimetres Hg**
VOLUME	**1**	**gallon (Imp)**	**=**	**1.2009**	**gallons (US)**
		gallon (US)	**=**	**3.7854**	**litres**
		gallon (Imp)	**=**	**4.5459**	**litres**
MISC.	**1**	**gallon (Imp)**	**=**	**10**	**lbs water (15°C)**

as a rough approximation:
100 ft/min = 1 knot = 0.5 metre/sec

APPENDIX F

Example Risk Management Assessment Matrix for Glider Pilots

	Category of Risk	Risk			Score
		Low	Higher (+1 pt)	Highest (+2 pts)	
Pilot Factors	Sleep	8 hours	6 hours	4 hours or less *	
	Experience	Multi-year recent	Multi-year gapped	First year	
	Site familiarity	Many flights	Some flights	First time on locale	
	Family/Personal	All is well	Some problems	Many problems *	
	Work	Some	Moderate	Swamped	
Type of Flight	Instructional ab-initio	Pre-solo	Post-solo	Advanced (Spins etc)	
	Licensed pilot solo	Experienced in type	Under 10 flights/type	1st flight in type *	
	Licensed pilot passenger	Experienced	Fist one this year	First 5 passenger rides	
	Aerobatics	Under instruction	First 5 solo aerobatics	Inexperienced	
	Cross-country	Diamond dist/goal	Gold/Silver equiv. OLC	Bronze not current	
Flight Factors	Duty day	Under 6 hours	6-10 hours	10 hours or more *	
	Currency	0-14 days	15-30 days	30+ days *	
	Planned flight time	Under 1 hour	1-2.5 hours	2.5 hours or greater	
	Number of flights today	1-4	5-7	More than 7	
Weather	Winds	0-10 kts	11-20 kts	Over 20 kts *	
	Crosswinds	0-7 kts	8-12 kts	Over 12 kts	
	Turbulence	Light	Moderate	Forecast severe *	
	Temperature	-10 to 20 C	21-30 C	30+ C	
Traffic	Traffic mix	Glider/towplanes	Mix winch/aerotow	Add GA/commercial	
	Traffic density	Few (1-4)	5-10	Very busy (10+)	
	Traffic type	Club ops	Contest	Contest/club ops./GA	
Contest Air Meet	Size	Under 10	11-20	20+	
	Experience	Multi-contest	Completed 1-2	New to contests	
	Pressures to fly	Contest in or likely	Some doubts	One more day needed	
	Power FLARM used	All gliders	75% or more	Under 75%	
	* If these factors are grouped 2 or more use caution or consider dual flight			**Total**	

0-14 pts – Okay to fly **15-20 pts** – Use caution or consider dual **21+ pts** – Fly with instructor or cancel

APPENDIX G

SAC Sequence of Flying Exercises
Preparatory Ground Instruction

Stage I Daily Inspection (demo on aircraft); demo SISTRSC-O. Primary effects of controls; gentle turns, control of speed.
Stage 1 link here

Stage 2 Aileron drag/ turns and soar technique.
Stage 2 link here

Stage 3 Stability/trim & further effects of rudder.
Stage 3 link here

Stage 4 Reduced g, unaccelerated stalls, recovery, slow flying.
Stage 4 link here

Stage 5 Medium turns and thermalling; straight flight.
Stage 5 link here

Stage 6 Demo takeoff & aerotow/winch launch, effects of airbrakes at height, approach control using airbrakes, overshooting and undershooting. Demo landing.
Stage 6 link here

Stage 7 Practice takeoff and tow/winch launch, turns; lookout, straight flight; stalls, approach and landing (from high final turn), thermalling.
Stage 7 link here

Stage 8 Advanced thermalling, demo circuit planning, practice approach and landing.
Stage 8 link here

Stage 9 Steep turns, thermalling, demo and practice collision avoidance, flying the circuit (normal final turn height), use of radio.
Stage 9 link here

Stage 10 Spiral dives and benign spiral, zigzag in downwind exercise (optional).
Stage 10 link here

Stage 11 Boxing the slipstream; low tow; high tow, further stalling exercises. (Climbing, descending and in a turn)
Stage 11 link here

Stage 12 Rope/cable break recovery technique at altitude and effect of angle of bank on stall speed.
Stage 12 link here

Stage 13 Slack rope on aerotow; rope/cable break recovery practice at altitude, sideslipping at altitude exercises, abbreviated circuit.
Stage 13 link here

Stage 14 Towplane upsets & emergency aerotow procedures, crosswind takeoff; laying off for drift on winch, sideslipping and sideslip on approach, illusions created by drift; crosswind landing.
Stage 14 link here

Stage 15 Descending on tow, spins and comparison to spiral dive. Airbrakes fully open before circuit exercise.
Stage 15 link here

Stage 16 Further spinning exercises; changing effect of the rudder at the stall; Spin left off a right turn, etc.
Stage 16 link here

Stage 17 Spins avoidance practice (recover before spin develops), instruments covered exercise, right-hand circuit exercise.
Stage 17 link here

Stage 18 Rope break demo at 500+ feet agl, abbreviated circuit.
Stage 18 link here

Stage 19 Off-field field selection and circuit planning.
Stage 19 link here

Stage 20 Rope/cable breaks flights (demo first at lift-off, then at low height, and medium height (300 feet agl), then student practice from only medium and higher heights with full briefing prior to flight.
Stage 20 link here

Stage 21 Practice lessons
Stage 21 link here

Stage 22 First solo Stage 22 link here

Stages 23-25 Post-solo exercises Links here

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Notes