SOARING ASSOCIATION OF CANADA
L'ASSOCIATION CANADIENNE DE VOL À VOILE

SOARING INSTRUCTION MANUAL

11th Edition
April 2011

Approved by the SAC
Flight Training & Safety Committee

Acknowledgements

The suggestions and contributions of members of the Flight Training & Safety Committee, FTSC, and the OSTIV Training and Safety Panel, TSP, are very much acknowledged in the writing of this manual. Contributions are taken from the FTSC and the TSP meetings at which safety is a leading subject for discussion. This leads to suggested improvements in safety and training methods which are tested at flying training seminars. In these ways we have tried to incorporate the latest and best methods from around the World.

Dan Cook, Chairman
Flight Training & Safety Commitee
2010 July 25

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FOREWORD

This soaring instruction manual was started in 1964 for use in the training of student glider pilots in Canada. This revision contains the same basic material related to teaching and learning in Part A, and the flying curriculum in Part B that was substantially revised and updated in 2003.

The SAC Instructional Program consists of five parts:

The Soaring Instruction Manual, Parts A & B

Instructor Handbook, the instructor's air notes in detail, and its companion

Instructor Pocketbook, abridged air notes, both for use in the air;

Pilot Training Record – Glider, the student's flight training record;

DVD Video Recording and Text;

SOAR and Learn to Fly Gliders, the student manual.

The aim of the program is to ensure that flying instruction shall be of a uniformly high standard within the soaring movement.

The Soaring Instruction Manual (this book)

This manual has been written to give general and specific information to the instructor, and advice on the flying exercises. It should be read in conjunction with the other materials discussed here. We recommend a thorough review by all instructors at the start of each season. It has two parts:

Part A *Teaching and Learning – The Instructional Role*

containing all the self-study and classroom materials, and

Part B *The Flying Training Curriculum*

describing all the flying exercises.

Instructor Handbook and Companion Pocketbook

Each of the lessons of flight instruction in the manual is summarized in the handbook in a form suitable for use during instruction. The notes will help ensure that all air exercises are thoroughly covered with no important details omitted. The pocketbook is an abridged version of the hand-book, and is designed for easy use in the air. Each booklet contains a recommended progression for the instructor to follow for each of the first several stages of instruction. Under each stage or lesson this shows who should fly what part of the exercise, and is designed to provide a logical sequencing of the student's learning. A listing of the required exercises overall is included and their sequencing is now given in the Instruction Manual and is repeated in these booklets. The list shows the recommended prerequisites that ideally should be achieved before each new stage or exercise is taught.

The Instructor Handbook is the longer version that describes each exercise in some detail and is designed for use while an instructor becomes familiar with and is being trained in the exercises. The Instructor Pocketbook is a shorter version that includes all exercises in much less detail. Both are designed for use in the air as an aide mémoire or memory jog.

Pilot training record (PTR) – Glider

This progress book shows all the exercises that should be completed satisfactorily. It is designed for the instructor to mark progress for each exercise, and space is provided on alternate pages for written comments by the student and instructor. The PTR should be used up to the time at which the student receives his or her glider pilot licence, after which it is to be retained by the club or organisation as a record of the student's training. The regular (personal) glider pilot logbook is to be kept at the same time to record flight date and time details, plus the instructor's name for each training flight.

The student should fill in the flight times, etc., in the training record, and the instructor is to show the details of the training given on each flight by completing each row with an evaluation of the relevant exercises. There are columns for all the exercises and for various training items to be filled in by the instructor. At the bottom of each page the student and instructor will sign off the page to certify that the details are correct. In this way the student and the next instructor (if different) will have a complete record of the training done on each flight.

CD Video Recording and Text

These contain a suggested text and notes for the demonstrations of the first four flying exercises to be used by instructors. They were originally prepared for use at the basic instructor courses as a cassette tape plus notes, and these are now also contained on a CD for use on your computer at home, in the car or at the club. The CD provides a very useful listing of the essential points to be covered in each flight, and an actual in-air demonstration of these lessons. These serve as reminders for the instructor, even years later.

SOAR and Learn to Fly Gliders (the student's manual)

This is the manual for student pilots to read before they begin flying and throughout their flying training. The manual provides additional background for the pre-flight briefings given by the instructor. The student should understand each successive exercise and stage in learning before going aloft for instruction. They should be advised to read *SOAR and Learn to Fly Gliders*, and to consult other gliding texts.

It should be noted that the student manual does not fully reflect the latest flying exercises that are in this Instruction Manual. The principal areas that have been amended cover further stalling and further spinning exercises. The teaching of the circuit and landing has been amended in this manual to start with the effects of airbrakes, then planning the circuit and lastly, flying the circuit. Lookouts in several situations, as well as recoveries from interrupted launches are covered in more detail to emphasize the importance of learning the correct techniques first. Safety is emphasized more at all stages of learning. Though the student manual may not discuss these aspects fully at present, this should pose no problem when the student is advised and taught accordingly. *SOAR and Learn to Fly Gliders* will be amended to add these points at the next revision.

The Soaring Instruction Manual

This manua1 has been prepared for the pilot who is starting to instruct and for the seasoned instructor who will use the updated manual to remind himself of the principles of instructing and of the flying exercises themselves.

Part A deals with learning, how people learn best. It continues with the teaching process and teaching methods to be used in the classroom and in the air during flying instruction. Student performance, instructing techniques and details of how to go about planning flying lessons (lesson plans) and giving flying instruction are included in Part A.

Part B contains the flying exercises arranged into a progressive number of chapters that include post-solo and post-licence exercises. The recommended sequence for teaching the exercises is given, together with prerequisites for several stages, so that learning to f1y gliders is done in a logical and progressive sequence. It is not vital that the exercises are covered in order, and some will often be taught together in a single flight. A recommended list is shown for exercises to be completed before the first solo, plus exercises required before the licence test flights.

Each chapter is divided into a number of sections:

- **Objectives:** Defines the main purposes of the flying lesson.
- **Motivation:** Gives the instructor some points to motivate the student.
- **Preparatory Ground Instruction**

Details the principles of f1ight, airmanship, and how to handle the glider, how to perform the exercises or maneuvers for that flight or series of lessons, all of which should be described before flying. This instruction will normally be in a classroom and would include the theory involved in the lesson and the details of how to fly the exercise.

- **Advice to Instructor**

General advice is provided for how to teach that exercise, and common faults made by students and how to correct the faults are shown.

- **Air Instruction**

Specific advice on how to teach the lesson is included here, sometimes in considerable detail so that the beginning instructor is reminded of all important points. These sections have been summarized in two separate booklets, the *Instructor Handbook*, which contains the instructor's airnotes in detail, and its companion *Instructor Pocketbook*, abridged airnotes. However, use of either booklet assumes good and adequate preparatory ground instruction has been given prior to the flight.

- **Post-Flight Review**

This is a most important part of any flying lesson; omitting it will deprive the student of the benefits of the review while the flight details are fresh in the minds of both pilots.

The manner in which, you, the gliding instructor apply your knowledge and the information given here and in *SOAR and Learn to Fly Gliders* will determine to a great extent your success as an instructor. The qualities of good teachers can be many, but the prime ones are:

Curiosity	Clear communication
Organization	Appreciation
Tolerance	Perseverance and patience
Humour	Wisdom
Skill, and	Respect.

To teach someone to become a competent and safe glider pilot requires a great amount of dedication on your part. The instructor who has the patience and skill to teach the average person to become a good glider (soaring) pilot will find a surprising satisfaction in soaring instruction. The responsibility to teach well, to give maximum value for money, to set the good example that the student will want to emulate, and to exude confidence and enthusiasm are the qualities that will set you apart from the other instructors.

Safety is an important aspect of flying training and later flying as a glider pilot. While there is no specific chapter devoted to safety, the opportunity is taken throughout the text to emphasize safety by providing specific advice and tips. Many of the recent additions to the manual arise from safety evaluations and incident and accident feedback, both from the Association's efforts to find out what went wrong and from the international gliding community through the OSTIV Training and Safety Panel.

New exercises were added to the 2003 revision to enhance stall/spin situational awareness and recognition, and stall/spin avoidance training. The curriculum is designed to provide a more logical sequencing to the learning by student pilots, and therefore logical teaching of the flying exercises by instructors.

Acknowledgement is extended to several individuals and organizations for contributions to this book. Flying instruction manuals no longer contain all original material, but are the distillation of many years input from many organisations and pilots. We extend our thanks to many people for their efforts, which have allowed this manual to be completed with up-to-date materials.

The male nouns, pronouns and adjectives such as he, him, his and himself are used to denote both genders where it is awkward to use, for example, his or hers, etc., repeatedly.

Soaring Association of Canada
L'Association Canadienne de Vol à Voile

Flight Training & Safety Committee

SOARING INSTRUCTION MANUAL

Part A
Teaching and Learning,
The Instructional Role

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CHAPTER A1
THE QUALIFIED SOARING INSTRUCTOR

The INSTRUCTIONAL ROLE

One of the most important responsibilities of a gliding club is training. This fact is readily apparent when it is realized that a large proportion of members of a typical club are engaged in some kind of training, whether to ab-initio trainees or to aspiring cross-country and competition pilots. The increasing and varied demands brought about by a rapidly changing technology make training an important activity in our clubs. Training, then, assumes a role that is vital to develop future pilots and to maintain our advancing pilots' competence and skills.

The flying instructor has one of the most important functions within the training role. His product, the graduate pilot spends a lot of money to become a qualified glider pilot. As such the student must be trained to the highest quality of knowledge, skill and overall competence. Obviously, the instructor is an important individual. If the student is technically competent and has an effective teacher, his skill will be multiplied ten, a hundred or even a thousand-fold.

Who is a good instructor?

When a critical analysis is made of the many teachers and instructors encountered by an individual throughout the years, numerous differences emerge. There are those who were outstanding in their effectiveness while others barely met the requirements of their position. Such inconsistencies cannot be tolerated in the gliding instructional role because, unlike many other sports, the consequences of instructing errors can be far more dangerous. The soaring instructor must have above average flying ability, a sound knowledge of the fundamentals of learning and instructing, and a dedicated attitude towards his instructing role. The quality of his performance and hence his product, are essential to the overall success of his club's training program and continued vitality. Last and in this case a very important point, good and effective instruction will teach and enhance a safety consciousness vital to the future enjoyment of the sport by all its pilots.

Instructor attitudes

If a person is to succeed in this vital role of flying instruction, he or she must have the proper attitude towards it. When an aircraft flies straight and level, it is in a balanced position in relation to the earth's surface. If the plane noses up or down or if it crabs, it moves *under strain – it does not like it!* To fly at peak efficiency, it must offer the least possible resistance to its movement through the air. Similarly, an instructor can progress smoothly through an objective only when effort is made toward a final goal and problems are balanced by a proper attitude. The student's attitude, feelings towards things, what he stands for, and the responsibilities that the student willingly assumes are powerful forces that determine what he does. Unless attitudes are understood and controlled they can thwart the most Herculean effort. The attitude of a flying instructor actually encompasses a combination of attitudes: his or her attitude toward the self, toward the students, toward the job and toward the club itself.

An instructor's attitude toward the self influences all other attitudes. To begin with the superior instructor in the club is proud of the role he plays. This person looks upon being asked to become an instructor as an opportunity to help the club, to return the favour, for example. He realizes the importance of the effort that he supports. As history shows, teachers have influenced the affairs of nations. An instructor's pride in his work is always reflected in the quality of his performance.

Effective instructors have an attitude of self-acceptance. They recognize their own shortcomings and inadequacies and work to overcome them. Certainly they never inflict them on their students. Self-acceptance is proof of maturity, and it is basic to an understanding of others. To develop an attitude of self-acceptance a person must patiently and objectively analyze his own actions and motives. Emotionally mature instructors do not blame others for their own mistakes; neither do they excuse their own omissions. They should acknowledge their own mistakes and try to fix them, in other words they must be able to see things in the clear light of truth undistorted by their own shortcomings.

Teachers exert an influence for good or bad on the personalities and attitudes of their students. For this reason an instructor must have a good attitude toward all students. A good instructor is not autocratic, but is a resourceful friend, with a friendliness that is both sincere and objective. Such friendliness is not a matter of conventional smiles and pleasantries. It is entirely genuine. An instructor should approach all students with a sincere interest in their success or failure. He must know when firmness and frankness will be in the best interest of the student and the club. Students will accept guidance if they understand why it is required. The ability to demonstrate a firm, frank attitude comes only with a fine sense of balance and with experience.

An instructor must also develop an attitude of respect for personality. You should strive to know each student as an individual and teach him or her as such. You as the instructor should feel obligated to help each student realize his or her fullest capabilities. A major deterrent to this attitude is stereotyped thinking. An instructor must avoid judging students in terms of groups: racial, geo-

graphical, intellectual to which he or she may belong. The importance of individuality cannot be overemphasized. You should determine the needs, interests, and abilities of each student and as far as possible, then plan to meet them.

A good instructor should aim to keep his or her professional distance. It is only natural for you to want your students to see only the best of your nature. In an overly familiar atmosphere students will soon detect your weaknesses and judge you accordingly. Since students want to respect and admire their teachers, guard against over familiarity if you hope to merit respect and avoid charges of favouritism. For example an instructor should be very aware when he is not *at arms length* with the student, e.g. family member, boyfriend or girlfriend, other close friend, or gliding partner. We should also differentiate between a *check* flight and a teaching flight. We can teach friends effectively, but can we maintain our objectivity when doing check flights? Usually this means that when doing a check flight and in order to maintain the arms-length relationship, the check instructor must not be a close friend. All instructors should be alert to the motives of those who are just starting gliding. If an individual is seen to be taking up soaring for the wrong reasons (because a boyfriend/girlfriend is doing it, peer pressure, or for a *macho image*) the instructor should tactfully and discreetly seek to guide the individual to a more suitable activity. We should try to avoid this person eventually becoming a liability.

A flying instructor has three functions: to teach, to set an example for pilot development and, by your own example, to set a high standard of knowledge, skill and overall ability. First, in your capacity as an instructor you must ensure that your students know the subject matter thoroughly, and then teach them to apply this subject matter in the air. Second, the maintenance of membership, and indeed the growth of your club begins on the flight line, and at this point you become the example for all students. Therefore try to set a consistently good example so that the students, on their part, can achieve and maintain a high standard. Third, in your knowledge of the subjects, in your ability to impart this knowledge and in your ability as a soaring pilot, you must set a pattern that your students will be inspired to emulate.

In summary, by attending an Association Instructors' Course and by applying your newly acquired knowledge and skills, you will be well on your way to becoming a good instructor. Your own personal qualities should also lead you to strive for even better qualifications. With increasing experience both your flying abilities and instructional techniques should reach a high standard. Four qualities that a good instructor should possess are enthusiasm, patience, sincerity, and adaptability. Enthusiasm is infectious and provides sound student motivation. Patience is needed when you will be dealing with students because a display of impatience can often cause ill feeling. Sincerity and a belief in what you are doing retain a student's confidence throughout the course. An instructor must be adaptable because each student is different and may require a distinctive approach. Attainment of this high level of instructional ability requires a continuous application on the part of the instructor. Try to observe and question those you consider to be good instructors, not to copy them but to discover those qualities that have made them successful instructors. Do not hesitate to ask advice from more qualified instructors. Your chief flying instructor and other senior instructors, by virtue of their experience, can provide authoritative guidance. New instructors in particular should make use of their experience.

The LEARNING PROCESS

One of our outstanding characteristics is that we humans are learners. We learn continuously from the time that we are born until we die. As an aspiring instructor we need to understand the learning process. We need to know what happens to the student when he or she learns and, in turn what we ourselves can do to make the student's learning as positive as possible. By understanding the learning process, the teacher can do much to enhance the student's receptiveness in training. To be able to vitalize the learning process, the teacher must first know what learning is. Learning has been defined in many ways, but all definitions and schools of thought have one idea in common – learning is active. It is not a passive process in which the student absorbs knowledge automatically. The learner may expand his knowledge, alter his response to a certain stimulus, acquire a new skill, gain a new insight, or change his behaviour in some other way. But whatever is learned, the student undergoes change when learning. If learning is change and if change implies action, then learning must be active.

Active versus Passive learning

It is best for the student to be actively involved when learning to fly. Rote learning, for example, which is passive learning, is useful for some applications but for complicated activities such as problem solving when learning to fly, it doesn't work. Active learning means being closely involved in the process. One cannot learn to fly by sitting at home and reading how to do it, the student has to be in the airplane, actively participating. Flying involves situations that include working through problems, evaluating situations, choosing options and making decisions for the next action to take. Being active and doing them oneself is the best way to learn these kinds of techniques. As an instructor you must remember this and put into practice an instructing technique that will keep the student active, for he will learn best by doing most of the planning and the flying.

Planning the student's learning activities

Efficient learning is the key to going solo and to obtaining a licence. It is largely up to the student how this will occur, with the instructor encouraging the student to always be ready for the lesson, and to be inquisitive about all aspects of the flying and of your instruction. Encourage questions if the student doesn't fully understand the objectives of the flight, for example, or of the maneuver that you have just demonstrated when in the air.

Mental preparation

Flying does not forgive the foolish. This should be extended to saying that flying is also unforgiving of the unprepared, of the pilot who has minimal skills and minimal knowledge. Hence it is possible to become a pilot who is sufficiently competent to fly around the circuit, for example. However, to become a superior pilot who can handle and adapt to the many different situations in flying, requires extra effort and mental application. Assist your students to have a focus, and encourage them to leave behind the distractions of everyday life when they come flying.

Mental preparation means thinking about flying even when driving to the club. It also means that the instructor must be going through the exercise in his or her head before getting into the cockpit. The student will emulate you and they should be encouraged to do likewise. It is a technique increasingly used in sports to visualize not only a whole race, for example, but also shooting for that elusive goal. The parallels in flying are visualizing the day's activities at the club in general terms, visualizing the preparations for the flight or flights, and in more detail yet, visualizing a particular maneuver. The visualization of the preparations for flight, of individual flying maneuvers and whole flights is seen today as a very important tool to efficient learning.

Mental preparation includes talking to and listening to other pilots and learning from them. However we have to be alert to the problem of pilots bragging about their exploits. They can glamorize their flying and this can include risk-taking that we do not want the other students to emulate! As an instructor, you can turn this around by asking questions about why the pilot got into the situation in the first place, how this might have been avoided, and how he managed to get out of it. Turn it into a learning experience for the students who may be listening to the pundit!

LEARNING PREFERENCES, or SENSORY LEARNING

All of us have learning preferences and many of us share more than one of the preferences described below. Often others will notice our own preferences before we do. Determine which preference best describes yourself and the student you are teaching. Adapt your teaching style to best help them learn and use the following words and methods to communicate ideas.

VISUAL	AUDIO-TONAL	KINES-THETIC	AUDIO-DIGITAL
See	Hear	Feel	Sense
Look	Listen	Touch	Experience
Appear	Sound(s)	Catch on	Understand
View	Be all ears	Make contact	Think
Show	Rings a bell	Grasp	Learn
Revel	Make music	Turn around	Process
Envision	Tune in/out	Concrete	Decide
Illuminate	Harmonize	Make impression	Question

Table 1 – Learning preferences

Visual These people memorize by seeing pictures, and are not so much distracted by noise. They often have trouble remembering verbal instructions and are bored by long verbal instructions because their minds tend to wander. They are interested in how the program looks. Visual people like colours in their lives.

Audio-Tonal These people typically are easily distracted by noise. They can repeat things back to you easily, they learn by listening, they also like music and like to talk on the phone. Tone of voice and the words used are important.

Kinesthetic Their talk is often very slow and breathy (they want time to feel the meaning of their words). These people respond better when you speak slowly. They remember by doing or walking through something. They will be interested in a program that *feels right* or gives them a *gut feeling*.

Audio-digital This person spends a fair amount of time talking to him or herself. This person memorizes by steps, procedures and sequences. They will want to know if your program *makes sense*.

An INSTRUCTOR CODE of ETHICS

Why Ethics?

The Soaring Association of Canada provides flying training to its members through clubs. Members are drawn from the general public who often know little

about aviation and who become involved in a glider flight for training instruction or merely for the experience. Gliding can impact on other airspace users and public safety. Whenever public safety is affected and/or public services are provided, the entrusted body has a responsibility for ethical behaviour and conduct. This includes but is not limited to standardized training methods, uniform performance standards, professional techniques, and adherence to recommended safety practices.

SAC Glider Instructor Mission Statement

Our mission is to provide effective and professional flight instruction to the members of the Soaring Association of Canada through established national standards of training and recommendations for flight safety, as developed by the Flight Training & Safety Committee for our gliding instructors. Our mission is to include the promotion of the organization and the sport of soaring.

Glider Instructor Code of Ethics

- Being a glider instructor shall be synonymous with the finest aspects of the sport of soaring: integrity, honor, and respect at all times for those who have placed their trust in you and your teaching ability.
- The public has a right to expect the best, most up-to-date and uniform instruction available. Therefore it is the duty of each instructor to learn any new procedures, techniques, and safety concerns. To remain outdated in instructing skills is unfair to fellow instructors and the public.
- Instructors are often in the public eye and therefore it is essential to present a picture of true sportsmanship and good behaviour when representing soaring/gliding as a whole and in particular when representing the soaring club to which they belong.
- As gliding is a sport enjoyed by many young people in their adolescent years, we have a responsibility to the youth of this country by setting an example for them to follow.
- All instructors shall maintain an *arms-length* relationship when checking pilots for competency and flying skill, for example for first solo privileges or licensing.
- Instructors have a moral responsibility to follow and maintain flight safety, flight standards, the aviation regulations and operating procedures established by the government, the Soaring Association of Canada and their clubs.

SUMMARY

The instructor must understand the changes that make up learning. As an instructor you must be able to define, observe, measure, and evaluate these changes. More important, you must know how to bring them about. To induce a desired change in the students, to help them learn, the instructor needs to understand what constitutes a good learning environment, why some students learn more readily than others, what makes some lessons more effective while others are not, and why one technique fails where others succeed. In brief, you need to know what learning is and how to help bring it about.

An instructor, who has only a few vague ideas about learning, may achieve some success by chance, but to achieve maximum effectiveness as a teacher you should know enough about the learning process to control it. You can control learning best if you learn some of the principles or laws that govern it. While the next chapter, Chapter A2 provides general advice to the instructor, Chapter A3 goes into the factors that affect learning (both positively and negatively), often called the Laws of Learning, and goes on to providing instruction for effective questioning techniques, which is a very effective teaching tool.

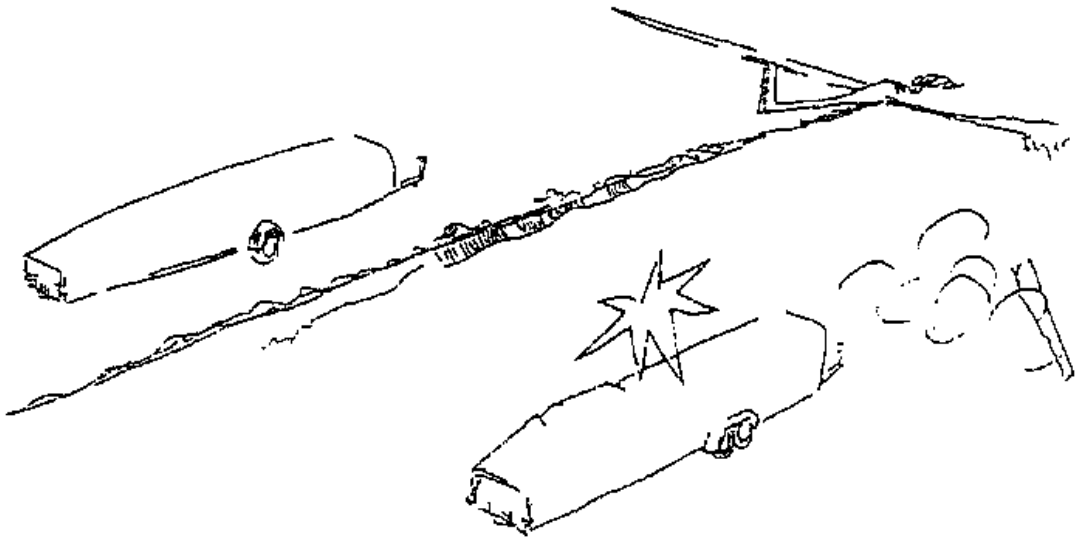


Figure 1 – Why do some pilots insist on taxiing up to their trailer?

The competency of the pilot was not equal to the task.
An alternative option was not chosen.

CHAPTER A2
ADVICE TO THE INSTRUCTOR

The PURPOSE of INSTRUCTION

The purpose of instruction is threefold: as an instructor, you must not only pass on your KNOWLEDGE and SKILL, but you must also develop certain ATTITUDES in your student.

Knowledge

Knowledge is considered to be the familiarity with facts, persons, or things. It is the total result of experience, deliberation, intuition, and learning.

Skill

Skill is the acquired ability to do something with ease, precision, and accuracy. It is usually applied to physical performance, but in some instances it may be purely mental; for example, mental skill would be used to solve a mathematical problem.

Attitude

Attitude is a state of mental and emotional readiness to react to situations, persons, or things. An attitude that is acquired through learning, conditions the individual to react in the same way to the same circumstances whenever they occur. Some of the more desirable attitudes to be developed in the student glider pilot include:

- **Pride** Develop pride in the student pilot by showing, by your actions, that you are proud of your ability to fly a glider. This is the best way to develop pride in others – they will wish to emulate you. Never approach a student in an apologetic manner and do not, by word or action, indicate that the training you are offering is anything but important.
- **Respect for authority** In developing this attitude, do not give the student a chance to resent or criticize you, the instructor. The student will respect you if you know your instructional material, show initiative in putting it across, and are fair in all your relationships with the student.
- **Acceptance of responsibility** This attitude is taught chiefly by example. The good instructor will also get the student to accept part of the responsibility for his successful training, by active interest and participation.
- **Enthusiasm** It is essentially true that *enthusiasm is caught, not taught*. If you approach an instructional session with vigour and pride you will find that this rubs off, and the student will undoubtedly respond well and enthusiastically.
- **Openness** An attitude that is open to change, a desire to improve oneself, an ability to respect nature, and a readiness to accept other people for what they are and to work to improve their abilities with whatever shortcomings they have. This goes also with enthusiasm, as this positive type of attitude also will rub off on your students.

METHODS of INSTRUCTION

Before a method of instruction is chosen for a particular exercise or maneuver you should remember that, in general, you will be dealing with the presentation of knowledge. This will be taught with the purpose of developing in the student a set of skills to master a specific task or operation. You will also help develop the student's way of thinking, or attitudes. These should be developed in the student in order to exert a direct influence upon his response to situations he will encounter later.

Although knowledge, skills and attitudes are separated above, they will normally be taught in the same lesson, with one or another predominating. Remember that the student learns through the senses, and therefore the more senses that are employed, the easier and better is the learning process.

Three methods of instruction are covered here and each should be employed to a greater or lesser degree during the teaching of a lesson or a maneuver. The three methods are:

Telling Teaching by telling is a method of imparting information and developing attitudes. It demands activity on the part of the student over and above simple listening. Telling implies more than mouthing words whereas listening implies student activity. This method of teaching is, by reputation, the poorest instructional method. Its limitations are:

- You cannot teach skills by talking about them, and
- You should not rely on words, if pictures or diagrams can be used.

Showing Another method of presenting facts, principles, concepts, and other kinds of knowledge is teaching by showing. This is very effective, because it appeals to more than one sense. Teaching by showing would be to use hand demonstrations, drawing diagrams, or to show videos.

This is a better method of teaching than telling, because it overcomes the natural limitations that many instructors have with the use of words.

Doing or Demonstrating This method is most important in every lesson in which a skill is being taught. At the time of teaching a skill, however, there will be some information or knowledge to be passed along. Safety, which includes knowledge and attitude, is most effectively taught at the same time as skill. The attitude of

pride of performance in flying ability is handled in a similar manner. In a demonstration you should perform the particular maneuver carefully and accurately. As you perform each step, describe specifically what you are doing, explaining fully actions that might not be observed if they were not pointed out. At each step it is important to point out the key points.

Your descriptions during demonstrations should be as brief as possible, without omitting any essential point. When describing the aircraft control effects to a new student for example, the words "to move the stick to the left (or right) until the desired angle of bank is reached" are more desirable than the simpler aircraft attitude description of "roll to a banked attitude" which you should use later. Of course the student should have a thorough understanding of the different attitudes and of how to produce a movement that produces that attitude. As the student advances and becomes more familiar with the effects of controls, you should avoid describing the movements of the controls themselves, but instead should advance to the simpler "turn to the right" type of command.

After performing a maneuver, with descriptions, have the student try it to see how much has been absorbed and to let the student benefit the most by actually doing it. While the student is trying the maneuver, do not rush or introduce additional new directions or instructions. Afterwards constructively criticize the student's flying. Do this first by discussing his or her good points, then go over the points that need correction and further practice.

Remember that learning to fly is progressive, and the early exercises lead quite naturally from one to another. It often helps to remind the student of this. The later maneuvers are mainly the application of the principles already learned. As the average student learns gradually, a certain lack of precision may be tolerated in the early stages. However, you must eventually insist on a safe, satisfactory standard.

Always remember that a student will learn much more rapidly if he is permitted *to do most of the flying*. This applies to many of the repeated demonstrations that you may handle. If possible, *talk* the student through a repeated demonstration rather than flying it yourself.

The TEACHING PROCESS — HOW to INSTRUCT

There are four basic steps in the teaching process, without which effective instruction is impossible. The four steps are:

Preparation
(Participation by the instructor and student).

The preparation necessary for each lesson or period of instruction includes the instructor's determination of what is to be covered, and the **objective** of the lesson, that is the goal he hopes to attain. It may also include home study or other special preparation by the student for the scheduled lesson.

Your presentation may be relatively informal, or it may include reference to *SOAR and Learn to Fly Gliders*, and the particular lesson to be flown. For the preparation to be effective, a Lesson Plan should be developed, so you can proceed logically from one step to the next. See page 42.

The lesson plan may be prepared mentally when you become an experienced instructor, planning a simple period of instruction, or the contents of this manual may be referred to in greater detail, as required. The lesson plan is simply your statement of lesson objectives, the procedures and facilities or equipment to be used for presenting them, the specific goals to be attained and the means to be used for evaluating the achieved results.

The ***Air Notes*** booklet contains abbreviated lesson plans for the air-instruction part of all lessons. This booklet has each maneuver broken down into simple steps in brief form, with no essential part left out. However, for a complete lesson plan the instructor will have to add the objectives, procedures, and evaluation criteria as necessary.

Explanation and demonstration
(Presentation by instructor).

Explanation and demonstration are the instructor's presentation of the knowledge and skills that make up the lesson. This phase may be divided, in the case of flight instruction, into pre-flight instruction on the ground, and flight demonstrations of maneuvers in the air. Explanation must be clear, pertinent to the objectives of the lesson, and based on the known experience and knowledge of the student.

The demonstrations should be presented to implement the explanations that introduce them. Include as little extraneous activity as possible and make sure the student clearly understands you are accurately performing the actions you have described. Immediately acknowledge and explain any deviation in performance from that described which may be caused by unanticipated turbulence, for example. Failure to do so may diminish the student's confidence in you and in your training of them.

During the demonstration aloft, always have the *Air Instruction Notes* for reference. Without a reference like this, even an instructor with many years' experience may miss an item or two of the demonstration and exercise, and this is not being very fair to the student.

Trial and practice
(Participation by student).

Trial and practice constitute the student's activity during the lesson. During classroom instruction trail and practice may consist of reciting written materials or solving problems on paper. During flight instruction, it means trying to perform the maneuver or exercise which has been explained and demonstrated by the instructor. It means practicing it until the student achieves an understanding of the factors involved and until he feels competent when flying the glider.

Although they are technically separate segments of a lesson, portions of the instructor's *explanation and demonstration* activities are usually alternated with portions of the student's *trial and practice* activities. Rarely does the instructor complete his or her explanations and demonstrations, especially of a difficult maneuver and then allow the student to accomplish his trial and practice, without interruptions for correction and further demonstration.

Review and Evaluation
(Participation by instructor and student).

Review and evaluation are integral parts of each lesson. Before the completion of each instruction period or lesson and perhaps in a post-flight review, ask your students to explain and evaluate their own performance and the extent to which they think they have met the lesson objectives. Compliment the student on good performance (praise goes a long way!), and explain any areas of poor performance. This must always be followed with suggestions for improvement.

Check off the student's performance in the appropriate section of the *Student Progress Logbook*, stating whether or not he requires additional instruction at that particular stage. Inform the student and give suggestions for reading and review, to prepare him for the next flight.

The OBJECTIVES of INSTRUCTION

The objective in teaching people to fly gliders is that they will get satisfaction and maximum enjoyment from their future participation in soaring. To do this they must understand what they are doing; they must be given help in developing their (mechanical) handling of the glider as well as (mental) decision-making skills as pilots. They must also be taught to develop their own critical judgement of their own performance. There are some basic rules for instructors; these will help in meeting your desire to be an effective and good instructor:

- **Avoid gimmicks in your teaching**

  This is particularly important in circuit planning where continuous assessment is necessary. For example, if the student has been used to turning over a fixed ground reference when flying the circuit during training, he will not suddenly develop the necessary judgement skills when visiting another club, or when doing a first cross-country off-field landing. So, avoid gimmicks in your teaching.

- **Make firm decisions and stick to them**

  An instructor who feels his student is unfit or the weather is unsuitable should not allow flying to continue against his better judgement.

- **Distinguish between pleasure f1ying and instructing**

  If you wish to take a student on a soaring flight as a passenger, this should be clearly understood before takeoff.

- **Set a good example in your own flying**

  Students will copy you, so don't do anything that you would fault your students for, such as landing too close to other gliders, or stopping your ground run alongside the glider's trailer! Gliding instruction includes the following principles:

  Safety – Responsibility – Communication – Orientation and – Skill

These and some additional principles are discussed in more detail in the following sections.

Responsibility

In all flying instruction, a gradual transfer of responsibility from the instructor to the student must take place. At the end of training the student must be 100 percent responsible for handling the glider, for decision-making (for example, when to turn towards the club to go and land) and for judgement (for example, circuit planning). Two rules arise out of this:

- the instructor should allow the student pilot practice at flying and at decision-making at the rate at which the student can handle it, and
- the student must clearly understand when he has control of the aircraft and when he is expected to make the flight decisions and when to plan the circuit to use his circuit judgement skills.

As the instructor, you should never hesitate to take over control (take the responsibility) for any good reason. Of course you will have given the student a reasonable chance at trying to rectify the problem, and if he fails, take over. In the early flights the student will be more confident knowing you will take over if things get too difficult.

When you let your student take over control let him or her take over completely. If the student feels you on the

controls, he will neither feel he has the responsibility nor your confidence, and he will absorb the lesson less well.

Whatever the student does, the instructor takes the ultimate responsibility, or blame, for anything that happens under his or her instructional supervision.

Communication

When trying to train someone to become a competent soaring pilot you will be faced with the problem of communicating to the student all that he will need to know and checking that it is understood. It will not be possible to communicate everything in only a few flights, but a student should never take off not knowing exactly what is going to be covered, or what is going to happen on each flight. Communication in the air can be greatly improved if a thorough ground briefing has been given. This will help two-way communication in the air by allowing time for the student to ask questions.

Whenever information has to be transferred from one person to another, communication difficulties may occur to a greater or lesser extent. Try to reduce these as much as you can. The use of standard phraseology as given on the CD for the first lessons is an example.

- **Two-way communication**

  Effective communication has to work both ways. So allow the student to participate rather than only being the *receiver*. One-way communication can lead to boredom, resentment, or confusion. Some instructors are so anxious to impart all they know that they don't stop talking. The student must be allowed periods of silence in which to digest what you have said and in which to work out the next move, or even to ask a question.

- **Questioning** Assessment of the student's understanding must be done constantly. Often by careful questioning you will be able to assess how much of what you said has been retained. Don't be surprised if you have to carefully repeat an explanation. Lack of understanding most often can be overcome.

- **Orientation and 3-dimensional space** If the student has not flown before, then all his or her experience will have been in two dimensions. All movements, whether walking or driving for example, will have been judged (instinctively) by reference to objects on the earth's surface nearby.

Flying involves a third dimension, height, and people have to develop ways of handling this, of locating themselves in three-dimensional space. You, the instructor will have to start the student by giving some reference points outside the glider. Unless you do this, the student will tend to locate himself inside the glider, an area that he knows he can handle two-dimensionally.

Remember to direct your student where to look, it is easy to assume he is looking at the right place or that he can learn this alone, but often he will be looking in entirely the wrong place. Students need the help you can give them in locating where various landmarks are and in how to see other aircraft in the air and even in how to *see*, to round out for a good landing.

Spatial disorientation is confusion as to which way is up, resulting in the pilot being unable to take effective action. The brain normally integrates various signals to tell the person which way is up. First, signals come from the inner ear, second from body sensations as in *seat of the pants* flying, and the third and the most powerful signals come from the eyes, which are watching the horizon. A pilot in a tight turn not watching the horizon (or who inadvertently entered cloud) will be flying by the seat of the pants. The stronger signal is now coming from the different forces acting on the body and inner ear, and may well cancel the weaker signal or no signal at all coming from the eyes. The problem is that the brain misinterprets this information, and the pilot is misled as to which way really is up.

This can happen equally to experienced pilots; however they have learned how to recover quickly and have in some cases taught themselves how to avoid it. The student pilot, however, can easily become disoriented and hence will be frightened. For example several spins in one flight will often upset the student pilot, so space spins apart into several flights. Also avoid letting a student become airsick and don't let them experience reduced g unexpectedly and without warning; their confidence will almost certainly be shaken.

Skill

In flying training we must give our students sufficient time to develop the needed physical and mental skills. These come with practice. It helps of course to have a good understanding of how the glider flies, but this alone does not make a good pilot; time must be allowed for the pilot to develop his or her skills.

How do we do this? First and foremost let your student do as much of the flying as possible. Second, don't teach more that one new idea or exercise at a time; too many new ideas introduced in one flight can confuse the student. Use the remainder of the flight, therefore, to practice and review what has already been taught.

Skill at doing something means that the person can rapidly carry out a sequence of mental and physical or mechanical actions over and over. This results in a smooth continuous flow of activity and it consists of three main functions. These are seeing or gathering data, evaluating and deciding on a course of action, and third, doing or

acting on the decision. This sequence is repeated continuously.

Restraint

If a feeling of antipathy develops between you and the student, consciously try to cure it, but if you can't, see if transfer to another instructor will help; it often does. However exasperated you may feel, keep your language restrained!

First Lessons

The technique of teaching anyone to fly is to explain the purpose of the maneuver before going aloft, then to explain and demonstrate how to do it in the air. Next get the student to do it, and last but not least, monitor what they do and correct any faults. It is vital that the first stages are given thoroughly by a competent instructor. Good and effective instruction is a combination of explanation and clear demonstration in the air.

Having given a demonstration, all students should immediately be asked to repeat it; to try it for themselves. They may need prompting the first time, but increasingly as they gain experience they should be able to tell you what they are doing and to anticipate what the glider will do. It is important to remember that there are a few demonstrations the student should *not* repeat, such as uncoordinated use of the controls for the aileron drag demonstration; the reasons are explained later, when the demonstrations in question are discussed.

Synchronize the information

During a demonstration it is important to give essential information which is exactly synchronized with what the aircraft is doing. Don't be distracted by the actions of the aircraft, such as at the entry to the spin. Then it is important to give warning before-hand, be silent while it happens, then explain what happened when the student can again give you full attention. The art of taking a student through an exercise is only perfected by thought and practice.

Speech and economy

Speak distinctly to make sure you can be heard, for without effective communication between you and your student, learning will not take place. In the often-short glider flight talking has to be very economical. Only discuss and correct faults in the air when the student can correct that fault in the same flight.

Student analysis of their own flying

As training progresses aim to have all students increasingly analyze and correct their own flying until they can do it all for themselves. And of course don't advance them to more difficult exercises until they have fully absorbed the basic exercises. Skill at handling will come later, but understanding the principles in the early lessons is needed as a basis for understanding and developing the later maneuvers.

Other instructors

As far as possible avoid changes of instructor. However there are bound to be occasions when you will teach a student part way through his or her training. If he says that another instructor told him or her to do a maneuver differently, don't criticize the other instructor, but explain that it may have been a misunderstanding. Try to ask the other instructor privately what had been intended.

Building a solid foundation

The good instructor never forgets that learning anything new is only possible if there is some background of experience on which to base the new knowledge. Many people who take up soaring as a sport have little or no flying experience on which to build; they have an immense amount to learn all at once. Failure to provide your student with a good base on which to begin to build his new knowledge and experience may lead to trouble for him, even years later.

Other glider types

Learn about and if possible fly other types of glider, especially those that your students will get to fly. You should always be able to discuss how they handle and to point out their good features.

Scanning

Gathering information is limited by how quickly we can sample; usually a maximum *sampling rate* for a new task is two per second. As skill improves we don't need a high rate because much extraneous information is rejected or not gathered. This allows greater anticipation.

As instructors we have to assist the student to suggest what information is important; then more time can be devoted to the task at hand and the student should not become overloaded.

Processing

Converting information into decisions is affected by reaction time, typically a third of a second but it can be much longer.

The rate of making decisions is important to learning a skill – more alternatives give a longer reaction time. If the demand for decisions adds too much pressure to the student, he overloads and his output of decisions falls sharply. Also if the situation is complex and there are a number of alternatives, it is easy for a student flying a glider to become overloaded. Think for a while back to

your own driving lessons and put yourself into a situation demanding a gear shift and a turn signal as an approaching car flashes his lights because you are on high beam!

The instructor can play a vital role here to reduce the complexity of a given task until the student can begin to handle it; this will occur when the student has the experience. A student who makes poor progress or unexpected mistakes may have been advanced too quickly or he may have been given too much to do on each flight. Normally, as his skill develops and flying becomes more familiar, his response speed increases because now he can select the signals that are important and can ignore those that are not.

Controlling

Finally, under the heading of skill comes controlling or acting, that is, converting input information into decisions that are then turned into actions. Initially a student will concentrate so much on controlling that he will have little time for anything else, such as keeping an adequate lookout. As he gains skill he will spend less time controlling the aircraft, as his initial input will be more nearly the correct amount; he will not have to make so many corrective control actions. Thus the student will have more time for other tasks. Help in this by suggesting what the student should be thinking about before the need becomes urgent. In other words, now is the time to build in some anticipation for what is coming up as the flight progresses.

Safety

The goals of the following principles of instruction are for all instructors to train pilots to think for themselves, to analyze their own flying. Yes, there will always be the chief flying instructor to *hold the hand* of the low-time pilots, but these pilots will someday be on their own. What better time than now to teach them to analyze for themselves and to then make the right decisions.

Safety requires that pilots form some unbreakable habits while they are students. It is no good trying to instill good habits after solo; it is far too late then. Start on their first flight because it is the first things learned that stay with them. For example by solo, students should feel very uncomfortable if the speed below 1000 ft agl (near the ground) is low – during their early training they should have developed the habit of maintaining a safe speed near the ground. We give them these habits.

Emergency procedures

Try to develop in your students a habit of confidence and cool headedness to protect them against the effects of panic. Panic is the sudden loss of confidence in oneself when faced with a sudden situation not encountered before, particularly if the situation is alarming. Therefore, let us try to teach our students to have faith not only in themselves but also in the aircraft; they must be well-trained in emergency procedures. Techniques for this are covered later in this manual.

Apprehension

Many people are apprehensive, particularly about flying. If a person is overly anxious or even frightened, their learning will be slow. These students need to be progressed carefully so that they can feel they are in control all the time. Perhaps it will help to delay stalls, for example, until after they are comfortable with the reduced-*g* sensation. Some degree of apprehension is normal, and this can be explained to the student. However, if a student gets scared badly during flying training he may very likely stop flying. Try to find why he is nervous; your inquiries and help can often overcome the fear. However, sometimes a student will remain nervous whatever you do. In such cases consider very carefully whether it would be wise to let this student fly solo.

Overconfidence

This situation can be another problem that the instructor has to deal with. It can be due to a feeling of superiority, or due to a *shell* of self-confidence put up to cover nervousness or unconscious fear. If your student fits into the first category, treat him as intelligent and insist on a really high standard in all his flying. If the latter category, encourage him and draw him out. Don't let him make mistakes because this will only perpetuate the *problem.* Instead, correct the errors and try to convince your student that he or she can do the exercise or maneuver correctly.

Lack of discipline

If a pilot displays a lack of discipline it may be due to inexperience, or it may be a mistake. Further training might help to avoid the same error again. Discipline is necessary to a safe operation as well as to the individual. Try to create the right atmosphere in which mistakes and flying problems are freely discussed with you and other pilots and instructors – we can all learn!

Correct seating

Students cannot learn well if they are not comfortable, cannot reach the controls or see out properly. Encourage the small pilots to bring their own cushions and/or approved ballast weights. Cushions must be firm and, in the case of seat cushions, the use of energy absorbing foam is highly recommended. Firm, high-density foam should be used for cushions used as spacers below or behind the pilot, to prevent the likelihood of being compressed too much when compressed by rapid acceleration on a winch launch, or during the winch climb. The

pilot, by pushing hard on the pedals, could also cause this. Firm cushions will help prevent *submarining* in a sudden deceleration such as a hard landing, with the possibility of internal injuries caused by the lap belt sliding up and therefore off the hips. Check that the student must be able to reach the stick when it is fully forward and the back cushions, of whatever type, are fully compressed. Finally always check that the student cannot straighten either leg when fully depressing one rudder pedal and then the other. This will avoid the possibility of the knee locking into a straight position (c.w. over-centre locking), which could cause a real problem in an emergency.

SAFETY CONCLUDED, is it ever?

Safety is a state of mind – it is the conscious awareness of what we do and of the consequences. Let us teach our students to develop analytical habits so that they will become aware of what they are doing in their flying and so develop into good and safe pilots. Good airmanship leads to safe flying.

Flight safety is an important aspect of flying training. Pilots and ground helpers or crew must be aware of the need for good safety practices at all times. You are in a position to observe and to put right any incorrect, unsafe and illegal practices. To be successful, a flight safety program requires proper supervision, necessary enforcement and proper training. The response of the club members to these items will define the club's attitude to safety and therefore its *safety culture*. The best safety culture is *generative*, by which is meant that all members actively work to improve safety through an openness to discuss problems and flying incidents. They want to learn from the mistakes of others. Your student learns by example – you must set this example.

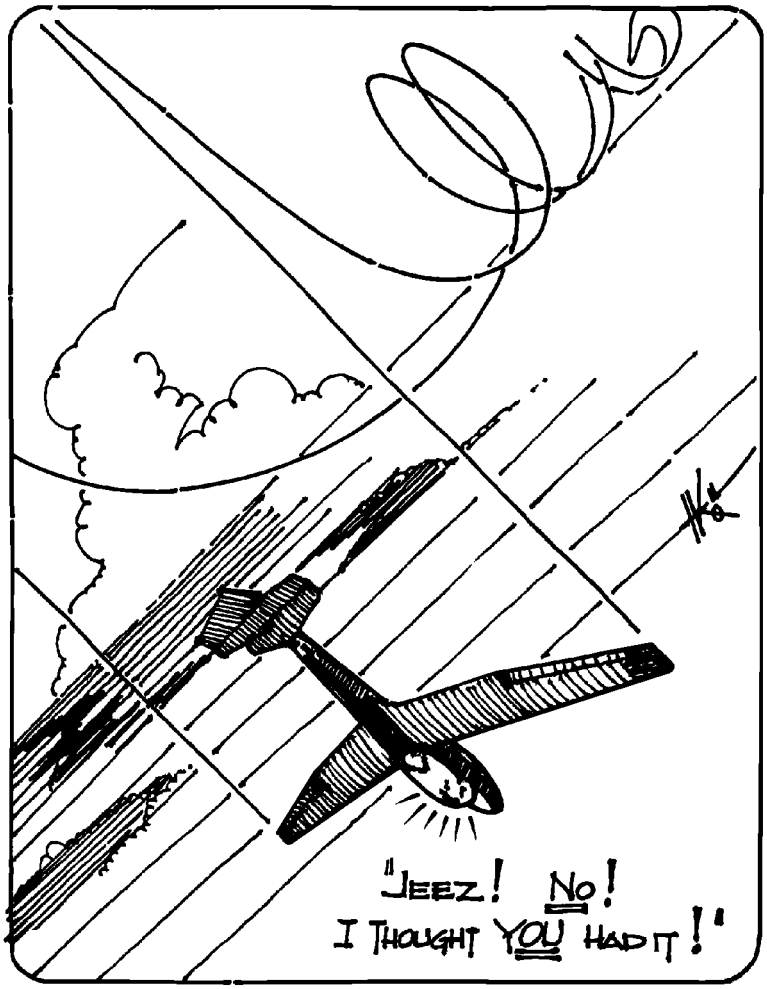
An experienced instructor is an effective supporter of the principles of good airmanship and flying discipline. As you gain experience, learn to recognize unsafe practices and do something to correct the situation. Practise flight safety by being alert to unsafe practices and taking the appropriate action. Follow up when you see an unsafe act, by asking the people involved what happened, and ask for their suggestions how they might avoid it next time. Then you offer comments and constructive suggestions for avoiding the problem. Many incidents for example, go unreported because the pilots feel some form of disciplinary action will be taken against them.

This is unfortunate, else how can we adequately review our practices if we lack information? The lessons from the incident cost nothing – it is a very cheap lesson. Compare an accident's cost in terms of damage to people and equipment and to their pride! We can and should learn from the mistakes of others, because we will not live long enough to make them all ourselves.

Promoting the principles of effective flight safety to students and other club members is the responsibility of all members, and as instructors we have to develop the fashion that safety consciousness by club members, pilots and non-pilots alike, is very important. Unsafe practices must be watched for, identified, and their elimination effected by firm, constructive and consistent action. Practise flight safety by being alert to unsafe practices and taking the appropriate action. Chances of a mid-air collision are greatest when no other aircraft are around – pilots tend to relax their lookouts when some distance away from the club and when away from thermal gaggles!

If we look back at our own training we can often remember the good instructors and the faults of the bad. Follow the example of the good and consult other, more-experienced instructors and then you should have no difficulty in teaching your students to fly well. In doing so you will be making one of the most valuable contributions to soaring that is possible.

Figure 2 – Who has control?



CHAPTER A3
LEARNING FACTORS & DECISION-MAKING

LEARNING and LEARNING FACTORS

Introduction

Who is a TRAINER? The Canadian Oxford Dictionary definition of the word ***train*** is *to teach a person, animal or oneself, etc., a specified skill especially by practice.* Hence a trainer is a person who trains others by making that other person practice that skill.

Gliding instructors are trainers. If you are an instructor, your aim is to give students good instruction and sufficient practice so that they can fly the aircraft proficiently and safely. Not only that but we aim to teach them to adequately plan their flights, to acknowledge that others use the same airspace by maintaining a very good lookout at all times, and to be always thinking ahead. This last factor is important, because decision-making goes on throughout all flights, and is vital so that the pilot safely returns to a landing either on the club field or into an unknown field safely and with minimal effects on the surroundings.

Learning

No one ever learns except through their own activity and there is, strictly speaking, no real teaching art, only the art of helping people to learn. The instructional techniques described in this section provide guidance that the instructor can use to stimulate student activity. Their activities may be mental or physical and it is through this process of directed activity that students learn the skills and knowledge required to become good, safe pilots.

The Learning Factors – the Laws of Learning

There are seven accepted laws. Read them carefully and determine whether they apply to you as you learn new skills and knowledge. If they apply to you, they will also apply to your students. Attempt to associate a single word that is used to represent the entire learning factor. These words will be used throughout the manual and in questions on instructional techniques. The seven learning factors apply to skills and knowledge. They are:

1 **Readiness** Ensure students are mentally, physically and emotionally ready to learn.

2 **Primacy** First things learned are best remembered. Teach new knowledge or skills correctly the first time.

3 **Relationship** The relationship between what the student already knows and new knowledge helps the student to learn. Teach lessons in a logical sequence of known to unknown, simple to complex, easy to difficult.

4 **Exercise** All students learn best when engaged in meaningful activity.

5 **Intensity** Vivid, shocking, dramatic, realistic and/or unexpected events and experiences are long remembered. Use this law effectively when instructing.

6 **Effect** Students will gain a feeling of satisfaction from having contributed to the lesson, and from having done well. This will contribute more to learning than when a feeling of frustration, anger or confusion is allowed to persist.

7 **Recency** The most recent things learned and practised will be remembered longest, hence summarize and practice the important points at the end of each lesson.

These *laws of learning* or learning factors are useful tools when they are applied correctly. A good question is how do these learning factors apply to flying instruction? In fact they are very pertinent to all kinds of instructing and teaching. Review and discuss with others the learning factors below; use these suggestions during your instruction.

READINESS

To learn, a person must be ready to do so. An effective instructor understands this necessity and does the utmost to provide well-conceived motivation. If a student has a strong purpose, a clear objective, and a sound reason for learning something, progress will be much better than if motivation were lacking.

Under certain circumstances you can do little, if anything, to inspire a student to learn. If outside responsibilities, interests or worries are weighing heavily, if schedules are overcrowded, if personal problems seem insoluble, the student will be unable to develop the interest to learn. To help make your student ready to learn, start with an attention-getting opener. For examples of opening sentences that are effective, listen carefully to the start of documentary films or interviews on television. Writers spend a great deal of time developing the exact words to tune you in.

State *specifically* what is required during the lesson and how you intend to prove that the student has the knowledge or can master the skill at the end of the lesson. Make all of your statements student-centered use the terms *you* and *we* when you describe what is to take place.

Tell students the lesson's **purpose** and stress the **benefit** from the new knowledge or skill. Try to give more than

one reason for learning, in case the student doesn't fully accept the first reason.

Specify where the lesson fits into the overall picture, and relate the lessons to past experiences that the students may have had. This statement provides a link with something students have learned before and allows them to build on that knowledge or skill. As an example, if you were discussing how the lift varies with angle of attack, relate this to holding the hand in the airflow at varying angles out of the car window. This concept is closely related to the Learning Factor of *Relationship*.

If the new material depends on students having mastered previous lessons, start with a review, and confirm that the required level has been attained before proceeding with the new material. Conduct a review and, if needed, briefly re-teach major points to clear up any misunderstandings.

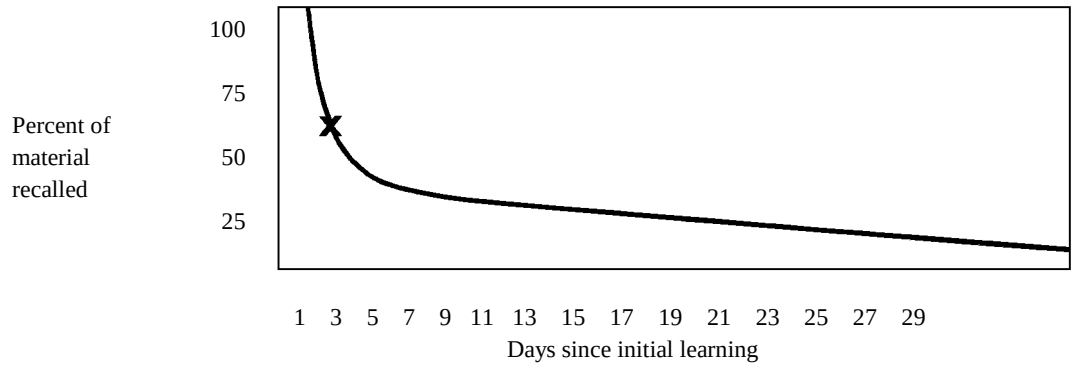
Plan to review each lesson and its major points. Students start to forget the moment they leave the classroom or gliding club. The greatest rate of forgetting occurs during the next *24-48 hours*. Ohio State University has carried out extensive research in this area and has designed a recommended schedule for when reviews should be done. Figures 3 and 4 show curves of how the memory fades. The memory *retention* graphs shown here were developed from the University's large body of students. Although one might think that these studies would apply only to knowledge and mental skills learned in a classroom, the graphs apply equally to handling or mechanical skills such as how to fly an aircraft. Reviews are equally important to solidifying knowledge, and mental and handling skills in the memory.

PRIMACY

Present and teach new knowledge or skills correctly the first time. When students are presented with new knowledge or skills, the first impression received is almost unshakeable. This means that what you teach must be correct the first time; you must rehearse your lessons thoroughly and remain current. Students may forget the details of lessons, but will retain an overall image of the skill or knowledge for a long time. For example you will not be asking the student to plan and fly the circuit on the first flight. However, you must perform the downwind checks, plan and fly perfect circuits correctly and well. The student will imitate you later; therefore any poor example shown at this time would have to be *unlearned* when the exercise comes up in subsequent lessons.

This suggests that the instructor must rehearse lessons to become thoroughly proficient at the skill and in answering questions related to the subject. Attempt to give a perfect demonstration of the skills (such as circuit flying) and maneuvers that you are teaching. Remember that if students read and study their manual without experiencing the exercise done properly, they may form an incorrect mental image of how it should be flown.

Try to start each lesson with a perfect demonstration. Sometimes it may be better to avoid talking during this demonstration to allow maximum concentration on doing the skill perfectly. While the student is practicing an exercise, supervise him very closely. Stop the student as soon as any mistake is noticed, then correct the error or mistake immediately. Failure to make the correction will mean that he will have learned the lesson incorrectly the first time, hence will retain the incorrect technique and skill. The mistake will be difficult to unlearn. Therefore, NEVER allow a student to make an error during the initial stages of training. Think of how you would train a student to defuse a live bomb!

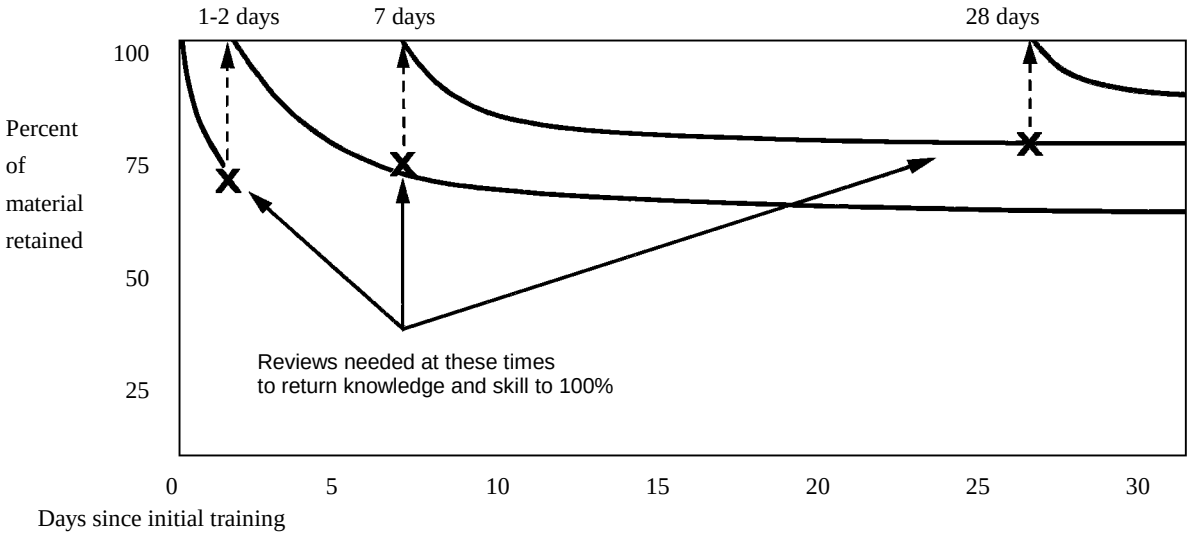


1 Statistics are based on an average cross-section of students.

2 Curve is very steep initially; within 2 days students will recall less than 70% of what they learned.

3 At the end of the month without reviews students will remember less than 40% of lesson material.

Figure 3 – Curve of loss of memory over time



1 To maintain at least a 70% level, a review should be conducted within two days.

2 After learning material a second time the curve flattens out somewhat, but after 7 days the student's retention is again down to the 70% level.

3 Another review and the curve really flattens out. The student's retention of the materials will be above 70% until approximately day 28. A review at this time will generally cause long-lasting retention of lesson material.

4 The amount of time required for reviews reduces each time a review is given:

Example:	initial training	-	50 minutes		
	Ist review	-	at 2 days	-	15 minutes
	2nd review	-	at 7 days	-	10 minutes
	3rd review	-	at 28 days	-	5 minutes

Figure 4 – Curves of Review and Retention of Memory

RELATIONSHIP

The relationship between old and new facts – how does the lesson tie in with what the student already knows and with the previous lessons? How does the current lesson fit in with future ones? If they are to learn effectively your students must understand the relationships between new and old facts, and between ideas and skills – they need to know. Tell students why they are learning a particular exercise, and at the same time how that exercise combines with previous ones and where it fits into the overall syllabus. Give students the right relationship at the start of the lesson – they will be more ready to learn. Continue the process throughout the lesson to help maintain the desire to learn. Present lessons in a logical sequence:

- known to unknown
- easy to difficult
- familiar to unfamiliar
- concrete to abstract
- simple to complex

Always review basic knowledge; give the student something that he can relate to, before proceeding to the unknown. A quick review of the previous lesson, for example, will allow you to build on the student's existing skill and knowledge to teach the next lesson. The process is continued until students have mastered all the required knowledge and skills.

Present new material in stages, confirming that students have mastered one stage before proceeding to the next. The length of time for each stage will depend on the complexity of the material to be covered; for example teaching circuit planning and flying the glider down to a landing, or the sideslip maneuver will usually require several flights.

Reinforce your student's learning of new facts or ideas by frequently summarizing the major points of your lesson. Give praise where it is due; this reinforces the learning experience.

Use examples and comparisons to show how the new material being learned is really not much different from a skill and knowledge already known by the student. The main purpose of giving an example is to paint a verbal picture so students can visualize the relationships between the new material and things that have happened before.

EXERCISE

Meaningful activity promotes the best student learning. Learning can only occur if the student is engaged in meaningful mental or physical activities. During flying training this is achieved through correct practice and repetition. Students learn by applying what they have been told or what has been demonstrated. As learning continues and is strengthened by practice, allow for this practice time in your lesson plans. At the same time you should ensure that the practice is directed towards a specific goal. Use questions, hypothetical problems, dual review, or solo practice to provide mental or physical activity.

If students are able to answer questions involving the words **how** and **why**, it usually means that they have a good understanding of the subject. As a soaring instructor these two words are probably the most important in your vocabulary. Study Table 2 and note both the instructor and student activity and involvement for each level of learning. Should you attempt to employ the *application* level of learning without having covered the *understanding* level, students will encounter much more difficulty than if they had mastered previous levels.

There are several suggestions for the instructor teaching a flying lesson. Avoid questions that are prefixed by the word **what**; try instead to use **how** and **why**. Give students the facts, figures and necessary knowledge, then ask the **how** and **why** questions to develop an understanding of the new knowledge.

Once a fact has been given, avoid repeating yourself, but then ask the student to relate it back to you. This strengthens learning and confirms the student's knowledge of the required material.

Challenge your student at his or her level of learning. Then provide only enough assistance to keep the student on track. When able to solve the problem alone, he will have demonstrated adequate knowledge and ability.

Test your student's knowledge and abilities frequently. This reinforces learning and builds confidence. However, before testing you must be reasonably certain that he can answer the questions or perform the skills, otherwise he may become frustrated. Testing will also identify areas in which students have weaknesses. This will allow you to re-teach to the required standard.

LEVELS of LEARNING		INSTRUCTOR ACTIVITY	STUDENT INVOLVEMENT	KINDS of QUESTIONS
I	Familiarization	Gives briefings	Listens	Where? & When?
II	Knowledge (information)	Presents lectures	Listens	What?
III	Comprehension (understanding)	Develops lesson by questioning	Answers and asks questions	Why? & How?
IV	Application	Demonstrates and explains	Imitates and practices	All
V	Analysis	Provides exercise situations	Breaks items into smaller components	All
VI	Synthesis	Provides exercise situations	Combines information into concepts	All
VII	Evaluation	Provides items to be tested	Records and draws conclusions	All

Table 2 – Summary of learning

INTENSITY

Use vivid, dramatic and realistic examples or unexpected events, when teaching; they will be long and better remembered than the mundane or tedious and uninteresting. It is well known that a student's *lookout* will improve considerably if they know another glider is close by and they are trying to locate it. Use this type of situation to enhance the experience and improve learning. Attempt to make your students' learning experiences exciting by being excited yourself and perhaps using any opportunity to introduce unexpected things to your students.

Example: After a student has become more relaxed, you notice that he or she increasingly disregards the SOAR technique to make a timely decision to return to the club for a circuit and landing. Allow the student to continue the current exercise until the glider is lower than normal, but safe, before you mention it. Your student will be surprised to be so low and yet far from the club, and will probably remember the experience for a long time.

The Law of Intensity implies that students will learn more from real experiences than from substitutes. You will have to use your imagination to develop vivid experiences for dramatic or realistic effects. However beware of the experience that is too dramatic, it may upset the student and have a negative effect on their learning and motivation. And you should never deliberately frighten your student because fear is not a good teacher, it puts people off and they do not, will

not wish to experience the same situation again. You should attempt always to show enthusiasm and sincerity for the subject you are teaching. Attempt to employ a wide range of speech variation, such as changes in rate, volume and voice pitch to keep students attentive.

Use appropriate and effective gestures while explaining major points. The lesson will seem to *come alive* and the points made will make a greater impression on your student. Use a variety of training aids to appeal to as many senses as possible. Of course each aid must relate directly to the subject matter being taught.

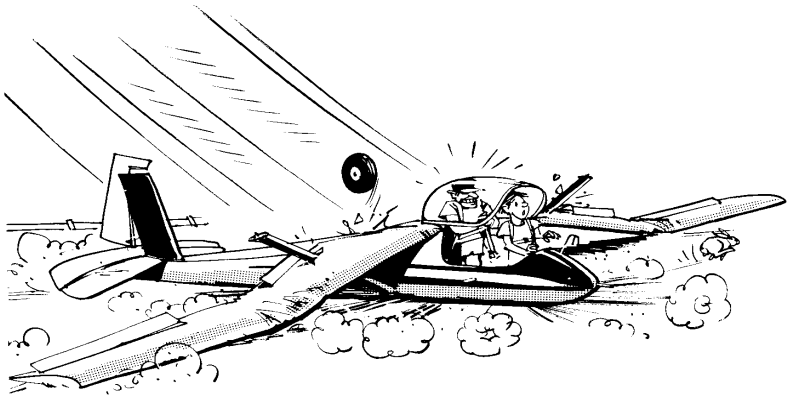
EFFECT

The Law of Effect says that satisfaction felt by the student from having contributed and done well will lead to better learning. Compare this to a feeling of frustration, anger, or confusion; never allow these feelings to persist.

Learning is strengthened when accompanied by pleasant feelings. Students will learn and remember more under these conditions than when feeling defeated, frustrated, or angry or a sense of futility develops. If you were to demonstrate a spin during the first lesson, the student would most probably be scared and probably not wish to continue learning! The experience would be very negative. This example is obvious but you need to consider how your actions could produce feelings of frustration or anger. For example, you ask a student to perform a maneuver and then you immediately emphasize all the errors the student makes. Each error may be obvious and your observations accurate, but how would the student feel? If the objective was to make the student feel defeated, it probably succeeded. It is better to point out the positive aspects of a stu-

dent's performance first, then discuss the major errors. Then finish with suggestions for improvement.

Whatever the learning situation, it should contain elements that affect your student positively and give feelings of satisfaction. Each learning experience does not have to be entirely successful, nor do students have to master each lesson completely; however, a student's chance of success will be increased with a sense of accomplishment and a pleasant learning experience.



Suggestions for enhancing learning, using the Learning Factor of Effect include allowing the student to contribute to the lesson by developing some of the new material from their existing knowledge. Do this by asking relevant questions to draw out the correct answers. In this way the student contributes his or her knowledge and ideas. During classroom and flying lessons, obtain feedback from students by asking questions, observing the performance of a skill and, if possible, watching for facial expressions or body language that show a lack of understanding. Always respond to feedback by answering the question and providing assistance and correction where needed.

Praise stimulates and goes a long way to enhancing learning. Show students how to improve and offer praise when improvement occurs. But remember that your praise must be sincere, students have a knack of telling when your are giving *automatic* praise; so be genuine in your praise!

Reinforce all your statements with reasons. Whenever you tell students something give the reason behind it, for example, why there are two static vents, one on each side of the fuselage.

When a student encounters difficulty in mastering a whole maneuver, break it up into smaller elements. This can be done with many lessons: the steep turn, the sideslip and the spin of course. Each can be broken into several small elements before the full maneuver is flown. Too often we can make the mistake of asking the student to attempt the full maneuver when his or her performance is deteriorating. It is better to go back to an earlier part of the maneuver, perfect that and then advance to the full maneuver again, possibly even on a subsequent flight.

Never use ridicule or sarcasm. You may feel these might take the place of humour; however, students can always tell when an instructor is using sarcasm or negative praise; it is often in the tone of voice!

Reward the student when something is done well. However the reward or praise must be genuine; here again, students can tell when praise is not sincere. You might set up a situation in a Daily Inspection for the student to notice, for which you give praise for noticing and taking action, for example a dirty canopy that he decides to clean. However, in no case should you deliberately sabotage an aircraft, unless that aircraft is one that is not to be flown at any time. The consequences are too dangerous if the tampering go unnoticed, and someone later flies the aircraft.

RECENCY

The last things learned and practiced will be remembered longest and best. This suggests reviews are needed to consolidate knowledge and skills learned earlier. The longer students are removed from a new fact or from an understanding or acquired skill, the more difficulty they will have remembering it. The need for reviews was stated earlier and a full circle has been completed – review – learn new material – review. There are several suggestions to enhance learning using this learning factor. Preparatory ground instruction is essential prior to the flying lesson. During this you will prepare the lesson always reviewing the main points by questioning. This may sound like the laws of *Readiness* and *Exercise*; however, *Recency* deals with the timing of the practice. Immediately prior to each flight you will give a briefing on the main points of the flight: who will do what, when and how, including a quick review of the main learning points by questioning. And then always ensure that you give a thorough debriefing of the important points at the end

of the flight or lesson.

At intervals conduct a review rather than introduce new materials; in other words, reinforce what has been learned so far. As an example, ask questions on the material or summarize the *need-to-know* material or conduct a test as the final part of your lesson. This is especially necessary if the student has been away for a period.

Attempt to finish lessons with practice of the most important parts of the lesson. This applies to solo lessons as well as dual exercises. Remember, students practice knowledge by answering questions and they practice skills by doing.

An important skill of any instructor is the ability to formulate and ask good questions. Good questions satisfy all the identified learning factors. The next section of this manual will deal exclusively with verbal questions.

OTHER LEARNING FACTORS

There are two more learning factors that should be included here, and these apply to the instructor and the student, and their interactions. Both are important to understand.

The Instructor-Student syndrome

One problem that can occur, and it is more of a problem when workloads are high, for example on takeoff (glider may be drifting off to the side) or on final approach (speed could be too slow), is what is called the *instructor-student syndrome*. This is where the student realizes that some aspect of the flight is not correct or ideal, but continues in the expectation that the instructor will prompt him or her to correct it. Meanwhile the instructor is waiting also for the student to correct it, and the instructor does not issue a prompt in time. They are each waiting for the other! In the final analysis the instructor is in danger of taking over control too late. Don't lapse into the trap that you think you can handle it, you have seen it all before. Err on the side of safety.

Transfer of responsibility

Decisions have to be made both by the student pilot when learning to fly and by the instructor. On the first flight of a new student the instructor makes all the decisions, but slowly transfers the responsibility for decision-making to the student pilot. By the solo stage the student should be making all the decisions with no prompting. The job of the instructor therefore is to phase in the decision-making required of the student. We teach them to assess the situation regarding themselves, that is *the pilot*, the equipment they will be flying, *the aircraft*, and *the environment* they will be flying in and *the flight* as it unfolds. Aim to give your students the confidence to make their own decisions, to act on them and ultimately to make many of the more routine decisions habitually and subconsciously. When they go solo you will be relaxed, knowing that you have given the student the best possible training that includes pilot decision-making skills using the SOAR technique devised for glider pilots.

DECISION-MAKING and TEACHING THE NEW PILOT

As stated in *SOAR And Learn To Fly Gliders*, the learning of decision-making takes on more importance when learning to fly compared to what we are used to in our ground-based lives. This is very important, particularly when under an extra cockpit workload or stress, because making conscious decisions seems to elude us when flying gliders. The instructor's role is therefore very clear. You, the instructor, must learn the technique if it is new to you, and in any case must learn how to best teach the technique to new students. To effectively teach this, first we must understand how people make decisions from the constant intake of data from all our senses.

The human is constantly engaged in information processing. We will be doing this in our sleep sometimes, but we consciously and mostly unconsciously make decisions all day from the information that we gather. The SOAR technique was initially developed from business school models of decision-making. These techniques are based on a series of steps:

- Identify the current **Situation** and from this develop an objective or goal,
- Generate alternatives to reach that goal, and predict the likely outcome,
- Evaluate the alternatives and select the best (safest) **Option**,
- Select this one alternative and **Act** on it,
- Monitor (did the prediction come true?) then **Repeat** the above steps.

The above underlined letters spell **SOAR**! This is the Association's model of pilot decision-making, or PDM. It should be taught to new students from the first instructional flight, so that by the time they are ready to fly solo, the students will have the technique ingrained in their minds. Now they will be making the right decisions without thinking too much about it; they will

have started to use the technique unconsciously. But first we discuss how people act in making and carrying out their decisions.

Experienced pilots probably plan and fly a circuit into the club's field almost unconsciously because they have done it so often before that they can talk to their passenger simultaneously! The new pilot, faced with a first landing at a new location, will probably be thinking hard! He will need to work out where and how to fly into this new runway – these pilots will have to draw on their previous knowledge to work it all out.

HIERARCHY OF RESPONSES

It is generally accepted that there are 3 levels of human performance: *skill-based, rule-based, and knowledge-based.* The three levels of performance form a hierarchy of responses as shown in Figure 5 on the next page. We are most comfortable with the skill-based level. We only go to the rules, and then reluctantly, when we are challenged by the demands of a changing situation to work out what we need to do. If an appropriate rule comes to mind, it will become the plan. If no rule applies, and this can be a rule-of-thumb or self-generated rule, we have to use our knowledge to handle the situation. These last two methods often involve *trial and error*. The failure of one strategy to resolve the problem may lead to trying another solution, or repeating the same one, even though it did not work the first time.

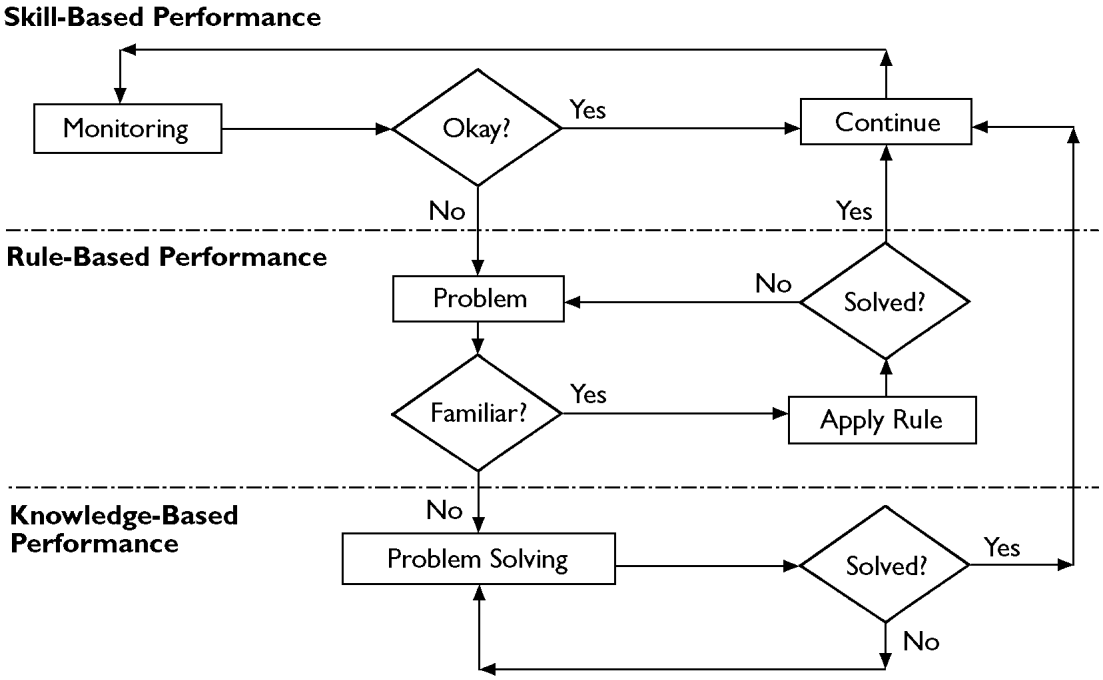


Figure 5 – Basic human performance model

Skill-based performance

Skill-based behaviour relies upon skills and methods stored in memory. These skills have been learned, refined and practiced for a long time; we can do them without conscious thought. Examples include controlling a car in normal driving. We control speed and direction while going down a road without thinking. With almost no conscious effort we can maintain speed and keep the car in our own lane. The actions have become automatic. Sometimes it is possible to talk to a passenger without sacrificing control for example, but if our concentration is demanded elsewhere too much (a cell phone demands much more of our attention) our driving will be less safe; we cannot concentrate on two tasks at the same time.

So too in flying, we maintain the wings level or our speed automatically through practice while maintaining a good lookout! We cannot do it really well the first time we try, but with practice, these actions become virtually automatic, and we can perform a task without consciously thinking about what comes next.

We can be vulnerable to certain types of errors while engaged in skill-based performance. These are called **execution errors.** They happen when we have the right idea, but something goes wrong. There are two types of execution errors, *slips* (doing the wrong thing), and *lapses* (leaving out something that is normally needed).

When using skill-based or automatic decision-making, if the task or conditions now become more demanding and require more conscious decision-making, we must devote mental effort to the task. This leads to the more complex and demanding levels of performance.

Rule-based performance

People perform rule-based tasks every day. We stop at a red traffic light; we need a stamp on a letter, and in very cold weather we really bundle up the children. These *rules* do not have to be thought about, we know them! They may not be regulations or laws but can be common practice. We all have such rules stored in our memories to deal with predictable situations. The rules are typically: *If this (condition) exists* then *do that*. All of us have rules like this in our lives. They are patterns that guide us in dealing with all kinds of situations.

Rule-based tasks involve a decision that has two components: Assessment of the **S**ituation followed by selection of an **O**ption for a suitable course of **A**ction. This looks strangely like the mnemonic S-O-A-R, the four steps for decision-making! The difficulty involved in decision-making depends primarily on two factors:

- How well we can see and define the problem, and
- The options that are available to handle this situation.

Information about the situation can vary between clear and ambiguous. The clearer the cues, the less mental effort is required to interpret them. In some cases, for example meeting head on, both pilots know they have to turn right, hence once the situation is defined the response is automatic. New pilots will take time to identify and understand a situation correctly, then they will have to look at alternative options and try to predict the outcome of each before selecting the best one for action. This represents a higher level of complexity and, therefore, is a more difficult variant of rule-based performance.

If we have a complex and difficult decision to make, it is more likely that the outcome will be less than ideal. This is regardless of whether the difficulty is in assessing the Situation or in our response to it. The main errors made at this level are poor assessment of the Situation, and selecting the wrong Option. Inexperience, limited observational skills, an inability to perceive *reality*, lack of information, and strong habits can all contribute to errors at this level of performance. Since rule-based performance involves conscious decision-making, these errors are the result of voluntary or deliberate acts and are called *planning errors*.

Knowledge-based performance

Knowledge-based actions are those which involve real problem solving. There are two conditions that can demand this level of performance: a new situation we have never seen before that we have to analyze before we can understand it, or a situation for which we have no available solution. In these cases we are forced to analyze the information and to apply what knowledge we have to develop a plan. Again there are two components: assessment of the Situation, and formulation of a plan based on evaluating different Options.

Humans are notoriously reluctant to go to this level of performance, and the outcome of creative problem solving like this typically achieves success in only 50% of cases! We need to think about this when leaving it too late to make an unplanned off-field landing; to admit we are low, to look for a suitable field and plan a circuit for example. Even worse is the very late decision to actually commit to the landing, when the much higher stress level can too often lead to the *freezing* of decision-making and acting! Since knowledge-based performance involves conscious decision-making, er-

rors at this level are the result of intentional acts and are again called *planning errors*.

DECISION-MAKING USING the S.O.A.R METHOD

Basic performance by humans is predictable. We have been studied forever! As instructors we can modify performance as well as responses to situations by training. Understanding how we perform tasks will assist the instructor to perform his or her job more effectively. Besides our lack of handling skills, what most of us lack when we start flying lessons is an effective decision-making ability when in the air. This is a foreign environment to a person when first learning to fly, and decision-making techniques that are used in our daily ground-based lives are either not thought about (most likely) or simply are not used to apply to flying. Every experience here is new! Hence we have to take our students through a deliberate process to give them a technique that can be quickly and easily learned and applied.

The Association has devised a method for decision-making; its mnemonic is **S – O – A – R**. It is based on a well-tried scheme used in adaptive management and it has the four steps detailed in *SOAR and Learn to Fly Gliders*. This shows the student pilot how to go about using the four steps of this decision-making technique, which he can use to make decisions to assess any situation, whether to do with flying or not. How should one approach the teaching of students to identify situations, to develop options and to act on them; and then to repeat the four steps?

On an early flight there is a big advantage to showing the student that you are thinking ahead, by verbally going through the four steps. During the pre-flight briefing mention that there is a technique, with the mnemonic SOAR, and that you will increasingly be asking the student to use the technique. However on a first flight you will only introduce the student to it, and on subsequent flights teach the student how to apply it. This technique can also be requested from the student so that the instructor can follow the student's thinking or pilot decision-making (PDM). Some students will find this difficult and it is tiring, so don't overuse it. Always brief the student on its use before a flight.

A person new to PDM would likely think that a set of automatic reactions or rules can be taught and then used for a variety of situations in flying, such as when descending down to a certain height, do this or do that, depending on the wind strength or direction. In other words, a rule-based approach to decision-making is all that is needed. This is certainly true of what we teach as an automatic first reaction to a rope or cable break, for example. This is an invaluable reaction when time is essentially unavailable for considering different options. However, when we have more time, the assessment of options can be skill-based or even knowledge-based, depending on the situation's complexity and the pilot's level of experience. Hence PDM using the four-step SOAR mnemonic is an invaluable tool that encompasses all levels of the human performance model, from the quick reaction of a rule-based reaction to the slower but considered knowledge-based decision when considering a complex situation.

SITUATION assessment

Starting with the first step, **S**ituation. The student must eventually be able to analyze all input information to assess his or her situation that needs a decision for action. Help the student through questioning to develop the skill to quickly assess the current situation. This is an important step, because many new students do not think ahead sufficiently; the skill has to be developed. By assessing all factors with the student before takeoff you will slowly develop his or her overall skill at applying the technique. In the air help him to think ahead, by assessing the current position and height for example, in relation to the club field, and whether to go for a likely looking cloud to find lift. Eventually he will need to be at the correct position and height for starting the circuit.

The situation refers equally to how well the student feels, physically and emotionally, what is the weather likely to do, how will it affect the flight, now and later in the day, what is the condition of the glider and physical well-being of the pilot (passenger)? These and other factors are all included under the first item, **S**ituation. Yes, the student will need to spend time thinking about these but time spent now learning the overall technique is well worth the effort; he should gain an understanding that these factors need to be assessed. When actually using the technique in the air, it will become less time consuming as the student gains the skills to keep tabs on the glider's position and height, or where the best lift or strong sink to avoid are located. Gradually the technique will become subconscious and the student should be doing it without thinking. Hence the occasional question to a more advanced student may be used to prompt him or her to tell you what your current situation is, and what action he is going to take.

The instructor's role in this is to assist the student to

see the situation, to be curious and inquisitive about it and about how the flight is progressing. You will need to discuss the student's assessments and to suggest answers at first. But as the student gains insights into his or her own assessment abilities and perhaps limitations, your questioning can decrease and may be replaced with your (appropriate) agreement and praise – positive reinforcements for the student's learning.

Before we leave this topic of the **S**ituation, think of how an instructor might have to use the SOAR technique. As an example, consider the situation of the student flying the final approach. The instructor must monitor the student's flying, and depending on the situation may allow the pilot to continue or may have to intervene. Hence the SOAR technique is not only for the student to apply, but instructors must use it very consciously, lest they take over control too late in a situation that is deteriorating quickly.

OPTIONS choose and predict outcomes

The instructor's next task is to help the student select and consider **O**ptions for the situation. At least two possible actions should be chosen that would solve or improve the situation. Next ask the student to predict what the outcome will be for each case, so that when the four SOAR steps are repeated, you will be able to compare what actually happened to what was predicted. Only in this way can the student build up the experience upon which to base future decisions. For now, you will have to assist the student to make the predictions based on your experience.

Instructors using the technique will also be assessing options, for example is the student aware of the decreasing approach speed? The instructor should be following through closely, and must closely monitor how the student acts in response to the instructor's prompts. Similarly instructors must assess such things as the state of the student's preparations, the weather and many other items before getting into the glider in the first place.

ACT on the best/safest Option

Students are sometimes slow to **A**ct on the best and safest option. But this is one of the aims of teaching this technique, to select the best option and then to take action by carrying it out. Sometimes doing nothing at that moment is a legitimate action, but the decision must have been a conscious one. If, as an instructor, you see a student taking no action, make sure it was deliberate and not because the pilot was omitting the four decision-making steps. This can happen on a solo flight, for example when the instructor is not in the glider, making it doubly important that you also monitor these flights.

Instructors have a choice of actions under different situations. Typically we should be prompting the student in such a way that they will become more conscious of the situation. It is important to sensitize their data gathering abilities too, to activate their senses. They will need help to assess situations new to them, and most situations in flying will be new! We have to realise that most data comes into our brains via our eyes, but pilots also hear speed in gliders and when flying we feel gravity and movements that help us maintain our balance through *the seat of our pants*. Instructors can help here by drawing the student's attention to these senses at appropriate times. We feel sick via our stomachs of course and can also feel unwell because of partying or inadequate sleep, and these situations demand that we **A**ct on the best option as well. It may well be to stay on the ground.

REPEAT the four steps

The next step is to **R**epeat the four steps, first going back to looking at the new and changing situation. Has the prediction come true? Why did it differ from the student's prediction and if not what is the new situation – do we have to alter our option in any way and act again immediately? Or did the selected option work out as predicted and are we now in a safer situation? The possibilities are endless, of course, and situations present themselves all the time when flying gliders.

Examples of situations

Two typical situations that present themselves to students and instructors are: the student is flying and the height is decreasing rapidly but the student has not yet sensed this, meanwhile the glider is flying away from the club field; and second, the student is flying on final approach and the glider's speed is declining slowly.

In both cases the first action of the instructor could be to ask a pertinent question to draw the attention of the student to the situation, with the hope that the student will use the four steps of SOAR to correct the problem. If he does not do so, a more direct question should be used, but above all try to improve the student's situational awareness at all times. If flight safety is jeopardized at any time, take over control to take action quickly, then return control to the student when it is safe to do so. However, be extra careful when giving back control on final approach because the student

may have relaxed and will not be ready to take over safely for the balance of the approach and landing.

In the examples above, how do you best teach the student to notice the situation without giving a direct command to correct the problem that you are seeing? Using the four SOAR steps, you already have assessed the situation. In both cases you have four options:

- Say nothing, hoping the student will notice and then take action,
- Draw the student's attention to the situation – "What's our situation?" Does the student then start the four steps correctly, and take action to correct the problem?
- Command the student to turn towards the club or to increase speed, or
- Take over control to correct the situation yourself.

CHAPTER A4
STUDENT PERFORMANCE

PATTERNS in LEARNING

If you are to understand the instructor's role, you must consider the ways in which students learn. There are four main patterns in learning, each of which seldom occurs in isolation, but interrelate with one or more of the others in any learning process.

Rote learning

Learning by rote is committing to memory, normally with no particular emphasis on understanding. Some material lends itself to this type of learning. However it depends upon repetition for retention, and usually involves one of the other patterns when what has been remembered is to be applied.

Trial and error

This pattern of learning is an attempt by the student to solve a problem or to reach a conclusion primarily through his or her own efforts. It may be compared with someone learning to play golf alone. It is a method that can be rewarding to the learner, however it is usually expensive, and time consuming. In flying it is potentially dangerous.

Guidance

The instructor provides considerable assistance in this pattern of learning. In flying training it is usually combined with trial and error where the instructor provides guidance to the student and then allows him or her to perform the task, guiding the student's efforts within set limits.

Analysis

This is a pattern of learning where the student is on his own and applies what he has learned to the situation that confronts him. It may be termed mental trial and error where the student reviews past experiences and finds something he has learned in the past that fits the present, new situation. Analysis develops the ability to find solutions to new problems or to improvise in unfamiliar situations. In a pilot this can be called pilot decision-making, or PDM – the ability to think and plan in the air. It is often called *judgement*, but this word is also applied in gliding to the judging of the circuit pattern and in flying down to the landing.

These patterns in learning are usually interrelated in any learning process. As an example, the steps to go through in learning how to plan an off-field circuit and landing may be mastered by first committing to memory the heights above ground and the checks for the set of actions and decisions to be taken at each height. Flying typical exercises close to the club field under the guidance of an instructor subsequently allows some guided trial and error. If a suitable field adjoins the gliding club's airfield, a successful practice off-field circuit and landing without assistance should be possible. How well a pilot will think his or her way out of a tight spot is determined by whether or not he has received systematic practice in learning to solve similar problems during flying training.

MOTIVATION

The factor that perhaps has the greatest influence on learning is motivation, the force that causes a person to move toward a goal. This force is active in some people and dormant in others, but it is always present to some degree. It can be rooted in any or all of the personal-social needs of the student. We often feel the need for security, for a new experience, for recognition, for self-esteem, for conformity, or the need to help others.

Such needs compel people to act, to move, to start working toward an objective, or to achieve a purpose. The instructor's responsibility is to first recognize and identify these needs and then seek ways of satisfying them through his or her teaching.

Positive and negative motivation

Whether motivation is positive or negative depends, in most cases, on the instructor's approach. Positive motivation promises a reward, while negative motivation is a threat. Positive motivation is preferred, not because it is more pleasant but because experience has shown that it gets better results. A professional instructor should use leadership rather than coercion – the results of positive motivation are longer lasting. Only use negative motivation as a last resort. It will often cause a great deal of activity, if only for a short time. As a general rule here are three types of negative motivation which should never be used. They are sarcasm, ridicule, and fear.

- **Sarcasm** Derogatory language used even in a joking manner, or saying the opposite of what is meant will cause not only resentment and uncertainty but will quickly destroy the proper student-instructor relationship.
- **Ridicule** Scornful language, designed to belittle or humiliate, will ultimately destroy the student's respect for his or her instructor.

- **Fear** Mild fear can be used effectively, as in physical security, or as discussed in the Law of Intensity. Strong fear should never be used because student reaction is unpredictable; the student may develop fear of flying or it may assume such proportions as to cause failure in the student's training.

STUDENT PROGRESS

Rates of learning

Although it would be convenient if the rate of learning could be consistent and predictable, it is not always so. Students may progress rapidly for a period, and then suddenly progress more slowly or even appear to regress for a time. Such variations are to be expected. It is your responsibility to detect them as soon as possible and if appropriate, to try and remove their causes, and to adjust your instructing accordingly.

Advances and plateaus

Learning proceeds rapidly at first when a new task is introduced then slows as a reasonable degree of proficiency is achieved. When plotted on a graph, this decrease in the rate of learning is shown as a levelling of the ascending curve that represents progress – see Figure 6, next page. As students achieve the ability to bring together other aspects of training, progress then tends to resume its upward climb at a slower but fairly constant rate.

The relatively level portion of the learning curve is termed a plateau. It may represent a period of training during which the student is perfecting the application of many new skills, and it appears to the student that progress is very slow. This may well be the case, because it takes time for these skills to be developed by the student. The brain also needs time to sort out the new data and to organize how to best store it in memory for easy recall. In fact, research shows that when a new skill involving coordination and movement is being learned, the brain will continue to work on how best to perform that maneuver when the person is subsequently sleeping. Explaining this to students helps them understand that in spite of feeling discouraged, progress is being made. They will soon find that they are beginning to *put it all together*. Having mastered many of the basics, their learning of the more advanced maneuvers will be made easier, and the rate of learning appears to quicken again.

The rate of progress in learning is affected also by several outside influences. This means that progress up the curve often is unpredictable. The rate is affected by such things as:

- Diversions
- Poor or inconsistent instruction
- Lagging motivation
- Emotional disturbances
- Training overload
- Upset training schedule
- The weather
- Equipment breakdown, and
- Unavoidable absences

Slumps or plateaus in the rate of learning are more likely to occur as the student advances to more complicated operations, such as thermalling with other gliders. Often the reason is that a student has failed to master one basic element of the maneuver, which leads to the appearance of deficiency in the performance of later elements. An example in this case could be uncoordinated use of stick and rudder in thermalling while keeping all other gliders well in sight.

Performance usually improves when this one basic element is mastered. You can accelerate improvement by careful fault analysis and by concentrating instruction on that particular problem.

Without competent instruction, students will probably not understand why they aren't improving and will become discouraged. This discouragement tends to prolong the plateau. During such periods try to help by explanation, and by isolating and correcting any faults. You may have to provide special incentives until normal progress is resumed.

Reversals sometimes occur, during which a student's performance becomes worse in spite of continued practice. Generally such reversals occur because of a faulty habit pattern or a faulty skill involving one of the basic elements of the maneuver or sequence. The student is now in danger of repeatedly practicing this wrong method or skill, until correction becomes very difficult. You must not accept such errors and misunderstandings as normal in the learning process. They must be corrected before progress can resume.

During advanced stages of learning, the rate of progress can be very slow. Example: An acrobat who can perform a routine to a level of 9.6 continually practices to improve the performance. Raising the score up to 9.8 or 10 requires extensive training and practice. This can happen with the advanced maneuvers when learning to fly gliders, for example crosswind approaches

and landings.

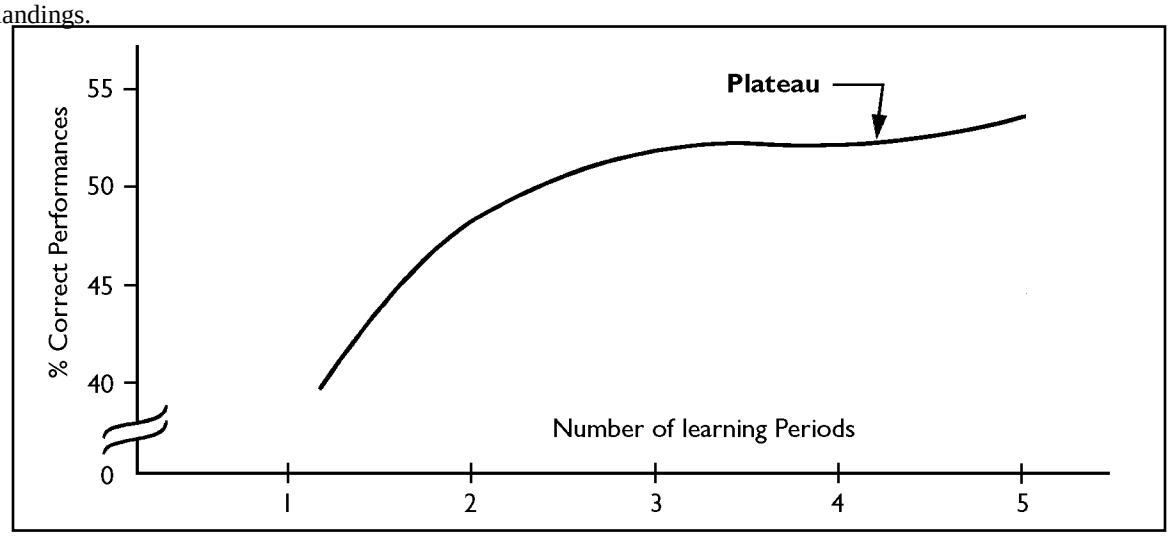


Figure 6 – Typical learning curve

Reversals in the overall rate of learning can also occur if you place too much emphasis on a single stage of the curriculum, one element of a maneuver, or a complete maneuver. It may help to progress to the next lesson or exercise; the one *problem* then has a chance to miraculously disappear.

INDIVIDUAL DIFFERENCES

You are likely to be discouraged when you discover that a well-planned lesson does not teach all students with equal effectiveness. Usually, however, you soon see that this is natural. In fact students seldom learn at the same rate. Differences in rates of learning are based on differences in intelligence, social and ethnic background, experience, interest, desire to learn, age, and countless psychological, emotional and physical factors. Each student is different. This fact dictates how much you can teach, at what rate, and when.

Differences in attitude

Each student will have his or her own personal attitude or method of thinking. The individual's pattern of thinking and reaction to the various philosophies and types of training must be reconciled. Also, is their attitude caused by hereditary or environmental factors? The root of an attitude problem may sometimes be found in a general attitude to life, or the club and its instructors. If the club has a good, generative type of atmosphere or *culture*, its students will be much more likely to acquire and to develop a good attitude. Our attitudes matter!

Differences in interest

People sense ideas and activities that possess special values, uses or attractions for them. Three general categories of interest are the vocational, educational, and avocational (interests outside one's main work). Students will have interests in different aspects of flying. Make an effort to take advantage of these, and to channel the student's interests and efforts so as to make his or her flying training as effective as you can.

EMOTIONS

Emotions play an important part in the training of student pilots. You must know the kinds of emotions, and techniques for controlling them. Most of us think of emotion as an overpowering feeling such as passion, hatred, or grief. These are not typical of the entire range of emotion. Everything we do and with which we come into contact is coloured by some emotional feeling. Emotions vary from mildly pleasant or unpleasant, and all the way up to feelings so intense that physical and mental activity is paralyzed. All of us experience a wide variety of emotions every day. Rarely do they bother us or interfere with our ability or willingness to do our job. However, students in flying training are in an abnormal emotional condition. Students are in unfamiliar situations where accelerated pressures are experienced over a long period of time. The learning situation tends to intensify the student's emotional feelings and sometimes his or her problems more than we would expect in everyday life. Learn how to recognize and overcome these problems, because they cannot be ignored.

Degrees of emotion

For our purposes, we will divide the various levels of emotion into three categories:

Mild This is the everyday type of emotion such as a small amount of satisfaction or dissatisfaction with our jobs, our personal lives, or with other people. Mild emotions affect motivation.

Strong This degree of emotion is not felt very often in everyday life, but causes most of our emotional problems in flying training. Strong emotions cause a large amount of tension in an individual, and no one can live or work normally under prolonged tension; however, strong emotion can be coped with.

Disruptive Very severe, deep-rooted emotional tensions will disrupt logical action and clear thinking. People suffering disruptive emotions usually require the assistance of a psychiatrist. They occur so rarely that you need only be aware that they exist.

The effect of strong emotional tension

A person cannot tolerate strong emotional tension over any length of time. It causes extreme nervousness, irritability, and an inability to relax. It interferes with normal eating and sleeping habits, and makes the person generally miserable. Everyone either consciously or subconsciously tries to relieve prolonged emotional tension.

The effect of emotional tension on learning depends on the method chosen by the student to relieve it. If the problem is attacked directly, and solved, learning is enhanced. For example, a student may have strong feelings of frustration or worry because of a deficiency in one phase of training. If he works harder, studies more, and receives extra instruction, progress will probably improve and tension will disappear. On the other hand, if the real problem is avoided, an escape mechanism may be used to reduce tension, and learning will suffer.

Use of Emotional Escape Mechanisms

Students often use escape mechanisms during flying training. Occasional use of escape mechanisms is normal in everyone, but their overuse indicates strong emotional problems. Therefore, learn to identify the symptoms; the student may be using one:

- **Projection** Transferring the blame from oneself to someone or something else,
- **Rationalization** Finding a believable excuse for one's actions or failure; trying to justify unjustifiable behaviour,
- **Resignation** Becoming resigned to the situation and giving up,
- **Flight** Physically or mentally removing oneself from the tension-producing situation, or
- **Aggression** Taking one's tension out on someone else by becoming belligerent or argumentative.

A student's over-use of one or more of the escape mechanisms, possibly along with other symptoms, may indicate an emotional problem. Take corrective action before emotional tension becomes extreme.

MEETING the DIFFERENCES

Try to recognize differences in aptitude, personality, and emotions among your students, and understand the necessity to treat students as individuals. When you have analyzed the situation and determined the differences, if necessary seek assistance from more experienced instructors or pilots. You will attempt to equalize the different levels of understanding, ideally raising the level of some without retarding the progress of others. Coping with differences among students is perhaps the greatest challenge of instructing, and finding the correct approach for each student is essential. Some traits and faults of students are fairly common and can be recognized easily. These and suggested corrective actions are discussed next, see Table 3 on page 34.

Nervous or under-confident

Nervousness or under-confidence in a student is a trait that may not disappear. Instruction may be too rapid and material may not be absorbed. Repeating the fundamentals and ensuring mastery will often alleviate this condition. This type of student deserveds praise whenever possible. Avoid rebukes. Patience is very necessary when dealing with such a student. The student must be aware that you are trying to help. Nervous students may be so apprehensive that they may not be suitable for pilot training. You should avoid high *g*force maneuvers and extreme glider attitudes unless they are essential to the lesson being taught. Take the time to build the student up to exercises involving different *g* loads or unusual attitudes.

Over-confident or conceited

First ensure that these types of student have the ability to match their confidence and, if so, set more difficult tasks that require greater accuracy. More criticism of imperfections is advisable. If a student has little ability, counselling may be required. And discourage any signs of familiarity.

Forgetful of instruction

At the beginning of training, students may forget previous instruction. These students require a great deal of patience and probably need more review than the average student. Extra time spent in briefing and debriefing, and more study on the student's part should be rewarding for all concerned.

Inconsistent

Students sometimes lack consistency in flying proficiency. You should try to find one of the many reasons for this. You must look at yourself and your attitude toward the student. Most of us have good days and bad days, but when a student shows large fluctuations in proficiency the instructor must look closely at his or her teaching. A change in approach or even instructors may be called for.

Slow starters

Slow starters may be students who find difficulty doing more than one thing at a time. Again, patience is mandatory. Progress may be slow, but encouragement will help.

Fast starters

Fast starters are usually students with previous flying experience who quickly grasp the initial air exercises. You should not omit anything from the briefings. Watch for signs of weakness when new work is introduced. This type of student usually slows down to the level of the others shortly after going solo. A high degree of proficiency throughout the course should not be anticipated unless the student has above average ability.

Immature

You must not be too harsh with students who appear immature. You will find that within a short time during flying training, they will mature. Your attitude is of prime importance in setting an example. Encourage and assist these students whenever possible.

Airsickness

Some students may suffer from airsickness induced by motion, reduced *g*, apprehension, claustrophobia, tension, or excitement. Attempt to find out what affects the student. When signs of airsickness show up, try methods of prevention. These include instructing the student to fly straight and level, stopping instruction, inducing relaxation by concentrating on looking out as much as possible, finding the airfield, making conversation about something else, or whatever will keep a particular student from becoming airsick. Remember most people can get airsick much more readily when not flying the glider, so make the student continue to fly it as much as he or she is able. And don’t forget to land as soon as convenient.

PROBLEM / SUGGESTED ACTION	Learns slowly	Know-it-all	Timid	Wastes time	Too aggressive	Antagonistic	Learns rapidly	Finds fault	Immature	Courts favours	Stalls, evades	Dominating	Inattentive
Provide less work	•												
Provide more work		•			•		•			•		•	
Give more individual instruction	•		•								•		
Be patient in correcting mistakes	•		•										
Give no chance to dodge responsibility		•	•	•				•	•	•	•		•
Rigidly check student's work		•		•	•			•	•	•	•	•	•
Let student know what is expected		•		•		•		•	•	•	•	•	•
Determine validity of grievances						•		•					
Give student more responsibility				•	•	•	•	•			•		•
Give more difficult assignments		•			•		•						
Require student to prove ability		•						•		•		•	
Have student work alone				•			•				•	•	
Keep student informed of progress		•		•				•	•		•		•
Tell student why progress is poor			•	•		•		•	•		•		•
Check at first occurrence				•				•	•	•	•	•	
Have a personal talk with student		•	•	•		•		•	•		•	•	•

Table 3 – Actions required to meet student differences

THE STUDENT-INSTRUCTOR RELATIONSHIP

The primary responsibility for establishing a favourable student-instructor relationship rests with you. The successful performance of your job requires that your relationship with students accomplish three things. It must maintain discipline and respect for you the instructor; these are necessary for any leader. Students must obey your directions, especially in the aircraft. They must follow your example and strive to carry out your instructions and suggestions for improvement.

The desire to help your student solve a problem is an important part of student-instructor relationships. An obvious willingness to help students with problems will do more than anything else to hold respect, loyalty, and cooperation. Counselling often solves the student's problems. It is a continual process; informal counselling takes place any time an attempt is made to help a student with flying training problems.

You want your teaching to produce good pilots who are able to use the initiative, judgement and skill that you have nurtured in them throughout the course. If students are to respect rather than fear or resent your authority, you must be fair, firm, and friendly. Achieve the following and you will be considered to have some of the qualities of a good instructor.

- Inspire your students to set goals that will stand them in good stead in aviation. Your exemplary conduct and high ideals will help in this goal.
- Be decisive. Weigh all the factors necessary to make decisions and then act with conviction.
- Be interested in your students and let them know by being familiar with their backgrounds, problems, and achievements.
- Respect their rights and when correcting mistakes, do so in a straightforward manner, never using sarcasm as a correction method.
- Acknowledge your mistakes. The admission that "You were right and I was wrong" does much to develop morale. If you do not know the answers to questions, say so, find the answers, and tell the student later.
- Be enthusiastic. Instructor enthusiasm is reflected in student learning.
- Encourage student initiative, self-reliance, ideas, and suggestions. By doing so, you teach your students to reason for themselves instead of driving them to rigid conformity. However, stress that there are certain boundaries that they must not overstep.
- Be ready to act with great understanding, patience, and enthusiasm, while providing leadership and guidance to young students also beyond the strict confines of the flight lessons.
- Be impartial and fair – never show favouritism.
- Never bluff – much of your subsequent instruction may be distrusted.
- Use humour. Appropriate humour creates goodwill and can be used to teach difficult subject material. But do not become so humorous that the business at hand becomes secondary.
- If you doubt a student's progress or motivation, arrange for an independent check. Perhaps some modification to your teaching approach may be needed. In extreme cases a change of instructor may be best; most club situations will permit this.
- Be aware that the use of cockpit communication demands suitable phrasing, speech level, clarity, and discipline.
- Teach your students to have mastery over the aircraft; to fly with verve and spirit to the limit of the aircraft's flight envelope; to know what they can and cannot do; but draw a very definite distinction between intelligent confidence and foolhardiness.
- Plan all solo lessons. Give your student thorough pre-flight and post-flight briefings, and make sure that they clearly understand the requirements and aims of all exercises during their solo flights. Thorough debriefings allow you to find out about difficulties that otherwise you may not hear about. To your student, failure to debrief may appear to imply a lack of importance of the exercise or a lack of interest on your part.
- If possible be present when your students are being debriefed after check rides or tests conducted by other instructors. You may find out points that you may have missed while flying with your student, and you should get useful details from this debriefing.
- Maintain a professional image.

ANALYSIS of STUDENT PERFORMANCE

Analysis of student performance is necessary at all levels of flying training. The ability to debrief effectively does more to separate the successful instructor from the poor one than does above average soaring and flying ability. You must realize that the sole purpose of this analysis is to improve your student's performance. A valid critique contains three essential elements:

- strengths,
- weaknesses, and
- suggestions for improvement.

Without each of these elements analysis is ineffective and will not accomplish its purpose. Strengths are analyzed to give a feeling of satisfaction and to show that you recognize what your student can do well. If you are unable to identify strengths to students, it will be difficult for them to believe that your identification of weaknesses is accurate. Positive reinforcement of his or her strengths will frequently do more for a student than any number of your suggestions for improvement.

It should be readily apparent why we must analyze weaknesses. This leads into the third element: specific suggestions for improvement. When you are critiquing a student, consider the following: If you are unable to suggest a remedy for overcoming a weakness, your student does not have that weakness. Positive suggestions are imperative if the student is to improve; however, you should limit your critique to the identification of a maximum of three weaknesses with their suggested remedies. Attempting to correct all the weaknesses that a student may have at one time may produce overload, particularly when flying. In this case the student may be unable to correct any weakness. During flying lessons, therefore, you should correct a single, major weakness first before considering the next. Improvement in a student's performance takes time – an expert will not appear overnight. More will be learned if a definite improvement in performance is experienced each time the student takes part in a lesson.

Attempt to follow the following recommended format when analyzing student performance:

When in the air;

- Identify major strengths,
- Pin-point a major weakness, and then
- Suggest a remedy to correct that major weakness.

On the ground;

- Identify major strengths,
- Identify a maximum of three major weaknesses, then
- Suggest remedies to correct these major weaknesses.

One way in which to think of a major weakness is to ask the question: "What item, if corrected now, would result in the correction of the greatest number of other faults?" As your student's performance improves, the weaknesses that originally were considered minor ones now become the only weaknesses. All weaknesses should be dealt with, but in order – deal with the most important ones first.

PERFORMANCE RATING

Effective analysis of student performance

This subject is a difficult one at first sight because there appear to be many factors that the instructor needs to take into account. However, to be fair to all students and to the ethics of instructing, all instructors should know how best to evaluate their students against a standard that is the same for all students.

There are some basic rules. Always strive for maximum objectivity to provide effective analysis of student performance. Never allow personal bias to affect the grading or analysis of any flight. Be objective when evaluating student personality and flying techniques. At times personality conflicts occur, but as a soaring instructor, you should keep these to a minimum, as would any professional instructor. In the area of flying technique, try not to become dogmatic and accept only one way to perform a maneuver; keep in mind there are usually several ways to accomplish the same maneuver, or sequence, safely and correctly.

Be consistent in your analysis. Always attach the same importance to an error, provided the circumstances remain the same. Without a consistent set of rules, you will be considered arbitrary or accused of playing favourites.

Be honest when critiquing; it is the best policy. The situation, in which you may attempt to motivate a weak student by giving better grades than deserved, jeopardizes the effectiveness of your instruction. Students want to know exactly where they stand and be given specific suggestions for improvement. This

is the sole purpose of analysis of student performance and emphasis must be placed on this function.

Rating methods – Relative and Absolute

The two most common types of rating used by flying instructors are the relative and the absolute. When the relative method is used each student is rated against others in his or her group. The student is rated against the so-called average of all students who have been in the situation and have received the same amount of training. The assessor simply says that a certain performance is below average, average or above average for the rated person's amount of training. When using the relative method it is the stage of training which determines the student's performance rating.

The second method of rating is the absolute method. In this, unlike relative rating, the performance of one person is never compared with the performance of another person. The only thing that is considered is the national (or club) accepted standard against which the performance is to be rated. It is the individual's ability when compared to how the item or maneuver should be properly performed *by the book*. When using an absolute method of rating, neither the amount of training nor the student's *expected* performance of the item would affect the rating. The only consideration is the *actual* standard or quality of performance.

COMMON RATING ERRORS

The following errors have been found to be common among people who are involved with rating others' performance.

Error of central tendency Many instructors hesitate to give either extremely high or extremely low ratings. They tend to group their ratings close to the centre of the scale. This error occurs most commonly in inexperienced raters. Because they lack confidence in their ability to rate, they assign *average* grades to all students as safe grades. Even with experienced instructors this error may appear in ratings of abilities that are difficult to identify, such as flying ability or decision-making. There are enough items in the pilot training record, PTR, to make it improbable that a student would fall in the central rating block on all maneuvers. Also it is improbable that any large number of students would fall in the *average* column. If an error of central tendency is taking place, true ability is not reflected in the student's PTR; therefore the rating is of little value.

Error of standards Some instructors tend to overrate or underrate everyone as compared with the ratings of most other instructors. They do this because of the difference in their standards. In flying training, the standards are in the mind of each rater and it is possible to have as many standards as there are raters. Experienced instructors are usually able to agree closely on ratings. This agreement indicates that their standards are similar. Inexperienced instructors agree less frequently, but generally will come closer as they gain experience. Make every effort to get more experience and standardize the judgement of inexperienced raters. If new instructors do not standardize their judgement through increased experience, there is cause for concern, in which case analyse some other factors to find the cause of these differences.

Logical error An instructor who has a logical error allows the performance on one item to influence the rating of another item that he associates with the first by a logical connection. For example, he allows his rating of the circuit pattern to influence the rating for landing, instead of grading each item separately. Individual items within a maneuver can be rated incorrectly through this type of logical carry-over. Try to remain alert and grade each maneuver separately and objectively.

Error of familiarity When an instructor rides with students every weekend for several months, he can lose some of the grading objectivity which he had during the first few flights. He becomes accustomed to some of the student's weaknesses or eccentricities and does not see them as errors because he is so familiar with them. Instructing for such a long period of time that the instructor begins to overlook errors that are common to most students can also cause this type of error. Anything that can be done to step back and get a new perspective will help avoid this error.

Error of halo Many instructors tend to assign ratings after being influenced by their general impression of the individual. Halo error is so called because the grades cluster like a halo around the instructor's general impression. We may like or dislike the student because of something he or she says or does or because of his personality or background and we let this feeling influence our rating pro and con. The student may stand out from the main group of students, and speak well in a social environment, but these qualities have nothing to do with flying the aircraft.

Error of narrow criterion Another error common to the new instructor is that of using the three students he has at the moment as though they

represented the whole range of proficiency. Instead of using all students as the criterion, he uses only the three students he now has and rates each student against the others. If he happens to have three superior students, he begins grading one down because that student cannot perform quite as well as the others. On the other hand, he might have three weak students, yet the one who does the best of the group begins to get above average grades.

Error of delayed grading If the rating is separated long enough from the lesson for the performance to be largely forgotten, then the rating will likely be erroneous.

If this happens the rater will often go to the central type rating for lack of information to justify extreme ratings. Another possibility is the flight will stand out in the rater's mind and the forgotten material will be rated according to this lingering impression.

Accurate rating is necessary in any training process if the process is to be validated and quality control maintained. This accuracy is difficult to achieve because numerous individuals of varying experience are involved. However, as an instructor, you must be aware of these error tendencies, and you should do your utmost to ensure that these errors do not occur in your ratings.

CHAPTER A5
INSTRUCTING TECHNIQUES

The DEMONSTRATION – PERFORMANCE METHOD of TEACHING

Introduction

A student-instructor once asked, "If I had time to learn only one method of teaching, which one should I learn?" The answer is the *Demonstration–Performance* method, because the primary concern of a flying instructor is training. Training is largely devoted to the development of mental and mechanical or handling skills, procedures, and techniques. Many skills are best taught by using this method. The method is not new. It may be one of the oldest known methods of instruction. One can imagine the caveman demonstrating to a son the procedure for making a club, and then have the child make one. This method can be broken down into five steps:

1. explanation
2. demonstration
3. student performance
4. instructor supervision, and
5. evaluation

Explanation and demonstration

The explanation and demonstration may be done with the explanation given first followed by a demonstration, or vice versa, or even at the same time. The skill or knowledge you are required to teach will determine the best approach. Consider the following: You are teaching a student how to plan and fly the circuit to the landing. Your options are to:

- Give an explanation of the maneuver with the background and theory, etc., and then demonstrate it, with or without in-flight explanations;
- Demonstrate the whole maneuver or sequence, *simultaneously* giving explanations of what you are doing and why; or
- Complete the circuit and landing with no explanations, and then give a detailed explanation of what you have done, with the background and theory, after the flight.

In teaching flying it is the recommended and accepted practice that *preparatory ground instruction* precedes the flying demonstrations. This ground instruction should not be omitted as it forms the basis for all the handling and decision-making skills that the student needs to develop to become a safe pilot. This is discussed more on page 49.

Your descriptions during demonstrations should be as brief as possible, without omitting any essential point. When describing the aircraft control effects to a new student for example, the words "Move the stick to the left (or right) until the desired angle of bank is reached" are more desirable than the simpler aircraft attitude description of "roll to a banked attitude" which you can use later. Of course the student should have a thorough understanding of the different flying attitudes and of how to produce a *movement* of the glider to make it e.g. bank or pitch. As the student advances and becomes more familiar with the effects of controls, it should become less necessary to refer to the movements of the controls themselves. Now you should be asking the student for a new speed, or to roll into a turn, and so on.

A suggested method for a flying demonstration in a glider, of a circuit and landing, would be to first give a perfect demonstration (to set the standard for the future performance) simultaneously explaining the major points. However if you were demonstrating a spin, it would be difficult to talk during the demonstration, since you want it to be as perfect as possible and it happens very quickly. In a spin the descriptions have to be very succinct and to the point! This shows that you will have to tailor, carefully, your explanation and demonstration to the upcoming maneuver, exercise, or sequence.

There is another advantage of giving a perfect demonstration. The students will be able to form a clearer mental picture when studying the student manual, *SOAR and Learn to Fly Gliders*, because they have seen the actual maneuver.

When demonstrating, include important parts of the explanation. Usually asking questions about what you are doing or should do, will give the student an opportunity to prove they know the procedure, although they have not yet flown it. After completing the circuit, approach and landing, immediately clear up any misunderstandings the student may have, and ask questions yourself, to determine how well the student has learned the lesson.

When demonstrating a fast maneuver such as a spin entry and recovery, review what you will be doing, noting what you want the student to notice, then demonstrate it. You will normally not have time for a full explanation of every step, but a limited description will be helpful. Leave periods of silence for the student to observe what is going on without having to listen to you at the same time. After the maneuver, go over its main points first, and ask the

student questions about it. This will allow you to assess how well they understood the whole procedure.

The next step is to instruct the student to perform the maneuver or procedure. If the student asks for a second demonstration, it may be because they are nervous. Tell him that you will be following through very closely, that you will talk them through it as necessary, so that they should have no concerns. If at any time they ask you to take over control, do so at once and confirm that you have control. Don't hesitate to take over control yourself at any time if safety is threatened. In fact you should take over control earlier than later; there have been too many accidents when the instructor failed to take over control in time.

Student performance and instructor supervision

After demonstrating a maneuver, with descriptions, have the student try it, to see how much he has absorbed, and to let the student get the most out of it by actually doing it. While the student is doing the flying and trying the maneuver, do not rush or introduce additional new directions or instructions. Afterwards, constructively criticize their flying. This is done first by discussing his good points, then the points that need correction and further practice.

Student performance and instructor supervision always occur concurrently during the initial stages of training. A student should not be allowed to make a major error at this time. Your monitoring of the student's flying and therefore your supervision must be close enough to detect the start of an error and you must stop the student immediately, to correct the fault.

Allow the student to perform the task in small segments, with you providing close supervision of each segment. If the student makes an error, correct it, taking over control if necessary to place the glider in the correct attitude (speed, or angle of bank, etc.) then hand over control to the student and continue with the student practice. On subsequent practices, depending on the degree of success of the previous attempt, add more items for the student to carry out. Continue the process until you feel the student can fly the complete maneuver alone. The aim of your teaching the maneuver is to get the student to perform it eventually with no assistance from you. At this point, you will be able to evaluate their performance, or ask a different instructor to evaluate you student's performance and provide you with their assessment.

Evaluation

The evaluation portion of the demonstration–performance method is where the student has the opportunity to prove that he can do the maneuver without assistance.

For the spin exercise tell the student that on this flight he is expected to carry out the entire process including decision-making using the SOAR technique, and the cockpit checks which include airmanship, which itself includes lookout, without assistance from you.

While the student is performing this maneuvre you must refrain from making any comments. Offer no assistance whatsoever, not even grunts. However, observe the entire process very carefully, so that you can analyze any errors that the student makes, and then debrief accordingly.

You should interrupt the student's performance if safety becomes a factor (lookout is a very important factor, speed and bank angle at the entry to a spin, speed and pull-up during the recovery, and there are more).

Success or failure during the evaluation stage of the lesson will determine whether you carry on with the next exercise or repeat the lesson.

Rules for using the Demonstration–Performance Method

Give a perfect demonstration or if not practical, show the finished product. An example is when teaching map preparation, show a map with a cross-country trip all marked out. This will show the students the standard expected in preparing their own maps.

Give a step-by-step explanation of the required task; use reasons, examples and comparisons to make the explanation clear. Then ask the student to imitate a step of the skill while you provide close supervision, such as practicing the entry to a steep turn until correctly done before going on to the next step of staying in the turn. Continue until the student has imitated each step. And provide time for the student to practice, with assistance as necessary.

Ensure that the amount of time you allow for student practice equals or exceeds the amount of time for the demonstration, explanation, and student performance under very close supervision. Students should take as much time or more to practice, compared to the time you took to teach.

An overall rule while you are demonstrating and explaining is your student must listen and observe;

while your student is performing, you listen and observe. **Never** ask the student to perform while you are explaining. Complete the exercise with an evaluation (final check) in which the student has the opportunity to prove what he can do. **Never** just explain and demonstrate a skill or procedure for students. **Always** ask the students to perform the skill to make sure it is done properly. Go over it again, until the skill is done correctly.

DEVELOPMENTAL TEACHING, or TEACHING by QUESTIONING

Developmental teaching is a student-centred method of teaching – you work with a student to develop solutions to problems. The instructor or teacher asks questions that require the student to use his knowledge to develop the answer. This may be to develop the next step in a procedure, to logically apply a principle, or to work out the final solution to a problem. Each student's perception and comprehension of the task govern his rate of progress in developing more complex ideas or solutions. Questions should be asked to review previously learned material, which will be used to develop the next step. Developmental teaching begins when students are asked to reason, to make suggestions and develop solutions for the next lesson or task.

Good teachers have used developmental teaching for centuries. Because of the requirement for every student to participate, developmental teaching is effective not only with small groups but with individual students. It can be used at any level of student knowledge provided you know or can determine the appropriate level from which to proceed. Depending on the subject, some lessons can be entirely *developmental*. More frequently, however, there will be a combination of teaching by explanation, where it may be more efficient to explain certain material, and developmental teaching where certain areas of the task can be reasoned with and developed by your students. In almost every lesson, some developmental teaching is appropriate and desirable.

The main advantage of developmental teaching is that it promotes efficient student learning because it satisfies all the basic requirements of learning. Because the students participate in meaningful activity, they are forced to think about the material being learned, as questions are answered verbally. Consequently interest is maintained, a sense of accomplishment is gained and effective learning takes place. You receive constant feedback and frequent confirmation of a student's progress.

Careful planning for developmental teaching is critical because you must formulate appropriate questions, which demand reasoning on the part of your students. The student will have to draw on his previously learned knowledge to work out the answers. You in your turn must be aware of the level of that knowledge. You will then be able to formulate the right questions to draw the information out of the student. Use standard questioning techniques, and handle student responses with tact and discretion. In addition to being a master of the subject material, you must be flexible in your approach. You must permit adequate discussion, yet exercise sufficient control to move towards the lesson objectives. As the lesson progresses, frequently summarize to consolidate the material.

Novice instructors are frequently apprehensive about trying developmental teaching. Experience has shown that students consistently surprise instructors if given the chance to participate actively in the learning process. The disadvantage of lecturing during preparatory instruction is that students are frequently told material that they already know, or that they reasonably can be expected to deduce on their own. The best teaching occurs when students are led to a point from which they can systematically direct their own reasoning to derive the solution to a task or problem. The secret of effective learning is to keep students mentally active. With developmental teaching, students are forced to recall previously learned facts and skills, to think and to put it together to come up with a solution or answer. In this way learning is enhanced.

QUESTIONING

Introduction

When presenting a lesson, you have many techniques and aids at your disposal. Questioning can be used to stimulate learning; in fact questions can be applied effectively to satisfy all seven laws of learning or learning factors.

It is difficult to ask effective questions; the technique is difficult and is normally one of the most neglected areas of instruction. Good questioning requires the ability to think quickly and easily while facing a class or student, to shift and change as thoughts occur and ideas develop, and to phrase questions clearly and simply. You must always remember the technique to follow when handling student questions and answers.

Purpose of questions

First, questions can be used to **promote mental activity**. You can state a fact and provide visual or

verbal support to back it up but the surest way for students to remember is working it out for themselves. Whenever you can use a question to make your students think and make sense of the facts, you should take advantage of the situation. For example, as a student works towards an objective, he often needs to recall pertinent knowledge and skills learned previously. A well-worded verbal question could guide the student's search for the required information, thus promoting mental activity.

A second purpose of questioning is to **arouse and maintain student interest**. Merely making a statement will often elicit a "so what" response, but asking questions makes students feel they are participating and contributing to the lesson, thereby arousing interest. You can maintain this interest throughout a lesson by the continuous development of facts and ideas. However, remember that a typical glider training flight can be short, so a continuous barrage of questions will be counterproductive. It is best to ask questions at suitable times, e.g. when the student is not concentrating on something new or when his pilot workload is low. Also remember – telling is *not* teaching.

Another purpose of questioning is to **guide thought**. By using questions you can lead students to think through to a logical solution. Questions can direct students' thinking through a definite sequence or towards particular objectives. During discussions you can use questions to guide your student's thoughts back to the objective if they seem to be wandering. As an instructor gaining experience, try to eventually guide students through an entire lesson by asking the right questions at the right times.

A final purpose of questioning is to **evaluate learning** for the benefit of both instructor and student. Questioning may be used after each stage of a lesson to ensure that the students are following you, before you proceed to the next stage. At the end of the lesson, questions confirm that students have attained the objectives for that particular lesson.

There are drawbacks to using questions to evaluate learning when teaching a class. Only random sampling of the class is obtained, because only one student answers each question. Overcome this by first asking the question, then selecting a student by name to answer it. If that student has difficulty, ask another student by name. In this way, you will make all students formulate an answer in their minds before you name the student for his answer. With a lone student, as in flying training, the above problem does not occur.

Desired qualities of good questions

If questioning is to serve its purpose, you must remember the following desirable qualities of good questions when composing or preparing to use them:

Questions must be EASILY UNDERSTOOD. They should be stated in simple straightforward language, should be brief, yet complete enough that students have no doubts about the question.

Ensure they are COMPOSED OF COMMON WORDS. Questions should be designed to measure knowledge of a subject, not use of language. Long words may give you a chance to display your vocabulary, but adds nothing to instruction. Remember, if students do not know the meaning of the words they will not be able to answer the question. Always keep your vocabulary within the grasp of your student.

Make the questions THOUGHT PROVOKING. Questions should not be so easy that the answer is obvious to all students. Students should be challenged to apply their knowledge. You should avoid using questions where your student has a 50/50 chance of being correct. Examples of these are the *yes/no* and *true/false* type, unless these questions immediately are followed by a *why* or *how* type question.

Restrict the questions to the MAJOR TEACHING POINTS OF THE LESSON. Questions must be built around these major points. Ask them at the proper time and place so that the major points are emphasized.

Students may be confused if questions are asked in a haphazard fashion. The intended purpose of the question may be lost. To ensure mental participation by all students, use the following steps:

ASK THE QUESTION State the question, applying the qualities of a good question. To do this you must have the question in mind before asking it. If questions are being used to evaluate learning or to confirm attainment of objectives, you should prepare them beforehand and write them in your lesson plan. It is often a good idea for beginning instructors to write out all questions until they are accustomed to thinking on their feet.

PAUSE Pause for 1 to 5 seconds after posing the question. You should pause to allow all students to think it over and formulate an answer (the time needed depending on the complexity of the question). During the pause you

should look over the class, being careful not to *telegraph* whom you are going to call upon to provide the answer.

NAME THE STUDENT Fit the student to the complexity of the question; consider giving the more difficult questions to the more advanced students. However, you have to ensure that everyone in the class is called upon to provide an answer with reasonable frequency. The most practical approach is to call upon students in a random order, and then indicate by a check mark on a seating plan card each time a student is asked a question. To get a broader sampling of learning and to maintain interest, you should periodically call upon other class members to confirm the answer made by the first student asked.

LISTEN TO THE ANSWER Always listen to the answer. An inexperienced instructor, after naming a student to answer a question, may begin to think about phrasing the next question. He may not be listening to the answer and might say "Right" to an incorrect answer. This could lead to student confusion.

CONFIRM THE CORRECT RESPONSE If the answer is correct, immediately acknowledge it is so. Other answers may have been evaluated carefully, but eventually no doubt must remain about the correct answer.

Handling student answers

The following techniques are useful when handling student answers, but above all always confirm correct answers when they are given.

DISCOURAGE GROUP ANSWERS When students answer as a group, it is difficult to determine who supplied correct or incorrect answers, thereby leading to student confusion. When teaching a new class, establish early that you do not want group answers but will call upon a student by name to answer. You may, however, want to use group answers at times to increase class enthusiasm.

DO NOT MAKE A HABIT OF REPEATING

ANSWERS This can get monotonous to students. If the answer given is not correct or needs clarification, pass the question to another student. If the students do not answer loudly enough for all the class to hear, ask them to speak more loudly and repeat the answer.

GIVE CREDIT FOR GOOD ANSWERS This is especially important for the weak or shy student. When using questions to develop points during a class, do not reject answers that may not be exactly what you are after, though they may relate to the subject. Give praise and try using a newly-phrased question to bring out your point. If you receive a completely incorrect answer, don't embarrass your student by saying "Wrong". Diplomatically state that the answer is not what you wanted and ask a supplemental question or refer the question to another student.

Handling student questions

Never discourage a genuine question referring to the lesson. There is an old saying, *For every student who asks a question there are six others who wanted to ask it.* Usually students ask questions because you have not given a clear explanation of the point or fact being queried. Some techniques to use when questioning students are:

ENCOURAGE QUESTIONS Let the class know early in the lesson that you encourage questions at any time the students are not clear on points being taught. If it will not interfere with the presentation of the lesson, it is usually best to allow questions immediately any point arises rather than waiting for a break in the lesson later. If you wait for questions, the point of concern may have slipped their mind.

PASS QUESTIONS TO OTHER STUDENTS Occasionally pass a student question to other members of the class; this will create interest and get class participation. Do not over-use this technique as the students may get the impression that you don't know the answer and are fishing for help. Above all, never use this technique for any question to which you do not know the answer.

REJECT QUESTIONS UNRELATED TO THE LESSON Quite often students will ask a question totally unrelated to the lesson. Politely reject the question, being careful not to offend the student. Suggest it is a question you would prefer to discuss after class.

DO NOT BLUFF No matter how knowledgeable you are of your subject, there will be times you will be asked a legitimate question and do not have the answer. If you do not know the answer, say so and do not bluff. Tell the class you will find the answer and ensure you do, then give the answer to the individual who asked as

well as the rest of the class.

ENSURE ALL THE CLASS HEARS THE QUESTION When a question is asked, check that all the class has heard it. When you answer the question, answer to the class and not only to the individual asking it. If a long detailed answer is necessary, the remainder of the class may lose interest and *tune out*; don't get into a conversation with one student.

LESSON PLANS – GENERAL PREREQUISITES

The following techniques, if applied in a conscientious manner, will assist you to give effective instruction. Because most flight instructors also teach some of the ground school courses, much of what is developed here applies also to classroom instruction. The techniques of lesson planning, instructing, questioning, etc., are equally applicable for providing instruction to one or two students for pre-flight briefings, air instruction and debriefings or to a classroom group. To present a lesson in a professional manner, you must prepare in advance. The following steps have been well proven.

Outline for a lesson plan

A lesson plan acts as a guide and keeps you on track during your presentations. It also makes sure important points are covered (not neglected because of a memory lapse). Include the following:

- Headings of main points,
- Sufficient notes to jog the memory on talking points,
- Specific questions and answers to confirm student learning,
- A visual aids plan and instructions (including a whiteboard or computer plan),
- A well thought out opening and closing statement,
- Estimates of the amount of time to be spent on each major idea or item,
- Any other point that you feel will help to get the lesson across.

Avoid writing lecture material out in full detail because this promotes reading the material while in front of the class. Avoid also single-space format as this does not allow for revising notes next time the lesson is to be given. Do not write in longhand unless you are able to read your notes at a distance of three feet; this makes you appear not to know your material because of having to look closely at your lesson plan rather than just glancing at it to jog your memory.

Before presenting any lessons to students you should be familiar with the flying course curriculum as well as the ground school course curriculum and with the Study Guide for the GLIDE exam, produced by Transport Canada. The syllabus for learning to fly gliders contained later in Part B of this manual and in the student's manual *SOAR and Learn to Fly Gliders* also contains some materials that will be used in the ground school course. You should be aware of the scope of the syllabus and its general directives.

Prepare the teaching area before the lesson

The classroom must be arranged for best student learning. If students cannot see all the aids, they may miss a point. Lesson preparation appears more professional if no time is wasted organizing aids or rearranging seating.

Prepare and check training devices and aids before the lesson

Preparation avoids embarrassment should an item not work, or if any chart, or slide were to be shown in the wrong order. Always ensure you have spare bulbs for any projector.

Prepare your students for learning

If your students are to learn, they must be physically, mentally and emotionally ready to do so. To help them get ready at the start of the lesson, tell them specifically what is required of them during the lesson and what they will be able to do at the end of the lesson.

Tell the students why they should take part in the lesson and how the new skill or knowledge will benefit them. Give as many advantages as you possibly can for having students learn, as they may not agree with some of your reasons. Give them an overall picture of the lesson, and show them how it fits into the entire course. Attempt to relate the new material to some past and/or future experience of your students.

The length of time required for preparing students to learn depends primarily on their background knowledge and the complexity of the material. As a general guide, the amount of time needed is approximately ten percent of the whole lesson time.

Start the presentation of new material at the Student's level of understanding

First determine the current level of understanding of the subject by the students. Conduct what is called a Threshold Knowledge Test (TKT) to determine what they know, or do not know. A TKT is simply a form of written or verbal examination of sufficient detail to tell you the actual level of knowledge of the students. If, on the other hand, you begin your presentation at a level where they do not understand, there will be confusion and time wasted. Little or no learning will take place.

During each lesson and during the whole course of instruction, conduct periodic reviews. A review of previous lessons should be done before starting each lesson. The review should consist of a series of questions. If your students answer correctly, you may continue but if the students show lack of knowledge, first re-teach.

Check with other instructors for the strengths and weaknesses of your students, and arrange your material to fit the students' needs.

Proceed at the rate of student comprehension

If you get ahead of your students during the presentations, you are in the same position as if you started above their level. How would you make sure that you are proceeding at the required rate?

First arrange your material in stages. Stop at the end of each stage and ask specific questions on the material you have just covered. If your students answer correctly, continue with the lesson. If they do not, re-teach the points they do not understand. The length of time for each stage depends on the complexity of the material being presented, *but a good general rule is 8-12 minutes.* Write out in full a number of well thought-out questions. Put these questions on your lesson plan and make sure they are asked during the lesson presentation. The feedback you get from these answers will determine whether or not your students understand.

Observe your students closely for facial expressions, which could indicate that they do not understand a particular point. If students say they understand, ask them a question to make sure. And encourage students to ask questions on points that they do not fully understand.

Before going on to more complex parts, provide lots of practice time for developing the basic skills.

Identify and emphasize major points for the students

During any presentation there is a mixture of *need-to-know* material that is extremely important, and *nice-to-know* material, which may or may not have to be remembered for a long period of time. How do we divide the parts of the lesson to most effectively get these points across?

There are several ways in which you can identify and emphasize points for your students. First prepare a visual aid of the main points; approximately 75% of learning comes from vision, onmly about 13% from hearing. The visual aid may be a heading on a whiteboard, chart, or slide. However it is still useful to use a variety of training aids to appeal to several senses (touch, feel, etc).

It is useful for the students to write the main points down in their notebooks; advise them to do so. As an alternative you could provide notes which include the main points. Tell the students when making an important point: "This point is very important, so remember it." By writing down ideas, they are using another sense; hence learning may be reinforced.

Prepare an orientation board (chalkboard or sheet of paper), that identifies the major points for a lesson. Students can refer to this board throughout the lesson, and this helps guide their thoughts to a specific area.

To add emphasis while stating an important point, raise the volume of your voice and reduce the rate of delivery.

Safety should also be emphasized up front, in addition to the main points. Include mention of points that are easily forgotten or difficult to remember.

Provide emphasis according to relative importance, the most important things getting a greater amount of emphasis. Emphasize points by giving verbal examples (real or imaginary); by comparisons (similarity or difference to known facts); and perhaps most important, by giving reasons for each point you make. Students tend to remember better if they understand the reasons behind each point they must learn.

Repeat the point frequently, by using summaries, or ask your students to repeat the point by answering your questions. Conduct periodic reviews of the need-to-know material but do not emphasize nice-to-know material.

And finally, ask the students to complete a home assignment of the important points of a lesson.

Give clear explanations and demonstrations

If students do not understand an explanation, you will have to re-teach by re-phrasing, or by going over the material a second time. The same applies to a sloppy or inaccurate demonstration.

Suggestions for ensuring that your explanations and demonstrations are clear include association. Start verbal explanations by referring to something already known by your students. Association of ideas makes it easier to follow your explanation. Use words and phrases that are commonly used. Avoid showing off your command of the English language by using long-winded phrases and long words. Keep it simple!

Attempt to reduce complex material and ideas to a simple, easy-to-understand form. The best way to do this is to start with something your students know about and build on that knowledge in small steps. If you are required to demonstrate something, make sure you can do it correctly before you show the students. Make sure all students can see even the smallest points of a demonstration, and if necessary, gather them around you.

If you are doing a simultaneous demonstration and explanation, break the demonstration down into small steps and explain each step thoroughly giving reasons, examples and comparisons.

Visual Aids – use them effectively

About 75% of all learning comes through sight. *A picture is worth a thousand words*. Visual and graphic artists or personnel associated with the production of visual aids can provide very good and effective slides, charts, and similar aids. Other instructors can often give the spark to an idea, and commercial displays in newspapers, magazines, television, and stores can be scanned for ideas. Finally, your own imagination, if you give it full rein, is an excellent source of ideas.

Types of visual support equipment include mock-ups, charts, diagrams, pictures or models, films and videos or CDs/DVDs, and sometimes people. When using visual aids plan the lesson first, and then select the type of visual support that helps students learn the material. **Do not** select a visual aid and then try to build a lesson around it. Just because the aid looks impressive does not mean it will fill the need of helping your student learn the must-know information.

Plan to use a visual display of all major points that are covered during your lesson. Simple wording in a slide is usually better than verbally repeating the main points again and again. Make your aids simple and clear. Eliminate all unnecessary data. Avoid the tendency to produce ornate, detailed artwork. Make aids that can be seen by all the students. Before you use it, put the aid in the position in which it is to be used. Go to the position of the student farthest away, and ensure that you can see it clearly. Adjust the lighting if it will help the students see the screen when using a projector, for example, but do not place the room in darkness. Students need good lighting to see you and to write notes. Think of the tendency also to fall asleep during evening lectures. You will need to constantly maintain student interest!

Use a variety of colour to add interest, but make sure you keep associated parts or ideas or a repeating idea in the same colour. In this way you help your students to follow your presentation more easily. When an aid is not in use, cover it up or remove it from sight. It can act as a distraction for your students if it is there but is not being used.

If the aid includes written words, make sure you do a spell check for correct spelling and grammar. You would be surprised how many times misspelled words are displayed for students.

If possible, stand well away from the aid and use a pointer, so that you do not obstruct the view of any student. If using charts, it is sometimes advisable to have two copies, one labelled and one unlabelled. The unlabelled one can be used later to test student knowledge. Alternatively, a duplicate work sheet of the chart can be given to each student to fill in or label.

Ask yourself the question: Will the aid help the student learn better, easier, or faster? Use their sense of sight *to show them as well as to tell them*.

Your Voice – vary the rate, volume and pitch when delivering the lesson

Any form of variety adds to student interest. Speaking in a monotone will generally put students to sleep, or at least allow their minds to wander off the subject. A good idea is to speak quickly, but distinctly while presenting *nice-to-know* material. This produces the effect of observable enthusiasm, and enthusiasm is contagious. But speak slowly when identifying *must-know* information. This allows students to separate the *need-to-know* from the *nice-to-know* material, and in most cases adds emphasis to the points being made.

Adjust the volume of your voice to the conditions under which you are instructing. If there is back-

ground noise you must raise your voice so that all the students can hear you. In a power 'plane and some gliders, this is vital. Generally you will have very little control over the pitch of your voice, but adjusting the volume and varying the rate of delivery will often help to vary the pitch to some extent. A low-pitched voice tends to command more authority than a high-pitched voice, so try modulating it if it tends to be high-pitched.

Feedback – getting feedback from students by looking at them

Eye contact gives students the feeling that you are interested in them and allows you to determine whether or not they understand what you are presenting. This is a little difficult if impossible to do in most gliders! However, in a classroom look directly at students, but do not stare at any particular individual for too long at a time. If a student averts the eyes it means you have stared too long and possibly caused some embarrassment, so look at someone else or out the window!

Make your eye contact impartial. Do not favour any individual student or group of students; include them all in your presentations.

Provide for maximum student activity during the lesson

Students learn more easily if they are actively engaged in the learning process. Remember that when learning the theory of a subject, the students' practice of that theory is usually by answering questions. Ensure that you ask questions throughout the presentation. You should use the questioning techniques detailed in the earlier section on

Questioning. Some rules to follow are:

Distribute your questions evenly among all students, to avoid having only a few students answer all the questions. And make your questions thought-provoking and challenging. Avoid questions that require a simple YES or NO answer, unless you immediately follow up with a "why?" or "how?"

Always have enough information in the stem of your question to guide the student's thoughts toward a particular area. Avoid general or ambiguous questions, such as "What goes up the cylinder of an engine?" You may not get the desired answer.

Meaningful activity while learning a skill is normally a combination of answering questions and practicing the various steps of the skill. Involve the students in the practice as soon as possible after the start of the lesson. If possible, build into the first part of the lesson a *hands-on* opportunity for your students. This increases their interest, and in most cases will give them a positive desire to learn more.

Always supervise student practice very closely; do not allow them to make mistakes from which they could begin to learn bad habits. If you do, it means you will have to re-teach them. The phrase *practice makes perfect* is only true if the person practicing receives close guidance and supervision, and

Remember, only CORRECT practice makes PERFECT!

When students are able to perform a task with a reasonable degree of proficiency, introduce some competition (speed or ability), or introduce a variation of the skill; but after they have almost mastered the basic skill.

LESSON PLANS – FLYING EXERCISES

Introduction

Lesson Plans are an essential part of teaching flying if the instruction is to be effective in terms of quality and use of time. Remember that time is often very limited in a glider flight under no-lift conditions. The following sections are written specifically to cover preparation of lesson plans for the flying portion of the curriculum. The techniques of instructing, questioning, lesson planning, etc., are applicable for providing instruction to one or two students for pre-flight briefings, air instruction and debriefings, however they are equally applicable when lecturing to a group in a classroom.

Tips to instructors and additional notes

The descriptions of each lesson given in Part B of this manual contain advice to instructors. These should be studied before each pre-flight briefing. They are the result of years of studying instructing techniques and fault analysis, and will they prevent an instructor from falling into certain avoidable pitfalls. Also, in many cases they will provide guidance for the expected normal student progress to meet certain standards, and will amplify teaching techniques.

The first section in the Lesson Plan gives tips to instructors. These should be studied before each briefing. They are the result of years of instructional technique and fault analysis and not only will they prevent an instructor from falling into certain avoidable pitfalls, but in many cases will provide guidance to normal student progress to meet certain standards, and will amplify teaching techniques. The second section provides a space for Additional

Notes. Write these down your observations and ideas whenever you get them.

Training aids

The training aids that are suggested for a particular lesson are given in this section. These are in addition to any basic training aids that are standard for any classroom briefing, such as a note pad, flip chart or whiteboard, erasers, markers, etc., and a glider model.

The most important prerequisite to the lesson, however, is to ensure that the student is ready to learn and therefore is receptive. To be receptive the student must be at ease. The necessary conditions for a good briefing are privacy, freedom from noise and distraction, particularly if outside, and adequate lighting and ventilation if inside.

Flying presents a challenge to your instructing ability. Imagination and initiative can meet this by developing a new training aid or by improving existing ones. Training aids are exactly what the name implies – they *aid* an instructor to present ideas. They aid the student in understanding these ideas, but they do not replace sound knowledge and basic instructing techniques. If you develop an original idea for a training aid, note this in the space provided so that you can evaluate this innovation and use it in your future briefings. It must be remembered, however, that if a devised training aid is worthwhile to one instructor and student, it will undoubtedly assist others. Therefore please forward details of your training aid to the Flight Training & Safety Committee for evaluation and possible adoption in revisions to the manual.

Personal lesson plans

Lesson plans for each flying lesson have been produced and are contained in the Association booklet *Air Instruction Notes*. However, these plans are limited to the in-air instruction phase of each lesson, and therefore should be enlarged to make a personal plan to cover the whole lesson. What is required is a more extensive lesson plan that starts at the ground instruction phase and finishes with the post-flight debriefing. The requirements for such a complete Lesson Plan are discussed in the following sections, and should incorporate the following steps for every lesson.

The review

A review should be broken down into two sections: Previous Lessons, and the Student's Pilot Training Record, PTR. The review of previous lessons is to ensure that the student has absorbed previous work so that he can proceed to the next lesson, and is best determined by questioning. This is particularly important in the pre-solo stages, where the work covered is so closely linked that, in many instances, it is inadvisable to introduce new work if the student has not absorbed the previous lessons well enough. In many cases, constant repetition is desirable in the pre-solo stages. The student is receiving flight-line instruction and maybe academic (ground school) instruction as well, and he can easily forget what was learned in a previous lesson. The extent to which you, the instructor, will need to review previous lessons will depend on the student's answers to your questions. The following suggestions may help in planning your questions:

- Each question should either be thought provoking or should require a quick factual answer. Questions requiring a "yes" or "no" answer prove little and mostly provide no useful answer.
- The student must understand the question. Terms that are familiar to the student must be used, particularly with students whose first language is not English. The situation and conditions should be clear to the student so that he knows exactly what type of answer is required.
- Each question should centre on only one idea. An instructor can solicit an answer to a question on a complex procedure by skillfully injecting "who – what – when – where – why?" The answers will indicate how well the previous instruction was absorbed.
- Avoid tricky or irrelevant questions. Try to ensure that the questions are challenging, and that the student has had a chance to review the material that he is being questioned on.

The student's answers to questions will determine the next step. If he has proven to the instructor's satisfaction that the previous instruction has been fully understood, the lessons may continue as planned. Should wrong answers be given, but indicate that he knows most of the previous work, then you must stop and correct any misconceptions before proceeding with the new lesson. On the other hand if he shows a profound lack of understanding of the review, there is little to be gained from proceeding with the planned lesson. You must instead make this lesson a review of previously learned material. Therefore proceed by again briefing for the previous lesson and then go flying to go over the exercises. In this way a better understanding develops, and the pilot has a chance to review the lesson for himself.

The second part of the Review covers student weaknesses. This entails a review of the student's PTR, to bring to light repeated or major weaknesses and critical areas. It also shows areas that will not have been covered as often as others. These points should be discussed with the student and possibly become the basis for a review of **Previous Lessons**. The importance of correcting these weak areas before he or she can proceed with new work must be emphasized. Students should be allowed to analyze their errors or weaknesses and suggest corrections. By participating actively in their instruction, they will continue to learn, even when solo.

The introduction

The introduction that you will give before each flight consists of the **Aim** and the **Motivation**. The purpose of the aim or goal is to tell the student what he is going to be taught and what he is expected to know or to have accomplished by the end of this flight. Normally the reason or motivation behind the teaching is included in the introduction portion of the briefing, but can be included in the presentation when giving a lesson on more than one exercise during the flight.

The presentation

The presentation is a framework of the main points of the lesson, plus a breakdown of each sequence into a logical chain of events. This breakdown is simply: *what – why – how*? If desired, points may be written down on a suitable surface such as a chalkboard on the side of the flight-line vehicle (or flip chart in a classroom) so that they are visible throughout the pre-flight briefing. However, they must be in a logical sequence from the student's point of view.

The **What?** part is the aim and requires no expansion in the presentation. **Why?** because motivation requires some detail. The student must understand why he or she is being taught this particular exercise. Enthusiasm is necessary in impressing upon a student the immediate importance of the lesson as well as the long-range goal. Future goals and achievements may be used as sources of motivation, as well as any known previous experiences that may serve as motivators. In most lesson plans, a topic for motivation is suggested, but with a little imagination an instructor can expand these ideas to suit the student and the prevailing circumstances.

The **How?** is the major part of the presentation. Your lesson plan should amplify the Lesson Plan framework in sufficient detail to make it possible for you, as the instructor, to give a comprehensive briefing at any time, without being at a loss for words and with very little review. After you have discussed motivation, the presentation should start with a description, in simple terms, of the maneuver or required sequence of events (such as planning, then flying the circuit and landing). Then give the presentation, but the student must participate. A briefing is not a classroom lecture.

Well placed and well thought out questions improve any method of presentation, and if the instructor can capitalize on the student's "learning-through-reading" ability, he or she will save time and effort. Frequent questioning will encourage this ability. However, you should retain control of the briefing and not question the student to the point where the answers constitute the whole presentation. He has presumably read a certain amount of the manual *SOAR and Learn to Fly Gliders*, and an air demonstration may have been given on an earlier flight. Hence he should be expected to know what is being discussed. By developing student participation in this way the student will realize the importance of studying the manual, whether or not you give reading assignments! Encourage the student to ask relevant questions; these must be answered of course.

The application

The first part here is to *summarize the presentation*. You should cover the broad points of the presentation clearly, quickly and concisely on the ground. Avoid the temptation to expand the summary to the point where, in reality, the presentation is repeated. You may have time in flight for a very quick review of the main points, for example during the aerotow just before release. First take over control, then you may quickly go over the main points; the student is now able to pay full attention to your briefing.

During the second part, *encourage your student's questions*. Students will more than likely endeavour to give the impression that he or she has understood the briefing. The student who does understand completely is the exception and you should point out to your student that this is his opportunity to clarify any difficulties. He may have asked questions during the presentation: and the instructor should go over these questions and the answers at this time. Time should not be wasted on irrelevant questions and answers.

The third stage of the application is to ensure that the student *has absorbed the presentation* by questioning him or her. Properly prepared questions will assist you to gauge the success of your briefing. These questions will let all students know that they

must pay close attention to briefings so that they can understand each point. Although example questions may be given in the lesson plans, try to develop your own questions to suit the needs of each student.

The fourth part, *outline the proposed flight*, should be a short description of the sequence of instruction to be followed during the lesson, using the *Air Exercise Notebook* as your guide.

The Air Exercise

The Air Exercise section provides a fairly detailed description of how the air time should be spent in covering a review of previous lessons; introducing and practicing new lessons: combining old and new lessons to increase general proficiency and demonstrating any new maneuver to be covered on the next flight or flights. The Air Exercise is used as a guide only; one student may grasp one lesson easily but take a long time to grasp another, while a second student may be so slow to learn that the instructor cannot cover the material in the given time. The student's PTR, when filled in with the necessary checks, serves as a combined air exercise guide, an aide-mémoire for debriefing, and a complete record of the flight training when completed. Use this to effectively cover all exercises well.

During the air exercise, the instructor should concentrate on the student learning the major points of the lesson. When analyzing or explaining a student's errors, take control of the aircraft so that the student may devote his full attention to the instruction. Do not be over critical of minor faults during the first one or two times that the student tries an exercise. It is a much better technique to correct major faults first, then as improvement is noted, correct the smaller errors.

The post-flight review

Most students do not like to receive undue criticism during an air exercise, particularly when the student may be older than the instructor! There may be some points that students will fail to grasp. Therefore with increasing experience as an instructor, try to develop suitable questions on these failings. Questions should be based on the student's weaknesses, and exploited to the fullest by encouraging him to analyze his own errors. Criticism must be constructive of course, and the student left in a good frame of mind by giving praise for his strong points whenever possible.

Questioning

Questioning the student on his progress after solo flights often extracts valuable information. If a good instructor-student relationship exists, he will tell you where he went wrong. This may call for a re-briefing on certain portions of the exercises flown, or you may note difficulties and then cover them as part of the review for the next lesson or solo flight. Note that after solo, students will be checked for progress in a dual flight approximately every five flights, so these flights should be used to cover any difficulties noted earlier.

Reading assignment

Each new reading assignment must be specific, that is referenced to the manual and its named exercise(s) or chapter(s). However do not overlook the need for assigning additional material that explains some item that you know is giving the student a problem. You may even find it necessary during the debriefing to ask the student to read the chapter covering the flight just flown, if some lack of knowledge was evident during the exercise. Of course it helps to read this in any case, as this helps consolidate the knowledge after the flight. During the pre-flight briefing before a solo flight, questions can be asked on the same material.

FLYING INSTRUCTION

This section provides details of how to go about giving flying instruction in the most effective manner, using the lesson plans developed previously. While many gliding clubs have suitable facilities close to the flightline for briefings and ground instruction, others lack them. However the ingenuity of instructors is well known, and it is possible to give effective instruction even out in the open, but free from distractions. Beware of giving insufficient instruction in the haste to get airborne. Adequate preparation is vital if the student is to receive his money's worth. Remember, too, that a pre-flight briefing is a legal requirement for all dual and solo flights by a student pilot.

Preparatory ground instruction

This is classroom type instruction, normally on a one-to-one basis; it does not exclude group instruction. It covers the steps needed to fly an air exercise. While basic theory of flight, where applicable, would previously have been covered in ground school, some theory may be necessary to explain a point related to the performance of the air exercise or to serve as a useful review.

Preparatory ground instruction should be given by an instructor before all new exercises are flown. If a classroom is readily available, it should be used, but instruction on the ground close to the flying and

away from distractions is acceptable. Essentially, all preparatory ground instruction should cover the theory required, and the practical aspects of *how to do a flying maneuver or an air exercise*. Ideally it should be given no more than 24 hours prior to the related training flight.

Pre-flight briefing

Discuss the details of the air exercise on a one-to-one basis just prior to flying, to make sure the student understands exactly what will take place. This is essentially a practical briefing on the Air Instruction in Part B of this manual, avoiding theory but including the important points, which are:

- What are we going to teach and learn?
- How are we going to do this?
- Where does it fit into the overall picture?
- Who will fly which parts of the flight, and
- Safety Considerations.

A preflight briefing is separate from the ground instruction just mentioned above. It must precede all student flights, whether or not there is a new exercise to be covered. It is also particularly important when sending a student solo. Points that should be covered include:

- Weather and airfield conditions (it is mandatory to obtain the latest weather forecast before flight);
- The glider to be used, its weight and balance, cushioning and cleanliness (canopy);
- Airspace considerations (glider areas) and NOTAMs; where the flying will be taking place;
- Duration of the flight, and any restrictions during soaring conditions;
- The sequence of exercises to be covered on this flight;
- Use of radio for providing advisories, and communication with other glider pilots and tug pilots during the flight;
- Review of airmanship (lookout, wind conditions, tendency to drift downwind while soaring);
- Decision-making situations and use of SOAR technique during the flight.

In-flight instruction

The in-flight exercise is the culmination of all ground training and preparation. To achieve maximum effectiveness, it must be flown immediately after the pre-flight briefing, and to avoid possible confusion, it should be flown as briefed. The following is a guide to the conduct of a training flight. Of course, variations may be necessary to suit individual student requirements and flying conditions.

Control of the aircraft – Who has control?

There should never be any doubt as to who has control of the aircraft. The following is a very good procedure for giving and taking control; all pilots must follow it, whether during instruction or mutual dual flying. With an ab-initio student or a more experienced student who is new to you, thoroughly go over this procedure with them before flying, and confirm that they know and understand the procedure before subsequent flights.

When you as pilot-in-command wish to hand over control to the student, say clearly **"You have control"**. Teach your student to take control only when ready and then to say **"I have control"**. Do not hand over control until you hear this answer.

At any time when you want to take over control, say firmly *"I have control"*, then take control, making sure that your student already understands he *must* relinquish control, and say at the same time *"You have control"*. Under a stressful situation you may have to be verbally and physically *very* firm when taking over control. As pilot-in-command, you are responsible for the safety of the flight. Your request to take over control should not be questioned; it should be acknowledged and acted on as quickly as possible by the student pilot.

When the student has control, you must not *ride* the controls. The beginning instructor is sometimes tempted to *assist* the student. Resist this temptation, because the student will be uncertain whether his actions or those of the instructor or maybe a bit of turbulence are moving the glider. Your student may feel that, because you are on the controls, you do not have confidence either in yourself or in the student. This could lead to a dangerous situation. Additionally you will rob your student of the feeling of accomplishing the maneuver independently. If there is a need to assist, for example during a rough aerotow, say out loud that you are assisting briefly, then say "You have control" again, wait for the student's reply, and then let go of the controls fully.

In-flight teaching

For most new exercises you should first review the main points of the maneuver and then give a per items as airspeed, trim and angle of bank, etc. Usually you can obtain this information from your student. Your demonstration should be a complete maneuver.

In the case of a complex maneuver, after the perfect demonstration, demonstrate a small portion of the maneuver giving a brief explanation before, during or after the demonstration. Have your student attempt this small portion. Watch closely for any major error. If you observe a major error, immediately stop the student, and take control if necessary. Explain to your student what was done incorrectly, and then demonstrate as soon as possible what to do to correct the error. Allow practice of that step before proceeding to the next step. Continue the process of demonstration, explanation, and practice with close supervision of each step until your student has completed the entire maneuver. Then allow continued practice, slowly withdrawing your guidance and assistance.

As your student gains proficiency, you may look for minor errors and correct them in the same manner! Remember though, learning to fly well takes time and you should concentrate on the major points first. Many of the minor faults will be corrected as your student corrects the major faults and increases his experience level. At all times give praise for good performance.

In a perfect world we would conclude the flight with a perfect demonstration of the exercise or maneuver to be learned next. This will help your student fully understand the manual when reading about the next exercise. Most important it will provide a desirable mental picture of the procedure or exercise (such as planning and flying a circuit to the landing). It is far better to read the manual after the exercise has been experienced; in this way the student does not fabricate an incorrect mental picture for him or herself that will have to be changed later (unlearned), remembering the Law of Primacy.

Analysis of student performance

When discussing a student's attempt at a maneuver in the air, it is usually best to take over control so that your student may devote his full attention to what you say. In some cases you may ask the student to analyze the errors in a particular sequence, but this usually will happen best during the later stages of training. Do not be overcritical of minor faults during the early stages. Correct major faults first and then, as improvement is noted, correct the minor errors. There are three methods of correcting a student's faults when flying:

… there is a correct and an incorrect way to point out an error to a student

- Draw the student's attention to some aspect of the fault so that he has to analyze the situation for himself and then suggest a correction to fix it;
- Tell the student directly what the fault is; he should then be able to correct it,
- Take over control to correct it yourself.

Of course a student will learn best if you ask him or her to analyze the problem, the first option above, but the student has to have the prior knowledge already to do so. The second and third methods of fault correction are not so good because you are essentially telling the student what to do or doing it yourself. Students can usually follow instructions! If you take over control it may be because of lack of action by the student and the situation is becoming critical. Better to take over control before it is too late.

An example of a typical fault and how to correct it is when turning. The early student often allows the nose to drop too far. You could draw his or her attention to the position of the nose, or the pitch attitude. What effect does the lower nose attitude have on the speed? The student should be able to answer correctly and to tell that the speed for the turn is too high or is increasing, then to adjust the pitch attitude accordingly. If the student does not respond as above, your next option is to instruct him to raise the nose to decrease the speed. The third option is to take over control and do it yourself, clearly the least desirable option because the student really does not learn well from this.

If a student indicates problems on a solo flight, it may be possible to analyze the problems from the student's description of his or her actions and the glider's response. The correct technique can then be reviewed and practiced on the next flight. Sometimes, however, students may not be able to identify or describe a problem clearly enough for a good analysis to be made when on the ground. You should then go through the maneuver or sequence on the next dual flight, when you will be able to evaluate the student's performance and then offer corrections to any faults.

Planning of flight instruction

To make efficient use of the time available, you should plan the flight to avoid delays between exercises. All your flights should be planned so that one exercise is logically and directly followed by another with a minimum time spent between flights. However if time is spent thermalling to regain some height so that the next exercise can be fitted into the same flight, this is very acceptable because this is the name of the game! To provide continuity in the typical short training flights in gliders, some clubs give students two consecutive training flights before they then take a rest.

POST-FLIGHT DEBRIEFING

Review with the student each exercise taught and practiced during the flight. The debriefing should include observed strengths and weaknesses, and suggestions to improve performance. Improvements can include suggestions for alternative actions to achieve the desired result, such as a decision to return to the circuit at a higher height next time. Finally give an outline of the next lesson, and specify a reading assignment in preparation for the next lesson.

A debriefing should be given after all flights, dual and solo. A good debriefing will include several main points, the first of which is to ask the student to provide his or her own assessment of the flight and their performance. Follow this with your assessment of the student's performance. This should include the strong and weak points, and advice on how to correct any faults and errors. Answer any questions the student may have, and assign study subjects where appropriate.

FLIGHT SAFETY

Flight Safety is an important aspect of flying training. The loss of life and needless costly accidents can only be reduced to an acceptably low level if we put an increased emphasis on Safety. When flying or assisting on the ground, all pilots and ground crew (who may be pilots too) must be aware of the need for good safety practices. An instructor is in a position to identify and then to eradicate incorrect, unsafe and illegal practices. To be successful, a Flight Safety Program requires the correct attitude towards it, good supervision, with pressure to comply, and the proper training. A student learns by example; we instructors must set this example.

Usually, the experienced instructor is a more effective supporter of the principles of good airmanship and flight discipline than the inexperienced instructor. The properly motivated and experienced instructor more readily recognizes an unsafe practice and is more inclined to do something about it. He is conscious of flight safety by:

- Being alert to unsafe practices and taking the appropriate action.
- Following-up when he sees an unsafe practice, by discussing it with the people involved to jointly agree how to correct the problem and to prevent a recurrence, and
- Realizing that good Flight Safety is not restricted to his student when flying – it equally applies to all pilots when assisting with launching and all other ground operations.
- Continuously working to improve the Safety Culture within his club, by developing attitudes in all pilots that foster an open approach to discussion of problem areas and a desire to learn from the mistakes of others.

The result of all instructors practicing the broad principles of Flight Safety will be to set the example for all club members towards eliminating unsafe practices. Flight safety consciousness by all students and pilots must become the fashion, and unsafe procedures must be watched for, identified, and their elimination effected by open discussion first, and second, by firm and consistent action as necessary to lower accident rates.

The resultant **Generative Safety Culture** within the club will do much to improve safety overall within the Association.

Throughout your instruction, you must stress:

- The need to constantly maintain situational awareness, and to plan ahead using the SOAR technique for pilot decision-making (PDM);
- The importance of maintaining a constant lookout;
- The importance of being conscious about eating the right foods at the right times, and drinking enough water before and during long flights (i.e. being fully fed up and adequately drunk!); and
- The need for awareness of the danger of loose ballast weights or other loose articles such as cameras in the aircraft.

A CHECK LIST for GOOD INSTRUCTION

The following checklist is offered as a review of what has been said in the preceding sections. Many of these points refer equally to classroom instruction as to flying instruction, and may be used to assist the lecturer in providing effective learning in the classroom.

1 Tell the student what the lesson will cover and what is the purpose; and stress the advantages of the new knowledge or skill to be learned.

2 Tell the students specifically what is required of them during and at the end of the lesson.

3 Relate the lesson to the student's past and/or future experiences and to what they already know.

4 Identify the main teaching points for the student by:

- Using visual support (e.g. flipchart, models, the glider itself, *handees* – e.g. use hands to illustrate wings/ailerons – or other visual aids); and by
- Referring to these aids.

5 Tell students where the lesson fits into the overall picture.

6 Confirm that students are at the required level before teaching them new material.

7 Present the new material a step at a time, in easily assimilated stages.

8 Introduce each stage of the lesson and provide a link or bridge between stages.

9 Obtain student feedback throughout the lesson. Your actions should include:

- Asking questions to obtain feedback on your teaching;
- Observing the student's performance of a skill;
- Looking at students (watching for body language, facial expressions); and
- Asking for student questions to clarify in their minds the points of the lesson.

10 Respond to feedback using these ideas:

- Answer questions as clearly as possible,
- Stop students doing or explaining a step of a skill incorrectly,
- Correct an error if one has been made,
- Explain why the student's performance is incorrect, picking the main points first,

- Review material or steps of the skill,
- Ask questions – how, what, why,
- Re-teach (if necessary) using verbal support, and
- Praise students for good work whenever appropriate, but avoid insincerity.

11 Be enthusiastic about the subject you are teaching.

12 Use variations in your speech, in rate, volume and pitch.

13 During the presentation of new material ask questions related to the objective(s) for the lesson.

14 Use standard questioning techniques, and handle student responses with tact and discretion.

15 Use a variety of training aids to appeal to as many senses as possible whenever such aids will contribute to achieving the objective(s) of the lesson.

16 Use developmental teaching methods where appropriate, to force the students to think about the material being learned, by questioning and reasoning with them to develop answers.

17 Provide sufficient meaningful practice of the main points of the lesson so that students confidently achieve the objective.

18 From the first instructional flight, start to develop decision-making abilities in your student using the **SOAR** technique.

19 Allot time relative to the importance of the teaching point.

20 Identify and correct errors or mistakes made by the students at the time they occur or as soon after as practicable.

21 When a student is having problems, try to help by explanation, and by isolating and correcting any faults. Show willingness to help students with problems.

22 Avoid placing too much emphasis on a single stage of the flying curriculum to the exclusion of the overall objectives.

23 Use clearly worded explanations.

24 Deliver the lesson in a logical sequence.

25 As the lesson progresses through each step, frequently summarize the main points to consolidate the material.

26 Ask students to perform accuracy tasks during later stages of the course (accurate airspeed changes, turn reversals, sideslip entries and exits onto a heading, etc.).

27 Confirm student learning by testing on the main points of the entire lesson at the end of the lesson.

28 Conduct periodic reviews of all lessons, especially at the start of training in gliders.

29 Provide a final summary that links all steps or stages to the objective(s) of the lesson.

30 Re-motivate students by telling how the new knowledge or skill will benefit them.

31 Channel the student's outside interests and efforts to make his and her flying training as effective as you can.

32 Learn how to recognize the student's personality, respond appropriately in your instruction and use your knowledge to assist in overcoming possible emotional problems.

33 At all times be very clear as to who has control of the aircraft. Ask for and confirm when you or your student hands over control of the glider to the other pilot. Try never to *ride the controls*, and say so if you assist the student pilot, even briefly.

Practise *flying safety* by being alert to unsafe practices and taking appropriate action. Try to develop and maintain a *generative* safety culture within your club. This is one in which pilots are very open to discussion of their flying decisions, good and not so good, at any time, and to reporting incidents (from which lessons can be learned). Such a generative safety culture is one in which all club members are working to improve the safety of soaring at all times.

Note that individual pilots are only expected to report incidents and practices that could have led to unsafe situations – nothing more! Students and regular club members are not expected to gather data (they are the ones to provide it) or to analyze potential safety issues, etc. These activities are usually done by experienced pilots who have volunteered to take on these tasks on behalf of all members

Soaring Association of Canada
L'Association Canadienne de Vol à Voile

Flight Training & Safety Committee

SOARING INSTRUCTION MANUAL

Part B
Flying Training Curriculum

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Rights of Way – General

1 - 7 are excerpted from the CARs – reference numbers are in [ ].

1. Notwithsatnding any other provision of the Air Regulations:
   the pilot-in-command of an aircraft that has the right of way shall , if there is a risk of collision, take such action as is necessary to avoid a collision; and
   where the pilot-in-command of an aircraft is aware of another aircraft that is in an emergency situation, the pilot-in-command shall give way to that other aircraft.
   [602.19 (1)]

2. When two aircraft are approaching at approximately the same altitude, the pilot-in-command of the aircraft that has the other on its right shall give way, except as follows:
   A power driven, heavier-than-air aircraft shall give way to airships, gliders and balloons,
   An airship shall give way to gliders and balloons,
   A glider shall give way to balloons, and
   A power-driven aircraft shall give way to aircraft that are seen to be towing gliders or other objects or carrying a slung load. [602.19 (2)]

3. Where an aircraft is required to give way... the pilot-in-command ... shall not pass over or under, or cross ahead of, the other aircraft... [602.19 (4)]

4. Where two aircraft are approaching head-on or approximately so and there is a risk of collision, the pilot-in-command of each aircraft shall alter its heading to the right. [602.19 (5)]

5. An aircraft that is being overtaken has the right of way, ... the pilot-in-command of the overtaking aircraft ... shall give way by altering ... heading ... to the right, and no subsequent change in the relative positions of the two aircraft shall absolve the overtaking aircraft from this obligation until that aircraft has entirely passed ... clear of the other aircraft. [602.19 (6)]

6. The pilot-in-command of an aircraft in flight or maneuvering on the surface shall give way to an aircraft that is approaching to land or is landing. [602.19 (7)]

7. The pilot-in-command of an aircraft approaching an aerodrome for the purpose of landing shall give way to any aircraft at a lower altitude that is also approaching the aerodrome for the purpose of landing. [602.19 (8)]

8. Slope soaring. When two gliders are flying on the same slope or ridge at approximately the same altitude:

the glider that has the slope on its right has the right of way, and
the overtaking pilot shall pass between the slope and the glider being overtaken. **
** Warning – local rules may differ; make sure you know them.

9. Thermal entry: Lookout to include searching above; Turn in the same direction as the glider(s) already in the thermal.

CHAPTER B1
PREPARING for INSTRUCTION

INTRODUCTION

There are many items to be covered in our work to produce pilots capable of handling the modern glider well. No longer should we be training pilots merely to fly adequate circuits and to be able to soar locally. Rather we should be looking ahead to the machines to which they will soon graduate. These sailplanes are capable of good cross-country performance, and we should equip the pilots with the smarts to handle themselves well. One of our main objectives, therefore, is to teach student pilots to become competent soaring pilots in a short time, able to maneuver with firm use of the controls and to handle the glider with confidence, and who are soon able to advance to cross-country flying via post-solo training. The C and Bronze badges are good stepping-stones. What better objectives to give to students, than to tell them we will take them up to these levels! How should we go about teaching the curriculum? First, some words are needed on airmanship.

AIRMANSHIP

Airmanship is the collection of intangible qualities that go to make a complete pilot. By this we mean that a good pilot is not merely a person who can handle the sailplane, but is one who has additional capabilities and qualities. Such a person comes with good abilities to manage his or her approach to flying, particularly with respect to safety. This includes keeping a good lookout, consideration of others in the air, of good planning before and during flight, and being aware of our human limitations.

Good airmanship involves protecting ourselves as well as the other pilots in the air and on the ground. It is the almost silent giving of advice. It is the example that we set by our own preparations and how we conduct ourselves before flight and in the air. Good airmanship is silent, it goes almost unnoticed because nothing dramatic happens. It is the continuous application of good judgement, not only about when and how we prepare for flight but of how we conduct ourselves in the air, and most importantly how we keep ahead of the game by planning ahead and keeping our options open for the unexpected. We are continuously questioning and suspicious about the situation, and therefore we are actively thinking of what to do next.

This is all very well to say, but how do we teach good airmanship? It starts obviously with the development of a good attitude to our own flying which would be helped if we started with a good approach to life in general! The student should understand that good airmanship is applied not only when flying but all the time at the club, whenever we are around gliders and other pilots. Airmanship is the way we look after ourselves, including maintaining a thorough lookout, it is looking after and being considerate of others, and it is difficult to teach! It is something that comes with our personality and may be difficult to change. It has to be developed as a continuous activity, as a deliberate thought process that eventually becomes part of our everyday activities. Good airmanship starts before we leave home for the club.

PREPARATORY GROUND INSTRUCTION

Before all flying lessons, the instructor must give adequate briefings. Usually there will be two such briefings, the first of which is called preparatory ground instruction, as described in Chapter A5, page 14 (the second is a shorter and mandatory pre-flight briefing, given just before getting into the glider). Preparatory ground instruction is typically a short lecture as given in a classroom. In this very important part of the training we will discuss in detail such major subjects as how the glider flies, circuit planning, the spin and how to avoid them, and so on, in fact all the major subjects. The session should be given free from flying distractions and may be fairly formal. It will usually take several minutes, depending on the subject being taught and the prior knowledge of the student. It is an essential part of learning to fly and should not be omitted. These lessons will enhance the student's understanding of gliding in all its facets, and therefore learning to fly will be faster and more complete. In each of the following chapters, details are given for instructors to cover in these lectures. Reference can also be made to the student's manual, *SOAR and Learn to Fly Gliders.*

PRE-FLIGHT CHECKS

Most students will know little about a glider and about how to prepare for a flight when they start. However, by the time your students are flying solo they should be able to prepare themselves adequately, to check the weather, and check their glider with little or no input from you. To begin with, you will be teaching them all that is to be done, and in later flights, you will be monitoring that they are satisfactorily preparing for flight. This includes the daily inspection of the glider at the start of the day, and the checks needed before every flight.

The pre-flight checks should include the pilots (are both ready?), the weather (is it suitable for the experience level of the pilots and the intended flight?), and the glider. These checks fall under the category of airmanship, that intangible quality that we all aspire to but at which pilots have varying degrees of success. We instructors can foster positive attitudes by our teaching, and by the example that we set in our own flying.

The checks start with the **I AM SAFE** checklist, and should be used before thinking of flying. An exterior, or walkaround check should include removal of the tail dolly and control locks (yes pilots have taken off with them on), and an interior check of the glider to look for any ballast, etc. The pre-takeoff **CISTRSCO** check is followed by the **CALL** and the **SWAFTS** checks. Because these checks are included as part of the first item that is listed in the Pilot Training Record – Glider, and because there are many of them, don't mark this lesson as satisfactory too quickly; you have lots of time.

PRE-FLIGHT BRIEFING

The pre-flight briefing must cover the main points of the upcoming lesson, and should refer back to the preparatory ground instruction session. Include now who will be doing what parts of the flight, for example in the first lessons the instructor will fly the glider until after release, the instructor will demonstrate with the student following through, then the student will practice, and so on. In later flights the student will be doing most of the flying, the instructor being restricted to the occasional demonstration and follow through as the student practices.

It is requirement of the Canadian Aviation Regulations, CARs, that all training flights be pre-authorized and signed off by the instructor and the student agreeing to the planned exercises or lesson plan. Therefore, make sure the flight record sheet is filled in and signed off by both pilots before the flight. It is also a CARs requirement that a pre-flight briefing be given to all student pilots whether they are flying dual or solo.

A further briefing may be given during the latter part of the launch, to remind the student of the essential points of the upcoming lesson. In this case, take over control if the student is flying, so that he can give you his full attention. Briefings should also include safety and Human Factors points pertinent to the lesson.

DEMONSTRATING

Who has CONTROL?

Before the first flying lessons, establish a routine for exchanging control of the aircraft between the instructor and student. Both of you must know at all times who has control. Use the words **"You have control"** when handing over control of the glider. The student must acknowledge with **"I have control"**. If you, the instructor wish to take over control, use "I have control" and explain to the student that control *must immediately* be handed over and acknowledged with "You have control". Words like "I have it" are not acceptable, as they can be confused, so avoid them. Use "I have control", and "You have control" only. It is vital that each pilot knows at all times who is in control, so establish this procedure with each pilot, whether a student or licensed pilot, as you first fly with them at your club.

Directions

Use the clock method to establish directions relative to the aircraft; this is used to point out other aircraft and to instruct the student to fly toward a point. Twelve o'clock is directly ahead, nine o'clock is to the left side at 90 degrees, and six o'clock directly behind, etc. When pointing out another aircraft, add whether it is above or below the horizon.

Instructor's Air Notes

Convenient notes for use in the air have been collected into the Instructor's *AIR NOTES*. This booklet contains notes or *memory jogs* for each lesson. The booklet includes the sequence for the demonstrations and student practice items for each of the first few lessons or flights. For later lessons the breakdown of who does what is not given because usually there will be several exercises combined in each flight. The recommended sequence of lessons is given below and in the Instructor's Air Notes.

In-air demonstrations

To demonstrate each point, first ask the student to *follow through*, which is to put the right hand lightly on the stick, and feet on the rudder pedals. In the first lessons the student should understand that you will only be able to show the amount and rate of control movements, not the actual forces to be applied (in later flights you will be demonstrating complete maneuvers or sequences such as use of sideslips on approach). Next demonstrate, pointing out essential points to be recognized or noticed. Then instruct the student to try it, with you directing the practice.

Explain to the student that for convenience you will sometimes refer to the glider's nose when discussing the attitude or pitching movement of the aircraft.

The student will not be able to see the nose, but should be able to use the principle to best judge the attitude of the aircraft relative to the horizon.

Try never to interfere with the student's practice; if the student has control, *keep your cott'n pick'n fingers off the controls!* If you touch the controls, for whatever reason, say so and then hand over control again. If you find it difficult not to interfere, try folding your arms but remember that under several conditions, it is vital to follow through and to have your hands very close to the control stick, for example on a first takeoff or landing.

When demonstrating the first lesson, think of the student who is trying to follow what you are doing to each control. The elevator is the most sensitive and its movement can be very difficult to detect by a new student pilot even as the nose pitches down, for example. Therefore make definite movements, to clearly show what happens. And remember that turbulence can require other control movements, so try to keep your demonstration as clear as possible, limited to what you are trying to show.

These principles should apply to all your instructing.

Keeping in range

It is easy to fly out of range of the airfield as you demonstrate or monitor the student's practice. Arrange your flight to always remain within easy gliding range and to allow arrival back at the high key area at the right height. The student may continue to fly as you plan when to enter the circuit even on early flights, because the student will not be planning the circuit in the early stages. But it is important to keep to the correct heights for each area or point of the circuit because the student increasingly will be aware of the heights and the positions of the glider in relation to the runway. You will be demonstrating an actual, ideal circuit somewhat later in the training program.

POST-FLIGHT REVIEW

This is an important part of all flying lessons and should always be given. Briefly go over the flight's main points, and ask questions to find out how well the student understood the lesson. Give the student an assignment such as to read the next chapter in the student's handbook, *SOAR and Learn to Fly Gliders*.

THE FLYING TRAINING CURRICULUM

The listing on the next two pages contains a suggested sequence for all the lessons and the exercises that are recommended to get the students up to a good standard for a glider pilot licence. Yes, you may not have seen some of the new exercises! There is some flexibility of course to this list. Instructors should adjust each flight to suit the current progress of the student within the overall scheme presented here. Although the list suggests approximately 30 flights as the number required to complete the training to solo, it is only an exceptional student who will be able to advance this fast. Normally in a typical gliding club's weekend operation some lessons will be repeated, and the instructor will need to review more often, to bring the student back onto the *normal progression line*. A *Pilot Training Record – Glider* is to be used for this, and this record will form part of the student's application for the glider pilot licence (it is to be retained by the club CFI).

In the recommended sequence, *Prerequisites* are shown in square brackets. The student pilot should achieve the skills shown in these brackets before being taught the new skills shown in the flight sequence. For example, the aerotow must not be taught before the student has satisfactory handling skills in medium turns shown as [Medium turns – 4] where 4 indicates the student is able to perform the maneuver without assistance and with only non-critical errors, as in the following table.

Allow all students to practice each exercise or skill after you have first demonstrated it, unless specifically instructed otherwise. This must extend into several subsequent flights. For clarity, this is not shown in the detailed listing.

RECOMMENDED SEQUENCE FOR TRAINING PROGRAM TO FIRST SOLO

The recommended exercises and the sequence in which they should be taught are shown on the two next pages in a series of stages from 1 to 22 to first solo, and from 23 to 26 for the post-solo stages. It is not vital that these are taught in this sequence, except for the early stages 1 to 12, less those elements identified with an asterisk; this allows instructors to be flexible. However, the student should meet the prerequisites that are specified before that exercise is first demonstrated by the instructor and practiced by the student. The prerequisites are shown below. It will be noticed that **level 1** will be used the first time an exercise is taught; it may be used somewhat later in the training program if the instructor has to take over control for the safety of the flight.

Level 2 refers to physical (and verbal) assistance; recognize that if the instructor handles the controls he will likely also have some comments, i.e. verbal assistance! In **levels 2 and 3** a remark or question

could be seen as assistance, depending on the context. A non-critical error is defined as an error that does not require intervention by the instructor; it is a minor performance deviation from the standard: the exercise or maneuver was performed safely and with sufficient accuracy to complete the objective. For reference refer to the solo standards that are defined in the *Recommended Solo Standard for Glider Pilots*.

Legend for prerequisites

Level

1 = Preparatory Instruction and demonstration has been given; **or** the Instructor had to take over control for Safety;

2 = Student is able to perform the maneuver, but with the Instructor assisting on the Controls;

3 = Student is able to perform the maneuver with only verbal assistance; the maneuver contained non-critical errors;

4 = Student is able to perform the maneuver with no assistance from the instructor, and with only non-critical errors;

5 = Student Flying Standard – Satisfactory for Solo; this maneuver was flown with precision, with no assistance from the instructor, only minor errors, and no major judgement or decision-making errors.

RECOMMENDED SEQUENCE FOR TRAINING PROGRAM TO FIRST SOLO

Stage #	Skills to be Taught and Practiced	Prerequisites
Famil.	**Instructor introduces CISTRSC-O, LOOKOUT and local area landmarks.**	
1	Demo Interior and Exterior Inspections; Demo CISTRSC-O and LOOKOUT; Primary Effects of Controls: Elevator, then Ailerons (and Rudder) to perform Gentle Turns entry and exit; Control of Speed	
2	Aileron Drag; Continuous Turns; demo SOAR technique	
3	Stability; primary Effect of Rudder; The Trim; SOAR Continuous Turns; Demo SWAFTS (including radio call)	
4	Reduced-g; Slow Flying; 1g Stalls; Turning onto a Heading; SOAR, SWAFTS.	
5	Medium Turns Thermalling Technique and Protocols; Straight Flight (towards a point on horizon)	[Effects of Controls & Turn Coordination – 3]
6	Demo Takeoff and Demo Aerotow/Winch Launch Effects of Airbrakes at height Approach Control using Airbrakes and Overshooting and Undershooting; Demo Landing	[Medium Turns – 3] [Speed Control – 3 & Straight Flight – 3] [Effects of Airbrakes – 3]
7	Practice Takeoff and Tow/Winch launch Turns; Lookout, Straight Flight; Stalls; etc. Approach and Landing (from high Final Turn) Thermalling*;	[Medium Turns – 4] [Medium Turns – 4; Effects of Airbrakes – 3] [Overshooting & Undershooting – 3]
8	Steep Turns & Advanced Thermalling* Demo Circuit Planning Practice Approach and Landing	 [Approach and Landing – 3]
9	Steep Turns, Thermalling* Demo and Practice Collision Avoidance Flying the Circuit (normal Final Turn Height); Use of Radio	[Medium Turns – 4]
10	Spiral Dives and Benign Spiral* Zigzag in Downwind exercise (optional)	[Steep Turns – 3] [Circuit Planning – 3]
11	Boxing the Slipstream; Low Tow; High Tow Further Stalling exercises (Climbing, Descending and in a Turn)	[Aerotow – 3] [1*g* stalls – 3]
12	Rope/Cable Break Recovery Technique at altitude Effect of Angle of Bank on Stall Speed	 [Further Stalling – 3]
13	Slack Rope on Aerotow; Rope/Cable Break Recovery practice at altitude Sideslipping at altitude exercises Abbreviated Circuit	 [Circuit Planning – 4]
14	Towplane Upsets & Emergency Aerotow Procedures X-Wind Takeoff; Laying Off for Drift on Winch Sideslipping & Sideslip on Approach Illusions created by Drift; X-Wind Landing	 [Sideslipping – 3]

Stage #	Skills to be Taught and Practiced	Prerequisites
15	Descending on Tow* Spins and Comparison to Spiral Dive Airbrakes fully open before Circuit exercise	[Aerotow – 4] [Spiral Dives – 3] [Circuit Planning – 4]
16	Further Spinning exercises*; Changing Effect of the Rudder at the Stall; Spin Left off a Right Turn, etc.	[Spins – 3]
17	Spins Avoidance Practice (recover before spin develops)* Instruments covered exercise*; Right-hand Circuit exercise	
18	Rope Break demo at 500+ feet agl Abbreviated Circuit	[Rope/Cable Break Recoveries – 4] [Abbreviated circuits – 3]
19	Off-field Field Selection and Circuit Planning	
20	Rope/Cable Breaks flights (demo first at lift-off, then at low height, and at medium height (300 feet agl), then student practice from only medium and higher heights with full briefing before each flight)	[Rope break demo at 500 ft – 1]
21	Review and Practice all maneuvers and skills	
22	First Solo flight	[All identified exercises and skills – 5]
23	Post-Solo: [dual flight after every 4 flights max.] Review basic maneuvers, upper air work, incl. descending on tow, Slipping Turn onto Final, etc.	
24	Upper air work – review of flight test elements, post-basic training exercises – see p B18-1	
25	Upper air work – review spins and spin avoidance, slips, etc., advanced thermalling, etc., off-field field and circuit selection	
26	Flight test review and recommendation	[All exercises and skills – 5]

Note: Exercises marked * may be postponed to the post-solo stages. If pre-solo training was compressed the dual flights should be more frequent after solo to cover all the missed exercises before licensing.

Legend for prerequisites

1 = Preparatory Instruction and Demonstration; or Instructor had to take control for Safety;

2 = Student able to perform maneuver with Instructor assisting on the Controls;

3 = Student able to perform maneuver with only verbal assistance; maneuver contained non-critical errors;

4 = Student able to perform maneuver with no assistance, with only non-critical errors;

5 = Student Flying Standard – Satisfactory for Solo; maneuver flown with precision, no assistance, only minor errors, and no major judgement or decision-making errors.

CHAPTER B2
PREPARING FOR FLIGHT & CHECKLISTS

OBJECTIVES

- To teach how to handle gliders on the ground including launch methods, signals and the emergency procedures;
- To teach thorough preparation for flight and actions to take before and after each flight; and
- To teach the student the **vital action** checklists to be used on each flight.

MOTIVATION

The need for a thorough understanding of how to manage the ground operations, inspections and handling of gliders, pre-flight preparation and for checklists are not immediately apparent to all students. To become safe pilots, they must be made aware these are essential for the safety of persons on the ground, and for the safety of every flight. Checklists are an easy way to cover all essential items such as in daily inspections, and before and in flight. By having them written in a list it is difficult to omit any item if the list is followed.

GROUND OPERATIONS

The student pilot should be shown the need for good ground operations. These are essential for the safety of pilots and aircraft. Points to be learned by all students early, and which instructors have to help with are shown below. At the same time, they should be made aware that all club members are expected to assist with ground operations. Information to be covered is:

- How to give a glider a daily inspection (DI). This is described in detail in Appendix D of the student's manual, *SOAR and Learn to Fly Gliders*.
- The need to give a glider a walk-around inspection prior to each flight, and what to look for.
- How to handle a glider correctly when moving it, and the need for an adequate number of people to handle it; handing over who has hold of a wing by saying "my wing" and "your wing".
- Which words to use when handling gliders; GO and STOP should be the only acceptable ones; there is no confusion. For example OKAY can mean either stop or go depending on the situation, and WHOA sounds awfully like GO. STOP means just that!
- Where to park and how to tie down gliders both at the flight line (airbrakes open as required) and in the tie down area, if your club has one. And never to operate a control through the window of a closed canopy, in fact to take a lot of care with canopies; a broken canopy means no flying and the cost to repair/replace can be very high!
- How to avoid aircraft being blown over and the need to park with the into-wind wing weighted or tied down. As an alternative, the into-wind wing can be left up, but in this case care should be taken to have the wind coming from slightly behind the wing and a stop (heavy tire) placed behind the tail. The glider will tend to weathercock to make the wind come from in front of the wing; thus the wind could generate undesired lift!
- The need to be aware of all aircraft movements, remembering that gliders are silent; to keep dogs and children under control and away from the runway.
- That each pilot when solo must remain with the glider until retrieve help arrives; gliders must never be unattended on the flight line.
- To use car tow ropes at least half a wingspan long.
- Method of filling in time sheets, and later, log books.
- Operation of the flight priority list for obtaining instructional flights.
- The club's expectations for assistance in the care of towplanes, winches and gliders.

GROUND SIGNALS – AEROTOWING

Start your student with a demonstration of the ground signals, and an explanation of any local club variations. Even if the club uses radio to signal to the towpilot, go over the signals that would be used for non radio-equipped aircraft; the pilot might one day visit another club that uses the standard ground signals and all pilots should know them!

It is usual to have two signallers, one who runs the glider wing (normally the upwind wing) and who initiates the signals; the other stands ahead and to one side of the towplane, visible to the towpilot, who repeats the signals. The glider pilot maintains responsibility for ensuring that it is considered safe

to take off.

The repeat signaller is responsible for repeating the signals given by the wing runner, for continued monitoring of the circuit for traffic, and for halting the takeoff should the situation demand. These points should be very clear to the students.

At some clubs the repeat signaller for the towpilot is not used. We should remember also that pilots will visit from other clubs and countries where signals differ from ours. In Canada, for example when initiating the takeoff, some pilots will call out "Take up slack" when they give the thumbs up signal, and will again call out "All out" when the rope is tight. Note that under some wind or runway conditions and with some aircraft other considerations may dictate that both signallers stand on a particular side of the runway. Make sure your students know the system in use at your club.

Wing runner and pilot actions

The wing runner is responsible for searching *above and behind* for traffic that would make a takeoff hazardous, while the cockpit checks are being done. For example, the wing runner checks that the approach is clear of aircraft on final or that may be approaching from another direction that could cause a problem for the glider or towplane that are about to take off. The repeat signaller assists with these circuit checks. The wing runner also provides a very important safety check that the tail dolly has been removed and the airbrakes are closed and locked. This person must not connect the rope until the canopy is closed and locked, at which point he should ask the pilot for confirmation that the brakes are closed and locked. The pilot should confirm that they are properly locked before giving the thumbs up signal. As part of these responsibilities, the wing runner must not raise the wing if there is any doubt about the safety of the takeoff.

Signal that takeoff is imminent

When ready, instruct the student to ask the wing runner, "All clear above and behind?" If clear, the wing runner will reply "All clear above and behind". The wing runner checks that the tail dolly has been removed and again that the airbrakes are closed and locked, then waits for the pilot to initiate the takeoff by giving the "Take up slack" (thumbs up) signal.

Take up slack

Instruct the student to initiate the takeoff by giving a clear thumbs-up signal as a visual command. The wing runner then raises the wing, and this is a warning to all, including pilots in the air, that a takeoff is imminent. The runner must not raise the wing if the latter part of the circuit (both sides) or takeoff run is not clear. The same applies if the glider appears to have any problem such as airbrakes accidentally left open. However, pilots of some modern gliders may deliberately leave the airbrakes open for the initial part of the ground run to assist the ailerons. Brief your students that this can occur.

The wing runner will then wave one arm vigorously in a 180 degrees arc from side to side in front of the body below shoulder height. The repeat signaller repeats for the towpilot who slowly taxies forward until the rope is tight.

Take off, or All out

When the wing runner sees that the rope is tight he will give the **all out** signal which is to wave the free arm in a full circle in front of the body. The wing runner may not be able to continue signalling, but the repeat signaller should continue signalling until the towpilot can no longer see the signal. When radio is being used for signalling, the repeat signaller will not be present, and the wing runner does not give any arm signals.

Emergency stop

The wing runner, repeat signaller or any nearby competent person shouts "STOP", and raises both hands above the head motionless and with palms facing forward. When teaching this signal, emphasize that the shout must be directed to the pilots concerned. Note also that the international aviation **STOP** signal may be used; the outstretched arms are waved back and forth above the head, the speed of the arm movement indicates the urgency of the required stop. Visiting power pilots for example know this, and will respond better to this signal. The towpilot's signaller repeats this and the glider pilot is to immediately pull the release. The towpilot also has to stop his aircraft.

We should also remember that **any** person should be instructed to give the signal at any time they see a danger. The **STOP** signal can and should be given to other power aircraft pilots, as appropriate.

An example of an emergency situation that has been quite common and that must be carefully watched for is – dive brakes are not closed and locked by the glider pilot prior to giving the **all out** signal. In this case the wing runner, having noticed the brakes are still open, must stop the takeoff by shouting, "STOP" and signalling the **STOP** signal at the same time.

Running the wing

The wing runner should hold 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. Some people have difficulty recognizing this, and if the glider initially swings to one side it is usually because the wings were not held level! The wing runner should note this and correct this error next time. In a crosswind the into-wind wing should be held slightly low.

Advise the runners to avoid loose articles and clothing that might catch on the wing, and have them run with the wing as far as possible.

GROUND and AIR SIGNALS – WINCH LAUNCHING

Here again, as for aerotowing, start your students with a demonstration of these signals, and include any of your club's procedures. There are four normal methods of signalling the winch, the first two being more popular compared to the other, older methods:

- by radio, either by the pilot or a ground person;
- by telephone;
- by a 0.6 m diameter Day-Glo painted paddle; and
- by a lamp provided with a switch and/or flasher.

The wing runner will relay relevant signals to a *winch signaller* (or launch controller) who in turn signals to the winch operator (in some operations the signaller initiates all signals independent of the wing runner).

Wing runner and pilot actions

As for the aerotow the wing runner is responsible for searching *above and behind* for traffic that would make a takeoff hazardous, while the cockpit checks are being done. For example, the wing runner checks that the approach is clear of aircraft on final or that may be approaching from another direction that could cause a problem for the glider about to take off. (The need for no aircraft in the circuit will be dictated by the local club's runway size, and whether the area needed for its landing is large enough to also accommodate the glider ready for takeoff.)

The wing runner also provides a very important safety check that the tail dolly has been removed and the airbrakes are closed and locked. He must not connect the cable assembly until the canopy is closed and locked, at which point he should ask the pilot for confirmation that the brakes are closed and locked. The pilot should confirm that they are properly locked before giving the thumbs up signal. The cable is then connected as the last item before the wing is raised, but the wing runner must not raise the wing if there is *any doubt* about the safety of the takeoff. The wing runner then waits for the pilot to initiate the takeoff by giving the "Take up slack" (thumbs up) signal.

Signal that takeoff is imminent

When ready instruct the student to ask the wing runner, "All clear above and behind?" If clear the wing runner will reply "All clear above and behind". The wing is then raised, and this is a warning to all that a takeoff is imminent. The wing runner must not raise the wing if the final part of the circuit or takeoff run is not clear, as discussed above.

Take up slack

Instruct the student to initiate the takeoff by giving a clear thumbs up signal as a visual command. The wing runner will then wave his arm vigorously in a 180-degree arc from side to side in front of his body below shoulder height. The winch signaller or launch controller repeats for the winch operator. Alternatively the glider pilot may give the signal by radio to the winch operator.

The signals are:

- the signaller or pilot will say "take up slack" continuously over the telephone or radio,
- the signaller will repeat the signal with the paddle, or
- the signaller relays the signal to the winch with a series of slow light flashes.

This is repeated until the slack has been taken up and the glider begins to move.

All out

When the rope is tight the pilot will give the **all out** signal by radio or the wing runner will signal by waving the free arm in a full circle in front of the body. The repeat signaller repeats this for the winch operator. The signal is continued until the glider wing is released. The signals are:

- the signaller or the pilot will repeat "All Out" continuously over the telephone

  or by radio until the takeoff starts,
- the signaller will wave the paddle in a 180 degree arc above shoulder height, or
- the signaller will give a series of fast light flashes.

Running the wing

While the runner is running the wing the launch controller will continue signalling to the winch operator.

At the same time he must monitor the takeoff and if there is any doubt about the safety of the takeoff the signaller must shout "**STOP**" and signal STOP to the winch.

Emergency stop

The wing runner, launch controller or any nearby competent person shouts "STOP", and raises both hands above the head motionless and with palms facing forward. Again note that the international aviation **STOP** signal may be used; the outstretched arms are waved back and forth above the head, the speed of the arm movement indicates the urgency of the required stop. Visiting power pilots for example know this, and will respond better to this signal. This is repeated by the launch controller (if he is not initiating the stop) using the signal below, and the glider pilot is to immediately pull the release and hold the control stick fully forward.

Having seen and/or heard the STOP signal the repeat signaller will:

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

An example of an emergency situation that has been quite common and that must be carefully watched for is; dive brakes are not closed and locked by the glider pilot prior to giving the **all out** signal. In this case the wing runner, having noticed the dive brakes are not locked closed, must stop the takeoff by shouting "STOP" and signalling the **STOP** signal at the same time.

Air signals to winch operator

It is possible for the glider to signal to the winch, if during the launch the airspeed departs from the recommended speed range: the signals are given below (if the pilot has a radio the procedure is much simpler). You should note that a modern winch with cable tension indication, or a torque-governed or constant-speed drive allows a different technique for speed control; but the basic signals should be taught and therefore these are given here.

Too fast

First ease off the backward stick pressure during this signalling, to reduce the angle of attack and improve control. Then yaw the glider left and right in a pronounced yawing motion using definite but gentle rudder movements. Continue until the winch operator reacts or until excessive speed makes it necessary to release. Note that yawing adds tension to the cable, hence the need to lower the nose to reduce this at the start of this **too-fast** signal.

Too slow

The **too-slow** signal is a distinct lowering of the nose, given by the glider pilot as he detects that the speed is reducing below the desired speed. The pilot must lower the nose, to reduce the load on the winch and to maintain the glider's speed if the winch does not return to the normal speed for the climb. The winch operator can quite easily detect this signal as the glider is rotating into the full climb. At an earlier point in the launch the winch operator may not be able to see the glider easily, in which case the launch controller, who will be able to detect the signal, will relay the signal to the winch operator.

There used to be a signal that involved rocking the wings, but at too slow a speed this is a dangerous thing to do, because a stall on the downgoing wing (always a possibility) could be the start of a spin, and this could lead to a fatal accident. Therefore this signal is no longer permitted.

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. 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*!

PREPARATIONS FOR FLIGHT

If this is prior to a person's first flight in a glider, explain fully what you are doing and looking for before the flight. Both you and your student must look at the following items; give advice and help as needed.

Pilots

Are both of you mentally ready, well rested and not under medication? See also the more complete **"I AM SAFE"** checklist on the next page. Proper flight preparation must include food and liquids, and suitable clothing, sunglasses and hat (which must permit adequate vision upwards, so allow no large peaked caps), and a visit to the toilet.

Weather

Is weather suitable now and for the projected end of the flight? Note the wind direction and speed before

climbing into the glider.

Equipment

Normally the regular **daily inspection** (**DI**) will have been carried out earlier in the day. Immediately before ALL flights, instruct all students to perform:

- Exterior inspection or pre-takeoff walk-around check to include removal of tail dolly and control locks, and
- Interior inspection for seat adjustment and security of attachment, and removal or addition of ballast as required. If ballast is not required, check absence of ballast weights, and for a lightweight pilot check correct ballast is inserted and properly secured.

All pilots must check that the pilot weight(s), solo or dual, falls within the limitations of the glider to be flown, and make sure the student can easily reach the controls. (Of course all pilots should be checking their reach and the maximum and minimum weights automatically on later flights.)

Towpilot or **winch operator** Include any special instructions to these people.

- For winch launching, the runway and area where the cable will drop must be clear of people and vehicles. Check the rope or cable, and the weak link, making sure the release ring and weak link are the correct ones for the glider.
- Positioning of the glider (obstacles, cross-wind?).
- Do up the lap and shoulder straps firmly or have someone else assist, especially on the student's first flights. When strapped in, check that the student can NOT lock the knees when fully deflecting either rudder pedal. It is too late when trrying to recover from a spin, to discover the student has the rudder fully deflected the wrong way and you cannot possibly straighten their knee by pushing harder! Move the student's seat forward more, or add a cushion or spacer that can take a large pressure without compressing.
- In the later stages of training, monitor that the student is adequately doing the above preflight checks, and don't do the checks yourself to save time.

PILOT'S CHECKLIST – I AM SAFE

I **Illness** Obviously no-one should fly when ill, but there any 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** This says we need adequate food and water. The quality of both items is important before and during flight. 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 gastro-intestinal upsets). Water is essential for us to function properly, and in the heat of summer dehydration can rear its ugly head. Even a small level of dehydration is enough to cause some loss of cognitive ability. Water should 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 flying should be permitted when the pilot is taking any form of medication. Is it safe, and why is the pilot on the drug in the first place?

S **Stress** It is very important to remove all sources of stress before flying. Gliding is a very relaxing sport under some situations, but it can be adversely impacted if the pilot comes with pre-stress, such as arguments with other people. Emotional stresses are distracting and can lead to mistakes and dangerous flying. The pilot should probably not fly – the safest option. Getting ready for flying in a stressful environment is not the best way to get ready for learning!

A **Alcohol** It goes without saying that alcohol does not mix with flying. Any amount will affect coordination, and the effects are multiplied at higher altitudes. The regulation of 8 hours minimum abstinence from drinking before flying applies only to very modest amounts of drink. The aftereffects can be felt as a mild hangover longer than we expect, and will have equally dangerous effects on our flying abilities until the body liquid and chemical balance is back to normal. Teach students that these effects are not readily apparent to onlookers, and least of all to the drinker. So exercise extra care.

F **Fatigue** Being tired is not a good state to be in when flying. As instructors we know the pressures to take one more flight after an all-afternoon session in the back seat. Beware this trap. Students should be advised to come flying already well rested.

F **Familiarity** This could be called currency, of being in practice, but it goes beyond this. During the later lessons with your students, talk again about this aspect of flying. For example they should think of when they last did some slow flying to review the symptoms of the stall, and when did they last do some spins avoidance practice. When did they review the flight manual of the glider they are now flying? When was the last dual flight with an instructor, for example? This item includes consideration of the weather; is it suitable and what is the forecast for later in the day? If any pilot has any doubt about their own currency, then advise them that a dual flight should be taken with an instructor. It is the safest option. Finally the aircraft; who DI'd it and what does the DI book say? The importance of the exterior **walk-around** and **interior** checks becomes more apparent when these types of question are asked.

E **Emotion** We make many decisions, and sometimes we are more or less logical about them, and it is arguable that all decisions are, ultimately emotional. We are mostly unaware of how our emotions affect what and how we do things, in other words mild emotions do not affect us that much, but they do affect motivation. Stronger emotions often disrupt what we are doing and can have a negative effect on our flying. Instructors must be aware of the range of emotions and how they can affect us. See also Chapter A4 of this manual.

In summary, if a pilot cannot honestly say *I Am Safe*, then do not fly.

COCKPIT CHECKLISTS

There are various times before and during a flight that a set of *vital actions* must be performed. They are so called because if any one item is omitted, the safety of the pilot and/or other pilots or people in the air or on the ground could be jeopardized. Start these checks on flight number one so that the student comes to regard them as normal on every flight. Even if your student seems to take time to do these checks initially, persevere, as it is better to establish these checks as normal habits now, rather than to have to inject them into the pilot's routine later.

The first letters have been arranged into easily remembered words or mnemonics. In order to be sure that every item is covered, it is important to start *again* whenever the sequence is interrupted. The following checklists include items that the glider may not have, such as flaps; however, this is the time to teach these very basic checklists – pilots must consciously consider these items. Teach the student to look at and confirm the pictograms or labels that will be located close to the handle or lever; they show the control surface or undercarriage (gear or wheel) for example in the open and closed (or down and up) positions. The student must confirm that the lever is in the correct position as shown by the pictogram or label.

Whenever possible, use a stick-on checklist label in the cockpit to supplement the memory. It is not considered adequate to make the pilot remember checklists by rote alone. We produce mnemonics so that the lists become easy to remember, so encourage your student to remember these lists! In a situation that can be stressful, for example, the pilot will revert to what was learned first, and if the checklist is in memory, the items have a chance of being done automatically. We know memory is unreliable though, so all checks should be available as a written list. (The Association stocks stick-on labels for the pre-takeoff and pre-landing checklists, for use on the instrument panel).

Students should be taught to use these lists now, and in later flying to develop their own supplemental lists for their sailplanes, which may include radio and electrical instruments. These lists should be written on a suitable card (perhaps laminated) for use in the cockpit.

PRE-TAKEOFF CHECK LIST

CISTRSC-O (Sisters CO)

C Controls. Make sure the controls can be reached even when the straps are fully tight, then check that each control is free to move over its full range and against stops. A visual confirmation of control movement in the correct sense should be performed as far as possible; this will have been done by doing a positive control check during the daily inspection.

I Instruments Set the Altimeter (to field elevation if the altimeter setting is not available), check instruments, yaw string, radio on (radio check can be performed as the pilot asks for height and place to be towed as towplane taxies into position; or speaks to winch operator if radio used for signalling during winching);

S Straps Check these are tight now, don't forget to instruct the student to ask you if yours are done up too;

T Trim and ballast Although a lightweight pilot should be in the habit of fitting the ballast weight before getting in, check again that the total weight of the two pilots is within limits for the allowable *cg* range, and properly secured;

R Release Instruct your student to check it now. Even if the club gliders usually have only one check a day there is value in teaching this habit to the student who one day will fly an aircraft on its first flight that day. Here we should mention the different types of release rings, and the requirement for the person who hooks you up to show the rings and weak link to the pilots. The pilot must check that the correct ring and weak link are being used. Do not have the rope or cable connected until the pilot is ready with the canopy closed, and airbrakes closed and locked.

S Spoilers and flaps Check airbrakes (spoilers), and point out that some gliders have an over centre lock which must be positively checked now. Set the flaps for takeoff.

C Canopy Close and lock it, and instruct the student also to check that your door or canopy is closed and locked. Now have the rope or cable connected, but only when the pilot is ready (never to an empty glider).

O Options When there is more time before starting this checklist, think about a possible emergency that could occur if the launch or tow is interrupted for any reason. The options to land safely are very limited when very low so decisions made now mean less time wasted trying to work out options following the launch interruption. As part of this process, the pilots must also assess the wind strength; is it suitable for a downwind landing if there is sufficient height to make a 180° turn? And what approach speed would be used? And landable areas and obstacles, can a safe landing be made into an adjoining field if too low to maneuver? Then reassess the options that both pilots have agreed upon, right now, immediately before initiating the takeoff.
Teach the student to check additional items before starting the takeoff. To become a good, safe pilot the checks must be done systematically and well. First, wind direction and strength: a quick look at the windsock to confirm the wind direction and strength. Second, the runway must be checked to ensure it is clear of obstacles moving or fixed. This is of course part of the takeoff procedure so make the student check the windsock and then the runway as part of his "All clear above and behind?" query to the wing runner. It is the pilot's responsibility to confirm and be satisfied that the runway is clear and the flight is safe to start. We cannot, and should not rely on the towpilot or winch operator to do this for us. Lastly, the pilot should consider when they might have to initiate a release and the post release actions.

Emergency situations

Explain to the student that if in doubt about the takeoff for any reason, release immediately. For example, to guard against an inadvertent hangup of the cable in the wheel if the winch snatches the glider, it is important to shout "**STOP**" and to hold the stick fully forward to prevent taking off if the winch starts to pull the glider forward.

A potential emergency situation is the low-level cable or rope break discussed above. If very low a landing straight ahead is the only option. As you pass suitable fields at intermediate heights as you climb on aerotow, discuss options with the student so that in later flights the student can practice this planning. In later flights, question the student on the options at different heights and positions relative to suitable alternate landing areas.

Pilots can ask themselves if they are ready to "WROLL"?

Wind, Release, Obstacles, Landable areas, Launch interruptions.

CHECKS PRIOR to STALLS, SPINS, AEROBATICS and RAPID HEIGHT-LOSS EXERCISES

This checklist should be done also before doing any large height-loss maneuvers, for example sideslips or use of dive brake exercises at height.

CALL

C **Cockpit** The straps must be checked tight; check that the canopy is properly locked and there are no loose objects in the cockpit; the clear vision panel should also be closed, particularly before more abrupt maneuvers such as sideslips and spins. Check **Controls** for full movement, especially the rudder if spins are on the agenda.

A **Altitude** Must be sufficient to recover above specified minimum;

L **Location** The glider is not over the airfield, farm buildings or town. Many clubs have specific locations for such practice;

L **Lookout** To make sure other aircraft are not around, the best maneuver to use is steep linked turns (clearing S-turns) changing direction by 90 degrees one way and back again 90 degrees, looking ahead and below; include looking for aircraft approaching from behind.

PRE-LANDING CHECK LIST

SWAFTS

S **Straps** Tighten ready for landing. Straps have a tendency to loosen, especially on longer flights, it is a good habit to get into now, to retighten them;

W **Wheel and water** Although you may not have a retractable wheel many gliders do; so instruct your student to *go through the physical motions now*, and look at the placard or words on the label to ensure that the wheel operating handle is in the down position; water ballast must be dumped!

A **Airspeed** This must be adequate for the anticipated wind speed and wind gradient on *final approach*. Ask the student to estimate the wind speed and direction then select the approach speed; note that the speed is not increased until the **low key point**; in a strong wind or in a crowded circuit, for example, there may be good reasons not to speed up, even perhaps to loiter.

F **Flaps** Lower or set them as appropriate for the approach and landing; is the speed below the maximum for flap lowering? And retrim if necessary. Flaps for landing are normally left to final approach;

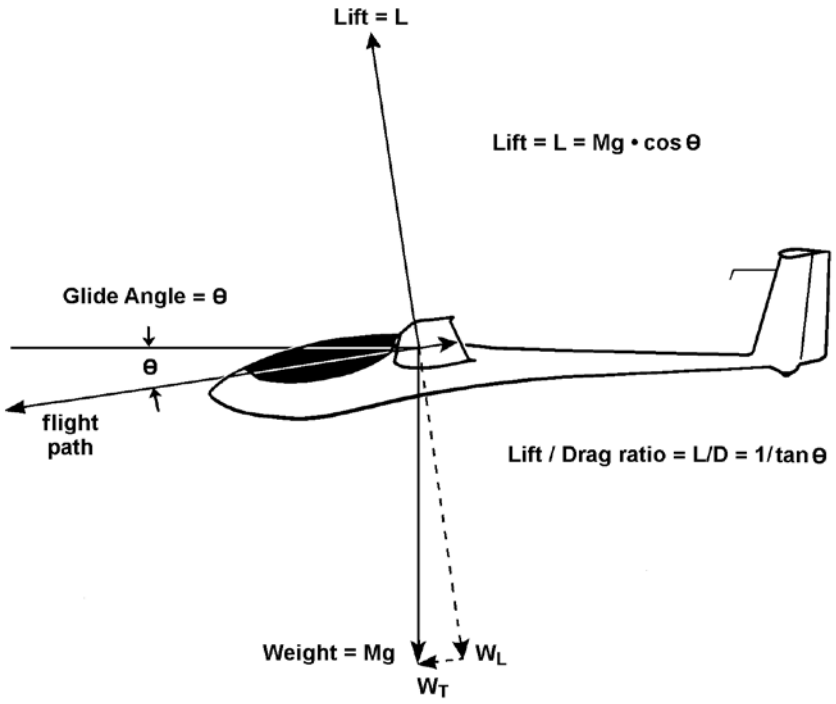
T **Traffic** Make the student check for traffic in the circuit area, including the possibility of someone on an opposite-sided circuit or on a long final approach; check also for aircraft and hazards on the runway. Make *radio call* at this stage to advise traffic of your intentions, after checking the selected frequency is the correct one for the local airfield;

S **Spoilers** or **airbrakes** should be unlocked, the handle confirmed to be the correct one, then the airbrakes must be *visually checked* for operation by looking at them as the handle is moved and kept ready for use (if the air brakes remain unlocked the hand must remain on the handle).

The pre-landing checklist should be started very conveniently before joining the **high key area**, (the holding area upwind of the airfield) and certainly before entering the downwind leg. This gives the student time to run through the checks and to get settled for concentrating on the circuit and landing. For this reason we should call it the *pre-landing* and not the *downwind* checklist. Therefore when a new student is first performing this checklist, make sure it is started well before the entry to the *high key area*.

The downwind leg should be flown at a minimum speed of 45 knots (50 mph). This should be adequate for most modern two-seat trainers. The speed should be increased before arriving at the **low key point** (i.e., opposite the *reference point*) or after descending below 500 feet above ground. When adjusting speed the pilot should be retrimming automatically as appropriate.

Note that the **A – Airspeed** item in the pre-landing check list is to calculate this speed; see also Chapter B9 for the formula to use for this calculation.



The weight may be considered as a force opposite to the Lift L, called W_L plus a force opposite to the Drag D, called W_T. They combine to give the resultant force = Weight = Mg

The force propelling the glider forward is the force W_T

hence the equivalent thrust = $W_T = Mg \bullet \sin\square$

Forces on a glider in a normal glide

CHAPTER B3 – EFFECTS of CONTROLS

OBJECTIVES

To teach the student the basic function of each control, and the response of the aircraft. Because this forms the foundation of subsequent instruction it must be taught clearly, thoroughly and competently.

PREPARATORY GROUND INSTRUCTION

First, a bit of theory! – How a glider flies

In this technological age, we benefit immensely as new designs of glider and new construction techniques give us faster and sleeker gliders. These machines are able to glide with extremely flat glide angles; some of us in fact wonder sometimes how does a glider fly? What propels it forward? The passenger or student may wonder about this too! At any time you should be prepared to discuss this aspect of gliding, and the following explanation can be studied to provide you with the necessary knowledge.

The diagram on the page opposite 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, Mg, is illustrated as a single force acting through the centre of gravity or ***cg***, and it is of course acting vertically downward. 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, Mg. 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 in the illustration. The tangent of the angle in degrees 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 one speed of the glider, the speed for best glide angle, or the speed for maximum L/D.

Opposite is a simplified explanation of the forces on a glider in straight flight; it will serve as an introduction to the upcoming lesson or flight, but may of course be discussed with a student at any time. A more detailed study of the subject will be given in the ground school course, often given by clubs during the winters.

The attitudes and movements of an aircraft

Before the student goes on a first instructional flight to learn the Effects of Controls explain that aircraft can move in six ways: there are three rotary motions and three translational motions or speeds.

The three rotary motions, or movements, are pitching, yawing and rolling; they are controlled respectively by the elevator, rudder and ailerons. The three translations are speeds in the three directions; these are forward speed, vertical speed and lateral speed. A glider is maneuvered or controlled by rotating it about one or more of the three axes. For example, a glider pointing north can only fly east by first rotating it to point to the east.

Aircraft fly in any of three basic attitudes or combinations of these attitudes:

- Nose up (in gliders gives only a brief climb),
- Nose down (which in gliders is the normal gliding or descending type of attitude),
- Banked, and/or
- A yawed attitude (which is a combination of two of the three basic attitudes and is used in side slipping maneuvers).

Effects of controls

The flying controls are operated from the cockpit by the control stick and the rudder pedals. Tell the student that sometimes the stick is called the control column or even the *joystick*.

The primary effect of each control is in its own plane. Point out here that the **elevator** controls the angle of attack, and that each angle of attack has a corresponding airspeed, airflow sound and pitch attitude. The elevator is often used to produce what is called a *pitch* change. Explain clearly what you mean when you use these terms.

The primary effect of the **ailerons** of course, is to roll the aircraft. So long as the ailerons are deflected the angle of bank will continue to increase as the glider rolls, so that to stop the glider continuing to roll, the ailerons must be centered. Point out that the ailerons are not used by themselves but are normally used simultaneously with the rudder. As it is not possible to demonstrate a pure rolling movement by using the ailerons alone, you will not be demonstrat-

ing this to your student. Instead you will demonstrate how to make turns in the glider, using the ailerons to roll the glider and the rudder *at the same time* to prevent adverse yaw. Aileron drag will be discussed and demonstrated to the student in the next lesson.

Although the **rudder** can produce yaw it is more normally used to prevent yaw, so that the glider does not slip or skid. It is important to explain that these three primary effects of controls are always the same whatever the current attitude of the glider.

Inertia

Like all bodies with any mass, a glider possesses inertia, that is it tends to maintain its speed. To change speed the pitch change must be held for some seconds before a marked change in speed becomes apparent. This can be quite noticeable when trying to increase speed.

Don't confuse the slow rolling of a sailplane as caused by its inertia alone – it is caused partly by the large wingspan and the change of lift distribution resulting from the changes in angle of attack of the two wings when rolling. Almost as soon as the ailerons are centered, the rolling stops because there is a large lateral damping force created by the (large) wing area. Even if there is a large mass in the wings (which gives the glider its rolling *inertia*) this inertia is often insufficient to maintain the rolling motion for more than a fraction of a second after the ailerons are centred.

Aircraft also exhibit a reluctance to yaw quickly because of a generally high moment of inertia about the vertical or normal axis. The sizes of the fin and rudder on different gliders will affect how easily the glider may be yawed or controlled in yaw.

Control of speed

Speed is controlled in gliders by the elevator. A change in pitch attitude will affect the speed; the more nose-down, the higher is the speed and the noise. When teaching speed control emphasize that attitude determines the speed, and it is best to use attitude as the primary reference for speed control. Listening to the speed is also important, so mention this when adjusting speed during your lessons. Teach the students to look at the horizon and to use it as the point against which to judge the glider's attitude. In the mountains or on hazy days, students initially may have difficulties with this concept, but after a few flights, they will be able to judge the horizon's location. We will use a pitching oscillation or *phugoid*, with the pilot *chasing the ASI*, to demonstrate and to emphasize that it is not easy to control speed by reference to the ASI alone.

Lookouts and the need for them

The main cause of mid-air collisions is failure to see the other aircraft in time. It is vital therefore to start the student on a first flight to become used to the idea of keeping an adequate lookout, even before we teach the effects of controls! This may take up valuable time, but an essential ingredient to good airmanship is being acquired, better teach it now than later when a habit of not looking out *habitually* in a planned manner may have become ingrained. The manner in which your student looks out is the only thing you can teach that could directly affect your lifespan!

Lookouts are particularly essential in thermalling with other gliders, in the circuit, in ridge and mountain flying, and when cruising for example under cloud streets. Although there are increasing numbers of gliders flying close to areas where commercial airliners also use the airspace, e.g. southern Ontario, it is the experience in Europe that most mid-air collisions are with other gliders.

There are some limitations to the eyes, and what they can tell us. Normally the eyes will focus at close to 1 to 2 metres when there is no clear object in view on which to focus. This can lead to tunnel vision in which our peripheral vision sees nothing and in effect shuts down. This can occur on hazy days when the pilot is looking into an essentially featureless field of view with no prominent object in sight. This condition is known as *empty field myopia*; though we think that we may be looking, we see nothing. The same tunnel-vision phenomenon can happen when the pilot experiences high stress levels.

There is difficulty also finding other aircraft when the ceiling and visibility are unlimited and the view is filled with detail; it becomes difficult to detect a moving object against all the detail, be it a cluttered cloudscape or ground details. This means that if we constantly move our eyes when searching we will not be able to pick out what we need to see. Hence we have to fix our eyes on a point – our eyes and brains are adept at picking out a change – so we are able to pick out a moving object, but only within a narrow cone of about 10 to 15 degrees. It is important also to remember that the eyes do not easily see motion directly ahead, so it is important to allow the eyes to pause during the scans to each side. An object moving over the background will be picked up by the peripheral vision within the cone, and then the eyes can be focussed more on the object itself to

identify it.

If we compare the scanning technique to that of maintaining a lookout when driving there are some important differences. First, car drivers in general are not used to looking *around*; their scan, if one is used at all, is much more limited to basically the road ahead. In a glider we are asking them to swivel the head, something people have varying difficulty with, particularly older people who have well-ingrained habits. Asking students to keep a good lookout and at the same time concentrate on flying will be difficult at first, but it is **essential** that we do this even as flying accuracy will suffer. But after a bit of practice, the lookout will become more automatic and flying accuracy will improve.

Lookout scanning technique

The method is to focus on one wing tip first, this then gets the eyes to focus beyond the at-rest 1 to 2 metre focus distance, then to look as far as possible behind the wing. Scan along the horizon, also above and below it (for example for a glider on tow approaching from below), pausing every 15 to 20 degrees, working to the front. Then look at and focus on the other wing tip, and repeat the scans to the front. Finally complete the lookout by **searching up and above the glider**, then look **ahead** again to the horizon. When the pilot is sure the area is clear of conflicting aircraft, a turn may be started. If a turn is to be made to the right, start by focussing on the left wing tip.

Types of lookout

There are seven (!) basic types of lookout. They are when a pilot is:

- about to change direction to make a turn,
- as above but at the same time climbing to slow into a thermal,
- climbing in a thermal,
- about to leave a thermal,
- in the circuit,
- when flying straight and level, for example when cruising between thermals, and
- when about to perform height-loss exercises such as airbrakes exercises, stalls or spins.

All rely more or less on the scanning method. The fine differences are not immediately apparent to a student, but these have to be explained as the lessons progress. Rather than teach seven separate techniques, we should teach the scanning technique as the basis for performing all the other lookouts. If other gliders are in the vicinity, this can be used as a teaching aid to emphasize the need for performing careful and continuous lookouts. To save time, we recommend teaching the basic technique during the latter part of the aerotow or immediately after a winch launch on a student's first instructional flight.

Although looking in the direction of the intended turn is a no-brainer, looking to the opposite side is not so obvious. However, another glider or possibly a faster-moving powered aircraft may be approaching from that side, and as the glider is rolled into the turn, the high wing may obscure the approaching aircraft and in any case the glider pilot is now concentrating in the turn direction. Hence take a good look to the *other* side as well.

Because mid-air collisions have occurred as gliders have climbed into thermals, this situation requires the scans to be finished by looking directly above and ahead before rolling into the turn. Thermal flying increases the cockpit workload, especially when there are several gliders also in the thermal. This can lead to neglect of other search areas as the pilot concentrates on the gliders he can see already! Looking **behind and under** the high wing for following gliders as well as **behind and over** the low wing in the turn direction are both important and should be taught. If the pilot is the only one present in a good thermal, he should expect others to join, hence keeping a good lookout throughout the turns is important. Seeing a glider early is going to avoid the "where did *that* come from?" exclamation as another glider rapidly climbs into the same circle. It is both pilots' responsibility to maintain adequate lookouts, and to keep tabs on all possible conflicts continuously, so as to avoid mid-air conflicts. Vigilance is still required because it is the experience that most collisions occur away from thermals!

When straightening out from a turn, especially from a thermal, a good lookout is needed to make sure that no glider is following on the outside of the turn. The lookout therefore must include looking **behind and under** the high wing for another glider that may be circling at the *same height* and that would be in conflict when the pilot rolls out of the turn. Search again to the *inside of the turn* and then straight ahead and *above*, before rolling straight. This lookout technique is applied also during the circuit, when it is important to be aware of other gliders and towplanes approaching the airfield prior to landing. A continuous lookout should be performed while flying the downwind leg, concentrating on the possibility that other gliders may be in the circuit ahead

and behind. The lookouts before the turns to the diagonal and base legs must look behind as far as possible, including looking above (on the outside of the turn) and below (to the inside of the turn). Before making the final turn perform a good search for aircraft that may also be coming in to land from the opposite side of the runway, or from a long final approach.

During **straight flight** the main areas of concern will be in a narrow arc to the front, from about the 11 o'clock to the 1 o'clock positions. This is the area that we should concentrate on, but not to the exclusion of the 9 o'clock to 3 o'clock areas, bearing in mind that when cruising between thermals or on a mountain ridge, other gliders could be following closely or approaching in the opposite direction at fast closing speeds. As the pilot searches for likely looking lift areas ahead therefore, he should be taught to maintain a good lookout for aircraft in these other sectors. This includes more careful attention also to airways and likely approach paths of jets and other commercial traffic close to major airports, and should recognize that closing speeds can be very high.

Finally lookouts are an essential part of the CALL check that is performed before doing **height-loss exercises** such as stalls and spins. There are some recently-introduced exercises such as the use of the airbrakes at altitude exercise that will be flown essentially in a straight line, and that will lose height rapidly. The lookout must concentrate on the areas below and ahead, and in the case of spin exercises the pilots should make sure no other aircraft are below in an area all around the glider. When the exercise is continued for some time or repeated, the exercise should be stopped briefly, and the lookout performed again before resuming the exercise.

PRE-FLIGHT BRIEFING

Immediately before getting in the glider, give the pre-flight briefing for this flight. Give the student a simple, but well thought-out explanation of the cockpit and controls. The explanations can be carried out in the hangar or on the field. At this early stage do not get involved in highly detailed or lengthy explanations. The student should remain outside the cockpit where he can easily see the motion of the control surfaces, including the trim tab and dive brakes. Initially a very brief description of the primary effects of the controls is all that is required. If necessary, explain with a single seat glider if a two-seat glider is not available. Make sure the student is facing forward, in the direction of flight.

Before getting in, teach the student how to perform an outside inspection or walkaround inspection of the glider. This is to check for damage from ground objects, air in the tires, the presence of control locks and tail dolly, inspection panels in place and so on. Then perform an interior inspection. This must include checking for loose objects like ballast – is it in place or does it need to be removed? In addition, is the seat properly adjusted and secured in place? The pilots will then get in the glider and should attach the shoulder and lap straps before starting the CISTRSC-O checklist.

Explain next who will be doing what parts of the flight, i.e. the instructor will fly the glider until after the release, he or she will first demonstrate with the student following through, then the student will practice, and so on. This will continue until the instructor takes over control for the major part of the circuit and landing. You may give a further briefing during the latter part of the launch to remind the student of the essential points of the lesson.

Remember that this briefing is short compared to the *preparatory ground instruction*, given earlier. This *pre-flight briefing* is the legally required briefing to be given to a student pilot immediately before every flight, whether dual or solo. Also include any safety points or Human Factors that will apply to your lesson, deal with anxiety etc.

ADVICE TO INSTRUCTOR – AIR INSTRUCTION

A first or introductory flight

If a person has never flown in a small powerplane or glider before, he or she should be taken up first as a passenger to get accustomed to the sensation of flying, and to the appearance of the country from the air. Even if this person has flown before, there is considerable value in a flight that does not involve serious instruction; it will accustom him to the aircraft and to the surrounding area.

Although as far as the student pilot is concerned this is in some sense a passenger flight, he should be put into the seat from which he will subsequently fly. Ask your student to keep his hands off the control column, and feet off the rudder pedals, particularly at the start of the flight.

Speak distinctly

Make every effort to speak distinctly, to find out whether you can be heard, and choose the most suitable words and phrases. At release height warn the passenger or student about the noise of the release,

and then allow them to pull the release if they have been pre-briefed and if they accept this.

Explain the highlights

While it is premature to make any serious attempts at teaching, explain what you are doing, such as flying towards the club, or you are in the circuit with the runway to the left. Point out prominent landmarks, the position of the airport and means of locating it. Encourage passengers to look outside the cockpit and to regard themselves as part of the aircraft. Ask questions such as "Where is the airport now?" As the opportunity arises point out the various attitudes of flight, and allow the passenger to briefly handle the controls. Mention that only small control movements are usually needed to fly the glider. (Non-instructors are not allowed to let passengers handle the controls.)

Airsickness

If, during this or subsequent flights, the student or passenger shows signs of airsickness, bring them down at once. Twenty to thirty percent of all first-time passengers experience slight nausea. Do not, however, mention to your passenger the possibility of airsickness before the flight. If he begins to go quiet, or the area behind the ear lobes goes pale, your passenger will soon feel sick, although he will not feel any sickness at this point. This is your sign that you must fly very steadily and land as soon as convenient. Try distracting him from any sensations by getting him to look out at particular landmarks, and to ask whether he sees the same things that you do. Suggest to the passenger that he or she open the clear-view panel if it is closed. Concentrate on the flying and don't become distracted yourself! If sickness does occur, do not make too much of it.

Power pilots

Power pilots will quickly notice before takeoff how close to the ground they are! They will need to remember this before flaring. Explain the takeoff and towing procedures and point out the lack of noise and vibration compared to a power aircraft. Let the pilot handle the controls on tow and in free flight if you feel comfortable. In free flight they will feel more at home. Point out that the glider is often flown closer to its stall speed than is typical for power aircraft and therefore its control response is slower. This is where the special ASI (usually 1½ revolutions) comes in handy. Point out that speed control in gliders is best achieved by controlling the pitch attitude and keeping a good lookout, and chasing the ASI does not do it! At slower speeds, pronounced control movements are needed to fly the glider well and more attention to coordination, with firm rudder use, is required.

Before the approach and landing, mention the smaller circuit and the strong need to assess the effects of the wind throughout the flying of the circuit**.** You may allow the passenger to follow through during the approach, the flare and hold-off for landing.

Induce the passenger to come back for more

Remember this is the passenger's flight; many people are easily put off flying so it is essential you try your utmost to see that they enjoy it and will want to come back for more. Use the *best* two-seater for introductory flights, the passenger will be more favourably impressed with the silence, comfort and great visibility in a modern glass-fibre machine! Don't fly passengers in the old clunker, in rough air, and do not do aerobatics, however mild, even if they have asked you to do some.

The first instructional flight

In this lesson you will be starting with teaching the basic LOOKOUT technique during the aerotow, or immediately after a winch launch, before explaining the *primary* functions of the controls, which are:

- Elevator produces and controls the Pitching movement.
- Rudder produces and controls the Yawing movement.
- Ailerons produce and control the Rolling movement.

Lookout

Although you are advised to teach the basic scanning technique during the first aerotow or immediately after a winch launch, stress the need for good lookouts before all turns, in turns, when straightening out of turns and when flying straight. Now is the time to establish good habits, before they become used to flying around without performing good lookouts.

Effects of controls

We will be demonstrating the effects of controls in this first lesson but we will not be showing all three *movements* of the aircraft separately because when rolling, for example, we always use the stick and rudder together! The important point here is that if the student were to practice use of ailerons by themselves to produce the rolling movement, and follow this with applying rudder also by itself for the yawing movement, the *law of primacy* says that the student's first lesson in flying will have to be unlearned! Therefore we use a coordinated gentle

turn in the first instructional flight, and during the turn discuss the effects of the controls separately. But the student will be using stick and rudder together in this first lesson.

When demonstrating in lesson, first make sure the glider is flying straight and that the wings are level. Use the front of the instrument panel or sides of the cockpit to help judge the attitude of the glider relative to the horizon.

Tell the student to place the feet lightly on the rudder pedals. On most types the heels should be on the floor to take the weight off the feet. The control stick should be held lightly (try to get the student to use the fingertips and not the fist) and the wrist should be free to flex. Again, teach the student to look ahead, to see clearly how the aircraft moves (for example, relative to a point well ahead, and to the horizon itself).

The following notes are too detailed to carry in the glider but a convenient shortened version is in the *Instructor's Air Notes*. Use those notes as memory jogs in the cockpit, but supplement them as needed to suit your preferences.

Pitching (the primary effect of the elevator)

Before demonstrating the primary effect of the elevator to produce a pitching movement, point out the position of the nose in relation to the horizon, with the aircraft in a normal level attitude. This is called the *normal gliding attitude*. Instruct the student to follow through, then continue.

Move the control stick forward by a small amount, and hold it there; notice that the glider's nose pitches down to a nose-down attitude. In this attitude, the airspeed slowly increases. Point out that this is because of the glider's inertia; it reluctantly changes speed (unless of course it is pointing steeply down).

When a gentle backward movement is made on the control stick, the glider will tend to pitch to a nose-up attitude. In this attitude notice that the airspeed will decrease. Then return to the normal gliding attitude by *lowering the nose*. This command to *lower the nose* is important because we no longer should refer to stick movements. This is linked to the stall recovery command (see later under *Stall Recovery* in Chapter B6, page B6-5).

Remind the student that the above is known as the *Pitching Movement* of the aircraft, and it is normally produced and controlled by the elevator. This pitching movement is a movement about the lateral axis of the aircraft. Also the elevator controls the angle of attack, and each angle of attack in straight flight has a corresponding pitch attitude, speed and airflow sound. This discussion is more usefully covered on the ground of course, before the flight.

Mention briefly now that most gliders are fitted with trim devices to help the pilot fly at selected airspeeds without having to hold a constant forward or backward pressure on the control stick. This is covered fully in the exercise on stability in Chapter B5.

Speed control and using the airspeed indicator

If time permits on this flight demonstrate the control of speed. A demonstration may not be necessary because you may well be able to instruct the student to do it as he continues to fly the glider. Ask him to read the ASI, then lower the nose and hold a new attitude. Again get the student to read the ASI and notice that it takes some time to speed up; because of the glider's inertia (not because of *ASI lag*, which is almost non-existent). Then take over control and demonstrate the airspeed oscillations as you try to control speed by watching the ASI only. However, do not allow the student to concentrate on the ASI to the detriment of maintaining a good lookout!

In this demonstration you will have to *impersonate* a student who has yet to develop the anticipation that you have. In other words he would let the speed go lower than desired, before beginning a correcting action. He or she will probably overcorrect so that the speed will again overshoot the desired value. Demonstrate this, then *fix* the attitude by using the horizon and show the student that, even in rough air, fixing the attitude is how to control the glider's speed. The ASI is only used as a check to ensure that the speed is what you want. This use of the ASI as a speed check is particularly vital in the circuit and on final approach, when the ASI should be checked more frequently. This will be mentioned again in the section on *Flying the Approach* in Chapter B8.

Yawing (the primary effect of the rudder)

Choose an easily identified object well ahead or on the horizon and have the student follow through on the rudder pedals only. To yaw the glider, press one of the rudder pedals, but not excessively, and notice the nose swing to the side. The glider continues to fly towards the object but with a distinct skid – the rudder does not turn the glider. If the pedals are centered again the nose will tend to swing back. During the skid, the yaw string outside the canopy will be blown to the side indicating that the glider is skidding sideways through the air. If a ball, slip indicator is fitted the ball will move in the opposite direc-

tion to the yaw.

Emphasize that the rudder is normally used to prevent the glider from slipping or skidding, by controlling any yaw. In other words it is used to keep the airflow absolutely straight with respect to the aircraft (more correctly the rudder moves the aircraft so that it flies with the airflow parallel to its longitudinal axis). The yaw string pointing straight up the canopy, or the ball in the slip indicator being in the centre shows lack of slip or skid. When demonstrating this movement, use only very small amounts of rudder deflection. Do not allow the student to try this use of rudder only, for two reasons. First, we do not wish the student to learn in this first flying lesson that yaw will lead to the glider rolling; further effect of rudder, remember? We don't want him to think that he can turn the glider with rudder alone – turns are covered in the next lesson. What we are demonstrating now is yaw, so try to keep it as a pure yawing motion, in other words keep it simple.

Rolling (the primary effect of the ailerons)

A rolling movement is a movement about the longitudinal axis of the aircraft, and the ailerons are used to produce it. As mentioned earlier, we will demonstrate this when rolling into a gentle turn using stick and rudder together.

Fly the glider with the wings level and point out to the student the level attitude of the glider with respect to the horizon (instrument panel or sides of cockpit relative to the horizon). Now demonstrate a banked attitude; you should turn a small amount as you maneuver back towards the airfield. Then return to wings level. Now initiate a gentle turn by applying ailerons and rudder together, e.g. to the left. Move the stick and rudder to the left and the left wing goes down, that is the glider rolls to the left. The effect of the ailerons is to roll the glider, and the rudder is used to prevent adverse yaw. How much rudder to use will come with practice, but we need to establish simultaneous use of the two controls now. Stop the rolling by centralizing the stick and rudder. During the turn the angle of bank may change and therefore this is controlled by using the ailerons and rudder together. Mention again that the primary effect of the ailerons is to roll the aircraft, but that we normally use the stick and rudder together at the same time. Next raise the wing (roll out of the turn) by moving the stick and rudder together to the opposite side and again centralize both controls as the wings come level. This can be repeated to the right.

Point out that so long as the ailerons and rudder are deflected the bank will continue to increase, hence when the desired angle of bank is reached the controls must be moved back to the centre. Although not strictly correct, we say centralize for brevity. Later we would say, "… Stop the bank from increasing", but note that we would not normally need to add "… with stick and rudder together". However, reminders later undoubtedly will be needed!

POST-FLIGHT REVIEW

This is an important part of the flying lesson and should not be omitted. Briefly go over the flight's main points, and ask questions to find out how well the student has absorbed the lesson. Stress again the need for performing good lookouts, even if this means that their flying is not too accurate at this stage! Discuss any safety or HF that were relevant to the flight.

Give the student an assignment such as to read the next chapter in the soaring student's manual, *SOAR and Learn to Fly Gliders*.

CHAPTER B4
AILERON DRAG, GENTLE TURNS and STRAIGHT FLIGHT

OBJECTIVES

To teach the student that ailerons have an undesired effect that causes adverse yaw, how to correct for this adverse yaw, and to teach gentle turns to fly towards an horizon reference point. Yes, we introduced the student to gentle turns in the previous lesson, but that was to show the effects of controls, and to allow the student to feel that he or she can fly by making useful turns from the start. In this lesson we will explain why the rudder has to be used together with the ailerons when making turns.

To place an emphasis on safety from the start, this flight also will be used to learn the rules of the air and methods to avoid other aircraft.

MOTIVATION

This is one of the first essential lessons that must be clearly understood, as it forms the basis of good, coordinated flight in later exercises. Soaring is characterized by turning in rising air. Hence accurate turns must be made to stay up and to gain height most efficiently. Knowing what to do when other gliders or power aircraft are close by is an essential part of developing good airmanship in students and enhancing safety of flying in gliders.

PREPARATORY GROUND INSTRUCTION

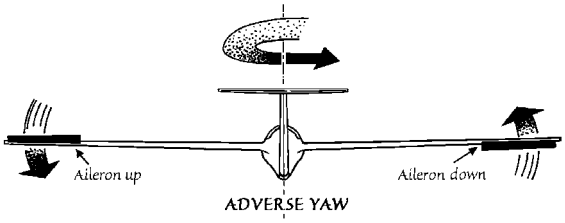
Introduction

This flight exercise will produce changes of direction; the student must be taught the rules of the air, therefore, and reminded to complete a good lookout before rolling into and out of all turns.

Aileron drag

When ailerons are used to roll the aircraft for a turn, there is a tendency for the aircraft to yaw in the opposite direction first, before and as it starts the rolling movement. This is known as *Adverse Yaw*. In modern gliders adverse yaw is not very noticeable but in sailplanes with large wingspans it becomes quite noticeable. It can be demonstrated easily in most types by movement of the ailerons alone. However, this demonstration is for the instructor only – the student should *not* repeat it. This is to avoid students practicing use of the stick only, because it would be one of the first things learned! This demonstration is followed by correct use of stick and rudder together to roll the glider, and it is this that the student should try to repeat.

During the demonstration, the down-going aileron increases the angle of attack locally, increasing the lift over that portion of the wing. In less aerodynamic terms the deflected ai1eron is pushed into the full force of the airflow beneath the wing, and this produces more lift, which helps to roll the aircraft. At the same time, this action produces more drag, called *Aileron Drag*. The up-going aileron causes the wing to produce less lift, also helping to roll the aircraft, but at the same time reducing the drag of that area of the wing. The resulting imbalance in the drag produces a yawing movement in the opposite direction, away from the intended direction of turn. Some pilots also think this is a primary effect of the ailerons, and in a sense it is, but because it is an undesirable effect we do not refer to it as a primary effect.



Use a glider on the ground to demonstrate the movement of the ailerons; ask the student to suggest which way it will roll and which way it will yaw. Then discuss how to prevent adverse yaw by using the rudder simultaneously with the ailerons. This is an essential part of this exercise and must be done.

Gentle turns

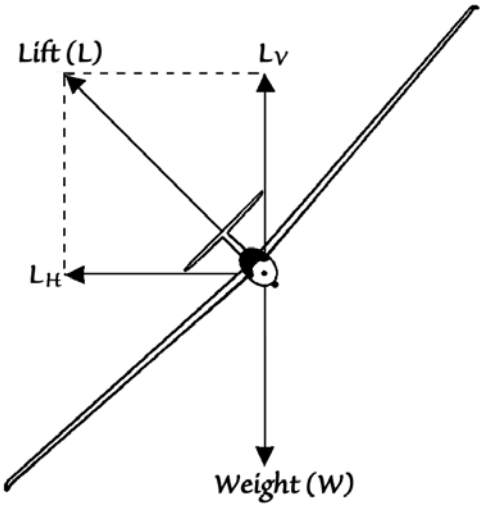
Before making any turn, point out again to the student that a good **lookout** for other aircraft must be made, as taught on the previous flight. Use the scanning technique, and when you are sure that it is all clear, look ahead again, then start the turn.

Turns have three stages

To turn an aircraft it is necessary to bank it in the desired direction of the turn so that the lift of the wings is inclined inwards, remembering that it is the horizontal lift force that turns the glider as shown in the diagram below.

There are three stages to any turn: rolling in, staying in, and rolling out.

To enter a turn use ailerons to bank the glider and simultaneously use rudder to prevent adverse yaw. When we reach the desired angle of bank, stop the



bank increasing with ailerons and at the same time reduce the amount of rudder. If the rudder correction is good the yaw string will remain pointing straight back, and the ball will stay in the centre, showing that the glider is flying as desired, without slip or skid. In a continuous turn the angle of bank is kept constant by making corrections with stick and rudder together; and the pitch attitude is kept constant with the elevator. During the turn the nose will be seen to move steadily around the horizon. The student should be instructed to watch for this effect.

To roll out of the turn, look ahead, then level the wings using ailerons and rudder together, and centralize the controls as the wings come level. Verify the pitch attitude, and correct it if needed.

At this stage it is more important to get the student to use the ailerons and rudder together, both when entering a turn and when rolling out of it. With practice the balance between how much aileron and how much rudder to use will be improved, although it need not be perfect now! So too the yaw string need not be centered, so long as the rudder and ailerons are used simultaneously. By all means point out the yaw string, and how slip or skid affects it; if the aircraft has a ball mention the effect on this too. Although we try to keep these centered by using the rudder, caution the student against concentrating on the ball or yaw string too much at this stage; the finer points of how to use the yaw string can be taught on later flights.

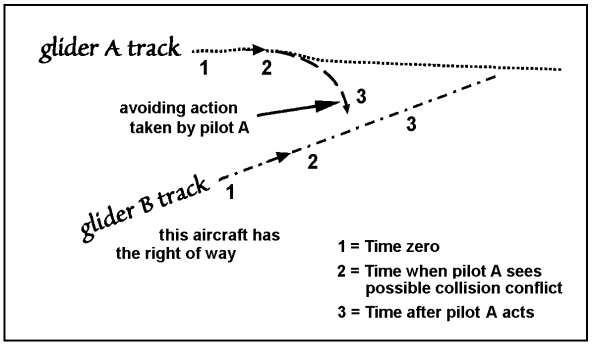
You may teach also an easy method of assessing the amount of rudder input as the student initiates a turn. By looking directly ahead it is easy to see whether the nose begins to swing (the glider tends to yaw because of aileron drag) before the glider starts to roll in response to the aileron deflection. If the swing is away from the intended direction of the turn, not enough rudder input has been used. Conversely if the nose swings strongly in the direction of the turn, and the glider has not yet started to roll, then the pilot has applied too much rudder.

You can see this effect also in a propeller-driven aircraft! This is a great technique, and it means that pilots do not have to concentrate on the yaw string or ball indicator, but can maintain a good lookout ahead and in the direction of the turn, of course.

Collision avoidance

Refer the student to the Rules of the Air inside the front cover of *Soar and Learn to Fly Gliders*. They are also inside the cover of this manual.These show that if a collision is seen to be imminent, both aircraft must alter course to the right. Teach your student that we cannot assume the other pilot has seen us, and if the situation demands, a diving turn to the right might be the best action.

Accident investigations show that head-on collisions are rare, so we need to discuss other hazardous situations with our students, such as gliders on converging courses. The example shown on the next page has another glider converging toward you at about the same height from your right. You *have* to give way.



A diving turn to the right, *towards* the other glider, will quickly get you below and behind the other aircraft. You will now be flying away from each other and the risk of a collision has been averted. If you had turned to the left, you would have turned your back on the other glider and soon lost sight of it. The other pilot may not have seen you either, and you have substantially increased the risk of a collision.

Although gliders have the right of way over powered aircraft, we should not assume the power pilot has seen us; we need to maintain our vigilance and make a move if necessary. During the pre-flight briefing concentrate on what actions to take to avoid other

aircraft, emphasizing:

- the aircraft on a collision course does not appear to be moving, it remains stationary in the canopy but it steadily increases in size;
- another aircraft at the same height is on the horizon and it is more difficult to see than one above or below the horizon;
- collisions tend to occur most often when the pilot is distracted (by adjusting the GPS/map reading) or when busy (in a thermal);
- in the circuit relative speeds tend to be low but collisions can occur from unlikely directions;
- one of the greatest risks of collision is from the front when it is difficult to see each other; extra care is needed with lookouts in the narrow-cone, field-of-view to the front.

ADVICE TO INSTRUCTOR

The Importance of lookout

Reminders of the *Importance of Lookout* should be given throughout training of course. Before rolling into or out of any turn a good lookout should be done by searching to both sides of the g1ider, concentrating mainly on the horizon, but particularly ahead and above as detailed in the previous lesson. There is some evidence that mid-air collisions have been caused by a glider hitting another from below; hence this looking *ahead and above* is needed as part of a good lookout. Large peaks on ball caps or hats are to be firmly discouraged in the cockpit because they hinder the view above. They are very useful on the ground however, to keep the midday sun from frying us.

Straight flight

The aim of straight flight is to keep the glider flying at a steady speed, in a set direction, with wings level, without slip or skid. At this stage in the student's flying this is a difficult exercise to do well since flying straight is really a whole set of gentle turns towards a point ahead that has been selected. Point out that if the glider appears to be turning, even very slowly, it is usually because the pilot has allowed the wings to bank a little or because of air motion such as a thermal. A visual check of each wing tip can be made to verify the amount of bank. To get back on course therefore requires a gentle turn the other way, using coordinated aileron and rudder inputs.

Use of controls

Explain to the student in these early exercises that normally the controls should be moved firmly, but by a small amount. Then wait to see if an additional or correcting control movement is required. Some students have a tendency to move the controls continuously (to churn the butter!) especially if they have seen an instructor doing so; this leads to over-controlling. Hence the above technique is suggested; first move the controls then wait for the response. This suggestion can be usefully repeated on later flights if the student is having a problem with over-controlling. It is better to prevent a bad habit now than have to correct it later.

Comfort

The student will learn more quickly if comfortable and is able to relax (make sure), and if the controls are held lightly. Watch carefully in these early exercises. You will be able to determine if the student is receptive to learning, and if a good lookout is being kept for other aircraft.

Aileron drag and adverse yaw demonstration

In teaching aileron drag, get the student to look at an object on the horizon so that the yaw or swing of the nose can be noticed more easily. Keep the rudder centered and point out to your student that you are doing so. Now ask the student to notice the yaw as you use the **ailerons only** to roll the glider; then roll level again normally. The student is *not* asked to repeat this demonstration because we are going to try to teach the student *coordinated* use of the controls. Imitating us now using the controls separately could teach the wrong habit.

Next repeat the demonstration using ailerons and rudder together. Point out that aileron drag is on1y produced when the ailerons are deflected; hence the rudder is needed during aileron deflection. Don't go into a continuous turn at this stage, we are still demonstrating how to prevent adverse yaw. Now instruct the student to attempt coordinated use of the ailerons and rudder to roll to a small angle of bank, and then roll level again. Until he has quite a bit of practice, the amount of rudder is only approximate but this is not so important as the need to establish now, the **simultaneous** movement of **both controls**.

Review and practice

You can extend this into a very useful practice exercise. First pick a reference point well ahead (on the horizon) and then correctly roll into and out of gentle turns by doing a series of linked turns, so that you will essentially fly towards your chosen point.

As proficiency improves, your student can roll more briskly to a greater angle of bank before rolling back the other way, and should eventually be able to keep the nose aiming at the point, without slip or skid. But for early attempts, limit the change of direction to about 30 degrees either way.

If the student begins to lose the correct timing or coordination between the ailerons and rudder, stop the exercise and start again from a wings level attitude. This is a useful exercise that can be practiced at any time.

Continuous turns

Next move on to continuous turns, as described above. First demonstrate and then let your student practice the three stages of rolling in, staying in and rolling out.

Don't forget – LOOKOUTS at all times.

AIR INSTRUCTION

Choose a reference point, and fly at a speed of about 45 knots in a typica1 trainer. First demonstrate aileron drag. Ask the student to point out the yaw of the nose in the *wrong* direction for the assumed turn. Don't let the glider bank very much, as we do not want it to turn appreciably. Don't allow the student to try this demonstration as it again requires use of one control only, because it could lead to poor coordination later.

Demonstrate how to overcome the adverse yaw; point out the centered yaw string, and the effect on it of either slip or skid. This is what we want students to practice! Instruct them to try co-ordinated use of controls when attempting to overcome adverse yaw, and make each student practice these *turn entries and exits* in both directions. If the student is having trouble with coordination, start again, each time from a straight and level attitude, and limit the change of direction to less than about 30 degrees each way. You will soon be seeing your student achieving well-coordinated, linked turns as you fly towards the chosen point.

When doing this exercise, fly initially upwind so that drift over the ground, especially as you descend, will not confuse the student. As he gets closer to solo he should be able to fly straight without slip or skid as he *crabs* over the ground in a crosswind.

At the end of this flight the instructor will do the circuit planning, and should demonstrate a quick and efficient pre-landing checklist, SWAFTS, before arriving at the high key area. The student can be allowed to continue flying the downwind part of the circuit to increase airtime as these exercises are being practiced. The instructor should take over control in the latter part of the circuit for the approach and landing.

POST-FLIGHT REVIEW

Student recall of essential points

Ask the student to recall the essential points of the flight demonstrations, and encourage him or her to ask questions. Be alert to the fact that many students don't like to ask questions, as they don't wish to sound foolish or too lacking in knowledge. However, questions and their answers to your questions will give you useful clues as to how well you have taught that lesson.

Student's introduction to flying

This completes the student's introduction to flying; he or she knows the effects of controls, how to maintain attitude, has been shown aileron drag and how to roll into, stay in and roll out of a turn. The student's basic skills should enable him or her to do much of the actual flying. You will need to prompt their efforts "to use the horizon to judge our angle of bank".... or "check our attitude"... or "how much ground can you see ahead?"… or "do you hear the airspeed increasing?", etc. Hand over control to the student as much as possible. And reinforce the need for a constant lookout.

Airspeed indicator

At this time the first of the instruments should be discussed. Explain the basic functioning of the Airspeed Indicator (ASI), and show your student the pitot and static ports, and the need to keep these clean.

Errors that should be covered are, calibration error, density error, position error and lag error. Problems due to icing are rare in gliders but you should cover the possibility that water can accumulate in the lines, especially to gliders left tied down outside. As this instrument is very sensitive, instruct the student never to blow into the pitot tube.

CHAPTER B5
STABILITY & FURTHER EFFECTS OF CONTROLS

OBJECTIVES

To teach the student that the aircraft has built-in stabilities, and how these different stabilities affect the way it flies. Also to teach the student the further effects of controls.

MOTIVATION

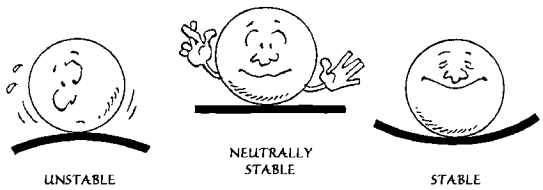
An understanding of these effects will help the pilot understand why the glider behaves in certain ways, and will enable the student to become a better, more competent pilot. It may be difficult to convince some students that the glider is stable, but an understanding of the principals will go a long way to alleviating any misgivings, and should provide the motivation needed to learn these points. If the student still has difficulties with this lesson, go back at a later stage in training and go over this lesson again, rather than tend to confuse the reluctant student at this early stage!

PREPARATORY GROUND INSTRUCTION

Stability

Any object which is stationary or in steady motion may be considered to be in an unstable condition, neutrally stable or a stable condition, as shown in the accompanying sketch. A ball, for example, resting on top of a dome is unstable because the moment 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 come to rest in a new position, depending on the resistance to the motion due to friction and air resistance for example. The ball in the hollow shape on the other hand is stable because if it is disturbed it will return to its original position. This return will likely involve one or more oscillations about the centre position, which due to friction will become progressively smaller until the ball again comes to rest in the centre.



Any aircraft may be said to be: Statically Stable or Statically Unstable, Dynamically Stable or Dynamically Unstable.

If, when a glider is disturbed in its flight path, it tends to return to its original path – it is *Statically Stable*, but if it continues to show a divergence from its path, 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 or there is no tendency to damp the oscillations which neither increase nor decrease in size.

FORMS of STABILITY

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

Longitudinal stability This is the stability about the lateral axis, it involves movement about this axis, and is the resistance to pitching motions of the aircraft. An aircraft unstable in this respect tends to continue a nose-up motion until it stalls, or a nose-down motion into a steep dive. In the design of a glider the horizontal stabilizer is sized and properly positioned to give the aircraft good long-itudinal or pitch stability. The longitudinal stability is very dependent on the position of the centre of gravity. If the c.g. is too far aft, for example with a lightweight pilot, the glider will tend to be less stable in pitch. This can be dangerous, and care must be taken to ensure that the glider is flown within the required weight and balance limits for that glider at all times.

Lateral Stability This is the stability about the longitudinal axis. It is the tendency of the aircraft to bank or unbank its wings once disturbed. An aircraft that is laterally unstable tends to roll. In glider design, the designer often employs dihedral to provide lateral stability. It is not easy to demonstrate this form of stability because there is an aerodynamic coupling between roll and yaw, which produces a spiral type of motion; it is not possible to divorce one from the other. Therefore explain that you will not demonstrate this feature.

Directional (Weathercock) Stability Directional, or what is often called *weathercock* sta-

bility, is stability about the normal axis. An aircraft with good directional stability will try to straighten out again to fly head on into the airflow, without slip or skid. The keel surfaces (the vertical stabilizer, rudder and sides of the fuselage of older gliders) give an aircraft this stability. Surfaces behind the *cg* are stabilizing, those in front are destabilizing.

As can be seen 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 that they will try to return to this condition after having been disturbed. A properly trimmed glider (in other words it is in balance), when flown with hands and feet off, will continue to fly steadily on its own; because it is inherently stable. If left to its own devices for any length of time, the glider might eventually go into a form of spiral with both airspeed and angle of bank increasing. This spiral tendency is caused by the aircraft's inherent *spiral instability*, however the glider is easily controlled in the normal way. This is mentioned again later under *further effect of ailerons.*

Further effect of rudder

Although the rudder is normally used to control or to prevent yaw, it may be used also 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 shortly tend to bank. This banking is initiated because during the yawing movement one wing advances faster that the other thus producing more lift. If the rudder is now held to the side this produces an outward skid. The dihedral of the wings (which gives the aircraft its lateral stability) plus the yaw gives the outer wing a larger angle of attack, and therefore more lift is developed by this wing than the inner wing. The rolling of the glider will therefore continue. This is known as the further effect of rudder. The combined yawing and rolling movements would eventually lead into a spiral dive if not corrected.

When briefing a student prior to flying, it is most useful to use a model, or even the club's two-seater, to show and demonstrate how the glider will react to the initial yawing and to the continuing skid. Caution the student that a rapid use of the rudder when flying slowly close to the un-accelerated 1*g* stall speed could cause one wing to stall, and if uncorrected by first unstalling the glider, this could lead to a full spin. This is covered later in further stall-spin exercises.

Further effect of bank

The further effect of bank is sometimes called the *secondary effect of ailerons* and must not be confused with aileron drag. Imagine that we roll to a banked attitude, and that we use the rudder correctly to prevent adverse yaw at which time the ailerons and rudder are returned to their neutral or central positions. The glider will begin to slip inwards 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 stability, or *tendency to weathercock* will try to remove this slip by yawing the glider towards the lower wing tip. It is this **yaw** that is called the **further effect of bank**. It is only indirectly due to the ailerons, of course, although some people prefer to call it the further effect of ailerons. Notice again that it has nothing to do with aileron drag.

This exercise can be used to demonstrate the fact that to fly a continuous turn correctly all controls have to be used, and that if left to its own devices the glider will eventually go into a spiral dive with both airspeed and angle of bank increasing, caused by the aircraft's inherent *spiral instability*. Although this is a difficult effect to demonstrate convincingly (and perhaps to understand when first learning to fly) it should be covered eventually during flying training. Choose a calm day. Precede the flight with a clear explanation of what you expect the student to observe.

The trim

To fly at any speed, the pilot moves the elevator in such a way as to adjust the glider's attitude for the desired speed. To do this the pilot has to provide a load through the stick; a heavy pilot will often have to pull back continuously (to apply a *backward pressure* to the stick) whereas a light pilot may have to push to maintain the normal gliding attitude. To overcome this stick force we *trim* the glider. The stick force becomes zero when the glider is properly trimmed.

There are two basic methods of trimming a glider – aerodynamic and mechanical. In the first method a trim tab is used on the trailing edge of one or both elevators. Moving this provides an up or downward aerodynamic load on the elevator. This load cancels the force that the elevator is applying to the push-rod system, the stick force reduces to zero, and the glider is trimmed. The trim tab is controlled by a small lever or handle mounted on the side of the cockpit; move the lever forward for a nose-down trim change, and backward for a nose-up trim

change.

In the second method, an internal spring or similar mechanism is used to apply a force to the elevator push-rod system so that when properly trimmed there is no residual force on the stick: the glider can be flown *hands-off*. In this type of system either a lever is used, as for the trim tab system, or a hand-grip on the stick is used to adjust the internal spring as the pilot adjusts the stick position.

ADVICE TO INSTRUCTOR

An understanding of stability and further effects of controls is essential for learning to fly properly. For some students this lesson may confuse them at this early stage if it is made too complicated. In such cases your demonstrations and explanations must be kept simple and be done in small steps. Don't omit this lesson, but if necessary return to it later when the student has more flying experience. It must be understood before solo. However, try to cover **stability** and **use of the trim** at this time, and return later to the **further effect of the rudder** and **further effect of bank** if needed. It is the secondary effects of controls that make coordinated flight so difficult to achieve, and a later understanding of these effects is usually very helpful, particularly if the student had difficulties understanding these effects earlier.

AIR INSTRUCTION

Keep demonstrations clear and simple. Only use small deflections of the controls when demonstrating each form of stability, then return the control to its central position. It is helpful to have calm air, and again, keep it simple.

Stability

When demonstrating **longitudinal** (**pitch) stability**, first trim the glider to fly hands-off in the normal gliding attitude, with the student observing. Clap your hands to show this! Get the student to 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. Use larger disturbances to show how stable the glider is, and how quickly it's longitudinal stability will return it to its original speed.

Weathercock (directional) stability

Get the student to look at an object on the horizon and notice how the nose yaws to the side of this object as you apply a small amount of rudder input. The rudder has to be centred again straight away (to avoid any further effects), and the nose watched to observe it yaw back again. This often occurs more slowly. Do not allow your student to practice this demonstration; it requires rudder only, and it is possible he may learn that he can *point* the nose with the rudder. We want to avoid this and to concentrate instead on coordinated use of ailerons and rudder, as discussed earlier.

Lateral stability

Lateral stability is not easy to see, as it is difficult to get a pure rolling motion without aileron drag! Hence we do not demonstrate this feature. Most gliders have a mild and easily controllable *spiral instability* that is discussed in the section below, under *Further Effect of Ailerons*.

Use of the trim

It should be possible to talk the student through this exercise, to learn to use the trim correctly. Start from the normal gliding attitude. To increase speed, lower the nose to a new attitude (do not refer to the speed or the ASI) and notice that a force is needed on the stick to maintain the new attitude (and hence speed). Now adjust the trim to reduce the stick force to zero. Check by letting go of the stick. If properly trimmed, the glider will continue to fly at the new attitude without a change in pitch.

Further effects of rudder

This demonstration is to be done by the instructor, and the student should not be asked to follow through. This is to avoid the student developing the bad habit of NOT coordinating all three controls together (note – Law of Primacy).

Fly at a speed slightly slower than that for the *normal gliding attitude*, but not close to the stall speed (!) and apply rudder one way (e.g. to the right) while holding the ailerons centralised. The glider initially yaws to the right, and the left wing speeds up and generates more lift; the glider rolls to the right. Continue to apply rudder, glider skids, note the yaw string, left wing generates more lift because of the glider's lateral stability or *dihedral*, and the glider continues to roll. Only a small rudder deflection is needed to begin this banking tendency. Maintain the pitch attitude and hence speed constant. Finally return to wings level by normal, coordinated use of the stick and rudder.

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.

Again, the instructor is to demonstrate this effect and the student should not be asked to follow through.

Roll to an angle of bank of about 20 degrees and then centralize both the rudder and control stick, and then fly *hands off* to let the glider fly by itself. In most trainers in calm air the effects discussed in the ground briefing can then be seen. As the speed increases the angle of bank increases and the nose tends to yaw more towards the lower wing. Recover to wings level by using the stick and rudder together, i.e., using the rudder to prevent adverse yaw.

POST-FLIGHT REVIEW

You may detect that some students will find it difficult to recall all the items of this lesson, particularly if you have covered all of them in one flight. Try to isolate each item and briefly go over the main points again, when you have landed. The most important points of this lesson are that first, the glider is stable, and second that the wings are kept level by using ailerons and rudder together, even when flying quite slowly. You should remind and caution the student that a rapid use of the rudder near the stall speed could cause the glider to start a spin (this is demonstrated later, in one of the exercises *Changing Effect of the Rudder at the Stall*, covered in Chapter B15). Discuss any safety or HF points that arise from the exercise

CHAPTER B6
UNACCELERATED STALLS & RECOVERY; SLOW FLYING

OBJECTIVES

- To teach the student to recognize the symptoms of an approaching stall, and to avoid an inadvertent stall,
- To teach the proper techniques to recover correctly from a fully developed stall,
- To develop coordination and to instill confidence in the student in handling the aircraft, especially when flying slowly.

MOTIVATION

To improve piloting ability, to enable the pilot to become relaxed and to recognize and therefore avoid a stall, to correctly recover from a stall with minimum loss of height, and to become confident at flying slowly while thermalling.

Pilots who are proficient at flying slowly will be able to learn to do correctly held-off landings more easily.

PREPARATORY GROUND INSTRUCTION

How stalls occur

For an aircraft to fly, the wing must produce lift equal to the load it has to carry. 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 an aircraft is flying in a normal gliding attitude this angle, called the *angle of attack*, is quite small. As the speed is decreased, the angle of attack must be increased to maintain the same amount of lift; the airflow over the wings will eventually begin to become turbulent near the trailing edge, but the wings will continue to generate sufficient lift to maintain flight. As the speed is decreased further, the angle of attack continues to increase, the smooth airflow over the top of the wing starts to separate from the surface and progressively becomes more turbulent, i.e. the smooth airflow no longer continues over the whole contour of the wings; lift decreases.

With the wings at the *critical angle of attack*, typically between 15 and 18 degrees, the point of separation of the smooth airflow moves further forward and drag is increased by the large mass of turbulent air being dragged along above the wing. The bottom of the wing still deflects air downwards but this is insufficient to support the glider's mass, and the aircraft is then said to stall; the aircraft ceases to fly in the normal sense, and the nose will pitch down even if the control stick is held fully back. The glider will always stall at the same critical angle of attack.

Most gliders are designed with *washout* along the wings. This is the progressive reduction of the angle of incidence from the inboard end of the wing towards the wingtip. As the airspeed is reduced lift decreases, hence to produce the same amount of lift the angle of attack has to be increased to compensate. Because of the washout of the wings, the angle of attack will be greater at the wing root, which therefore will begin to stall first. This means that the ailerons are still effective even while the pre-stall buffet is felt. Keeping the wings level with normal use of the ailerons (and rudder to prevent adverse yaw!) is therefore possible.

In level flight the speed at which the stall occurs will vary little, but can be affected by the wings being wet from rain, or being contaminated with ice or dirt and bugs. In a turn the wings will need to carry extra load because of the centrifugal force in the turn, and this increases the stall speed. However this lesson concentrates on the 1*g* or unaccelerated stall. A later lesson covers accelerated stalls and their avoidance.

Indications of an approaching stall

A most important part of this flying exercise is to be able to recognize the approach to a stall. The indications are:

- continuous nose-high attitude, though this does not have to be the case,
- increasing back pressure on the stick needed to hold up the nose,
- changing response of the glider to the controls, i.e. of the elevator and ailerons,
- an absence of or reduction in noise, accompanied by a slower than normal airspeed,
- an increased rate of descent and eventual nose-down pitching motion, even if the stick is held fully back,
- a buffeting or shuddering of the glider or of the controls before and at the stall.

A pilot eventually should be able to recognize these indications instinctively, even in rough air. Lots of practice at slow flying can be excellent for improving a pilot's recognition of these indications, and piloting abilities, by concentrating on stick and rudder coordination.

FACTORS AFFECTING STALL SPEED

Load

The speed at which the stall occurs depends upon the load that has to be carried by the wings; if the load is increased the stall speed becomes higher. A higher load occurs in a recovery from a dive, for example, and in all turns.

The total weight at which the average two-seat glider can be flown can vary appreciably. Hence, in straight flight the unaccelerated stall speed will vary by a few knots. This will be somewhat higher for a glider at its maximum all up weight, when the effect can be noticeable during thermalling and when landing, when extra speed is required to be able to make a good flare just prior to the touchdown. When the glider is being flown in a turn, the wing carries an extra load caused by the inward acceleration forces involved, and this increases the stall speed. Similarly if the glider is loaded with water ballast the glider could be considerably heavier, resulting in a noticeably higher stall speed, even when flown straight and level.

Airbrakes (Spoilers)

Modern gliders are fitted with airbrakes (or dive-brakes) powerful enough to slow the glider rapidly when close to the stall speed. Spoilers have a smaller effect on the stall speed, however the extra drag that both airbrakes or spoilers produce will decelerate the glider and could stall it unless the pilot lowers the nose sufficiently to compensate. Noticeable buffeting can also occur before the stall. The stalling lesson includes a stall with the airbrakes open, to investigate their effect on the symptoms and the stall speed.

Flaps

Lowering flaps increases the lift coefficient at the same airspeed, thus allowing the glider to be flown more slowly before it will stall. Drag can be noticeably increased. If the glider is flown very slowly with the flaps down, care must be taken if the flaps are raised because the glider could stall unless the nose is lowered sufficiently to first increase the airspeed to above the *clean* stall speed.

Slow flying demonstration

Before you start this in the air, instruct the student that a suitable area must be chosen and that the CALL check must be done. In fact, continually check for traffic during this exercise particularly as the view ahead will be restricted. Use this exercise to teach the student to recognize the symptoms of the approach to the stall, to become familiar with the feel of, and to become proficient at handling the glider at these slow speeds.

Unaccelerated stall

All that is required to recover from a stall is to reduce the angle of attack of the wings by lowering the nose. This will tend to happen automatically because, at the stall, the nose will pitch down on its own, and the glider will pick up speed. However, it is important to teach the student to assist this reduction in angle of attack through positive action. This requires the instructor to give the recovery command as soon as the nose begins to pitch down, to reinforce that it is the pilot making the recovery and not the glider alone.

Recovery sequence

The sequence to recover from a stall is:

- lower the nose,
- check the ASI reading,
- look ahead (up) and return to the normal gliding attitude, and
- note the height that has been lost.

Note that the recovery is quoted as *lower the nose*, NOT move the stick forward. Also see *Reduced-g Sensitivity as a Cause of Accidents* later in this chapter.

If the nose does not drop while flying slowly towards a full stall, the glider will *mush*. Note that the glider is stalled, with a high sink rate and the stick fully back, but that the glider does not pitch up more (changing response of the glider to the elevator at the stall). Again recover as before.

Having lowered the nose, the student will expect the glider to pick up speed – the more the nose is lowered the quicker the acceleration. It is now important to check the airspeed indicator, to confirm that the glider is indeed *flying again*, then to look up (at the horizon).

This looking up is designed to maintain the orientation of the pilot, as at the stall many students tend to look down at the ground below, and so they lose a sense of their pitch attitude, i.e. how much they are or are not diving. The final part of the recovery follows immediately, and it is to return to the *normal gliding attitude*. By knowing their current (diving) attitude relative to the horizon, they will know how much they will need to recover from the dive.

If one wing drops at the stall

Sometimes, if the glider is not flying straight or because of a gust one wing may stall first, to recover the first thing to do is to unstall the glider. Level the wings in the normal way *once airspeed has been regained* and return the glider to the normal gliding attitude.

If, on the approach to the stall one wing tends to stall first this can be prevented by first lowering the nose to unstall the wings. Then, when the speed has again built up, the pilot may use the ailerons in the normal way, with the coordinated use of stick and rudder (to prevent adverse yaw). If the ailerons were to be used in an attempt to level the wings while flying close to the stall speed, they may be quite ineffective or even have the opposite effect to that desired. Lowering the aileron on the down-going wing in effect increases the wing tip's angle of attack more than the rest of the wing. Because the aileron area could be close to the stall angle already, the outer section of the wing will now stall, and the glider will roll in this direction. Next, the increased drag of the down-going wing will tend to start a yaw which, if it is allowed to continue, could lead to autorotation and the next item on the student's agenda could be the development of a spin! It is important, therefore, to stress that ailerons should not be used to level the wings until the airspeed has increased to a more normal value.

ADVICE TO THE INSTRUCTOR

Stalling is a major contributor to accidents in Canada, and this is often because pilots fail to recognize the symptoms and the situations that lead to stalls. Training in stall recognition and avoidance must therefore take on more priority at both the basic training stage and later when the pilot is advancing to steeper turns and the spinning stages of training before first solo.

Emphasize now and later in stall training that the glider will stall *in any attitude and at any speed* if the critical *angle of attack* is reached.

Slow flying to demonstrate the stall symptoms

Before you actually get to the full stall, do some slow flying to demonstrate the symptoms. First go through the CALL checklist; in fact this must be done before the slow flying exercise and before all stalls. If the student does not remember it, teach it again now; it is covered in Chapter B2, page B2-8. It is essential that the student knows it now, before you begin your demonstrations.

Slow flying

When handling the glider when close to the stall, be especially aware of its tendency to roll. This will be quite noticeable, and the glider may want to roll off one way preferentially. At the same time, the sink rate will increase noticeably and the glider will feel distinctly awkward to handle. Sailplanes with their long wings and excellent lateral damping tend to wallow around, but it is possible to fly all modern gliders close to the stall using coordinated ailerons and rudder normally. Although the rudder by itself can be used to help keep the wings level when flying slowly, this technique is not recommended when flying gliders – see Chapter B15, page B15-8; *Changing effect of rudder at the stall*. The glider will respond and will roll quite slowly in response to rudder inputs. In other words, the secondary effect of rudder produces quite a slow response. However, if one wing stalls first the response is very rapid! If the rudder is used to try and level the wings, the danger is to apply too much rudder input for too long, causing a spin entry as the down-going wing starts to rise, but the other wing becomes more fully stalled because of the excessive yaw and slowing of that wing. A fast spin entry can occur which, if not stopped very quickly, could produce a full spin! On the other hand, a glider that is flown with coordinated stick and rudder and that *drops* a wing at the stall is much more likely to recover the wing drop very quickly if the wings are first unstalled by the pilot immediately *lowering the nose*.

Hence, if one wing does drop suddenly at the stall the faster way to recover (and to prevent this roll deteriorating into a full spin) is to unstall the wings first; lateral damping is restored immediately and *the rolling stops*. The glider is then flown out of the slight dive using perfectly coordinated aileron and rudder. This is also discussed in some detail in Chapter B15.

When the student is first practicing stalls, watch for a tendency to try to lift the downgoing wing with ailerons and to lift the nose before speed has been re-established – correct what could become a bad habit as soon as possible. It is better to encourage the student to *feel* they have to allow the glider to begin truly flying again, before starting to pull the nose up to recover from the slight dive and to level the wings.

The stall and recovery

There are several important points to teaching the stall recovery. For example, if the demonstration is not done correctly then the value of the exercise can

be substantially reduced. Consider the following before teaching stalls.

The instructor to guarantee a stall

You should be able to guarantee that the glider will stall in the way that you want; that is, nose pitch down or not (remembering that we can get some two-seater gliders to mush along, nose up in a full stall).

Demonstrate the inadvertent stall

Secondly, your stall demonstration should, as far as possible, represent the *inadvertent* stall. The stall should be approached gradually. If you have to make it stall by a rapid control movement, this is because the original approach to the stall was too slow; play down this point.

If you hold the stick back after the stall, the glider will most likely regain flying speed, but will then stall again. In your demonstration, therefore, the recovery and simultaneous description of what you are doing to make the recovery should be started as soon as the glider actually begins to pitch the nose down on its own.

Stall recovery sequence

The stall recovery sequence is to *lower the nose* and then to check the ASI, look ahead at the horizon and then return to the normal gliding attitude.

In gliders, which are far more pitch sensitive than the typical power plane, this action will often produce a fairly violent pitch-down with a noticeable *reduced-g* feeling to the pilots. This feeling is accentuated in the front seat of a modern two-seater because the pilot is a good distance ahead of the centre of rotation. Some instructors have preferred to use the words *reduce the back pressure on the stick*. However, the words "reduce the back pressure" are probably satisfactory for power planes in which the pilots are closer to the centre of rotation, and the pitch change therefore would not induce a strong, reduced-*g* feeling. This is to be avoided in gliders. Hence the preferred words refer to the desired *motion* of the glider – read on for more good reasons for this instructing technique.

"Reduced-g Sensitivity" as a cause of accidents

In the past, some accidents have been attributed to the pilot being sensitive to the reduced-*g* sensation, and to feeling that this means the glider is still stalled. The stall recovery command used to be *stick forward*, and some pilots continued to push forward even though they were diving and at well over the stall speed. If they felt the reduced-*g* of the push-over, then they would feel stalled, push forward more and so make the situation steadily worse. A typical cable break on a winch launch requires a firm reduced-*g* pushover. A sudden downward gust in a thermal or a downdraft on approach for example, can each produce an exaggerated reduced-*g* feeling, and we must train our pilots to recognize when they are stalled and when they are in a reduced-*g* situation but are still flying above the stall speed. The stall recovery sequence has been selected to try and avoid this type of accident to glider pilots.

Reduced-g sensations and the sensitive pilot

Because some people are sensitive to a reduced-*g* sensation, stalls to them are particularly upsetting at first. These pilots need to be treated more carefully. Continued exposure to some mild push-overs as described here, will desensitize them and make them less susceptible to the sudden feeling of dropping. An instructor who has been taught this procedure should check the susceptibility of each student to reduced-*g* sensations before starting the stall exercise.

Do NOT ask your students to follow through during this reduced-*g* exercise, but ask them to place the hands on their knees or to hold on to the shoulder straps. Describe what you are doing as you perform the exercise. From the normal gliding attitude, increase speed by lowering the nose to about 15-degree nose-down (if student reacts very adversely to this, stop the exercise). Next, continue the *push-over* to about 30-degree nose-down and carefully watch the student's reactions. Pull up into a climb; then pitch the glider down to normal flight as the speed drops. This should allow you to assess adequately the sensitivity of your student. If the student is in any way sensitive to these reduced-*g* sensations make a notation in the student's pilot training record for other instructors to see. Explain that, even under reduced-*g*, the glider is flying; it is not stalled, you can stop the first pushover at any time. Relate the feeling to that of the *falling* feeling at the stall, which cannot be stopped until the glider has regained speed.

You may use similar maneuvers to desensitize the student on subsequent flights, eventually getting your students to do the maneuvers themselves. Emphasizing the words *lower the nose* as the stall recovery command, should help reduce the probability of a pushover type of accident happening to them in the future.

Teach the stall in stages

It is very useful to first use slow flying to demon-

strate the symptoms of the approach to the stall, and then do a full stall (when the nose pitches down). Repeat this for a wing drop at the stall, and then perform a stall with the airbrakes open. Finally perform a full *mushing* stall, and note that during this stall, the nose does not pitch down. Make sure that the CALL check is done before all these exercises. Make sure the airspace ahead, below, to either side and behind is clear of other aircraft; use the recommended clearing S-turns for the search. To become familiar with the symptoms of the approach to a stall, the student does not have to stall the aircraft! However, practicing correct stall recoveries and regaining straight and level flight with minimum loss of height is very important.

Unaccelerated or 1g stalls

To demonstrate a wings-level stall, start by asking the student to perform the CALL check, and instruct the student to remove his or her hands and feet off the controls (hands to hold the shoulder straps for example) while you take over control for a first demonstration. Reduce the speed by about one knot per second and get the student to notice the symptoms of the approaching stall as the speed reduces. Sometimes you will not be able to produce a *clean* stall this slowly; the glider will merely mush along at a high sink rate; notice the variometer. Reducing the speed a bit more rapidly will then produce an actual stall. Talk out loud as you recover by lowering the nose and allowing the glider to regain speed – check the ASI, and then look ahead to get oriented with the horizon again. Gently ease out of the dive to the normal gliding attitude. Note the height lost. Then hand over control and follow through as the student tries a stall and recovery. Then repeat for a wing drop at the stall, starting with a demonstration, inducing a wing drop if necessary. The student then is to repeat this, with you emphasizing to the student to level the wings only after the airspeed has recovered to above the stall speed.

When students are first learning to do stalls like this, it is unlikely that they will actually read the ASI. However, by teaching them to glance at it, they will be learning the sequence; in later flights they can be expected to read it or to notice that the speed is increasing. It is important too, to have them look up to be able to recognize their attitude relative to the horizon, and then to recover and to return to the normal gliding attitude.

Stalling in a turn

Perform stalls from a turn also. Start from a well coordinated shallow-banked turn. Point out that the glider will have a tendency to over-bank; this may lead to use of top aileron to prevent this. Try to keep a shallow angle of bank – if the glider over-banks, start again from wings level. Before the glider actually stalls, practice regaining the correct attitude and speed in the turn. Then let the glider stall in the turn, and recover quickly.

In these and later flights continue to practice gentle stalls, and also review and demonstrate the effects of reduced-*g* by doing a pushover at a speed above the stall speed. Then compare the reduced-*g* sensations to those of a stall.

Stall with airbrakes open

The stall will occur at a higher speed, and the symptoms will include more buffeting, also possibly buffeting of the elevator. The student should notice the higher speed and the recovery should of course include closing the brakes.

GENERAL COMMENTS

An important point that needs reinforcing several times is that the elevator is ineffective when flying more slowly than normal (it will not raise the nose as expected). If the student has not appreciated this early on, the stall needs to be demonstrated carefully again, making this point.

Go through the CALL check thoroughly, with the intention of searching ahead and below; this is different from when searching before a turn!

Students sometimes fail to stall, and actually begin to recover before the glider has fully stalled! They may think that the nose high attitude is the stall, be apprehensive, or may be sensitive to reduced-*g*. Another way that a student may surprise the instructor is to enter a stall and recover differently than expected. It may be because you have not made yourself entirely clear about what type of stall entry and the recovery that you wanted.

It is important to cover the differences between reduced-g sensations that occur when the glider is pushed over from nose high to nose down (as in a pseudo-stall and recovery), and the falling sensation that occurs at the stall. In the first case the glider may not be fully stalled and is still controllable, in which case you can demonstrate this as the glider is pitching nose down by pulling on the stick to stop the falling feeling. If this is not convincing, try a pushover at higher speed and either rock the wings or stop the pushover momentarily (the elevator is effective!). It should be obvious that the glider is not stalled. In the second case of the stall, the elevator is

ineffective and the pilot has to increase speed before the falling sensation stops.

Power pilots have learned to recover from a stall by pushing the stick (hard) forward. As the glider instructor, you may be caught unawares, so give a careful pre-briefing to this pilot. Follow through closely when he or she is doing some first stalls in a glider.

WARNING *Panic can sometimes set in with a student pilot when you are demonstrating stalls and recoveries. A rapid change of attitude or an unusual attitude and sensations can be upsetting to people, for example, to those who have not been adequately desensitized against reduced-g sensations. Their reactions, if they are following through, can be dangerous if they freeze on the controls. This means that the instructor should never ask the student to fly the glider or even follow through in a situation that he or she has not experienced first as a demonstration.*

POST-FLIGHT REVIEW

Recall the indicators Try to get the student to recall all the stall indicators, and the correct recovery. Discuss the reduced-*g* sensation and relate this to the falling feeling in a pushover or sudden down-gust, even at normal flying speeds. And, compare this to the sensations at the stall.

Solo practice at safe heights Review the dangers of flying too slowly close to the ground, particularly when approaching to land. When solo, the student should be encouraged to practice slow flying and stalls at a safe height.

Need for good airmanship Remind your student again of the need for good airmanship at all times, in this case of the need for no loose articles in the cockpit, and for a good **CALL** check prior to doing stalls.

Compass Review the compass with the student, how to read the heading, and how to correct for deviation using the compass correction card to fly on a desired heading. You should also go over how to correctly swing the compass, and discuss the compass error known as the northerly turning error.

Safety and HF points may include discussion of low g sensations, spatial disorientation, or air sickness.

CHAPTER B7
MEDIUM TURNS & THERMALLING

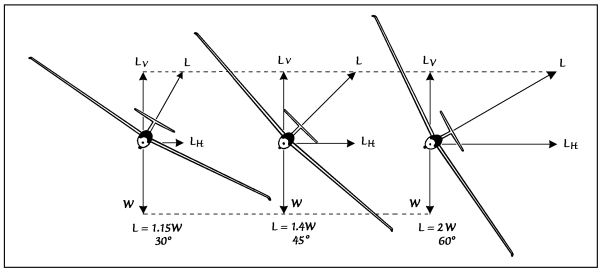
OBJECTIVES

- To teach the student how to correctly enter, stay in and exit from medium turns (30 to 45 degrees angle of bank) briskly and with conviction,
- How to thermal effectively using medium turns, and
- To establish a good technique for performing a lookout before, during and when exiting turns. This is very important, and you should emphasize this now and during all flights.

MOTIVATION

Correctly coordinated turns are necessary to become a good pilot. Flying accurate turns will enable the pilot to climb in the weakest lift. Maintaining a good lookout will ensure that conflicts and possible mid-air collisions will be avoided.

PREPARATORY GROUND INSTRUCTION



The increased lift needed for increasing angles of bank

Forces involved in a turn

For a glider to turn it is necessary to provide a force to the glider in the intended direction of the turn. This is done by banking the glider so that the lift force L, which acts normal to the glider's wings, will now be inclined such that part of this lift will provide the necessary turning force. The vertical component of lift L_V will equal the glider's weight W, while the horizontal component of lift L_h, or centripetal force, will provide the necessary force to accelerate the glider towards the center of the circle it is making. The greater the inward 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.

Because the Lift L must be sufficient both to support the glider *and* to provide the inward Centripetal Force L_h, it must be greater than that in straight flight.

The centripetal force is the force that, acting horizontally on the mass of the glider, accelerates it in the intended direction of the turn. The apparent increase in weight of the pilots is due to this acceleration that acts towards the centre of the turn; the pilots will feel that they are applying an extra force *normal* to the seat. This force is a combination of their weight (acting vertically down) and the centrifugal force (equal and opposite to the centripetal force, acting horizontally outwards away from the centre of the turn). Combined, it feels as if the pilot is being forced more into the seat by an amount equal to the equivalent *g* force. At 45° angle of bank, this *g* force is 1.4, making the pilot feel 40% heavier! The lift generated by the wings is similarly 1.4 times normal. This increase in lift has to be achieved by increasing the airspeed or the angle of attack, or by a combination of the two. In all but very shallow turns, teach the student that to produce more lift, he or she will have to increase the airspeed. Increasing the angle of attack sufficiently will be not possible normally, especially in steep turns; some gliders will run out of elevator authority first.

Load factor

The load factor is defined as the ratio of the lift to the weight. In a steady glide it is equal to the cosine of the glide angle. Because modern gliders have a very flat glide, the load factor under these conditions is essentially equal to one. In a turn the load factor increases because the total required lift is increased, as shown in the figure above. For example, for a bank angle of 60° the total lift is equal to twice the weight; that is, the load factor equals 2.

Pitching maneuvers will also increase the load factor in which case its value is determined by the airspeed and the radius of curvature of the flight path. Pulling out of a dive is one example of a maneuver that can produce high load factors.

Steep turns – the need for increased lift

The figures above illustrate the greatly increased lift that has to be generated as the angle of bank is increased beyond about 45°. The increase in lift above an angle of bank of about 45° should be achieved mainly by increasing the airspeed and by some further increase in the angle of attack. Unless the pilot deliberately increases the airspeed, the angle of attack may approach that of the stall. In turns therefore for increased lift – increase the airspeed. Notice

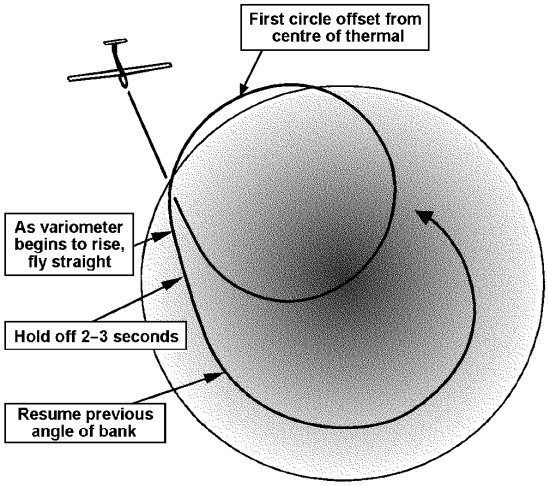
too that the load factor increases directly as the lift increases.

The requirement for increasing speed is important, and before starting any medium turn therefore, teach the student to increase speed appropriately.

Functions of controls during a turn

Each control has a definite function during a turn:

- the ailerons control the angle of bank;
- the elevator controls the angle of attack of the wings, hence the glider's pitch attitude in the turn, and thence the airspeed; and
- the rudder prevents any adverse yaw that is encountered during the entry to the turn. During the turn it is then used to correct any small amounts of slip or skid that occur.

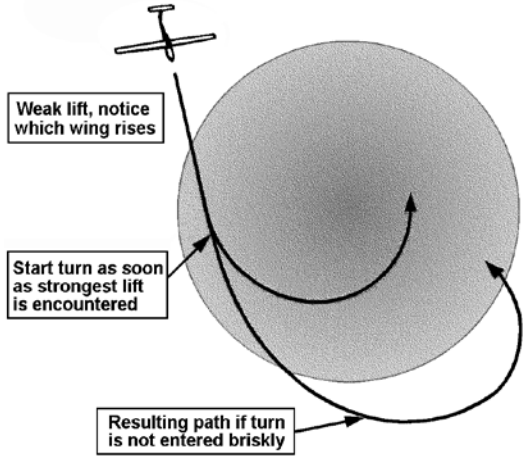


Once the turn has started, the faster-moving outer wing produces more lift than the inner wing. This means that you will have to prevent the over-banking caused by this extra lift of one wing. For small angles of bank and in well-designed gliders this effect is small.

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. *Bottom* rudder, or rudder in the direction of the turn is needed. As explained before, remember that the rudder is used only to prevent slip or skid once the turn has been established. The elevator is used during the turn to keep the nose sweeping in a level path around the horizon, thus keeping the airspeed constant.

THERMALLING TECHNIQUES – ENTERING and CENTERING

Imagine you are flying straight, looking for a thermal. If you do nothing, the glider will neatly steer between the thermals, because one wing will usually be lifted first, tilting the glider away from the stronger lift. To steer into the thermal therefore, carefully evaluate which wing tends to rise more as the thermal is felt. The turn is initiated as the strongest lift is entered, but because of instrument lag (the variometer might take several seconds to fully respond) the turn should be initiated ahead of the maximum reading. Roll briskly into the turn towards the rising wing or the glider's path will take it out of the thermal again. If the first circle is offset from the centre of the thermal, as shown in the next diagram, one will notice a low vario reading diametrically opposite the center of the thermal.



One method of thermal centering is shown in the diagram opposite. As one continues to circle, wait until the variometer reading begins to rise, and then level the wings to fly straight into the area of stronger lift. Hold a straight course for about 2 to 3 seconds (though with experience the student will be able to judge better how long to wait) before resuming the previous angle of bank. It is easy to draw the diagram, but much less easy to *see* the thermal when flying. Therefore constant looking out at ground references or better still, clouds, will help one to visualize where the strong lift is, and to choose the direction in which to fly.

Thermal entry protocol

A circling glider will most often mark a thermal, and other pilots who are looking for lift will come to join. When in a thermal we must be aware that others may come to join in, and therefore the lookouts must be performed also with this in mind. To help

ensure safety when entering thermals that are already occupied by other gliders, protocols have been established. First it is essential to circle in the same direction as others already in the thermal. Hence align the glider so as to enter on a tangent to the other thermalling glider or gliders. Then perform a good lookout to both sides, looking carefully also ahead and above for other gliders that may have been missed. As the thermal is detected, start turning so as to enter towards the thermal's centre, keeping the other glider diametrically opposite in the same circle. If more than one other glider is thermalling at approximately the same height, try to keep equally spaced from them, and keep them in sight.

If entering a thermal from below another thermalling glider, care must be taken if a climbing turn is used to enter, so as to avoid the possibility of colliding, either with a following glider or with the one seen already in the thermal, it has happened! A preferred technique is to climb up alongside the thermal, establish the desired speed and, when it is clear, then to move towards the centre of the thermal as stronger lift is encountered.

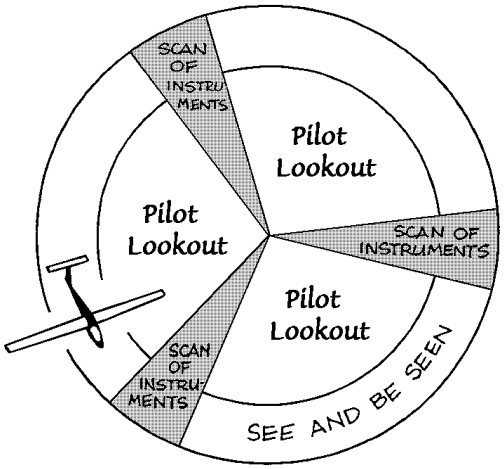
Collision avoidance while thermalling

The importance of maintaining an adequate lookout while in the thermal cannot be over-stressed. The following technique can be used very effectively to teach good airmanship in this vital area. Imagine the circle in which you are thermalling divided into three segments. Then divide the time of each segment into a short period for scanning the instruments, and a longer period for looking out. A typical circle at medium angles of bank will take about 30 seconds to complete. Therefore an instrument scan will use 2–3 seconds, leaving 7–8 seconds for each lookout. This should be your aim for teaching a student for a maximum lookout period and a minimum instrument scan. This system lets the pilot locate the best lift in the circle, and allows a good search of potential blind spots. With an audio variometer the need to scan the instruments becomes less important, in fact the student should be encouraged to use his peripheral vision to observe what the ASI is showing, and to maintain the correct speed by reference to the glider's pitch attitude.

If there is one other aircraft in the thermal teach the student to keep the other glider on the opposite side of the thermal, in line with the inner wing tip. Should more gliders join the thermal, the student should position the glider so that the other pilot(s) can see him or her easily. And teach the student to leave the thermal immediately if he loses sight of a nearby glider and believes it is close behind. We should never assume that the other pilot has seen us, or that he will take the avoiding action. Emphasize that we should never deliberately fly closely under or over another glider, the pilot may not see us, and turbulence could quickly reduce any vertical separation.

It is now that a student picks up good thermalling habits; if his thermalling is not too good don't worry; his lookout technique is your main concern at this stage. Our motto should be:

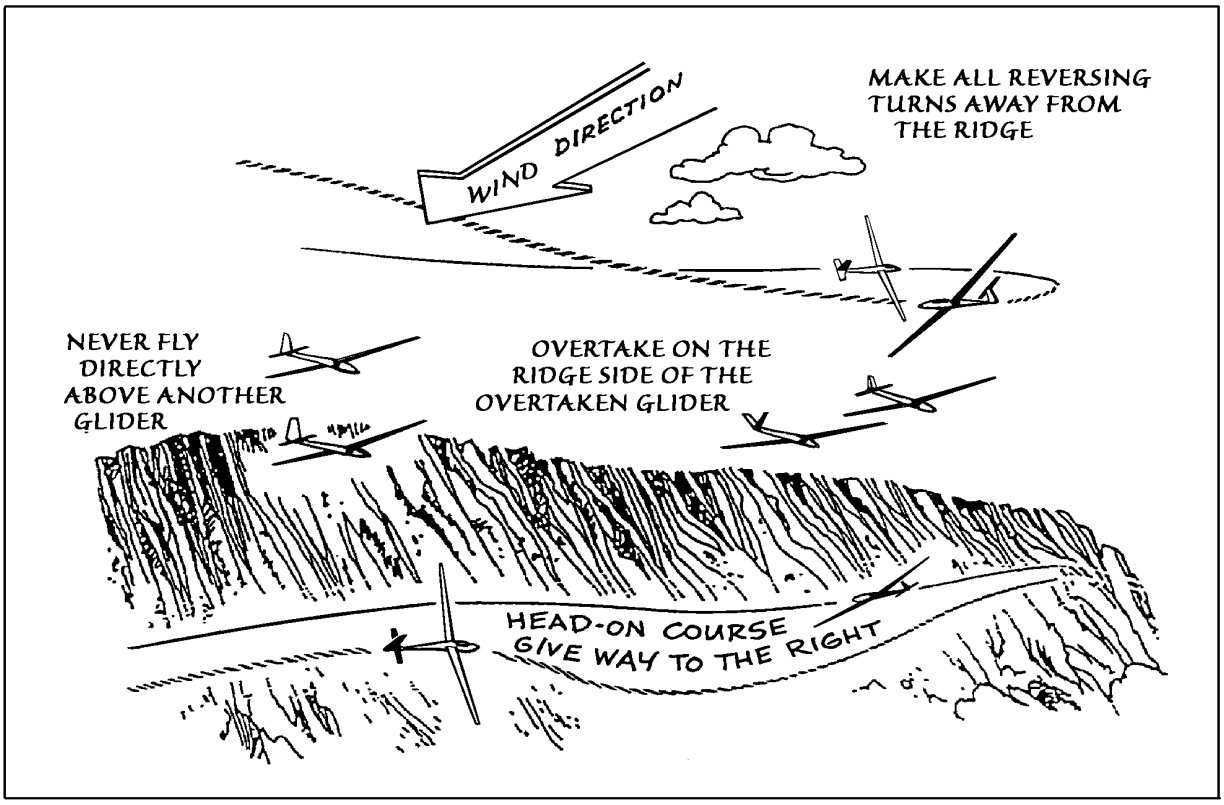
SEE and BE SEEN at all times



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 as long as the wind keeps blowing.

The technique is to fly parallel to the slope, crabbing into the wind slightly to prevent being blown towards 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 wind direction caused by the topography. Local ridge rules are often used to account for special hazards, but the general rules illustrated in the picture are followed almost everywhere.



ADVICE TO THE INSTRUCTOR

The **major objective** in this exercise is to produce pilots who are firm in their use of the controls, to roll briskly into and out of turns with conviction and confidence. In the early stages of training, concentrate on making the student practice entries and exits to turns. This will require good coordination to roll into and out of the turns without adverse yaw! Later, continuous turns should be practiced, including turns of 360 degrees and more.

During first attempts to do continuous turns, most students have some problems. Typically, these problems are too much rudder input when entering the turn, and failure to keep the nose up so the speed increases too much once in the turn. Unless the student is corrected at this first stage, he or she will likely form the habit of misusing the rudder. The habit can to some extent be corrected, but it will return in moments of stress, just when we don't want it to. This is vital for all instructors to remember, because teaching it correctly the first time will give the student the good technique with the minimum of mistakes, and is then more likely to become an accurate and safe pilot. Return to the *Learning and Learning Factors* in Chapter A3 to see why this is so important!

An accurate turn is a prelude to successful soaring, so practice at accurate turns is important. Turns should be taught while flying at various speeds, and the student should compare the effectiveness of the controls at these different speeds. Devise simple precision tests, such as figure-eight patterns. The student should be taught to increase speed slightly before entering a turn, and then to make the turn without changing the speed. As the student develops handling skills, an alternative method can be used; it is to lower the nose as the bank is applied, so that the speed gradually increases to the desired value as the glider reaches the required angle of bank. This requires more precision but is an excellent exercise to develop more accuracy in flying. Before rolling briskly into a steeper turn, however, the speed must be increased first.

It is a good idea to practice turns some distance upwind of the airfield and then ask the student to fly back. This teaches how easy it is to become lost. Frequently make the student use the *SOAR* pilot decision-making (PDM) technique while he keeps track of his position relative to the club.

Sometimes a student makes good turns when he is concentrating on them, but accuracy deteriorates when turns are combined with other exercises, during the circuit for example. The only remedy for this is to insist on a high standard at all times, correcting the faults when they occur, and drawing the stu-

dent's attention to the yaw string during these exercises.

A student is apt to become more proficient in turning in one direction than the other; this may be because of a standardized direction of circuit, to looking out to one side, or to the characteristics of the aircraft, or other causes. Watch for such an inclination, and make sure to practice turns in the other direction to counteract this tendency. Remember, making the student change direction in a series of turns alternately to right and left gives excellent practice in control coordination. This was first taught as in Chapter B4; it can be extended now into a series of 90 degree turns, alternately one way then the other.

At this stage in your student's training it is very important to emphasize the need to establish a good lookout technique because the consequences of a collision are more drastic than a bit of sloppy flying. Look both ways as well as behind the glider before turning, and always keep a good lookout particularly along the horizon and in the direction of the turn during the turn. Point out too, that the modern sailplane when entering a thermal may do so from below as the pilot slows and joins the thermal. In some areas of the country there is appreciable power plane activity and airline routes into terminal areas come close to some clubs, so the lookout must therefore include *above and below* areas. Instructors in the back seat often have their view restricted by wings and by the student's head and shoulders, so keeping a good lookout by both pilots is vital. Two sets of eyes are better than one!

Need for increased lift in a turn

There are two ways in which we can increase the lift generated by the wings in a turn. The first is by increasing the airspeed and the second by increasing the angle of attack. In learning to fly medium turns we should be concentrating initially on a 90 degree change of heading, i.e. to practice for the turns used in the circuit. For these turns it is vital to fly with adequate airspeed; the student should feel distinctly uncomfortable whenever he enters such a turn with insufficient speed. In these first lessons with your student, therefore, teach the good habit of increasing speed slightly before he or she enters any turn (do not refer to thermalling at just above the stall buffet at this point). In later flights introduce the second method of increasing speed, which is more appropriate for thermal entries, for example.

Over-use of rudder in turns

The most common fault in making turns is to overuse the rudder, because the student may think that the rudder is the primary turning control. If this is the case, the early instruction did not properly teach him the effects of controls and their coordination, that is, rudder to prevent adverse yaw. The student should be reminded that to change direction by even a very small amount he or she must bank the aircraft; if needed, go over aileron drag and the use of the rudder to prevent adverse yaw again; this could be a very useful review.

A useful technique for learning how much rudder input to apply when entering a turn is as follows. Look ahead at an object on the horizon (remember?) before starting the turn. As the stick and rudder are applied, watch for yaw to occur before the banking starts:

- If the yaw is in the direction of the turn – too much rudder deflection,
- If the yaw is adverse – not enough rudder input.

This technique may be used of course with a motor glider or power plane. We don't really need the yaw string in these types either!

Lookout before turn entry

Before starting any turn have the student look out for other aircraft, particularly in the same altitude band. Remember to search also ahead and above as the last part of each side scan. You will also have to assist the student in seeing other aircraft. Do this by pointing out any aircraft as you see them and suspect that the student has not already done so. Then during the turn a constant lookout is needed; again prompting from you will be necessary before the student will acquire this good habit.

Instructor demonstration and student practice

First, demonstrate to the student how to do a good medium turn. Precede this by a good lookout, the required speed increase, and it should be well coordinated. Watch for early or adverse yaw as the student starts the turn, as described earlier. Then roll out of the turn, and now instruct the student to repeat the exercise and tell you what he or she is doing.

Concentrate initially on entries and exits, emphasizing the need for an increased airspeed prior to entering the turn. As your student's proficiency increases, he should be rolling into the turn briskly, with firm control inputs. In the turn, he or she should be controlling the bank at the desired angle, keeping the yaw string straight and the speed constant by maintaining a constant pitch attitude. Once established in a well-coordinated turn, the pilot should also re-trim to remove the excess stick force. At the same time

he or she may prefer to think in terms of the nose sweeping around the horizon, neither rising above nor falling below it.

Faults in turns

A number of faults can occur when flying a continuous turn:

- Failure to perform a good lookout before rolling into the turn,
- Looking out to the side as the turn is started,
- Failure to perform a good lookout before rolling out of the turn,
- Slow rates of roll and under-banked turns,
- Varying angles of bank in the turn,
- Increasing angles of bank in turns,
- Allowing the angle of bank to decrease,
- Poor use of the rudder in the turn, resulting in yaw string all over the place,
- Under-ruddered turn entries,
- Over-ruddered turn entries,
- Too slow an entry speed,
- Varying speeds in the turn.

This list appears daunting! The first fault is very dangerous and you should immediately stop the turn, even if it means taking over control. The student should soon learn to look out adequately before rolling into a turn! The next fault gives poor coordination and poor speed control in the turn. The third fault should be corrected as for the first.

Slow rates of roll and small angles of bank are relatively easy to achieve even with poor coordination, but are potentially dangerous when done so. Therefore we should only accept turns with approximately a 30° degree angle of bank, and pilots should be prompted to enter and exit from all turns with firm control inputs so as to achieve good roll rates. Nervous students may be allowed to start with more gentle turns but should be encouraged to eventually reach the 30 degree bank. This is especially important because we will be concentrating on well-banked turns for the turn onto final approach. We do not want a pilot performing shallow-banked turns low to the ground!

It is often difficult for students to recognize small changes to the angle of bank. This may be because they are concentrating on other things, or they may be over-controlling. To reduce this tendency, suggest the student rest his arm against the thigh or brace it against the waist, so that the whole arm cannot operate the stick. The wrist will provide adequate leverage. To help in seeing the small changes in bank angles you will notice that sometimes the student is holding off the bank too much, or turbulence has lifted the inner wing. Notice that as the bank decreases students will often try to increase the turn rate with using too much rudder input. This must be corrected, first by recognizing that it is happening and second by increasing the bank angle and continuing the turn, now correctly coordinated.

In correcting faults in turns you can draw the student's attention to that fault by the techniques discussed in Chapter A5 under the section Flying Instruction. To maintain control of the speed, for example, he or she should check the pitch attitude relative to the horizon, and finally the amount of slip or skid. It is here that you can introduce him or her to the method for correcting slip or skid using the yaw string or ball, as you have not used this up to now; in the gentle turn stage, you were concentrating on stick and rudder coordination, remember? Explain this procedure, first on the ground, and then give prompts in the air. This methodical approach to correcting faults in turns will help the student learn quickly.

Although the above (verbal) methods will not always correct a problem, don't despair. Another method of correcting faults is to take over control and demonstrate the fault to the student. Then demonstrate how the maneuver should be done correctly. This should help the student to recognize this type of fault next time it occurs.

If a turn is entered briskly and at too slow a speed, the glider will probably slip towards the lower wing, which will result in a sloppy entry and an increase in the speed. It might enter a spin if the pilot overuses the rudder and applies up elevator as he tries to roll into the turn. This can occur, for example, when in a thermal and the pilot has inadvertently allowed the speed to decrease too much and now tries to tighten the turn in stronger lift. On the other hand, a well-banked turn at an adequate entry speed is unlikely to result in a slip or spin entry. Therefore, before entering a medium turn stress lookout, increase speed, and then roll into the turn with coordinated stick and rudder.

Varying speeds in turns can be caused by poor coordination, poor visibility, *chasing the ASI*, not enough practice, not re-trimming in the turn and possibly changes in lift and sink when thermaling. Concentrate therefore on keeping the attitude con-

stant and explain why these changes seem to be out of the control of the student! Fairly frequent monitoring of the ASI is also needed, especially when in the circuit, when the horizon and steeper angle of the approach are different to thermal or practice flying. The usual visual clues are different and cannot be relied upon to maintain the speed under good control.

If the bank and speed are increasing in the turn (especially in a steep turn) this may be the start of a spiral dive. Overbanking or failure to correct a sideslip, both of which make the glider weathercock, can cause a spiral dive. Correct this situation by reducing the bank angle, reducing speed to bring it under control, and then resume the turn.

Stalls at steeper angles of bank

It is perhaps worth mentioning here that, although theoretically it is possible to stall a glider at any angle of bank, and we can calculate the stall speeds, in practice it is very difficult to stall most types of glider in a turn of 30º or more of bank. Such a stall would require a pronounced movement on the stick, which may not be available to *pull* the wing to the stall angle. Most of the elevator movement will have been used to generate the extra lift needed for the turn.

The above effect is because of the small radius of turn that is flown at slow speed (for example, when thermalling), which may require almost full elevator travel to fly the turn properly. The elevator has no more *authority* with which to increase the angle of attack, making it difficult to stall the glider (compare this to a faster moving power plane in which a stall in a steep turn is a real hazard). This loss of elevator authority in a glider will occur earlier at maximum all-up weight, and is a potential hazard when flaring to land under these conditions. Therefore extra speed is vital.

Student's continued practice

As the student's proficiency improves, instruct him or her to practice turns to specified directions, and to exit from a continuous turn onto a specified heading. Let the student do continuous turns and rapid reversals of turns. This practice should be at speeds ranging from just above stall speed to twice stall speed. The turn is most important and students must learn to do them well.

SUMMARY

Teach students to be firm in their use of the controls, to roll the glider briskly, with conviction and confidence. In the early stages, concentrate on making the student practice entries and exits using good coordination to roll into and out of the turns without adverse yaw. Later, continuous turns should be practiced, including turns of 360 degrees and more. Do not permit a student to continue after making a mistake; stop and correct an error immediately, and then allow student to try again. Watch for overuse of the rudder when entering the turn.

Failure to perform an adequate lookout before a turn is dangerous; immediately stop the turn, even if it means taking over control. Looking to the side gives poor coordination and poor speed control in the turn. Failure to perform a good lookout before rolling out of a turn, especially from a thermal, should be corrected. Once established in a well-coordinated turn, re-trim to remove the excess stick force.

Faults in turns should be corrected as soon as they are detected. Verbal methods will not always correct a problem; if necessary, take over control and show the fault to the student, then demonstrate how the maneuver should be done correctly.

AIR INSTRUCTION

During this exercise the student should be encouraged to maintain an adequate lookout and to locate the airfield frequently so that he will develop a good sense of his whereabouts. At the same time he should be encouraged to use the SOAR, PDM technique for ensuring he gets back to the club at the right height by making well thought out decisions in plenty of time.

When the opportunity arises, allow the student to try some thermalling; excellent practice at continuous turns can be achieved. The technique for centering the thermal can and should be demonstrated, and the student encouraged trying it. Continue to stress the need for collision avoidance at all times while thermalling and particularly when flying between thermals. This last point should be emphasized because most mid-air collisions between gliders actually occur outside or when actually entering thermals. It is when pilots are close together in thermals that they concentrate on maintaining separation, but when away from thermals, they tend to relax so far as lookouts are concerned. So too, modern electronic navigation instruments or flight directors take concentration away from lookouts, so stress the need to learn how to use these devices when on the ground, not in the air.

Practice at maintaining separation is required to develop good airmanship and it is best to do this when

dual, when the instructor can ensure that the student is maintaining a good lookout (and a second pair of eyes!) while concentrating on thermalling. The instructor is there to provide feedback to the student on their thermal flying and lookout practice.

On ridge soaring sites the need for constant vigilance cannot be over-emphasized. Aircraft can climb rapidly, and closing speeds as two gliders approach each other are high. Maintaining an awareness of where the other gliders are is most important. Although there will not be the chance to do continuous turns close to the slope these should be practiced after sufficient altitude has been gained, and when clear of the ridge.

Although the diagram on overtaking on the ridge is technically correct the choice is between being turned into if overtaking on the outside, or being squeezed into the rock face if the glider ahead moves in nearer to the ridge as you overtake it. It may be far preferable to shorten your beat along the ridge, or to temporarily leave the ridge.

POST FLIGHT REVIEW

Discuss the flight with your student and go over the main points first. These include:

- The desirability to handle the glider with firm control inputs, to roll into and out of turns briskly. In your review include the major faults from the flight, and how these were corrected.
- Emphasize good lookout techniques; the consequences of a collision are more drastic than a bit of sloppy flying. Search also above and below, before entering, during all turns and before leaving a turn and particularly when leaving a thermal.
- Remind the student of the need to increase speed before entering a turn; later, the alternative method is to allow the airspeed to increase as the bank is applied. All students should feel distinctly uncomfortable flying slowly below 1000 feet above ground level.
- Discuss the need to practice turns upwind of the airfield, and go over how to apply the *SOAR* pilot decision-making (PDM) technique to keep track of the position relative to the airfield.
- Slow rates of roll and small angles of bank are potentially dangerous particularly when poorly coordinated. Turns with approximately a 30° angle of bank are important for a well-banked turn onto final approach. Remind the student that slow and shallow-banked turns low to the ground are dangerous! Remember the faults that the student showed during the flight and again remind him or her how to avoid them next time.
- Include safety and HF lessons learned from flight such as vertigo, inner ear, head position, etc. Always finish your post-flight critique with a note of encouragement; you want to leave the student in a positive frame of mind, even if he or she made all the mistakes in the book!

CHAPTER B8
THE APPROACH and LANDING

THE EFFECTS of AIRBRAKES, FLYING the APPROACH & LANDING

OBJECTIVES

The objectives of teaching the series of exercises that make up the approach and landing is to teach them in a logical sequence, to maximize learning in a minimum number of flights. First, the student should be taught the effects of the airbrakes at altitude, and then allowed to practice using them and coordinating their use with the elevator, also at altitude. You should teach this as an essential skill before the student first tries using the brakes on an approach. As part of this skill set, we teach the student to recognize overshooting and undershooting and therefore how to use the brakes to fly the approach to a landing. The second major objective is to teach the student how to judge the flare (or round out), the hold-off, and finally the landing.

Because learning the more difficult skills of planning, judging, and flying the circuit take time, it is important to spread the teaching of them over several flights. Therefore, it is recommended to teach the approach and landing first, as in this chapter, followed by teaching the planning and flying of the circuit, which is described in the next chapter.

The effects of airbrakes and flying the approach exercises

Before these two exercises are taught, your student must have reasonable elevator, aileron and rudder coordination, plus good speed control. Therefore these exercises may be taught quite early in the student's training provided the previous exercises have been taught and the student has had reasonable practice at flying the glider. For winch trained pilots who have had little or no soaring practice and rather less airtime per flight, their handling skills will lag behind those of an aerotow trained student for a similar number of flights. Therefore, take care not to advance the student too quickly to controlling the airbrakes on the approach to a landing.

The objectives of teaching the effects of the airbrakes at altitude is to permit the student to experience the forces and trim changes without the complication of the approaching ground to worry about. Airbrakes can develop large amounts of drag so their handling must be carefully taught and practiced. Having reasonable ability to handle the coordination between the elevator and brakes to maintain a constant speed will allow the student to then fly the approach.

The student will next learn the Reference Point technique, that is the method of adjusting the glide slope on the approach so as to land the glider precisely on the chosen spot on the runway. The technique recognizes undershooting and over-shooting as the basis for adjusting the airbrakes.

The landing

When the student has acquired reasonable control of the glider and can fly straight and with good speed control, the instructor should demonstrate a landing, and on a subsequent flight allow the student to fly the glider down to the landing. The instructor might be able to talk a competent student down to a landing early in training. This can be a useful means of building confidence, but in this case the instructor should operate the airbrakes. But, beware of problems that can develop if this landing is bungled; the instructor is then committed to correcting faults caused by the student not being able to fly well enough to begin with. The student will likely lose confidence and find subsequent landings difficult.

Circuit terminology

Learn and use the standardized terminology for the points around the circuit. The **Reference Point** is the point at which the glider would hit the runway if it were not rounded out. This change from the old *Aiming Point* is to avoid the tendency of pilots to *aim* the glider at the ground with the elevator. The Reference Point is opposite the **Low Key Point,** the point in the downwind leg at which the height should be a minimum of 500 feet agl. The Reference Point may be chosen and agreed before flight, or selected when approaching the airfield and when planning the circuit. See also Chapter B9 Part 1.

MOTIVATION

Essentially there are three parts to be learned in the first of the following exercises. Learning how to use the airbrakes (spoilers) effectively, how they affect the glider's glide path and speed, and how to judge **overshooting** and **undershooting** when flying the approach, and **the landing** itself. Clearly it is necessary to learn how to control the glider on the glide path, and being able to judge overshooting and undershooting helps this. Then the student will need to be able to judge the landing itself; there should be no extra motivation needed!

PREPARATORY GROUND INSTRUCTION

Approach control devices

Airbrakes produce profile drag and are used primarily to increase the steepness of the approach. They are used to produce variable amounts of drag, but at the same time they have an effect on the lift and trim of the glider. They also increase the stall speed slightly; this is important when considering a bounce or ballooning when landing.

Powerful airbrakes can slow the glider appreciably, especially when descending through a strong wind gradient, hence good coordination between the elevator and brakes plus frequent reference to the ASI are needed to maintain a safe speed. Normally it will be necesasary to change the attitude of the glider when closing the brakes (nose up) and when opening the brakes (nose down), and when the speed has settled down again, adjusting the trim accordingly.

Airbrakes can reduce the glide angle from say 1:28 with brakes closed to 1:6 with brakes fully open. The forces needed to open and/or close the brakes can be significant, and the exercises are designed to demonstrate these effects at different speeds.

Airbrakes

The airbrakes are the flat rectangular plates in the wings that, when opened, project into the airflow. At high speeds there is a marked deceleration when the brakes are fully opened, and a distinct pitch change is needed to maintain speed; this is particularly important for your students to understand for flying the final approach. Some brake designs can limit the glider's speed to below Vne, the never exceed speed, in a dive of up to 45 degrees. Pilots sometimes open the airbrakes for the start of the takeoff run to improve the aileron response; the open brakes tend to improve the airflow over the ailerons. Trailing edge airbrakes are attached to the rear of the wings, and they extend above and below the wings. They can be very powerful, particularly if they occupy a large part of the wing span.

Because of the design of the airbrakes of some gliders, the reduced pressure over the top of the wings tends to suck them open. It is therefore very important that they are closed and properly locked before takeoff. When opening them in the air they may tend to suck open violently to their full extent, especially at higher speeds. Airbrakes can substantially increase the stall speed. They may produce a buffetting on the elevator or rudder.

Spoilers

These are usually hinged plates, fitted on the upper wing surface. They spoil the lift and so increase the rate of sink. They do not increase drag as much as airbrakes, however they steepen the glide angle with only a small effect on the airspeed. A small change in trim may be required. Spoilers increase the stall speed by a small amount.

Flaps

Flaps are fitted to the L-13 Blaniks, for example, and many competition sailplanes with which the flaps may be used with a negative setting for high-speed cruising. Flaps are also used for better thermalling performance at low positive settings, and as an approach control at higher positive settings. Extremely steep approach angles are possible at settings above about 50 degrees. It is important to remember that raising the flaps from about the 20 degree position can substantially increase the stall speed. Stress to students that flaps should not be raised when near the ground because there will be a sudden loss of lift, causing the glider to sink rapidly and/or to stall, with a resultant hard landing.

Effects of airbrakes (or spoilers) exercise

This exercise may be introduced when the student has reasonable coordination between the three controls: elevator, ailerons and rudder, and good speed control using the elevator and trim correctly. The intent should be to show the student, and for the student to experience:

- The tendency of the brakes to suck out (compared to spoilers that do not show this effect).
- There is a need to change the glider's attitude as the brakes are opened, to maintain the speed for the approach.
- Increased rate of descent – check variometer (acknowledge any effects on the descent rate if you are in lift!).
- The high forces required to open and close the brakes (some brakes can suck open against the pilot's efforts; on some gliders, the brakes cannot be closed unless the airspeed is below a certain value).
- Buffeting of the elevator and rudder if this occurs.
- When closing the brakes, especially powerful dive brakes, the need to raise the nose to limit any tendency for the airspeed to increase.

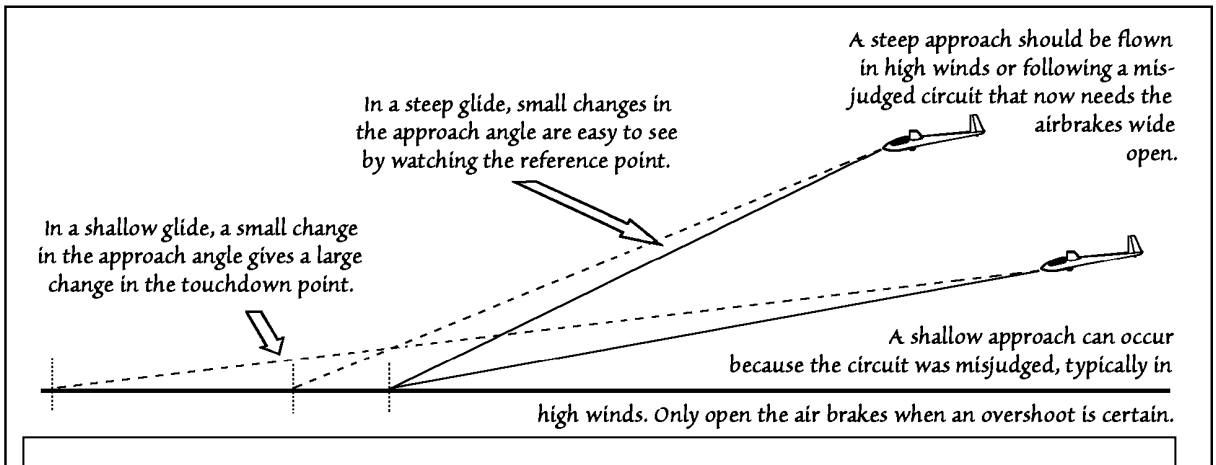
If the forces required to operate the airbrakes vary

significantly with airspeed, the student should practice at different typical speeds. This prepares the student for the possible need to open the airbrakes in an uncontrolled dive, and for the situation where the pilot has failed to control the speed on approach and subsequently experiences difficulties closing the brakes. This is a potentially critical safety point, for example when converting to a new type.

Students who are also power pilots should be warned not to think of the airbrake lever as a throttle. Also remember that these pilots are used to longer and shallower approaches. If they see they cannot maintain height in the circuit or on final approach, they may think that closing the brakes will allow them to maintain height; this can be disastrous in gliders.

Approach control exercise

Before starting this exercise the student should have good coordination between elevator, aileron and rudder, good speed control and good directional control in straight flight, and have completed the previous *Effects of Airbrakes* exercise satisfactorily. The student should also have flown a number of approaches to the roundout and landing to a good standard while the instructor prompts use of the airbrakes. This exercise introduces the student to judgement and decision-making that are needed for flying the circuit by first teaching the concepts of undershooting and overshooting.



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

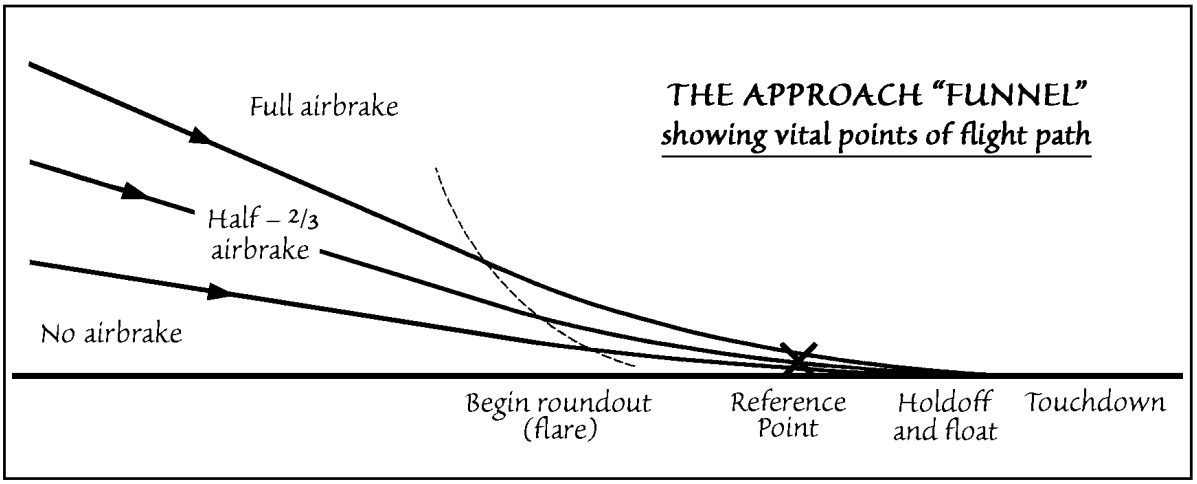
Overshooting and undershooting

We see these effects by noticing whether a point ahead on the ground, such as the Reference Point, or the **RP**, appears to move up or down the canopy as we fly on the approach at a constant speed (constant pitch attitude). If the RP is moving down, the glider will fly over the point – the glider is overshooting. If the RP moves up, the glider is undershooting, because it would hit the ground ahead of the RP. When the brakes have been adjusted correctly, the RP will remain stationary in the canopy; it will then appear only to be getting larger as you and your student approach it. This is the reference point technique; it is used for judging the final approach path towards the reference point. Note from the diagram below that it is easier to judge the glide slope from a high or steep approach than it is from a shallow approach.

If the student has difficulty imagining overshooting and undershooting, a ground demonstration of walking towards a mark on the lawn is an effective teaching aid. In all flights the student should be establishing an overshoot condition on final approach before opening the airbrakes. Explain to the student that, because opening and closing the brakes causes a change in drag, he or she will need to adjust the attitude to keep the speed constant. Gentle, small movements of airbrakes (especially powerful double brakes) will help initially. Only small corrections will then be needed with the elevator to maintain a constant airspeed. Mention also that if an aggressive correction is made to handle a sudden drop in airspeed caused by a wind gradient (lowering the nose), the RP will move up the canopy. If a student cannot recognize an undershoot situation, then he or she is not safe to go solo.

The approach

The descent path is controlled with the airbrakes using the Reference Point technique, all the time keeping the speed constant with the elevator. As the glider descends through a wind gradient, normally it will be necessary to reduce the amount of airbrake, to compensate for the increased sink rate, at the same time



adjusting the elevator to maintain speed. Emphasize to the student that the ASI must be referred to more frequently during the approach because the changing perspective of the horizon and runway lower down is no longer a reliable indicator of the glider's attitude, which is one way to judge the airspeed.

The second part of this exercise is judging the angle of the approach; is it too steep or too shallow? The airbrake opening to be aimed for is half *effectiveness*, usually obtained at about an airbrake setting of $^{1}/_{2}-{}^{2}/_{3}$ open. At this setting the pilot will have available some reserve of glide path control, either way. If we start with the $^{2}/_{3}$ setting there will be more margin for a possible undershoot, which of course is far more dangerous than an overshoot. The approach can be visualized as a funnel, with the upper boundary equivalent to full airbrakes (say L/D of 6:1 or a glide angle of 10 degrees in a typical modern 2-seater) and the lower boundary at an L/D of about 28:1 or 2 degrees with the airbrakes closed. Hence the $^{1}/_{2}-{}^{2}/_{3}$ airbrake setting should give an approach angle of about 9:1 or 6 degrees.

At the end of the approach it is important to reduce the amount by which the airbrakes are open to no more than about one half. This is to avoid a tail-first landing, or a heavy landing or even a stall, which may occur with some gliders unless the pilot is very fast at completing the flare at the right height!

It is obvious that we must keep well clear of obstacles such as trees on the sides of the runway or on the sides of the approach during all approaches. Obstacles may be other gliders on the ground, either parked to the side or being readied for takeoff closer to the landing area. Teach your students to remain well clear when approaching to land. At most locations, obstacles become more apparent when low down. In such cases students are liable to fixate on them, so keeping well clear on all flights must be the rule, even when the student is not flying.

The landing

The landing consists of three distinct phases; the flare, the hold-off, and the touchdown and roll out. Before being allowed to land the glider, the student must have reasonably good speed and directional control of the glider. This means that unless the student can fly along a landing line towards the RP under good control, it is premature to allow an attempt at a landing.

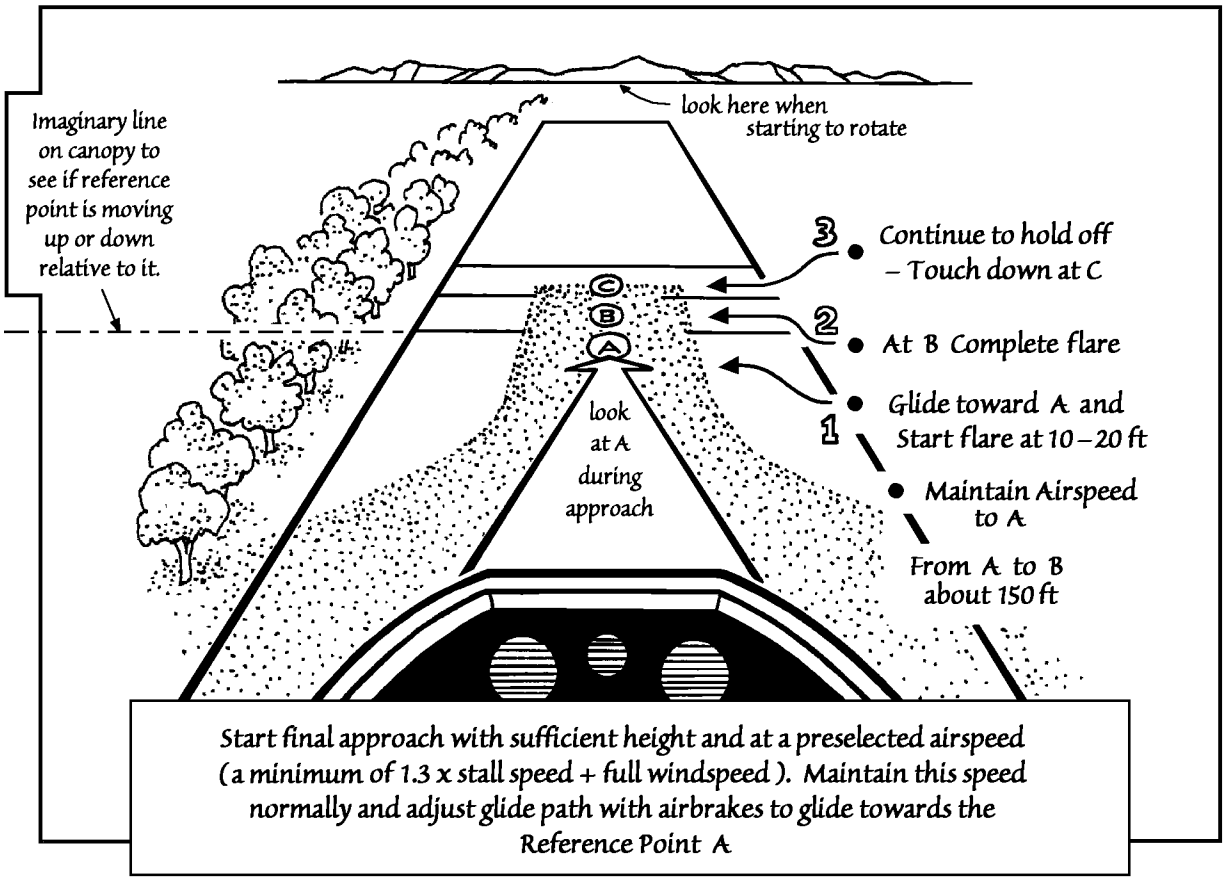
The flare or round out is started at a height that will depend on the steepness of the approach, being higher for steeper, full brake approaches for example. Pilots take some time to develop their abilities to judge when to start the flare, and this depends on several additional factors. These include the control movements needed to rotate the glider and its response to the controls, and the local topography and the visual clues available to the pilot. To provide a good visual picture of the height at which to flare, teach the student to look ahead along the runway a distance that is typical when driving on a highway, 40 metres or more. They can relate to this, and students will get vital height and sink rate information from looking well ahead and from their peripheral vision looking at the ground features to the sides. If a student continues to have problems judging heights, suggest that he or she practice looking at the sides of the runway during your takeoffs, and the sides of the road, or adjacent fields, etc., while out driving, and try to visualise what it would look like from the cockpit. Teach them to fix the airbrakes during the flare, hold-off, and landing. This helps to avoid pumping with opposite hands in the wrong sense, if the landing goes wrong!

The pilot will be gliding towards point **A** while on final. At a height of 10–20 feet, the pilot begins to

flare. The flare is sometimes called the *round out* and it is completed by point **B**. Should your student encounter heavy sink on the approach, the brakes must be closed and the nose lowered to maintain airspeed, the wind gradient is probably beginning to grab the glider. If the approach speed is slow, make sure the student understands the need to lower the nose to try to regain speed. If the glider is undershooting, the pilot must close the brakes and hold the nose down to maintain speed.

the perspective of the landing area, for example, a large grass area versus a marked runway, the slope or unevenness of the landing area, rate of sink, and the control movements required to flare.

The above type of landing is called a low-energy landing, which means that when it touches down, the glider 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 energy or speed at the touchdown



Having flared the glider, the student must now adjust the attitude to that required for touchdown. The glider is then maintained in this held-off attitude. Now ask the student to try and fly to the end of the runway. This is not possible, of course, because the glider will gradually lose speed until it slowly sinks at **C** onto the main wheel and tail wheel (or skid) almost simultaneously. This is the *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. If the pilot flares and holds off too high or the glider bounces, the pilot must close the airbrakes immediately, to give a safe margin of airspeed. The brakes may be fully opened again after landing a second time. Judgement of the round-out point depends on the steepness of the approach, was too high. In this case, a new touchdown will have to be made, starting from the high point after the bounce.

Once rolling on the ground the pilot may fully open the airbrakes, and use the wheel brake. Finally, the flight does not end until the glider has come to rest with one wing tip on the ground. It is necessary for the student to continue to keep the wings level as long as possible and to steer with the rudder to keep straight until the glider comes to rest. (At some clubs gliders make a slight turn off the runway to ensure the area is clear for any following gliders.) On gliders without tip protection, the aileron can protrude below the wing's lower surface. Therefore, teach the student to centre

the stick as the wing drops, to avoid possible damage to the aileron.

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. This needs practice if the student has been well trained in held-off landings, because he will have to adjust the thinking and technique to *fly on* and not to hold off. After touchdown, the student must keep the glider's attitude constant to avoid the possibility of taking off again. In addition, he should keep the nose skid or wheel (if there is one) off the ground as long as possible to avoid unnecessary shocks to the aircraft, its instruments and the pilots. The glider's nose skid (if it has one) should be put down immediately if necessary to avoid running into a hazard.

Pilots must use care when fully opening the brakes, and be careful if they touch down with them fully open. On some gliders, the wheel brake is operated by the airbrake (or spoiler) lever when it's in the fully open position. Knowing this, the student can avoid skidding on a locked wheel.

Remember that a good landing is preceded by a good approach, and a good approach by a good circuit. If your approaches have been consistently good, that is with the speed always under control, the glide path steady at a fairly constant airbrake setting, and the flare and hold-off also consistent, then the student will form a good idea of what he or she has to aim at and achieve.

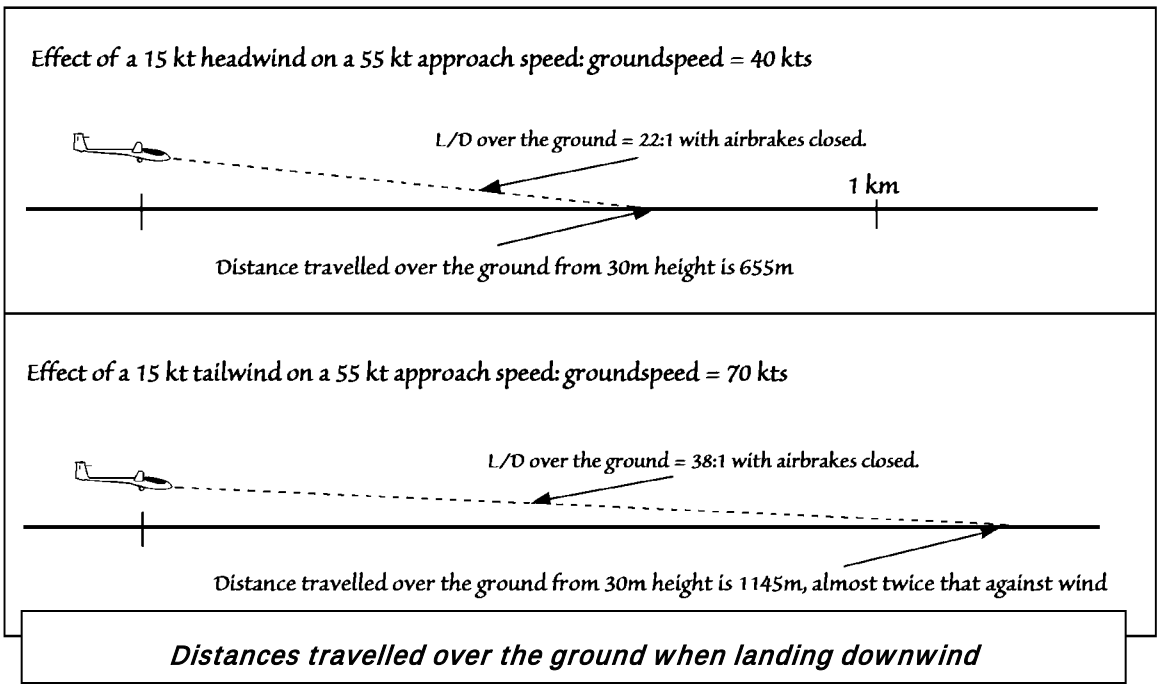
Downwind landings

Discuss with your student the possibility that, one day, he or she may have no option but to land downwind. This adds the wind speed to the airspeed to give a much higher ground speed than for a normal landing (which 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 knots.
- Ground speed with wind = 55 + 15 = 70 knots.

If the student is used to the normal slower ground speed and has to land downwind, he should not be surprised by this increased ground speed, and then be tempted to slow down too much! In the above case the ground speed is 75% greater than normal and the diagram shows that the glider will cover a far greater distance over the ground – in this case about 73% greater with no airbrakes. This exercise is best done later in the training program after the student has been landing consistently from normal approaches.

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, the pilot must quickly choose a reference point on the runway. The position should be chosen to leave a comfortable approach path while allowing as much length as possible beyond the reference point. On turning onto the final approach, instruct



Distances travelled over the ground when landing downwind

the student to control the glider so as not to increase speed – note that the airspeed will tend to increase as the glider descends through the wind gradient. This is in contrast to the normal situation of penetrating against the wind when the effect of the gradient on the glider is to decrease the airspeed!

Now the pilot must establish an overshoot, in the same way as for a normal into-wind approach. The pilot must be prepared to open the dive brakes smartly as otherwise he may have difficulty getting down onto the runway and stopping in time. It will be necessary to carry out a well held-off landing with the wings as level as can be managed, and once running on the wheel, the wings held level as long as possible. The pilot must keep straight with the rudder as normal when on the ground. 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, and a ground loop is a distinct possibility. To avoid hitting another glider or obstruction, instruct the student to make sure that there is adequate clear space on both sides during the approach and landing.

ADVICE TO THE INSTRUCTOR

The effects of airbrakes exercise

The first part of this lesson is the effects of airbrakes exercise. It should be flown immediately after release from the launch, but because rapid height losses will occur, you should leave time for getting into the correct area for the start of the circuit. If possible choose an area of lift in which to do this. The student should perform the CALL check first. With rapid height losses we don't want to land on another glider, so keep a good lookout immediately ahead and below!

For the first practice by the student you should fly at a normal approach speed while the student operates the airbrakes. Having adjusted the speed and trim, bearing in mind the distance and direction that you are flying relative to the airfield, instruct the student to confirm visually that he has hold of the correct lever, by looking at the label or pictogram next to the lever. This should become a normal and automatic procedure for the student. Then smoothly open the airbrakes, also checking them visually by looking along the wings, and then operate them over their full range. Stop at the $^{1}/_{2}$–$^{2}/_{3}$ airbrake setting and compare the lever position to the opening of the airbrakes themselves. Finally, the student should close and lock the brakes.

Point out the different effects at this time that are mentioned under *ground instruction* earlier in the chapter. The student should take over control to repeat the exercise. This will be more difficult because he now has to concentrate also on maintaining the speed by adjusting the attitude as needed. The student should first fly at the normal approach speed, then unlock the airbrakes and operate them smoothly over the full range; finally close and lock them. Then fly at different speeds to feel the forces needed to operate the airbrakes over a range of airspeeds, including diving the glider close to the maneuvering speed Va, then smoothly opening and closing the airbrakes. Exercise care with gliders whose brakes tend to suck open violently, so before reaching Va operate the brakes first at lower speeds. Because spoilers are not designed to be as effective as airbrakes and will not limit the airspeed in a dive, do not demonstrate operating spoilers at close to Va.

APPROACH CONTROL EXERCISE

Overshooting and undershooting

Demonstrate these effects first on a long approach. Plan, therefore, a circuit that will have a higher final turn than normal and choose a *reference point* well along the runway. To save time in the air, agree on the reference point before takeoff. On this long approach show the student how the reference point appears to move, first when the glider is undershooting. It may take a long time for the student to recognize the undershoot, so if you land short of the reference point it will not matter, and it is safer than running into the bushes on the approach! Then make the student practice the use of the airbrakes on one or two subsequent long approaches. Insist on the correct heights for the final turns when they are doing all the flying.

To demonstrate undershooting and over-shooting, go through these steps:

- Instructor to fly the approach and landing – student to follow through,
- Confirm your *reference point* as you pass the landing area on downwind,
- Make a final turn higher than normal,
- Demonstrate an undershoot, and ask the student to tell you which way the *reference point* is moving in relation to the canopy,
- Maintain a steady speed and attitude – emphasize this to the student,
- Demonstrate an overshoot, and ask the student to tell you which way the *reference point* is moving in relation to the canopy,

- Maintain a steady speed and attitude – emphasize this to the student,
- Finally, demonstrate a steady approach at $^{2}/_{3}$ airbrake opening with no apparent movement of the *reference point* in relation to the canopy – emphasize the steady speed and attitude to the student – this is the ideal approach angle we should be aiming at in all subsequent approaches.

Always have two options for a landing area; in other words, pick an alternate landing area as a normal technique – more on this under *planning the circuit*.

Approach control using the airbrakes

It takes some skill to be able to judge and control the approach well; hence, during the first approaches you may need to prompt the student frequently, especially if the workload is high. Prompt the student to use and adjust the airbrakes and make attitude changes as needed to keep the speed constant. During the student's training try to cover the full range from no brakes needed, to a full-brake approach. For a no-brake approach, the only safety margin is any excess speed and the distance between the *reference point* and the airfield boundary, so choose a point well into the runway to make this a safe demonstration. Watch for consistent full-brake approaches; the students may be *aiming* the nose at the *reference point* and allowing the speed to vary from the chosen approach speed. This may be more apparent in gliders with powerful brakes, and the habit, if formed, can become a real safety concern when the pilot converts to a glider with less powerful brakes.

We should also consider power pilots and how they react to the use of airbrakes when first converting to gliders. Until they are quite experienced, they as well as ab-initio students should be taught to fix the airbrake position during the flare and touchdown, ideally at the $^{1}/_{2}$ – $^{2}/_{3}$ airbrake approach setting. Power pilots are used to a longer and flatter approach than is typical for most gliders hence they will not think too much about planning their circuits and approaches. They also may close the airbrakes, subconsciously thinking they are opening the throttle to maintain height or even climb during a low approach; this is very dangerous in gliders! Do not gloss over these aspects of flying the circuit during power pilot conversion training.

Allow the student sufficient practice to be able to coordinate the elevator with the brakes to maintain speed. This is essential before you allow the student to practice judging the glide slope and using the brakes on the subsequent approach, flying down towards the Reference Point.

When on final approach, precise airspeed control is essential because excess speed can result in overshooting the reference point and/or problems with flaring (tendency to balloon). This is important particularly with modern high performance sailplanes. Too slow an airspeed can result in a high sink rate, particularly through a strong wind gradient, which will lead to a hard landing or landing short, or perhaps even a stall. *In strong winds, flying faster* against it produces a flatter glide over the ground, even though the sink rate is higher. Hence penetration against the wind is better achieved at the higher airspeed.

You should challenge your student to achieve a high degree of proficiency in speed and glide path control when flying the circuit. No bad habits should be tolerated; *accuracy now will help later* when converting to higher-performance machines.

Normally, of course, airbrakes are used for glide path control but sometimes they inadvertently open during the takeoff run. If the takeoff run appears unusually long the student should check that the brakes are closed as they may have been sucked open and the pilots may not have noticed. If the towpilot waggles the rudder, it is a signal to check that the dive brakes are indeed closed. However, it is still very important to check that they are closed *and locked* when doing the pre-takeoff checks.

The landing

Before takeoff demonstrate the desired held-off attitude for the touchdown. After the student is strapped in, ask a helper to hold the wings level, canopy closed; then adjust the glider's attitude. Ask the student to look ahead and notice the pitch attitude, that is the relationship of the nose to the horizon or the features at the end of the runway.

This is the attitude for the touchdown that you must remind the student about just before flaring. Get the student to look well ahead; this will help him or her to adjust the attitude of the glider, as it was demonstrated before the takeoff. If the student is having problems judging the height just above the runway prior to touchdown, a more deliberate glance to the side can help the pilot's peripheral vision, to better judge the height. Practice this before takeoff. If a *power pilot* student tends to raise the nose too high when holding off, the glider will be difficult to land well; it is better to concentrate on keeping the attitude constant, maintaining this as long as possible after touchdown.

During the student's flying, be prepared for anything to happen. This means that you should be very alert, with your hands on your knees, ready to take control. The right hand might be close to the stick, with the palm of the hand in front of the stick, but not touching it. The feet should be close to or on the rudder pedals. During the flare and hold-off, when the glider is floating, keep the left hand close to and behind or on the airbrake lever, to prevent the student moving it back at the same time as the stick is being moved back. The right hand now is to prevent the student suddenly pushing forward *to land* the glider.

Sometimes the student will round out too late, usually because he or she is not looking ahead far enough. A reminder to look ahead as for driving on a highway will help. Possibly do the flare yourself by taking over control; don't delay taking over control too long. Beware the student freezing on the controls, so be firm with your commands if time permits.

If the glider is held off too high, it will sink radually onto the main wheel provided its attitude is kept constant. Of course, closing the brakes can reduce the sink rate. If the glider bounces, the same actions should be taken, maintain the attitude and immediately close the brakes, and then do a second held-off landing. If the student does round out too high it is because he has misjudged the height; under these conditions the instructor will have to react depending on the actual situation at the time.

- If the glider's speed and attitude are OK, and the airbrakes are approximately half or less open, hold all controls steady and allow the glider to sink onto the ground.
- If the glider's speed and attitude are OK, but with the brakes nearly full open, prompt the student to ease the brakes in, or do it yourself.
- If the speed is too low for safety and the brakes are open, take over control "I have control", close the brakes and ease the nose down to try and maintain or increase speed.

A very common gliding accident is the instructor failing to take over in time. When close to the ground, don't wait too long, it is better to take over firmly and be safe than to allow the situation to become too difficult. If you do take over, remember that some students will not be ready to take back control; they will have relaxed to the point at which it would be dangerous for them to resume the flying. Although the general idea is to allow students to fly as much as possible, we don't want the occasional crash to blot our logbook!

POST-FLIGHT REVIEW

After the **effects of airbrakes** exercise at altitude, remind the student of the need to keep the hand on the airbrake lever, after the brakes have been opened, to avoid them being sucked open further. Watch that the student is able to coordinate with the elevator and to monitor the speed more frequently, and again review this aspect of the flying. If not already covered, now would be the time to discuss the use of the brakes if, under some flight conditions, the speed is accelerating through Va, the maximum maneuvering speed.

During the student's attempts to fly the approach, speed control is vital; review this after each flight. If the approach path was not clear of obstructions, mention this and suggest how to change the approach next time. Also comment on the method used by the student to judge overshooting and undershooting and how the reference point appears to move relative to a point on the canopy (at constant attitude!), and any effects from a wind gradient that may be present. Compare the achieved glide path with the desired glide path at the $^{1}/_{2} - {}^{2}/_{3}$ airbrake setting.

Students may show a number of faults when attempting the landing the first few times. Sometimes this is because they are trying a landing too early and they have too high a workload, and they are stressed. Typical faults are caused by not looking ahead enough resulting in poor judgement of the flare or round out. This may be because they become fixated on the reference point, or have difficulties with the two hands operating the different controls. Obstructions to the sides can also cause the pilot to be distracted, and usually a swing towards the obstruction! Don't be too concerned if the student does not spot land the glider immediately. No *reference point* may be the problem, or it may have been chosen in the wrong place for the conditions. Begin to insist on more accuracy later in training though.

Watch for rounding out too high: take over control only if necessary, e.g. to complete the landing; but do not delay taking over control until it is too late. It is better to take over too early than too late. Maintain control to the landing; students often relax and will not be prepared to take over control again under these high-workload conditions. Don't make too much of such an attempted landing, but concentrate instead on the positive aspects of the flight. Safety and HF points may include discussion of control errors, misuse of air brake close to ground, etc.

CHAPTER B9
PART 1 THE CIRCUIT PLANNING

OBJECTIVES

We teach how to plan the circuit in the following lessons. The main objective is to get the student to visualize the circuit pattern in three dimensions, something that many have difficulty with because they have so far lived in a two-dimensional world. These lessons include teaching what pattern should be flown under the prevailing situation of the glider's current position, height, traffic and wind speed, and how to enter the circuit and fly it. A large part of these lessons is getting the student to see the runway from different positions in the air. The student should begin to form a mental picture of what it looks like when the glider is at the right position and height in various positions before and in the circuit, or when the glider is too high at its current position, and certainly when it is too low!

MOTIVATION

Planning of the circuit is an essential skill to be learned. This requires the development of spatial (position and height) judgment, and planning skills to work out what circuit pattern to fly. We need to remember that a good circuit is needed as a prelude to a good landing. The techniques covered in this lesson will allow the student to plan a circuit now and later, for example when flying cross-country into a strange field, and to make a well-controlled descent into that field.

TERMINOLOGY and BASIC PATTERN

The diagram on the following page shows what is called the High Key Area; it is the area from which the downwind leg is to be started. The word key is used because a critical decision is to be made in this area, the decision to commit to the landing. In addition, we use the word area as opposed to point because we should not be gearing the start of the circuit to a point (as in over the red barn). The area also will change for different wind and other conditions. The Reference Point remains as the point at which the glider would hit the runway if it were not rounded out. This name is to avoid the tendency of pilots to aim the glider at the ground with the elevator. The Reference Point is opposite the Low Key Point is the point in the downwind leg at which the height should be a minimum of 500 feet agl. This is the second key decision point. Choose and agree on the Reference Point before flight, or select it when approaching the airfield and when planning the circuit.

It is noted that the circuit described here is not the usual rectangular one in which the downwind leg extends beyond the downwind end of the runway. What should be emphasized is that glider pilots have only one chance at a landing and this circuit is designed to get them on the ground as safely as possible, not only to the club airfield but later on when performing an off-field landing. If local conditions make it necessary to depart from the recommended circuit heights and pattern described in this chapter, the principles detailed here should be followed.

PREPARATORY GROUND INSTRUCTION

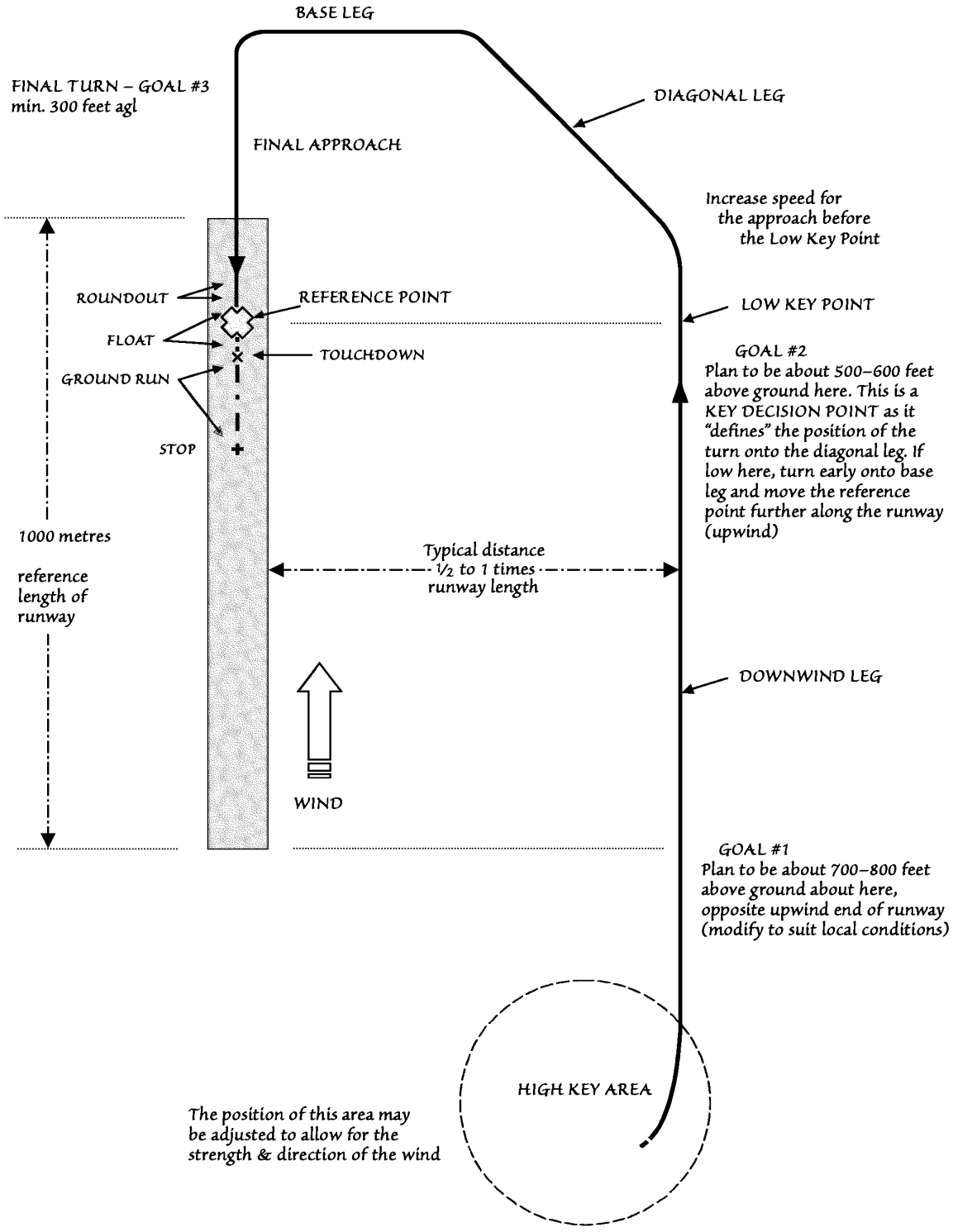
Teaching the circuit can take a few flights or many flights depending on the student's aptitude and perhaps more on the abilities of you, the instructor. Start by giving a thorough explanation of the circuit procedures to the student, pointing out the normal circuit pattern to be flown. The normal pattern as discussed here may differ from club to club, and this will depend to a large extent on local conditions and current club practices. The basic objective remains the same, and this is to arrive at a safe speed and at the right height and position for the final turn. For reference, specify a minimum height of 300 feet above ground for this turn, to be judged by comparison to the heights of ground features such as trees or buildings, not by the altimeter!

First, planning the circuit (or pattern) is taught, and second, flying the circuit and making adjustments to allow for other traffic, the effects of the wind, lift or sink in the circuit, and so on. Part 1 of this chapter covers how to plan the circuit, and Part 2 covers the flying of the circuit.

The circuit pattern

We all understand that a good circuit is vital to making a good landing. Take the opportunity to emphasize this point to your student as often as you can during training, because a glider pilot has to get it right the first time; he does not have a motor to allow an overshoot for a second try!

For safety reasons a standard circuit shape is adopted, and all aircraft should follow this. There are two common circuit patterns and both are basically rectangular. The first starts with a crosswind leg, followed by a downwind leg, a diagonal leg, a base leg and a final approach towards the runway. The second pattern omits the crosswind leg and the circuit is assumed to start on the downwind leg. Explain the towplane circuit if it differs from the sail



STANDARD CIRCUIT

plane circuit. Be aware that the diagonal leg is a modification to the standard circuit that has been adopted by many gliding organisations. That being said, some pilots do not use it. It is shown opposite.

High key area. The position of this area is usually well upwind and on the circuit side of the runway. Care must be taken not to fix this to a geographical feature; it is preferable to talk of a general area to be in before starting the circuit. In soaring, gliders have vastly different performance; hence, pilots will vary the length of the downwind leg accordingly. The pilot(s) should plan the circuit pattern itself, taking into account other traffic, the wind direction and strength, and the glider's current position and height.

Reference Point (RP)

An essential to making a good approach is to decide on the intended **RP**. When in the *high key area* the student should be taught to select a reference point, though initially you might have to suggest this point. This is the point that determines most decisions that are made in the circuit such as whether to lose extra height or to turn, in addition to being the point that will be used to judge the final approach. At the latest, this point must be selected when going through the 500-foot height above ground on the downwind leg. It should be a mark on the runway; put one there if necessary and remember it could be a patch in a ploughed field when he is flying cross-country in another year or two. Then have the student select this point in later flights. When choosing the *RP* it is necessary to select an alternative landing area in case, because of heavy sink, the chosen spot becomes out of range or the landing area becomes congested with other gliders. Teach students to fly their circuits always with an alternate landing area in mind.

The position of the RP must be beyond the runway threshold a sufficient distance to provide an undershoot area in case of extra loss of height on final approach. Landings consistently on the threshold show inadequate safety margins, and pilots who do this are leaving themselves open to landing short in the future. It is recommended the RP be chosen a minimum distance beyond the airfield boundary or runway threshold, to provide this safety cushion. It should be marked on or beside the runway as an easily seen reference mark.

Downwind leg

At the start of the circuit, it is important to plan for a good entry into the downwind leg. This is shown in the diagram as **Goal #1**. If we omit the crosswind leg, the downwind leg is started at a point upwind of the end of the runway at about 700 to 800 feet above ground level or higher when the airfield or circuit is busy. The lateral position will be approximately about 1/2 of a runway length to the side of the runway (500m), but choose it with the wind strength and direction in mind. It will be closer to the runway under a crosswind that is tending to blow the glider away. And place the downwind leg further away from the runway when the wind tends to move the glider closer. The distance upwind of the end of the runway will depend on the length of the runway and the wind strength, being further upwind for stronger winds. Once in the downwind leg the glider's height must be judged by reference to objects on the ground, and by the appearance or perspective of the runway. The student should try to avoid using the altimeter. The best ground reference to use of course is the RP.

While flying the downwind leg, the student's objective should be to arrive at the low key point at the **minimum** height above ground of 500 feet, which is **Goal #2**.

Diagonal leg

Having passed the *low key point*, and before the *RP* is obscured by the wing or cockpit structure, the glider is turned (any angle between say 30–70 degrees) onto the diagonal leg. This allows the pilot to maintain the landing area easily in view. Also of interest is the fact that the glider will now remain at a steady or decreasing distance from the landing area, and will not be flying further away, as would be the case with the previous totally rectangular circuit. Consequently the glider should be at a height from which a $^{1}/_{2}$ – $^{2}/_{3}$ airbrake approach may be made to the landing area from any point along the diagonal and base legs. If low the glider may be turned in towards the runway to make a base leg earlier, or if high, the diagonal leg may be angled out to extend the diagonal leg, as shown in the diagram below.

Base leg

The turn to the base leg is judged by reference again to the *RP*. To avoid being drifted away from the field while flying the base leg, the student will *crab* slightly into wind. Keep referring to the *RP*; this will help to judge when to start the final turn. The base leg is also used to adjust the glider's position and height to a point from which a safe final approach can be made. If still too high the dive brakes also may be used to increase the rate of descent.

On base leg stress the need to look for traffic

making a long final approach or an opposite-side circuit. Make sure the student checks that the selected landing area is free of hazards such as other gliders. Get in the habit of doing this now, so that on an off-field landing that might have to be made in later years, the student will be checking for hazards.

Final Approach

The main goal in the circuit, **Goal #3**, is to arrive at the final turn about 500m from the RP at a height that will enable a pilot to reach the intended reference point, and to touch down slightly beyond, leaving enough distance on the runway to make a full stop. A minimum of 300 feet above ground is the reference height to aim at, and this should be judged by looking at large trees or buildings and by the perspective of the runway in comparison to these and other ground features.

Although it is desirable to choose an RP that is consistent and that will be used most of the time, the student must be taught to remain flexible. For example if necessary, he should be able to select an RP that is in another area of the airfield, to land on an alternate runway or even to land downwind if the need arises.

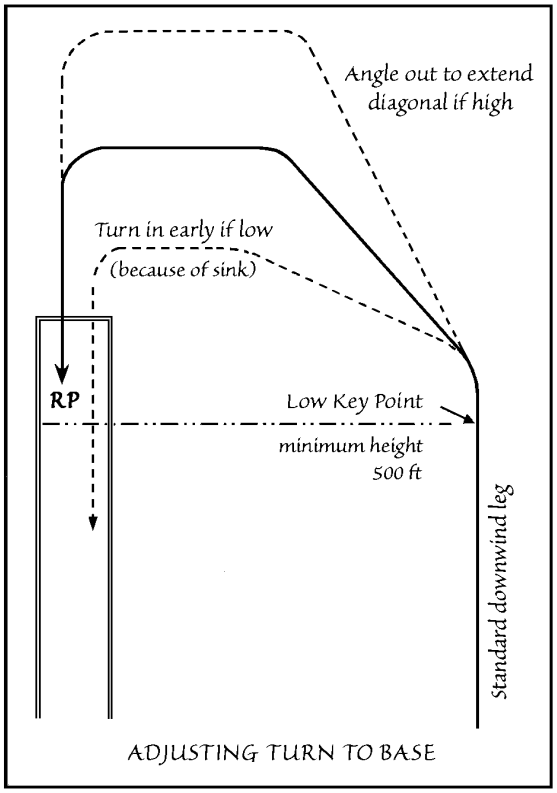
Reference Point technique

During the final approach, the RP should be visually confirmed. It should then be watched and the student should be reminded to confirm that he will overshoot the RP before opening the brakes. The *reference point technique* is then used to judge whether this point is *moving up* or *moving down* relative to a fixed point on the canopy. If the glider is going to overshoot, the RP will seem to move down the canopy; hence open the brakes a bit to steepen the glide. If the opposite happens and the glider is going to undershoot, the point will be seen to move up the canopy; the brakes should be closed to flatten the glide angle.

Remind the student to adjust the attitude to keep the speed constant, because opening and closing the brakes changes the drag. Gentle, small movements of dive brakes (especially the powerful double brakes) will help initially. Only small corrections will then be needed with the elevator to maintain a constant airspeed.

Running out of height in the circuit

If the glider is allowed to get too low for a proper circuit, and if the *normal pattern* over the ground is flown, the final turn will be made at a dangerously low height. Even though an inexperienced pilot might recognize that he is running out of height there is a magnetic fascination to getting back to the normal landing area. This must be resisted. Instead the student should fly what is called an *abbreviated circuit.* When a pilot starts to recognize that he is



running out of height in the circuit he should be taught that when he reaches a height of 500 feet above ground in the downwind leg, this defines a new *reference point* – it is opposite on the runway. The *new RP* now is used for the balance of the circuit. The turns to the diagonal leg, the base leg and onto final will be made at the usual safe heights above ground.

In some cases when low, the pilot will tend to fly closer to the runway. This has two effects. First it increases the angle to the landing area, making it appear that the situation is normal. However, the distance to the runway will become too small and the height is therefore also low, which we know already. The effect of making the angle look okay is that the pilot is in danger of believing that he or she is at a safe height; the reality of the situation often is not recognized. This is at the root of many accidents – not believing what is going on is actual ***reality!*** The final turn is also in danger of becoming a 180 degree turn – this should also be resisted because of the distinct possibility of losing a lot of speed during the turn, and not being able to recover it quickly, especially in windy and turbulent conditions. In a

case like this, such a turn must be started higher than normal and with plenty of speed.

When low and trying to conserve height many a pilot will unconsciously fly the glider more slowly, just when he or she should be flying faster! Flying more slowly when low becomes more critical when sinking air is encountered. Most pilots have experienced an increase in airspeed when flying into lift. The opposite occurs when flying into sink! And sink plus a decreasing wind speed on final can be deadly.

Hence by flying too slowly, this further loss of speed (especially in a wind gradient) will increase the loss of height even more. Trying to complete the turn onto final under these conditions will likely cause a stall and spin off the turn. If an instructor has difficulty spinning the trainer at altitude where there is no wind gradient, he should try doing so under these conditions! Impress on the student that it is better to retrieve the glider from up the field after an abbrieviated circuit than to be retrieving the bits from the heap short of the runway.

Winds and wind gradients

This is an important topic for your student. Take time to discuss the effects of the wind on the glider's circuit and on how the student should plan the circuit as a result. The effects vary with glider performance, and with the strength and direction of the wind. In stronger winds the downwind leg will be covered faster over the ground, hence the glider will tend to arrive at the low key point more quickly than normal and possibly too high unless the high key area is moved further upwind to compensate. In crosswinds, the high key area and hence the downwind leg should be moved towards the wind, and the glider crabbed into wind. This helps make sure the glider's track over the ground is correct in relation to the runway. If the glider were to be flown heading in the usual (no-wind) direction, making no allowance for the wind for example, the circuit would be increasingly difficult to organize as the height reduces. Talk about how to recognize these effects, and how to compensate for the wind.

Discuss wind gradients on this and later flights, particularly when there is an appreciable wind. The wind speed progressively decreases near to the ground because of surface friction caused by trees, crops or buildings. The effect is most marked in a strong wind blowing over uneven ground, or in early mornings and in the evenings when the wind at ground level can be very light but at 50 to 100 feet it can be quite strong. The effect of a strong wind gradient on a sailplane approaching to land is to cause a sudden drop in airspeed, and this decrease is particularly noticeable if the airspeed is only marginally higher than the stall speed. The increase in sink rate (and drop in airspeed) can become alarming. The glider will also land shorter.

The airspeed to use for the final approach is critical and must take into account the possibility of a wind gradient. The formula, given earlier in this chapter, is designed to give an adequate margin. However, all gliders have a flight manual that include recommendations for many situations including approach speeds. These should be known and followed.

It is poor airmanship to bank steeply so close to the ground that the wings will be across the wind gradient. In such a case, the upper wing will be in the stronger wind and will be developing more lift. The lower wing will be in the weaker wind, and will be developing less lift; the glider will tend to over-bank quite strongly and attempts to prevent this with corrective aileron deflection could induce the wing with down aileron (the lower wing) to stall. Successful flying through wind gradients on final approach demands that we start with adequate airspeed, that we are alert to a decreasing airspeed (we must lower the nose), and to an increasing sink rate (close the airbrakes). In windy weather it is very helpful to keep extra height in reserve until after the final turn, and then to use the airbrakes to lose the height. If the airspeed drops and the glider begins to sink rapidly with the airbrakes open, close them immediately.

Flying against the wind

The effect of the wind on the glider can be noticeable especially when low to the ground. This is very important when flying the circuit, when the ground speed will be higher going with the wind than flying against it. When flying the downwind leg with a strong wind from behind, the inexperienced pilot will tend to slow down because of the high ground speed. Compare this to when flying into wind on final approach, when this same pilot will get a rude shock as the slow ground speed may well lead to an undershoot.

The glider will make little progress when flying into a strong wind, therefore the final turn should be made within the boundary of the airfield. What should the pilot do if he does turn too far downwind? In this case, having settled onto the final approach, he will find that the glider appears to be undershooting; it will land short of the runway. The instinctive reaction is to raise the nose in an attempt to stretch the glide. It is of course the wrong thing to do particularly in a strong wind, as the glider's

ground speed will be further reduced, resulting in even less progress being made against the wind. The glider will continue to sink, probably at an increased rate, resulting in a steeper approach to land even shorter. The gradient has to be traversed before the landing, and at the reduced airspeed the pilot is asking for a stall, or at best a heavy landing.

Immediately it becomes apparent that there is a chance of an undershoot the pilot should lower the nose to well below the normal attitude for the approach. The objective is to gain speed as rapidly as possible. Initially the glider will lose height more quickly but it will also penetrate against the wind and will have a safer margin of speed to penetrate the wind gradient itself. The diagram below shows dramatically how effective it is to increase the airspeed to penetrate against a strong wind. Even if the speed appears to be far too high, the penetration is good and the glider is being flown under good control close to the ground.

The best speed to use when flying against the wind is to add half the estimated wind speed (at ground level) to the speed for best glide angle (best L/D speed). Because the best L/D speed often is not known, the rule of thumb is to use the same speed as the approach speed, calculated as part of the pre-landing SWAFTS check, and then add half the wind speed for the best speed to fly.

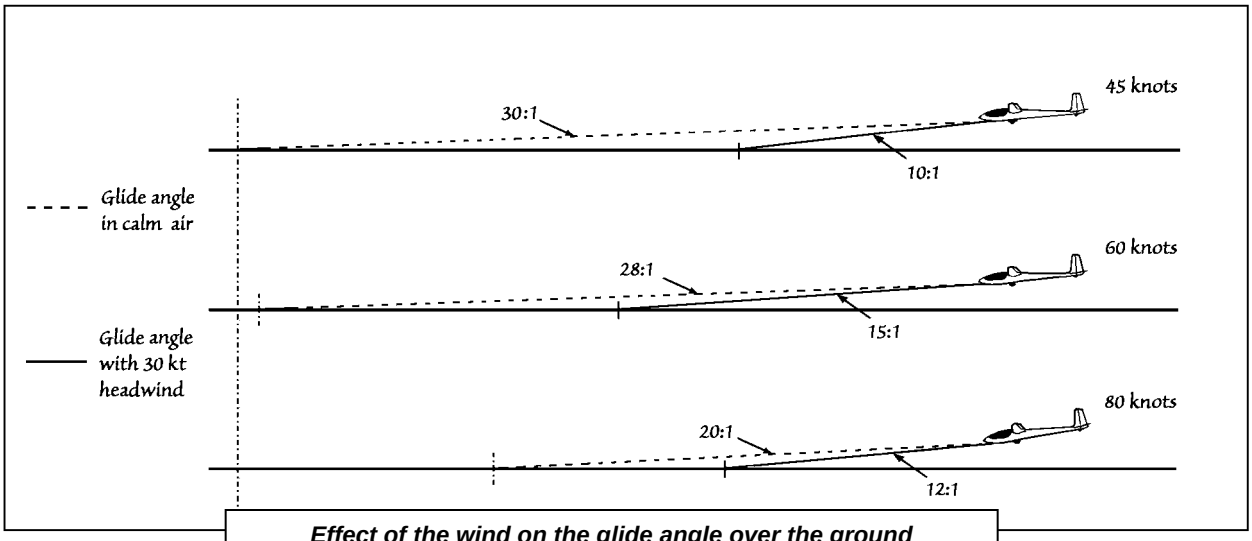
Judging heights in the circuit

During the student's flying your task is to help develop their judgment of the distances and heights from the glider to the landing area from all parts of the circuit pattern. Heights and positions in the circuit are best judged by first observing the landing area from the glider. The student manual *SOAR and Learn to Fly Gliders* discusses two techniques that may be used; the angle method, and the height and distance method, discussed below. What we wish to finish with is a student who can look at the airfield from any position around the airfield and at different distances, and say that he or she is in a good position to arrive in the high key area at a safe height to start a circuit.

When the ground elevation is unknown or the glider is lower than about 700 feet agl, the altimeter should not be relied on and the pilot must use his eyes. The lower we are the better we are at judging heights, and the perspective of the ground features and their size is a very good indicator of the height above the ground. This is why we must use our eyes and not the altimeter to judge heights in the circuit! This is important for judging the final turn height, which should in any case be no lower than 300 feet, judged by reference to the heights of large trees and buildings.

A useful way to judge the circuit is to combine the distance from the runway with the apparent angle down to the landing area. This helps to estimate height if we imagine a glide down to the landing area from that position. As it is possible to have the same angle at any distance from the *RP*, we must combine the correct angle with the distance to obtain the desired height. If the distance is correct but the angle is too small then the height is low. If distance is too small and height is correct then the angle will be too large; the glider is too close and the pilot will 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.

Teach the student to observe the landing area from all positions in the circuit, including from the *high key area*. This will enable the student to form a men-



Effect of the wind on the glide angle over the ground

tal picture of what it should look like. 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 judge the angles and the distances to the landing area (and the alternate landing area) continuously to keep the heights under control, and to make adjustments when needed.

ADVICE TO THE INSTRUCTOR

Planning the circuit

Any lesson starts with a demonstration. The demonstration of planning the circuit that you give should be as precise as possible and the circuit should be the one that you would wish the student to plan and fly when solo. It is important to make sure the student does not do the flying and does not follow through. This is to permit full attention to be given to the demonstration and your comments, decisions and actions without the distraction of having to concentrate on flying as well. This demonstration is to show the student the angles, distances and heights at the various points of the circuit, and how to judge them. You should discuss location of high key area, reference point, down wind leg, low key point, offset and base leg, and final leg along with goals 1-3. Avoid the temptation at this time to explain everything about the circuit and save it for the next demonstration on *flying the circuit.*

Humans are generally poor at judging angles – one angle to one person is quite different to another, so do not specify a numerical value to any angles down to the RP. Instead, show the student what angles look comfortable, what *the picture* looks like when the glider is in the right position anywhere in the circuit. As you fly the circuit give the reasons for the decisions as well as the resulting actions that you take. Concentrate first on the major points that are included in the ground instruction sections above that you will have discussed in more detail on the ground. A safe alternative approach path and landing area should always be chosen, so include this in the demonstration.

Admit it if your demonstration is not as good as you wished, for example, height not right. If you get low, say so, and talk through the decisions to correct the problem. Corrections such as this are likely to be very valuable learning tools, so do not keep quiet when things don't go the way you would have wanted!

Student flying the circuit

On the next flight after the circuit planning demonstration, have the student make planning decisions but the instructor demonstrates the circuit speed changes, lookouts, and circuit adjustments. Let the student fly the final approach and landing. From now on the student is to increasingly do all the planning and decision-making regarding the positioning of and arrival in the *high key area*, when to start the downwind leg, and to make all subsequent decisions in the circuit down to the landing. Initially their handling of the glider will deteriorate because of the increased workload, so prompts may be needed more than usual. Go over the previous flight and remind the student of the basic objectives; these are to arrive at the right position for the final turn, at the right height and at a safe speed. An alternative landing area should be included in the student's planning.

Help develop the student's abilities to judge the angles and heights for the various positions in the circuit by asking for feedback regarding these variables as the flight progresses down to the landing. Part 2 of this chapter goes into the flying of the circuit in detail, and includes advice to the instructor for each part or section of the circuit.

POST FLIGHT REVIEW

After the flight, ask questions to see how the student saw the circuit and the reasons for different decisions. Assess factors such as getting low, or being too far to the side and the decisions to correct these. Ask additional questions such as what would the student have done at certain points in the circuit to change the way that it was developing. All this is useful learning, and relies on your feedback being helpful and it being related to the preparatory ground instruction and pre-flight briefing. Discuss any safety or HF points such as collision avoidance, lookout, mental fixations, distractions, and airmanship

CHAPTER B9
PART 2 THE CIRCUIT

FLYING the CIRCUIT

OBJECTIVES

The purpose of flying a circuit is to organize traffic arriving at the airfield to fly in an orderly manner, it being vital to know what pattern other aircraft will fly to maintain a safe operation. By specifying a standard circuit pattern, pilots will be better able to fly safely together with any other gliders and aircraft that are about to land.

The main objective in flying a circuit is to arrive at the right height and position to be able to make a safe final turn with adequate speed. Backing up from this point, we have intermediate points or areas in the circuit at which decisions are to be made. These will have been demonstrated on a previous flight, hence on the succeeding flight(s) the student should be assisted with decision-making. The objective is to learn how to judge the circuit and to make the right decisions to fly the circuit safely.

Exercises included as part of **flying the circuit** are:

- The *zigzag on downwind* exercise(optional),
- The *running out of height in the circuit (the abbreviated circuit)* exercise, and
- The *airbrakes open* in the circuit exercise.

The first two of these exercises need to be covered when the student is first becoming used to planning the circuit and flying it consistently. Cover the third exercise later as part of the flights closer to solo. It is also an exercise recommended for the training and flight checking of a pilot converting to a motorglider.

PREPARATORYGROUND INSTRUCTION

For the student pilot's first attempts to plan and fly the circuit, first discuss when to fly towards the **High Key Area**, and the desired heights and positions of the glider at the **Low Key Point** and the **Final Turn**. Additional details to remember must be covered now, before flying, and may be recalled as the flight progresses, as below.

Before starting the circuit

Throughout the flight, the pilots must monitor the glider's position and height relative to the airfield using the **SOAR** technique. At the same time the student should be taught to assess the wind direction and strength (using the windsock at the airfield or other wind indicators such as smoke or the surface of water) to decide on the best position for the *high key area*. For example, adjust the position for the wind direction and length of the runway, with strong winds requiring the *high key area* to be more upwind. In crosswinds, move it closer to or further from the side of the runway. Assist the student to make a definite decision to join the circuit and plan to approach the *high key area* at about 1000 feet above ground. When this has been decided, start the **SWAFTS** pre-landing checklist and try to complete it efficiently and quickly before entering the *high key area*. Remind the student how to calculate the **approach speed.** This is the A – Airspeed item in the pre-landing check. The **downwind** leg itself is best flown at 45 knots (or 50 mph), not at the approach speed. Thus:

Approach Speed = 1.3Vso + Vw

where Vso is the 1g stall speed of the glider, and

Vw is the wind speed (max. gust anticipated).

The approach speed should never be less that 45 knots (50 mph) for training gliders, and higher for two-seaters that require a different speed. The speed should be increased to the chosen approach speed as the low key point is approached. This formula is a generic formula that should stand a pilot in good stead when flying an older type for the first time.

The manufacturers of modern gliders recommend a minimum approach speed in their manuals, plus mark the ASI with a bug at this speed. Use this speed, modified as above if not stated otherwise in the manual, for increasing wind and gust speeds, and to suit the airfield itself.

High key area

As the glider approaches the high key area, prompt the student to keep a good lookout for traffic approaching the area and in the circuit. Then reassess the height, distance and angle to the landing area, looking for obstructions on the ground. The student should now plan what sort of circuit to fly, and visualize the complete circuit from the vantage point of the *high key area*.

Choose an *alternate landing area* also when in the *high key area*, such as further upwind on the runway, or choose an alternate runway if available. This is to allow for obstructions on the airfield or to allow for extreme sink that can place the chosen land-

ing area out of reach (see *Alternate landing area* section below).

If the *reference point* is not chosen before the flight, choose it now, before entering the downwind leg. If the glider is too high, you may continue to practice turns for example by leaving the *high key area* and return later at the desired height. If the glider gets low, start the downwind leg immediately, fly a modified circuit as needed or plan to land on an alternate landing area.

When in the *high key area* it is important to make turns only *in the same direction* as the circuit that is to follow. However to be safe, an immediate turn in the opposite direction onto the down-wind leg is acceptable if the glider is already low.

Look for any following gliders before entering the downwind leg, and adjust the speed to the best L/D speed for the downwind, and then re-trim the glider. When turning in the circuit look for other aircraft **above, below, inside, and outside all turns by searching also under the high wing** and **above the low wing**. This is not excessive; there have been incidents in the circuit at clubs. Being aware of other gliders leading or following in the circuit goes a long way to maintaining separation and safety close to the ground.

Downwind leg, Goal #1

The decision to start the downwind leg should be made to put the glider at a height of 700–800 feet agl at a suitable position upwind of the end of the runway; this is the position of Goal #1. Refer again to the Standard Circuit diagram in the beginning of this chapter. Although the altimeter is still fairly reliable at this height (provided that the flight has not been so long that the atmospheric pressure has changed) give the panel a careful tap near the instrument to unstick it. This should be the last reference to the altimeter in this circuit. However, teach the student to continually monitor the ASI and variometer.

On the downwind leg major adjustments can be made by angling in or out, by using the airbrakes or by extending the diagonal and base legs if very high because of strong lift. If adjustments are made, the student is to regard the balance of the circuit as a new circuit that must be re-planned; it will not always be the best idea to continue with the original plan. Fly at the same best L/D speed but increase the speed in sink. The student must keep monitoring the variometer throughout the circuit to be quickly aware of changes in the lift or sink that might require modification of the planned circuit. At this time choose an alternate landing area in case the usual area will not be available or cannot be reached.

In a crosswind the glider's heading is changed to compensate for drift, by crabbing towards the wind. In a strong crosswind the downwind leg may be flown further in or further out from the runway, crabbing to maintain the track parallel to the runway. Using areference point on the horizon helps to maintain a parallel track. Have the student continually assess the height, angle and distance to the landing area and adjust the downwind leg as appropriate.

Both pilots should maintain a good lookout and keep aware of other gliders in the circuit. If there is a need, adjust the glider's path so as to maintain separation from other gliders that may not have seen you. Do not assume the other pilot has seen you! Look for aircraft crosswind at mid field.

Keep the alternative landing area in mind; this is an important point to remind the student, and constant watching of the chosen landing area will show whether it remains clear of obstructions. If a vehicle or person moves into the landing area it is usually better to make the first part of the approach with the brakes closed. This allows the glider to fly over the obstruction and to land beyond it, rather than have to try and fit between obstructions or to land earlier and risk running into the obstruction. As the glider arrives close to the *low key point*, adjust the speed to that for the approach and use a value as chosen earlier when completing the pre-landing checks, then re-trim.

Alternate landing area

Sometimes the usual landing area may be blocked at the last moment by a vehicle or person, or another glider that has just landed and not been moved. Teach your student to choose an alternate area so that a panic situation does not develop when on final approach. The alternate area could be on the usual runway and beyond the assumed obstruction, or on an alternate runway or other suitable area on the airfield. The habit of choosing an alternate will serve him well when on a cross-country flight and he has to choose a landing field. Many accidents have been caused by a decision to change the landing area very late on the approach, so teach students to make the choice when on downwind.

Low key point, Goal #2

As the glider arrives at the *low key point*, the speed should be increased to that for the approach and landing. If during flying the downwind leg the stu-

dent decides he will be high, he has a choice either to extend the downwind leg slightly or to use the airbrakes. If low, he should turn onto the diagonal leg early to avoid going downwind of the airfield boundary.

If the glider becomes much too low for a normal circuit, prompt the student to fly a modified circuit. This should be the same, normal circuit pattern, but with the landing further towards the upwind end of the field. In other words, move the *RP* further up the runway. Use this new position of the *RP* to make the decisions for the turns to the diagonal and base legs, and onto final approach. Stress that the first two considerations should be to maintain an adequate airspeed, and to complete the final turn at a safe height. It is much better and safer to fly an *abbreviated* circuit to land further up the runway. If the pilot were to continue downwind at too low an altitude, he or she would have to make an off-field landing because of *running out of height in the circuit* (see later in this chapter, page B9-6).

Explain to the student that it is very important, once committed to a landing, to never attempt to soar even if lift is encountered. Rules to remember: use airbrakes to descend and never *turn your back* on the field – you may drift further away and fly into sink, which will result in a hazardous attempt to reach the field, or will result in an outlanding.

The student is to continue checking the height and position relative to the landing area and decide on any needed adjustments. Goal #2 is to be at the *low key point* at a height of 500–600 feet. At this point definitely decide to stop using the altimeter, our height judgement from looking at ground features is much more reliable. If too high adjust height by reducing the angle of the diagonal leg or by using the airbrakes with care.

The pilot must look for any following gliders by looking again above, below, and under the high wing and above the low wing when turning; also search for aircraft making an opposite-sided circuit. Clubs often have their towplanes fly on the opposite side to the gliders for example.

If the glider becomes very high relative to the current circuit position, never use full airbrakes to let down in a straight line. The glider may descend onto another glider immediately below, whose pilot may not have seen you. Instead make a series of sweeping turns one way and then the other as this allows a search below and behind as the turns are made.

If not already done, choose a suitable *Reference Point* or *RP* now. It should be directly opposite the glider when it is at the *low key point*. Teach the student to visualize the diagonal leg and base leg positions for the balance of the circuit. If at any time the student finds the glider at a minimum of 500 feet above ground, even before arriving at the *low key point*, this then defines the position of the RP. It does not matter if the original RP is not opposite; the new RP must now define the balance of the circuit. Read also *Running out of Height in the Circuit* on page B9-15.

Diagonal leg

Normally the student will turn onto the diagonal leg after passing the *low key point* before losing sight of the landing area. Some clubs may not fly this pattern for local operational reasons, in which case beware of flying too far downwind, particularly in a strong wind. The diagonal leg avoids the situation that when the turn to base leg is made from an extended downwind leg, the glider may be too far from the landing area for a normal $^{1}/_{2} - {}^{2}/_{3}$ airbrake approach, and could be dangerously low. This is more critical in off field landings where pilots have lost sight of the RP flying well downwind.

Although they will have been checked earlier as part of the SWAFTS pre-landing checks, the pilot will soon be using the airbrakes. Therefore in preparation for the approach, he must now identify and take hold of the airbrake lever. Do a quick check again along the wings as the brakes are opened to confirm that the correct lever has been selected. (Although this will have been done earlier, the brakes may not have been used in the circuit up to now and the free hand may have been used for other tasks, hence the brakes will have been closed and locked again). And the pilot should continually monitor the airspeed indicator at a suggested interval of 2 to 3 seconds.

Now is the chance to make any adjustments to the diagonal leg to compensate for the wind and any deviations in the desired height.

- If low or drifting because of the wind, turn onto base leg sooner, or if still too low for a normal final approach path, turn onto final early.
- If too low to reach the planned RP, plan to land on the undershoot area or on the previously chosen alternate landing area.
- If close in but at a good height, angle away from the chosen landing area, or move the RP into wind and land further up the field or runway.

- If high, continue the diagonal leg further before turning onto the base leg, angle it away more from the runway or use the airbrakes.

Base leg

Check airspeed regularly, and check again that the landing area is free of obstructions. Continually assess the distance and angle to the RP, and the height from the appearance and perspective of ground features. The student should be adjusting the base leg to compensate for wind drift and position by crabbing into the wind. If still too high he will need to lose excess height with careful use of the airbrakes.

Perform a final good **lookout** to both sides, **above** and **below**, for aircraft on a long final approach or on the opposite side of the runway (e.g. towplane circuit). Then the final turn may be started. **Goal #3** in the circuit is to be at the right height and position for a safe final turn. A 300-foot height is the minimum recommended, and the position should allow for an approach using an airbrake setting of $^{1}/_{2} - {}^{2}/_{3}$ open.

Final turn, Goal #3 and the approach

Although airbrakes may be used in the final turn if the air speed is high, they should be closed before the final turn in pre solo flights. Do NOT teach or allow a pilot to adjust or open the airbrakes part way through the final turn. The effects are likely to upset the new student pilot; he will have difficulty with speed control and the sudden increase in sink rate and loss of height can be alarming.

Deliberately lower the nose slightly as the final turn is started even if the speed is considered adequate and is at the pre-selected approach speed. This should become a normal habit in all pilots and is a safety feature designed to guard against a too-slow final turn.

If the glider is very high, the brakes may be open throughout the turn if airspeed is sufficiently higher, and this should be practiced in later flights. The final turn is to be at a good angle of bank, normally at about 30 degrees, therefore do not start the turn early. A turn started early leads to a shallow angle of bank and more time taken to complete the turn. Then, if the pilot wishes to tighten the turn he may use too much rudder input. The consequence is a possible spin and recovery from a spin this low down is unlikely. Always insist on a well-banked final turn with adequate airspeed.

Maintain the lookout to the circuit side to search for gliders behind in their downwind leg, and check the airspeed. The pilot should select a landing line on the centreline of the landing area, well clear of side obstructions. Normally this would be on the runway centreline but at many clubs the airfield is sufficiently wide that the landing area is usually to one side, with the takeoff area on the other side. Take care not to approach close to gliders or other obstructions to either side of the landing line, and adjust the line to avoid obstacles if present. And check the airspeed.

If the turn is not onto the landing area centreline, adjust this as soon as possible, and maintain adequate speed if the angle of bank is increased e.g. in a ***Pear Turn*** maneuver. See later under *Further Spinning Exercises.*

Monitor speed as before, every 2 to 3 seconds. Use the airbrakes to control the descent rate at constant speed and the pilot should be encouraged again to achieve the desired glide path or angle of the approach at the previously used $^{1}/_{2} - {}^{2}/_{3}$ brake setting. And be prepared to close the brakes and land long to clear other gliders or vehicles on the runway. And check the airspeed!

Speed control

When on final approach, *precise airspeed control* is essential because excess speed can result in overshooting the RP and/or problems with flaring (tendency to balloon). Too slow an airspeed can result in a high sink rate, particularly through a strong wind gradient, which will lead to a hard landing or landing short, or perhaps even a stall. The approach may be steepened by using the airbrakes or the flaps on some gliders, or by sideslipping. The following must be remembered: *Airbrakes control the rate of descent, and the stick controls the pitch angle or attitude and hence the airspeed*.

Or, remember with:

Airbrakes for **Altitude**,

Stick for **Speed**.

In strong winds, flying faster against it produces a flatter glide over the ground, even though the sink rate is higher. Hence, penetration against the wind is better achieved at the higher airspeed. Dive brakes can be used in a dive to limit the speed, or to lose height rapidly for example when wave flying.

ADVICE TO THE INSTRUCTOR

Teaching the circuit is a process that can take many flights so it can and should be taught carefully, with no essential points omitted. This chapter has attempted to show all factors that must be considered

when planning and flying the circuit. Instructors are encouraged to add items that they think are important and that have been omitted or only briefly described.

Flying the circuit safely requires the student to be taught the necessary skills to control the aircraft down to the landing. Besides the circuit planning skills needed, these skills must include:

- how to perform the pre-landing checks efficiently and quickly,
- how to calculate the final approach speed,
- how to make a safe final turn at a safe minimum height and speed,
- how to adjust the glide path using the airbrakes or spoilers,
- how to handle the aircraft through the wind gradient, and finally
- we must teach the student to perform a well held-off landing (minimum energy) and rollout to a standstill.

Before the student is to start planning and flying the circuit for the first few times, it is important not to load the pilot with too many or difficult exercises immediately prior to going to the *high key area*. The student needs to have time to prepare for the upcoming circuit planning and flying. Later in training, high workload exercises may be flown immediately before the circuit, and will simulate the extra stress that the student will feel sometimes when solo. An important point about circuit planning by the student is that if at any time the instructor makes a decision and prompts the student, then the instructor is in effect demonstrating the circuit again! Allow the student to make errors and then debrief thoroughly to emphasize the way in which the circuit might be modified next time, or in which a different decision would have affected the circuit. If the error is such that the safety of the flight is in question, take over control to correct it or to complete the approach and landing, and then consider whether another demonstration on a subsequent flight is needed.

The following additional exercises form part of the normal curriculum and are shown here because they would not normally be pre-briefed, but should be performed and talked through as part of other flights, as the opportunity arises.

Zigzag on downwind exercise (Optional)

This exercise is designed to assist the student to assess the correct positioning on downwind, and is used after the student has first started planning and flying the circuit. It is important that the instructor is relaxed about flying this, when the glider will deliberately be flown away from the runway, to show what it looks like to be too low. A good lookout is required throughout the exercise so as to avoid conflicts with other gliders in the circuit.

The instructor starts the exercise by taking control as the student is flying towards the *high key area*. The glider is then angled about 45 degrees to the runway centreline at a position that is higher and too far to the side for a normal entry to the downwind. Continue on this angle toward the airfield, and ask the student to advise you when he thinks you are at the correct distance from the airfield and angle (*the picture* of the runway looks right) to start a normal downwind leg. If the student initially identifies a position too far away advise that it is too far (give reasons, e.g. crosswind effect) and continue toward the field. If he identifies a correct position, confirm the decision, but advise the student you will deliberately continue toward the airfield. This is to allow you, a little later, to angle away to intercept the downwind leg at a lower height.

If the student allows the glider to get too close, turn away from the field and explain the situation. The angle down to the runway is too large and the glider is too close. Even though the height may be correct for that position on the downwind leg, the circuit is now too cramped because the distance is too small.

Angle away from the airfield at about 45 degrees before the *low key point*, and again ask the student to advise you when the position and angle to the runway will be correct on the downwind leg for this lower height. Note you will intercept the downwind leg part way along it, and before the normal low key point. Use this exercise to make the student more aware of the angle to the runway, the distance to the landing area and the height having to be continuously monitored to ensure a good circuit prior to the final turn.

During this exercise do NOT indicate the correct distance from the airfield. Only show the student that a selected position is too close or too far away, then continue the exercise by turning back into the zigzag pattern.

When flying away from the runway and becoming low before the *low key point* height, be very conscious of your own limits and when you would wish to turn back toward the runway, even though the student might not be saying that the glider is too low.

Running out of height in the circuit (abbreviated circuit) exercise

This exercise may be performed at a convenient time after the student has started planning and flying the circuit. It should be given as a means of keeping the student alert and preparing him or her for future surprises when beginning to show consistent circuits. Note that this is more of a demonstration than a surprise exercise, with the instructor assisting the student while who is flying the glider.

Take the opportunity to demonstrate an *abbreviated circuit* if the student begins to run out of height before or in the circuit and arrives at a height of 500 feet minimum before reaching the normal *low key point*. Or before returning to the *high key area*, deliberately try to have the student practice extra turning for example, to reduce the height to below the normal so that an abbreviated circuit has to be flown. As an alternative the instructor is to deliberately take over control in the *high key area* or even in the downwind leg, reduce height to below normal, then hand over control again. Now instruct the student to plan the balance of the circuit, assisting in the selection of the new RP as well as *talking the student down* on a first abbreviated circuit.

At the minimum of 500 feet agl a new low key point has now been defined and this means that the RP is on the runway opposite to or abeam the glider. The balance of the circuit is to be flown with respect to this new RP (it will be further up the runway than normal). Emphasize that it is better to fly the rest of the circuit and the final turn at the normal safe heights than to be picking up debris short of the runway! Make the point that it is hazardous to fly a very low circuit. Always teach the student to have an alternative landing area on the runway. In cases of great loss of height the student is free to land anywhere on the airfield, to make an opposite-sided circuit, to land downwind or to land on an adjacent field if so low that the club's runway is out of range.

Airbrakes open before the circuit exercise

This exercise is to be given at any time after a presolo student's circuit judgement is secure and consistent. The exercise has the element of surprise, increases the workload, and can be stressful; but it is a useful technique to improve the student's confidence. The exercise can be chosen to use up excess height or time after a good soaring flight.

At a point in or before the *high key area* the instructor is to take control and open the airbrakes fully and the student is then given control for the balance of the flight. The instructor must first have determined that the exercise is consistent with traffic safety and that it is possible to fly a steep and smaller than normal circuit to a safe landing on the runway, on another runway or even downwind. Of course the circuit will likely be very abbreviated. Emphasize to the student that such an unusual circuit is perfectly acceptable. The instructor is to monitor closely and, if necessary, close the airbrakes and take control if the student's actions indicate this should be done.

This exercise is recommended also for the pretraining of a pilot who is converting to a motorglider. This would cover the eventuality of the pilot not starting the engine, or failing to retract the engine in time, and an emergency type of landing having to be made with the engine still deployed.

AIR INSTRUCTION

You, the instructor will be monitoring the student's planning and flying of the circuit, and the adequacy of the lookout. The lookout needed in the circuits are different to those higher up, and require all pilots to actively think of where other aircraft might be coming from. Assist the students to develop their circuit lookouts.

The most important part of the circuit is the approach. If a student judges heights well, he should require $^1/_2 - ^2/_3$ airbrake opening during the final approach. If too high, he can use more brake opening to increase the rate of descent. A final approach without airbrakes should be avoided at this time during training but is a useful exercise at a later stage. Follow through closely on the approach and use of airbrakes; finally monitor closely the flare and landing. Be prepared to take over control by keeping close to but not holding the controls.

POST-FLIGHT REVIEW

Important points to include are the circuit planning. A typical question to ask would include why was the circuit flown as it was, what would have been the outcome if the glider had encountered heavy sink? What would the student modify next time, and did the student notice the effects of the wind gradient? These are some of the questions that can be asked to determine what the student was thinking about at the time. This provides useful insights into how they plan. Comment also on the student's planning decisions and suggest alternatives that might have worked.

Flying in the circuit requires debriefing as well. Comment on the student's choice of speeds, and speed control, especially on final. Did the student carry out good and thorough lookouts? We want a well-banked final turn; did the student achieve this or did he start the turn too early and then make a shallow-banked turn? Comment also on the use of the airbrakes, and the hold off, landing and rollout.

Discuss safety and HF that result from the flight and explain how stresss reactions common in the landing phase can effect the pilots ability to fly the circuit.

CHAPTER B10
TAKEOFF, AEROTOWING & EMERGENCY PROCEDURES

OBJECTIVES

To teach the student how to correctly take off in a variety of situations, how to solve problems during takeoff, emergency procedures during the initial stages of the takeoff and while on tow at greater heights.

MOTIVATION

All flights start with a takeoff that must be done correctly. Aerotowing is a skill needed to handle a variety of conditions while flying in formation behind a towplane, either to climb to release height before a flight or to retrieve a glider from a second location. Emergency procedures are an essential part of safe gliding because of a possible rope break.

PREPARATORY GROUND INSTRUCTION

Preparations for takeoff

The first considerations must be; are you, your student, and the aircraft ready for a safe flight, and is the weather and the flying environment within your student's capabilities? Next, it is necessary for good airmanship to do *two* inspections before getting in the glider: first an *external* inspection or walk-around inspection of the aircraft, and second an *internal* inspection of the cockpits. By the time the student is ready for solo he should need no prompting. Emphasize to your student that once started on the flight and he is climbing behind the towplane, there is no chance to put things right without an unplanned landing. For all flights at this stage, the student will be performing the **CISTRSC-O** checks as usual, and should search the area **ahead and above** for hazards and other traffic before giving the *take up slack* signal.

Think about it, and teach the student to plan ahead for the unforeseen emergency during the early part of the tow, that is why the O – Options item is at the end of the pre-takeoff checklist. The student will not be surprised because if the launch should be abandoned prematurely, the options have been thought about already, and decision heights have been reviewed. Go through these options with your student, and at a suitable time mention that he should always go through the options with another licensed pilot when pleasure flying later. Make sure both of you make a conscious decision about **who has control** particularly for the early part of the flight with a student doing the takeoff the first few times.

Ground operations

Make sure that the glider is properly lined up on the takeoff path, and directly behind the towplane. A quick glance at the windsock will confirm wind speed and direction, information that you and the student need in case of a rope break during the early part of the takeoff. The student, having completed the CISTRSC-O pre-takeoff checklist satisfactorily and having been hooked up should ask "All clear above and behind?". When sure that it is clear of obstructions ahead he should give the *take up slack* signal. The student should monitor the wing runner's signals. At some clubs the glider pilot may give the signals to the towpilot by radio.

The takeoff

As the speed increases and the controls become more effective the student will use normal amounts of control inputs. The idea is to get the glider running on the main wheel. To do this the pilot will have to pull back to raise the nose off the skid or front wheel, or push to raise the tail wheel or skid. The glider does not have to be deliberately lifted off; it will become airborne at the right speed if it is held at the correct attitude. Lifting off early produces more drag on the glider and can make the takeoff run longer. The glider is also likely to be difficult to handle at the slow airspeed. As speed builds up there will be a tendency to climb too fast unless the pilot progressively moves the stick forward (some two-seaters require a push on the stick even during the tow; this is more noticeable with a very light front pilot!).

If one wing drops to hit the ground, or directional control is lost (more than about 30 degrees off the runway heading), the student pilot should be taught to **release immediately** even if you think you can rescue the situation. The student on an early solo flight will not be able to, hence he or she must be taught this safe release procedure; remember the Law of Primacy! If the student is not fast enough now, you the instructor, should release to demonstrate the urgency and safety of making an immediate release.

Having become airborne, usually before the towplane, the glider must be held just above the ground to prevent the possibility of pulling up on the towplane's tail, making it difficult for the towpilot to take off smoothly. If the towplane takes off first this should be a sign that all is not well with the glider unless it is very heavy with water ballast, or the air-

brakes could be open, and an **immediate release** should be actively considered.

Initial climb

When the glider takes off and is held just above the ground as the towplane continues to accelerate, the glider will be in the slipstream. As the towplane rotates and then begins to climb the student should be ready to begin climbing as well. The slipstream will go beneath the glider and it will now be in the *high-tow* position. This is the *reference position* for the towplane relative to the glider. Make a mental note of the position of the towplane against an imaginary mark on the canopy ahead, and teach the student to keep the towplane in this *imaginary sight*.

If the towpilot takes off as soon as he can and then climbs and accelerates, the initial climb will be gradual and the glider pilots are unlikely to be taken by surprise. However, if the towplane is held down until climbing speed is reached, the initial climb can be very steep especially if there is an appreciable wind gradient, which will cause the speed to increase even more. The towpilot is then likely to *pull off* the excess speed and the glider pilot could find himself well below the normal position. Getting back into position in a controlled manner is now very important to avoid creating a towplane upset, see also the section later, *Towplane Upset Situation*.

During the initial climb take the opportunity to point out the effect of the wind gradient on the climb of the towplane, and in some cases, the tendency of the glider to get too low. Anticipation is the key to staying in position.

Aerotowing (High-tow position)

During the climb, the wings of the glider are kept parallel to the wings of the towplane. The vertical position of the glider relative to the towplane can be readily held by normal use of the elevator. A convenient reference for the vertical position is the imaginary sight on the canopy. As a check during the tow, the pilot can place the towplane's wheels slightly above the horizon; a distance of 1–2 metres is not excessive with modern towplanes and this can and should be checked by moving down to *touch* the slipstream. In most situations the slipstream will be a metre or so below. In mountainous terrain or when you cannot see the horizon try to keep the towplane in the centre of the *imaginary sight*. This technique is preferred even when you can see the horizon clearly; the horizon allows the student to adjust the glider's position to keep the towplane wheels where he wants them to be.

The most common reason for getting out of position is that the pilot does not maintain the same bank angle as the towplane during turns. Should the glider start oscillating from side to side, assist the student to get back into position. The effort of students to stop this oscillation on their first aerotows often leads to even larger oscillations.

The easiest way to correct this is to get the wings parallel to those of the towplane and then to allow the pull of the rope to move the glider back into line. For a large deviation to the side, the pilot should make a correctly coordinated turn towards the towplane. Then gently turn the other way just before reaching the centre position otherwise the oscillation may start again. Anticipation is the key to staying in position. When turning, the glider should be banked to match the bank of the towplane.

To keep flying in the same circle, the glider's nose should be pointed approximately at the tip of the upper wing of the towplane. In this way, the glider will stay about at the same radius of turn that is being flown by the towplane, the desired situation. Normally in smooth air, only small corrections are necessary to keep in position behind the towplane. If the air is turbulent, it may be necessary for the student to apply rather firm and fast corrective control actions before returning to normal control movements. Care must be taken to avoid overtaking the towrope while on tow and subsequently removing the slack in the rope too rapidly as this could cause a rope break.

Emergencies on tow

A good practice to adopt is to call out the height of 300 feet as the glider climbs beyond the airfield boundary. The concept is that when the student has called out the 300-foot height, he has made a *conscious* decision that from the current position of the glider, it would be possible to lower the nose to regain a safe manuevering speed, then turn around and land back on the airfield safely. You may have to modify this height for airport characteristics and for very windy conditions when a landing straight into wind would be advisable. Remember the "O – Options" item in the pre-takeoff checklist? It is to discuss with the student the heights at which different actions would be needed to handle a rope break or premature release by the towpilot. Prior to takeoff therefore, it is up to you, the instructor, to brief the student on these emergency procedures during early training. Later you should expect the student to select the options and to agree on choices with you. Then during the initial phases of the takeoff and tow

the student may be asked to repeat what his or her actions would be in case the tow is interrupted. This will develop in the student the anticipation necessary to take immediate action in case a real premature release or rope break occurs.

Releasing from tow

Upon reaching the release height and before releasing the rope, both pilots must search *above* and to both sides, particularly to the right. If clear, look back at the rope, then pull the release handle and follow the post-release check:

- Visually *ensure* the rope has released, call "Rope gone", then turn gently to the right.
- Adjust flying speed for the exercise, usually slowing down from the higher tow speed.
- Raise wheel and visually check the placards or signs that it is up and locked.
- Adjust the trim, and finally
- Confirm the location of the airfield – if unsure of location, watch the towplane to see where it goes!

Do not turn until the release has been confirmed. The objective of turning to the right after release is to get clear of the towplane's slipstream and the waving rope quickly. It also allows the towpilot to see the glider, and he can now safely start a descent.

Do not attempt to gain extra height by climbing just prior to release. This is a dangerous maneuver that adds extra stress and wear to the release mechanism. It also often knots the towrope. Note the difference between the undesirable, deliberate climb after release, and the instruction given here, simply to adjust flying speed and then adjust the trim. A deliberate climb after release is liable to develop into a bad habit that could lead to an unconscious loss of speed after a low-level rope break or wave-off on a later flight. Such maneuvers can lead to spins when the pilot tries to make a rapid turn, to get back to the field for example.

The subsequent exercises should be flown with reference to the high key area and the airfield, unless climbing on a ridge, in wave, or in a strong thermal with little drift. If the exercise is properly planned, the student, upon completion of the air exercise, should be properly positioned for the *high key area*, upwind of the downwind leg of the circuit.

Lateral oscillation on tow

During a tow in calm air, pilots sometimes begin a side-to-side oscillation, and then have difficulty stopping it. It starts because the student does not easily recognize the banking of the glider initially to one side, and therefore he does not take corrective action quickly. A useful exercise can be done in calm air to demonstrate this effect. Start by allowing the glider to drop one wing very slightly from straight and level. Do nothing except observe. What happens next? The glider will start to turn away from the towplane and, as this happens, the pull of the rope then yaws the glider back again. As the lower wing is accelerated, the glider will tend to bank the other way and turn, now more rapidly to the other side (secondary effect of rudder, remember?). Control the glider now to level the wings. If the wing drop is allowed to continue the situation could diverge more, to the point at which you will have to take firm action to return to straight and level flight behind the towplane. Develop your student's ability to recognize this subtle wing drop. Give a demonstration to show the student that even a small wing drop should be corrected.

Towplane upset situation

There are certain conditions during the early part of the takeoff and tow when it is possible for the glider to inadvertently lift the tail of the towplane. If the glider just gets a little 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 this has become known as a slingshot effect. The towpilot has little warning and usually cannot react in time to save the situation. It is important that you thoroughly brief your students on this phenomenon. It does not have to be covered when first learning towing skills, but must be taught before first solo, for example. There is also a very real danger that if low and climbing up quickly to get into the correct position, the glider pilot (particularly when on the *cg* hook) can get into a critically high position faster than he or the towpilot can react and release. The pull of the towrope on the glider and its nose-high attitude combine to overcome the authority of the glider's elevator, and the glider climbs sufficiently high as to lift the tail of the towplane, and this can happen in 2 or 3 seconds, and the situation becomes divergent**.**

The ONLY possible safeguard is for the glider pilot to release and to do so the instant the glider starts to get too high.

You must emphasize this because situations seldom arise requiring the student pilot to release early, so they are not conditioned to think about the possibility. Lower performance or older gliders (low wing loading, low stall speed and with a high wing) have the greatest need to release quickly under the upset situation. The critical factors are:

- Gliders with *cg* hooks, a low wing loading and high wings (with low tow hook),
- Lightweight pilots flying close to minimum cockpit weights,
- Turbulence and strong wind gradients,
- Too steep a climb when getting back into position from below the towplane,
- Short rope,
- Pilots inexperienced in aerotowing but who are experienced on winch launching,
- Distractions.

Winch pilots are particularly vulnerable when they have had only a few aerotows, because they may momentarily forget they are being towed and not winch launched; it has happened. Distractions such as trimming that requires a change of hands (K7) or closing the window (they usually stick!) are likely to cause the student to get out of position quickly. If ever the student begins to lose sight of the towplane and/or becomes high behind it, he should be taught to release immediately.

An upset can occur when several factors combine to create difficulties for the pilots. For example, if there is a strong wind and the towplane climbs steeply immediately 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. This is so fast that neither the glider nor the towpilot have time to react to save the situation, and the towplane can be fatally pitched into the ground. Rope length is important; the time taken for a slingshot to upset the towplane varies with the square of the rope length. A safer length of 60 metres gives four times the upset time of a 30-metre rope. Although upsets of this type are extremely rare, 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 subjected to a nose-up pitching moment especially when being towed faster than normal. Older types of glider such as the K8 and the 2-33 can be affected, particularly when being accelerated. Think of these types when winch launching; they require full forward-stick initially, and yet the glider still rotates rapidly into a steep climbing attitude as it is accelerated. You certainly don't want this steep climb behind a towplane!

An upset can also occur when turbulence causes an initial disturbance to start the glider climbing rapidly. Unfortunately, the weak link of the towrope does not provide protection to the towpilot from this type of accident. This is because the force on the rope is still far below the breaking strength of a typical weak link at the start of the slingshot effect. The tail is lifted and the tug is forced to descend whatever the tug pilot tries to do to pull up. Many carbon fibre sailplanes loaded with water ballast can have their centre of gravity higher than normal (caused by wing flexing) and with the towplane pulling on the *cg* hook, such as on a PIK-20, the glider's elevator authority can be insufficient to prevent the start of a slingshot type of upset. In all cases, adequate training is required. If your student has limited experience with aerotowing or with flying a particular glider, extra dual check flights are strongly recommended, especially under windy and turbulent conditions.

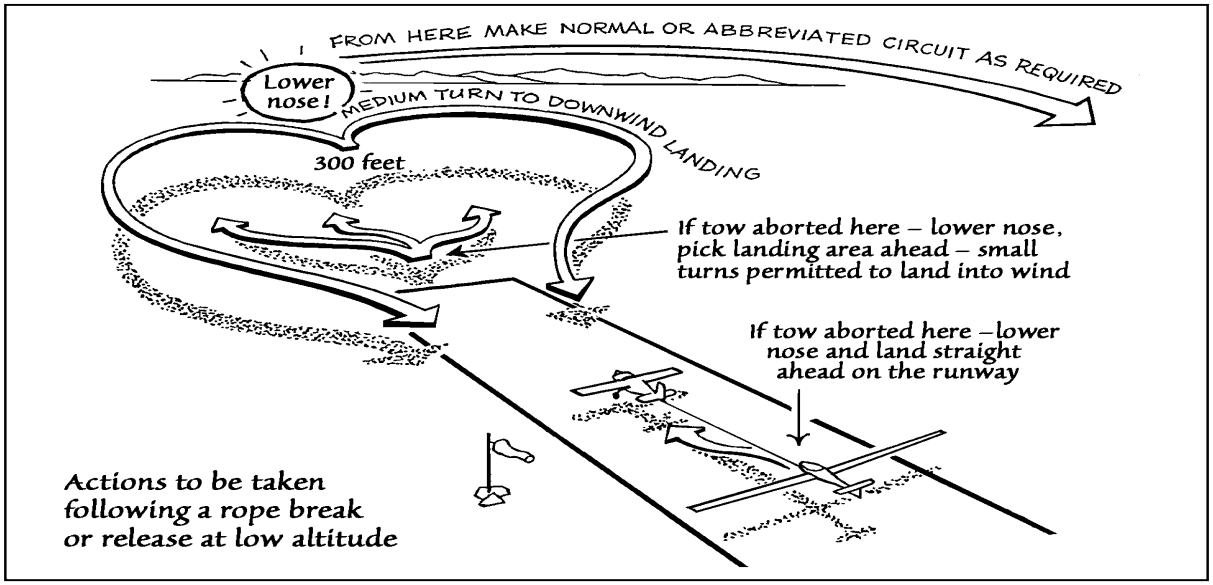
Failed launch procedures – rope break or towplane release

It is always possible for a weak link on the towrope to break, or for the towpilot to release the glider, for example because of a malfunctioning engine or the glider being wildly out of position. Procedures to handle such emergencies must be explained to the student, and the student must learn and practice them. In fact, a new exercise was introduced with the previous edition of the manual. It is to learn the recovery technique and to practice this a number of times at altitude before the exercise of a low-level release is sprung on the student. See under *Advice to Instructor*.

It must be stressed to the student that it is very important to have a plan of action for a rope break worked out ahead of time. The procedure should be decided for each part of the takeoff and tow. It is most critical below 300 feet height. As shown in the diagram below, it is recommended that below 300 feet a landing back on the field should not be at-

tempted. The first **essential action** in case of being released by the towpilot or if the rope breaks, is to check the airspeed and to immediately lower the nose to the normal approach attitude (or lower) to ensure a quick return to a safe speed. In addition, the view ahead is better, to see where the pilot will go to land. There is only one situation where the student should not lower the nose automatically without thinking. This is just at the point of or immediately after the takeoff.

must consider the ***O**ptions* and predict what will happen with each option, because he has to choose one of them next. For example, what will happen if he starts 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? These types of question can be asked ahead of time, and will greatly reduce the stress levels when an actual break occurs. Now get the student to choose the safest option and ***A**ct* quickly, as there is not much time for hesitation.



Remember it is dangerous to attempt to turn around to land on the runway when **very low and slow**, so the first choice should be the automatic reaction to check the airspeed and to lower the nose. Remind the student that if the towplane fails, it may be because of the engine overheating or misfiring, hence the glider's speed at the wave-off or release may have decreased to below normal without being noticed!

Time for pilot Decision-Making

Because every situation has its own peculiarities, you may also teach students to use their Pilot Decision-Making (PDM) skills to make a safe landing. A low-level launch interruption is a very useful situation that is amenable for a review of pilot decision-making. Having checked the airspeed and then adjusted the glider's attitude to regain and to maintain a safe speed, the student now has a bit more time to assess the ***S**ituation*, particularly if he has some useful height under the glider.

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 he has planned ahead, the situation may be slightly different. Next, tell him he

Next, he should ***R**epeat* the process by reassessing the developing new situation. Was the prediction for his chosen option accurate? Is there still sufficient height to continue the turn, for example, and is the speed still safe for the conditions? If not, he should immediately act to correct it, and assess new options. Then act on the safest option, and repeat the process. Note that the automatic reaction to a low-level emergency can be modified safely by good judgement. Appendix A shows further examples that are analyzed with this 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 the left hand close to (not holding) the release knob. This can be close to the airbrake handle as well, in which case the student can close the brakes promptly if a bit of rough ground allows them to pop open or he receives the rudder waggle signal from the towpilot. Teach the student to keep the back of the hand against the airbrake handle, not around it! Now, if a rope break occurs when low or the glider pilots are signalled to release immediately – this is another possibility – the pilot can pull the release knob without delay because the hand is very close to

the knob. In summary then, if the launch is interrupted (the glider is released or the rope breaks) very low down, teach your students to follow these actions:

- Check airspeed and lower nose immediately, to maintain and/or regain adequate flying speed (if very low to the runway do not lower the nose in this situation).
- Land ahead making only minor adjustments in direction to avoid obstacles ahead. If the wind is from one side the preferred direction to turn is into wind.
- Make no turns except into wind, and
- Pull release to let go of any rope still attached to the glider.

Above 300 feet, the student can be told he may decide when it should be possible to return to the runway with either a downwind landing or a much-abbreviated circuit. At this point he can deliberately remove the hand from the area of the release knob.

Again, if the rope breaks, he must check the airspeed, lower the nose to maintain the glider's speed, and turn initially so that he is flying across the wind. Now he must assess the situation – can he land safely downwind on the field – wind less than 10 knots and no hazards on the runway? Alternatively, can an abbreviated circuit be flown or must an off-field landing be made? Teach the student not to wait, but to make a decision, act and concentrate on landing. If landing downwind on the field, the pilot must land as soon as possible well clear of hazards. The wings must be kept absolutely level as long as possible to prevent a swing and possibly a ground loop (caused by the weathercocking tendencies of the glider).

Slack rope exercise

It is possible inadvertently to produce slack in the rope under a variety of conditions, so learning how to remove the slack is necessary. This can be taught, for example during a turn. The instructor is to demonstrate first, by allowing the glider to move outside and slightly above the towplane's circle. Then develop some slack in the rope by turning sharply towards the towplane and descending. The slack will begin to reduce as the glider is made to follow the towplane that now may be climbing rather rapidly compared to the glider! To avoid a snatch on the towplane and glider, yaw away from the rope as the rope tightens. If the slack is excessive, use the airbrakes carefully, and again yaw the glider and close the airbrakes as the slack is removed. If the glider has descended well below the towplane before the rope tightens, the rope may break when it is snapped tight. Give the student practice at this exercise on this and other flights.

Rope break recovery procedures exercise at altitude

Perform this exercise at altitude several times. The objective is to get the recovery procedure ingrained in the student's memory before a simulated rope break is given during a tow. Note here that a rope break is synonymous with a premature release by the towpilot. The student is to fly, with the instructor prompting.

From the best L/D speed at height, raise the nose to the normal towing attitude. This will give a decreasing airspeed. As the speed drops towards the 1*g* stall speed, call "break"; this is to simulate a rope break or a premature release (towplane engine not developing full power). The student is to immediately check the airspeed (and say what it is) then lower the nose to **below** the approach attitude and **wait.** *Now start counting the time taken to reach a normal safe maneuvering speed of 50 knots minimum*. Remind the student that the airspeed may be close to the stall speed if the towplane waves off the glider when low to the ground. It is vital to get the nose down after a break, to regain airspeed as quickly as possible. A turn may be started *only* when the airspeed is adequate. It is not normally necessary to release a towrope – but a winch cable should be released. It is illegal to drop anything from an aircraft and towropes normally drag below, and do not become a hazard to the glider. When the speed has returned to the normal approach or safe maneuvering speed, stop counting the time, and comment on the long time that it takes to accelerate up to the desired speed. It is longer than many people believe! This is why we need to repeat the exercise several times at altitude before doing a rope break simulation low down.

Repeat this exercise several times on this and other flights, with counting the time taken to attain the above approach and safe maneuvering speed, and before the rope break exercise is done low down. Always fully brief the student before any practice.

Emergency procedures

Three emergency air signals are necessary between the glider and the towpilots:

- Rudder waggle by the towplane,
- Wing rolling side to side by the towplane, and

- Move to the side and roll from side to side by the glider.

***Rudder-Waggle* by the towplane**

This signal is to tell the glider pilot that the **dive brakes** may have opened, and that they must be **closed immediately**. If they are open they will have a profound effect on the climb rate. If they are not closed smartly the tug pilot will likely release the glider. If the tug pilot gives the *check your airbrakes* signal and the brakes are indeed closed, teach the student to be ready for the **release immediately** signal to follow shortly. This makes pure sense, but not a lot of students are able to extrapolate this.

***Wing-Rolling* by the towplane**

Release immediately – the towpilot has a problem but he has sufficient time to give this signal. The towpilot is ordering the glider pilot to release immediately. This signal can also be called the wave-off signal by the tug pilot. If the glider pilot does not comply, the tug pilot will release the glider.

***Wing-Rolling* by the glider pilot**

When the glider pilot cannot release, position the glider to the **left** of the towplane and rock the wings by distinctly rolling one way and back again. The tug or towpilot will release from his end. Having given the signal return to the correct position behind the towplane; if necessary repeat the signal.

Failure of glider release

When the glider pilot has signalled to the tug pilot by moving to the left side and rocking the wings, the towpilot will return with the glider on tow to the airfield at the same altitude, and will then release the glider from the towplane end. Should the rope then release from the glider it will fall near or on the airfield. Instructors must explain this procedure to their students so that proper actions will be taken if a student should encounter this problem when flying solo.

Failure of both glider and towplane releases

Such an occurrence is highly unlikely but if it should occur the following procedures apply. Having signalled that the glider cannot release it will soon become apparent that the towplane cannot release. The glider pilot or pilots will have to do a formation landing which is not such a big deal as it sounds! The towplane will fly a wide circuit and maintain a low descent rate so that the glider will be able to keep the rope tight by flying in the slipstream and using the dive brakes as needed.

When on the downwind leg the glider should be moved down into the low-tow position. The towpilot will make a shallow power-on approach even with the glider in the low-tow position. Both aircraft will tend to land together. Having landed keep the rope tight as before, or use the wheel brake to avoid picking up the rope with the glider's wheel. Keep to the right of the towplane so as to avoid hitting it; the towpilot should steer to the left slightly. While keeping to the right, avoid putting too much tension on the rope as you may inadvertently steer the towplane into a groundloop.

ADVICE TO INSTRUCTOR

Medium turns ability needed to learn to aerotow

Learning aerotow is not all that difficult, provided the student can do well-coordinated medium turn entries and exits before he tries the aerotow first. Aerotowing is a skill that is often learned gradually, so don't expect rapid results; if the student gets too far out of position he may well become discouraged if he is trying the tow too early in the development of his flying skills. When he is trying for his first few tows don't let the student get out of position too far. If necessary demonstrate, with the student following through. Remember, all flying behind the towplane must be coordinated, stick and rudder together, and with the yaw string (or ball) straight back.

If the student gets too low or high during the climb, the *sight* on the glider canopy and placing the towplane in the centre is the best technique for getting back into position. As the glider climbs more rapidly than the towplane, the pilot will be lowering the nose steadily to maintain the towplane in the centre of the sight, so that when the correct position is reached, the glider will no longer climb relative to the towplane; and vice versa. Hence there will be no overshooting!

When starting the aerotow many pilots will tend to over-control without realizing it, for example a student will be trying too hard to maintain height position, with the result that he will tend to overshoot up then down. If much too high, descending must be done carefully, so as not to produce slack in the rope. If necessary yaw the glider or use the dive brakes judiciously. If at any time the **student loses sight** of the towplane under the glider's nose he must be taught to **release immediately**. Overcontrolling can be prevented by using the fixed sight technique where the towplane is placed in the imaginary sight on the glider canopy.

Sometimes it seems that students wander all over the sky, particularly in smooth air as they make an attempt at formation flying – a seemingly impossible task. The student should be using well-coordinated control inputs to stay in position. A faulty technique is to point the nose at the towplane using rudder only. This teaches a student bad habits at the very beginning of his or her training. It is liable to lead the student into trouble later. For example, during a low-level final turn when he needs to tighten his turn he is liable to use too much rudder input to *point the nose* – result – spin.

Aerotow demonstration

Try to demonstrate the ground run, takeoff, initial climb, full climb, low-tow and high-tow positions, and the methods of maintaining vertical and lateral positions behind the towplane and the lookout and release procedures in one flight. There are many points to emphasize, the main ones are:

- ***Takeoff*** towplane and glider to be in line before the ground run starts; as glider moves steer with the rudder; briefly review options for what to do if launch is interrupted; as the towplane lifts off, mention the correct position of towplane in canopy for vertical station-keeping on tow;

- ***Climb*** demonstrate vertical positioning of glider relative to towplane, using mark or *sight* on canopy; then demonstrate lateral positioning by keeping wings parallel to towplane's wings and allowing pull of rope to move glider into line for small deviations, and making coordinated turns for larger deviations; note adverse yaw is more pronounced on tow, so larger rudder forces are required;

- ***Release*** lookout, look at rope, call "rope gone", turn right, adjust flying speed, raise wheel, visually check against placard, adjust the trim and visually confirm location of airfield.

The initial attempts by the student at trying the takeoff and tow should be confined to the tow only. Tell the student that you will take off and do the early part of the tow, but allow the student to take over control, with you following through, for the last 500 to 1000 feet of the tow. On later flights allow the student to perform the actual takeoff and initial part of the tow, but take over control at about 50 feet height. He or she can then give you undivided attention as you comment on the takeoff, while it is still fresh in his or her memory. The student can then resume the tow.

Preparation for tow interruptions & rope breaks

It is important to develop a *pre-planning* habit in the student for actions to take in case of a low-level interruption of the launch (rope break or release by the towpilot). Questions such as, "What are your options if the rope broke now?" will help develop good planning habits, and should bring the response, "I will check the airspeed and lower the nose, and land ... there." Discuss his choices and compare to your own decisions. This can be done first when you are doing the flying when the student has more time to look at and consider where an emergency landing might be made. Your favourable comments will reinforce a good choice of action. The student may get wildly out of position when they are flying and you ask this question, so watch for this.

Later in their flying, and only when they have mastered the recovery procedure (exercises done at altitude) to regain the approach speed, start the sequence of rope/cable break exercises at low heights. See *Rope Break exercises after takeoff and at low height* in this chapter for the actual exercises. It is very important that these rope/cable break demonstrations exercises are done in the correct sequence and that they are completed before the first solo flight.

High-tow versus Low-tow position

Most clubs in Canada use the high-tow position for local flying. The low-tow position is used for long cross-country tows, and the student should be familiar with its advantages and features.

Prior to this exercise, the towpilot should be advised that the instructor and the student are going to perform high and low-tow practice. At a height of about 1000 feet above ground during a normal tow, ask the student to 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 slipstream: you may allow the student to follow through on the controls with you.

If the glider is held directly in line behind the towplane during the transition to low-tow position, the effect of the propeller slipstream will be minimal. Point out the mild vibration of the glider to the student. When the glider has passed completely down through the slipstream, and is in the low-tow position, note the smooth air again, also note the position of the towplane against the canopy, and make imaginary *reference* points. The towplane may seem unusually high. If during this maneuver the glider is allowed to move out to one side, it will tend to roll

towards the towplane as one wing only moves through the *downwash*. This can be handled easily.

To maintain the correct position while in low-tow position the towplane can be sighted conveniently through a new imaginary sight on the glider's canopy. Mention that while climbing, the towplane will appear much higher than when flying straight and level.

Cross-country tows

When it is necessary to tow the glider cross-country, the low-tow position is recommended. This minimizes the workload particularly in rough air. It is important to observe the glider's maximum aerotow speed and to make sure that your towpilot knows the emergency signals. Discuss and agree on these before takeoff! During the cross-country tow alternate landing areas must always be selected in good time. Proper clothing must be worn if the pilot is to function well, particularly in cold weather.

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, and if it does so, the glider pilot must release immediately and turn away from the cloud.

Boxing the slipstream exercise

This exercise is a very useful one to teach students not only where the slipstream is located, but to improve their handling abilities and to give them more confidence for flying behind the towplane. The exercise should be introduced when the student shows a good ability to handle the tow. It may be talked through, although a demonstration may be needed in some cases.

Having briefed both the student and the towpilot, start by demonstrating when flying on a straight part of the climb. The box is an imaginary square around the slipstream; a useful start is to fly through the slipstream to a point below it, noting the position of the towplane in the canopy. This fixes its position in the mind of the student. Next, move out to the side half a wingspan or more. Then descend to the corner of the box and pause there for a few seconds. Continue to the corner above, a short pause, then across to the normal high-tow position. From now on, you can box the wake by starting to move across to one of the top corners, down to the lower corner, and so on back to the start.

All the flying behind the towplane to do this maneuvering must be well coordinated, that is the rudder must only be used to prevent yaw. To fly to one side of the slipstream, therefore, requires the glider to be banked slightly to the outside. On no account should the glider be slipped out to the side; there is a great temptation to do this, but you must be ready to correct the tendency.

Emergency procedures on aerotow exercises

These exercises cover the eventuality of the airbrakes opening inadvertently on tow, together with a demonstration of the two emergency signals from the towplane. Descending on tow is a separate exercise. Before doing the exercises, pre-brief the towpilot and clearly define the heights at which you want to start as being agl or asl. These exercises are to be done with the student flying, as below.

Dive brakes open and towplane wave-off signals

Discuss this exercise **thoroughly** with the towpilot before the flight. At a height of for example about 1000 feet you will be instructing the student to *crack* open the airbrakes or spoilers, and then to gradually open them more fully so as to feel their effect on the climb. The student should note the change in climb rate. The towpilot should also notice these effects, and you will ask him to allow a few seconds for this, after which he should then demonstrate the rudder-waggle signal. When this is given the student is to close and lock the brakes immediately. Not only does this show the student what the signal looks like but also will allow you to emphasize that it means **close the brakes** immediately.

At a higher height on the same flight (just before release height) ask the towpilot to demonstrate the glider wave-off or **wing-rocking signal**. This means of course that the towplane is having engine or other problems and requires the glider to **release** immediately.

Notice that both signals are given after thorough briefings to all pilots. They are common practice at some clubs during the pre-season check flights of all pilots, and provide useful practice for the towpilots! Because glider pilots have confused them, it is essential to distinguish between them so that in the one case the pilot checks that the airbrakes are closed and locked, and in the other case he releases immediately. By actually demonstrating them and operating the airbrakes in the one case, we should reduce the chance that the signals will be misinterpreted.

Descending on tow exercise

Sometimes it is desirable to descend on tow, for example during a cross-country retrieve. Learning how to do this safely is better now than later in a high-

performance single seater! As for the previous exercises, pre-brief the student and towpilot before the flight when requesting this exercise. Descending on tow may be combined with the previous exercise, care being taken to adequately brief the towpilot about what he is asked to do.

At approximately the normal release height, instruct the student to open the airbrakes gradually. Note the airflow sound, and the effect of the airbrakes on the rate of climb. After approximately 10 seconds, the towpilot will give the **check airbrakes are closed and locked** signal by waggling the rudder. The student is to immediately close and lock the airbrakes.

The towpilot will then gradually reduce power to fly straight and level. Instruct the student to move the glider down into the low-tow position; in this case the towplane will appear on or slightly above the horizon. When this is accomplished, the towpilot will reduce power some more, to give a descent rate of up to 3–4 knots (300–400 ft/min). Note that this exercise may be modified to allow towplane cooling procedures to take priority. The student must maintain the glider below or just in the slipstream to provide the extra drag needed to keep the rope tight. If needed, the glider may be yawed slightly to keep the rope tight; the airbrakes may be used also to help keep the rope tight. Take care not to exceed the maximum aerotow speed during the descent; there is a tendency to overspeed in the descent, in which case the airbrakes may be used to increase the drag further.

After a stable descent has been flown for a few seconds the towpilot will return to straight and level flight, at which point the student should close and lock the airbrakes if they were open, and then return the glider to the **high tow** position. The towpilot will then give the **release immediately signal** by rocking the wings. The student should release with no delay and then follow the normal post-release checks.

This exercise will be used also during pre-season checks by many clubs, in which case it serves a useful purpose to allow the towpilots in the club to practice giving the signals, as well as being a useful review of these signals for all pilots. In cases where the towpilot's signals are not clear, de-brief the pilot concerned and ask for clear signals on the next flight.

AIR INSTRUCTION

Starting the aerotow

Start the student on aerotowing by allowing the student to take over control at a safe height after takeoff. Later, when the student can maintain position behind the towplane reasonably well, allow him or her to attempt the takeoff and early part of the tow. On the student's first takeoffs, take over control at a low height and debrief immediately while he is not concentrating on the flying. Then hand over control again. Monitor the student's flying closely, and don't hesitate to take over control, particularly on the first takeoff and towing attempts.

Towplane upset emergencies

Stress that if at any time the glider pilot loses sight of the towplane, he should release. Sometimes it is easy for a glider with a *cg* hook, a low wing-loading and a high wing on the fuselage to get into an uncontrollable climb behind the towplane. The glider is essentially being winch launched and it will very quickly put the towplane into a full-power dive into the ground.

Re-read the earlier sections dealing with the towplane upset problem, particularly during the initial climb when it is vital that the glider is not allowed to climb higher than the towplane.

Rope break exercises after takeoff and at low height

These manuevers are to be demonstrated first in all cases, but the student should not be asked to perform any rope break (from aerotow) exercise below 300 feet. See also the section on *Rope Break Recovery Procedures exercise at altitude*, page B106.

The motto here is to plan ahead. Demonstrate these exercises several times, with the student following through, in each case after a thorough briefing:

- At very low height, just above the runway (land straight ahead on the runway).
- At an intermediate height that does not allow a return to the runway (land ahead on the runway if it is sufficiently long and overshoot space is available, or land in a suitable field if available beyond the runway, and retrieve arrangements have been made).
- At a height from which a safe downwind return to the runway is possible [if speed and height are adequate for maneuvering, assess **S**ituation (use SOAR technique) and choose safest **O**ption for an emergency landing].
- At a higher height; fly an abbreviated circuit if height is adequate; or when landing downwind

[if headwind is less than 10 knots] select a new reference point, or **RP**, on the part of the runway closest to the approaching glider.

Warn the towpilot and *fully brief the student* before each of the demonstrations outlined above. If any traffic hazards exist, do not demonstrate or practice.

These rope break exercises are to be done in the correct sequence and they should be completed before a first solo flight. Ideally the first two should be done at low heights that require a landing straight ahead (two **demonstrations** only, student does **not** repeat). This is designed to establish in the student the correct recovery and the landing straight ahead as the first choice for action. When this has been established, a launch interruption at 300 feet may be demonstrated, with the recovery and turn to land downwind on the runway. The student is to practice this, again after a full briefing. In fact, all these exercises are to be fully briefed before takeoff. The only rope break that is to be given unannounced is that required as part of the licence check-flight requirements (the break from sufficient height for an abbreviated circuit may be announced or unannounced).

Landing downwind

If landing downwind back on the airfield after a low-level release or at any time, point out the higher ground speed, and the need to use the dive brakes to land as soon as possible on the runway; the ground run will be longer than normal. The wings will also need to be kept absolutely level for as long as possible to avoid a ground loop.

Completing aerotow training

When the student is beginning to master the aerotow it is time to introduce the following exercises that have been described earlier. A good preparatory ground instruction session will be needed to cover them before flight. These exercises may form part of many different flights but should be checked off the student's Pilot Training Record as they are satisfactorily completed. These exercises are:

- High-tow versus Low-tow position,
- Cross-country tows,
- Boxing the slipstream exercise,
- Dive brakes open and towplane wave-off signals exercises, and the
- Descending on tow exercise.

POST-FLIGHT REVIEW

It is difficult to remember the aerotow that occurred half an hour ago, so when reviewing this, do so as you climb on tow. For example, take over control at 50 feet to review the takeoff and initial climb then hand over control again. This is important for their first attempts at the takeoff. Take over control higher up if the student is having problems later, demonstrate how to do it correctly, for example boxing the wake, then allow him or her to try again, and comment on their attempts as soon as convenient.

It is still useful to review the aerotow when you have landed, and perhaps suggest a review of the manual before the next flight as there is a lot of material to be covered in this stage of training.

CHAPTER B11
WINCH LAUNCHING & EMERGENCY PROCEDURES

OBJECTIVES

To teach the techniques for winch launching, and the emergency procedures needed to handle cable breaks.

MOTIVATION

Winch launching is a very quick and relatively inexpensive launch method; being completely different from aerotow it is learned as a separate stage in learning to fly gliders.

PREPARATORY GROUND INSTRUCTION

Preparations for takeoff

Before starting any takeoff, the first considerations must be; are you, your student and the aircraft ready for a safe flight, and is the weather and flying environment within your student's capabilities? It is next necessary for good airmanship to do *two* inspections before getting in the glider: first an *external* inspection or walk-around inspection of the aircraft, and second an *internal* inspection of the cockpits. When ready for solo, the student should need no prompting to do these. Emphasize to your student that once started on the launch there is no chance to put things right without an unplanned landing. For all flights at this stage in training the student will be performing the **CISTRSC-O** checks as usual, and should search the area **ahead and above** for hazards and other traffic before giving the *take up slack* signal.

Teach all students to plan ahead for an emergency during the early part of every launch, using the O – Options item at the end of the pre-takeoff checklist. The student will not be surprised because, if the launch should be abandoned prematurely (cable breaks can occur as well as the winch engine can lose power or stop), the options and decision heights have been reviewed and thought out already. Go through these options with your student, and emphasise that he should always go through his options, for example, with another licensed pilot when pleasure flying later. Make sure both of you make a conscious decision about **who has control** particularly for the early part of the flight with a student doing the launch the first few times.

Signals, cable hookup procedures and retrieving

The student should be familiar with the ground signals, with operation of the winch (though this will usually come later), cable retrieve, and with the method of assembling the cable and hook up to the glider.

Ground operations

Make sure that the glider is properly lined up on the takeoff path. A quick glance at the windsock will confirm wind speed and direction, information that you and the student need in case of a cable break during the early part of the climb. The student, having completed the CISTRSC-O pre-takeoff checklist satisfactorily and having been hooked up should ask "All clear above and behind?". When sure that it is clear of obstructions ahead he should give the *take up slack* signal. The winch will begin to pull in the cable and when the cable is tight the wing runner will give the *All Out* signal. The student should monitor the wing runner's signals. Note that at some locations the glider pilot will be giving the signals to the winch operator directly by radio.

The takeoff

Give a careful description of the acceleration at the start of the ground run, the initial climb and rotation into the full climb. You should discuss pitch control motions from the initial acceleration, when a definite nose-down stick movement will normally be needed; this forward pressure on the stick may be relaxed for the ground run during which flying speed is gained. Teach the student to allow the glider to leave the ground, ideally at about a 15-degree climb angle; all this will occur in a few seconds. Mention that to a pilot trained initially on aerotow, this will appear *very* fast compared to his previous experience. The pilot will have to respond equally quickly.

The student will have to use coarse movements of the ailerons on the initial ground run to keep the wings level, keeping straight using the rudder while still on the ground. In fact the rudder may have to be applied before the *all out* signal is given, to compensate for an off-centre c.g. hook and the yawing tendency caused by the pull of the cable, or because of a crosswind tending to weathercock the glider. As the speed increases and the controls become more effective he will use more normal amounts of control input. The idea is to get the glider running in a level attitude on the main wheel. To do this the pilot may have to pull back slightly to raise the nose, the skid or front wheel. Many gliders tend to rotate into the climb fairly quickly, and for some the pilot will have to push on the stick to prevent a premature takeoff and steep climb. The glider does not have to be deliberately lifted off; it will become airborne at

the right speed if it is held at the correct attitude. Lifting off early produces extra drag and the glider is likely to be more difficult than normal to handle at the slow airspeed. In fact because of the rapid acceleration of some winches there would then be a danger of getting into a high-speed stall or flick roll situation from which a successful recovery is not possible.

If the student has 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), teach the student pilot to **release immediately**. If the student is not fast enough, you, the instructor, should release to demonstrate the urgency. The reason is to avoid accidents caused by the glider swinging into a possible groundloop and being damaged or causing damage by hitting an obstacle such as a person, aircraft or vehicle. It is particularly important to emphasize this action as a primacy learning factor, for any problem such as the above (teach the student to keep his left hand very close to the release handle during the initial ground run). If anything appears not right at the beginning of the ground run, now is the time to release and start again.

When teaching winch launching, explain the whole operation and the different emergency procedures thoroughly and carefully.

Takeoff and initial climb

Following the takeoff, provided a speed of at least 50 knots has been reached and with continued acceleration, only then allow the glider to rotate into a gentle climb. Brief the student whether this requires the stick to be held forward, eased back, or to be in the *normal* position. With a glider such as the Ka-8, even on the c.g. hook, it may be necessary to hold the nose down deliberately. Only start rotation into the full climb above a height of about 200 feet. Emphasize this very strongly as in case the winch should fail and/or the cable break, recovery from too-high a nose-attitude at low height will result in a heavy landing or even damage to the glider.

Take care to give good demonstrations to the student, before he is allowed to try the takeoff and transition from the ground run to the initial climb.

Full climb and release

After reaching a height of approximately 200 feet, steepen the climb gradually to the full climb attitude. The elapsed time from takeoff to the full climb should be no less than approximately 5 seconds (see also later under *Advice to Instructor*). The airspeed should continue to be at least 10 knots above the 1g stall speed. Again, give a clear demonstration of this so that the student knows what is wanted when he tries a launch. During early attempts, the student may not climb as steeply as required to achieve a good overall height. Encourage the student to do so and give the clues by which to judge the climb angle.

If the glider is in the full climb attitude and 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. This will increase the angle of attack and cause the glider to *mush* and increase the drag, causing extra loading on the winch. This in turn will make it difficult for the winch to increase speed, unless it is very powerful. Hence, 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 either having problems or that the operator does not recognize the low speed. In either case you should teach the student that he must 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 speed is not restored immediately, release and carry out the failed launch or cable-break procedure, given later in this chapter. The student must obtain more speed before returning to the normal full-climb attitude.

On the other hand, if the airspeed is too fast, the glider should not be climbed more steeply in an attempt to reduce the speed. Again, this will impose extra loads on the winch. The remedy is to lower the nose to reduce the angle of attack and then give the TOO FAST signal (yawing movement of glider), and have the speed reduced before resuming the normal full-climb attitude.

Even with the correct speed in the full-climb attitude, an excessive amount of backward stick movement may cause a *porpoising* motion near the top of the launch. Control this by briefly reducing the backward movement or pressure on the stick. At the top of the launch, the cable will increasingly pull the glider downwards. The nose should be lowered just prior to releasing (the winch operator will often slow or stop the winch as a signal to release). The pilots can usually feel that the cable has released (it is not necessary to pull the release three times; this action unnecessarily increases wear on the release mechanism). If possible, bank the glider slightly and try to observe that the cable has departed.

Correcting for drift

It is usual to want to track straight towards or slightly upwind of the winch during the climb. To do this steer into wind to counteract the drift that would otherwise occur, to give the desired track; after release the cable is more likely to fall on the runway and not in an adjacent field.

Emergency procedures

There are several procedures to learn; these all are concerned with what to do following a winch failure or cable break. The main procedure to learn is the cable break recovery procedure at altitude and this should be thoroughly learned before a simulated cable break is given low down.

Prior to takeoff

If the glider over-runs the cable while on the ground, there is a possibility that the cable could be picked up by the wheel or skid. The student should be taught to pull the release immediately, to shout, "**STOP**", and to hold the stick fully forward. The ground crew should then signal the winch operator also to stop.

This is an important area of operations that all club members should be briefed on, and in which they are competent to act as ground crew; don't omit them in your instruction.

Cable break or winch failure

During the launch the glider is in a nose-up attitude, and if the cable breaks or the winch motor fails suddenly, the nose will initially rise further. This is because the wings are producing enough lift to climb *and* pull the cable; if the pull of the cable is suddenly lost the glider will tend to nose up. Airspeed will be lost quickly unless recovery action is taken very promptly. Teach the student to quickly lower the nose firmly to (a push over at 0.4 to zero g) to regain any lost speed to a safe manuevering speed. The release may then be pulled (pull it firmly once to drop any part of the cable that may be attached).

The most common winch accident is after a power loss below 100 feet. Modelling has indicated safe and unsafe combinations of climb angle, airspeed, height, push-over g, and recovery dive angle. It seems that pilots may not be aware that a crash can follow a single error. Many of these accidents are from instructors *pulling the release below 50 feet (15–20m).* It is now recom–mended that this be a demonstration only, not a student exercise.

At intermediate heights of approximately 200 feet and up to 300 feet, excess height may have to be lost before making an approach to land in front of, or alongside the winch. An S-turn is usually made, but bear in mind that the speed must be a minimum of 1.3Vso + Vw, as for a normal approach. Teach the student to plan ahead, much as he is taught to make plans for aerotow rope breaks, before takeoff. For example in a cross-wind situation, if the cable breaks when you are too high to land straight ahead, first turn *away* from the wind. Now the student will have time to assess the height and decide where to land. The final turn should be back towards the field, to land into wind.

If the cable breaks at a higher height, again the nose should be lowered immediately, and the release handle (knob) pulled. There is a great temptation in many of us to try to land back at the launch point (and this is not specific to either aerotow or winch-trained pilots, both are susceptible). This can be very hazardous as you and your student may find yourselves too low for a safe final turn, and statistics show that successful landings are not guaranteed. Up to about 500 feet height, therefore, fly ahead and go beyond the winch a sufficient distance that a 180º turn can be made prior to then making a downwind landing back on the runway. Above this height, the student should be taught to fly an *abbreviated circuit* and to land at the upwind end of the runway if necessary. It is far better to be retrieving the glider from the far end than to be demonstrating how to cartwheel a glider at (or usually before reaching) the launch point!

Cable will not release from glider

In the unlikely event that the cable hangs up on the glider, the glider should be flown in a spiralling descent centred on the winch. The winch operator will cut the cable with the guillotine. This will allow the glider to be flown downwind, in which case it will usually be possible to land on the runway into wind. Fly at a much higher speed than normal and, if possible, keep within the boundaries of the airfield. If you are able to maintain flying speed, the event will usually end with no damage to the glider or pilots.

Cable break procedures exercise at altitude (above circuit height)

Perform this exercise at altitude several times. The objective is to get the recovery procedure ingrained in the student's memory before a simulated cable break is given during a winch launch. Remember that a cable break is synonymous with a failure of the winch. Note that the winch engine could fail slowly or suddenly! The student is to fly, with the instructor prompting.

At altitude, dive slightly to increase speed to approximately 70 knots, then raise the nose to a normal winch climb-attitude of approximately 40degree nose up. The airspeed will decrease rapidly. As the speed drops through about 45 knots, call "break"; this is to simulate the cable break. The student is to immediately lower the nose to *below* the approach attitude and **wait.** Now start counting the time taken to reach a normal approach speed of 1.3Vso + Vw minimum or 55 knots minimum. Remind the student that it is vital to get the nose down after a break, to regain airspeed as quickly as possible. Start a turn may be only when the airspeed is adequate. Release the cable by pulling firmly, but only once. When the speed has returned to the normal approach speed, stop counting the time; now comment on the long time that it takes to accelerate up to the desired speed. It is longer than many people believe!

Pilots have a tendency to want to turn when the attitude of the glider appears right, not when a safe maneuvering airspeed has been regained. Instructors should persevere with the practice at altitude until the recovery is automatic; this takes more than one practice session. This is why we need to repeat the exercise several times at altitude before doing a cable break simulation low down.

Repeat this exercise several times on this and other flights, with counting the time taken to attain the above approach and safe maneuvering speed, and before the cable-break exercise is done low down.

Always **fully brief** before any practice.

Cable break exercise from failed launch

In all cases, these maneuvers are to be demonstrated first. Do not ask the student to perform any cable break exercise below 300 feet. This follows the same procedure as for aerotow rope breaks. Demonstrate this exercise several times; each time first with the student following through, then this is to be practised by the student simulating the following different conditions:

- At a height from which a safe downwind return to the runway is possible. If speed and height are adequate for maneuvering, assess **S**ituation (using SOAR technique) and choose safest **O**ption for an emergency landing.
- At a higher height that allows an abbreviated circuit. Land downwind if headwind is less than 10 knots; when landing downwind select a new reference point, or **RP**, on the part of the runway closest to the approaching glider; or fly an abbreviated circuit but only if height is adequate.

Warn the winch operator and *fully brief the student* before each of the exercises outlined above. Include at least one flight in which a slow degradation of the winch engine power is simulated at or above 300 feet. This is to allow the student to learn the feel and the differences from a sudden cable break. If any traffic hazards exist, do not practice.

These cable break exercises are to be done in the correct sequence and they should be completed before a first solo flight. Ideally, the first should be done at a low height that requires a landing straight ahead (instructor demonstration only). This is designed to establish in the student the recovery and the landing straight ahead as the first choice for action. When this has been established, a cable break at 300 feet or higher may be demonstrated, with the recovery and turns to land at the upwind end of the runway or downwind on the runway as appropriate. Note that all these exercises are to be fully briefed before takeoff. The only cable break that is to be given uannounced is the one done as part of the licence check-flight requirements.

Landing downwind

If landing downwind back on the airfield after an interrupted launch or at any time, point out the higher ground speed, and the need to use the airbrakes to land as soon as possible on the runway; the ground run will be longer than normal. There will be a need to keep the wings absolutely level for as long as possible, to avoid a ground loop.

ADVICE TO INSTRUCTOR

General considerations

The main hazards at each stage of a winch launch reported in 2006 by the UK to OSTIV from an analysis of accidents over a 19-year period are:

Condition	*Hazard*
Ground	cart-wheeling
Rotation	stall/flick roll
Power loss < 100 ft (30m)	stall
Power loss > 100 ft (30m)	spin
Other	cable.

The two dominating criteria for a stall during rotation are a low airspeed and a high rotation rate. Modelling indicates that a glider with a 1g stall speed of 34 knots rotating at an airspeed of 50 knots

will stall at a rotation rate of 20° per second. Therefore it is vital to allow the speed to increase adequately, with continued acceleration before allowing rotation to occur. The elapsed time from takeoff to full climb-attitude should not be less than about 5 seconds.

The most common winch accident is after a power loss or cable break below 100 feet. A UK study indicated safe and unsafe combinations of climb angle, airspeed, height, recovery dive angle, pushover g, etc. It appears from this that pilots are not aware a crash can follow a single error, for example, pushing over too vigorously when this close to the ground can leave insufficient height to prevent a heavy landing. Many of the accidents analysed over the 19-year period were from instructors *pulling the release below 50 feet (15–20m)*. The Flight Safety & Training Committee now recommends that this be a demonstration only, not a student exercise.

All pilots must observe the posted maximum winch speed, so that when the speed increases towards this value the pilot will start signalling before reaching this speed. Powerful winches allow for a different technique for the climb, by which the pilot adjusts the glider's attitude to control the speed. It is recommended, however, that you teach the **too fast** signal (yawing the glider alternately side to side) and lowering the nose to signal **too slow.** Only teach these two signals for control of the speed – these will provide a good basis for the student's future flying.

Weak links

A properly designed weak link is essential, appropriate to the glider to be launched. Some weak links change characteristics with use (they work harden) and so must be inspected carefully before each launch. If damaged or elongated beyond its allowable amount, replace it before the next launch. It goes without saying that the weak link must be the correct one for the glider to be launched; if not it must be changed before the launch takes place.

Fly the glider throughout the launch

The glider has to be flown throughout the launch. This may sound obvious but is very important as failure to do so may cause the glider to stray off the desired direction, or more important, the pilot may not achieve a good launch height. All control inputs must be well coordinated or the glider may slip or skid and not achieve an optimum height. In a crosswind, the glider is still flown coordinated throughout the launch, but is oriented into wind sufficient to compensate for the drift that the crosswind otherwise causes.

Signalling for speed changes

When signalling for a change in speed it is imperative that the nose of the glider is first lowered. This in itself is the *too slow* signal. This is to prevent an inadvertent stall, particularly if the glider's speed is marginally above the stall speed to begin with, in which case one wing will possibly stall first in any turbulence. If this situation were allowed to develop, it would most likely lead to an incipient spin or full spin, unless immediate and correct recovery actions are taken. The lowering of the glider's nose is the only approved signal to request more speed.

If the speed is *too fast*, a simple yawing signal is needed. Here too, the nose should be lowered first to guard against the possibility that the speed will be cut abruptly, leaving the glider with insufficient speed all of a sudden.

Top of the launch

Toward the top of the launch the cable will start to pull the nose down to a more normal attitude. The glider may cease climbing, especially if the operator throttles back to signal the pilots to release. Continuing with the steep climb attitude will only increase the load on the cable and the glider; the glider will probably *mush* rather than climb. Therefore teach the student to temper the back pressure on the stick, to achieve a continuing climb, until the winch operator throttles back. Immediately this signal is sensed, lower the nose to the normal attitude, or slightly lower (this unloads the hook on the glider). Then pull the release handle firmly once only (to prevent undue wear on the release and hook mechanisms). Pilots can usually feel when the cable is released, even if it *back releases*. Yawing the glider or banking it slightly should allow the pilots to see the cable (and its parachute) now on its descent.

AIR INSTRUCTION

Pre-takeoff checks

Pay particular attention to securing ballast weights during the pre-takeoff checks. The pushover from a cable break will often produce reduced-*g* forces that can dislodge unsecured weights which can become a real hazard. The pilots should be well supported behind the back (particularly short pilots) to prevent rearward movement during the rapid acceleration at the start of the ground run. A pilot may otherwise shift backwards and involuntarily pull back on the stick! The straps, especially shoulder straps, should be well tightened; the pilots must be well secured!

Teaching the climb

The nose-high attitude of the climb could alarm ab-initio students, even power pilots converting to gliders. Reassure them and don't let them take over control for the first part of the climb too early in their training. The power pilot may have to be reminded to allow the glider to assume the climbing attitude, rather than to hold forward stick pressure, which is often his first (automatic) reaction.

For the first few launches you should fly the glider for the initial part of the climb, and then hand over control for the steep part of the climb. When your student has confidence with this part of the launch, let him try the takeoff, initial climb, and transition to the full climb.

Releasing the cable

Most gliders have a hook or a mechanism that will make the hook release automatically whenever the angle of the cable exceeds about 80 degrees from the longitudinal axis of the glider. This prevents the pilot from easily over-flying the winch without the cable being released automatically. The pilot should always have the flight well under control so that the cable rarely *back releases*. A back release is an indication that the top of the climb was not well executed; the student should try to remember the angle of the glider at this point, and avoid a back release by un-loading the wings at the top of the climb. A release under full tension can snarl the cable on the winch's drum, so lowering the nose is to unload the cable for a normal release by the pilot.

Controlling direction during the climb

It is difficult for the student to recognize the glider's direction during the climb, mainly because the usual *object on the horizon* cannot be seen, and in any case, the pilot has to concentrate on the steep climb angle. Drifting off the runway centre line because of a crosswind is also difficult to recognize. Suggest that a cloud or ground reference to the side of the cockpit can be used for directional guidance.

Cable breaks

Cable breaks should be taught and practiced, especially so for pilots who are converting to the winch from aerotow training, perhaps many years ago. In these cases, retraining by practicing the recovery procedure at altitude several times is vital and is strongly recommended. For all deliberate cable-break practices low down, the student should be pre-warned. He should be fully briefed as to what to expect and what recovery actions he will need to take.

POST-FLIGHT REVIEW

It is often difficult to remember the details of the launch after landing. Hence, try to discuss the main points of the launch immediately after releasing the cable and settling down at the top of the launch. Make it brief, and include suggestions for an improved launch, but remember to say something positive at the end of any critique. Then continue with the planned lesson.

CHAPTER B12
STEEP TURNS, SPIRAL DIVES & ADVANCED THERMALLING

OBJECTIVES

To teach the student how to correctly make a steep turn, to increase speed before the turn, to maintain control of speed and bank angle in the turn, and to continue a good lookout during the turn. This is a prelude to teaching how to thermal using steep turns and to teach the student how to recognize and recover from a spiral dive.

MOTIVATION

Steep turns are used to alter course rapidly, and are used in one technique for centering a thermal. Steep turns are also good for improving flying ability in general, and are a prelude to the spiral dive exercise, and the later wingover and other acrobatic maneuvers.

PREPARATORY GROUND INSTRUCTION

Before entering a steep turn, defined as between 45° and 60° angle of bank, it is important to first have a good look around for other aircraft, and this must include below and above the glider, and be very thorough in the direction of the intended turn. Then increase speed, recognizing that the stall speed increases in a steep turn because of the need to develop more lift in the turn. This increase in lift, compared to that in straight flight, can be considerable as shown in the table on the next page. The extra speed will help develop the needed extra lift.

Above about 45°, the *g*-loads and stall speed increase rapidly. This is because in any turn the wings have to develop this extra lift to provide the horizontal force to make the glider turn. This can be achieved partly by increasing the angle of attack of the wings. In a steep turn this is not enough as the critical angle of attack of 15–18 degrees may be reached and the wings will stall. A speed increase is therefore vital before entering a steep turn. In a steep turn some gliders are difficult to stall because the elevator often does not have enough extra authority to get the wings up to the critical angle for the stall; the glider will fall away from the turn instead, in a somewhat messy sideslip.

In a 90 degree bank the vertical component to the lift is zero, hence a continuous turn is impossible and the glider will rapidly lose height. A steep turn is rarely used continuously in thermalling; not only is the sink rate of the glider greater than at shallower angles of bank but, because the airspeed has to be higher, the diameter of the turn tends to be larger. The glider may then be outside the strong lift in the core of the thermal. Care has to be exercised in turning steeply in rough air, as the extra *g*-loading caused by a sudden gust has to be added to the *g*-load caused by the turn. In this case the total *g*-load must be kept below the design load capability of the glider. An angle of 60° is a sensible limit; take care with greater angles of bank.

Method of making a steep turn

There are three stages to making a steep turn: rolling in, staying in, and rolling out. But before entering the turn it is important to perform a **good lookout** above and to both sides, particularly in the direction of the intended turn.

Bank angle (degrees)	*G* load	Stall speed increase (%)	Typical glider stall speed (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 angle of bank, g-loading and stalling speed

Rolling in Having made sure it is safe to start the turn, increase the airspeed to about 40 percent above the maximum L/D speed, and make a coordinated roll into an angle of about 45°; at a

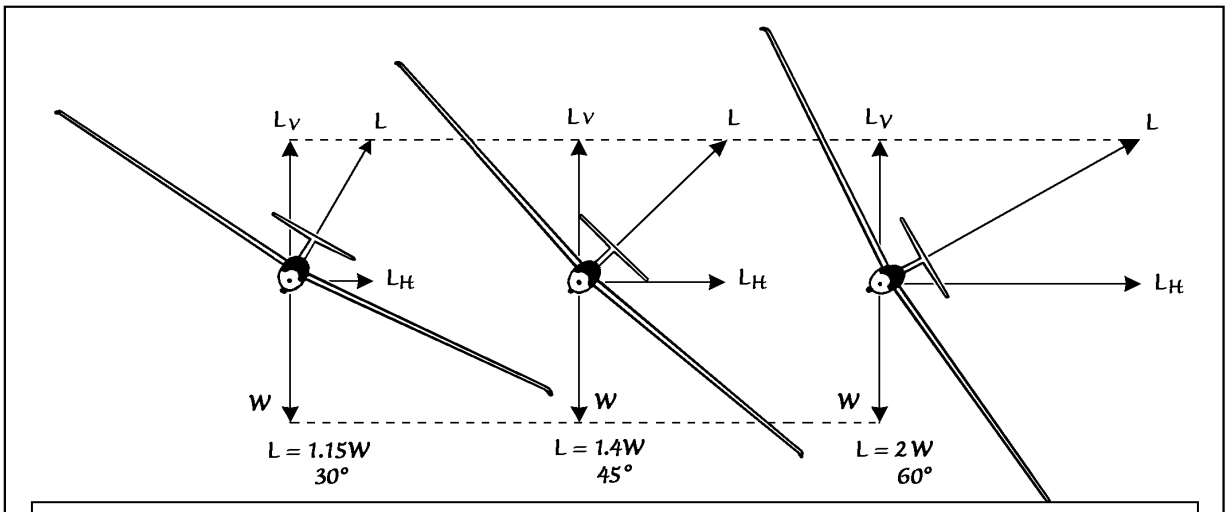
later stage of training this may be increased to an angle of bank of 60°.

Staying in

To stay in a steep turn the student will use a similar method as for a medium turn. The objective is to maintain a constant angle of bank (remembering to use rudder for good coordination) and to maintain a constant airspeed. A good lookout must be main-

tained throughout the turn. This is different than a lookout before entering the turn and must concentrate the lookout in the *direction* of the turn.

The controls will have been briefly centred when the desired angle of bank is reached. To stay in a constant turn a noticeable backward pull on the stick will be required in spite of the higher airspeed: in some two-seaters it will not be possible to fully trim the glider, so this back pressure will have to be maintained. During the turn the student will have to *look up* to see the horizon ahead, and will have to correct any tendency to over-bank. The turn must remain well coordinated, with the yaw string straight back and the ball in the centre.



Effect of increasing angle of bank on the lift that the wings must develop

Rolling out

Be sure the student performs the look-out by searching on *both* sides, including *under* the high wing, then *above* and to the front before rolling out of the turn. Recovery is similar to a medium turn. First, look well ahead to refer to the horizon and level the wings with coordinated use of stick and rudder, and then re-establish the normal gliding attitude. There will be a tendency for the nose to rise, either because of the trim itself, or from the back pressure on the stick that had to be applied during the turn – this nose-rise should be watched; the stick will have to be deliberately pushed forward against the trim. Then, re-trim the glider at the desired speed.

Spiral dives and recovery

A spiral dive may be described as a steep diving turn, with the glider in a nose-down attitude in which the airspeed can increase very rapidly. A spiral dive can be entered unwittingly from a medium to steep turn, for example when thermalling, in which case it can creep up on the pilot slowly. A poorly executed spin entry is also likely to give a spiral dive, much more quickly and violently this time! Unlike the spin, a spiral dive is a condition of *unstalled flight*. When a spiral dive is done as a deliberate maneuver, either from a steep turn or during spinning exercises, the following precautions should be observed:

- Considerable height will be lost, so the exercise should be started at a safe altitude.
- Airspeed will increase rapidly; take care not to exceed the glider's maneuvering speed.
- Recover gently, as a harsh recovery from a spiral dive can result in excessive loads, with the danger of structural damage. Consider the lower wing: it has a large bending moment at the wing root because first, the glider is pulling out of the dive and second, because the wing is applying an upward moment to unroll the glider from the banked attitude.

The standard method for **spiral dive recovery** is:

- Relax the back pressure on the stick to reduce the *g*-loads on the aircraft, then
- Level wings with ailerons, using coordinated rudder sufficient to prevent adverse yaw,
- Ease out of the dive.

Any attempt to pull out of a spiral dive by increasing the backward stick movement without first levelling the wings will simply tighten the spiral and the airspeed and *g*-loads will continue to increase.

The benign spiral

A benign spiral is a dynamically stable, uncontrolled (hands-off) descending spiral at a near constant airspeed in maximum drag configuration, e.g. airbrakes out and wheel and flaps down (but beware of any flap speed limits). Use this technique to lose height rapidly. A typical situation is when wave flying where a benign spiral may be used to descend from above cloud when the wave window threatens to close over. It may be practised on a good thermal day when time is up and the pilot needs to get back to the club.

To demonstrate this maneuver, perform the **CALL** check then, from a well-coordinated medium turn, trim the glider to fly at about the best L/D speed and check that it will fly steadily with hands and feet off the controls. Every glider reacts differently and needs to be tested for best trim location – airspeed excursions may be less with trim full back, for example. Now slowly open the airbrakes fully, and monitor the turn, the hands and feet remaining off the controls but hold the brakes open. This requires some discipline the first time it is done! The glider will descend at a high rate, especially if it has powerful airbrakes. The speed and angle of bank may oscillate, but will remain close to the original angle of bank and airspeed. Observe the glider's reactions and note the descent rate, all the time maintaining a good lookout. A demonstration for confidence building would be to disturb the glider slightly in the spiral; this will not destabilize the spiral.

Advanced thermalling technique

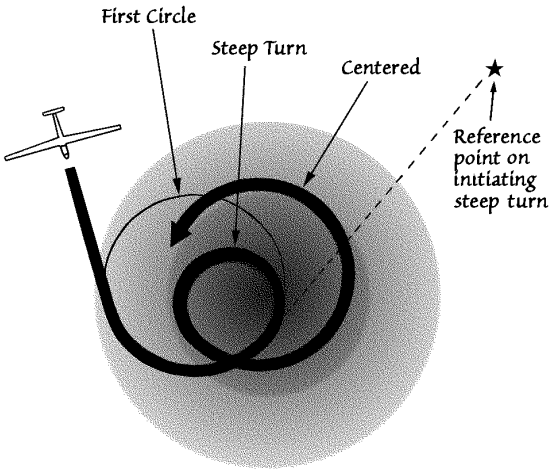
When the student can fly more accurately and has tried a few steep turns, a more effective method of centering than the one learned under medium turns can be taught. The method was first developed by Heinz Huth (twice World Champion), and involves a steep turn for less than a complete circle.

The first circle will be established where the pilot thinks the best lift is, but it may not be in the centre of the lift. As the glider flies into the stronger lift, the technique is to pick a reference point straight ahead, and increase the angle of bank to that of a steep turn. When this reference point is in line with the lower wing tip, or slightly in front of it, the pilot should resume his normal angle of bank. The glider will have done a steep turn for 270 to 300 degrees of a full circle, and will have moved its circle toward the centre of the thermal.

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

We may remind our students that a circling glider will often mark lift – others will join in, arriving from what may seem nowhere and from any direction. Particularly on a marginal day, other gliders may come to join the thermal. They will even come towards you if your student is making practice turns in zero sink! Remind the student of the need for a constant lookout for other gliders in the thermal or nearby.

ADVICE TO INSTRUCTOR



The steep turn

When first introducing your student to the steep turn, do not be tempted to allow the student to develop too steep an angle of bank. A 45-degree angle is sufficient to teach the correct techniques, and perhaps to allow the student to exhibit the faults that you will now need to correct.

The student may not appreciate the need for a very good lookout during steep turns; concentrate on this when first attempting continuous turns. Also the student may not realize the importance of the extra speed needed, so insist on a definite speed increase before rolling into the turn.

When rolling into a steep turn, progressively more backward movement is needed on the stick as the angle of bank increases. As for a medium turn, the angle of bank and pitch attitude are maintained by normal use of the controls, and the yaw string should show no slip or skid.

We can visualize a turn as a combination of a yawing movement and a pitching movement. If the glider is banked and it is yawing only, the nose will progressively move lower relative to the horizon. To correct this and to keep the nose moving (sweeping)

steadily around the horizon some pitching movement (up) must occur. We do this by *raising the nose*, pulling back on the stick. The steeper the angle of bank the more pitching movement is required to maintain an accurate turn, until finally at 90 degree angle of bank, the turn (if it were possible) would be a pure continuous pitching movement. During the turn ask your student to raise the feet off the floor; the extra *g*-loading of the steep turn will be appreciated!

If speed seems to be increasing, and pulling back further on the stick does not reduce the speed, use the following technique. Reduce the angle of bank to that of a medium turn, get the speed under control, and then resume a steep angle of bank. In fact, the student would be approaching a spiral dive situation; you have just introduced the student to the spiral dive recovery.

The spiral dive

The spiral dive demonstration and practice must be preceded by the CALL check. Because a spiral dive is most often entered from a steep turn, for example when thermalling, your demonstration may be started here from a steep turn. As you demonstrate mention the increasing airspeed (and noise), increasing *g*-loading, and point out that you are *unstalled*. Before the speed builds up too much, recover as above, paying particular attention to reducing the load on the aircraft by relaxing the back pressure on the stick as you roll the wings level. Point out again that a spiral dive can result from a poorly executed spin entry, and that the clue is the rapidly increasing airspeed. This will be demonstrated as part of the spin exercises.

Thermal centering using steep turns

As the opportunity presents itself, allow the student to try the steep turn technique for centering thermals. Talk students through the technique to remind them of it, paying attention to picking a ground feature or cloud ahead as they start the steep turn. If the thermal is really small they will have to turn very steeply to make best use of the lift; point out the extra back pressure needed on the stick to *pull* the glider round the turn. Mention that the best lift in the thermal does move around so that the pilots have to continually assess where it is, and centre it accordingly.

Faults in steep turns

Watch for and correct the faults that can occur in steep turns. With some of them, take over control and immediately stop the maneuver, correct the student and then start the maneuver again from wings level, or from the turn if the fault is during turning. These faults are:

- Failure to increase speed properly before starting the turn,
- Failure to look out adequately – including under the high wing – before rolling into and out of the turn,
- Tendency to enter too quickly,
- Tendency to allow bank to increase – aileron input is usually needed to hold off the bank,
- Failure to apply adequate back pressure to the stick to control the speed in the turn.

Initial attempts at steep turns should be limited to less than one revolution before resuming a more normal medium turn.

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POST FLIGHT REVIEW

It is very useful to ask your student to review the flight, particularly to point out the increasing speed and *g*-loading in the spiral dive. Take the opportunity to review other parts of the flight, as now the student will be doing most of the flying (i.e. except for your demonstrations). At this stage, students should be encouraged to assess their flying and the flight, but they may need coaxing to do so, with you providing your comments and positive feedback on the good points.

Because the spiral dive and the benign spiral exercises are liable to use up height very rapidly, your student may soon find the glider is a bit low to get back to the high key area at the right height. Use this to reinforce that by now he should be constantly using SOAR to make the decision when to return to start the circuit at the correct height.

The chance to try thermalling should always be taken; staying up is the name of the game, right? Advanced thermalling using the steep-turn technique for centering can be used on a number of flights as the opportunity arises. It can be demonstrated in calm air but should be practiced when thermalling, paying particular attention to a good lookout at all times. If the glider is fitted with an audio variometer now is the time to get the student used to interpreting the signals while he is maintaining a good lookout.

A useful review of the student's attempts to use the steep turn technique should be made when on the ground, perhaps pointing out that once the glider is centered, less vigorous turns are needed to maintain the glider in the centre of the lift. Finally, point out the areas in which he is doing well, and give encouragement.

CHAPTER B13
SIDESLIPS & FURTHER STALLING

OBJECTIVES

To teach the student the different techniques for side slipping and when to use them, and to introduce the student to further stalling exercises that are designed to proof the pilot against inadvertent stalls.

MOTIVATION

Sideslips are used to lose height rapidly, usually on final approach, and to make a straight approach in a crosswind. Good pilots are able to use the sideslip under a variety of conditions to land in restricted areas (for example on a cross-country flight).

Further stalling exercises are designed to enhance the student's understanding of the slow flight regime, and to prepare the student for unexpected responses of the glider close to and at the 1*g*, and several accelerated stall conditions. We teach these exercises also to increase the pilot's confidence in the glider in the more unusual situations, to recognize these situations so that a stall may be avoided, and if a stall does occur, to recover with minimal loss of height. The student will also experience the differences between the falling feeling at the stall and from a pushover. By learning these aspects of stall behaviour a pilot will become a safer and more competent pilot.

The emphasis should be on stall avoidance, not the stall itself.

PREPARATORY GROUND INSTRUCTION – SIDESLIPS

Purpose of the sideslip

There are two main uses of the sideslip; first to increase the rate of descent while approaching to land and, second to counteract for drift when approaching in a crosswind. The sideslip has a variant, the slipping turn in which the sink rate can be very high and in which particular care is needed when flying it.

Note that the sideslip is taught to complete a pilot's training, but if a pilot is seen to use a sideslip on most approaches it is an indication that he is misjudging the heights and is too often high on final approach.

Definition of a sideslip

The sideslip is a maneuver in which the glider is banked but in which the natural tendency to turn is prevented or reduced by use of the rudder; the glider then slips towards the lower wing. Very high sink rates are possible particularly when doing a slipping turn.

Entering a sideslip

A sideslip can be started using any of the following techniques, or a combination of them:

- Start from a coordinated turn As the glider turns towards the intended direction, apply top rudder to enter the sideslip. This is a great way to start a sideslip from the final turn, because the turn can be arrested as the glider turns towards the runway. Be aware of the wind direction and the preference to have the into-wind wing low.
- Bank the glider first **Keep the rudder centred as the glider is banked. The aileron drag will yaw the glider away from the bank; then apply rudder to maintain the sideslip.**
- Apply rudder first then lower the wing **This technique helps in some gliders that are reluctant to slip.**
- **Bank the glider and simultaneously apply rudder**. This does require practice to do well, and your student should become proficient at the technique before going solo. Perhaps this is the first method that usually comes to mind but it omits showing the student the basics of the required bank angle and amount of yaw, and does not review the further effects of rudder. This technique should be flown after the ones above, and the student encouraged to practice and perfect this technique later, when flying solo for example. It is also a very useful maneuver to try out with a new glider, and will show the pilot some of its handling characteristics.

Sideslip to counteract drift exercise

A sideslip may be used to counteract drift caused by a crosswind on the approach to land. In this case, the glider is flown with the glider's axis parallel to the runway centreline but it is slipped towards the wind only sufficiently to counteract the wind's effects. In most winds the required angle of bank is small. This effect and the sideslip will be tried at altitude first before using the technique in an actual approach.

Staying in the sideslip

During a sideslip the airspeed indicator should not be relied upon for accurate indication of the speed.

A pot pitot (or a pitot in the air intake), a pitot that is sensitive to yaw, and the position of the static ports (on either side of the fuselage, for example) all affect the ASI reading when the glider is yawed. Therefore, the student will have to control the speed by controlling the pitch attitude of the glider.

It is not easy to hold most gliders in a steep sideslip as the authority (power) of the rudder is inadequate to overpower the weathercocking tendency, and the glider will turn. However most gliders will sideslip easily, and a high rate of descent is possible when also using full airbrake.

The feel of the rudder will change in a sideslip; the load usually becomes very light or may even reverse, in which case the pilot will have to use extra force to centralize the rudder during the recovery. Care must be taken not to roll out too rapidly during recovery of the sideslip because aileron drag will make the nose yaw uncontrollably and the student will be discouraged during his first attempts!

If in the event that the sideslip is continued to too low an altitude, the lower wing will be in the slower *wind* (caused by the wind gradient) and it may be difficult to level the wings. The lower wing tip could stall, particularly if the aileron is deflected down in an attempt to lift the wing. Care must be taken to level the wings at an adequate height above the ground. This also allows the student sufficient time to get well aligned with the runway prior to landing. Sideslips can be either a regular sideslip or a *forward* slip or they may be combined into a slipping turn.

In the regular sideslip the glider's longitudinal axis is parallel to the runway centreline, and when using the technique to counteract for a crosswind the glider will remain on the runway centreline. In an approach directly into wind, the glider can be sideslipped from the side of the runway centreline and the recovery is completed as the centreline is intercepted. In this case extra care must be taken with a good lookout to ensure there is no aircraft also approaching straight on, with which the sideslipping glider might collide.

The forward slip, on the other hand, is used when the glider is on the centreline but with the glider heading to one side of the runway. To recover, the glider must be yawed towards the runway so that it is heading along the centreline (note: in gliding the term *forward slip* is rarely used; the above name distinctions are not made and all such maneuvers are usually called sideslips).

A slipping turn is done by increasing the bank angle beyond that at which the rudder can maintain directional control. The rate of descent can be very high particularly when turning steeply and using full airbrake. Recovery is made as for a normal turn but ample height must be allowed (high rate of sink) because a low final turn can take the glider into the ever-present wind-gradient. The slipping turn can be used when going into a field with tall obstructions on the downwind boundary, or when the base leg has been made too close in to allow a normal turn followed by a sideslip.

PREPARATORY GROUND INSTRUCTION

Further Stalling or Accelerated Stalls Exercises

These exercises are to concentrate primarily on teaching the student how to avoid an inadvertent stall under a variety of situations. They are also designed to improve the student's confidence in handling the glider when close to and at the stall in a variety of attitudes. Before teaching these exercises make sure the student is comfortable with recovering from 1*g* stalls, including wing-drop stalls. Mention also that these stalls are important to do, to teach the student that a glider can stall in any attitude and at speeds considerably above the 1*g* or unaccelerated stall speed. Before doing any of the following exercises, carry out the CALL check.

Accelerated stall while climbing

This exercise simulates an inadvertent stall and shows the recovery from situations such as:

- A poorly flown steep climb into a thermal to reduce the airspeed by trading speed for height,
- A steep climb after a fast finish to a task at the end of the day when the pilot will likely be tired and relaxed, and maybe also is not fully concentrating on the situation, and
- Following a winch launch failure.

Besides discussing the situations that can lead to these inadvertent stalls, this exercise will be used to show that when the wings are stalled there is a *lack of elevator effectiveness at the stall*. In fact, the elevator is ineffective at raising the nose even as it pitches down at the stall because the airspeed is below the 1*g* stall speed. Emphasize to the student that you will demonstrate this effectiveness by touching the stick against the stop. The *nose must be lowered* (stick moved forward) to unstall the wings, even though the nose is pointing down, then when the speed has recovered to near normal, the nose can be raised again to the normal gliding attitude. When the

recovery is initiated, the glider accelerates rapidly, and a smart recovery to the normal gliding attitude will limit the speed increase. Ask the student to repeat the exercise and to recover immediately the first symptom is noticed; this is to build up the student's awareness of, and to help avoid such situations that can lead to these inadvertent stalls.

Accelerated high speed or descending stall

This exercise simulates the pilot trying to prevent the nose dropping further, *before* the glider has regained its flying speed after an inadvertent stall even though he has felt that the correct recovery actions have been taken.

In this exercise, the pilot starts at a higher speed and holds the glider in a nose-high attitude. As it stalls the nose drops sharply; the pilot is assumed to then try to prevent the nose dropping further by pulling back too soon and abruptly, thinking that with the attitude of the glider now nose down, the flying speed is also adequate. This is in effect anticipating too soon that the speed has recovered, and the pilot is anxious to recover quickly by initiating the recovery too early. In most cases the glider will buffet and stall again in a secondary stall at a higher speed, and the glider will remain nose down, descending at a steady speed (indicates the stall) and at a high rate of descent. One wing may descend faster than the other and a spin could develop unless the pilot makes a swift recovery from this *wing-drop* stall.

Emphasize again the need to observe the ASI to check that the speed is increasing and is above the 1*g* stall speed before the recovery actions are started. Before a recovery can be made, the only action that will increase the speed is to release the back pressure on the stick; then the glider can be recovered to the normal gliding attitude.

After your demonstration, you will instruct the student to repeat the exercise, but to recover immediately the first stall symptom is noticed. This action is to prevent a stall and is a useful exercise to repeat on different flights.

Accelerated stall in a turn

Enter a turn at about a 30 degree bank and begin to reduce the speed to reach the pre-stall buffet. Mention the unusual control positions that will be needed to maintain the angle of bank and the desired pitch attitude in the turn as the speed reduces. At the onset of the pre-stall buffet note the airspeed and compare it to the 1*g* stall speed. Immediately *lower the nose* (reduce the back pressure on the stick) as for a wing-drop stall; and the glider will recover.

Ask the student to repeat the above but immediately the pre-stall symptom(s) is noticed recover by lowering the nose. This recovery action is to prevent a stall.

This exercise points out that in a steep turn considerably more speed is required to sustain the turn without stalling.

Effect of angle of bank on stall speed

This exercise demonstrates dramatically the increasing stall speed as the angle of bank in a turn increases. The speed at which the pre-stall buffet occurs will always be at the *same angle of attack*, irrespective of the speed, as discussed earlier under *stalling* in Chapter B6.

This exercise is a demonstration only because it requires a high level of skill to perform well. The student is also not to follow through, but is to observe and call out the airspeed when he detects the pre-stall buffet at each angle of bank. Mention to the student in the preparatory ground instruction the numbers to be expected and how this exercise is to be flown.

AIR INSTRUCTION – SIDESLIPPING

Before doing any sideslip on final approach, practice them at higher altitudes. There is value to pointing out the correct bank and (pitch) attitude for a sideslip before any sideslip is attempted; the feeling of sliding sideways on the seat can be disconcerting and the student will not at first concentrate on listening or watching. So, start from a correctly coordinated turn, and use this to point out the bank angle and attitude; it will be the same during the sideslip. Now apply top rudder and the glider will start to do a sideslip. The secondary effects of rudder will tend to level the glider's wings, so control the bank angle. The nose will tend to rise, so control the attitude too. Now centralize the rudder and return to level flight using the controls normally.

Note that this demonstration can be done without reference to a direction or reference line on the ground. Next direct the student to repeat the above. Ask him or her to pick a reference line later, after he has attempted a few entries to a sideslip, and can control the recoveries satisfactorily.

A variation of this air instruction is to talk the student through doing it all. But follow through yourself closely! This can be very effective as a learning tool because the student will quickly learn how the glider should feel, and how much of each control can be used. You may have to encourage the stu-

dent, for example, to apply more rudder input or to level the wings a bit. There is a lot going on. How they respond will depend on their abilities of course, also on their self-assurance and the confidence you give them through your voice. Don't forget the value of a demonstration though, and don't hesitate to take over control if needed.

When he has acquired some initial skill at sideslipping you can teach the other techniques of entering a sideslip. Once the student is reasonably competent, you can go to using sideslipping on final approach, but this should be limited to occasions when the height is much too high at the final turn and the circuit has been misjudged. Sideslips to handle a crosswind will require smaller angles of bank and a high level of handling skill to do well, so practice when you can.

The glider will lose rudder authority before running out of aileron control. This is important to remember, as excessive bank angles close to the ground and in the wind gradient are dangerous and are difficult to recover from. Always have a safety height below which a full sideslip is discontinued. The height of tall trees is a good guide if you have them close to the airfield.

Sideslip to counteract drift on the approach in a crosswind

To demonstrate this effect at altitude, which we should do first, ask the student to choose a reference line at 90 degrees to the wind, and note the drift when flying straight and level with the glider heading parallel to the reference line. Next, get the student to initiate a gentle sideslip into the wind to counteract the drift, and maintain the glider's track parallel to the reference line. Now note that the angle of bank that is needed to counteract drift is not that great and that a considerable degree of skill is needed to fly a good approach using the technique.

Sideslip to increase rate of descent on approach

When sideslipping on the approach, always use the flight manual recommended approach speed, or airspeed as calculated for the estimated wind and gust speeds:

Approach speed = 1.3Vso + Vw (full wind + gust speed).

If obviously too high and overshooting, use a sideslip to fly down to the reference point. The student should first set up the sideslip by yawing away from the intended approach path. The glider's track will then be along the landing line or runway centreline (sometimes this sideslip is called a forward slip). Teach the student to recover to straight flight with adequate height to allow a normal flare, hold-off and touch down. If there is a crosswind, the student should lower the into-wind wing, and only use the airbrakes to increase the rate of descent as needed. Ease off the bank slightly if necessary close to the ground to allow adequate wingtip clearance.

A minimum recommended height for the recovery is 100 feet above the ground, and this should be judged by reference to objects such as large trees or buildings.

Slipping turn prior to landing exercise

As the sink rate can be very high during the turn, this exercise should be demonstrated and practised first at height. Before the exercise perform the CALL check and make sure no other aircraft are anywhere below. Simulate the entry to the final turn normally, and then gradually apply rudder to initiate a slip inwards during the turn. Maintain the approach speed by careful attention to maintaining pitch attitude. This should only be continued for less than 90 degrees, similar to what would be flown on an actual final turn. The recovery must be completed first to return to the coordinated turn, and then assuming a sideslip will be continued on final. Finally repeat with using the airbrakes, noting the very high descent rates. Mention again that this maneuver might only be used in making a turn onto final into a short field when there are high obstructions on the periphery of the field. Use the exercise to reinforce the fact that to do the turn safely, a high degree of skill and adequate practice first at altitude, are needed.

Faults in sideslipping

Three are several difficulties that students have when first making sideslips:

- Banking the glider too much, i.e. running out of rudder authority. The pilot must unbank the glider and then resume the sideslip.
- Poor speed control when the ASI is unreliable by not maintaining the pitch attitude, the pilot allows the nose to drop.
- Poor understanding of functions of the controls to enter a sideslip; return to practising entering into and coming out of the sideslip from a well coordinated turn at altitude. This should be a useful review of the basics, then make the student repeat the other entry methods. Again this may become a review of these entry techniques!

AIR INSTRUCTION – STALLS

The CALL check must be completed before doing any stall exercises. Ask the student to do this. These further stalling exercises are designed to teach the student how to avoid inadvertent stalls, and this must remain as an important part of these lessons. The recovery sequence is important, to teach the student how to recover with minimum height loss and to prevent a secondary stall.

Always demonstrate each exercise first, with the student *not* following through. This is to avoid the possibility of panic in a susceptible person when the glider abruptly changes attitude, climbs or descends in what some pilots describe as *exciting* maneuvers! See also Chapter B6. The instructor should never ask the student to fly the glider or even follow through in a situation that he has not experienced first as a demonstration.

Accelerated stall while climbing

This exercise simulates a poor entry into a thermal from high speed, a high-speed task finish and climb, or a winch launch failure. To perform this exercise, increase speed slightly then pitch the glider up to a climbing attitude of about 30 degrees; maintaining this attitude. As the speed drops, some symptoms may be absent or not obvious. At the stall, the nose drops sharply, even with stick fully back (point this out to the student by touching the stick against the stop) and again note the ineffectiveness of the elevator at the stall.

The recovery is to *lower the nose*, i.e. reduce angle of attack by moving stick steadily forward even though the nose is already dropping. Then as the speed increases to above the stall speed, use the controls normally to ease out of the dive. *Ease* is the word to use in the cockpit to prevent an abrupt pull that may induce a secondary stall, covered next! In addition, note the height lost. Now the student should be asked to repeat the above but recover immediately the first symptom of the approaching stall is noticed. This action is to prevent a stall.

Emphasize again during this exercise that when the wings are stalled the elevator is ineffective at raising the nose, and the stick must be moved forward to unstall the wings first, then the nose can be raised.

Accelerated high-speed stall

This next demonstration is to show the effects of pulling back on the stick too early in the recovery. This is not easy to do convincingly and needs practice!

In this demonstration, the speed should be increased to 55–60 knots and the glider pitched up to about 30 degrees nose up. At the stall, initiate a normal recovery by lowering the nose (*ease* the stick forward) and point out to the student that this is what you are doing. When the glider has pitched down to below the horizon and before the 1g stall speed is reached, pull back abruptly and fully on the stick as if you were trying to prevent the nose going further down (an action that a nervous pilot might do particularly when the workload is high or when he is stressed). Emphasize this to the student. If the glider has not been stalled cleanly and is flying too fast, the demonstration will not work! Ideally, the glider stalls in a secondary stall and it will remain nose down. The student should fully understand the need to relax the back pressure sufficiently to recover from this stall, even though the glider appears to be flying normally, but in the nose-down attitude. One wing may descend faster than the other and a spin could develop unless the pilot makes a swift recovery from this *wing-drop* stall.

This demonstration will need to be practiced before trying to give the demonstration with a student! It will show what happens when the recovery from a stall at a higher speed is initiated too soon, producing a secondary stall.

Effect of angle of bank on stall speed

Start this demonstration by asking the student to take his or her hands and feet off the controls. Now with the wings level, slow only to the pre-stall buffet at which point the student is to call out the speed. Then increase the speed to above the stall speed that you expect for the next angle of bank of 20 degrees. Roll into a banked turn at this angle, and now slow to the pre-stall buffet. Ask the student to note the speed. Next, you should repeat the above at 40º and 60º (2g) angles of bank. The student should recognize that the increase in stall speed with bank angle is not linear and that as the angle of bank increases so does the *g*-load; at these steeper angles tell the student to lift his or her legs! Similarly the loads on the aircraft are higher, hence the need for care when rolling to a wings-level attitude when recovering also, for example, from a wing-drop stall.

ADVICE TO INSTRUCTOR

Sideslips can be confusing to students, so a good basic understanding from the first is needed to help them. Teaching first-things-first is the aim of showing the student the bank angle and pitch attitude in a normal turn, before adding rudder input to make the glider slip.

With a student who is doing well and is clearly able to handle the glider well, the sideslip exercise may be talked through. The advantage is that the student feels the effects of his or her inputs, and is therefore likely to be more comfortable and relaxed than when experiencing the (unusual) sensations as the instructor demonstrates. When you give a demonstration and apply rudder to counteract the turn, ask the student to tell you what is happening to the glider (keep the stick in the same position). The glider will begin to level its wings, and the student should be encouraged to analyse what is causing this. When he does the maneuver alone, again ask the student to notice what the glider wants to do. This will help later when he does not have the benefit of your analysis from the instructor's seat.

The effect of the wind gradient on the glider when it is in a sideslip is a potentially hazardous situation that should be explained carefully when on the ground. It is not possible to safely demonstrate the effect (!), but it is essential to cover it during a pilot's training

Note that a sideslip will occur during a crosswind takeoff that is correctly controlled. This is adjusted promptly by turning into wind as both aircraft leave the ground, and then by aligning the glider with the towplane when clear of the ground.

When first demonstrating and the student is practicing sideslips, the dive brakes should not be opened. This conserves height while the student is practicing. Later, the brakes should be opened to demonstrate any buffeting effects on the elevator and rudder, and to practice with the high sink rate.

Deliberately start a final approach higher than normal to allow the student to practice sideslips, and to recover with adequate height. Useful crosswind approaches can be flown with the sideslip technique, taking care (with a low-wing glider especially) to level the wings in plenty of time to maintain ground clearance during the flare and hold-off.

The stall exercises will use height rapidly so start from a higher than normal tow, and never neglect the CALL check, with the **lookouts** designed to look ahead and below. If there are thermals around, use them to gain useful height before examining the stall further. These exercises are very useful to improve students' confidence not only in the glider but also in themselves because they will be subjected to the reduced-*g* and the falling sensations at the stall, and will learn the various situations that can lead to the inadvertent stall. Learning to relax the natural tendency to pull back on the stick as the nose drops is very important, and you should encourage this during the student's flying of these exercises. However the main name of the game here is stall avoidance, and while stall recoveries are a necessary part of the training, stall avoidance practice should not be neglected.

POST-FLIGHT REVIEW

Encourage the student to analyse the exercises just practiced and instruct him or her to review the manual as a useful follow-up.

Points to cover for the sideslip exercises include:

- The different ways in which a sideslip may be started,
- The lack of sufficient rudder authority in some gliders to maintain a large angle of bank in the sideslip without starting to turn,
- The effect on the airspeed indication caused by the airflow over the pitot and static ports,
- The extra attention required to track along the runway centreline on approach allowing for a crosswind, and during a high approach but with no crosswind.

Points to cover after going through the stalls exercises include:

- At the stall the pilots feel a falling sensation,
- This is only stopped when the glider has gained speed and the pilot pulls out of the dive, therefore,
- The need to avoid pulling back on the stick as the nose moves down through the horizon – a normal-appearing attitude does not guarantee that the speed is normal!
- Emphasize that the glider may not have stalled under certain conditions (e.g. turbulence on approach) but the pilots still feel the falling sensation; in the debriefing adequately discuss the differences in the situations that cause this falling feeling.

CHAPTER B14
CROSSWIND TAKEOFFS & LANDINGS

OBJECTIVES

To teach the student the different techniques for making a crosswind takeoff and landing, and to recognize and handle the illusions created by drift when in the circuit.

MOTIVATION

Because the wind seldom has the good sense to line up directly along the runway centreline, learning these techniques will allow the pilot to fly safely under these conditions.

PREPARATORY GROUND INSTRUCTION

The takeoff

There are two problems encountered when taking off in a crosswind. First the glider will tend to weather-cock into wind, and second the upwind wing will tend to rise as the wind gets *under* the wing especially if the pilot allows the wing to rise when the glider starts to move.

The first tendency is for both the glider and towplane to weathercock into wind. The pull of the towrope will help to keep them straight, and this can be helped further by placing the glider to the side (upwind) of the towplane. The glider pilot will also have to keep straight down the runway of course, by using the rudder at the start of the ground run.

To prevent the wing rising, the wing runner will hold the wing lower than normal, so that the glider will be doing a slight sideslip as the takeoff commences. Teach the student to continue to hold the wing down slightly after the wing runner lets go.

In a strong crosswind it helps to place the glider upwind of the towplane, i.e. displaced sideways slightly on the runway as mentioned above; the pull of the rope tends to keep both aircraft straight. As speed increases and the rudder becomes more effective the glider should be moved into position in line behind the towplane. The glider should be held firmly on the ground until it has proper flying speed, and then lifted clearly into the air to prevent a bounce (sideways) after takeoff. As the towplane lifts off and weathercocks into the wind the glider should be aligned behind it. On narrow runways which may have obstructions down each side it may be necessary to crab the glider into wind immediately after it becomes airborne, so as to avoid drifting over the obstructions.

The above procedure can be thought of as three stages: I – the initial acceleration, II – the ground run up to flying speed, and III – the liftoff and initial rotation into the climb.

The rudder on all gliders is ineffective until some measurable airspeed is reached. The handling of the glider has to consider whether it has a nose skid or wheel, or a tail wheel that can help keep the glider straight while on the ground. The differences are considered later in this chapter. Once the rudder becomes effective, Stage II of the takeoff is reached. Now the rudder is used to keep in line behind the towplane.

After taking off, the glider and towplane will often stay close to the ground for a few seconds before rotating into the climb. This is Stage III when, to prevent the glider moving out of line behind the towplane, the glider should be yawed (crabbed) or banked slightly to correct for the crosswind. When the correction has been made the yaw string should be straight! This is easier said than done, because it is not easy to fly sideways over the ground, keeping the yaw string straight and the glider in line with the towplane all at the same time. On runways that are narrow, it will be necessary to remain in position over the runway (i.e. to the side of the towplane that may have rotated into wind so as to fly parallel to the runway centre-line) to avoid obstacles on either side of the aircraft. The glider will remain yawed for a little longer to do this.

At winch launch clubs, the above points should be discussed with students, bearing in mind the very quick acceleration and takeoff compared to aerotowing. During winch launches use the rudder to keep straight on the initial ground run, perhaps applying the rudder in anticipation of the crosswind's effect. Note that with an off-centre *cg* hook the rapid acceleration at the start of the takeoff gives a strong pull on the cable, which will tend to yaw the glider to one side; again use the rudder as appropriate.

The landing

The aim of a crosswind landing is to transfer the glider cleanly from the air to the ground. This means that it must touch down while it is not drifting sideways over the ground, and while it is under good control. If it lands while drifting, side loads on the wheel could cause damage. There are essentially two techniques to landing in a crosswind, the crabbing method and the sideslip method. Experienced pilots may use a combination of these two methods.

In both methods the glider must be transferred cleanly onto the ground, in which case these landings will not always be minimum-energy landings.

The crabbing method

During the final approach the glider is crabbed into wind but the glide path will be along the runway centre-line. The amount of the crab should be adjusted as the glider descends, for example as it flies through the wind gradient. No slip or skid should be apparent.

At the crucial point of the hold-off, swing the glider with the rudder so that the glider lines up with the direction of travel along the runway. Then let it touch down immediately. If the touchdown is delayed, the crosswind will start the glider again drifting sideways over the ground. After touchdown, keep straight with rudder. If the crosswind is strong, keep the into-wind wing slightly lowered to reduce the side load on the wheel.

The advantage of this method is it may be used in very strong crosswinds, but care is needed as the pilot has to judge when to kick the glider straight with the rudder just prior to touchdown.

Note that as the glider is yawed to line up with the direction of travel over the ground, the into-wind wing will tend to rise (secondary effect of rudder). The student will have to control this, and as stated above, keeping this wing slightly lower will allow the glider to slip towards the wind.

The side-slip method

With this technique the glider is lined up with the runway (or direction of travel over the ground) and the amount of the slip is adjusted to compensate for the crosswind. The amount of bank is usually not as steep as when doing a sideslip to lose excess height, so the glider may usually be safely landed with this smaller amount of bank. Caution is needed with low-wing gliders that have little dihedral as the wing tip could come too close to the ground. In these cases the bank angle must be reduced prior to the flare and hold-off, and some crab angle might be needed to prevent drifting sideways over the ground.

Other than the fact that the glider is approaching with a certain amount of sideslip, the flare and hold-off are continued normally; the into-wind wing is kept slightly low following the touchdown as before, and as the glider comes to rest the pilot should lower the into-wind wing if possible. The advantage of the method is it is easiest to use in light winds – its disadvantage is that with low wings there is not much ground clearance. Also, this is not a good method to use if the glider shows poor sideslipping characteristics. A golden rule when flying in crosswinds (and at other times!) is to:

Always allow adequate space on either side f the takeoff and landing paths.

Illusions created by drift

The effect of the wind on the path that the glider makes over the ground can be quite noticeable at low altitudes. 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 much more than doubled. This effect is obvious when flying at the lower heights usual in the circuit.

Flying across a strong wind will make the glider appear to be crabbing, while the ball and/or the yaw string are centred. Such effects are not very noticeable at high altitudes because the apparent movement over the ground is too small to be noticed. These effects become important in circuit flying, when it is essential to maintain speed and to fly well-coordinated turns.

The turn onto the diagonal and base legs in a strong wind will cover more ground than a similarly banked turn in a light wind. Explain that as the student turns, he will increasingly appear to be drifting or skidding outwards as he makes these turns.

Start the turn onto the diagonal leg a little sooner, therefore, to compensate for the first effect. However, the skid can be an illusion as the drift is *over the ground*. The pilot may be flying perfectly with no slip or skid, but peripheral vision is translating the drift over the ground into a feeling that the glider itself is skidding through the air. This is particularly noticeable on the base leg (the glider is lower and is now at right angles to the wind). There is a greater or lesser tendency by many pilots to then apply rudder to try and remove the apparent skid, ie. rudder towards the wind. This is dangerous, especially when low and in turbulent air, and could lead to an entry to a stall/spin situation. Watch for this, and when flying onto the base leg, check that the yaw string is straight.

The apparent skid as the glider crabs along the base leg becomes more noticeable as height decreases, and can lead a pilot into applying too much rudder also for the final turn. Again this is accentuated in strong winds. Students should be taught to fly well-coordinated turns, and to resist the temptation to apply too much rudder input to tighten the final turn. Relate this back to how a spin is initiated, particu-

larly from a too-slow turn. Again mention the wind-gradient effect, which is not present when practicing spins at higher altitudes, but is always waiting to grab the weary pilot at the end of the day as he approaches to land.

AIR INSTRUCTION

Crosswind takeoffs

A crosswind takeoff is no particular problem for most gliders with a nose hook but begins to become difficult with a *cg* hook because there is no straightening effect from the initial pull of the cable or rope. On some gliders the *cg* hook is not on the aircraft's centreline so that there is a slight yawing moment applied when the rope tightens. This helps or hinders depending on the wind direction.

Glider positioning relative to towplane

Position the glider slightly to the upwind side of the towplane as required, and ask the wing runner to hold the into-wind wing lower than the other wing. To avoid pulling back on the wing and causing a swing into the wind, the glider pilot may prefer the wing runner to hold the down-wind wing. Explain this to the student at a suitable time, even though the normal practice with the two-seaters may be to hold the wing on a certain side of the runway irrespective of the wind.

Fixed tail or nose wheels

Gliders with fixed tail wheels should be held with the tail firmly on the ground for the start of the takeoff run, to get the benefit of the steering by this wheel. Once the rudder becomes effective the tail can be lifted and the takeoff continued normally. Most modern two-seaters, such as the DG-505, Puchacz, the ASK-21, Twin Astir, and PW-6 have fixed nose wheels which also afford some steering effect for the initial acceleration. The Blaniks (tail skid or castering tailwheel) do not give this initial steering and must be steered from the start with the rudder. Once airborne it is important to prevent a sideways bounce on the runway, hence the need to have adequate speed before allowing the glider to lift off.

Note that single seaters are prone to problems with crosswinds and the points made in this section can be usefully made when briefing a pilot who is converting to a single-seat glider.

Practice crosswind landings first at altitude

Crabbing approach and hold-off

When flying at release height or after climbing in a thermal or on the ridge, and before returning to the field prior to attempting a crosswind landing itself, instruct the student to select a reference line on the ground, at right angles to the wind, to simulate the runway. Then instruct him or her to practice an actual crabbing approach and hold-off. It will be difficult to visualize the correct amount of crabbing needed, but going through the exercise at a safe height, and then kicking the glider straight with the rudder will show the student what to expect on the actual landing.

Sideslip approach and hold-off

Repeat with a sideslip approach. Here, the correct amount of sideslip, which is usually not very steep, will be apparent when the glider no longer drifts sideways over the reference line. Remind the student of this when he is doing the actual approach and landing.

Illusions created by drift

Take the opportunity to point out the **illusions created by drift** during the diagonal leg and particularly the base leg when the wind, particularly in strong winds, is more directly from the side of the glider. Then ask if the student notices the tendency to use too much rudder for the final turn. Do this whenever there is a strong wind – it does not have to be a crosswind.

ADVICE TO INSTRUCTOR

The crosswind landing is an important part of a pilot's ability and it should not be treated lightly. Whereas the pilot can get help in a takeoff from the pull of the towrope, and by positioning the glider slightly on the upwind side of the towplane when on the ground, he has no such help when landing. Both the crabbing and sideslip methods should be taught. It requires finesse to balance the crab or slip with the crosswind, so plenty of practice is needed.

The sideslip method for the hold-off and landing is less appropriate with low-wing sailplanes or sailplanes with a low dihedral angle. Most two-seaters have ample wing clearance. Therefore at the last part of the approach, as the pilot begins a normal flare and hold-off, the angle of bank must be reduced slightly. Care must be taken to touch down cleanly, as the glider will begin to drift if it is held off too long. A skidding touchdown should be avoided.

Most trainers have their *cg* ahead of the wheel (the

Blaniks are an exception). This reduces the weather-cocking tendency once on the ground because of the substantial side area of the fuselage ahead of the main wheel, and with the nose wheel on the ground to help steer straight. The rudder is sufficiently powerful usually to keep straight in strong crosswinds when the glider first touches down. The inertia of a glider with the *cg* ahead of the wheel will also tend to keep the glider straight as it is braked since the mass of the glider is in front of the braking force. On sailplanes with the *cg* behind the wheel the tendency to swing is accentuated because the *inertia effect*, which is quite powerful, adds to the weather-cocking effect. This is particularly noticeable in light crosswinds when the inertia effect can be larger than the weather-cocking effect. Any swing must be corrected very quickly. If the sailplane has a fixed tailwheel instead of a skid, keeping the tail firmly on the ground will help to keep straight. The wheel brake can play a part too, because if it is used too enthusiastically the effect is to lift the tail wheel, which loses its steering effect (e.g. on the Blaniks and IS-28 twin Lark) and any bad swing could result in a ground loop.

There can be several difficulties that pilots have with crosswind landings. Trying the exercise too early in their training can make the student apprehensive because of the closeness of the ground. If the student is not yet good at judging a normal flare and touchdown, a crosswind approach and landing attempt is likely to overload the pilot. Obstacles close to the ground will add to the workload, particularly if the wind is tending to move the glider closer to that side. It will certainly help to practice a crosswind approach by simulating such an approach at altitude first, before doing one at the end of the flight.

POST-FLIGHT REVIEW

Take the opportunity to review crosswind techniques whenever there is a crosswind. Include a discussion of the limits, as published in the glider's operating or flight manual, which might contain some special crosswind handling recommendations.

Although you will be practicing by taking off and landing along the runway centreline, there is nothing wrong with landing more into wind, as conditions allow. Such landings should be practiced first with the instructor also in the glider. Safety must come first, and if there is more glider activity on the field, extreme care must be taken if an abnormal procedure is to be practiced.

When flying in strong winds, pilots will be adjusting their circuits to fly the diagonal and base legs closer to the airfield boundary. Point out to your students that they can anticipate having to do the same, in fact they can learn by observing others. At the same time this gives you the clue that illusions created by drift may be covered usefully on your instructing flights!

CHAPTER B15
SPINS

OBJECTIVES

To teach the student to recognize, to avoid, and to recover correctly from a spin; in particular to teach the student the situations under which spins are most likely to develop so that they may be avoided.

MOTIVATION

Learning to recognize the symptoms of a spin will allow the pilot to prevent a full spin, and learning how to recover properly will allow recovery with a minimum loss of height. Learning to recognize and to do full spins and precision recoveries (for example, onto a heading) will improve pilot ability and confidence.

Unfortunately, teaching recognition of the symptoms alone has one serious weakness: in most cases of truly accidental spins there is *no warning* that anything untoward is about to occur. This might seem a strange argument but the evidence is in that a glider can be made to do a fully-developed spin quite easily without any of the *traditional* warning symptoms being present. It is therefore essential that the student be taught the full spin, and the several situations and the conditions that lead a glider into spinning.

PREPARATORY GROUND INSTRUCTION

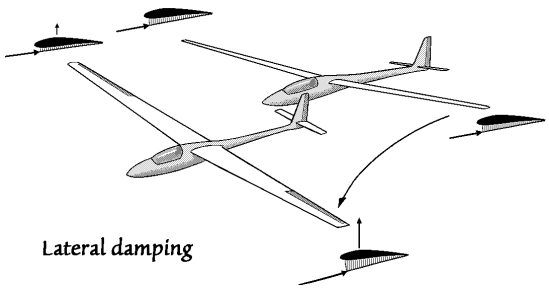
Mechanism of a spin

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, so it rolls, yaws, and pitches at the same time, while descending. But first, a review of stalls with your student is in order before the spin itself is discussed, because a glider will not spin without first being stalled.

As discussed in Chapter B5 under Stability, an aircraft in normal 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 will tend 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, because 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, 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 critical stall angle) is increased even more by the downward motion, the wing stalls more completely and it tends to drop even faster. Meanwhile the other wing that is now rising has a smaller angle of attack, and it may be developing some lift. The net effect is to allow the glider to roll more towards the lower wing. The down-going wing develops more induced drag than the other wing, and this effect of unequal drag yaws the glider now towards the lower wing. Unless the glider's wings are unstalled the rolling tendency will continue (auto-rotation). Because the glider is stalled the nose also pitches down, the glider now assumes a more nose-down attitude and a constant speed, so that the spin develops from a complicated motion of simultaneous rolling, yawing and pitching. The glider follows a helical or corkscrew path downward while it rotates around a vertical axis. The pitch attitude varies from fairly flat to steep, with speed and load factor, or *g* forces, remaining fairly steady. This is what is known as the fully-developed spin.

Once unstalled, the glider will stop rotating. The glider is again controllable. This means that if one wing starts to drop when the glider is approaching a stall, the student should immediately lower the nose to reduce the angle of attack, and he will instantly regain lateral damping and hence control. This avoids the stall and possible spin entry.

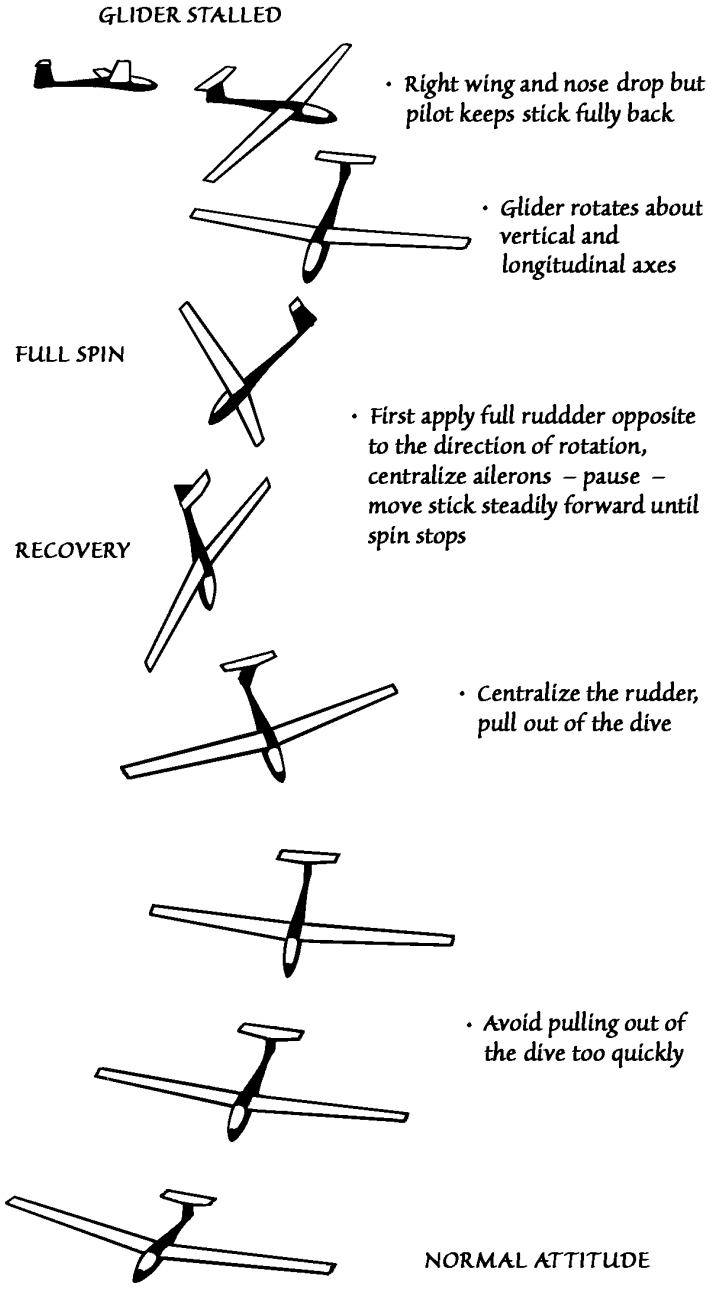


The location of the centre of gravity of the aircraft has an important effect on the spinning characteristics. Most gliders will refuse to spin with the *cg* at the forward limit, and will spin readily if the *cg* is close to the aft limit. Some gliders will spin quite differently with the *cg* at the 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 CS-22 Airworthiness Requirements (replaces JAR-22) that gliders will recover from a fully-developed spin when the pilot uses the *standard recovery procedure*. All modern gliders are type-certified to these requirements. However for a number of gliders the manufacturers may specify variations of the recovery procedure. If your club has such gliders in its fleet, include both the standard recovery sequence and the manufacturer's variation with your students.

A spin may develop from a wing-drop stall, either in straight flight or in a turn. If recovery action is not taken immediately, auto-rotation will start, and simultaneously there may be sufficient drag to start the yawing movement toward the down-going wing. A full spin will soon develop. In some gliders this behaviour may be seen during a stall exercise, when one wing drops first. In both cases (in level flight and in a turn) there will be the usual stall symptoms but in a thermal under rough conditions, or at higher angles of bank, these symptoms may not be noticed. The spin avoidance recovery is the same in both cases. Several later exercises will look at this behaviour of gliders in some detail, so as to develop an awareness in the student pilots to assist them to recognise the situations that can lead to, and hence to avoid stalls and spins.

Recovery from the developing spin (the wing-drop stall)

To recover from a wing-drop stall that is the prelude to the full spin, the wings must be unstalled immediately. As soon as the wings are unstalled, lateral damping is restored and the tendency to roll off into a full spin is checked. Use of the rudder should be confined to that amount necessary to prevent any yaw developing as the pilot levels the wings (using coordinated stick and rudder after the wings are unstalled). No attempt should be made to *pick up* the dropping wing with the secondary effect of rudder because this could be counter-productive. The glider might yaw excessively, will feel awkward to handle and usually greater height losses occur. There is also the danger that the glider will go into a spin in the other direction (also see later spin avoidance execises). The recommended technique for gliders with their long wings is to first unstall them, lateral damping returns, the rolling stops and the glider can be flown again immediately in a coordinated manner.



The full spin recovery

The recovery from the fully-developed spin is different from that above, and this must be clear to the student. The full spin demands a specific recovery technique, and all pilots must understand it. Check the aircraft manual of the aircraft you are flying for the recommended technique. The standard method of recovery from the spin is:

- apply full rudder, *against the direction of rotation*, and centralize the ailerons (stick to the centre, but not immediately forward – see next paragraph), then
- pause slightly (only a short pause of about half to one second is needed),
- move the stick steadily forward until rotation stops, then
- centralize the rudder, **look up** and
- pull out of the dive.

If the speed starts to build up excessively, start the pull up earlier, or be more vigorous in the pull up (see notes opposite in *Recovery and rapid speed increases*).

Apply the rudder first, as this will reduce the rate of rotation. Because of the reduced inertia effects of the (forward) pilot and tail masses as the rotation slows, there is a marked nose-down pitching effect. This helps unstall the wings. On some gliders the downward movement of the elevator tends to blanket part of the rudder and this reduces its effectiveness. There are some V-tailed gliders in which full elevator authority is not possible with the stick forward. Because of both these effects therefore, teach application of full rudder first, before the stick is moved steadily forward to unstall the wings. The rudder alone is insufficient to recover all gliders from a full spin, hence the elevator must be used in combination. If you doubt this try an older glider or a modern sailplane that spins readily – you may be surprised as it enters a spin in the opposite direction (see also later exercises on spin avoidance)!

When the spinning stops the rudder should be centred immediately, otherwise a spin in the opposite direction may be started, especially if the stick continues to be held fully back. On the other hand if the stick has been moved forward there is little risk of the aircraft remaining stalled.

During a spin the ailerons tend to be deflected by the airflow, so they must be centred deliberately during the recovery. Similarly the rudder can be deflected by the airflow to the maximum limit (in the direction of the spin) so that the force required to deflect the rudder fully in the opposite direction is *much greater* than in normal flight. The student should be told why this is so, because he may think that a normal force is enough to obtain full rudder deflection against the spin.

Pulling out of the dive completes the recovery from the spin. Some of the height lost in the spin can be regained by climbing as the speed reduces, pushing over as the speed returns to normal. And finally, but not least:

Emphasize the importance of a **GOOD LOOKOUT** at all times!

Recovery and rapid speed increases

Situations involving severe nose-down attitudes have the potential for rapid and potentially catastrophic speed increases. If speed control becomes an issue the preferred control technique is a smooth but rapid pull out at the *buffet boundary* or 4 to 4.5 positive *g*, whichever arrives first. This ensures a rapid recovery to level flight with minimum height loss, while the induced drag associated with the higher *g* will limit or reverse any further speed increase. Minimize roll inputs during the pull out and use a lower *g*-loading if the particular glider has a maximum design *g*-rating below +5.2*g*. Use of terminal airspeed limiting airbrakes for speed control in this situation has a number of disadvantages, so it is not advised. These include considerably lower *g*-load available for pull-out, higher cockpit workload, greater altitude 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.

Situations that produce inadvertent spins

There are several situations that can lead to a glider spinning, and these 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 flying too slowly, possibly in turbulent air, when misuse of the rudder at the stall causes a spin.
- While tightening the turn onto final having

flown beyond the runway centreline (Pear turn), or

- When suddenly tightening a turn in a thermal with inadequate airspeed, and the glider spins; and
- After a launch failure when, immediately following a winch-launch cable break or a rope break, the pilot attempts a low-level turn with the airspeed still too low, and the glider spins.

Very few pilots recover from an inadvertent low-level spin;

Stall/Spin recognition and avoidance are the main goals of these exercises.

It is perhaps easy to demonstrate a spin from flying straight and level with the speed being reduced steadily. Because pilots will more typically enter a spin inadvertently from one of the above situations, the training for spin competency and spin avoidance should concentrate on these situations. If all of us can remember these situations, we will be able to avoid them. This is the first line of defense, and is really a case of prevention being better than the cure. Typical training considerations are described in the following sections.

Flying too slowly while thermalling

The first situation occurs when the pilot is flying too slowly and is concentrating on climbing in a thermal. This can lead to an unaccelerated spin, however few pilots actually enter a spin from a thermalling turn; they can and do get to the wing-drop stall, but fix this instantly by relaxing the back pressure on the stick. The wings are unstalled, lateral damping is restored and the tendency to roll into a spin is prevented. This can happen often in a soaring season, and many pilots thus prevent themselves from entering a fully-developed spin.

During the turn onto final approach

This second case is more dangerous, and occurs if the pilot is flying too slowly near the ground, and during the final turn applies too much rudder input. This happens because the glider appears to be skidding because of drift in a strong wind: therefore the pilot tends to overuse the rudder. Or it could be that he is merely trying to tighten the turn, again by using too much rudder input. This phenomenon occurs when a pilot is low to the ground and it is a human intuitive tendency next, to use too much rudder input and not enough bank for the turn.

A spin also can occur because the pilot is trying to stretch the glide and is therefore slowly losing speed by trying to raise the nose a bit; or a spin could be caused by a combination of all the above factors. The student must be taught that this final turn, of all turns, must be well co-ordinated and flown at an adequate approach speed. Flying too slowly low down with the wings banked across the wind gradient and applying too much rudder input will easily produce a spin, even if the glider type is difficult to spin at higher heights (where there is no wind gradient).

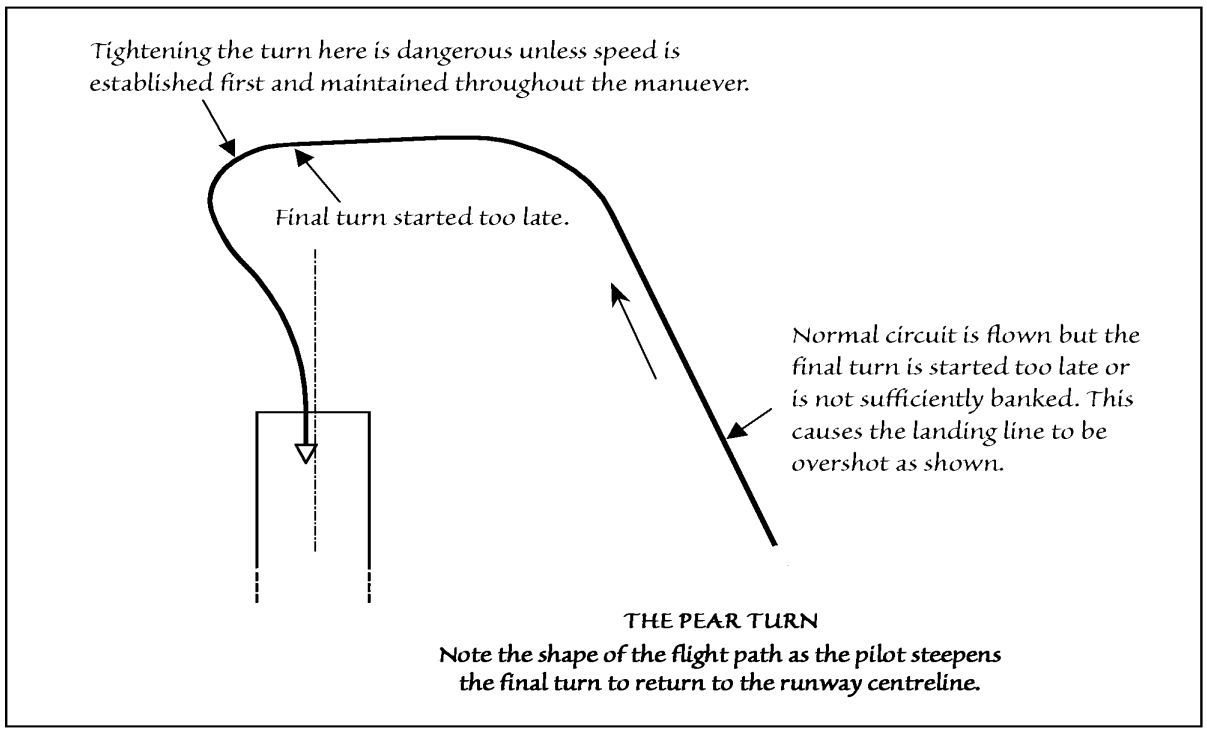
Note here that in real life the spin entry is more subtle than the above suggests. In reality the nose is raised a tiny amount and nothing registers as abnormal in the pilot's mind. This is a crucial point, because *failure to recognize* the key points in any developing emergency will take the pilot rapidly beyond the point of no return.

The Pear Turn: tightening a turn onto final, or in a thermal

An inadvertent spin can occur during the final turn when the glider has overshot the runway centre-line, and he/she tightens the turn with overuse of the rudder and not enough airspeed. A pilot will typically run into this when he has returned from a long flight, it is the end of the task and he has relaxed too much before completing the flight. All pilots should be aware that this factor is present, maybe not for the student who returns say half an hour after takeoff, but he or she should be taught about this none-the-less. This is a situation, then, that you should teach the student to anticipate and hence try to avoid.

Having flown beyond the runway centre-line, the pilot has to tighten the turn to get back on the centreline. This has now become known as the *Pear* turn (German: *Hundekurve*) and is shown in the illustration above. The speed may have reduced to marginally above a safe maneuvering value and the pilot tries to tighten the turn. Similarly it can happen to a pilot who is on final approach and who changes his mind at the last moment about where to land. Or it could happen higher up, to the pilot who is slowing down from a higher speed, and who enters the circuit with abrupt control inputs. In either case he is caught out.

A second situation of a tightened turn is while thermalling, 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 angle of bank, particularly if the pilot is pulling back hard on the stick to tighten the turn. During this attempt to increase the



THE PEAR TURN

Note the shape of the flight path as the pilot steepens the final turn to return to the runway centreline.

bank angle, the attitude of the glider will have appeared quite normal to the pilot. He 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 at above the 1g stall speed. Again, the recovery is normal, either lowering the nose to unstall the wings at the initial wing drop stage, or if the full spin has developed, using the full spin recovery sequence.

Recognizing the onset of a spin early is very necessary so that the pilot can prevent a full spin developing. Taking action early, automatically, and instinctively, using their newly-learned reflexes, is what we are aiming for. Knowing how the glider reacts at various stages of a spin will increase his confidence to be able to handle any situation. Better still, teach all students to avoid the low and slow final turn, and the Pear Turn!

Launch failure, cable break and rope break recoveries

The next two situations are less obvious; the first is equally as dangerous as the low final turn. Many pilots have a built-in desire to return to the takeoff point and this can be hazardous. If the winch cable should break during the steep part of the climb the glider will lose speed rapidly, even if the pilot takes immediate action to *lower the nose*. Pilots who were initially trained on aerotow but who are now winching are the most susceptible to this low-level spin, described below.

The cable breaks and the glider pilot lowers the nose firmly. It takes some seconds to pitch down, and as the glider achieves the normal gliding attitude the pilot banks steeply to turn around to try and land back on the runway at the takeoff point. Chances are that the airspeed is well below the normal or 1g stall speed, however, because the glider is in a reduced-*g* pushover, the wings do not stall immediately! As the glider banks, the pilot also has a tendency to apply too much rudder (a strong tendency when low, as discussed above) perhaps to *help* the turn. He also pulls back on the stick to *pull* the glider round in the steeper turn. It is academic now, knowing that the glider is in a spin so low! If the glider does not spin readily, like the 2-33 or the ASK-21 without tail ballast, it will lose a lot of height in the spiral dive that develops instead. So it is vital to have thorough conversion training to the winch for pilots who were initially trained on aerotow because they will be flying sailplanes that will spin easily from this type of attempted turn.

In the case of a rope break or early wave-off on aerotow, the glider pilot could find himself facing an immediate landing in an unfamiliar location. If he tries to make an immediate turn to land back on the airfield, chances are that he will run into the same sort of trouble as the winch pilot above. This can be more of a hazard if the towplane has been struggling with engine problems, in which case the airspeed at

the release may be much slower than normal. The glider pilot will not necessarily have noticed this because of concentrating on keeping position. Hence it is very important to emphasize with students that they must check the airspeed immediately and if it is low, they must lower the nose to below the normal approach attitude to ensure they regain adequate speed as soon as possible. If the pilot starts a steep turn before the speed has been regained, a stall and spin is likely to occur. Such accidents have occurred, so beware of low speed maneuvering. Always advise all students of the dangers of not maintaining adequate speed, particularly when close to the ground in these typical situations.

General

The essential parts of the spin lesson are that the student should learn the situations that can lead to a spin, and to recognize the onset of a spin very early so that he can take correct avoiding actions automatically and instinctively without thinking too much about it.

Finally, the student should be taught to recognize and to do the correct recovery from a fully-developed spin from each situation, and to recognize each one for its dangers particularly near to the ground. Remind your student about recovery sequence variations that may be receommended in the pilot's operating handbook or glider manual. Point out the differences in response under a wind gradient, which we cannot show at higher heights where these spin situations will be explored. Later when familiar with spinning, ask the student to do some spins and to recover onto a given heading. This is the precision spin and is a useful exercise to improve skills and confidence in handling the glider. It could help one day if a spin starts close to a mountain ridge when recovery should be away from the ridge!

AIR EXERCISES

General

The spin exercises can be divided into two stages, requiring several flights overall. The first stage covers full un-accelerated spins and recoveries from situations such as a slow final turn, the main problem area. The second set of exercises is designed to proof the pilot against the inadvertent spin and includes accelerated spins such as those from an attempt to turn quickly after a low-level launch failure.

The student should not be apprehensive about the spin by the time he is ready to try one. He should have had a reasonable amount of flying slowly, and should be used to the wing-drop stall and immediate recovery to prevent the stall from developing further into a full spin. Hence start from a review of the symptoms of the stall by doing a bit of slow flying.

Airmanship

For these exercises it is important that the *cg* position is within limits. If a light-weight instructor is flying in an attempt to reproduce a good spin, it is very important to ensure the cg is forward of the rear limit. Ideally it should be at the position that the student will experience when first flying the same glider solo. Extra ballast may have to be carried to ensure this, in which case it must be securely fastened so that it can't move during flight.

You must allow sufficient altitude for a safe and adequate recovery. Full spins should not be started lower than 3000 feet above ground, and recoveries must be completed by 2000 feet above ground. Before doing any approach to the spin, full spin or similar spin-avoidance exercise, the CALL check must be done to make certain that no other aircraft are in the locality.

Approach to a spin exercise (wing-drop stall)

After the CALL check, take over control and ask the student not to follow through (unless he is comfortable with doing wings-level stalls) and enter a slow gentle turn. Gradually slow down, the nose will hardly need to be raised to notice the symptoms of the stall. In this case we are reproducing what looks like a *normal* situation, but from which an un-accelerated spin might occur, see also below under the full spin entry. If one wing does not drop at the stall, yaw the aircraft slightly to induce one wing to drop. Make a note of the height. As the wing drops at the stall, autorotation will now start, and simultaneously there may be sufficient drag to start the yawing movement toward the down-going wing; this is the prelude to a full spin.

Recovery from the wing-drop stall

To recover, *lower the nose* immediately to unstall the wings. As soon as the wings are unstalled, lateral damping is restored and the tendency to roll off into a full spin is checked. Use of the rudder should be confined to that amount necessary to prevent any yaw developing in the direction of the dropping wing. Note the height lost after the recovery to level flight.

Following a demonstration the student should be asked to perform the exercise. To recover, use the

command "lower the nose" to your student – he will know what to do! Watch for the student trying to *pick up* the dropping wing with the secondary effect of rudder or even by using the ailerons. Use of the rudder could be counter-productive as greater height losses usually occur.

Trying to level the wings with the ailerons while the wings are stalled may cause the lower wing to drop further. Watch for any tendency by the student to use ailerons to lift the downgoing wing; now is the time to catch this before it becomes a bad habit. This is quite common and is caused by the student's normal reflexes. We are now trying to develop some new reflexes, in this case to allow the glider to speed up first, i.e. to fly again before levelling the wings normally.

The full spin entry from an under-banked over-ruddered turn

Try to give a convincing demonstration before you permit the student to perform a full spin and recovery. For the first demonstration, ask the student to hold onto the shoulder straps. The first demonstration should be of a few turns, during which the constant speed, full rearward position of the stick and constant g-load must be pointed out.

To relate the spin to a realistic flying situation, imagine you and the student are approaching the final turn and the glider is being flown too slowly: obviously we will do this at a higher than normal height. Enter a gentle turn and then steadily reduce the airspeed by raising the nose a very small amount, and by applying 10 to 20 degrees of bank. The glider will become established in a turn, with nothing apparently wrong. Now rudder may be misused, by using it deliberately to try to increase the rate of turn. This is the situation of the pilot trying to stretch the glide towards the airfield at low height and with the runway off to the side, trying now to turn toward it. Paint this picture for the student! Imagine that you are low and are reluctant to bank the glider more!

If we keep applying rudder and at the same time keep moving the stick back we will find that the glider will lose speed *at a constant pitch attitude*. Nothing appears wrong to us in the glider, but it is slowly losing energy ... As the rudder is applied more, the drag is further increased, and the nose drops a bit as the glider seeks its trimmed speed, but we resist with moving the stick further back... the glider is drained of energy. We are now very close to the stall...

In spite of the near normal attitude, the glider starts to lose lateral damping. A wing goes down a little, very high drag is produced at the wing tip, the nose yaws more strongly (the last warning that something is wrong), we apply just a bit more backward movement to the stick and next thing the glider is pointing at the ground in a rapidly developing spin. *This is how low-level spins happen in real life.* The pilot will be achieving some sort of coordination between rudder and elevator, with increasing deflections of both; the glider flies at a reasonably constant rate of turn and at a constant attitude, and it offers little warning of the impending spin. It will enter the spin smoothly, usually with no warning at all. It is one of the most insidious traps in our sport.

If a full spin does not develop, you have performed the next exercise – see below! Say so, and go through the spiral dive recovery. Then review the spin entry and recovery, and then try the spin again. When the student first tries a full spin, concentrate first on the recognition of the spin, and after only half a turn or so, recover, each time going a little further with the spin entry before starting the recovery.

Spin attempt but glider enters spiral dive

Repeat the above spin demonstration, but allow the glider to transition into a spiral dive. Point out the increasing speed and increasing *g*-loads and compare them to the spin. Now recover from the spiral dive – reduce *g*-load, level wings normally, and ease out of the dive.

Further spinning exercises

The following exercises have been devised to proof the pilot against the spin from a variety of situations, and will normally be given later in training when the pilot is comfortable with the full spin and recovery as practiced and described above.

- **Changing effect of rudder at the stall** – misuse of rudder at the stall causes a spin,
- **Spin to the left off a right turn** and vice versa,
- **The pear turn** – rapidly tightening the *final turn* at normal speed after overshooting runway centreline,
- **In a thermal** when the turn is tightened suddenly in stronger lift without first increasing the airspeed, and
- **After launch failure**, from attempt to turn at normal gliding attitude after a rope or cable break, when the pilot tries to initiate a turn before adequate speed has been regained.

Changing effect of rudder at the stall

Start at the normal gliding attitude and speed with the student's hands and feet off the controls. Apply full rudder one way, then wait 2–3 seconds, and ask the student to describe what happened. The reply should mention lots of yaw and not much roll.

Repeat at 1 knot above the 1g stall speed, with the wings level and the glider at a steady speed. Apply full rudder and wait... ask how much yaw and roll this time (abrupt and lots of roll, not much yaw). Recover of course as soon as possible to unstall the glider. This is a very powerful demonstration that misuse of the rudder near the stall will make the glider spin!

Spin to the right off a left turn (and vice versa)

Start from an under-banked turn to the left. As the glider is slowed and as the left wing is allowed to drop, slowly apply full aileron to try to lift the wing and full rudder to prevent the yaw toward the lower wing; as the glider slows to the stall buffet, it may spin to the right. Use of the rudder here is in effect anticipating the spin – it is applied too soon, and this induces a spin in the opposite direction! Emphasize that in an inadvertent stall the *first action must be to unstall* the wings of the glider. In any stall situation, the same recovery action is used for wings level or a wing drop at the stall.

Spin from a pear turn, and off a steep turn in a thermal

The first case refers to a rapidly tightening *final turn* at normal speed after overshooting the runway centreline or landing line; the second situation occurs from a well-banked thermalling or medium but uncoordinated turn. Both are to be avoided of course.

Start with a 45 degree bank at close to the stall speed for that angle (about 52 knots for the L-13). Draw the student's attention to the fact that the speed is well above the *normal* or 1g stall speed. Do not explain what you are doing next. While maintaining the bank angle and attitude with ailerons and the elevator normally, steadily apply more rudder (you may also have to pull up more on the elevator). The glider will enter a spin. Recover in the normal way.

Explain that suddenly tightening a final turn or trying to thermal tightly low down with inadequate airspeed, is likely to result in a spin that cannot be recovered from before hitting the ground. Hence in any low-height situation, if the wing starts to drop the recovery action must be to unstall the wings as quickly as possible, and then to level the wings normally when flying speed is regained.

Spin after launch failure

Describe the scenario: from an attempt to turn at the normal gliding attitude after a rope or cable break at a low height, when the pilot tries to initiate a turn, and adequate speed has not been re-established. Simulate this by raising the nose as appropriate (aerotow or winch climbing attitude). As the speed decreases to just above the stall (remember, we are simulating a slow failure of the towplane engine, or a similar winch failure/cable break), call "break" and positively lower the nose to the normal gliding attitude. As soon as the attitude *looks normal*, start a medium coordinated turn and try to maintain the same normal gliding attitude. The glider will immediately stall and a wing may drop if the controls are held for the intended turn. Allow a spin to develop when demonstrating, and recover (from the spin or spiral after it is correctly identified). Note the height lost.

Use this exercise to emphasize that the glider's attitude alone is not a reliable indicator that a turn can be started safely. The student should try this situation, but, when the glider starts to enter the spin, recover immediately; note the height lost in this case. Repeat again, this time making sure that the glider regains adequate speed before rolling into a turn. Also remind the student that it takes a noticeable amount of time to regain speed after a launch failure; this was covered earlier under rope and cable break recoveries (see Chapters B10 and B11).

ADVICE TO INSTRUCTOR

General

The spin is a most important lesson to be covered, and it must be related to realistic situations such as the too-low final turn. It also illustrates the need for adequate speed in the circuit. If the speed is well above the stall speed, even for the well-banked final turn, the pilot will be safe and will not stall/spin. Don't forget though, that sailplanes with their large wingspans are particularly susceptible to overbanking in wind gradients. Our students should develop a good recognition of all the situations that lead to a spin, and have no apprehensions about spinning. Students will also be taught to develop new reflexes, to be able to avoid spin entries from a variety of different situations, and to recover quickly from both the wing-drop, and the full spin.

Because students often take a long time to recognize and to recover from a full spin a great deal of height can be lost. Teach the student to recover with a

minimum loss of height.

Many pilots enjoy spins. These people should be encouraged to be increasingly accurate in their spin recoveries, and to try and avoid situations that can lead to spins in the first place. They must always be careful about doing a thorough CALL check before starting spins.

Reproduce realistic spin situations

It is important to simulate a realistic situation under which an accidental spin occurs, when demonstrating the first full spin to the student. What we should first try to reproduce will be the low-level turn at a decreasing airspeed. This is the situation that pilots can get into when *stretching the glide* while they are trying to turn onto final approach and also are reluctant to bank the glider beyond a shallow angle of bank.

Later flights should be used for performing accelerated spins such as the Pear Turn on final approach and the accelerated spin when thermalling. In all cases the pilot can make these turns or maneuvers safely, but only if he has *sufficient speed* and height to do so. These spin situations should be demonstrated at a safe height. In the case of a winch operation, this must be covered during training following a thermal climb or after a suitable aerotow to a safe height. In the case of conversion training of an aerotow-trained pilot, the training for the cable-break situation must be thorough, as habits relative to aerotowing will have been formed.

Holding off the bank or over-using the rudder to tighten the turn when flying slowly can lead to a stall and wing drop, which can develop into a spin unless quick recovery actions are taken to unstall the wings to stop the auto-rotation. When low a spin can develop rapidly because the wing drop is *helped* in some situations by the wind gradient. Remember the lower wing is in the slower moving airflow over the ground, hence it will be flying more slowly than the upper wing. The glider will be difficult to unbank without stalling the lower wing even more. Tell the student that we don't practice this maneuver close to the ground for obvious reasons, so we cannot demonstrate this effect. However, remind him or her of the effects of the wind gradient because they can catch the unwary.

Experienced pilots avoid spins by early and judicious use of the elevator; the rudder is not used much, in fact its use is confined to applying it just enough to prevent any yaw developing in the direction of the down-going wing. Teach students that they should *not attempt to pick up the wing with secondary effect of the rudder*. Remember that the glider will enter the spin in this situation from a *normal gliding attitude*, and that to get the glider to spin it is not necessary to artificially raise the nose, or to apply a bootful of rudder just as the glider stalls!

The full spin

From the instructional point of view it is essential to be able to perfect the technique that will exactly simulate what pilots do in real life. Remember that what we are trying to achieve for instructional purposes can be produced by a low-time pilot and regrettably even high-time pilots when low to the ground without them thinking, and unfortunately with very serious consequences. Use this exercise to emphasize that no pilot is immune.

This *constant attitude entry* to a spin is perhaps unique to gliders. Because it is one of the main sources of spins to gliders it should be the method that is first used to demonstrate the spin to a student, and the method with which the student will concentrate during practice sessions. Don't forget the other spin situations though; they too catch out pilots, so students should be familiar with them and should fly them at altitude so that they can recognize them easily and perform the correct recovery automatically.

When doing spins it is useful to record the height lost in the maneuver. So have the student note the height before entering the spin. Again note the height after the recovery. The student will be too busy to remember heights or to read the altimeter when first doing spins, so you will have to note and call out the heights. On later flights the student, having been exposed to the need to read the instruments, will begin to do so on his or her own.

It often helps to have the student look *up* at the horizon during the spin; this helps maintain their orientation, and is necessary if he is to recover onto a known heading. Recoveries onto known headings should be encouraged on later flights as a further development of the student's skills.

The nose-high spin entry

There is no doubt that teaching spins from a nose-high attitude is misleading to the student, because it does not represent the inadvertent spin that catches us out. Also it will not provide the student with the protection that he needs in terms of recognition of the pre-spin symptoms and situations. Instead we should concentrate on the unaccelerated spin from

the normal flying attitude. In later flying we must cover the further spinning exercises.

SUMMARY

Never say that a particular glider cannot spin – it may never have been flown in a situation that made it spin. We should remember those pilots who have spun into the ground without realising at all what was happening. Because of this we now require thorough training to recognize the situations that lead to spins. Also we require all students to be knowledgeable about all spin situations, and skilled at handling the glider to avoid the full spin.

Because some two-seaters are indeed reluctant to spin, it is necessary for this exercise to use a two-seater that will spin readily. It is recommended that the Blaniks, Ka-7 and K-13, Puchacz, PW-6, Krosno and the Lark IS-28B2 be used for this spin training. Also, since *cg* position has a lot to do with the spinning characteristics of each glider, care should be taken to ensure that it is always well within the allowable range. Should the glider have the cg at the forward end of the allowable range and be reluctant to spin, a lighter instructor may have to be substituted.

Use of airbrakes during a spin generally has a stabilizing effect but they can cause some pitching motions, which are sometimes bad, and it depends on the glider. The effects of flaps vary with the glider. Generally lowering the flaps encourages spinning, so mention that in the landing configuration on a final turn most flapped gliders are very susceptible and the flaps should not be raised unless the glider has adequate airspeed. Try this at altitude first!

Too many spins on one flight can be disorienting, so limit their number. If climbing between stall/spins, limit the number of attempted full spins and let the student equilibrate again! Spins can be disorienting, more to some people than others.

POST-FLIGHT REVIEW

Leave your student in a confident frame of mind: this may require another flight or two on the same day to cover some aspect of the spin and recovery. These exercises cannot be hurried or glossed over. A thorough understanding and good recovery technique are essential, and will stand the student in good stead for the rest of his flying career.

Problems can and do occur when pilots make sloppy final turns; relate what you have just done to this and the other situations that can catch out the inattentive pilot. For example the inadvertent spin on a final turn is unrecognized because of what looks like a normal turn. The glider will spin from what looks like a normal (slightly nose down) attitude in the turn. Go over the symptoms that will warn the pilot to take avoiding action to prevent a spin in the first place. Mention that the recovery from the spin must include moving the stick steadily forward even though the nose will be quite nose down while in the spin; it is still necessary to lower the nose further!

The position of the c.g. can have a profound effect on the glider's spinning characteristics, so go over this aspect and mention in particular the need to be properly ballasted when solo to maintain the c.g. at approximately the same position as when flying dual.

If using a recovery sequence specified by the manufacturer, mention the need also to be competent with the standard recovery sequence.

It is again useful to review with the student the spin recovery actions, and compare them to the spiral dive, its recognition, and recovery sequence. Having said this, the post-flight review must be positive and not too long: the student will usually have a lot to think about and questions to ask, so listen carefully too.

Discuss safety and HF from flight.

CHAPTER B16
BEFORE and AFTER the FIRST SOLO

OBJECTIVES

To prepare the student for solo flying and to ensure that all necessary pre-solo items have been covered prior to sending him or her on the first solo flight.

MOTIVATION

To build confidence in your student and to give the benefit of reviewing some items while he or she is still flying dual.

ADVICE TO INSTRUCTORS

Approaching first solo

When the student is approaching the first solo stage make sure he or she passes the pre-solo exam. The questions are designed to find out whether the student has fully absorbed important points covered during his or her training, to situations which may be encountered while flying solo, and to cover essential aviation regulations that include air traffic clearances, instructions and procedures as they apply to control of VFR traffic at uncontrolled airports and aerodrome, special VFR regulations, information circulars, and A.I.P. Canada supplements.

Typical examples of the more important flying questions are:

- What options would you have if the tow rope or winch cable broke *below* 300 feet above ground?
- What must you do if the towplane rocks its wings?
- Describe the recovery procedures for the spin; and for the spiral dive. What are the essential differences?
- You have drifted downwind in a weak thermal and are not sure if you can get back to the airfield. What are you going to do?
- Two gliders are 4approaching to land at the same time (specify their relative positions); which has the right of way?
- What are the conditions under which a person may fly gliders as a student pilot? (e.g. documents, supervision, etc).

Rope or cable breaks

As part of the normal training immediately prior to first solo, instructors should carry out at least two simulated and un-announced rope breaks, by releasing at a suitable height for a return to the airfield, see again Chapter B10 under AIR INSTRUCTION, *Rope break exercises after takeoff and at low height*, page B10-6, and Chapter B11 under *Cable break exercise from failed launch*, page B11-4:

- At a height from which a safe downwind return to the runway is possible from aerotow, e.g. above 300 feet, or straight ahead from a winch launch, and
- At a height that allows an abbreviated circuit, e.g. at about 500 feet.

These exercises, from an aerotow or winch launch, will require good judgement and skills on the part of the instructor. Remember that these two exercises should be carried out with sufficient height to reach the airfield safely, yet too low for the student to make a normal circuit pattern. In these two cases, the student glider pilot is expected to carry out the recovery procedure with no hesitation, and to establish a safe maneuvering speed before attempting any turns, followed by landing safely. It is important for you to inform the towpilot of your intentions, and to ensure that no other gliders are likely to conflict with the student making the approach and landing.

Circuit planning and flying abilities

The student should be proficient in correcting all types of poor landings. During pre-solo instruction, if the student consistently makes good landings, the instructor should deliberately spoil some of them, to give the student practice at correcting faults. Before the instructor considers a student eligible to fly solo he must be satisfied that he can readily plan circuits from both sides of the runway, and from unusual positions. A circuit in which the entry is deliberately low should be included so that the student recognizes he is *running out of height* and his or her corrective action is to fly an abbreviated circuit.

The amount of instruction required to get a student to the solo stage will vary, depending on the age and aptitude of the student, the frequency with which the student comes to fly, the instructors' abilities, and other factors. Everyone varies in their capacity to learn, and often the student who is a little slow ultimately makes the better pilot. A student who is sent solo too soon and has an unnerving experience may lose confidence not only in himself, but also in his instructor.

Review of maneuvers

At pre-solo time, review any maneuvers that appear to have been recorded infrequently in the student's PTR. The following are some that you should look

for:

- Sideslips,
- Further spinning exercises, and spins avoidance,
- Cable and rope break procedures,
- Aerotows in rough air, and
- Crosswind takeoffs and landings.

Student's airmanship

Pay particular attention to your student's airmanship at this time. Does he or she maintain an awareness of what is going in and around the glider and on the airfield, and this includes a good lookout technique? It is the student who will be responsible for *all* aspects of his or her later flying, so he should be making all the decisions now. Specific ones to be aware of are:

- Hazards in the takeoff path,
- Dive brakes opening during the takeoff,
- Other aircraft, and the need to realize that the other pilot may not see them,
- Wind gradients, particularly in the calm of the evening,
- His or her airmanship in general, and how he judges and flies the circuit, particularly after a long flight.

The pre-solo and first solo flights

It is preferable that at least one of the pre-solo flights be given by an instructor other than the student's regular one. The last dual flight before solo should be done with the regular instructor; the student will be more relaxed if he does not realize he is in the final checkout stages. If at any time these two instructors discuss the circuit with the student or suggest a course of action, then they should realize that they are making the decisions, not the student pilot!

For the first actual solo flight do not concern the student with too many last minute instructions, but give a word of encouragement, and send him or her aloft on this, undoubtedly the most memorable flight of his or her career.

Conditions suitable for a solo flight

It is the regular instructor's responsibility to ensure that suitable conditions exist for the student's first solo flight. The following are among the precautions to be observed:

Time of day The evening, when conditions are calmer, is often a good time to send a person solo. The lighting can be difficult as the sun gets lower, and it can cause bad reflections in a canopy to give the student a difficult tow – ask the towpilot to avoid towing directly into the sun! As the sun sets shadows get longer, giving a different perspective for the circuit and approach. It can get darker on the ground, but remain adequately light above. A liberal amount of daylight must remain for the anticipated flight and landing.

Weather factors The first solo flight should have suitable weather conditions that are forecast to continue. For example, a first solo flight should not be attempted when a thunderstorm is in the vicinity, or when an impending frontal passage could be reason to shut down the operation soon. A cumulonimbus or thunderstorm can cause abrupt wind changes and turbulent conditions over a fairly wide area, they do not have to be close to the airfield.

In mid-summer we tend to forget that haze can impede visibility and that this can become quite obstructing as the air cools in the evenings. Think very carefully before sending a student solo under hazy conditions when a horizon is not visible.

Traffic conditions At airports where unusually heavy traffic conditions are encountered at some periods of the day, it may be advisable to consider a first solo flight at a later time.

Student fatigue After a lengthy session of dual instruction the student may be so fatigued that it is inadvisable to send him or her on a first solo flight, even though he is performing satisfactorily. Generally speaking, the dual flight preceding a first solo flight should not exceed 20 minutes.

As soon as possible after the last check flight, the instructor and/or the student should securely fasten the straps in the empty seat, advise the student he is going solo and advise the winch operator or towpilot that they have a first solo launch. Make sure the student understands that the glider will trim differently with only one pilot, and that he realizes the extra need for keeping a sharp lookout now that he will be alone.

Legalities Last but not least, the student's student pilot permit must be validated for solo privileges after satisfactorily passing the re-

quired pre-solo exam.

Supervision

All of the first solo flights should be supervised by the instructor authorizing the first solo from the ground. The instructor should have radio contact with the student to provide assistance. In addition, any first solos in a new type should also be supervised by radio from the ground. Circuit/landing phase is critical not to be distracted.

After the first solo

Praise the student for the achievement of going solo (soaking with a pail of water maybe, but think of the cold! Flowers gathered from around the field are a nice touch, but cutting clothes can be unwelcome and unfriendly). Remind your new solo of his student pilot privileges, and the need to remain under an instructor's supervision. Some students might feel that their training is finished when they go solo, and the only time they will need to go back to dual is to be checked out for flying a more advanced type of glider. The student should be encouraged to ask for dual flights any time he runs into any problem, and to cover later training prior to license. Regular dual checks are imperative for the student in the early solo stages, as he could develop sloppy flying habits, which can be hard to break if allowed to go on too long unchecked.

No flight by a solo student should lack purpose. The requirement to sign off on all flights will to some extent cover this, but try to ensure that the exercises chosen for practice are the ones needing the work and are agreed before the flight. In other words, he should not be left to fly aimlessly about, but should always have in mind maneuvers/exercises to practice. A suitable checklist should be used to aid students in covering them all prior to licence.

The student must be convinced that he or she will only become a good soaring pilot by continually practicing in this manner and that a flight during which he has not learned something is a flight wasted. Remind him or her that whereas safe flying was a requirement before going solo, considerable polish must be acquired before he or she can become a Licensed Glider Pilot. A high degree of precision is necessary for later conversions to higher-performance sailplanes, and for carrying passengers and flying cross-country.

POST-FLIGHT REVIEW

Go and congratulate your student as soon as possible after their first solo! And present to him or her your usual club memento (and an *A* badge).

Your student will not be too inclined to listen to adverse criticism, but if something went wrong, it you must discuss it and make sure it is understood. Above all, leave your student in a positive frame of mind, and give a firm reminder that a dual check flight at the start of each day when they come to fly again is a normal club requirement. Later on, they will probably be allowed to fly solo after verbally checking with the instructor who is on duty, and after receiving the required briefing and instructor sign-off for all these pre-licence flights.

CHAPTER B17
POST SOLO FLYING

INTRODUCTION

Although the new solo pilot will be flying solo as often as he can, the instructor will still be involved as the student pilot will remain under supervision. Now is an ideal opportunity to cover some extra areas or areas only gone over briefly so far, and to consolidate lessons learned prior to solo. This chapter therefore covers items and suggested approaches for the instructor to pass on to the aspiring soaring pilot.

PREPARATORY GROUND INSTRUCTION

You can start by asking the pilot whether there are any areas of his flying that he would like to go over with you, perhaps on one of the pre-licence dual flights. You should in any case check the student's PTR and determine the lessons that were covered briefly; there may be some items not checked off, for example. Go over these now on the ground, and plan to cover them in a flight if you feel it is necessary.

ADVICE TO INSTRUCTOR

At this point in a student's flying he will be very happy that he is flying solo, and may feel that he can fly very well, and probably rightly so. However, look back on your own early solo flying and you can probably say that your flying has improved considerably since then. So one of our aims now is to steer the early solo pilot towards constantly improving his and her accuracy.

It is *important* to remember that student pilots may only fly under the supervision of an instructor, even when solo. A briefing is required under the Aviation Regulations, and the authorized exercises (or stages from the PTR) must be shown on the flight daily record sheet and signed off by both the student and the supervising instructor. This briefing should include discussion of the prevailing weather conditions, especially pointing out crosswind conditions, and the wind gradient that will be encountered on the approach. This is easily ensured at a club that requires a *duty instructor* to be present during flying. In all cases when students are flying solo, an instructor must supervise them. Your students will be flying sometimes when you are not there, so it is an excellent morale booster if you follow up when you can with the students that you taught, to ask about how they are doing.

During the student's pre-licence solo flying he or she should be encouraged to have a plan for each flight that will encourage practicing all the lessons learned before solo; such a plan should be part of the club's training program. It would show a sequence for twenty solo flights, interspersed with some dual flights. By the time the student has completed this list, he or she will have covered each maneuver that is in the curriculum, and you or another instructor will have had several dual flights with the student during this time.

Early solo flights should concentrate on practising coordination in turns, lookout techniques, and becoming comfortable with flying slowly and doing stalls and recoveries. Accuracy in flying the circuit together with good speed control is a good objective to suggest to the student. Later flights should include thermalling practice and other advanced exercises such as sideslips, spins, and steep turns. Watch your student's *spin practice* from the ground. These flights should be interspersed with dual flights during which you should review exercises such as sharp stalls, spins and sideslips. Show the student more advanced thermalling techniques, for example.

The Bronze Badge defines an excellent set of tasks that can be the basis for consolidating important exercises such as field selection and off-field circuit planning. Review collision avoidance and the correct use of radio and the airspace around terminal areas also at this time. It is very useful to go over such tasks during poor weather when thermal flights are not possible.

Circuit planning, good lookout and airmanship, use of the SOAR technique and quick but thorough performance of all checklists are all important, and you should audit them on each flight.

The purpose of the dual flights is to *check* that the pilot's abilities match the objectives of the flight and the current conditions. But, more important perhaps, these flights are to provide an opportunity to teach the pilot something more, and to pass on some of your attitudes and philosophies towards safety, soaring itself, and cross-country flying.

Try to instill in your student the desire to improve and to always have an objective for each solo flight. He should be encouraged to take real pride in what he does; you can help by gradually demanding a higher and higher standard and not settling for the minimum. Useful feedback can be given to the student after all flights in a post-flight debriefing, at which time you also will obtain a good idea of where the student might need some more dual prac-

tice. In this process, get your students into the habit of planning their flights by doing their own briefings. Below, the various phases of flight are looked at for ways in which you, the instructor, can help the early solo student pilot improve his or her skills.

Basic flying skills

The pilot's abilities will depend very much on the conditions and the club in which he trained, the types of trainers used, the experience of the instructors and on how often or consistently he came to learn. When they have the desire, people can learn to fly under very different situations. It is now the instructor's job to fill in the gaps and to try to overcome any limitations of the earlier training. Basic flying skills are most important, and the student must be encouraged to broaden his experience, for example he can be encouraged to fly under progressively more challenging conditions.

Launch method

Aerotowing automatically means that the student will receive adequate time for practice of the basic skills, and of the emergency procedures such as spin recoveries. This is not always the case for winch launching. On the other hand, winch-trained pilots will come with good launching skills, and with good circuit and landing abilities. Such pilots will need to be taught how to soar; otherwise they will have to learn by themselves, which is often frustrating and inefficient.

Aerotows allow pilots to take advantage of lift when it suits them. The pilot has adequate time to really develop good handling skills, and he can be taught to pick the next source of lift, for example, and therefore learn to soar as part of basic training. These pilots will have had fewer landings and may never have had a poor landing to sort out. The instructor can help here by *messing up* a circuit and landing or two so that the pilot can be taught how to deal with the inconvenience; it will be too late to try and rescue a poor landing when first solo!

Flying the glider

The main flight problem area is the turn; it is a complex maneuver that requires all three controls to be coordinated. Here we have a new student learning to fly, and we start with the basics, that is the turn. We next proceed to the effects of controls, and we progress to aileron drag. This sequence of lessons gives the student the knowledge required to make a turn correctly; the job of the instructor has been to guide the student's efforts to do it well. How well has he learned?

An accurate turn is a prelude to successful soaring, so practice at accurate turns is important. An interesting point to remember is that most students overestimate the angle of bank in a turn, so they will most likely have practiced at shallow angles. This can occur because, during earlier training, instructors may not have emphasized good roll rates and well-banked turns are desirable goals for flying gliders. A useful method of checking the angle is to time the turn; at 50 knots and at an angle of 30 degrees one turn takes 28 seconds, and at 40 degrees, the turn takes 20 seconds. A simple check, therefore, is to make the student time his turn at a well-controlled speed!

During shallow turns a slight back pressure on the stick is used and if the pilot has become used to making such turns he will have become used to this slight back pressure. When increasing the bank angle, therefore, the turn is very likely to become less accurate as more back pressure is needed to maintain a constant attitude, and from previous habits he may not realize that he needs more back pressure to maintain a good attitude. Rough air makes this more difficult, and will sort out the accurate from the sloppy pilots!

So encourage the pilot to get out of the habit of flying shallow turns by practicing steeper turns, when extra back-pressure will need to be applied. See the flying of 60° banked turns in Chapter B12.

Workload

It is often not appreciated that pilots fly in a relaxed fashion only after achieving a good degree of proficiency at flying by *instinct* and then only when things are going well. When the action gets interesting, the workload can get quite distracting in that the pilot will concentrate on one aspect of the flying to the detriment of all the others. An example is an imminent off-field landing when there is a strong wind, and the height is a bit low, but the pilot is still thermalling and trying to climb. Has the pilot not been keeping track of the height, or is he refusing to accept that the glider is getting very low? The pilot's recognition of the *reality of the situation* is not adequate, and his or her situational awareness has not been well developed earlier.

It is here that his or her earlier training should come to the rescue ... He or she must of course fly accurately and at an extra five knots speed perhaps. He does not need to spin in from this low. What the instructor must try to teach the student is to start planning for this off-field landing early enough that the cockpit workload will not get too high because the

student:

Has *planned ahead* sufficiently,

Has *considered the different options*, and

Has *made a choice* to act.

When turning, the workload can get high as the pilot will be busy with lookout, with pitch attitude control (with the occasional check of the ASI) and with checking the yaw string for example. If the student is attempting to centre a thermal while climbing, the cockpit workload gets higher still.

A good technique for spreading out this workload is to use a deliberate sequencing of the tasks. For example, the time must be shared between lookout, flying the glider (and keeping the ball or string in the middle), reading the instruments (the low-time pilot will tend to concentrate on the variometer), and maintaining his or her position relative to other gliders in the thermal. Spending too much time on one will allow too little on others; the aim here is to improve accuracy so that tight turns can be made automatically *without thinking of the mechanics of it*, while concentrating on lookout and keeping in the thermal's centre.

So accurate flying of thermals is to be practiced at all times, and the student should be continually encouraged to *think ahead*, to consider the *different options*, and to sequence the *tasks* so that he is not caught with too much to think about all at once.

Further considerations

Flying accuracy, flying at a safe speed, and thinking and planning ahead seem obvious enough; these cannot be neglected, as the consequences are also obvious! There are, however, some further items that must be considered for the early solo pilot, and which the instructor should be aware of and which can be covered again at this stage.

Speed control

Modern gliders have quite a different feel than earlier machines in that they have excellent trims that allow all stick forces to be removed, and there is far less noise in the cockpit because of good streamlining. Speed control can be difficult and the pilot may find quite unexpectedly that the glider is flying too slowly. This becomes dangerous if he is low, because knowing he is in a spin now becomes a bit academic.

It will usually take a few seconds for the speed to reduce to a critical value under typical flying conditions, so monitoring the speed every few seconds seems logical; the glider will be flying at a safe speed. The exception is when flying under very turbulent conditions when a gust-induced stall could occur. This requires the speed to be high enough to cover this contingency; and the speed should of course be monitored more often.

Spreading the workload between the need to fly accurately, the need to fly with a safe speed, especially when low and in turbulence, the need to plan ahead and the need to maintain an adequate lookout requires practice. The instructor should emphasize the importance of recognizing changing situations and the need to adjust to them.

Dual Flights

Sufficient dual flights should be planned to practice emergency situations and build stress inoculation against undesireable stress reactions.

CHAPTER B18
POST BASIC TRAINING

INTRODUCTION

At the point where pilots obtain their glider pilot licence, their flying skills can be at a basic level only. The training has consisted of elementary maneuvers, often at an elementary level of competence, sufficient to qualify for the licence.

To improve the new aviator's flying skills, the maneuvers and exercises of this chapter should be covered. They should form part of the post-basic training of all glider pilots who aspire to becoming safe soaring pilots. Some of the maneuvers also reflect the later flying that a cross-country pilot will use for his benefit and increased enjoyment. It is desirable to teach and practice some of these maneuvers during the student's solo, and pre-licence flying. Some may be taught before solo, which will generally benefit the student's confidence, flying skills and overall abilities. The maneuvers and exercises are:

- Flight at maneuvering speed, V_A
- Flight at or near 90% of V_{NE} (omit for gliders with a high sink rate at this speed)
- Steep turns, 60-degree bank
- Precision spin
- Wingover or chandelle, and
- The climbing turn.

It is important that a qualified gliding instructor, who is proficient in these maneuvers, do this training for students.

OBJECTIVES

To improve pilot skills and safety awareness by teaching precision maneuvers; also to increase a pilot's enjoyment of flying by flying well.

MOTIVATION

The mastering of these simple maneuvers will improve the pilot's abilities to handle an emergency situation, such as an inadvertent spin beside a steep mountain face or in a thermal with other gliders below, and will prepare the pilot for some normal flying techniques used in our sport. Steep turns are often flown when thermalling, for example, and the wingover is a maneuver that is useful in taking turnpoint pictures, though these are seldom taken today.

Other exercises help to improve the coordinated use of the controls, and enable the pilot to get to know the aircraft a little better, thereby improving confidence and flying skills.

Flight at Maneuvering Speed (V_A)

Purpose To explore the flight envelope of the glider; to develop the skill of the pilot further; to familiarize the pilot with a medium climb attitude; and to expose the pilot to reduced-*g* forces.

Flight procedure

- Perform CALL check,
- Align with reference line on ground, such as a road, fence line, straight edge of forest,
- Accelerate to V_A, flying straight, wings level,
- Trim the glider,
- Continue to fly at V_A for a while, encouraging the student to fly some turns, left and right, to familiarize himself with the control responses at this speed,
- When realigned with reference line, smoothly pull up until a 30-degree climb angle is attained,
- Maintain this climb for a few seconds,
- Lower nose smoothly at slightly reduced-*g* to best L/D attitude and speed, keeping wings level, and lastly, re-trim the glider.

Points to consider

- V_A is the maximum speed at which full control deflections are permitted.
- For many glider types V_A is the maximum rough air and/or V_{NE}, the redline speed and is the maximum speed at which the limit load factor may be imposed.
- Emphasize importance of lookout at all times!

Flight at or near 90% of V_{NE}

Purpose

To further explore the flight envelope and become familiar with high speeds and maneuvering, and with a steep climb attitude. To expose the pilot to *zero g*, and to the recovery from an unusual attitude, and to further prepare the pilot for a winch, cable-break emergency.

Flight procedure

This maneuver is similar to that of flying at maneuvering speed, V_A, but with these differences:

- Flight speed is at or near 90% of V_{NE},

- The climb angle is 45 degrees,
- The pushover is at zero g, and
- The exercise is completed at final approach attitude and speed.

Considerations

- The glider may be overstressed if flown at V_{NE} in turbulent conditions.
- At or near V_{NE}, all control inputs must be gentle and smooth.
- At V_{NE}, the controls should be deflected only to a maximum of $^1/_3$ of their full range.
- At or near V_{NE} the glider may be overstressed if exposed to the limit load factor.
- Emphasize importance of lookout at all times!

Steep Turns at 60° Bank

Purpose

To further develop coordination and speed control; and to be able to best use narrow thermals.

Flight procedure

- Fly continuous turns to the left and right,
- Practice transitioning smoothly from one direction to the other,
- Practice exiting turns onto a predetermined heading,
- Pay attention to speed control,
- Re-trim glider as needed.

Considerations

- In a properly flown 60-degree turn, a load factor of 2 is reached.
- The wing loading increases rapidly as bank angle is increased beyond 60°. At a 70° angle of bank, the load factor is almost 3, and at 80° it is 5.75!

Remember that a useful trick for getting the angle of bank correct is to time the turn; at 45 knots and 40° angle of bank, one turn takes 18 seconds. A simple check, therefore, is to have the student time his turn at a *well-controlled speed!*

The Precision Spin

Description and purpose

This spin is to be done to the left and right, with a minimum of one turn. The precision part of the maneuver refers to recovery onto a given heading. Its purpose is to develop the skill of the pilot and to enable the pilot to exit an inadvertent spin precisely onto a predetermined heading.

Flight procedure

- Assure yourself that the *cg* is within limits and that height is adequate.
- Perform the CALL check.
- Align with a reference line on the ground, or pick a reference point in the distance.
- Induce a spin while flying straight, wings level along the reference line or towards the reference point.
- Perform a minimum of one revolution (two revolutions should also be performed).
- Recover precisely on a predetermined heading, using the standard recovery technique.
- The exercise is completed, after a height-gaining pull up, when flying at normal attitude and speed with the wings level.

Considerations

- The exercise must not be performed in turbulent conditions.
- Excessive speed and *g* forces are to be avoided; but
- If the speed starts to build up excessively, start the pull up earlier, or be more vigorous in the pull up (see notes below).

Recovery and rapid speed increases

Situations involving severe nose-down attitudes have the potential for rapid and potentially catastrophic speed increases. If speed control becomes an issue the preferred control technique is a smooth but rapid pull out at the *buffet boundary* or 4 to 4.5 positive *g*, whichever arrives first. This ensures a rapid recovery to level flight with minimum height loss, while the induced drag associated with the higher *g* will limit or reverse any further speed increase. Minimize roll inputs during the pull-out and use a lower *g*-loading if the particular glider has a maximum design *g*-rating below +5.2*g*. Use of terminal airspeed limiting airbrakes for speed control in this situation has a number of disadvantages. These include considerably lower *g*-load available for pull-out, higher cockpit workload, greater altitude loss during recovery, and difficulty of smooth and timely application.

Finally, but not least, emphasize the importance of a **GOOD LOOKOUT** at all times!

The Wingover

Description and purpose

The Wingover is half a *Lazy Eight*. It is a 180 degree change of direction carried out by flying a horizontal line followed by an up-line of 45 degrees. This is followed by a constant radius turn at 45 degrees of bank. The roll out of the turn should be into a 45 degree down-line, parallel to the original up-line. At the top of the turn the wings will be vertical, in the knife-edge attitude. Two such maneuvers, one to the left and one to the right combine to form the Lazy Eight. This advanced maneuver is to further develop the pilot's coordin-ation, timing and speed control.

This maneuver has been called a *Chandelle*, but in Europe this name refers to what is described next in this manual as a climbing turn. It is felt more appropriate perhaps to call it by its descriptive name, the wingover. Two such maneuvers combine to form the *Lazy Eight*.

Flight procedure

- Perform the CALL check.
- Align the glider parallel to a ground line that runs parallel to the wind direction. Make a note of a reference point perpendicular to the glider, i.e. in line with the upwind wing, towards which the turn is to be made.
- With the wings level, accelerate to between 70 and 100 knots.
- Pull up smoothly at about 2½ *g* to a 45 degree up-line.
- Hold this line straight for only a second, using a reference point in the sky if there is one. Now roll at maximum rate to an angle of bank of 45°. Stop rolling and continue smoothly with a coordinated turn for 180 degrees at the constant bank angle.
- As the plane in which the turn is made is inclined at 45 degrees, the wings will be vertical at the top of the turn, in the knife-edge attitude, but the glider should be flown through the turn in a coordinated manner. The timing should be such that, at the high point of the turn, a 90 degree change of direction will have been made (the nose is now pointing towards the reference point). The glider's longitudinal axis should be parallel to the horizon, the angle of bank at 90°, and the speed should be just above the stall speed.
- Roll out at maximum rate (but be careful as the speed may still be close to the 1-g stall speed) to a 45 degree down-line, parallel to the original up-line.
- Hold this line momentarily, then pull back firmly to horizontal flight, and
- Re-establish the normal gliding attitude and speed.

Lazy eight flight procedure

The lazy eight consists of a wingover in one direction, immediately followed by one in the opposite direction. Therefore, as the glider is recovered to level flight after one wingover (the first half of the lazy eight), repeat the procedure to complete a second wingover the other way, and as the glider is completing the pull up to level flight at the end of the second wingover, the lazy eight is completed. To make an effective lazy eight the two wingovers must be connected promptly and smoothly.

Wingover and lazy eight considerations

- Although the entry speed has a wide range of choice, the lower entry speed of 70 knots means the energy available may not be sufficient to hold the up-line for more than an instant. Slightly higher entry speeds may be desirable.
- Strictly speaking, the angle of bank should not be varied. Initially, a lesser bank angle may offer an easier introduction to the maneuver but sufficient speed will be needed to sustain the turn throughout the 180 degree change of direction.
- These maneuvers may be flown into wind in order to avoid excessive drift.
- All control movements are to be done firmly but smoothly, avoiding abrupt control inputs.
- Emphasize importance of LOOKOUT at all times!

The Climbing Turn

Description and purpose

The climbing turn has a great value in training. It appears simple but requires considerable coordination, judgement and timing. It can be used to advantage to use up excess height or speed when coming back to land. The goal is to achieve a 180 degree change of direction at a constant angle of bank while

climbing, finishing with the wings level and at the normal gliding attitude just above the stall speed. This maneuver further develops the pilot's coordination, timing and speed control. It is a method of converting speed into height, while changing heading by 180 degrees.

Flight procedure

- Perform the CALL check and then align the glider with a reference ground line.
- Accelerate, flying straight, wings level, to about 80 knots.
- Roll fast into a 60° bank, keeping the nose pointed at a reference point ahead, i.e. rolling without turning.
- As soon as this angle of bank is reached, smoothly pull straight back into a 180 degree turn at the 60° angle of bank. The primary control to make this turn is now the elevator! Keep the nose 10-20 degrees above the horizon throughout the turn.
- When the heading has changed by 90 degrees, look around to see the ground line and monitor the turn's progress to roll out on the reciprocal heading.
- As soon as the 180 degree turn is completed, roll the wings to level, and the speed should be just above stall speed. Use this opportunity to practice slow flight.

Considerations

- The exact speed at the entry depends on the type of aircraft used. Higher speeds provide more energy and make it easier to perform this maneuver.
- It is important to maintain the bank angle at 60º throughout the turn.
- Allowing the angle to increase steeply causes a nose drop and speed increase.
- When selecting the speed for the entry to the turn in the procedure above, take into account that the glider will continue to accelerate for as long as the nose is well below the horizon – avoid an excessive speed buildup.

Emphasize the importance of LOOKOUT at all times!

APPENDIX A
OFF-FIELD LANDINGS

INTRODUCTION

The first off-field landing is truly a memorable event, when the lift *runs out* and the pilot has to select a field he has never seen, then plan a circuit and land in it.

There are so many questions that seem so automatic at the club, but now take on more importance that it seems there is little time as the pilot inevitably descends. Following a landing the pilot will open the canopy, let the heart slow down, take a deep breath... and listen to the silence, nobody around ... Quite a sensation this; it will remain for many years.

Field landings

When venturing out from the club on a first cross-country flight some pilots are reluctant to depart because they have for so long flown within gliding range of the club. This is understandable, but the simple expedient of learning how to choose the right sort of field to land in, and to plan a suitable circuit, will go a long way to making the departure easier. It is important to remember that the pilot should be psychologically ready for a land out. He or she should be flying on the presumption that a land out will be needed; not otherwise!

One of the most difficult skills to learn is this ability to select a suitable field from the air and to plan and fly a safe circuit into it. On a cross-country flight the pilot should of course always be able to land safely in a field, hence teach your students never to fly over unsuitable terrain unless they have sufficient height to reach a good landing area.

Bad luck does not enter into the equation when landing in a field.

If they damage the glider because they did not notice the slope or that the crop was very tall, this was not bad luck, but an error on his or her part when they failed to notice the problem and act in time. Hand on this philosophy and tell them to keep it in mind, it may be a tough one, but it is true!

When out on a flight, those fields down there can look huge if over the prairies, or small in other parts of the country. In any case, as the pilot loses height and will suddenly realise that he or she is going to have to land in a few minutes! Let the student imagine he is out of easy gliding range of the club, and below there are not too many fields, or so it seems, and the adrenaline starts to pump.

One of the difficulties of selecting a suitable field is that he will not be able to see the details on the ground clearly until he is too low to make possible a sensible or safe change of field. In other words a pilot has to have a basic knowledge of the types of crops and ground or topography over which he or she is flying, and to remember that a good approach into a poor field is much better than a poor approach into a good one. The following sections describe the important aspects of selecting fields and planning circuits for an off-field landing.

Heights for decision-making

When starting cross-country flying, the following heights are suitable for most low time pilots. As they gain experience they will be working to lower limits; however, they must remember that the sooner they make the decision to land the better. At the beginning stages it is unwise to try to catch a thermal low down because the glider will most likely drift away from the chosen field and the pilot will be putting his glider and himself at an increased risk. It is not worth it! The following sections discuss the heights for decisions needed to adequately plan for an off-field landing. The criteria for selecting fields are also given in the next sections. They are summarized in Appendix B of the manual *SOAR and Learn to Fly Gliders*, for anyone to copy and laminate if they wish to carry it in the glider.

2000 feet above ground Starting at a height of about 2000 feet above ground level, if the lift is failing and the flight looks like ending soon, start by locating suitable looking areas for a landing. A good rule of thumb here for a typical early cross-country glider that the student will likely be flying is that it will cover approximately 4 miles for every 1000 feet height loss. He or she will need another 1000 feet for the circuit and landing; hence from 2000 feet agl the radius of action is about 4 miles. Remind the pilots that they can cover more ground by flying downwind.

1500 feet As the pilots descend they will be able to see more details in the fields, and by about 1500 feet they should have chosen two or three suitable looking fields. Next they must consider the surroundings. Are there streams that would indicate sloping ground, power lines to avoid, and obstacles around the fields such as tall obstructions that would create turbulence on the approach? As an example, if they can detect a slope to the ground, it is probably too steep to land on! They should have a good idea of the wind direction from ground clues such as smoke and the surface of water that they can see. Tell them to make a note of the sun's position relative to the wind; they will

need this information later as they fly the circuit. A good way to choose which field to land in is to visualize an approach into each field, and using the SOAR technique of decision-making, and then to choose the option with the safest and best outcome.

1200 to 1000 feet By 1200 to 1000 feet the pilot will have made his or her choice of field. It should be at least 2000 feet long for the first off-field landings, and he should choose a diagonal if it is more into wind. Indecision here can really cut into the time needed to get ready and to start the circuit. Advise the pilot not to delay these decisions, as he or she will need to be planning the circuit in detail and starting the pre-landing SWAFTS check list, and time is getting short.

1000 feet By 1000 feet the pilot will make a commitment to land and at 800 feet he will commence the downwind leg of the circuit. So from now on he should be taught to forget all lift and concentrate on the landing; to position the glider to the side of the field well upwind, and make an effort to visualize the circuit that he will be flying. There is a double tendency here to fly too close to the field and to plan a circuit pattern sized according to the size of the chosen field. If it is small, the circuit will be small! And vice versa. If the pilot gets too close to the field, not only can he not see it well but also he will be making the circuit very tight. His turns will need to be steeper than normal and he may find himself too high and with little space to widen the circuit to use up this height. Therefore teach the pilot to plan for a comfortable pattern to fly, based on a typical pattern at the club.

The last height check that is needed is when opposite the reference point on the field, chosen earlier. The altimeter may well not be a useful instrument now, particularly if the pressure has changed during the flight and the ground is at a different height to the departure field. Although simple arithmetic should allow the pilot to subtract the map's heights from the altimeter reading to get the height above ground, mistakes are easily made in the air! He or she will have to rely more on height judgement, by referring to ground features, particularly for the last few hundred feet of the descent. Teach the student, even during regular circuit bashing before solo, to avoid using the altimeter from now on.

500 feet Aim to be opposite the reference point at about 500 feet above the terrain, and from there use the preferred method of judging when to turn onto base leg. At this point he will increase speed for the approach, remembering that in a modern glider excessive speed could cause an overshoot. The student should give him or herself adequate height over obstacles, and once he is safely over them and above the landing area, give a reminder that he may use full airbrake to touch down early.

Again he should aim to make a fully held-off landing so as to achieve a *low-energy* landing, as discussed in Chapter B8. If the glider has flaps and he is landing in a crop, he should retract the flaps, and keep the wings as level as possible to avoid a ground loop from catching a wing tip in the crop.

Wind direction

This could change during the flight and is vital to know. Drift over the ground can help a pilot detect the wind direction, if smoke or water cannot be seen. Cloud shadows help too, but remind your student that the wind direction close to the ground could be different than at cloud height. It usually blows along valleys for example, and is affected locally by large bodies of water or a storm cloud He should plan the approach essentially into wind.

Size of field

The size should be as large as possible with a long into-wind dimension. Available length can often be related to the distance between rural roads (1 or 2 miles on the prairies), but in some areas close to towns, the fields can be quite small. A good guide is the spacing of power poles where a field at least five pole-spaces long is a bare minimum. This should be increased considerably if there are any hazards such as trees or poles that will have to be crossed on the approach. And remind the pilot that an into-wind diagonal across a field can be used to increase the landing run; he or she does not have to land parallel to the edge!

The size of the field that is needed for a successful landing also will depend on the slope of the ground, the skill of the pilot, the approach hazards, the surface of the ground and the wind strength. If there is a good wheel brake tell the pilot that he could use it effectively by flying onto the ground early rather than doing a fully held-off landing.

If there is a large choice of fields close to the club, and when being trained, the pilot tends to choose a field with good undershoot and overshoot areas; this probably means he or she cannot guarantee a safe landing in their field of choice when flying alone. If this is the case, perhaps the student should not even be flying cross-country at this stage. The instructor may be able to help the pilot by increasing the difficulty of the exercise. If the pilot still cannot or will not choose

a shorter but suitable field, it would be better to have these pilots practice spot landings from odd directions and into different parts of your home field instead. Then later it would be appropriate to return to this exercise.

Slope of the field

A great influence on the upcoming landing is the slope of the proposed field, as this will materially affect the length of the landing run. One of the best ways to fully evaluate the slope is to look at the field from each side, and to look for telltale signs such as wet areas or hollows which have been avoided by the farmers due to the low-lying land. This requires time, and the above decision heights are designed to allow for this type of inspection.

Any down-slope will increase the landing run considerably; in fact the pilot may not be able to land and to stop when going down even a moderate slope! Never plan to land downhill. Landing across a slope is feasible, but care should be taken to avoid touching the uphill wing on the ground and going down the slope after touchdown. If the pilot has to land on a slope, landing up the slope is preferable even with a tail wind. However, extra speed will be needed, and advise him to be aware of the need to rotate the glider through a larger angle than normal to avoid a heavy landing.

Approach hazards

Some form of hazard always borders a field, whether it is a low fence or a high bunch of trees. Some are almost invisible, such as electric fences within the outer boundary of the field, or power poles along a treed or bushy boundary. Others are very visible, and these can present their own hazards.

Teach the students to look for these, and having found a hazard, teach him to cross at a safe height, remembering that tall objects such as trees or buildings create turbulence so extra speed will be needed to maintain good control on the approach. A good rule of thumb to use for the effect of an obstruction is to consider that the length of field lost will be ten times the height at which he crosses the edge of the field. Hence he will cover over 1000 feet for a typical 100-foot height of crossing the field boundary.

Type of field and its surface

Fields vary in their suitability with the time of year and time since they were worked. For example, a field that looks smooth but has not been worked recently could hide gopher holes whereas these would be absent in a freshly harrowed field. Some field types are preferred, and will vary from one area of the country to another. Discuss these with other pilots in the club, and look at fields on the way to the club to keep up to date on crop progress and harvesting practices. Give these ideas to your students during regular instructing sessions.

Among the best types of field are freshly harrowed fields, followed by ploughed and summer fallow fields. However, we should aim to land parallel to ploughed rows as landing across the furrows will be very rough! Stubble is next best followed by grass. However grass can vary greatly, depending on how recently the field was sown and/or cut for hay. If it is used for strip grazing we must be careful to look for the telltale signs of slight colour variations along a line which would indicate an electric fence.

A field with a new crop in it may appear green from a low angle but will look browner from on top. The surface may be quite soft. Other tall stemmed crops such as corn, flax, and canola are not suitable for a landing though they would be better than an adjoining bush area or rough ground.

As for animals, there are not many occasions that a person will have to land in a field containing animals, unless the pilot is in a very sparse area for suitable fields such as in the Maritimes. Animals vary in their reactions to a glider. Cows are curious, and the pilot may need to keep them clear of the glider. Horses tend to get excited and can gallop in random directions. Sheep will congregate in groups and will usually stay clear. In general, we try to avoid sharing a field with animals!

In all cases of what sort of field to choose, the best teacher is the individual – pilots should look at fields close to the club and after landing go over to them and compare their airborne assessment with the ground view. They may be quite different at first, but after a bit of practice the student (or licensed pilot now!) should be able to assess a field quite satisfactorily.

SUMMARY, and the Farmer

Don't forget to remind pilots that they are landing on someone else's property. The objective should be to cause a minimum of damage to the field and its crop, and then to contact the owner as soon as possible. Advise them to explain that they had to make an emergency landing; and wish to make arrangements to retrieve the glider, again making an effort to minimize any damage to crops. The pilot may wish to photograph the farmer with the glider and send him a copy later; so remind your pilot to obtain the farmer's name and address! The pilot must make sure the landowner is happy with how the glider is to be removed from

the field, and that if the farmer demands damage compensation the pilot should exchange with him details of their insurance.

Finally as he leaves the farmer's field with the glider, ensure that any opened gates are secured again. Suggest a follow-up post card of thanks.

APPENDIX B
PILOT DECISION-MAKING

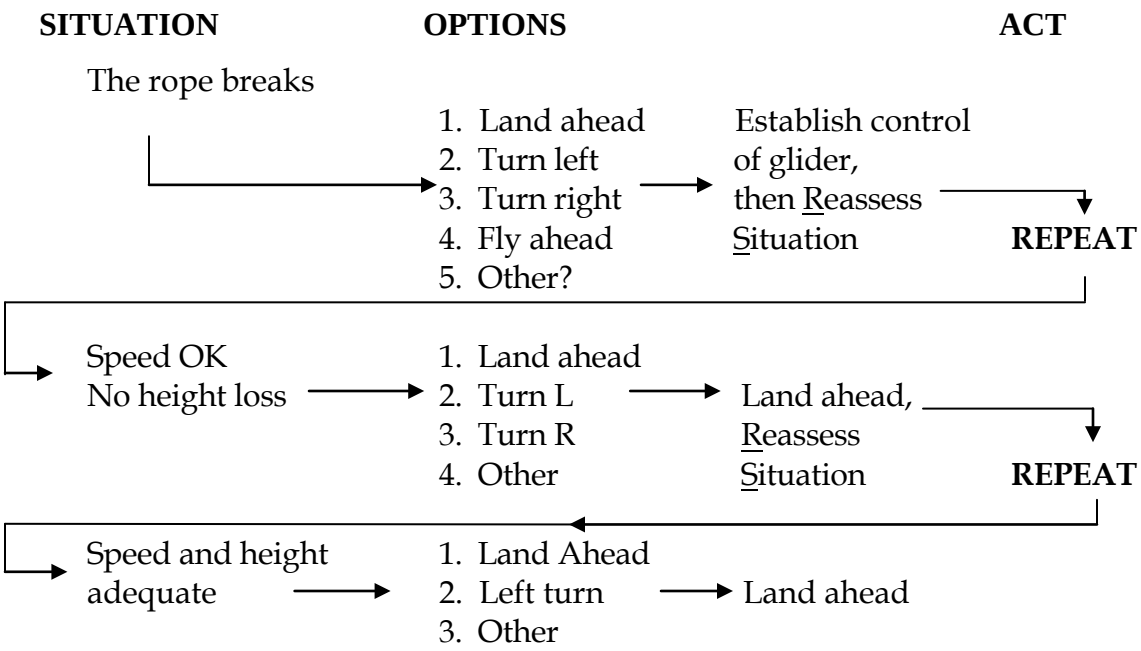
THE *SOAR* TECHNIQUE

To illustrate the technique in action, a few examples of 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 on 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 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 does he see? What does he do? What should he 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 tow-plane, when the speed could be marginal.

The pilot could have turned left towards the stubble field, but he was a low-time pilot and he considered the left turn more dangerous than going straight ahead to land. We are also operating by the rule for a rope break below 300 feet, to land straight ahead, with only a brief turn into wind if needed.

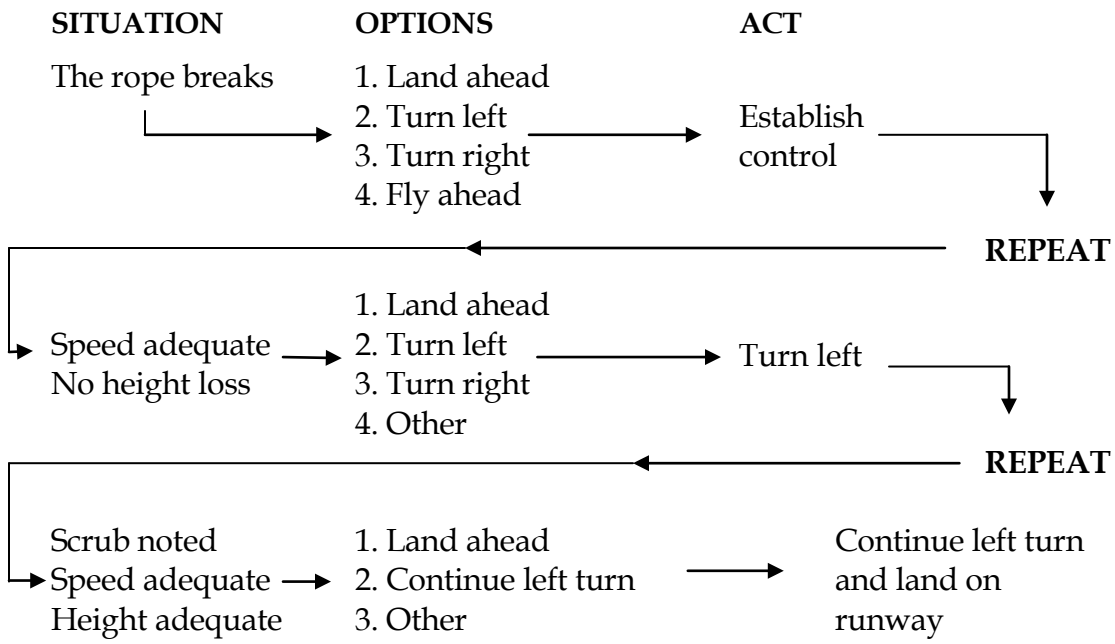
For a situation where a landing straight ahead is out of the question, the pilot must still react automatically, but his or her responses may be modified now by using the SOAR technique i.e. by good judgment.

The next example shows how this would be done. The **Situation** is: 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 little glider flying time solo, and is not too experienced on the glider.

The pilot saw and knew that landing ahead would end in disaster. Therefore, he began the left turn even though the turn would lead toward 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 original 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 en route on a cross-country flight. The situation could go something like this. The pilot is flying a 15m glass fibre racing sailplane, and is at a good height above the ground. This would allow for several more minutes before having to land. This pilot a few minutes earlier 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. However, ahead the sun is shining and (perhaps?) promises lift. There are not many suitable fields underneath, but the pilot is under pressure to continue.

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

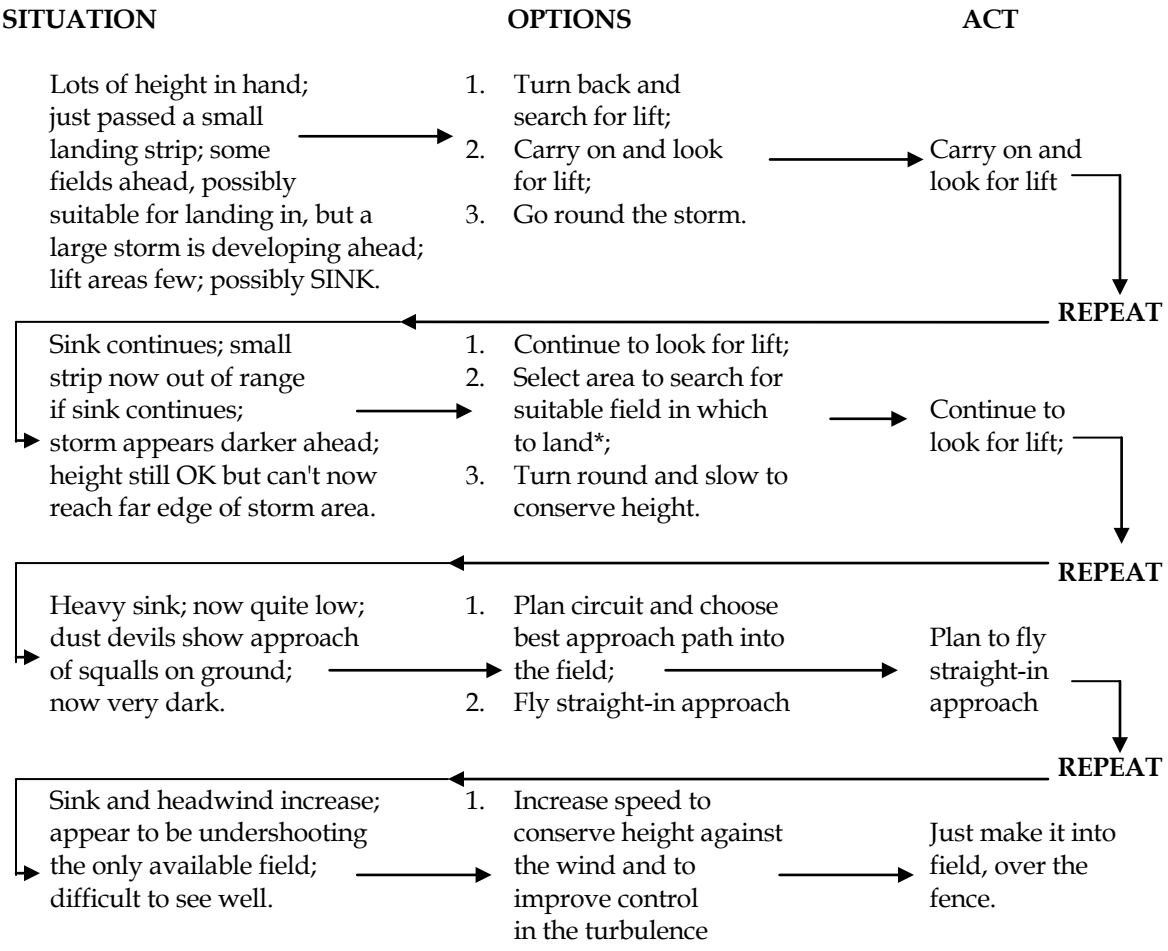


Of course we can imagine a student doing the flying on final approach. You, the instructor, are watching and are following through. The student is slowing down imperceptibly. This is the **situation** as you begin to feel uncomfortable with the declining speed. What are your **options**? Say nothing, hoping he 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; he does nothing. The speed continues to decline so you now have new options! Say, "Lower the nose to increase speed" which is an instruction to the student; or if you had more time you could ask the student to read the ASI and tell you what it reads. This is perhaps a better teaching point than simply telling him or her to increase the speed, a command that the student will not necessarily learn from! If he does not recognize the speed is declining by reading the ASI, and therefore he does not act quickly enough, your only option might be to take over control and **act** yourself to increase the speed.

This and similar situations should be visualized by you for when you will be instructing, so that when in the heat of the moment you have a **situation** and therefore **options** to consider. In addition, 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. 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 disastrous consequences of *pushing on* and having to plan an 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 the example that is shown next page, the pilot clearly left the decision to land too late. The lure of the sun ahead, promising lift to allow him to continue in the quest to reach the second turnpoint could have resulted in an accident. He was clearly a pilot who pushed *his luck*. "It can't happen to me, I can handle it," he says. With luck on the pilot's side, he 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.

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

Another question that occurs occasionally could be whether to fly at all. The situation could be that the person had a rough week and, though the weather looks great for thermalling locally, they have a slight headache. Maybe have 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? Are they going to be able to concentrate well? An increasing wind is predicted, and it is strong already. He or she is tempted to say they can handle things, eh? Okay, so now you as an instructor will advise this person to summarize the four steps and see how to use PDM to come to a safe and logical decision:

Situation 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. Winds are predicted to increase, and are already strong.

Options There are only two options right now – 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 when did this pilot last eat?), and concentration will suffer; in fact the pilot will be distracted from **flying the 'plane**. Probably he will make a poor circuit and hence a poor landing. With the increasing wind, a serious situation

If this pilot stays on the ground, the **predictions** are that he will gradually get to feel better. He can even do some useful 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** PDM technique to reach a decision.

SUMMARY

Before solo aim to have your students able to go through the four-step process without thinking and without being prompted by you when they should be using the method. Occasionally ask them how they are doing and whether they are assessing the situations as you would. See if you agree with their options and choices, and if you agree with their general decisions.

A few days before a first solo, you may ask the student, for example, to continue thermalling when you yourself might feel it is best to fly towards the club and prepare to land. You may be doing this deliberately, to *test* them, to see whether he or she is planning ahead using the SOAR technique. Other similar exercises to make it more of a challenge, to prepare them for later solo flying, might include getting the student to agree with you to fly toward a good looking cloud when they should really be flying toward the club, because you are getting too low. Alternatively, an exercise could be to practice field selection and circuit planning for an offfield 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 student skills to become a good solo pilot. All pilots have to practice to become proficient at PDM using the SOAR steps. A few flights practicing these types of exercise with an instructor's advice will improve their proficiency greatly.

Do not forget 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 advise the students to practice the technique when flying solo, as it will be vital to them under situations that call for rapid decision-making, such as when landing in a strange field. Their pilot decision-making, or PDM as we call it, will be based on the predictions for the options that they are evaluating at that moment. As instructors, we don't get off lightly either! We should be consciously using the SOAR steps when instructing – especially in the critical areas of the approach, for example. You can think of others such as a low-level rope or cable break. You may have to evaluate several options very quickly and make decisions to enable you (or your student) to make a safe landing.

APPENDIX C
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 very start of the sport. The historic ones, first earned in bungey launches off hillsides into ridge lift, are the **A, B,** and **C badges**, and they recognize the basic soaring skills. Each club, following the pilot's first solo flight, now awards the introductory A badge. 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, the **FAI Silver badge**, is rather less easy to achieve as it requires a five hour flight, a cross-country flight of 50 kilometres, 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 the flight goals is documented according to FAI rules, and *Official Observers* are appointed to help with the documentation.

The requirements of the Silver badge can take a year or two to complete; as a result, the intermediate **Bronze badge** was introduced to bridge the gap and to provide the aspiring pilot with a more easily achievable set of goals. It is entirely administered within each club. Become familiar with how the club administers this badge and how the training for it is done. It is an excellent set of tasks to keep up the student momentum towards becoming a much more competent and skilled pilot. The checklist at the end of this appendix shows all items to be completed. Become familiar with them so that you may soon be able to teach the exercises and knowledge requirements for this badge.

THE BRONZE BADGE

The purpose of the Bronze badge is to foster continued interest and a desire for a pilot to improve his or her abilities by acquiring additional skills and capabilities beyond the basic Transport Canada Glider Pilot Licence. 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). The badge is available from SAC's National Office.

The required training at the club may be completed normally after first solo during the time the pilot is working towards his or her 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:

  Two soaring flights each of 2 hours; and

  Three 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.

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
- Cross-country procedures – club require-ments checkout
- Basics of advanced instrumentation (speed-to-fly,

TE compensation, final glide calculator)

- 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 choices that are made 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.

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 de-rig and 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. Trailer reversing exercises should be practiced, 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. So discuss the problems of inadequate brakes, and poor loading that can lead to fish-tailing on gravel roads. Such conditions can and have led to accidents where the glider is damaged.

Bronze Badge Requirements

The checklist and application form that is in *SOAR and Learn to Fly Gliders* is shown opposite. It may be copied and reduced in size to fit inside the pilot's logbook.

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 during Dual Flight		
9	Final Glide Exercise during 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

Bronze Badge requirements completed .....

Bronze Badge issued and logbook signed .....

APPENDIX D
TRANSITION TO MOTORGLIDERS

INTRODUCTION

More of these gliders are appearing on the Canadian scene as they are gaining popularity. These gliders can be grouped into capabilities of self-launch, sustaining only, and touring. The latter group is increasing in availability and can have ranges in excess of 1000 nm and can be flown closer to sport-plane capabilities. Pilots progressing to sustainer engine (turbo), self-launching, or other motorgliders should obtain a thorough dual checkout in a similar glider before attempting solo flight. Pilots have had difficulty with these glider types, and the procedures in this appendix should normally be performed in a two-seat motorglider, but if none is available they should be performed solo. This Appendix has been prepared to provide guidelines for pilots transitioning to a sustainer engine, self-launching or other motor glider. The three types are:

- **Self-launch**. The engine is used for the launch. The motor will be shut off once normal gliding altitude has been reached and the glider is then used as a pure glider;
- **Sustainer**. Use of the engine for cross-country assist. The MG will be launched and flown as a glider, but the motor will be used to prevent an out landing, including flying the glider back to base under power in the event lift vanishes. Cross-country distances would likely see diamond distance attempts with potential returns approaching 250 km;
- **Touring**. The touring motor glider, TMG, can be used as use as a self launching glider or powered sport plane, including remote landing sites at up to 1000 nm ranges.

Many of the older models have complicated starting procedures and can distract the pilot from the task of safely flying the ’plane. In addition, most of these sailplanes have poor performance when the engine is deployed but not operating. A series of flights and exercises have been devised therefore, to assist pilots to safely convert into their motorized sailplane. The pilot must become familiar with handling the aircraft under these emergency conditions before attempting a flight solo with the engine on. The initial airfield selected for this training should have a fairly long runway (4000 to 5000 feet) and have many off-field landing options close by. Learning on too short a runway will be difficult.

Experiences with transitioning pilots to a TMG show the average power pilot can require up to 5 hours on type to be cleared for solo and a glider pilot require 10-12 hours. These flights are mostly touch and go, except for approximately one hour cross-country flying. This translates to about 25 take-offs and landings for the power pilot, and approximately 65 for the glider pilot. Experienced pilots may require fewer hours, and the check instructor can give guidance.

Pilots flying TMGs cross-country will potentially have to deal with more complicated issues related to airspace, radio procedures, controlled airports, and ATC procedures. This will require more elaborate flight planning and navigation skills.

This Appendix has been prepared to provide guidelines for pilots transitioning to a sustainer engine, self-launching or other motorized glider. It is hoped these guidelines will help pilots convert safely into engine takeoffs and emergency landings when first flying their new motorized glider, and to cover the needed additional skills for cross-country flying.

GENERAL GUIDELINES

- Before using the engine for the first time in either the sustainer or self-launching gliders, the pilot should become thoroughly competent at flying the glider without using the motor. This will require a number of soaring flights, launching by aerotow, during which the characteristics of the glider can be explored and mastered.

- Takeoff performance in a self-launching glider can be greatly affected by weight, slope of the runway, length/wetness of the grass, hard runway surface, wheel brake, density altitude, bugs on wings, etc. Before takeoff under the glider’s own power, a physical landmark for a lift-off decision point must be selected to allow a safe abort. If not airborne by this point the takeoff must be aborted.

- Never attempt to deploy the engine and start it in the circuit. It is recommended that when planning to deploy and start the engine, circle over your selected landing field. Climb away while circling over the field until certain the engine is performing well.

- Do not deploy the engine in flight unless you have picked out a landable and reachable field with the engine out but not operating. Should the engine not start, you will need the field in short order.

- Once the engine is deployed and does not start by 800 feet agl do not continue to attempt a start or try to store the engin, unless this is an automatic (one-button) action. Shift your concentration to completing an abbreviated circuit and landing with the engine extended. The downwind, diagonal and base legs will have to be much closer than normal to the intended landing area.

- Glider pilots who intend to fly a TMG should receive additional ground school training emphasizing the points above and make use of the recreational pilot permit curriculum as the standard. In addition, potential

TMG pilots could attend a powered flight ground school to fill in the voids in the glider ground school training.

• A bronze badge is the minimum requirement for glider cross-country flight. Glider pilots who wish to fly a TMG without the PPL or RPP cross-country training and experience should complete:

- Checkouts on type to include a sufficient number of dual flights to demonstrate normal and emergency handling of the aircraft under power, and as a glider; and

- Dual cross-country practice in a TMG in powered flight in excess of 50 km to include flight planning, navigation, diversion skills, and a remote airport landing.

• If an aircraft is registered as a glider, the pilot requires a glider pilot license and an endorsement by a glider instructor (themselves qualified on method of launch) on each method of launch the glider pilot intends to use. For more definitive information about the licensing requireemetns for pilots of these gliders, contact the Flight Training and Safety Committee at sac@sac.ca.

TRANSITION FLIGHTS

Training and checkouts in a two-seat glider

If a suitable two-seat glider with powerful airbrakes is available the pilot should first practice:

- Circuits with the airbrakes open sufficiently to simulate an open and windmilling motorglider engine producing a large amount of drag,
- Full airbrake landings, and
- The stall and speed recovery exercises described below.

The first stage is to permit the pilot to become familiar with the motorglider's performance and handling without the engine deployed, using another more familiar glider and launch method. This may take several flights.

The preference for training and checkouts is with an instructor in a dual motorglider with similar performance to the solo motorglider. If a qualified motorglider instructor is not available then the pilot should perform a self-checkout in his motorglider after completing the above exercises satisfactorily in the two-seat (non-motor) glider.

Motorglider engine handling practice on the ground

The next stage will be to practice deploying, starting/stopping, and retracting the engine while on the ground. Some engines have very complicated procedures that require a checklist to ensure correct completion. Before moving on to the following stage, these skills must be mastered.

Motorglider handling practice with windmilling engine

The next series of flights are with the motorglider and will explore the glider's handling with the engine deployed but with a windmilling propeller. The aim is to simulate a launch failure on takeoff at a safe height, e.g. 3000 feet agl, and to determine the minimum safe height above ground that is needed to complete a turn back to the airfield. Using a familiar launch method, climb to a safe altitude for upper air work. Deploy the engine and complete the following two stages of exercises with a **windmilling** propeller:

• Perform a few stalls from a climbing attitude (simulating a normal climb with the engine operating). Recover from the stall to a normal gliding attitude and airspeed as required for the windmilling prop condition, and note the height lost. Note also the time taken to regain speed. Repeat a few times trying to recover with minimum height loss and minimum time to recover to a safe speed. To become fully comfortable with the stall characteristics, repeat this exercise on extra flights.

• The second stage for these practice exercises also involves the windmilling propeller (except with sustainer engines where an engine failure on climb-out will not be simulated). The exercise should be repeated several times to become fully comfortable with the maneuver. Dive to gain speed to above that for a normal climb (the pilot's handbook recommended climb speed). Transition into the normal climb attitude by pulling up. When the speed reduces to the recommended minimum climb speed, assume that the engine fails suddenly. Note the height and time. From this **simulated climb** recover promptly to an exaggerated nose-down attitude to regain a suitable approach speed as fast as possible. Note the height lost in this maneuver and the time taken to reach a safe maneuvering or approach speed. Only when this speed has been reached perform a 180-degree turn to simulate a return to the takeoff runway. Once on the reciprocal heading with wings level, note the height lost and the total time taken to complete the maneuver since the assumed engine failure. A height loss of 500 to 700 feet and 10 to 15 seconds or more is not uncommon.

** It is doubly important to recognize that **an engine failure low to the ground will require a landing straight ahead**, and that there is a dangerous height zone within which it is very important to lower the nose as quickly as possible to maintain airspeed. At the same time, if the nose is lowered too much, it may be difficult to avoid a very heavy landing. Pilots should therefore practice recoveries to simulate this situation, noting the minimum height required to regain adequate speed suitable for an immediate normal held-off landing with the engine wind-milling.

Repeat the exercise for a 10-knot headwind, noting the time taken to reach the higher approach speed and total height lost. This will allow calculation of the absolute minimum height above ground that would be required to return to the airfield and to complete an engine windmilling, downwind landing following an engine failure on the climb out. Below this height the pilot *must* land the glider straight ahead.

Motorglider landing practice with windmilling engine

The next series of exercises are to practice landings with the propeller windmilling. Be prepared to execute an abbreviated circuit as the rate of descent will be high and the approach path much steeper than normal. Once the pilot is comfortable with landing and judging the circuit with the engine windmilling, the exercises can move on to the takeoff (if solo training) practice stage.

Motorglider takeoffs

Practice the takeoff and be prepared for trim changes created by the propeller thrust. Engine speed control will be important and the climb angle with the more powerful engines may be impressive! For older self-launching gliders note that the takeoff run may be somewhat longer and the climb-out angle lower than for other launch methods, and this will depend of course on the engine power and propeller thrust plus effects of hard surface or grass, density altitude, etc. Therefore obstacle clearance on a short runway could be difficult. Takeoffs must be practiced first on a long runway before attempting shorter field takeoffs and landings. Be prepared for launch interruptions on takeoff and have your **O**ptions predetermined as part of the pre-launch CISTRSC-O, and the glider and the pilot's personal pre-takeoff checklists.

Lastly, partial loss of engine power or thrust must be treated as an engine failure, and a safe speed recovered before turns are attempted. If the glider is below the absolute minimum height above ground required to return to the airfield and the prop is windmilling, never try to do a 180-degree turn, but go to a field straight ahead for an emergency landing.