National Défense
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A-CR-CCP-301/PT-001

TRAINING MANUAL

AIR CADET GLIDING PROGRAM

HOW TO GLIDE MANUAL

ENGLISH

Cette publication est disponible en français sous A-CR-CCP-301/PT-002(F).

Supersedes Chapter 6 of A-CR-CCP-242/PT-005 dated 2012-01-31

Issued by the Commander Royal Canadian Air Force under the authority of the Chief of Defense Staff

OPI: 2 Canadian Air Division / Director Air Force Training **2017-01-31**

FORWARD

1. A-CR-CCP-301/PT-001 Air Cadet Gliding Program How Glide Manual is issued by the Commander Royal Canadian Air Force under the authority of the Chief of Defense Staff.

2. This publication is effective on receipt and supersedes all previous editions and amendments, which are to be withdrawn and destroyed.

3. Comments and suggestions should be forwarded through the appropriate Region Chain of Command to the NCA Ops O at NATL CJCR SP GP, info 2 CDN AIR DIV / ACGPSET.

4. Note, Caution, and Warning headings in this manual are defined as follows:

NOTE

To point out a procedure, event or practice which is desired or essential to highlight.

CAUTION

To emphasize operating procedures or practices which, if not correctly followed, could result in damage or destruction of equipment.

WARNING

To emphasize operating procedures, practices, etc., which, if not correctly followed, could result in injury to personnel or loss of life.

Contact Officer: ACGPSET, 2 Cdn Air Div

RECORD OF AMENDMENTS

Insert latest changed pages and dispose of superseded pages in accordance with applicable orders.

Dates of issue for original and changed pages are:

Original	0	2017-01-31	Ch	2	
Ch	1		Ch	3	

This is a new document, based on information taken from the 31 January 2012 edition of the A-CR-CCP-242/PT-005 ACGPM, particularly Chapter 2 and Chapter 6.

Total number of pages in this publication is 80. Change 0 consists of the following:

Page No.	Change No.	Page No.	Change No.
Chapter 1 STUDENT PREPARATION			
New Issue	0		0
Chapter 2 GROUND HANDLING			
New Issue	0		0
Chapter 3 AIR HANDLING			
New Issue	0		0
Chapter 4 CIRCUIT AND LANDING			
New Issue	0		0
Chapter 5 SLOW FLIGHT, STEEP TURNS, SLIPS, AND FORWARD SLIPS			
New Issue	0		0
Chapter 6 STALL, SPINS, and SPIRAL DIVES			
New Issue	0		0
Chapter 7 AIR TOW			
New Issue	0		0
Chapter 8 GROUND BASED LAUNCHING			
New Issue	0		0
Chapter 9 SOARING			
New Issue	0		0

TABLE OF CONTENTS

TABLE OF CONTENTS

CHAPTER 1 - STUDENT PREPARATION FOR THE GPS COURSE

1. This manual is intended for general guidance, techniques and tips - much like the Soaring Association of Canada's SOAR manual. The overall Air Cadet Gliding Program is governed by the A-CR-CCP-242/PT-005 and your Gliding Region will have Flying Orders, Standard Operating Procedures (SOPs), Aircraft Operating Instructions (AOIs)/ Owner Manuals and Pilot Information Files (PIFs) which apply to your local flying operation.

INTRODUCTION

2. All pilots must strive to be highly skilled and thoroughly competent. Initiative, trained reflexes, and task proficiency all contribute towards becoming professional pilots.

PHYSICAL CONDITION AND MENTAL ATTITUDE

3. Your physical condition is extremely important. If flying lessons are to be absorbed quickly and completely, you should have a reserve of physical stamina. Nutrition is also a key element. The glider pilot course is physically demanding so maintaining a good healthy diet is paramount to ensuring that your stamina is maintained. Even if you are in top physical condition, the assimilation of all the information you receive in the first few days will be fatiguing. Try to keep your mind free to take in everything your instructor says.

YOUR INSTRUCTOR

4. Your instructor is a highly qualified pilot whose aim is to teach you to become a competent pilot. To this end, your instructor will expect your best effort and when emphasis is placed on exactness, it is done for your benefit.

PREPARATION

5. To make the most of each flight you must be completely prepared for the lesson. Ensure that you read and understand all the reference material assigned to you. Given an infinite amount of time and resources, anyone can learn to fly a glider. But you do not have such luxury. You only have one summer. Be eager and enthusiastic.

QUESTIONS

6. Do not be afraid to ask questions. Ensure that you seek a solution to each problem, as no one can learn too much about flying. Pilots with years of experience and thousands of hours are still asking questions and learning.

7. Your instructor will brief you before each flight or series of flights. In the pre-flight briefing you will be told what you will do, why you will do it, and how you should do it. Question any point that is not clear.

8. After each Flight/Air Lesson, your instructor will review the lesson. This is your chance to clear up any misunderstanding and to review what you have learned. Be sure to have a complete understanding of your errors and the action you must take to correct them. Again, ask questions while they are still fresh in your mind.

9. Aircraft Operating Instructions (AOIs) contain all the essential information relative to a particular type of aircraft. Use your AOIs and your Owner's Manual as references and review frequently**.**

FLIGHT SAFETY

10. The overriding factor in all aspects of flying is safety. On the flying field there is a great deal of activity. You must always keep a good look-out for aircraft, vehicles, and other hazards. Always use caution when moving around aircraft.

WARNING

Stay well clear of the propeller of a tow plane at all times and always approach an aircraft with a running engine from behind the wing.

11. Before take-off, make sure that all necessary checks are completed. Careless pilots are not only a danger to themselves, but also to the occupants of other aircraft. Do not take your responsibility lightly. For your own safety, as well as for that of others, get into the habit of thoroughly completing your checks. Conversely, do not disturb others while they are completing their checks.

12. An important flight safety requirement during your flying training is a clear and positive understanding of who has control of the aircraft. The procedure for handing over control to the student is:

Instructor: "YOU HAVE CONTROL"

Student response: "I HAVE CONTROL"

13. When the instructor wishes you to relinquish control, the order is given as follows:

Instructor: "I HAVE CONTROL"

Student response: "YOU HAVE CONTROL"

14. Control must never be relinquished until the order and the response have been given. Never be in doubt as to who is doing the flying.

15. Loose articles can be a serious flight hazard. Anything that is loose could reposition itself and jam the controls. Ensure that all loose objects are properly stowed, including the radio and ballast.

LOOK-OUT

16. You must keep a good look-out. Obviously, you must stay alert to prevent the development of any situation that could require immediate evasive action. While maintaining a vigilant look-out, be particularly conscious of other aircraft known to be in the area. Remember, there is a blind spot over your wings. Never assume that others see you.

17. A technique for improved look-out is to focus your eyes first on a distant object, such as a ground feature or edges of clouds, then divide your field of vision into sectors and scan each

individual sector in vertical and horizontal sweeps.

18. Before beginning a turn, scan your whole field of vision, and pay particular attention to the direction in which you are about to turn. Remembering to look in the proper direction at the proper time will keep you busy initially, but as you gain experience the extent of your look-out and your awareness of other aircraft will improve. Poor look-out is a primary contributing factor in most mid-air collisions.

19. Pilots use the clock-elevation system to point out traffic. Examples of aircraft being reported at “2 o'clock high**"** and "4 o'clock low" is shown in Figure 1-1.

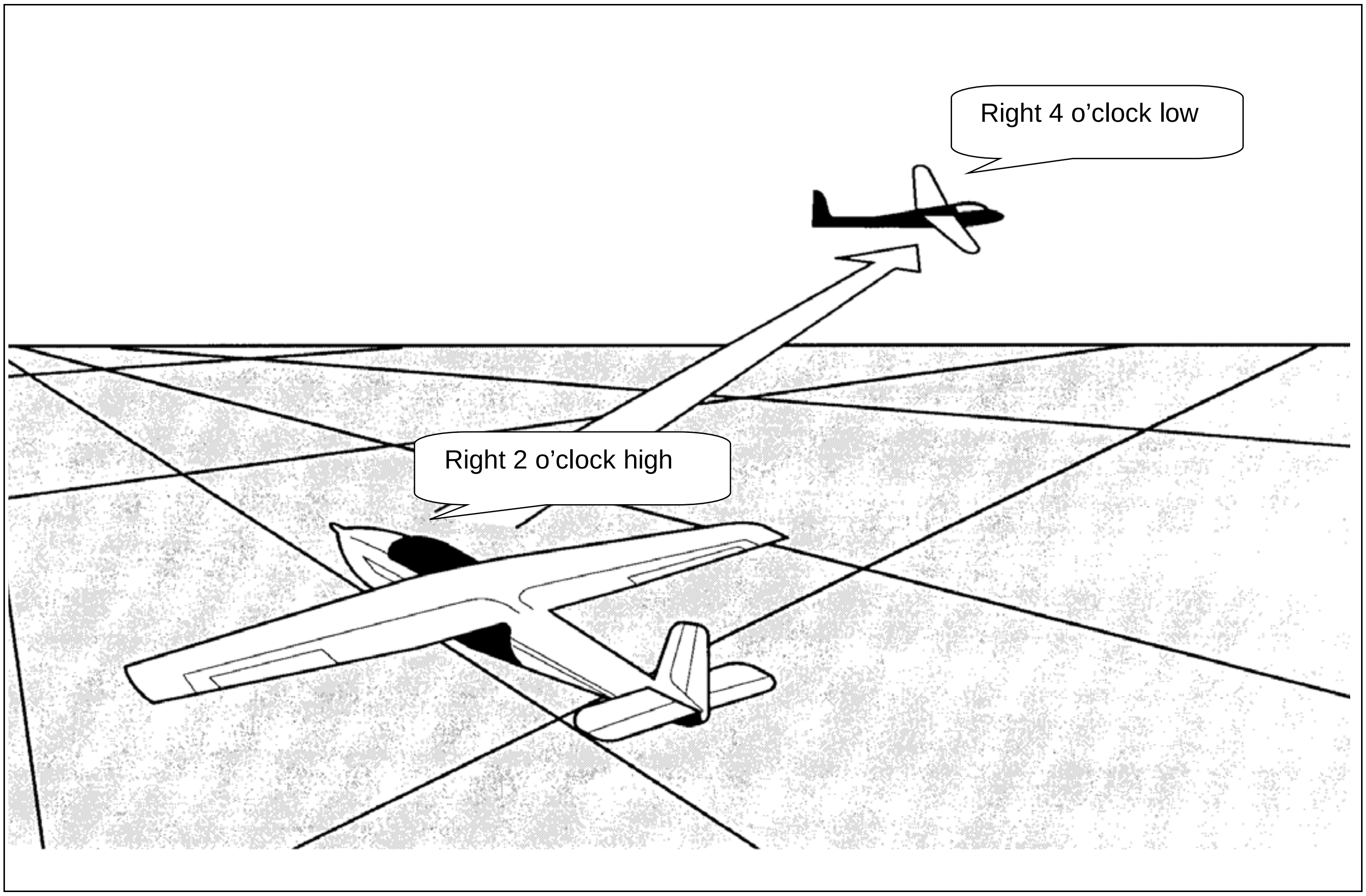


Figure 1-1 Clock-Elevation System

EMERGENCY PROCEDURES TRAINING

20. Practicing emergency procedures is a normal part of any flying course. You will be required to respond to various scenarios based on inputs from your instructor while in the air, while in class, or on the flight-line. Your response to these scenarios should not be rushed! Take your time, speak clearly, and ensure you cover all the items in the checklist completely. Time permitting you can add good airmanship considerations that are not covered by the checklist but would contribute to the safe recovery of your crew and aircraft. For example - selection of your off field landing site, review of winds, radio calls, harness security, etc.

21. Your instructor will initiate an emergency training scenario with the words “Simulated" followed by a short statement of the type of emergency. The emergency training scenario will

be complete when your instructor announces “Simulation complete”. Your instructor will only conduct emergency training with one event at a time. The intent is to give you practice, gain knowledge, and build your confidence in handling the aircraft.

22. In the event of an actual emergency always remember: AVIATE - fly the glider first, NAVIGATE - focus on flying your glider safely, and COMMUNICATE - you have a radio to use.

LOGGING FLIGHT TIME

23. You must always record the hours you fly. This record is used to confirm how current and proficient you are on your aircraft type. CAR 401.08 lists the minimum items you must record for each flight AND there may be more requirements in your national and regional flying orders.

24. You may also be asked to log time for aircraft. This is also based on CAR requirements and again the method of logging will vary depending on your Region and local flying site.

25. When logging time, do not confuse computer/calculator decimals with the colon used to separate hours and minutes. For example, 8:30 on your timing device is not the same as 8.3 on your calculator. 8:30 on your timing device is actually 8.5 on your calculator.

26. When converting minutes to decimals, or reverse, use the following chart as taken from Transport Canada, ***Aeronautical Information Manual**, TP 14371, 4.0 Miscellaneous, 4.1 Air Time and Flight Time*.

0 to 02 = .0	03 to 08 = .1	09 to 14 = .2
15 to 20 = .3	21 to 26 = .4	27 to 32 = .5
33 to 38 = .6	39 to 44 = .7	45 to 50 = .8
51 to 56 = .9	57 to 60 = 1.0	

CHAPTER 2 - GROUND HANDLING

DAILY INSPECTION

1. Prior to each day's flying, a daily inspection (DI) must be performed on the glider. This is a thorough check of the glider to ensure that it is airworthy. Complete your DI as detailed in the AOIs.

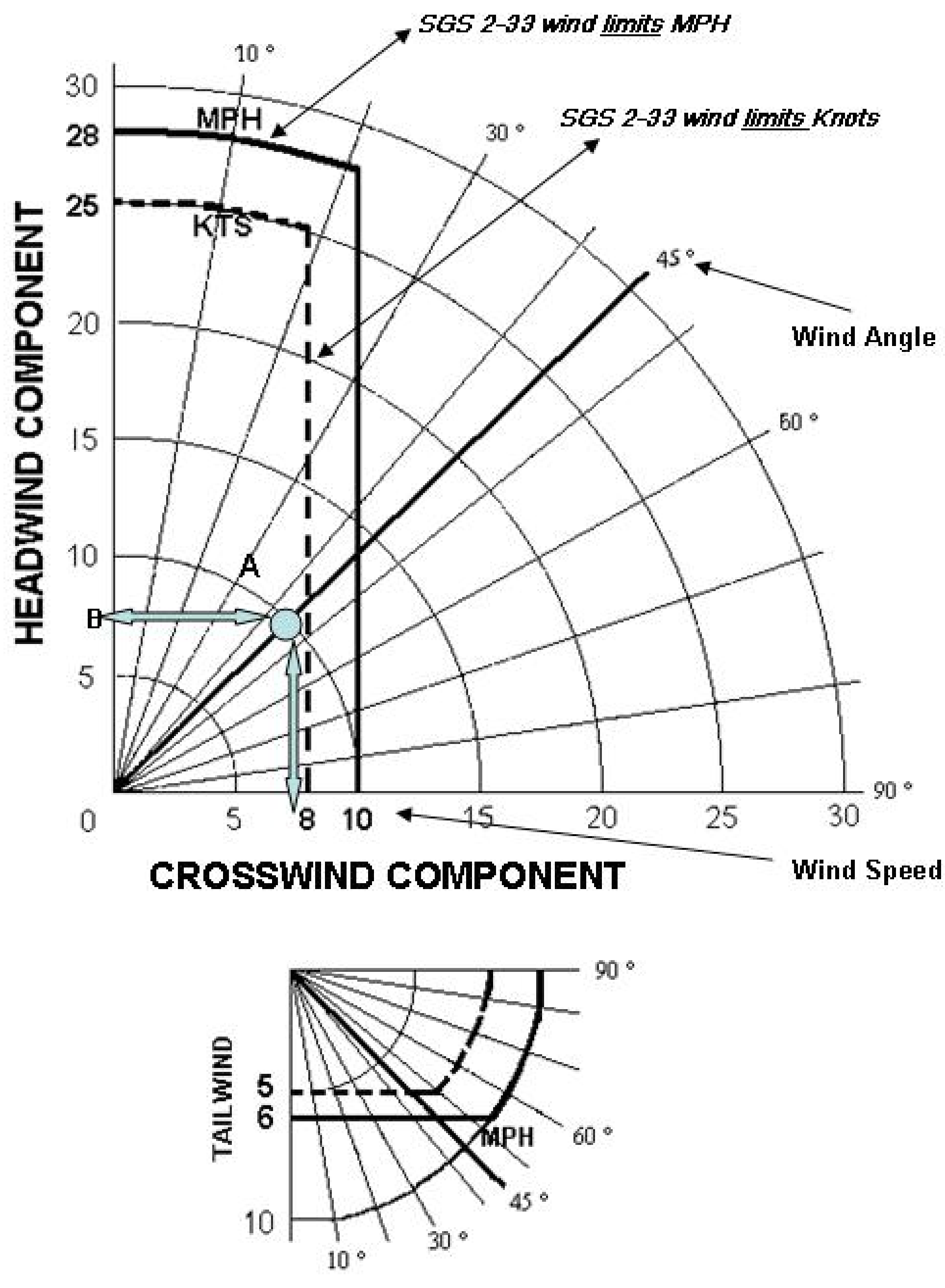
WIND CONSIDERATIONS

2. Winds are particularly relevant for gliders because of their relatively light-weight construction, relatively slow airspeeds, and lack of propulsion. While it is very easy to stand on the ground and see clouds and even precipitation that may affect the flight of a glider, winds are not easy to see without some assistance. Yet wind strength and wind direction play an important role in a glider pilot's decision making prior to flight and during flight.

3. Consider a canoe moving across a pond. If the pond is smooth the canoe moves with little difficulty and in the direction desired by the paddler. But should the canoe be on a stream or river the paddler must manipulate the canoe to compensate for the moving water. To move across the current the paddler must point somewhat into the current. If moving against the current the paddler must expend more energy to make any headway. If moving with the current the paddler can use less energy, but now potentially may have too much energy and may float past the required target. Glider pilots face this same problem; but without any form of propulsion (paddle or propeller) the glider pilot must convert altitude into airspeed to proceed from point A to point B while compensating for any head, tail, or crosswind.

4. The glider AOIs list the wind limitations for your glider. If you are not sure that the crosswinds are within your operating limits, use a Crosswind Component Chart.

5. Following is a typical Crosswind Component Chart. An example for the Schweizer 2-33 has been included to assist your understanding. The Airmanship section of From the Ground Up provides more information.



Shown Example - Wind is 45 deg off runway at 10 knots.

Solution - Enter wind angle at 45 deg, follow radial inward to 10 knot wind speed arc. At the intersection of the radial and arc read straight **down** for crosswind component and straight **across** for the headwind component.

Could you fly a 2-33 in this example? YES !

Figure 2-1 Crosswind Limitations Example

LIMITED PRE-FLIGHT INSPECTION (WALK-AROUND)

6. You should always do a walk-around to inspect your glider before taking off. This is similar to the DI, but is a quick check of critical components on the glider.

STRAPPING IN

7. Determine the need for ballast. If required, install the ballast and ensure the ballast is secure.

8. Climb into the aircraft and position yourself comfortably in the seat.

9. When sitting in the cockpit confirm that you can see over the nose of the glider and that you can move the control column to all four corners. Can you reach the spoilers? Can you open and close the spoilers? Can you reach the release? Can you move the rudder pedals to their furthest distance forward? If you cannot do all of these, adjustments are required. See the glider AOIs on how to install seat spacers and associated requirements.

10. Strap yourself in. Ensure that you tighten the lap belt before you tighten the shoulder straps. This will ensure that the lap belt stays around your hips.

PRE-TAKE-OFF CHECK

11. The pre-take-off check covers essential items in the cockpit, aircraft configuration and ballast which are found in on the placard mounted on the dashboard and in the glider AOIs. Note that all items must be completed prior to hook-up.

PRE-TAKE-OFF HAND SIGNALS

12. The hand signals that are used prior to take-off are detailed below. More specific details of the signals to be used for controlling the air tow launch of gliders are found in the A-CR-CCP-242/PT-005 Air Cadet Gliding Program Manual.

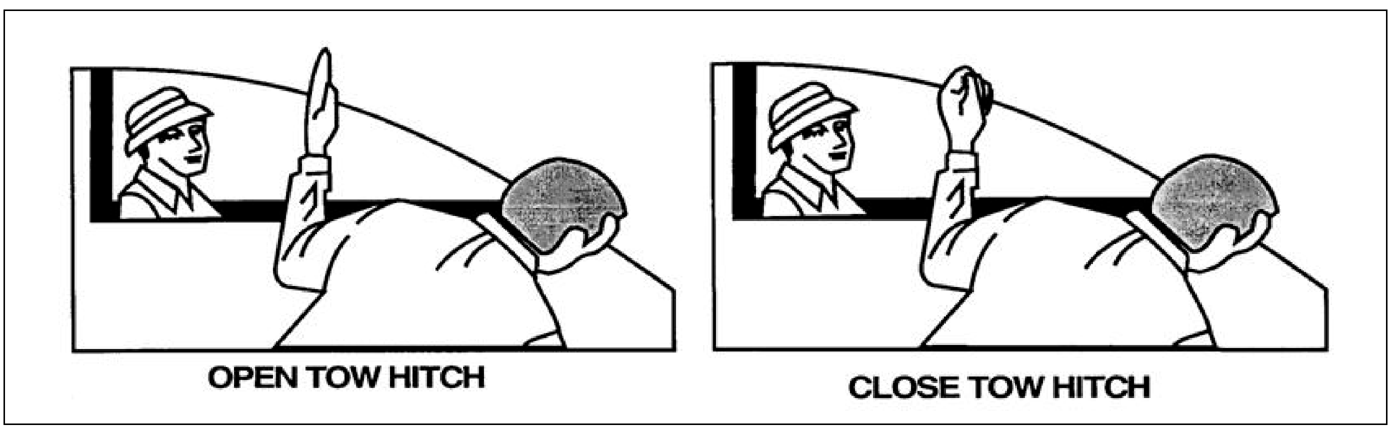


Figure 2-2 Pre-Take-Off Hand Signals

13. Schweizer glider and tow plane tow equipment diagrams are found in the Air Cadet Gliding Program Manual and applicable aircraft AOIs.

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CHAPTER 3 - AIR HANDLING

AXES OF THE AIRCRAFT

1. Having control of an aircraft means that you are free to manoeuvre the aircraft into any desired attitude. Unlike land-borne vehicles, an aircraft has the ability to pitch, roll and yaw. This movement is always about the lateral, longitudinal or vertical axes, which pass through the centre of gravity (CG).

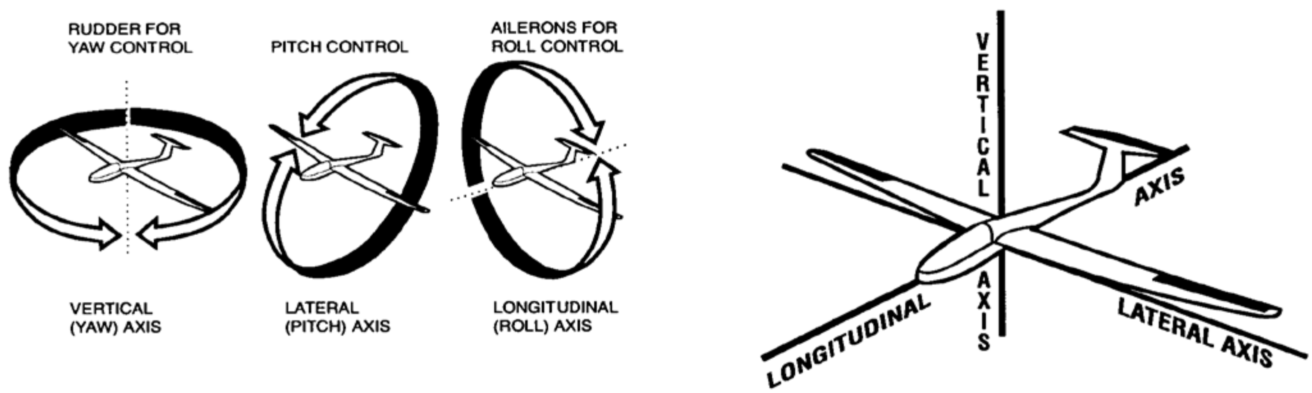


Figure 3-1 Axes of an Aircraft

CONTROL SURFACES

2. The control surfaces can be used individually or together. They are positioned as far as possible from the CG to give the best leverage.

APPLICATION OF CONTROLS

3. Your instructor will demonstrate the effect and use of the controls in various attitudes of flight. Normally, no single control can manoeuvre the aircraft correctly. To fly the aircraft accurately, control movements must be coordinated and must be applied smoothly and evenly. Rough or erratic movements of any of the controls will cause the aircraft to react accordingly. When a control surface is moved out of the streamlined position, the air flowing past it causes a pressure differential on the control surface that can be felt through the control column and/or rudder pedals.

CONTROL COLUMN

4. Hold the control column with your right hand in a relaxed and comfortable manner. Do not grab or squeeze it. Relax your arm and hand so that you can feel any pressure that is transmitted from the control surfaces.

5. The amount of pressure exerted on the control column by the control surfaces is governed by the speed at which the surface is travelling through the air and the degree of

deflection. Conversely, the amount of pressure you have to exert on the control column varies with the pressure transmitted from the control surfaces. Sometimes, especially during air tow, you may have to grasp the control column more firmly, but more often, all necessary pressures can be applied with your hand relaxed on the control column.

RUDDER PEDALS

6. Apply pressure to the rudder pedals smoothly and progressively with the balls of the feet. The rudder pedals are interconnected, as one pedal moves forward the other one must be allowed to move rearward.

TRIM SYSTEM

7. Gliders are equipped with a trim system that helps the pilot by reducing the need to exert excess pressure on the control column during flight.

8. Set the attitude for the airspeed desired. Remove any unwanted control column pressure by adjusting the trim. For example, if you have to hold back on the control column or push forward, adjust the trim. Re-adjust a little at a time. It takes patience. Always re-trim when you feel an unwanted pressure on the control column. A properly trimmed aircraft requires minimal control inputs from the pilot to maintain airspeed.

SPOILERS/DIVE BRAKES

9. The spoilers/dive brakes are used to reduce lift on the top of the wings and for aerodynamic braking. They can be extended at any speed. Their effectiveness is more pronounced at higher airspeeds.

10. **Effects**:

   a. Increased rate of descent;

   b. Slight change in pitch attitude;

   c. Reduction of airspeed; and

   d. Slight increase in stalling speed.

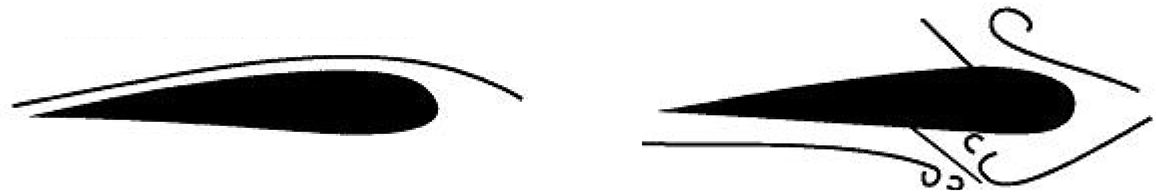


Figure 3-2 Spoilers and Dive Brakes

11. When in the circuit, it is good practice to keep your hand on the spoiler handle and periodically look at your spoilers to confirm their setting.

PRIMARY EFFECTS OF CONTROLS

12. The flight attitudes of the glider are described as positions of the glider nose and/or wings in relation to the visible horizon. Your instructor will demonstrate various flight attitudes to you in your first flights.

13. The primary effects of controls (movements) are as follows:

a. **Elevator.** The following are applicable:

(1) Produces and controls pitching movement, airspeed and altitude. While in a straight glide if you ease the control column back (elevator up), the nose of the glider will move upward in relation to the horizon and the airspeed decreases. This can be ascertained, without reference to the ASI, by the reduction in wind noise. If you pull the control column back quickly, there will be a marked increase in seat pressure and the airspeed will indicate a more rapid decrease.

(2) Conversely, if you ease the control column forward, the nose of the glider will appear to drop in relation to the horizon, the airspeed will increase, wind noise will increase and seat pressure will lighten. Remember, it does not matter what attitude you are in, a movement of the control column forward or back will cause the nose of the glider to move up or down in relation to the horizon

b. **Ailerons.** Produce and control rolling movement, banking and turning. Movement of the control column left and right causes the ailerons to move. Left control column causes a roll to the left, and the horizon appears to tilt to the right (movement around the longitudinal axis).

c. **Rudder.** Control, prevent and regulate yawing movements.

14. To summarize, the **pitching** movement is perhaps most easily described as the movement of the nose about the lateral axis, produced and controlled by the elevator. The **rolling** movement is the movement of the aircraft about the longitudinal axis, produced and controlled by the ailerons. The **yawing** movement is the movement of the nose about the

vertical axis, controlled by the rudder.

STRAIGHT GLIDE

15. In a straight glide, the glider will maintain a constant descent rate of approximately 200 feet per minute (fpm). To achieve a straight glide, choose an attitude using outside references and confirm your references with a cross-check of the flight instruments. This method of controlling attitude will result in precise aircraft control.

16. Positioning of the canopy frame in relation to the horizon is the most commonly used reference. The distance between the base of the canopy and the horizon assists you in maintaining the correct gliding attitude, while the angle between the canopy base and the horizon assists you in maintaining the correct bank angle.

17. The airspeed indicator will indicate a constant reading in steady-state flight. An increase in airspeed indicates a lower pitch attitude and a decrease in airspeed indicates a higher pitch attitude.

18. Keeping the wings level uses the same concept. Each wing tip should be the same distance above the horizon in straight flight.

19. Do not concentrate too much on one reference. Fixing your attention in one place not only hinders your progress, but is detrimental to safety because you are not maintaining a good look-out.

20. Familiarity with outside references and instrument indications enables you to determine the control inputs necessary to control the attitude of the aircraft. Control movements should be smooth and co-ordinated. Accurate control is never a static situation, but requires frequent small corrections to keep the aircraft in the desired flight path.

21. When the aircraft is in uncoordinated flight, the yaw string is displaced from the centre. In uncoordinated flight your body tends to lean towards one side of the cockpit, which gives you the sensation similar to that felt when rounding the corner in a car. Coordinated flight should be free of slip or skid (Figure 3-4) even in a steep turn, and your body should remain in a comfortable, upright position.

22. The tendency to fly with one wing low is a common fault. Sitting off-centre in the cockpit usually causes this.

23. Another common problem is fluctuating airspeed. Looking at the ASI too much usually causes this. Due to the lag in the instrument, you up chasing the airspeed. Fly by reference to the horizon.

24. Do not compromise aircraft control and look-out when carrying out aircraft checks by focusing your attention in the cockpit for too long a period of time.

CHANGING AIRSPEED

25. Airspeed changes in a glider are made by simply changing the pitch attitude. To change the airspeed, set the nose of the glider to the desired pitch attitude and check the ASI to confirm the proper pitch attitude. Use your trim if required.

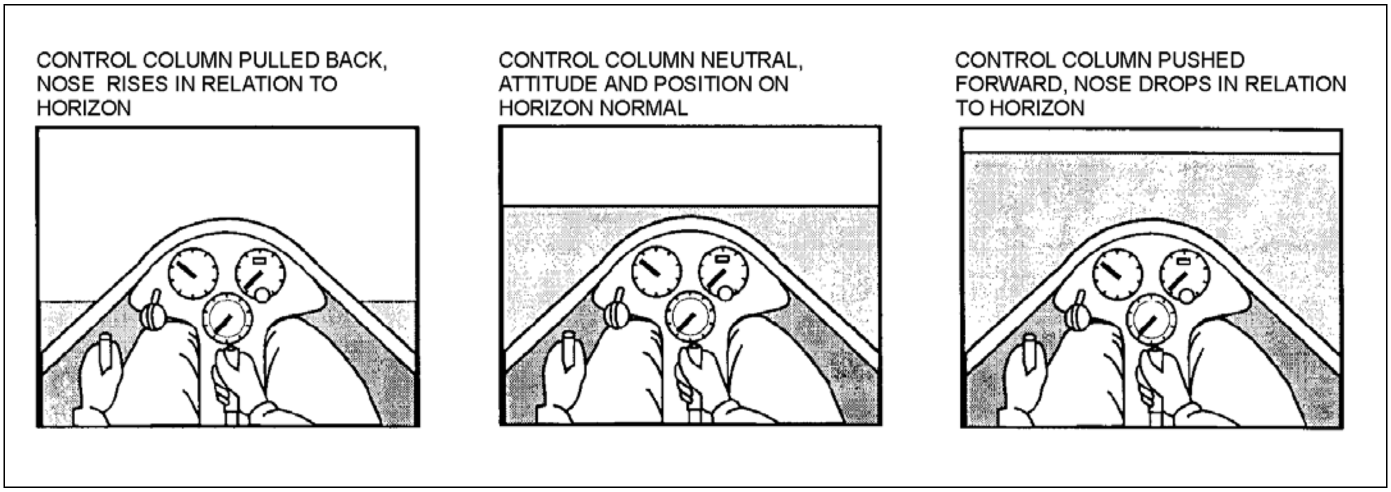


Figure 3-3 Pitch Attitudes

26. It is important to know these attitudes because the glider ASI lags. Students who fly with reference only to the ASI end up chasing the airspeed and have trouble maintaining level glide.

27. **Trim** is an invaluable aid for accurate gliding flight and is designed to relieve the pilot of a sustained load on the control column. A trim change is called for when you find you have to hold continuous control column pressure, however slight. The ideal method of trimming is to set and maintain the glider in the desired attitude while trimming off all control pressures, so that the glider maintains the desired attitude with minimal pressure on the control column.

28. After you have had some practice in a straight glide and have learned to check all your references properly, you will be able to establish any desired wings level attitude in a few seconds. You will learn to look around quickly and to establish pitch, bank, and direction simultaneously.

SECONDARY EFFECTS OF CONTROLS

29. If the glider is intentionally rolled into a banked attitude and the rudder pedals are held central, the glider will sideslip towards the lower wing. As a result of this slip, the airflow will strike the keel surfaces of the glider and it will yaw (weathercock) in the direction of the slip, with the nose going around and down towards the lower wing tip.

30. The yaw caused by the slip and weather cocking is a secondary effect of roll, or expressed differently, a further effect of aileron control.

31. The effects of adverse yaw may also be noticeable as the glider is initially banked. In a roll, the glider has a tendency to yaw away from the intended direction of the turn. This tendency is the result of aileron drag. The up going wing, as well as gaining more lift, also experiences more induced drag. Use of rudder in the turn corrects this tendency.

32. If a glider is allowed to yaw and the ailerons are held neutral, the result is a flat turn in the direction of the yaw – an outward skid. During the skid, a greater amount of lift is produced on the outer wing than on the inner wing that results in a rolling movement or bank.

33. The roll caused by the skid is a secondary effect of yaw, or expressed differently, a further effect of rudder control.

34. The practical points of the secondary effects of controls for the pilot to note are that either a roll or yaw, uncorrected, will lead to a steepening descending turn.

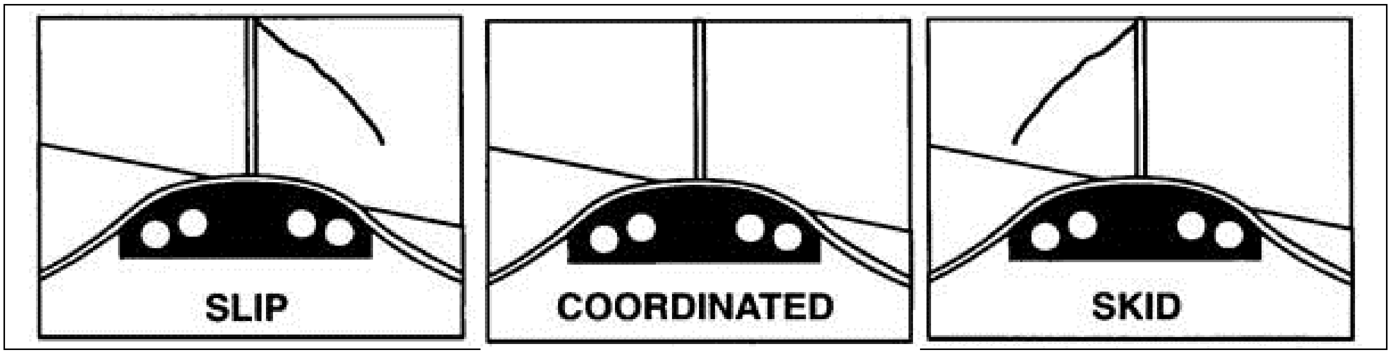


Figure 3-4 Yaw String

35. A common error that occurs once a turn is established is misuse or over-control of the rudder. One of the least expensive and most efficient slip/skid indicators is the yaw string, a piece of yarn mounted in the free air stream in front of the pilot as shown in Figure 3-4. The yarn remains aligned with the glider when the controls are properly coordinated, but indicates a slip by moving toward the outside of a turn, or a skid by moving toward the inside of the turn. A simple rule of thumb for applying the proper amount of rudder is to apply the rudder opposite to the direction the string is pointing until the string is centralized making sure that the angle of bank does not change.

TURNING

36. A coordinated turn requires the simultaneous use of all three flight controls.

37. The three classes of turn for the glider are gentle, medium, and steep:

a. **Gentle.** The gentle turn is approximately 15 degrees of bank;

b. **Medium.** The medium turn is approximately 15 to 30 degrees of bank. A medium turn is the normal way of changing direction in flight, especially in the circuit; and

c. **Steep.** The steep turn is any turn over 30 degrees of bank. It is used for rapid changes of direction and will be discussed in detail in a later section.

38. **Entry.** Before entering a turn, look around to make sure that the area is clear and that it is safe to change direction. Starting from the opposite side of your turn, scan the sky in sections. Pause to focus periodically.

39. Once you have completed the traffic check, look ahead and correct the nose position so

that the proper attitude is achieved prior to the turn. While looking straight ahead, apply aileron and rudder pressure together in the direction of the intended turn and roll the glider to the desired angle of bank. With this application of pressure, the ailerons move out of the streamlined position and cause the glider to roll into a turn. Rudder is used simultaneously to coordinate the turn.

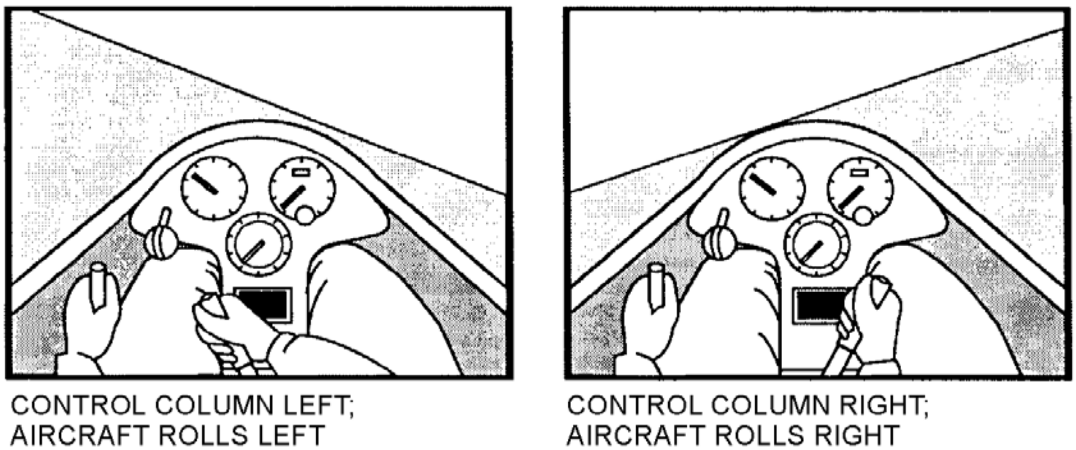


Figure 3-5 Roll Attitudes

40. The response of the glider depends on your ability to judge how much pressure should be used on the controls. If you want a slow rate of roll, use light, smooth movement; for a faster rate of roll, apply greater movement. The movement should be applied in proportion to the amount of change desired. In the early part of your training, you should practice rolling into turns slowly, until you have learned to feel the pressure properly. As your proficiency increases, you may roll into the turns at a progressively faster rate.

41. During straight glide, note the attitude of the nose in relation to the horizon. As you apply bank, keep the nose in that position. As the bank increases, apply gentle back pressure to compensate for the loss of the vertical component of lift and balance the effect of centrifugal force. In gentle and medium turns, the required increase in back pressure is comparatively small, but in steep turns, the back-pressure required to hold the attitude becomes more pronounced. An attitude close to the glider's best L/D is normally sufficient for gentle and medium turns. However, for a steep turn, the pitch attitude will have to be adjusted to a higher airspeed prior to turn entry.

42. **During the Turn.** Once you have established the desired angle-of-bank, release the aileron pressure smoothly. Some of the rudder applied during the roll may be taken out. The glider will remain in the turn, and the control surfaces will be in the neutral, or streamlined, position. Do not release the back-pressure because constant pressure is needed to maintain the pitch attitude. Throughout the turn, hold the bank constant and make aileron adjustments similar to those made for a straight line. Yaw is eliminated by correct use of rudder to keep the yaw string centralized. Airspeed is controlled by using the elevator to maintain the proper gliding attitude.

43. During turns, concentrate primarily on visual reference and look-out, while occasionally referring to the flight instruments. Do not stare into the turn. Maintain your desired angle of bank and continue to scan for traffic.

44. To maintain desired angle of bank, and airspeed, and coordination, and traffic avoidance while turning, many glider pilots use a three or four word mnemonic to help them cover each item. One example you might use is:

a. **T** – traffic - scan for conflicting traffic;

b. **A** - attitude - look to your front to confirm the glider's nose is set to maintain the desired attitude;

c. **B** - bank - look at the pitot tube, or use the bottom of the instrument panel to confirm your angle if bank is correct; and

d. **C** - coordination - look at the yaw string to confirm your rudder and aileron inputs are coordinated.

45. This is only one example. Seek out experienced glider pilots or your instructor for other options that might work better for you.

46. **Roll-out.** Take off bank with the aileron, control yaw with rudder and relax back pressure on the control column. Centralize the control column and rudder as the wings come level and re-check attitude/speed.

47. **Turning Recap.** Perform the following:

a. Look ahead, apply aileron and rudder together;

b. Maintain the desired bank with control column and then reduce rudder. A slight back pressure will be required;

c. Re-check nose position and angle of bank; and

d. Keep a good look-out.

48. **Remember that in a turn there should be three constants:**

a. Constant angle of bank;

b. Constant rate of turn; and

c. Constant airspeed.

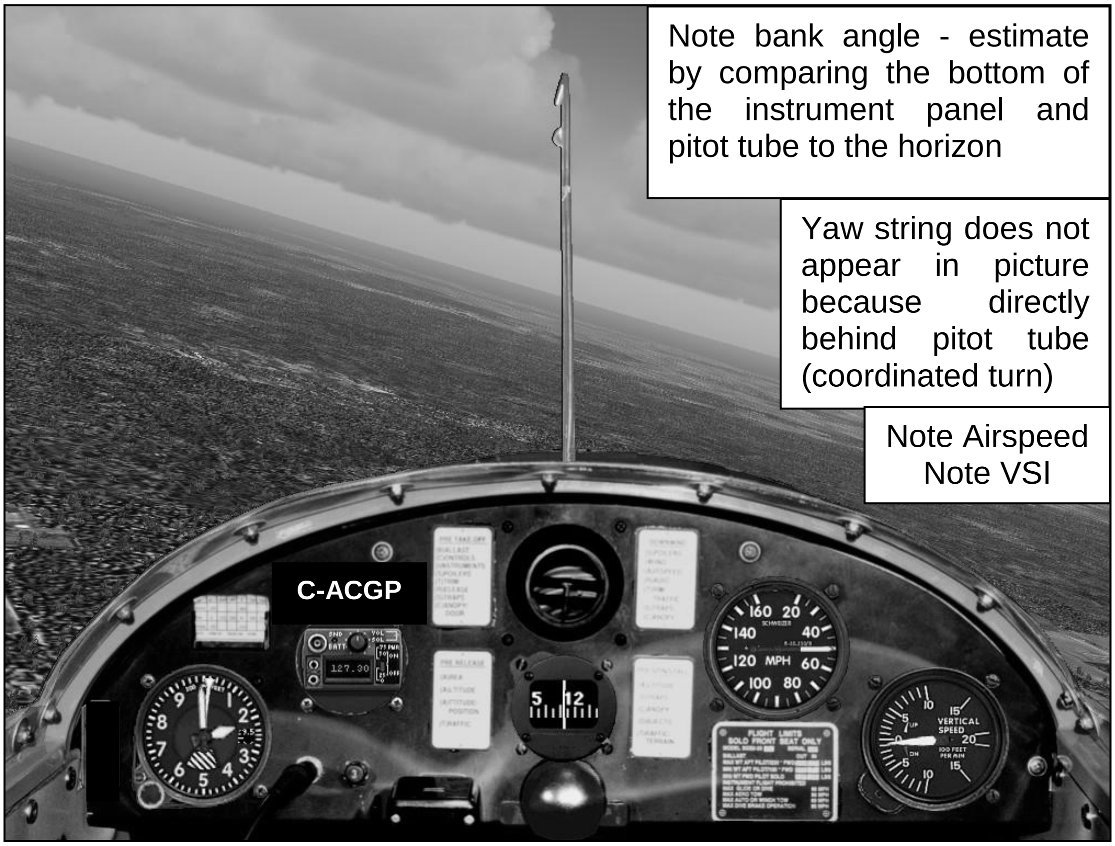


Figure 3-6 Gentle Turn

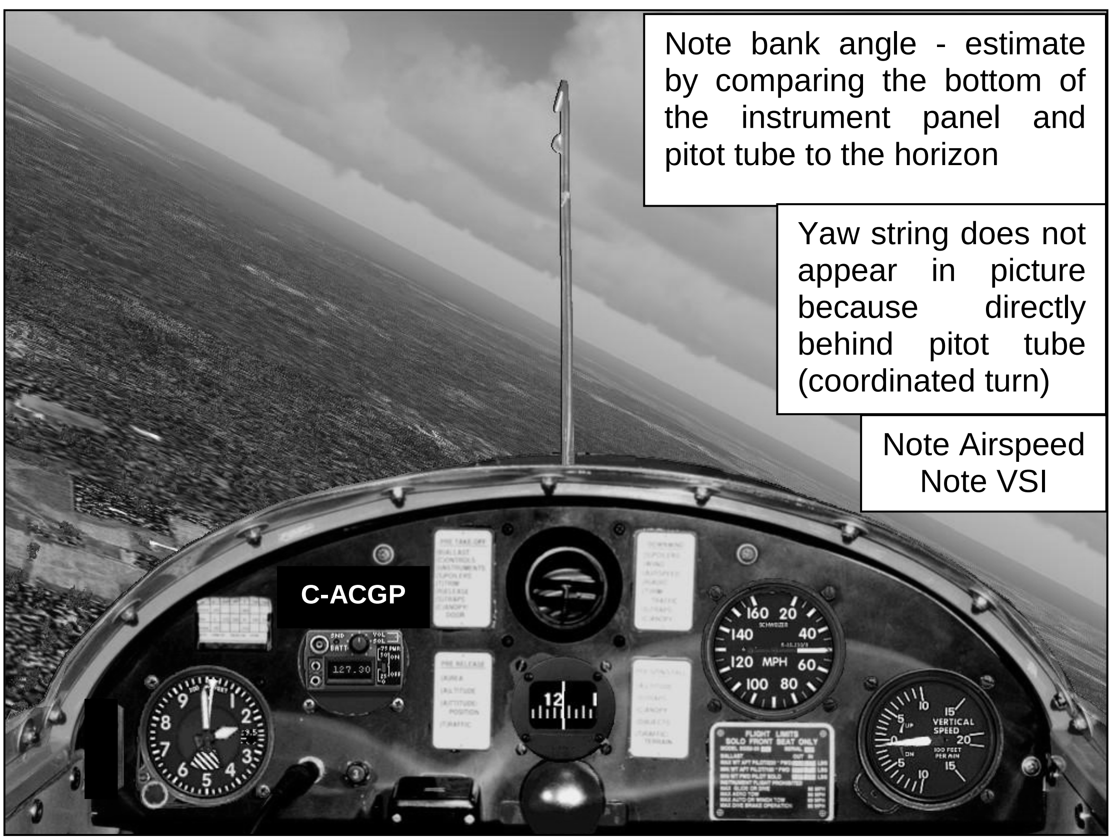


Figure 3-7 Medium Turn

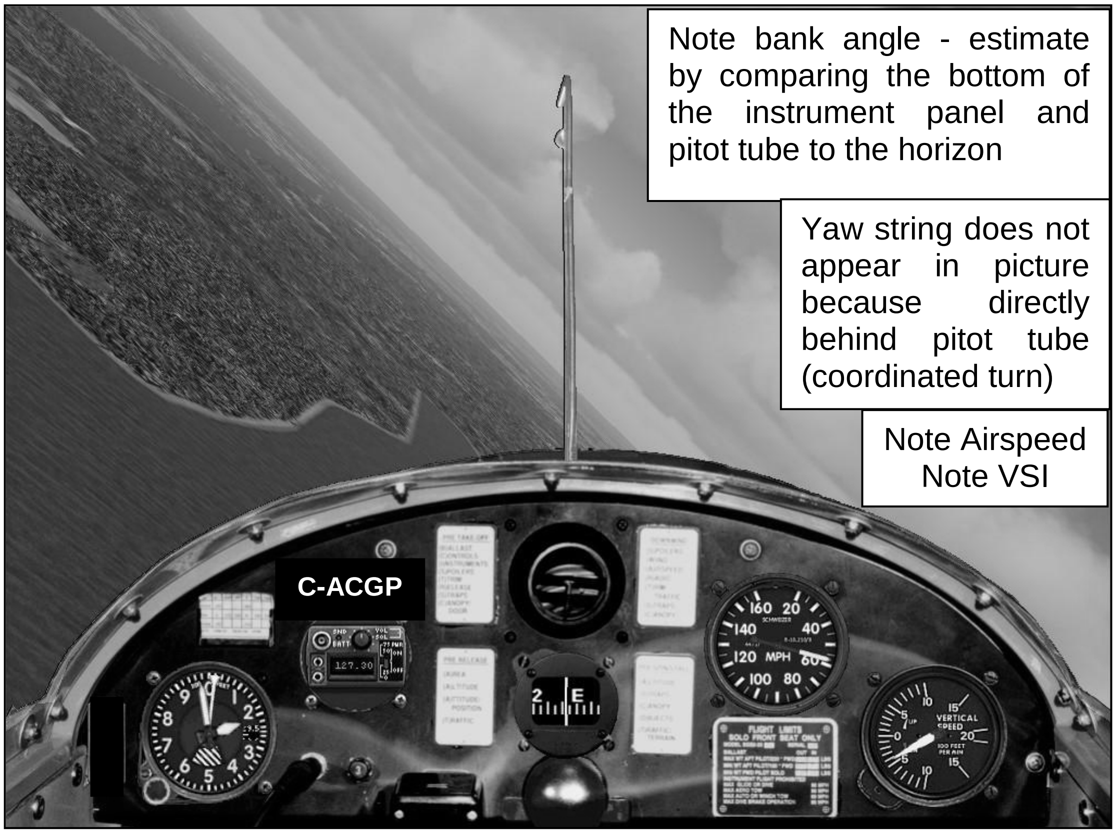


Figure 3-8 Steep Turn

CHAPTER 4 - CIRCUIT AND LANDING

INTRODUCTION

1. This section describes glider circuit procedures including the traffic pattern, final approach, and landing. The information in these paragraphs is somewhat generic in nature. Always refer to your glider AOIs and Region Orders and SOPs for specific instructions, speeds, or altitudes.

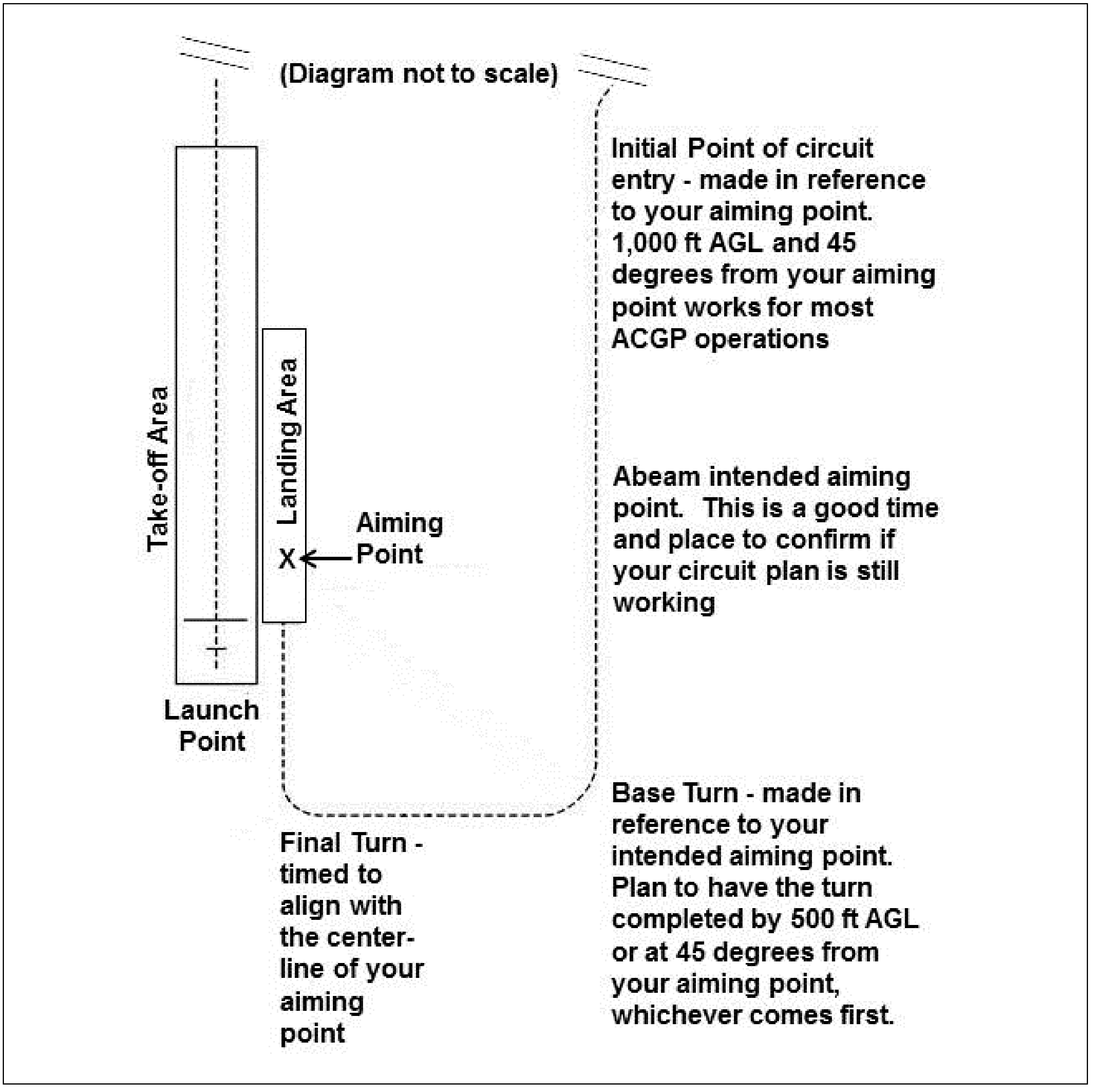


Figure 4-1 The Circuit

CIRCUIT PLANNING

2. Established circuit procedures ensure the orderly flow of traffic and that the glider always remains in a position to facilitate a safe landing on the aerodrome in the event of unforeseen circumstances (such as heavy sink).

3. The circuit consists of entry at the initial point (IP), down wind leg, a turn to base, a base leg, a turn to final, a final approach, and a landing.

4. Unlike power flying, it is not always possible to use the normal rectangular pattern. This is due to thermal activity, downdrafts, wind shear, wind drift, etc. As a result, you must continually adjust your circuit pattern to suit the conditions encountered. The following diagrams will enable you to appreciate what is required. At each stage of the circuit there are corrections you can make if you are not at the right altitude and/or position (e.g., angle in, increase or reduce spoilers, sideslip, angle out, etc). It is important to recognize errors early and correct before large corrections are required. Always PLAN to fly a rectangular circuit.

5. Circuit planning, is just that - planning. Before leaving the ground, good glider pilots plan their circuit based on the weather conditions at the time of takeoff. Then, when they begin their circuit, they make adjustments based on those conditions. Throughout the circuit, glider pilots may need to continually make adjustments to their original plan. Flying the perfect square circuit is not as important as making your planned aiming point safely.

INITIAL POINT (IP)

6. The circuit is made up of several key points to aid you in judging your altitude with relation to your position in the circuit. The first one is the IP. This is the beginning of the circuit and the beginning of your circuit plan. In <u>ideal</u> conditions, you should be over your IP at approximately 1,000 feet AGL, at an approximate 45 degree angle across from your intended aiming point, and at an approximate 20 degree glide slope from your intended aiming point.

7. Your wing strut can be used as a tool. Project your intended path ahead – will your wing strut move over your intended aiming point at 2/3 up the strut?

8. In high wind conditions, your circuit can be initiated closer or higher, which will assist in storing altitude for your final approach which will then be converted into energy/airspeed. Planning to start the circuit closer plus higher is not always needed since in high wind conditions, the glider's groundspeed during downwind will be much higher hence the glider will arrive at the base turning point earlier with having lost less altitude along the way.

DOWNWIND

9. The downwind leg is most often flown at 50 mph. Good airmanship may dictate the requirement for a different speed, such as traffic separation, operational requirements, etc.

10. After crossing over your initial point and proceeding downwind, you should begin your **pre-landing check**. Ideally, this should be completed prior to the halfway point of the downwind leg, but do not focus so intently on your pre-landing check that your position relative

to your desired aiming point becomes skewed.

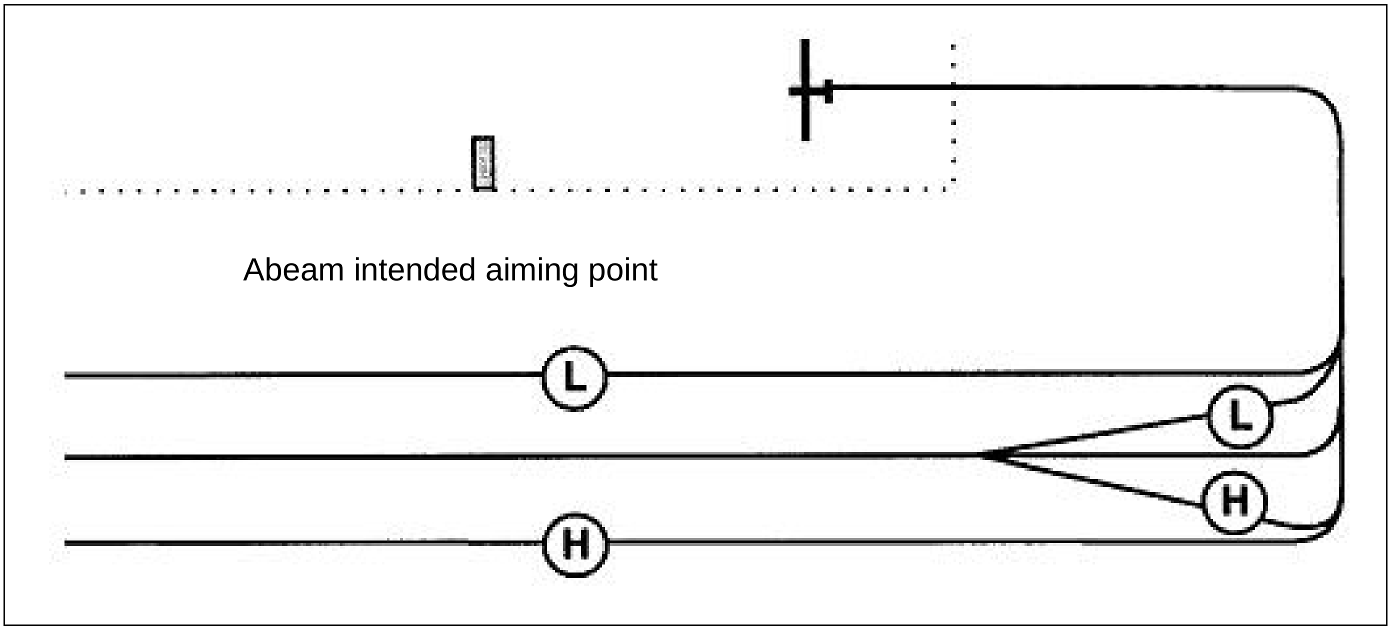


Figure 4-2 Downwind Modifications

11. At the halfway point of the downwind, you should be adjacent to your intended aiming point at approximately 800 feet AGL. Your intended aiming point should be approximately 20 degrees low or, stated a different way, about two-thirds of the way up the wing strut. This will give you the proper lateral distance out from your intended aiming point, as well as a yardstick to judge rate of descent.

12. Once established on downwind, compare your position, altitude, and sink rate to earlier flights. Look at your intended aiming point. Assess your angles. If the angle has become steeper than desired, angle away your aiming point. If the angle has become flatter, angle toward your aiming point.

13. After the halfway point of the downwind you should have a good idea whether you will be high or low for the base turn and you can adjust accordingly. You can adjust/close your spoilers and/or shorten the downwind leg if you are low. You can even start angling in towards the landing area if you are extremely low (note Figure 4-2). If you are high you can use spoilers to lose the excess altitude or you can angle out slightly to give yourself a longer base leg.

14. If not already done so, complete your pre-landing check. Return your hand to your spoilers after the check.

15. Always consider your position, altitude, and sink rate by comparing your present condition to your intended aiming point. Continually asses if your plan is working. If your plan is not working, make an adjustment (close spoilers, turn early, open spoilers, angle out, etc)

BASE TURN

16. The turning point for base leg is normally when your intended aiming point is about 45 degrees over your shoulder. Plan to turn base so that the turn is completed above 500 feet AGL.

NOTE

Any crosswind on downwind leg will require a crab to eliminate sideways drift; and since the glider's fuselage is not parallel to the landing area when crabbing, the 45 degree angle might not be as easy to see when crabbing to counter a crosswind.

17. When flying in high wind conditions (15 knots or greater), consider delaying the use of spoilers and turn onto the base leg early.

18. Winds will affect your base turn. If you have a wind that is pushing you away from your intended aiming point, you might need to turn base earlier than no or light wind conditions. If you have a wind that is pushing you toward your intended aiming point, it might be best to wait until your 45 degree angle before turning. If you have a wind that results in a headwind on base, your might have to close your spoilers, another option could be to turn base earlier than no or light wind conditions. Conversely, if you have a wind that results in a tailwind on base, using more spoilers may be required. Adjust. Adjust. Adjust.

WARNING

The base turn is when your glider will be at the most critical combination of low altitude combined with farthest distance from your intended aiming point. Turning over the same point flight after flight is frequently not possible because of changing wind conditions.

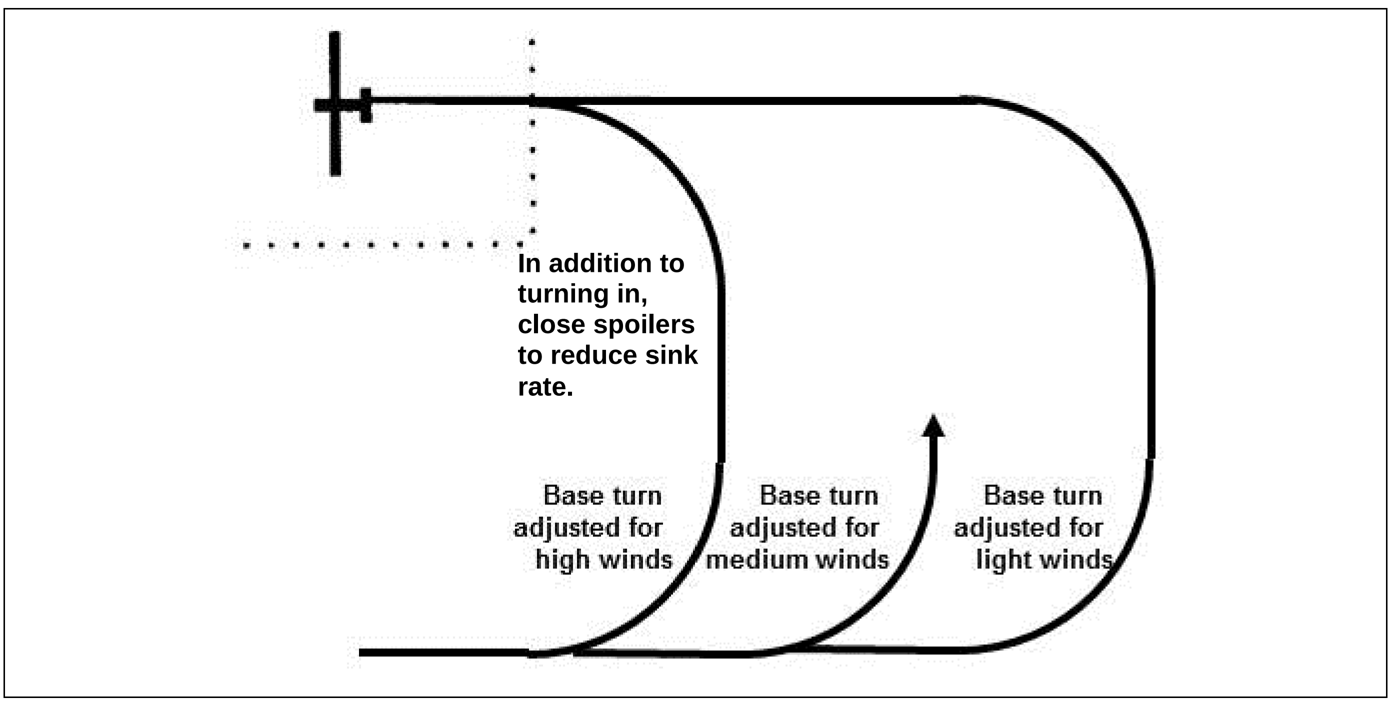


Figure 4-3 Base Leg Modifications

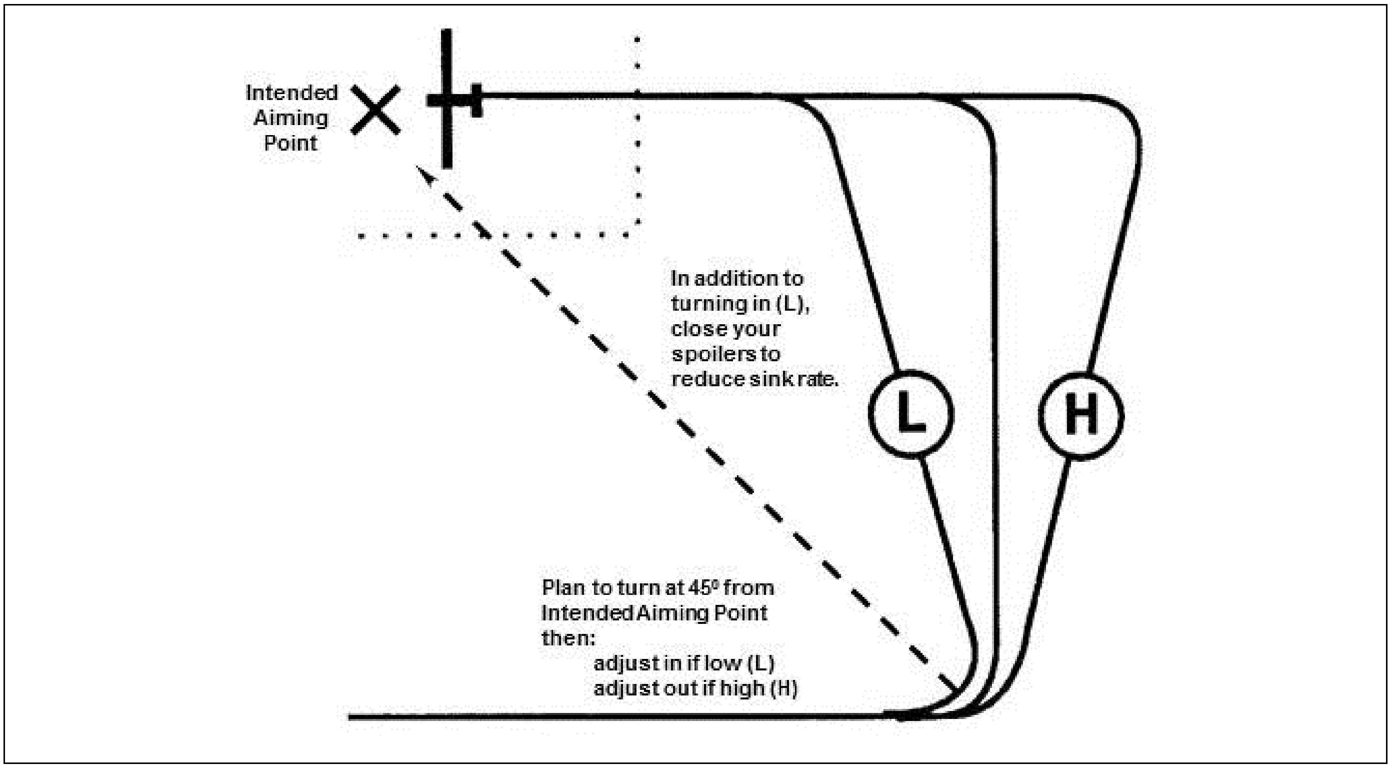


Figure 4-4 Adjusting Base Turn

BASE LEG

19. Once the base turn is completed, compare your position, altitude, and sink rate to previous flights. If you have a headwind component, this may be a good time to increase your airspeed to your calculated final airspeed. Once again, compare your position and sink rate to previous flights and decide if your plan is working. Do you have a headwind, tailwind, crosswinds, or calm winds on base? Look ahead to your planned final turn point. Plan to save enough altitude on base to complete the final turn by 300 feet AGL while having enough energy to combat the headwind on final.

20. Remember that wind drift will have to be dealt with at all times, so do not forget to crab as necessary.

21. At all times, trim for the proper speed and keep your hand on your spoilers.

22. On base you increase your airspeed before the final turn to counter any head or cross winds. If you have a tail wind on base (another reason for doing a good wind assessment during your pre-landing check) you might want to wait until established on final to make this speed change. Remember that it is better and safer to arrive with a few extra miles per hour than to be too slow.

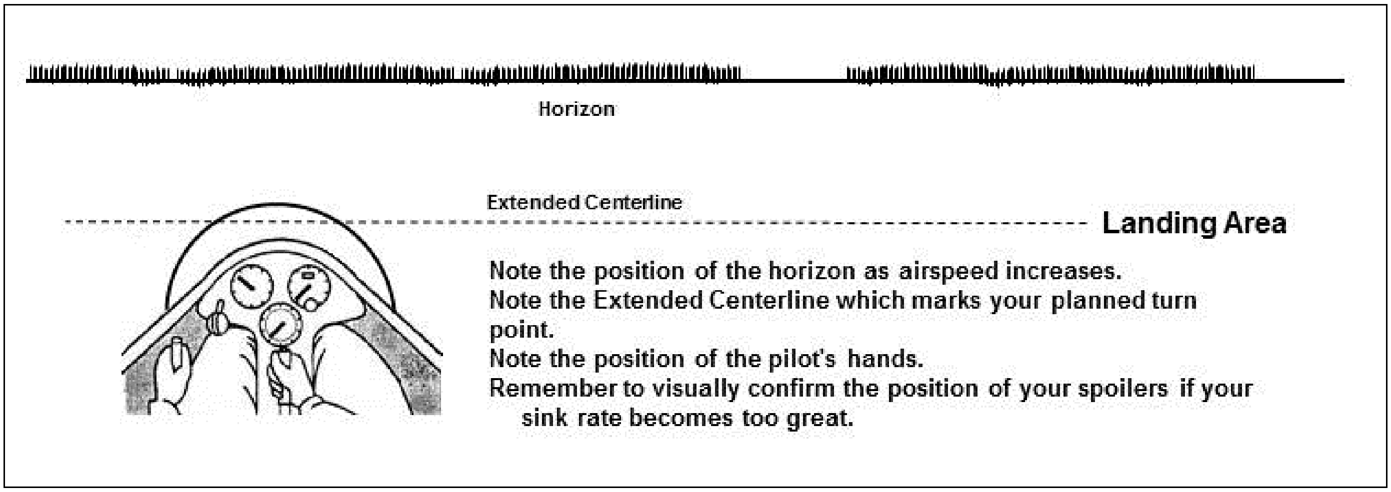


Figure 4-5 On Base

23. In all phases of the circuit use spoilers if, and when, required. If by chance you encounter a very strong updraft (thermal), then you may combine the spoilers with a forward slip to counteract the unwanted lift. But remember, once altitude is lost, it cannot be regained. Early in the circuit, use spoilers with caution.

CAUTION

> Combining a forward slip with use of full spoilers will result in a very rapid rate of descent, at times increasing to 1,000 fpm or more. Waiting for the exact altitude before removing the control inputs for the slip will often result in descending below the intended altitude.

24. If you decide that you are lower than planned:

a. Close your spoilers. Are they open? Did you look to confirm?

b. Angle in toward your final approach path. It needed, and if your landing area is large enough, you could adapt your base leg into your final approach and land diagonally.

c. Do not reduce speed. Do not try to "stretch the glide". Maintain your planned approach speed.

FINAL APPROACH

25. **Final Approach Speed.** To compensate for headwinds during final approach, the FAS is calculated as part of the pre-landing check. It is good practice to add 1 mph to airspeed for each mph of head wind component.

26. You should plan your circuit pattern so that the final approach is made with a glide angle that allows two sorts of corrections: steepen the glide path, by further extension of the spoilers; or flattening the glide by closing them. Ideally, the final approach should be flown with a spoiler setting that has 50 per cent of the effect of full spoilers. In no wind conditions, the ideal

approach angle will be flatter than when the approach is made into a wind. The more promptly height adjustments are made to maintain the ideal approach path, the fewer problems will be encountered on landing. You should get used to judging your height on final approach without reference to the altimeter.

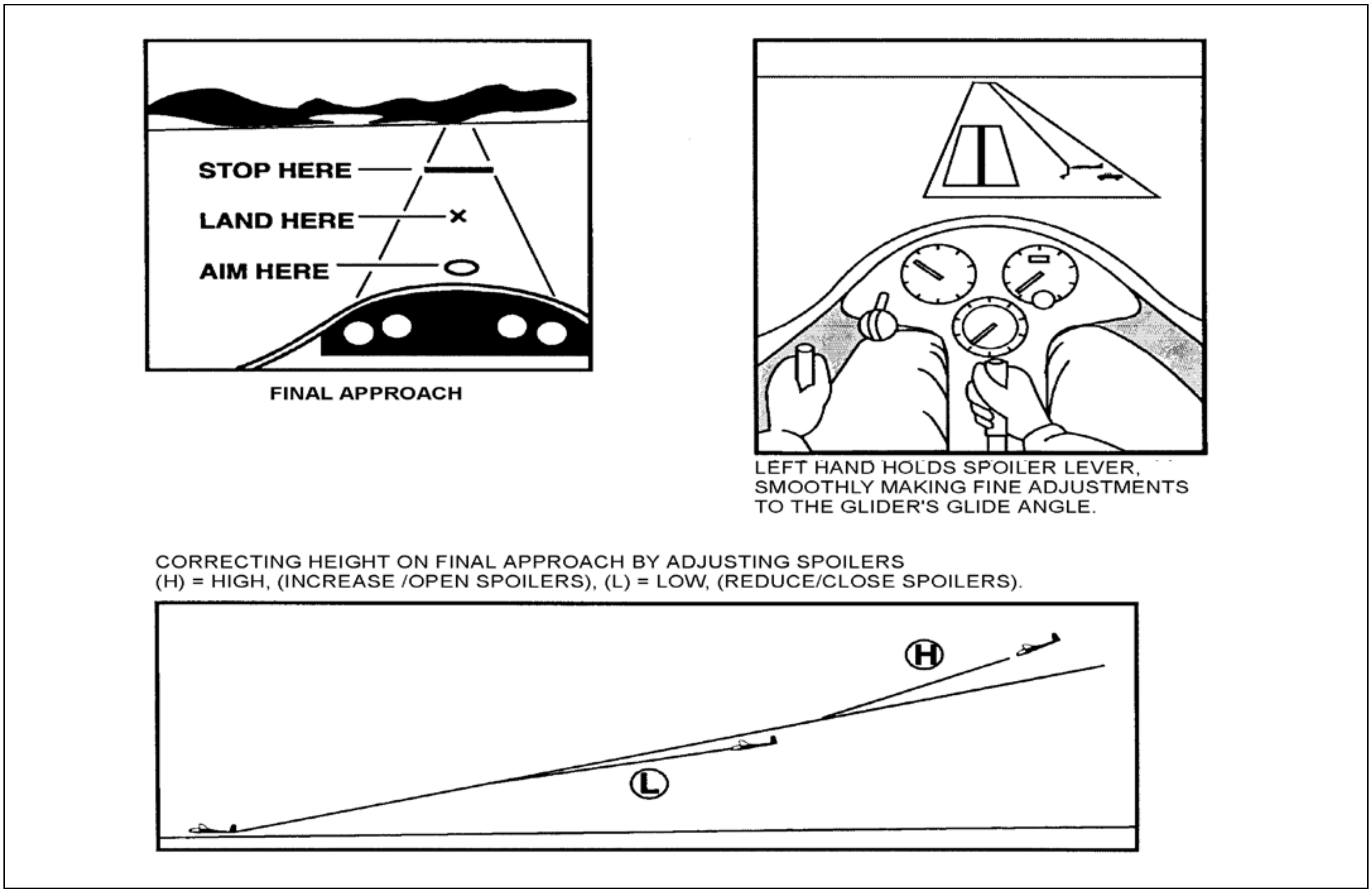


Figure 4-6 Final Approach

27. **Misaligned Approach.** If you are misaligned because of a poorly timed final turn or insufficient crosswind correction, regain the centre line by using coordinated turns or slips as appropriate. Which technique you use will be dependent on your altitude, the distance from the landing area, other air traffic, ground features, and winds. When correcting into a crosswind it will take more time to regain the centerline than if you are correcting with the crosswind. Some considerations are:

a. **Coordinated turns** are more effective if you are significantly displaced from the centre line. They provide an efficient method to fly back to the centre line, because when you remain coordinated the increase in sink rate is minimal thus maximizing your gliding distance. Coordinated turns are often the best realignment method if you are at or below the glide slope, but always consider altitude, ground features, position, winds, etc;

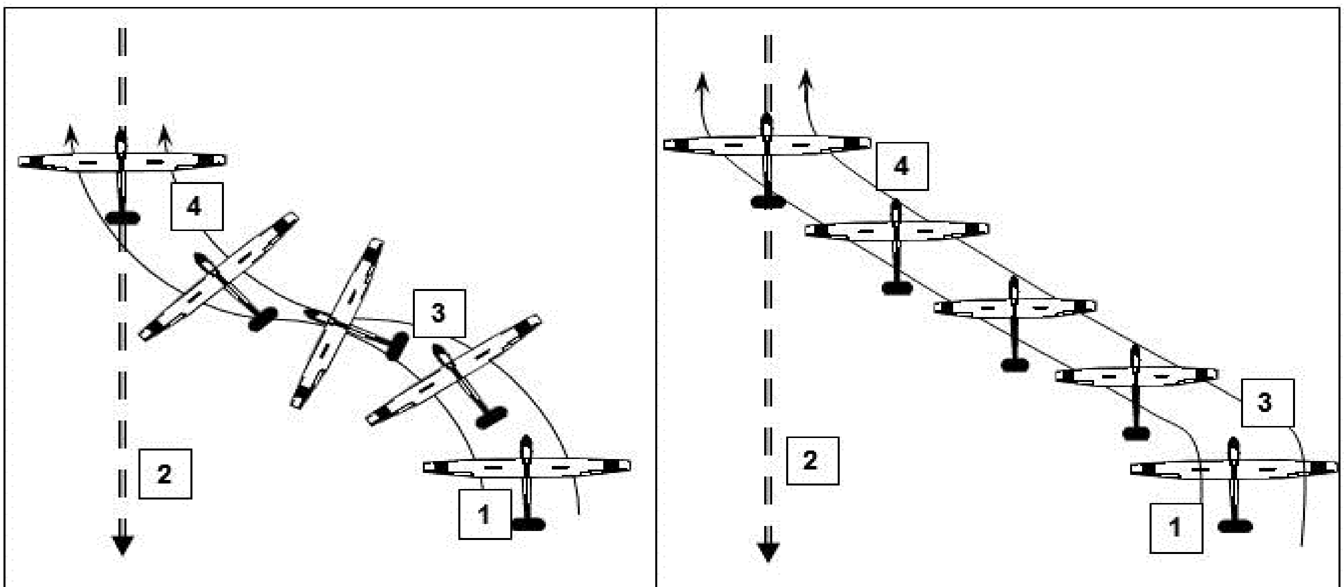
b. The disadvantages of using coordinated turns are you must change the alignment of the longitudinal axis twice and you must judge when to start your turn to realign with the centre line. Poor timing of the realigning turn might result in another misalignment and the need for another correction. Coordinated turns are not a good option when very close to the ground because the risk of striking a wingtip increases the lower you become.

c. **Slipping** is more effective when you are slightly misaligned or if you are above the glide path. If you are only a short distance from the extended centre line there may not be much space to complete two coordinated turns so a slip may be the better choice. If a slip is already being used to maintain a crosswind correction, then you can increase or decrease the amount of input being used to regain the centre line; and

d. The disadvantages of using a slip is it will increase your rate of descent, may take longer to track back to the centre line, and may leave you short of your aiming point.

WARNING

With either method, as you move closer to the ground, less angle of bank must be used to avoid striking a wingtip.



Pilot rolls out for Final Approach [1] but is not lined up with the extended centerline [2] of the intended Landing Lane. Pilot initiates a coordinated turn [3] toward the extended centerline then uses a second coordinated turn [4] as glider gains the desired line. Amount of bank used is dependent upon required amount of correction. Advantages - familiarity with coordinated turns - relatively small increase in sink rate - excellent for large alignment corrections Disadvantages - two steps needed (entry and recovery) - poor timing of recovery may result in overshoot of path	Pilot rolls out for Final Approach [1] but is not lined up with the extended centerline [2] of the intended Landing Lane. Pilot cross controls to initiate a side slip [3] toward the extended centerline then removes inputs [4] as glider gains the desired line. Advantages - good for minor alignment corrections - if already adjusting for crosswinds, may only need slight increase or decrease in inputs - assists in losing excess altitude Disadvantages - unfamiliarity with cross controlled flight - fluctuating heading control during entry and recovery - large increase in sink rate - poor timing of recovery may result in overshoot of desired path

Figure 4-7 Misaligned Approach

28. Once established on final approach, check your aiming point. It should be stationary. If it is moving under you, you are overshooting/high. Use more spoilers, use a forward slip, or use both in combination. If your aiming point appears to be moving up, you are undershooting/low. Close the spoilers. At some time during these corrections you will achieve the desired glide path. Adjust spoilers as required to maintain the desired glide path.

29. Maintain your final approach speed to the round out by cross-checking your ASI during the final approach. Do not try to correct an undershoot by lifting the nose of the glider (slowing down). Conversely, do not try to correct an overshoot by pushing the nose down (speeding up).

CROSSWIND APPROACHES

30. Keep the downwind and final approach legs in line with the landing strip by compensating for wind drift by using crab; keeping the yaw string centred. Use rudder to re-align the fuselage with the landing strip when you are about to touch down.

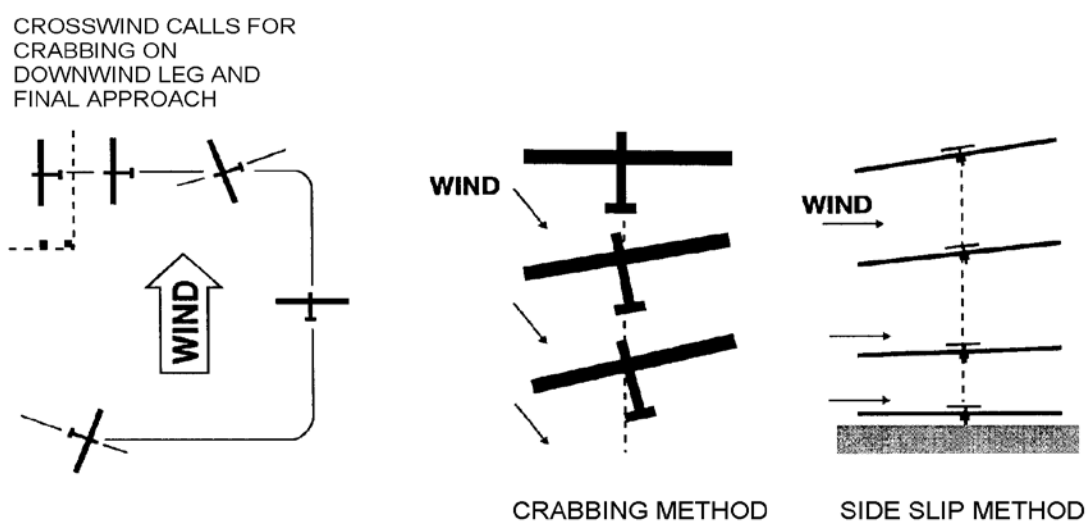


Figure 4-8 Options to Compensate for Crosswinds

31. Another crosswind correction method is to keep the into-wind wing low during the final stages of the approach thus slipping into the wind. Using this method, the fuselage remains lined up with the landing area throughout.

32. As the glider rolls to a stop, use rudder to counteract its tendency to swing into wind (weather cocking effect caused by the vertical tail surface). Keep the into-wind wing low until you come to a full stop.

STRONG WIND DOWN THE RUNWAY

33. If strong winds are present or develop unexpectedly, the circuit will require modification;

that is, the circuit altitudes or circuit pattern or both will have to be adjusted. Making the circuit smaller (tightening the pattern) results in additional altitude being available (stored energy) which can then be used to counteract the effect of strong winds.

34. Some glider pilots use a **rule of thumb** that adds 100 feet to the circuit altitudes to compensate, approximately, for each 10 mph of headwind. Other pilots always start their IP at the same point regardless of wind, then adjust the timing and location of their base turn to accommodate for winds.

35. Whatever technique you use, remember, altitude lost cannot be regained, but excess altitude can be eliminated, when necessary, by the judicious use of spoilers, slipping, positioning, or any combination of these methods. In summary, remember these concepts:

a. Remember that a strong wind down the runway is normally a strong tailwind on downwind, a strong crosswind on base leg, and a strong headwind on approach. This is why planning ahead - before you leave the ground - is important.

b. If the crosswind is strong on downwind, use crab to eliminate drift either away from or into the runway. See Figure 4-8. A 10 mph crosswind on downwind will require approximately 10 degrees of crab to eliminate the drift.

c. If there is a strong headwind, especially over 15 mph, base leg should be started earlier than on a 10 mph than on a more calm day, and spoiler usage on base should be limited. Some glider pilots turn when the glider passes the approach end of the landing strip. Some glider pilots turn as they pass their intended landing point. See Figure 4-3. Again, whatever technique you use, turning early will prevent the glider from drifting too far downwind.

d. On base leg, crab must be used to prevent drifting too far away from the runway. Remember that a 10 mph approach headwind is a 10 mph crosswind on base leg and will require approximately 10 degrees of crab to eliminate drift.

e. In a strong headwind, the start point for final turn must be higher than normal, closer to the runway than normal, or a combination of both because the higher approach speeds result in higher descent rates and steeper approach angles. This is why in strong winds the base turn would be made earlier than in light winds - to store altitude which is then converted into airspeed to counter the affect from the adverse wind.

PENETRATION APPROACHES

36. A penetration approach is defined as an attempt to increase gliding distance, for whatever reason, by placing the glider in ground effect at a high energy state. The following edited excerpt from an article in <u>Soaring Magazine</u> (Feb 90) clearly identifies the futility of the procedure:

> *"Is diving into ground effect worth it?* ***NO!*** *The high aspect ratio of gliders keeps induced drag small, therefore making any drag reduction to ground effect small as well. Additionally, any drag reduction is significant only when the wing is just a few feet above the ground a condition hard to fly consistently or safely, especially*

in a high-wing glider. ***UNLESS THE PILOT FLIES THE PROFILE PERFECTLY AND THE TERRAIN CONDITIONS ARE IDEAL, GLIDING DISTANCE WILL BE LOST.*** *Therefore, in order to maximize glide distance, fly L/D max airspeed adjusted for wind and hold that airspeed until the flare/round-out." (written by: Chris Hadfield, Chuck Louie, Ken Green, Rick Husband, and Nate Jones)*

LANDING

37. The last phase of the approach is the landing. The aim of the landing is the smooth transition from the air to the ground at a minimum rate of descent and forward speed for the prevailing conditions.

38. On most gliders, provided the airspeed is correct, you can fully open the spoilers once in the position to land. However, when opening the spoilers fully, use caution because the full aft position of the spoiler bar is the wheel brake and you do not want to land with the wheel brake engaged.

39. At a safe height (which depends on the airspeed and descent rate of the glider) start slowly easing back on the control column to round-out gently into level flight. Make sure you keep the calculated approach speed up to the point of round-out. In doing so, be careful not to pull back too hard and start climbing again. All you need to do at this point is to make a smooth transition from a nose low attitude to a straight and level attitude. The glider will then settle on the ground gradually. Do not try and force the glider onto the ground.

40. Monitoring your attitude and ASI during the final stages prior to touchdown is essential. If your airspeed is too slow, close the spoilers immediately. Below 50 feet, you do not have room to increase the glide angle for more airspeed; the closure of the spoilers is your best course of action.

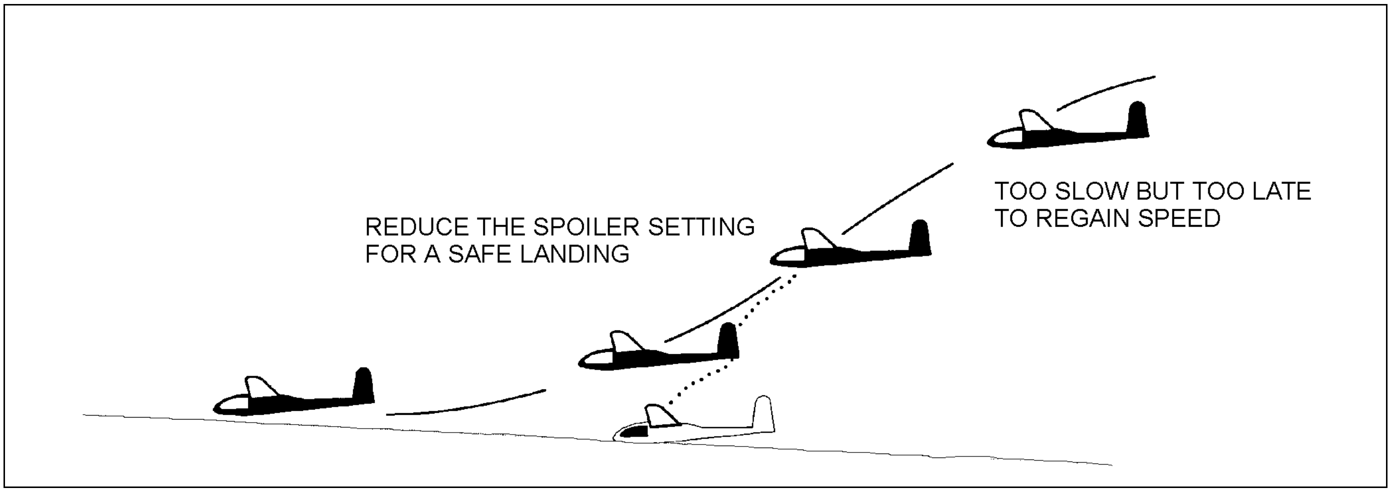


Figure 4-10 Slow Approach

41. When landing in a crosswind you must prevent drift to maintain your intended path over the ground. There are two methods to do this: wing low (sideslip) and crabbing. If using the wing low approach (sideslip), the into-wind wing must remain low during the approach, hold-off, and touchdown until the glider comes to a full stop. If the wind is such that side slipping cannot eliminate the drift, the crab method must be employed. Immediately before touchdown the glider should be yawed so that it is parallel to the landing path. In both methods, crab and

sideslip, the tendency of the glider to weathercock after touchdown must be prevented by using the rudder to keep the fuselage aligned with your aiming point.

42. Touchdown can be accomplished with the spoilers open fully, partially, or closed (as required). At the early stage of your training, it is preferable to land with spoilers open since this will help to prevent you from ballooning should you move the control column too far back during your hold-off. Maintain your glide about two feet above ground while looking straight ahead. When the speed has dropped so low that flight can no longer be sustained, the glider will touch down. As the speed decreases more pronounced control movements will be needed to hold wings level and to maintain directional control. After touchdown, and when you feel and hear your wheel rolling on the ground, continue to ease the control column back until it is fully aft.

43. If you touch down too hard and bounce or apply too much back pressure on the control column and balloon, you should immediately level off and then, if the spoilers are open, close them. From this point it will depend on how high you are above the ground. If you are close to the ground, allow the speed to decrease and carry out a landing. If you are quite high, you will need to make a gradual descent to again round out for the landing. Be careful not to pump the control column back and forth, this only leads to porpoising (more commonly known as Pilot Induced Oscillations).

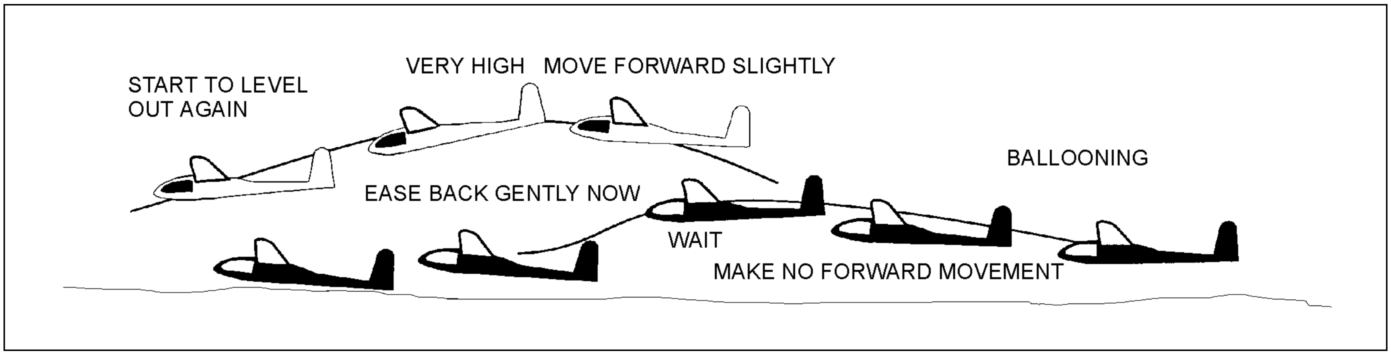


Figure 4-11 Balloon/Bounce Recovery

44. Once on the ground, use braking as required. Use of extreme hard braking or pushing the glider nose into the ground should be avoided unless absolutely necessary to avoid obstacles. Frequent use of such techniques may contribute to structural damage in the skid area.

ILLUSIONS OF DRIFT

45. The closer you fly to the ground the more apparent the illusion of drift becomes. It is particularly dangerous when in the circuit.

46. As the glider is flying in a parcel of air, its movements, or perceived movements, can be misleading, especially if the wind speed is strong and/or gusty. Some of these indications are as follows:

a. When heading into a strong wind, your speed over the ground is markedly reduced;

b. When heading downwind your speed over the ground appears more rapid. You may be tempted to reduce the glider's speed to a point where one you may stall; and

c. In crosswind conditions, lateral drift is quite apparent. This can be demonstrated if you line up with a section line or road.

47. When you turn from into wind to downwind you will experience what seems to be an inward slip. Do not be misled by this illusion. Check your yaw string and this will confirm if you are flying coordinated.

48. If you are turning from downwind into wind, you will gain the impression that you are skidding. Once again refer to your yaw string. The drift is there; do not let it fool you.

49. The slower you fly and the closer you are to the ground, the more apparent these illusions will become. It is most important to know and interpret these signs and not be fooled into using corrective actions when they are not required. Cross-checking the ASI and yaw string is critical in conditions of drift illusions.

FLIGHT IN PRECIPITATION

50. Flying in rain introduces visual and aerodynamic differences with which you must be familiar. During the circuit to landing, as one nears the ground, these differences can pose a significant hazard.

51. Rain droplets on the canopy and the lower light levels common to overcast conditions can reduce the pilot’s ability to judge height information. Rain or drizzle streaming across a windscreen also reduces visibility and causes distortions to the visual field known as “refractive error.” In these situations, objects appear lower than they actually are, thus pilots tend to believe they are higher than they actually are. Careful monitoring of instruments, especially the airspeed indicator and altimeter, is required in the circuit.

CAUTION

Aerodynamic differences have been identified when flying in rain. Water build-up on the upper surfaces of the wing and water around the static ports of the pitot-static boom can affect position error and raise the indicated airspeed at which stall occurs. Refer to your AOI.

52. Forward slips in rain tend to be quite smooth, without the usual pedal vibration and buffeting. Unfortunately, buffeting that normally precedes a stall may also be absent during flight in rain.

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CHAPTER 5 - SLOW FLIGHT, STEEP TURNS, SLIPS and FORWARD SLIPS

SLOW FLIGHT

1. The following paragraphs are based on the FAA Glider Manual, found at: https://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/glider_handbook/media/faa-h-8083-13a.pdf

Slow flight is defined as controlled flight at an airspeed that is less than the normal gliding speed.

The objective of practicing slow flight is to develop the pilot's sense of feel and ability to use the controls correctly, and to improve proficiency in performing maneuvers that require low airspeeds.

Pilots must develop an awareness of the particular glider flight characteristics in order to recognize and avoid stalls that may inadvertently occur during the low airspeeds used in takeoffs, climbs, thermaling, and approaches to landing.

Maneuvering during slow flight should be performed using outside visual reference. It is important that pilots form the habit of frequently referencing the pitch attitude of the glider for airspeed control while flying at low speeds.

The maneuver is started from either best glide speed or minimum sink speed. The pitch attitude is smoothly and gradually increased. While the glider is losing airspeed, the position of the nose in relation to the horizon should be noted and should be adjusted as necessary until the desired airspeed is established.

During these changing flight conditions, it is important to re-trim the glider, as necessary, to compensate for changes in control pressures. Back pressure that is excessive or too aggressive on the elevator control may result in an abrupt increase in pitch attitude and a rapid decrease in airspeed, which lead to a higher angle of attack and a possible stall.

When the desired pitch attitude and airspeed have been established, it is important to continually cross-check the pitch attitude on the horizon and the airspeed indicator to ensure accurate control is being maintained.

When proficient in conducting slow flight in straight flight, turns can be practiced. During turns, the pitch attitude may need to be decreased in order to maintain the airspeed. If a steep turn is encountered, and the pitch attitude is not decreased, the increase in load factor may result in a stall. A stall may also occur as a result of abrupt or rough control movements resulting in momentary increases in load factor.

Slow flight should also be practiced with extended spoilers/dive brakes. This provides additional understanding of the changes in pitch attitude caused by the increase in drag from the spoilers/dive brakes.

The actual minimum controllable airspeed that can be achieved depends upon various conditions, such as the gross weight and CG location of the glider, the maneuvering load imposed by turns and pullups, and gust loads. Slow flight requires coordinated use of rudder and ailerons. The diminished effectiveness of the flight controls during slow flight helps pilots develop the ability to estimate the margin of safety above the stalling speed.

Common errors during maneuvers in slow flight include:

- not establishing or maintaining the desired airspeed.
- not using trim.
- rough or uncoordinated use of controls.
- not recognizing indications of a stall.

STEEP TURNS

2. A steep turn is any turn over 30 degrees of bank. It is used for rapid changes of direction and may be needed in emergency situations to avoid other aircraft. During soaring flight, the steep turn is also used to spiral within a thermal.

3. Steep turns require a high degree of pilot coordination and skill, and are a valuable means of increasing flying proficiency. Poor aircraft control or inattention during steep turns may result in a stall or a spiral dive.

4. The steep turn is just a continuation of a medium turn to over 30 degrees of bank. Control inputs are the same but are allowed to take effect longer. However, for a steep turn, the nose low pitch attitude will have to be increased so that you achieve a higher IAS prior to turn entry. Steep turns require some margin of extra speed because the stalling speed is higher due to the higher wing loading. As proficiency in steep turns develops, turns of up to 60 degrees of bank may be comfortably flown.

5. The amount of back pressure required is dependent on the angle of bank. It is the rearward movement of the control column that pulls the wing to a slightly larger angle of attack that produces the additional lift required for the turn. Gentle turns require very little extra lift, whereas steep turns need much more. You will notice that if you fail to add back pressure, the nose drops quite quickly in a steep turn. Remember to relax back pressure as you bring the wings level.

6. If the bank becomes too steep, the nose tends to drop due to the resultant slip. If you use elevator alone to raise the nose and reduce the speed, the glider will tighten into the turn and enter a spiral dive. To correct this situation, you must first reduce the angle of bank with aileron and then raise the nose of the glider to reduce the airspeed.

SLIPPING

7. Slipping (side, forward, or turning) is a deliberate uncoordinated condition used mainly to lose excess height or correct for wind drift on final approach. When used with full spoilers, it will produce a very high rate of descent. In every slipping manoeuvre, the glider is placed in a banked attitude. Then, its tendency to yaw is either reduced or prevented by rudder inputs. Although simultaneous control inputs are required to establish the correct degree of slip, the manoeuvre itself is carried out by deliberate use of the controls to produce uncoordinated flight. During slips, the elevator is used to maintain the desired attitude. Note that the ASI will not provide an accurate reading because of the angle of the pitot tube to the relative airflow.

8. When slipping, it is important to understand the difference between maintaining a constant flight path and maintaining a constant heading. In a nil wind situation, if the nose is pointed down the intended flight path, the glider will slip off the flight path towards the low wing. Therefore, in this case, the longitudinal axis or the heading must be altered, using rudder, away from the down-going wing to prevent the glider from slipping off the intended track. Conversely, in a crosswind situation, a slip into the wind will prevent the glider from drifting off the intended track, while allowing the glider's longitudinal axis to remain aligned, for example, with the runway for the landing.

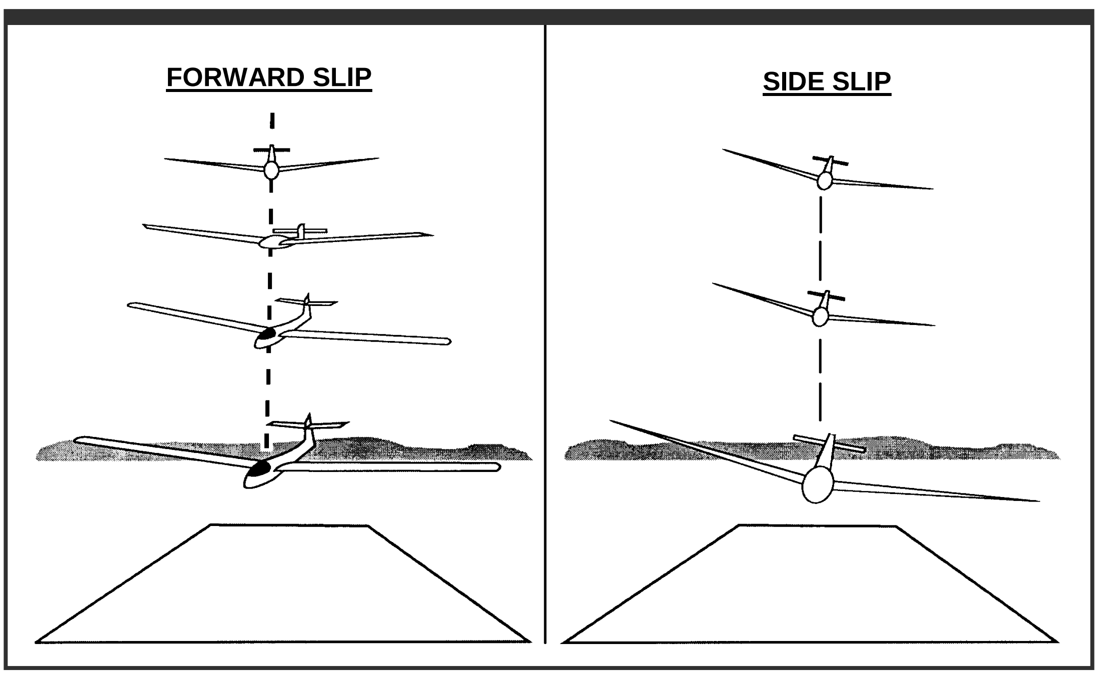
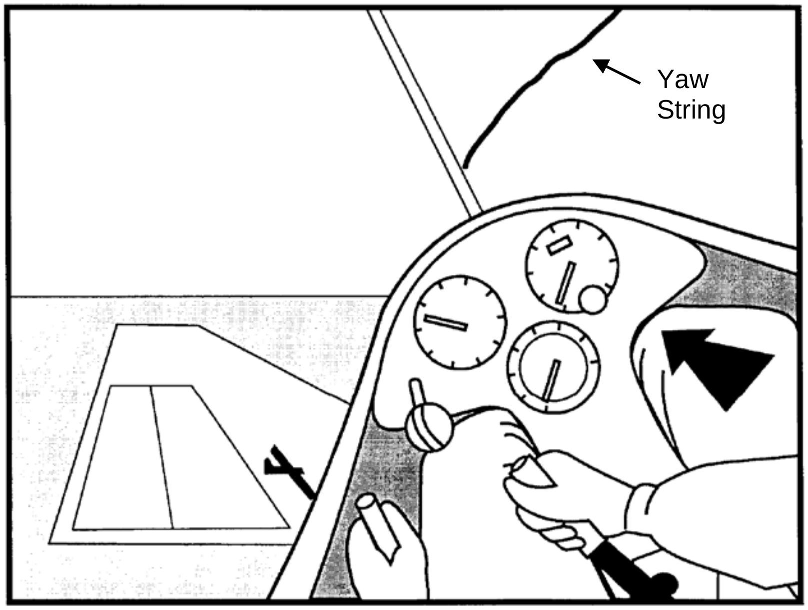


Figure 5-1 The Forward Slip and the Side Slip



AILERON AND RUDDER ARE APPLIED IN OPPOSITE DIRECTIONS; THE AIRCRAFT SLIPS TOWARD THE LOWER WING AND THE YAW STRING MOVES OUT TO THE OTHER SIDE.

Figure 5-2 Cockpit View of the Forward Slip

9. **Forward Slip** (longitudinal axis is not aligned with flight path)**.** The forward slip starts by simultaneously banking the glider with aileron and applying enough opposite rudder to move the longitudinal axis off the desired track over the ground and away from the down-going wing. Because the longitudinal axis is now at an angle to the track over the ground, the glider will continue to move along the desired track over the ground rather than moving laterally towards the low wing. During the slip, use elevator to maintain the desired attitude. To recover from the forward slip, release the rudder to allow the glider to return to its original heading, level the wings with aileron, and adjust the pitch attitude with the elevator to maintain the desired airspeed.

CAUTION

Combining a forward slip with use of full spoilers will result in a very rapid rate of descent, at times increasing to 1,000 fpm. Waiting for the exact altitude before removing the control inputs for the slip will often result in descending below the intended altitude.

10. **Side Slip** (longitudinal axis is aligned with flight path)**.** A side slip, unlike a forward slip, is a manoeuvre during which the longitudinal axis remains approximately parallel to the original direction of flight, but in which the track over the ground can move either left or right (in a nil wind situation), or can be prevented from moving sideways (during a crosswind situation). To enter a side slip, bank the glider and simultaneously apply sufficient opposite rudder to prevent the glider from turning. The amount of bank and rudder required will depend on either how quickly you want to move laterally or how strong the crosswind is. To recover, level the wings with aileron and take off the rudder at a rate that will ensure that the longitudinal axis does not change. When used for landing, this crosswind procedure is often referred to as the “wing low method”.

COMMON FAULTS IN SLIPPING

Fault	Correction
Glider pitches up on entry.	Often caused by poor elevator/pitch control. Entry should be smooth and prompt, not aggressive
Not enough bank on entry.	Applying rudder too soon may be dangerous. This can lead to spin. Apply more aileron; delay application of opposite rudder.
Glider yaws toward lower wing, despite full opposite rudder.	Reduce angle of bank.
Glider pitches up on recovery.	Push forward on control column. Often caused by aggressive inputs. Slow the pace of your control inputs, similar to exiting a gentle turn.
Unable to maintain desired track over ground.	Adjust angle of bank or rudder input.

Figure 5-3 Slip Faults and Corrections

11. **Slipping Turn.** The slipping turn is used to lose height while turning. The yaw or turn induced bank is partially prevented by the application of opposite rudder. It differs from a forward or side slip in that the glider continues to turn while losing altitude. A slipping turn can be started from a straight glide, from a coordinated turn. It can also be entered from a forward slip.

12. To enter a slipping turn from a straight glide, roll the glider into the turn, and blend in opposite rudder to slow the rate of the yaw or turn.

13. To enter a slipping turn from a coordinated turn, reverse the rudder so that the opposite rudder is being applied.

14. To enter a slipping turn from a forward slip, add bank and reduce rudder.

15. In all cases, increased bank will be required to achieve the required rate of turn or a specific roll-out point. To recover, level the wings, release the rudder and adjust the pitch attitude to maintain the desired airspeed. Anytime during the slipping turn, you can revert to coordinated flight by reversing the rudder and adjusting the bank angle

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CHAPTER 6 - STALLS, SPINS, and SPIRAL DIVES

INTRODUCTION

1. This section will familiarize you with the symptoms and recovery from stalls, spins, and spiral dives.

STALLS

2. **Theory of Stalls**. The term stall, when speaking about aircraft, is the condition in which the lift from the wings can no longer support the weight of the aircraft. Normally, the airflow over the wings is smooth, with some minor turbulence towards the trailing edge. As the angle of attack is increased beyond the optimum angle, the airflow begins to break up and becomes progressively more turbulent and the area of turbulence thickens and spreads towards the leading edge. Greater angles of attack produce even more turbulence, until a point is reached beyond which there is a sudden loss of a large percentage of the total lift. This angle is known as the critical angle or stalling angle. The indicated airspeed at which the wings stall is known as the stalling speed. An aircraft can stall at any airspeed, in any attitude, provided that the critical angle is exceeded. The most important factors affecting the indicated stalling speed are weight, spoiler/dive brake position and load factor.

3. Another phenomenon occurs as the angle of attack increases: the centre of pressure (C of P) moves steadily forward until the stalling angle is reached; then it moves sharply back.

4. Because of the loss of lift and the movement of the C of P, two things happen at the stall:

   a. The nose may drop; and

   b. The glider will lose altitude.

5. When the aircraft is completely stalled, a wing may drop and there will be yaw in the direction of the low wing.

6. **What You Must Learn About Stalls**. The four important things you must learn about stalls are as follows:

   a. Recognize the symptoms of an approaching stall;

   b. Take action to prevent the stall, but if not able;

   c. Recognize the stall itself; then

   d. Take the correct recovery action.

RECOGNITION OF IMPENDING STALL

7. Once you recognize the symptoms of a stall, you know that the aircraft is approaching a critical condition of flight that requires fast, positive, corrective action. The following table has been prepared to help you recognize an approaching stall:

Symptom	Method of Recognition
Nose High Low Airspeed	These warnings are most noticeable when the glider is about to stall from the straight glide attitude and are indicated by the lack of wind noise. Individually, a nose high attitude or a low airspeed does not constitute a symptom of a stall, but when they occur together, the glider will stall if you fail to take recovery action.
Sloppy Controls	The effectiveness of the ailerons decreases as the airspeed decreases. At the stall, large movements of the control column can be made with little effect.
Buffeting	Just prior to the stall, the glider often shakes as the turbulent air flows over the horizontal stabilizer. This buffet may be absent during flight in precipitation.

Figure 6-1 Symptoms of Approaching Stall

8. If you continue to ignore the symptoms, you may feel a mushing or sinking sensation indicating that the glider has stalled. Mushing is not always readily apparent, but it is always present. If the stall has been entered from wings level flight, the nose high attitude will still be apparent but the Vertical Speed Indicator (VSI) will show a high rate of descent. If back pressure is maintained on the control column, wing and/or nose drop may occur. Depending on weight distribution, the nose may not drop, but the glider will continue to mush through the air with an increased rate of descent.

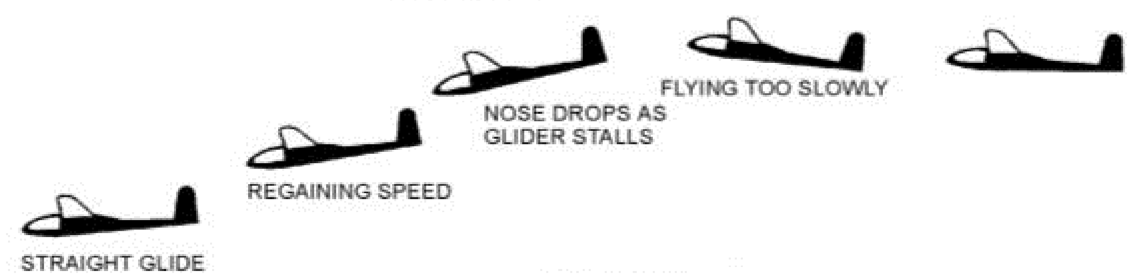


Figure 6-2 Stall and Recovery

STALL RECOVERY

9. The aim in stall recoveries is to recover with a minimum loss of altitude. See your aircraft's AOIs for the appropriate stall recovery.

10. The amount of initial control-column movement depends on the airspeed and the degree of stall. Sometimes, a relaxation of the back pressure is sufficient, while at other times, a firm positive forward movement is required. If you apply too much forward movement, you will lose too much altitude; if you apply too little, you will not recover. Similarly, when easing out of the dive, if you raise the nose too rapidly, the aircraft may go into another stall; if you raise it too slowly, the aircraft will lose excessive altitude and gain excessive airspeed.

11. Normally, you will initiate recovery action as soon as any of the stall symptoms become evident. During your flight training you might allow the stall to fully develop so that you can learn and understand the whole recovery procedure. If there is a wing drop, do not attempt to raise the wing with aileron until you have first unstalled the wings, as this could aggravate the situation by causing undesired roll.

PRACTICING STALLS

12. **Entry.** Always perform a Safety Check before practicing stalls. To enter a straight ahead stall, raise the nose to the desired attitude and let the airspeed decrease. Hold the attitude until you recognize the symptoms of the stall. Either recover immediately or continue holding the attitude to practice a full stall.

13. **Recovery**. Use the standard recovery procedure in your glider AOIs. Do not allow the nose to drop too far or the glider will gain excessive airspeed. The ideal recovery is accomplished by releasing only enough back pressure to unstall the wings and fly the glider out with minimum loss of altitude and without gaining excessive airspeed.

POINTS TO REMEMBER

14. The elevator controls the angle of attack of the wings in flight and any excessive backward movement on the control column can pull the wings beyond the stalling angle.

15. Unless you recognize that the glider is stalled you may attempt to stop the nose dropping by pulling back on the control column. This will delay or prevent any recovery.

16. Easing forward on the control column allows the wings to unstall.

17. When stalling in a turn, the inner wing will usually drop.

18. If a wing drops, ease forward and apply opposite rudder. Then level the wings with ailerons and return to normal flight.

INCIPIENT SPIN

19. The incipient stage of a spin is the transitional stage between a stall and a fully developed spin. It can occur when the wrong technique is used in a stall recovery. Usually, the warning symptoms are obvious enough for you to recognize the incipient stage in time to recover before the aircraft goes into a fully developed spin. Immediate centralization of the controls (primarily the release of back pressure to unstall the wings) results in recovery from an incipient spin to a stabilized condition of flight.

20. If you were to become disoriented or did not recognize the symptoms of an incipient spin, you could go into a fully developed spin.

21. See your AOIs for the appropriate spin recovery.

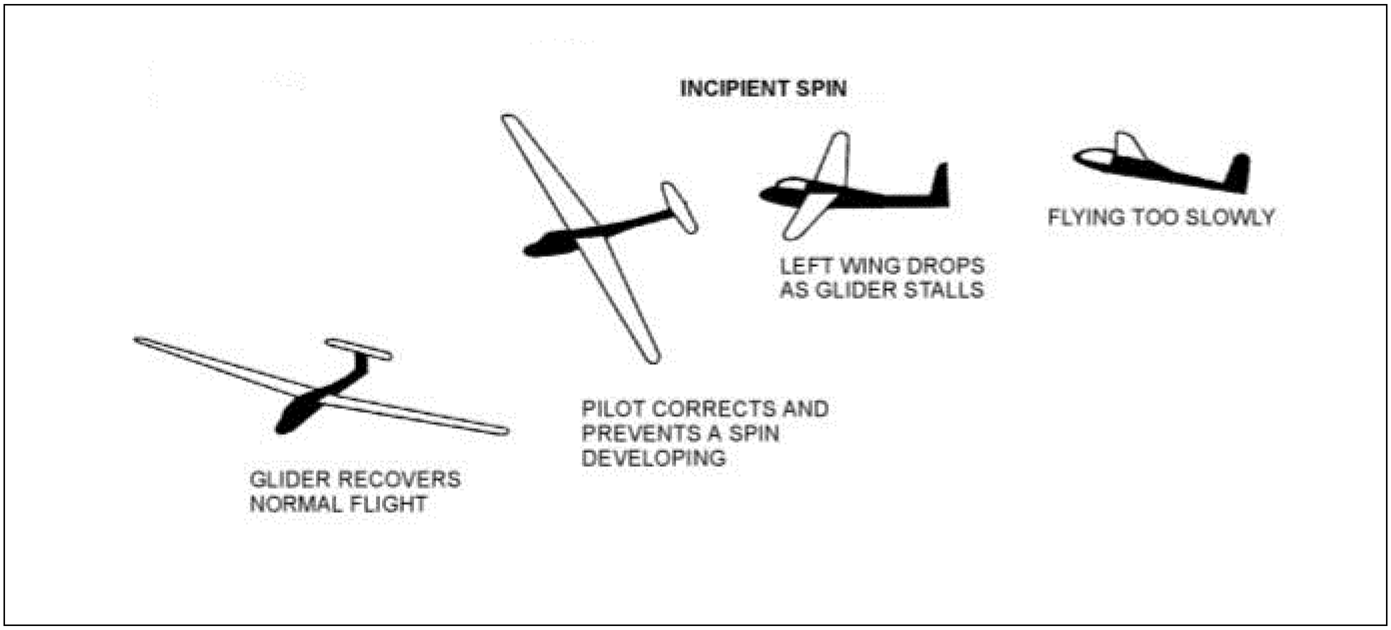


Figure 6-3 Incipient Spin and Recovery

ENTRY – INCIPIENT OR FULLY DEVELOPED SPIN

22. On completion of your Safety Check, enter the spin without delay. Entry can be made from a straight ahead stall or from a skidding turn.

23. Raise the nose just above the horizon or enter a gentle skidding turn while continually adding rudder into the direction of turn and opposite aileron to prevent bank while pulling back on the control column. When you feel the buffet, pull the control column full aft and apply full rudder in the intended direction of spin. If you wish to recover in the incipient stage, recover now. If you wish to practice a full spin, hold the controls in place until the spin develops.

24. To keep the glider in a full spin, hold the control column fully back and at the same time maintain full rudder in the direction of the spin until commencement of the recovery procedure. Due to the glider's stability and length of the wings, the wing tips may not be stalled. Therefore, you might need to hold opposite aileron in during the spin to facilitate autorotation.

RECOVERY

25. To recover from a fully developed spin, you must first break the stall and stop the rotation. In the 2-33, relaxing the back pressure is sufficient to break the stall – dramatically throwing the control column forward is not necessary. Next, to stop the rotation, apply rudder opposite to the direction of the spin. Once the rotation has stopped, roll the glider level using coordinated control inputs, then pull up.

26. Pulling up assertively will minimize altitude loss and avoid contact with the ground. The 2-33 can sustain multiple G's. Pull. The induced drag resulting from the pull up will do more to prevent over-speeding than opening spoilers.

27. During the spin, sit erect and observe the ground through the canopy. Do not move your head unnecessarily. This may induce vertigo and/or airsickness.

SPIRAL DIVE

28. In contrast to the spin, the spiral dive is recognized by increasing airspeed and higher "G" loading. Any delay in recovery will result in both dangerously high speeds and "G" loading.

29. **Recovery.** Use coordinated control inputs to roll the wings level and assertively pull out of the dive. Just like the spin recovery, induced drag resulting from the pull up will do more to prevent over-speeding than opening spoilers.

CAUTION

During the spiral dive recoveries you will have to overcome the natural tendency to pull back on the control column prior to levelling the wings. Increased back pressure will only tighten the spiral rather than bring the nose up.

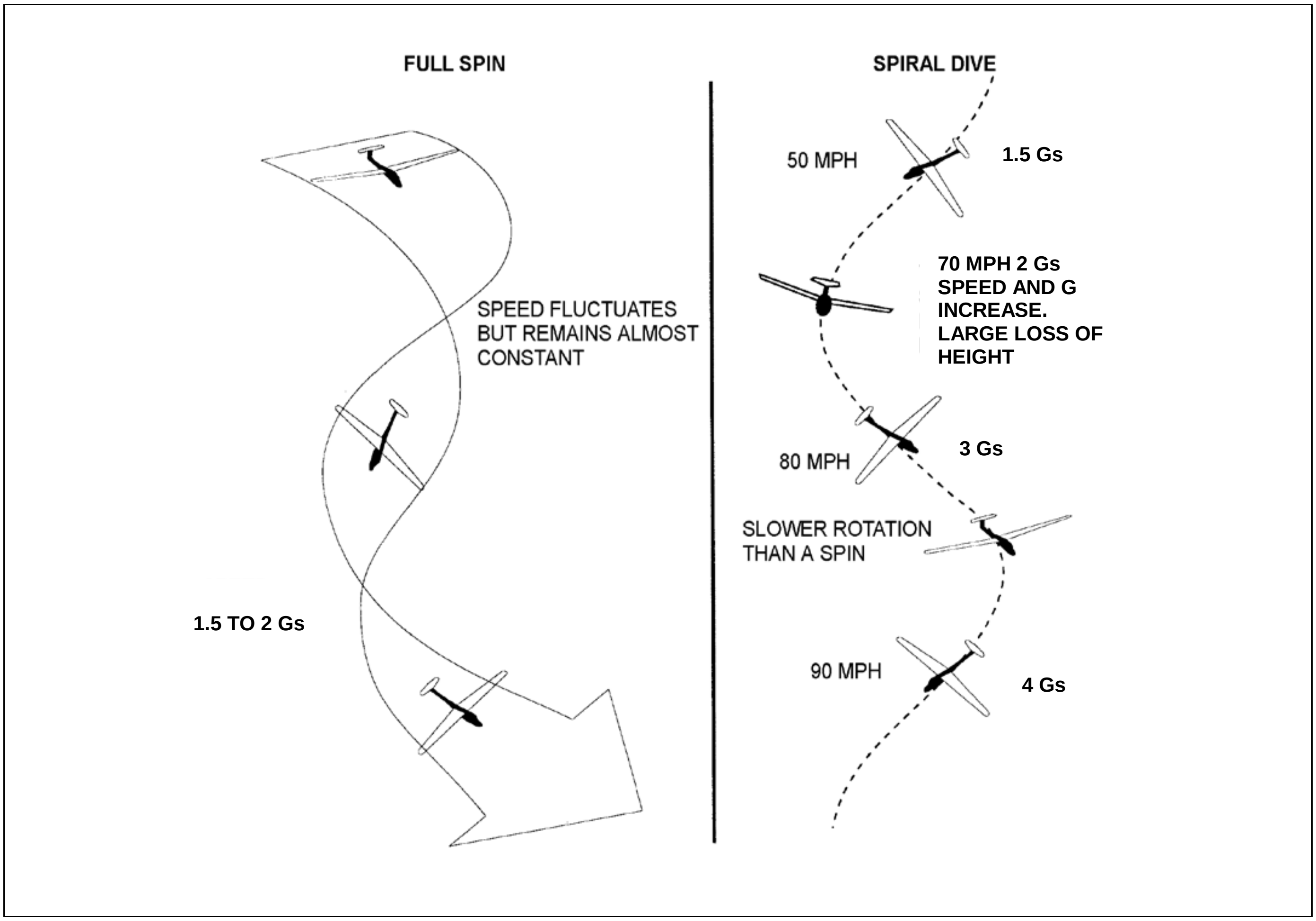


Figure 6-4 Spin and Spiral Dive Recognition

SPIN AND SPIRAL DIVE RECOGNITION

30. It is important to be able to recognize the difference between a spin and a spiral dive. Using the wrong recovery might make the situation worse and you might be unable to recover.

a. Spin:

(1) airspeed may initially increase when the nose drops then becomes relatively constant or fluctuates

(2) descent rate remains constant;

(3) G load remains constant.

b. Spiral:

(1) airspeed increases rapidly and continues to increase;

(2) descent rate increases;

(3) G load increases.

RECOVERING FROM NOSE LOW ATTITUDES

31. When recovering from nose-low attitudes, remember to level the wings before you ease out of the dive. It is possible to exceed the rolling-G limitations of the glider if back pressure is increased while rolling wings level. Further to this, leveling the wings quickly prior to applying back pressure will position the lift vector towards the horizon which will make maximum use of the extra lift produced by increasing the G on the glider.

CHAPTER 7 - AIR TOW

TAKE-OFF

1. Once you are ready for take-off, give the correct signals. Use your left hand for all take-off signals:

   a. Level Wings - give the 'Thumbs Up' while calling out the signal;

   b. Take Up Slack - show the thumb and index finger while calling out the signal;

   c. All Out - show the thumb, index, and middle finger while calling out the signal.

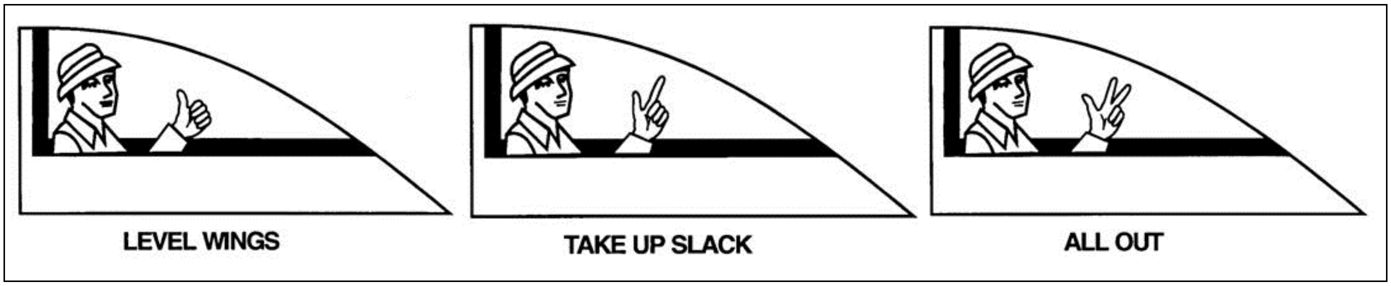


Figure 7-1 Take-Off Hand Signals

2. Maintain directional control with the rudder. Allow the glider to achieve a level attitude and maintain this until airborne. The glider should lift off at about 45 mph; however this speed will vary slightly depending on aircraft weight. Ideally, the pilot will fly at 3 to 5 feet AGL and keep in position directly behind the tow plane. You will find that you have to apply forward pressure on the control column as the glider increases speed.

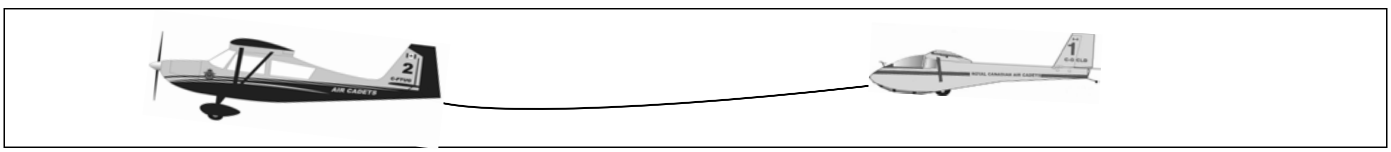


Figure 7-2 Glider 3 to 5 feet higher than tow plane

3. Some types of tow plane, such as high powered or tricycle gear tow plane, will require you to fly somewhat higher than 3-5 feet because their slipstream/wake is stronger/higher.

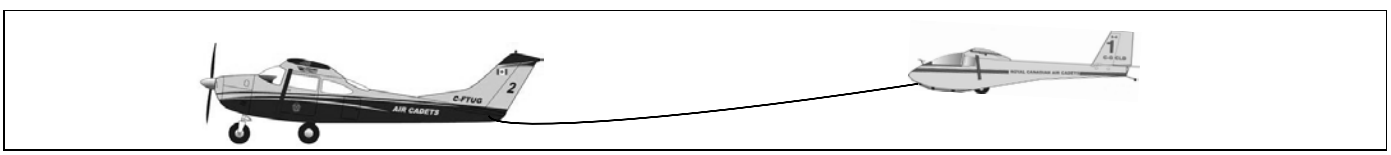


Figure 7-3 Glider higher for aircraft type

4. Control effectiveness is very poor during the initial ground run, so at low speeds all corrections 'initially require large control deflections. As speed increases you will find that a reduction in control inputs will be required.

5. When the tow plane achieves climb speed and climbs out, assume the correct tow position. (See Figures 7-2, 7-3, and 7-4).

6. If the initial climb by the tow plane is steeper than normal, be sure to climb away with the tow plane so as to remain in the correct relative position.

CROSSWIND TAKE-OFF

7. A crosswind affects the glider on take-off. As you move to position on the runway, check the windsock so you can recognize and anticipate a crosswind. Another quick check is to observe the yaw string when lined up behind the tow plane. It will tell you the direction of any significant crosswind.

8. Crosswind take-offs require coordinated action by you the pilot and the wing person to prevent the glider from weather cocking. The wing person should hold the into-wind wing slightly low and continue to do so as the take-off roll begins. Which wing tip is held by the wing person is not as important as ensuring the into-wind wing is somewhat lower. How low the into-wind wing needs to be held, and on which side the wing person should be on will depend upon the actual winds, but ultimately this decision rests with you, the pilot.

9. Before starting the ground roll, you should position the control column into the wind to keep the wing from lifting and apply opposite rudder to track straight down the runway. As the take-off progresses, the controls become more effective and less input is required. The ailerons will then keep the upwind wing down and the opposite rudder will prevent weather cocking.

10. A crosswind take-off requires a higher than normal take-off airspeed to allow a clean break with the ground. This prevents the glider from drifting during the lift-off transition, which can cause excessive side loads on the main wheel.

11. The tow plane will normally still be on the ground immediately after the glider becomes airborne; therefore, crab should be applied to maintain a position directly behind it. Alternatively, the upwind wing can be kept slightly lower and the opposite rudder applied to maintain a straight track down the runway. This is referred to as the wing low method for crosswinds. If crab or the wing low method is not applied, the glider will drift and this makes it extremely difficult for the tow pilot to maintain directional control and may prevent a safe take-off.

12. Once the tow plane is airborne, the tow pilot will apply the necessary crab to maintain runway centreline. You should manoeuvre directly behind the tow plane.

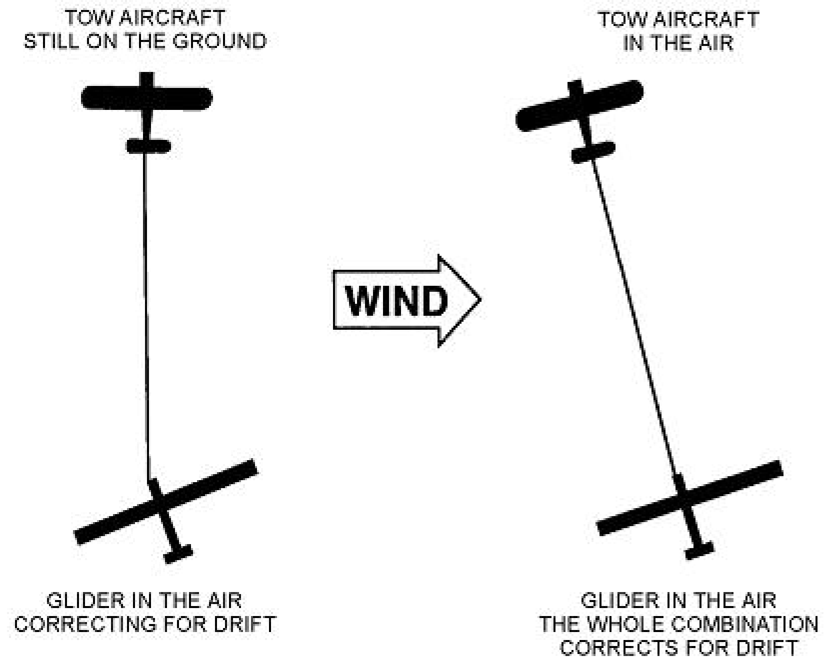


Figure 7-4 Crosswind Take-Off - Crab Method

AIR TOW POSITIONS

13. The two air tow positions in common use are referred to as "high tow" and "low tow".

14. For the high tow or "normal" position, the glider is flown above the tow plane's wake and maintains approximately the same altitude as the tow plane i.e., the tow plane fuselage or wing appears on the horizon.

15. For the low tow position, the glider is flown below the wake of the tow plane, which places the glider approximately 30 feet below the level of the tow plane.

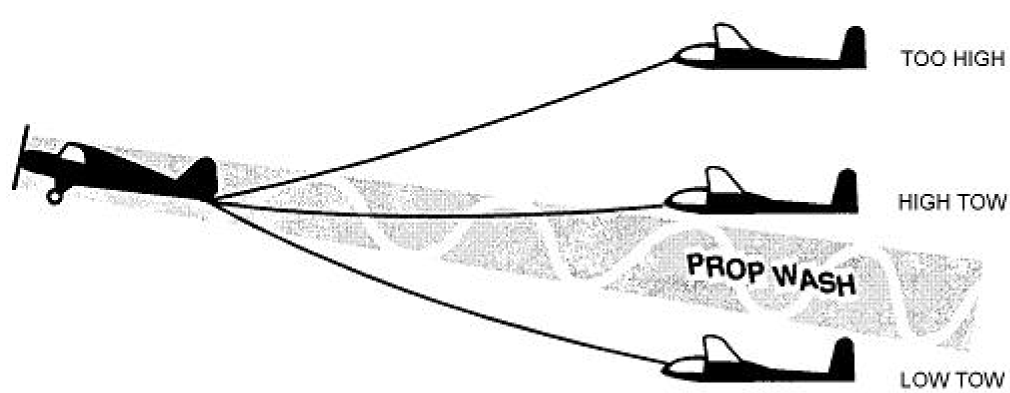


Figure 7-5 Tow Positions

16. Tow Positions Use. The high tow (or normal position) is flown during routine air tow launches, with the low tow position reserved for use during training missions and when descending on tow either to change altitude, to recover a glider under tow, or during cross-country flights.

Use the horizon to position the glider behind the tow plane.

Note the position of the yaw string: directly back indicating coordinated flight while on tow

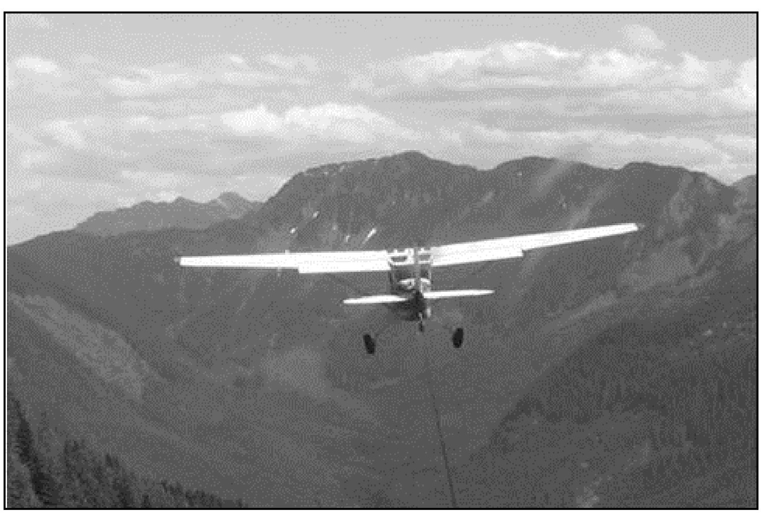
Figure 7-6 Tow Plane Wings on Horizon

17. **Use the Horizon** as your main reference point to position your glider behind the tow plane. There are three common air tow positions listed below. Which is used will depend on the tow plane being used, conditions of the day, and length of tow rope.

a. Tow plane wings on the horizon (Figure 7-6);

b. Tow plane wheels on the horizon; or.

c. "Crossing the X" with the tow plane's horizontal stabilizer as it passed through the wing strut - wheel strut intersection (Figure 7-7).



Note the position of the horizontal stabilizer as it appears to pass through the intersection of the wing struts and wheel struts.

This is a common method used to remain in position for operations without a clear horizon (mountains, haze, etc).

Figure 7-7 Crossing the X

18. **Vertical Corrections.** If the glider gets too high on tow, the tow plane's tail could be pulled up and cause the aircraft to dive. To return to the normal tow position ease forward on the control column. Avoid allowing too much slack to develop in the rope. If needed, use a slip to decelerate. In extreme cases, you may use the spoilers. If so, do this with caution.

CAUTION

If you get into a position where you can no longer see the tow plane, release immediately.

19. If you find yourself too low there is generally no cause for alarm. In fact, some countries do their training in the low tow position. For long distance tows it is the preferred method, as some find it is easier to keep station with the tow plane. In any event, all that is required is to release some forward control column pressure and allow the glider to gently climb back into the proper high tow position.

20. **Lateral Corrections.** You may find yourself off to the side of the tow plane. This is relatively harmless provided you do not start snaking back and forth by making inappropriate control movements.

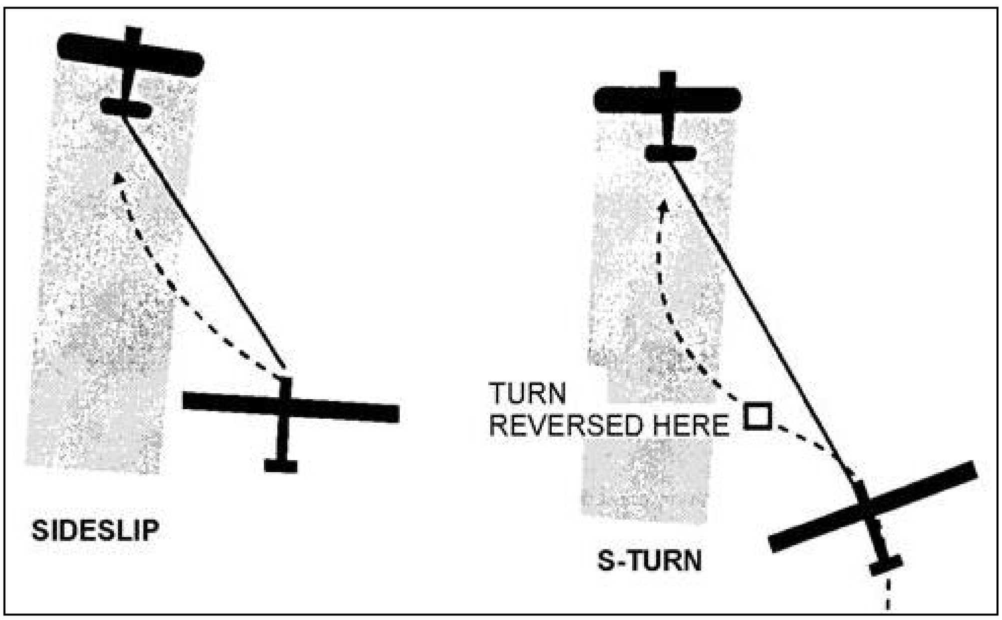


Figure 7-8 Lateral Tow Corrections

21. Lateral displacement can be corrected in a variety of ways:

a. **Do Nothing.** Hold wings level and since the rope is under tension it will pull you back in behind the tow plane.

b. **Sideslip Back into Position.** Apply a little bank towards the tow plane and use opposite rudder to prevent a turn.

c. **Reposition with a Very Shallow "S" Turn.** Make sure you take corrective action prior to obtaining the proper position or you will overshoot your mark.

d. **Keep the wings level and use rudder** to ease back into position**.**

TURNS ON AIR TOW

22. During a turn on tow, the glider's nose should be pointed towards the outside wing of the tow plane (the exact amount will be determined by wing span and angles of bank), the longitudinal axis of each aircraft should be at the same (but opposite) angle to the rope; and the vertical fin should be on the outside of the fuselage (you should see more of the inside of the tow plane’s fuselage).

Figure 7-9 Correct Turn Position

Figure 7-10 Outside of Turn

23. **Position Error in the Turn.** Unintended changes in the angle of bank can lead rapidly to lateral positioning errors. Too much bank and the glider will track to the inside of the turn; too little bank and the glider will track too far to the outside of the turn.

BOXING THE WAKE

24. One of the manoeuvres that you can do is “Boxing the Wake”. This will show you just where the tow plane's wake is, demonstrate the turbulence of the wake, and increase your confidence in handling the glider as you become proficient at moving around and through the tow plane wake.

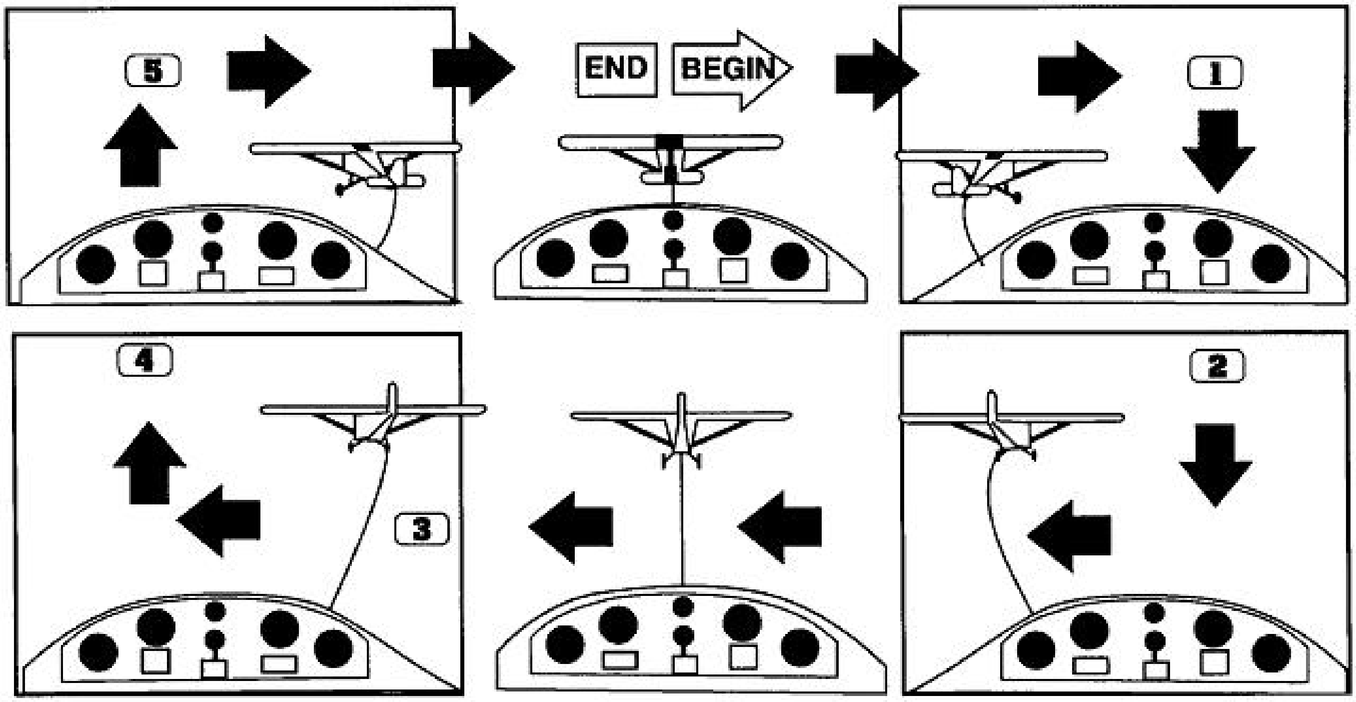


Figure 7-11 Boxing the Wake

25. The objective of the manoeuvre is to move from one tow position to the other, forming a rectangular pattern, and returning to the original position while avoiding the wake. The sequence used is as follows:

a. Using a slight amount of bank, move laterally to a point just outside the wing tip of the tow plane.

b. Holding rudder (to keep from being pulled in), increase the forward control column pressure to descend to the low tow position. Hold position with rudder and elevator. Some forward control column pressure might also be needed.

c. Centralize rudder and initiate a slight bank to move back to the central position, maintaining the low tow position.

d. Using a slight bank, move out to the opposite side of the tow plane.

e. While holding enough rudder to maintain lateral displacement, release some forward control column pressure and allow the glider to climb back up to the high tow position.

f. Slowly release the rudder to allow the glider to resume the normal high tow position behind the tow plane.

CAUTION

Moving rapidly from station to station could result in controllability problems for the tow plane, including Tow Plane Upset.

SLACK ROPE

26. The glider normally follows the tow plane at a distance dictated by the length of the tow rope. However, changes in relative airspeed by either aircraft can cause slack in the tow rope. If the difference in airspeed is substantial, it is possible for a large loop to develop. This presents an immediate hazard since a loop of sufficient size could reach back far enough to entangle a wing or control surface.

27. **Causes.** A change in speed of either the glider or tow plane that allows the two aircraft to come closer together will result in a slack tow rope. Ways in which slack rope may be created are identified in the following subparagraphs:

a. **Climbing** the glider above the normal tow position and then attempting to descend back to the proper position is a manoeuvre often flown by student pilots in the early stages of training. The climb, followed by the sudden descent, provides the glider with excess speed and results in a slack tow rope;

b. If a glider **over-banks** during a turn and moves rapidly to the inside, the fixed length of the rope will cause it to accelerate forward relative to the tow plane. The typical reaction of the student pilot is to overcorrect in the turn back toward the correct position. With extra speed at the glider, the result of the change in direction is slack in the tow rope;

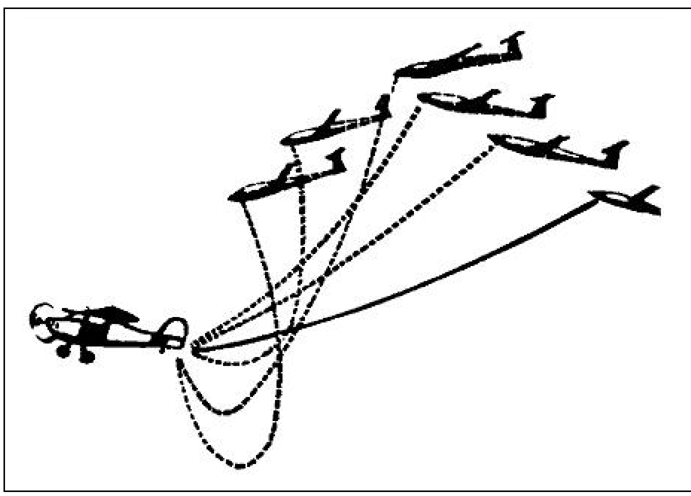


Figure 7-12 Slack from Climb-Descent

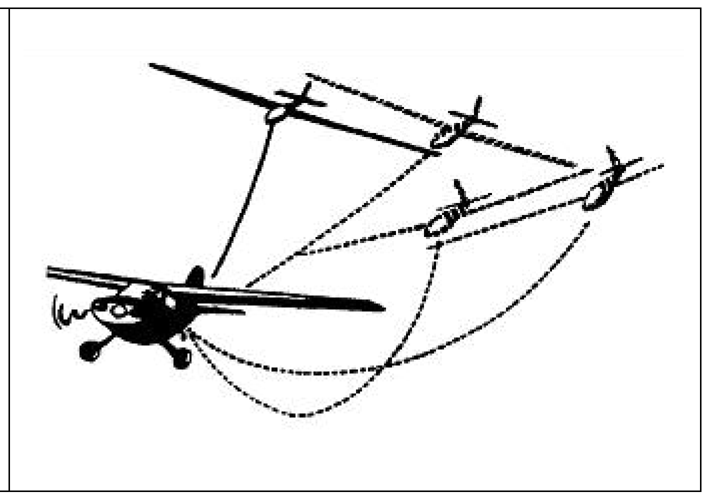


Figure 7-13 Slack During Turn

c. During a **descent**, the tow plane may not gain as much speed as the glider on tow. This can lead to a steady increase in tow rope slack as the glide angle is increased;

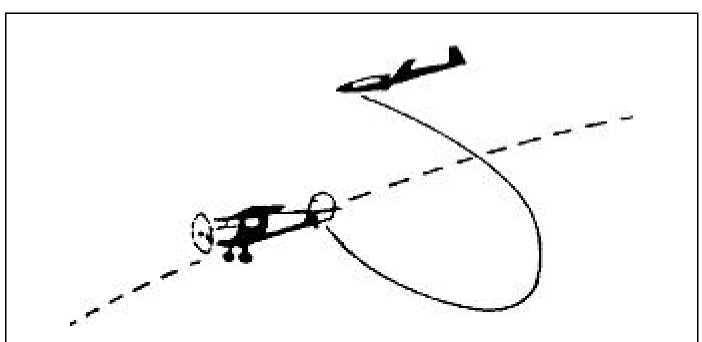


Figure 7-14 Slack During Descent

d. A similar situation is an unexpected **deceleration** of the tow plane can cause the glider to overrun the tow rope; and

e. **Turbulence**, caused by daytime heating and winds, can cause the glider or tow plane to be 'bounced around'. On turbulent days, the tow plane may fly into lift and begin to rise well before the glider arrives at the same area of lift. As the glider pilot behind the tow plane, you compensate for the rising tow plane and allow the glider to rise to regain position. But then the glider also flies into the area of lift. Thus the lift combined with your earlier correction potentially puts the glider in a too-high position. Then, just as you get all this figured out and get the glider back into position, the tow plane flies out of the lift, perhaps into sink. You must now descend to return to position, perhaps gaining speed and creating a slack rope.

28. **Hazards.** The hazards of a slack tow rope include entanglement, an inadvertent back release, a rope break, or damage to the canopy from a released tow rope and ring. Excessive slack is particularly hazardous due to the possibility of entanglement with weaker structures of the glider. Excessive slack combined with light back release tension can also produce an unexpected release at low altitude or during a cross-country tow. Rope breaks commonly occur when slack in the tow rope is followed by acceleration of the tow plane.

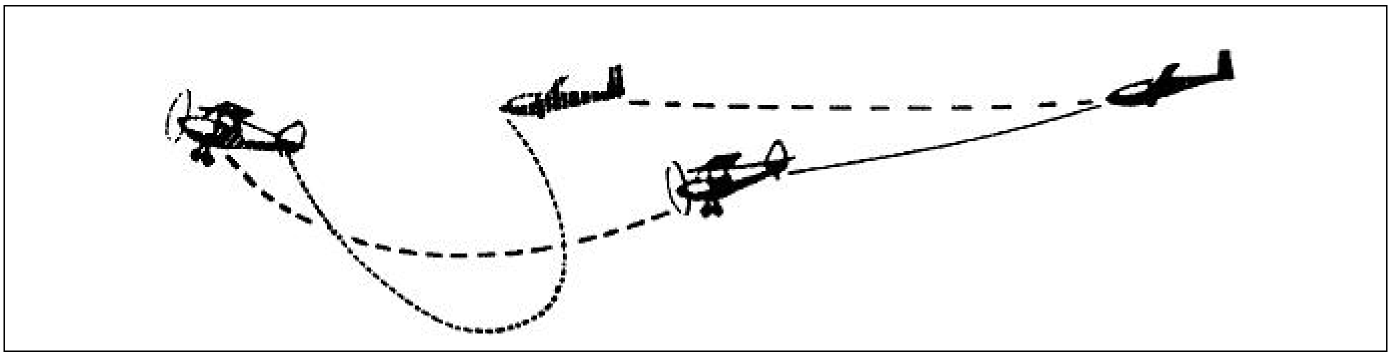


Figure 7-15 Possibility of Rope Break/Back Release

29. **Corrective Techniques.** The degree to which the slack rope occurs determines the urgency with which you must react:

a. Get away from the loop by yawing the nose of the glider away from the slack. When the slack is almost taken up, yaw back into alignment with the tow plane and ease forward on the control column. This will prevent excessive stress on the tow rope and reduce the possibility of the weak link breaking; and

b. Carefully applying spoilers, with or without yawing away, is also an option. When the slack is almost out, close the spoilers and lower the nose slightly;

30. A slack rope, caused by **turning back too rapidly** from an outside acceleration in a turn, can be corrected by:

a. Adjust the angle of bank to coincide with that of the tow plane;

b. Hold position by flying formation with the tow plane allowing the glider to decelerate; then

c. When the rope is taut, move back into the proper tow position

31. For slack rope occurring **during a climb**:

a. Take immediate corrective action to stop the increase in slack by yawing away from the loop;

b. Discontinue the yaw once the slack stops increasing and **STAY AWAY FROM THE LOOP**; and

c. Maintain the same bank attitude as the tow plane and use slight nose down attitude to equalize the glider speed with the tow plane as it accelerates under climb power.

32. For slack rope occurring **during a descent**:

a. Take immediate corrective action to stop the increase in slack by yawing away from the loop;

b. Discontinue the yaw once the slack stops increasing and **STAY AWAY FROM THE LOOP**; and

c. Transition to the low tow position and deploy sufficient spoilers to maintain a taut rope.

33. Do not hold any slack rope corrective technique in place any longer than required. Once the slack begins to decrease, cease any corrective inputs and return to normal tow position. Holding corrective procedures in place any longer may result in the glider being out of position when the slack has been corrected. The resulting sharp pull of the glider back into position may result in a rope break.

TOW PLANE UPSET

34. When a glider on tow rapidly diverges to an excessively high or low tow position, the resulting forces can be sufficient to produce overpowering forces on the tail.

35. Tow plane upset can be caused by you allowing the glider to descend low on tow in the early part of the climb, made worse by poor anticipation when transitioning from a low tow position back to the normal tow position, a poorly controlled transition by the tow pilot from the level accelerating phase into the climb, and the effect of the wind gradient.

DESCENT ON AIR TOW

36. Descent during air tow is used to descend under ATC control, descend to maintain clearance from cloud, or descend during the recovery of a glider under tow. To reduce the problems associated with slack rope which occur during a descent in the "normal" tow position:

a. Gradually move the glider to the low tow position, i.e., below the slipstream; and

b. Deploy sufficient spoilers to maintain a taut rope.

AIR TOW RELEASE

37. Prior to the point of release, carry out a Pre-Release Check that includes ensuring the glider is in a safe location, position, and altitude to release, and ensuring there is no conflicting traffic. See your local SOPs and glider AOIs for specifics of your Pre-Release Check.

38. When ready for release, stabilize the glider in a slightly higher than normal tow position. This position will allow you to carry out a soft release by gently easing forward on the control column to reduce tension on the rope before releasing.

39. A hard release is acceptable, but not ideal since the force of the hook contacting the front release mount can cause damage, particularly when done multiple times a day.

40. At the release point, pull the release knob, hold it open momentarily (1 to 2 seconds), repeat and visually confirm separation from the rope. Commence a gentle climbing turn to the right to provide separation from the tow plane. Once in a straight glide, trim the glider for the desired airspeed.

Figure 7-16 Use Tow Plane to Estimate Height

41. 10 feet above the tow plane is enough to set up for a soft release. If you are unable to determine the sight picture for being 10 feet above the tow plane, use the structure of the tow plane itself. Figure 7-16 shows the highest you should be for release: the tow plane is approximately ½ of a wingspan below the horizon. Other positions are possible depending on tow plane type, rope length, etc.

AIR TOW EMERGENCIES

42. As a glider pilot, it is very important that you are aware of the actions required when an emergency occurs, such as a rope break. The following is a brief overview of some in-flight emergencies that may occur during air tow and some general steps you should take. Always be familiar with the emergency procedures in your SOPs and glider AOIs.

43. **Ground Abort** - Immediately release the tow rope while maintaining positive control of the glider. In those situations where the glider has obtained sufficient speed to overtake or pass the decelerating tow plane, manoeuvre to the right (the tow pilot will move to the left).

44. **Canopy Open In Flight** - An inadvertent opening of the canopy in flight is not common, but may happen. Remain calm and:

a. Continue to fly the glider (Aviate);

b. Assess your situation considering the phase of flight, position, and altitude (Navigate);

c. If able, close the canopy;

d. If unable to close the canopy, plan for sufficient altitude and airspeed to compensate for the increased drag when returning for landing; and

e. On air tow, consider communicating with the tow pilot via radio, remembering to compensate for the wind noise picked up by the microphone (Communicate).

45. **Deployed Spoilers During Air Tow -** In the event you have inadvertently left the spoilers deployed during take-off, the tow pilot may not be able to maintain a climb or even level flight. If time and altitude prevent the tow pilot from contacting or signalling you to close your spoilers, the tow pilot may release you without warning.

a. If time and altitude permit, the tow pilot will signal you by vigorously moving the rudder from side to side. This visual signal is the quickest way to advise you that the spoilers are deployed. The tow pilot might also follow up with an advisory radio call;

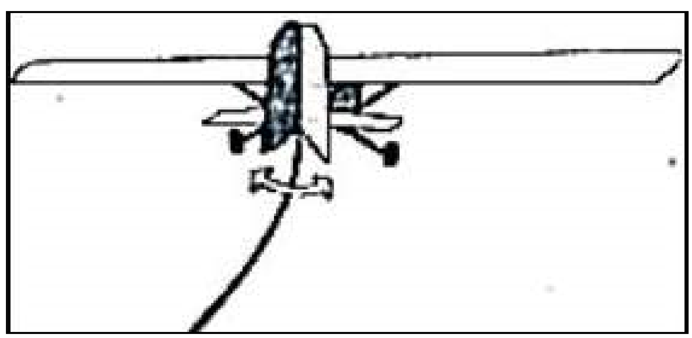


Figure 7-17 Confirm Spoilers Closed Signal

b. Immediately close your spoilers. Visually confirm they are closed; and

c. If spoilers are not (or cannot be) retracted and the tow pilot is able to continue with the air tow, anticipate a climb to a position and altitude from which a safe recovery of the glider is possible.

46. **Tow Plane Emergency** - In the event of a complete engine failure:

a. If time permits, the tow pilot will signal you to release by rocking wings vigorously; and

b. You must release the glider immediately, set the attitude for best glide, and complete the emergency procedure appropriate for the remaining altitude.

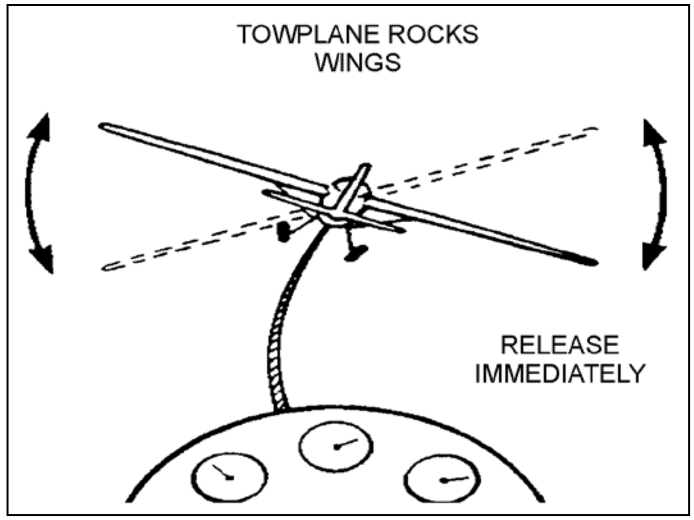


Figure 7-18 Emergency Release Signal

47. **Tow Plane Power Loss -** Glider pilots should always be prepared for a tow plane engine failure. Most often, and if possible, tow pilots will consider their altitude, position, and your experience level in their decision to release the glider. If reduced tow plane engine performance does not inhibit safe flight, the tow pilot may tow the glider to a position ensuring a safe recovery for both tow plane and glider.

48. **Tow Plane Upset**. Tow plane upset is caused by the rapid movement of a glider on tow to an excessively high position, and can be accompanied by glider movement well to the right or left of the normal tow centre line.

a. If a glider climbs on tow, it also increases its airspeed because it flies around the arc of the circle whose centre is the tow plane. Increased airspeed makes the glider climb even faster, and the result is a slingshot effect. The elapsed time in such an occurrence, from normal tow to an uncontrollable situation, is as little as three seconds. The vertical and horizontal forces generated at the tail of the tow plane can cause a severe pitching motion resulting in the complete elimination of lift through the creation of a negative angle of attack or an angle of attack exceeding the stalling angle. A simultaneous horizontal force can produce a yaw sufficient to place the tow plane in a spin;

b. Altitude may not be sufficient to recover from the tow plane upset and subsequent spin, especially if the upset occurs below 1500 ft AGL; and

c. The risk of tow plane upset is particularly acute if tow ropes significantly shorter than 200 feet are being used. For example, momentary loss of control by a glider pilot attempting to close a canopy that has opened or a rapid, over-controlled attempted recovery from a low position can easily lead to a position well above the height of the tow plane. With a short tow rope, the vertical component of the load vector at the tow plane's tail increases rapidly as the glider moves out of position. See your SOPs for rope lengths approved for use at your location.

49. **Glider Cannot Release from Tow Plane**. In the event that the glider release mechanism fails to release the tow rope, proceed as follows:

a. Notify the tow pilot of the release malfunction by radio, and prepare for release by climbing approximately 20 feet higher than the normal high tow position;

b. If radio communication is unsuccessful, fly out to the left and level with the tow plane so as to be in a position to be easily viewed by the tow pilot. Once this position has been achieved, briskly bank your wings back and forth to indicate to the tow pilot the failure to release; and

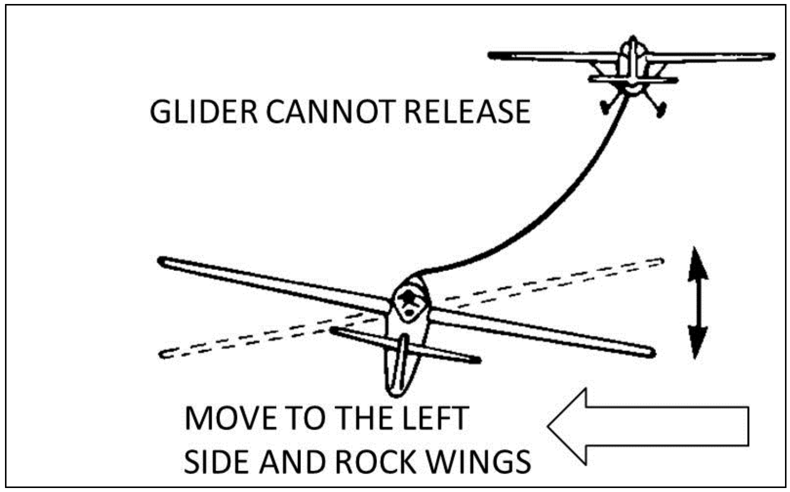


Figure 7-19 Glider Cannot Release Signal

c. For the final approach, maintain an altitude high enough to allow the trailing tow rope to clear all obstacles and personnel.

50. **Glider and Tow Plane Cannot Release**. In the event that neither the tow plane nor the glider can release:

a. Descend to the low tow position and deploy full spoilers. The spoilers should be left fully deployed for the recovery and maintain the low tow position throughout the approach and landing;

b. Expect the tow pilot to modify the circuit to lengthen the final approach and to land long so that the glider does not get below a normal glide path;

c. After landing, expect the tow plane to decelerate quickly because of your glider skid contact and braking; and

d. During roll out, move to the right hand side of the tow plane. The tow plane will move left.

CHAPTER 8 - GROUND BASED LAUNCH

GENERAL

1. Ground based launching refers to Winch and Auto launch methods. The only difference between winch and auto launch methods is the very early stages of launch: auto launch is similar to air tow until the glider lifts off, and then the launch profile, techniques, signals, and hazards become the same for either method.

2. These paragraphs are only a brief synopsis of ground based launching. Pilots should refer to A-CR-CCP-302 ACGP How to Winch Manual for the full discussion on winch launch techniques.

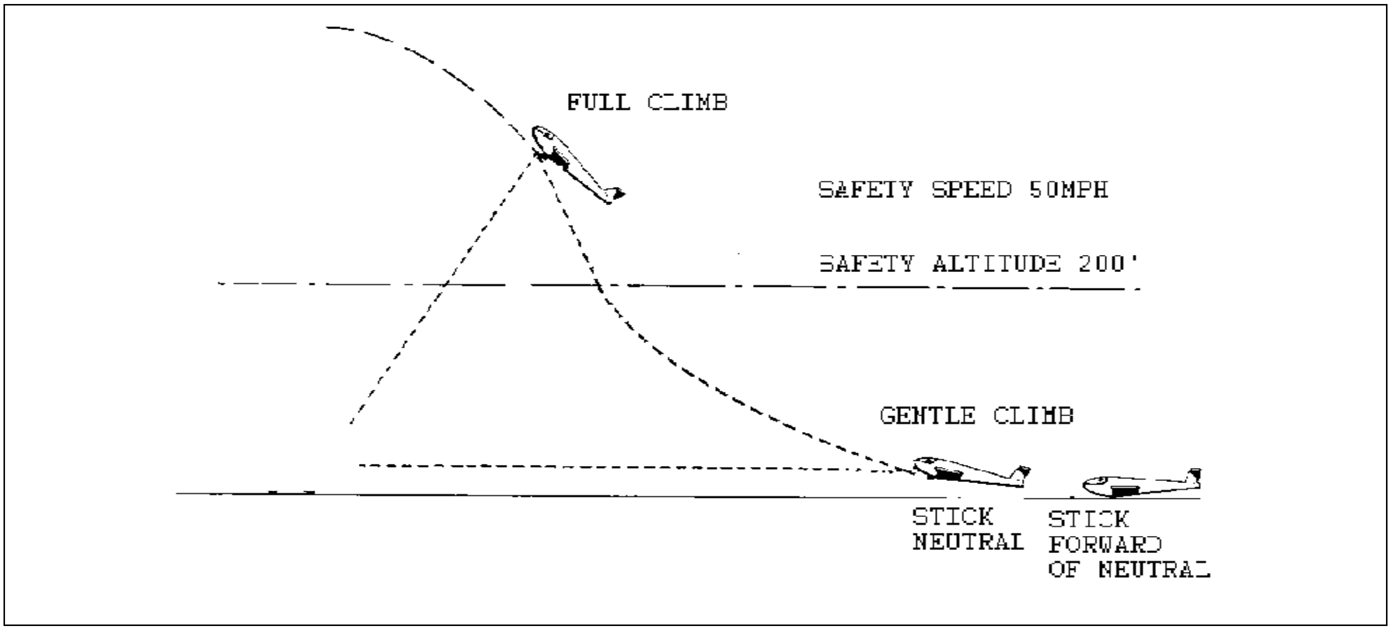


Figure 8-1 Ground Based Launch Profile

TAKE-OFF AND CLIMB

3. On initial take-off, adjust the control column pressure to become airborne yet remain in a gentle climb angle until safe climbing speed is reached.

4. Do not fully raise the nose to the best climb angle until passing through 200 feet AGL and achieving the glider's ground based launch Safety Speed. The ground launch safety speed for any glider is based on the formula: $1.5V_S$. Refer to your AOIs.

WARNING

Never put the glider into a nose high attitude such that it will be impossible to safely recover should a launch failure occur.

5. During the climb, maintain the airspeed at approximately 25 mph above the stall speed.

6. **Maximum Ground Based Launch Speed** - If the airspeed continues to increase after

the maximum climb angle has been established, and is such that the maximum ground based launch speed may be exceeded, immediately reduce the climb angle by lowering the nose to prevent over-stressing the glider. If this procedure is unsuccessful:

a. **But** the airspeed is still <u>within acceptable limits</u>, yaw the glider from side to side to signal a reduction in power.

b. **And** the airspeed exceeds or <u>will probably</u> exceed the launch limit speed, immediately abort the launch and carry out a landing as specified in your glider AOI emergency procedures.

7. **Ground Based Launch Speed** - If the airspeed falls below the ground based launch Safety Speed, or will <u>probably</u> decrease below this speed, immediately abort the launch and carry out a landing as specified in the AOI emergency procedures.

8. **Top of Climb.** If the glider porpoises (bounce up and down) at the top of the climb, release some of the back pressure on the control column until the porpoising ceases.

9. The nose of the glider being pulled down towards the horizon is an indication that maximum altitude has been gained.

10. **Releasing Tension.** Before activating the release, check forward slightly to take release the tension off the rope.

CLIMB CONTROL SIGNALS

11. In the event that a reduction in the climb speed is necessary, reduce the climb angle and yaw the glider from side to side to signal for a reduction in power.

12. If the glider exceeds, or is accelerating so fast that the glider will likely exceed the maximum ground based launch speed, activate the release.

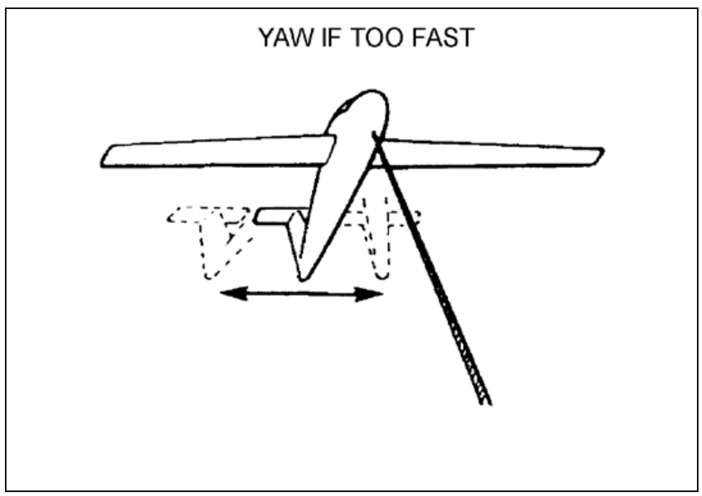


Figure 8-2 Too Fast Signal

13. There is no 'too slow' signal for ACGP ground based launches. If the glider airspeed falls below the Safety Speed, activate the release.

LAUNCHING IN CROSSWINDS

14. Drift will probably not be constant throughout the climb because of the wind gradient. To eliminate drift and maintain a straight line in the climb, initiate gentle coordinated turns into the wind (as if using crab in the circuit).

15. If required to avoid obstacles, plan to release the rope upwind of the launch area so that the wind drift will not cause it to fall in an unwanted position.

GROUND BASED LAUNCH EMERGENCIES

16. **Ground Abort.** If there is any possibility that the glider may overrun the rope on an aborted ground based launch, immediately release and manoeuvre the glider to provide separation from the rope and associated launch equipment.

17. **Power Loss / Premature Release -** The nose high attitude and rapidly decreasing airspeed that exists immediately after a rope break is quickly followed by an initially high rate of descent as the aircraft recovers normal flying speed. In ground based launch operations, downwind landings are discouraged because they are often difficult to execute properly, due to the position of the glider being only partway up the runway during the majority of the launch. Always refer to your SOPs and AOIs for altitude specific emergency procedures.

18. **Release Mechanism Failure.** In the event you are unable to release the rope during a ground based launch, over-fly the winch or launch vehicle and attempt to generate a back release. If this does not work, the winch operator will use the guillotine or the launch vehicle operator will use the vehicle release. In either case, you will have to plan your approach with enough altitude to allow the trailing rope to clear all obstacles and personnel. Use your radio for communication with the ground to assist with your approach planning.

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CHAPTER 9 - SOARING

1. The following material has been extracted from a variety of popular soaring sources. This material should not be taken to be an endorsement of procedures contrary to those detailed in the ACGPM or your local flying orders. Familiarity with this information will benefit you when gliding for longer period of time than a routine training mission, when trying to stay aloft to build time, and when conducting actual soaring missions. These paragraphs discuss conditions commonly found at most ACGP gliding locations. For more information on soaring check out the Soaring Association of Canada website or books. When viewing other sources of soaring information, please remember you fly the 2-33 Schweizer - its flight and safety characteristics may be quite different than the newer designs most often discussed in up to date soaring manuals.

THERMALS – THEORY

2. A thermal is a mass of air that ascends because it contains water vapour, or is warmer and therefore less dense than the air around it. As the thermal rises, it mixes with the surrounding air and grows larger. Usually it seems to break away from the ground as a bubble and then develops into a doughnut or vortex ring shape that gradually grows in size as it gains height.

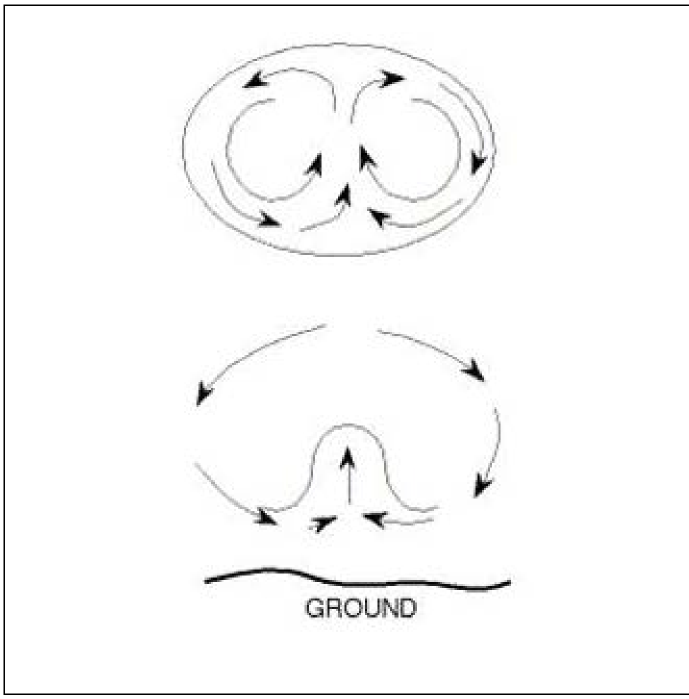

Figure 9-1 Vortex Ring Thermal

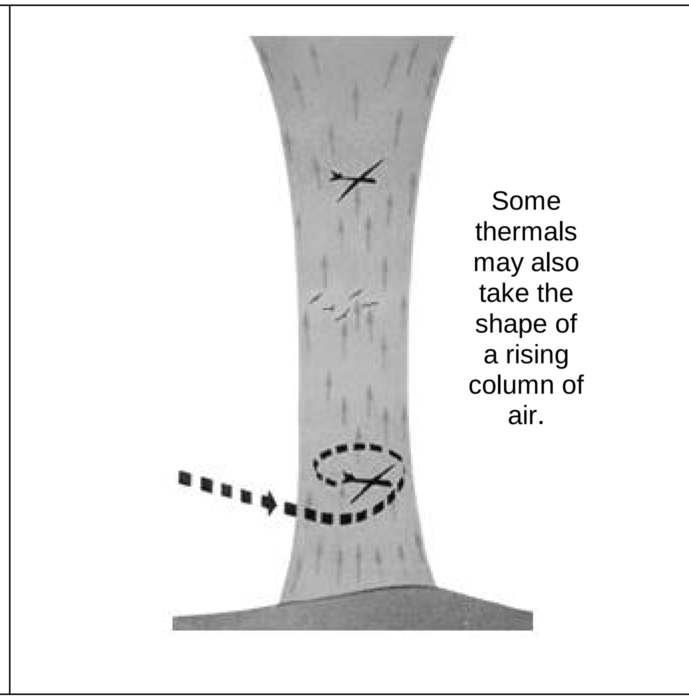

Figure 9-2 Rising Column Thermal

3. The reduction in the atmospheric pressure with height causes both the thermal and the surrounding air to cool down. Unless the air is very dry, the moisture in the thermal will eventually condense out to form a cumulus cloud. As this happens, the latent heat absorbed when the moisture was evaporated at ground level is released. This extra heat helps to strengthen the lift in the cloud while the cloud is developing.

4. The life of a cumulus cloud is of particular importance to glider pilots. The first sign of

the cloud is a patch of milky haze. Wearing sunglasses will help make the haze patches more visible. Then wisps of cloud form which rapidly develops into a firm looking cloud with a flat base and a rounded top. After only about ten minutes, the edges and bottom of the cloud become ragged and the cloud quickly erodes and disappears. In some cases this process is prevented by a fresh thermal revitalizing the cloud. If the cloud is a large one, it may develop on one side and dissolve on the other.

5. When the air in the cloud starts to descend, the cloud begins to evaporate and this will absorb large quantities of heat. The cooling of air because of this evaporation will cause strong down-currents. Glider pilots must learn to distinguish which clouds are still developing, and must try to avoid flying near clouds that have started to decay.

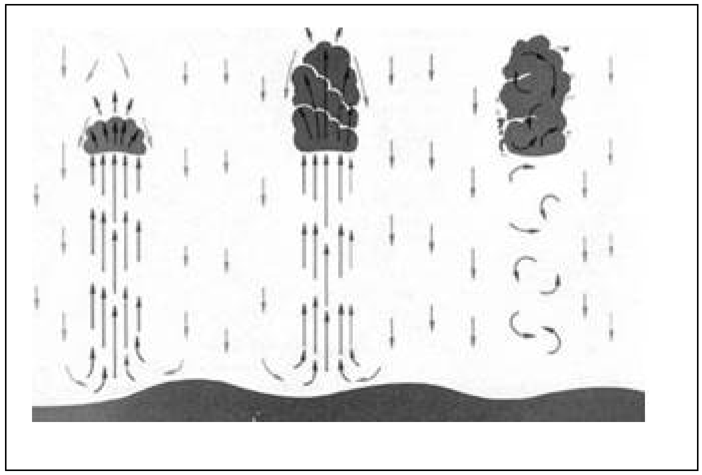

Figure 9-3 Cumulus Stages

6. If cumulus clouds are forming, the best method of finding a thermal is to search near the cloud for the thermal that is creating it. On many occasions there are no clouds and you must search the ground for places that are likely to produce thermals. Thermals are produced by air that has become warmer that the air in the surrounding area and number of factors in combination can be used to predict where thermals may occur.

7. The general characteristics of a thermal may vary widely in different conditions. Some thermals are large and smooth, and others are narrow and turbulent. In average conditions, the rate of climb may be over 900 feet per minute. In thunderstorm conditions, climb rates of 2000 feet per minute are normal. The size of a thermal is quite important because the glider must be able to fly inside of it to climb. Below 500-600 feet most thermals are either too weak or too narrow to be used effectively. Thermals drift downwind as they rise, so cumulus clouds will form downwind of the thermal source.

8. The shape and form of thermals is very complex and variable, and there seems to be no hard rules for their development. Normally though, the position of best lift on a particular day will usually be found to be in a consistent position relative to the clouds and cloud shadows. You should try to analyze the position of the best lift relative to the cloud in the first few thermals and determine if all of the thermals conform to the same pattern. If they do, heading directly to that position under each cloud can save time.

THERMALS – CREATION

9. The essential condition for the production of a thermal is that one mass of air must be warmer than the air surrounding it. The actual temperature of the air mass is unimportant, and thermals can in fact be found in both tropical and arctic conditions.

10. When the heat and light waves from the sun strike the ground, some are absorbed and

raise the temperature of the surface, but the rest are reflected back into the atmosphere and dissipate. The increase in temperature of the ground will vary depending on the surface. If the heat waves from the sun must pass through a layer of cloud or dust before reaching the earth, a large proportion of them are absorbed and do not reach the ground. A thin layer of cloud or smog can prevent or seriously limit thermal activity. During the course of a day in which good soaring conditions exist, there are often periods when the overdevelopment of cumulus clouds cuts off direct sunlight. This results in a period of poor conditions as the cloud disperses and is followed by a gradual improvement.

11. The amount of radiation absorbed by the earth also depends on the angle at which the sun's rays strike the ground. In winter, the days are very short, and by the time that the ground has become warm enough to commence thermal activity, the sun is beginning to go down again. In hilly country, the surface heating will be much greater on slopes facing south, where the sunlight strikes the ground at almost right angles. Usually, high ground or hilly ground is good for producing thermals, and thermals starting from hilltops are likely to be stronger than those from adjacent valleys. Higher ground in usually better drained than lower-lying land, and will warm more rapidly. A thermal leaving the valley will have lost part of its heat by the time it risen to hilltop height, and will be cooler and weaker than a thermal starting from the hilltop.

12. The type of soil, the surface and the crops all have a strong influence on the creation of thermals. Sand and chalk soils are good thermal producers, whereas clay is generally poor. A study of a geological map is often valuable if planning a long distance flight. Drainage is often the most significant factor. Even a light rain shower will cool the ground sufficiently to prevent thermals from forming for some time. A dark surface will absorb more heat than a light one, but the ground being damp or covered by crops may offset this. Smooth surfaces also get hotter than dark ones, and black top highways, runways and parking lots may generate strong thermals.

13. Woods are very slow to warm up, and are usually much colder than any surrounding fields until late in the afternoon. Once they have warmed up, they give off their heat slowly and remain much warmer than their surroundings later on in the day. This is because the trees trap large quantities of air. Thermals from wooded areas seem to be large areas of very weak lift that are often best used by cruising without circling. If the woods are extensive, a slight diversion to fly over them may enable the flight to be carried on for many more miles when all other thermal activity has died out.

14. Long corn and similar crops can trap large quantities of air and prevent it from breaking away from the ground until it has reached a high temperature, giving good thermals.

15. High winds make if difficult for large thermals to exist near the ground, although even on the windiest days there may be strong lift just below the cumulus clouds. The coastline has a pronounced effect on the production of thermals. In summer, the land soon becomes warmer than the sea, but cools down again at night so that it soon becomes cooler than the sea, causing land and sea breezes. The cool air from the sea takes some time to warm up enough to produce thermals, so with a sea breeze, few thermals are formed within five to fifteen miles of the coast.

FINDING AND USING THERMALS

16. Birds often use thermals, and can instinctively find them. Watching birds can help an observant glider pilot find areas of the strongest lift. In strong thermals, dust and pieces of paper may be carried up, giving a clear indication of the location. Dust devils may also form. The best time of day to look for thermals to start is between mid-morning and mid-afternoon.

17. One of the most noticeable indications of thermals leaving the ground on a mostly calm day is the change in surface wind. The occasional cool breeze felt on a summer day is the air moving in to take the place of the air in a rising thermal. The breeze will blow towards the rising thermal.

18. Cumulus clouds in their developing stage mark the top of a thermal.

19. At low altitudes or whenever the conditions look poor, the glider should be flown at the speed for best gliding angle so that the maximum amount of air is covered. If the rate of sink of the glider is abnormally high, indicating that the glider is flying through sinking air, height will be conserved by flying a little faster for a few moments to reach better conditions. If rising air is encountered, even if it is too weak to result in anything but a reduced rate of sink, speed should be reduced to the minimum sink speed. The aim should be to cover as much air as possible while searching and no circling should be done unless lift is found.

20. A surface wind in excess of 10 knots usually means stronger winds aloft resulting in vertical wind shear. This shear causes thermals to lean noticeably downwind. When seeking a thermal under a climbing sailplane and you know or suspect that thermals are leaning in shear, look for lift upwind from the higher aircraft.

21. During the search it is important to fly the glider in straight lines and not to let it turn. Otherwise it will turn slightly away from the outskirts of thermals. Reduced sink may indicate the edge of a thermal, a thermal just forming, or one just ending. A turn should be made immediately to explore the surrounding area for stronger lift. Because the vertical speed indicator lags, waiting until a strong rate of climb is shown will likely put the glider beyond the strongest part of the thermal.

22. Generally, slight turbulence, and then a sensation of rising will be felt as the lift is encountered. If the glider happens to fly through the extreme edge of the lift, it may be banked away from the thermal, and a turn should be made immediately towards the wing that was raised. Within a few seconds of starting the turn, the vertical speed indicator shows whether it has been made in the correct direction. If the turn has been made the wrong way, it is best not to change the direction of the turn. Instead, keep a steady turn with constant speed and bank. This will ensure that the glider will come back into the lift again and that there is no chance of losing all contact with it.

23. Generally, the strongest lift is found at the center of the thermal. One of the simplest methods of centering in a thermal is first to assess the readings of the vertical speed indicator to find where the best lift lies and then to move the glider over until it is circling in the strongest part of the thermal. As you circle, wait until the vertical speed indicator registers a climb, and then level the wings briefly to fly straight into the area of stronger lift. Fly straight for 2-3 seconds before resuming the turn. The radius of the turn can be affected by a change in the angle of bank, variation in airspeed and by inaccuracies such as slipping or skidding. Unless

the bank is held constant and the speed steady, the turn will be uneven and the thermal may be lost.

24. Any banking should be done briskly, with good co-ordination. The best airspeed to fly is the minimum sink speed, or a few miles per hour above the buffet-before-the-stall. If the buffet is felt, the airspeed is to low, and the airflow over the wing is creating excess drag.

25. Lift is usually weaker near the base of the clouds, and is stronger at slightly lower altitudes. When the lift is divided into areas of strength, they are referred to as 'bands'. It is in the lower height bands, between 2000 feet AGL and about 1500 feet below the base of the cloud that the strongest lift can often be found. By using only the lower height bands, a glider can be flown cross-country at a higher average speed, because less time is spent climbing in weak areas of lift.

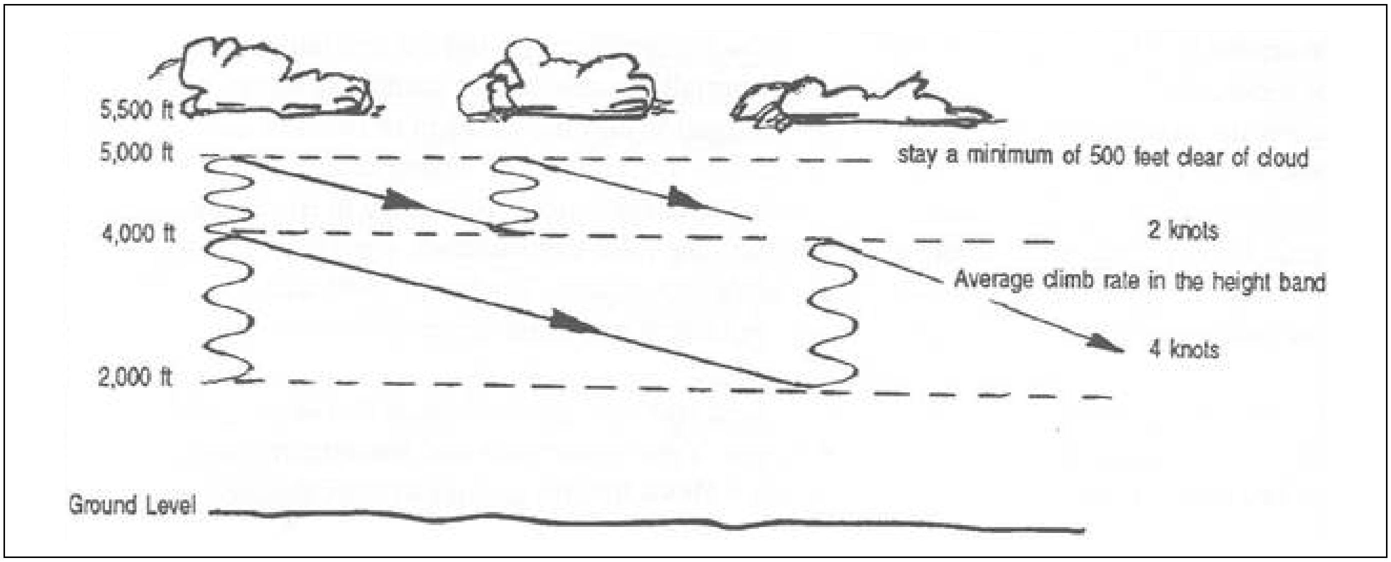

Figure 9-4 Height Band Technique

SAFETY IN THERMALS

26. The risk of collision during thermalling is a very real one, and therefore each pilot must know the positions of nearby gliders at all times, and all gliders must turn in the same direction. When joining other gliders in a thermal, it is dangerous to fly straight into the centre, even when the other aircraft are well below. The difference of height will disappear very quickly as you fly through the sinking air near the thermal and as the other gliders continue to climb. Instead, start a wide turn outside the other gliders and only move in when you are opposite to the nearest one. This gives the other pilot a reasonable chance to see you.

27. A useful method for maintaining a good lookout while circling in a thermal is to imagine your 360° turn divided into three segments of lookout, with brief (1 or 2 second) periods between for glancing at the instruments. Blind spots are most often located behind and above the glider, and these areas should be checked regularly.

28. Never pass close under or over another glider. It may dive or pull up without realizing you are close by. When two gliders are climbing in nearby cores, both pilots should take care to prevent their circles from intermeshing. Any need for sudden avoiding action is a sign of

danger. Never assume that the other glider has you or will take avoiding action. Always leave the thermal if you loose sight of a nearby glider for more than a few seconds.

HILL/RIDGE SOARING

29. When wind blows over a hill or similar obstruction, the air above it is deflected upwards and can be used by a glider. If the ridge is small or the wind is light, this lift may only be sufficient to delay the descent. In better conditions the lift may be sufficient to support the glider up to two or three times the height of the hill. Provided that the wind keeps blowing in the right direction, there is almost no limit to the duration of soaring flight in this kind of lift. The height, shape and length of the hill have a great influence on the strength and area of the lift.

30. The wind meeting the hill will try to avoid flowing directly over it and will spill around the ends of the hill, so that the lift there will be poor. A long ridge of hills is much better for soaring than a short or isolated hill of the same height. The lift may also be spoiled if the ridge is in the lee of other hills.

31. Provided that the shape of the hill is reasonably smooth, the best lift will be found over or in front of the steepest slope. A cliff will give good lift but there is often an area of turbulent air close to the face where the air piles against the steep obstruction. The surface of the hill can seriously affect the strength of the lift, particularly at low altitudes. If the slope and foot of the hill are wooded or broken ground, the lower layers of air will be slowed and made turbulent so that, although the lift may be strong at height, the lift near the hillside may be poor and patchy, resulting in a forced landing of the glider gets low.

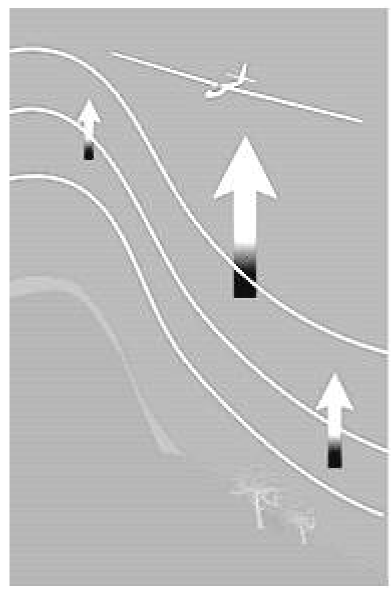

Figure 9-5 Ridge Lift

32. The lift is stronger and extends higher on days when the air is unstable. The direction and strength of the wind are the greatest factors affecting the soaring conditions. Good soaring is usually only possible when there is adequate wind blowing within about 20° to 30° of a direction perpendicular to the line of the ridge.

33. However, if the hill has spurs and indentations, it is often possible to soar a very limited part of the hill, wherever there is a long enough face more or less into wind.

34. To best utilize ridge or hill lift, the glider is flown into a position in front of the brow of the hill and is moved along the ridge by turning slightly out of wind so that a gradual movement along the ridge is obtained without being blown beyond the top of the hill. The position of best lift in relation to the ridge varies considerably and only experiment will determine whether it is better to fly directly above the hilltop or forward of it. When flying in the lift, the speed flown should be minimum sink speed, or slightly higher as need to prevent drifting with the wind. In sinking air, speed should be increased to progress along the ridge in search of better conditions

35. Even very experienced soaring pilots should consult local instructors before flying at an unfamiliar site. Ridge lift is limited in use by the height that it reaches, and should generally be considered as a way of extending the length of the flight in order to locate thermals or wave lift. Within 500 feet of the hillside no thermal turns should be made as they interfere with the routine of other gliders and increase the risk of collision.

36. The take-off and landing area may be at either the top or the bottom of the hill. Ideally, suitable fields should be available in both positions, so that launches can be made from the top and emergency landings at the bottom when required. The greatest disadvantage of the site on top of the ridge is that when the wind is strong and ideal for soaring, there is likely to be an area of strong turbulence and high sink rates on the approach and landing. The winds at circuit altitude are often very strong, and the glider will make very little forward progress through them at normal flying speeds. In marginal conditions, the site at the bottom of the hill has a distinct advantage, as soaring can continue below the top of the hill and still end with a normal landing at the site.

37. Once the glider sinks down to the level of the hilltop, the possibility of a landing at the bottom of the hill must be considered, and fields selected. It is possible to cruise for some distance in the small amounts of lift near to the ridge to move closer to more suitable landing areas. Once above such fields, the flight can be continued in the hope of the lift improving, and a landing can be made if this doesn't occur. If a landing at the base of the hill is necessary, the altimeter should be ignored, so that differences in height from the takeoff point don't cause confusion.

38. Good hill soaring conditions often cause overcrowding and there is always a risk of collision if a good lookout is not maintained by all of the pilots all of the time. Every turn on the ridge must be started by turning away from the hillside and a glider must not circle in the vicinity of other aircraft near the hill. When overtaking along a ridge, the glider overtaking must pass between the other glider and the hill so that if the slower glider starts a turn there is no danger of a collision. When ridge soaring, the glider with the ridge to its right has the right to stay in the lift at the ridge, and the approaching glider with the slope to the left must give way by turning to the right, away from the hill. Turns are generally only started at the established turning points, and shouldn't be started before any gliders in front of you have turned.

WAVE SOARING

39. In certain atmospheric conditions the airflow over the hills or mountains forms into wave shaped disturbances that continue up to great heights and can be maintained for long distances from the lee of the original source. These are referred to as 'mountain waves', 'lee waves, or sometimes 'atmospheric gravity waves'. A standing wave can be considered to be an example of hill or ridge lift in which the deflection of the airflow over the hill is transmitted to from one layer of air to another, to height of eighteen to twenty times the hill height, and occasionally higher. Waves are most likely to form when a strong wind of around 20 knots is blowing at about a right angle to the ridge, when the wind direction is constant, and the wind speed increases with height. As long as the wind is blowing within about 30° of perpendicular to the ridge, the mountain wave can begin. In high winds, rates of climb of 600 feet per minute are common. In strong winds, the air stream downwind of the hill will be affected, and a series of 'lee' waves will form, continuing for great distances and gradually diminishing in strength. The distance between wave crests depends on the wind speed, the size of the obstruction (hill)

and the atmospheric conditions. The wave closest to the ridge is called the primary wave, followed by secondary and tertiary waves.

40. Visible evidence of the existence of wave conditions is limited unless clouds form. The clouds that are normally associated with wave formations are long strips of elliptically shaped clouds that lie at right angles to the wind, parallel to the hill. They remain almost stationary, in spite of the strong winds. Called lenticular clouds they may be low, medium or high clouds and can be recognized by their smooth outline. The mark the crests of the waves at cloud formation level, but the wave lift does not necessarily end at this level. There may be additional lenticular clouds at higher levels.

41. The lift associated with wave conditions is in the form of large areas of rising air lying parallel to the range of hills. The lift is very smooth, due to the stable and laminar airflow. The air may be so smooth that no control inputs are required for long periods. Lenticular clouds can be used as position-markers, due to their stationary positions, or a point on the ground may be selected. In this way the location of the best lift can be maintained. As height is gained, it may be necessary to fly faster to maintain a stationary position, due to the stronger winds. Because of the form of the wave, with areas of high lift and sink, circling like a glider in a thermal will not work, but instead will place the glider into an area of sinking air. Contingency plans are very important, as clouds can form rapidly below the altitude of the glider. The direction of safe landing areas should be known at all times.

42. In some conditions the air below the primary wave forms a rotor, sometimes called roll cloud, which causes the air to be violently unstable to the extent where it may be severe enough to destroy light aircraft. Rotor may be marked by clouds in some cases, and will look like a very ragged cumulus cloud, in which the swirling of the cloud can be clearly seen. The rotor cloud may be topped with a layer of lenticular clouds.

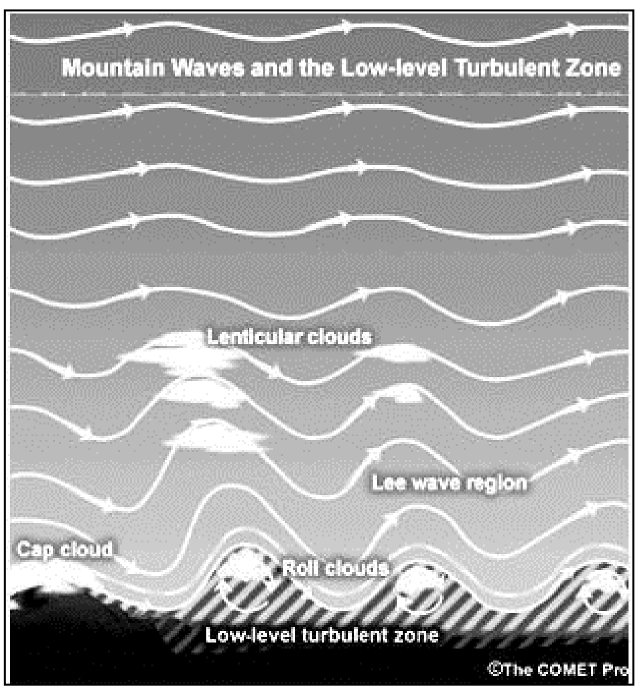

Figure 9-6 Mountain Wave

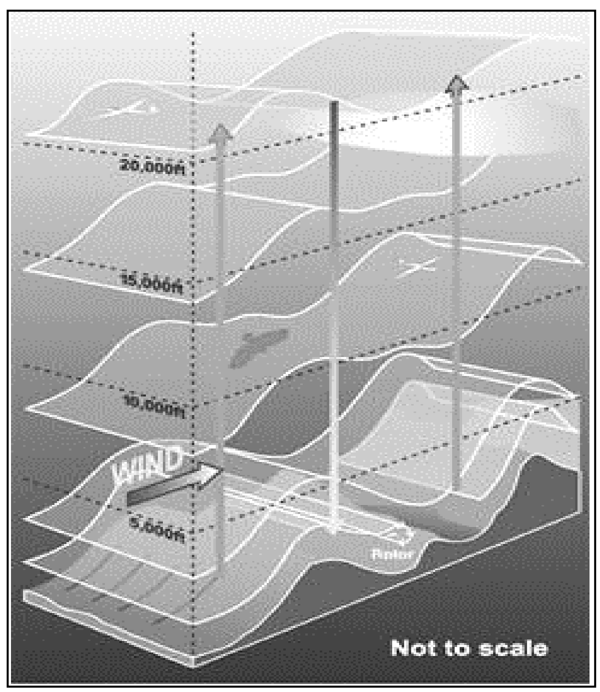

Figure 9-7 Wave Diagram

UNINTENTIONAL OFF-FIELD LANDINGS

43. Unintentional off-field landings rarely occur if constant attention is paid to the altitude and position of the glider in relation to the point of intended landing. This is especially important while manoeuvring in the circuit during periods of high winds or thermal activity. Lack of attention or carelessness is usually the reason pilots find themselves too far downwind from the touch-down point or too low to safely make the field. In the event that modification to the circuit pattern is insufficient to ensure a safe landing at the intended landing area, thus making an off-field landing necessary, the following procedures apply:

a. **Decide early.** The decision to land should always be made while sufficient altitude remains to fly a standard pattern. On tow and cross-country flights, the experienced glider pilot always keeps a good landing field within range. Keeping the glider within the 45-degree vertical reference to the field, with allowances made for wind direction, surface condition, and height of obstacles, will ensure a safe recovery;

b. The choice of a field should be made while ample altitude is available. You should never wait until the last moment to select a field and be forced to make a straight-in approach. On cross-country flights, use the radio to have the tow pilot assist in selecting a suitable field by making low approaches;

c. **Choices.** Fields with newly harvested crops offer the best surface. Un-harvested crops such as high grain, corn or sunflower should be avoided due to the increased risk of aircraft damage;

d. If the chosen site contains rolling terrain, the landing should be made uphill to aid braking action even if slightly out of wind; and

e. Once the off-field landing has been successfully completed, you should remain with the glider, indicate the "all's well" to the circling tow plane and attempt to contact the launch site by radio.

44. The wind direction and strength are vital factors to consider when choosing a landing area. For this reason, you must always be aware of the direction of the surface winds. Smoke is the best wind indicator. Flags, ripples on trees, corn and large areas of water are also useful. It may also be possible to note the amount of drift across the ground when at lower levels. Although upper wind is rarely from the same direction as the surface wind, the direction of movement of the shadows of the clouds can also give a general indication of the wind.

45. If the wind is strong, the search for a suitable field to land in should be made by flying downwind, since this allows the glider to cover the greatest distance, and gives the largest choice of fields. The choice of an upwind field is often limited to those almost directly below the glider, as flying into the wind will cause the glider to loose significant altitude.

46. The landing should be made as near into wind as possible, in the direction that gives the best approach and landing. Approaching into wind has the benefits of a steeper approach, lower landing speeds, and a shorter ground roll. Downwind landings should be avoided in almost all cases.

47. Fields located alongside roads predictably have power lines along them. These can often be almost invisible from the air – look for the poles at evenly spaced intervals. If these need to be crossed on the approach to land, it can make the landing very dangerous. A general guideline is that obstacles reduce the useable length of the field by about ten times their height (a 50 foot tree reduces the useable length of the field by 500 feet).

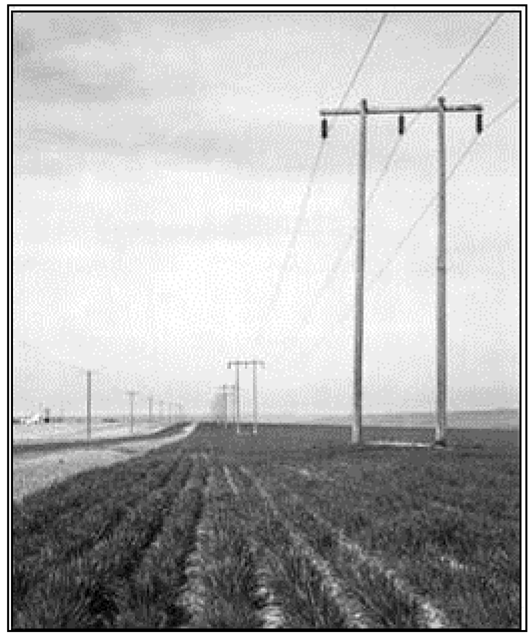

Figure 9-8 Power Lines beside Field

48. Ideal for landing is a freshly cut stubble field. Golf courses occasionally have adequate area to land in, as do large playing fields, if deserted. A single soccer field is too small to land in normally.

Figure 9-9 Stubble Field

49. The required size of the field depends on its direction in relation to the wind and on the heights of any obstructions on the approach path. If possible, a path should be selected which avoids the need to approach over high trees or buildings.

50. The surface of the field should also be considered. Recently cultivated fields are preferable to grass fields. Cultivated fields must be smooth enough for the farming machinery to operate, but grass fields may have ruts and large stones that are not visible from the air. Landing should be made along the lines of furrows or crops, even if this means a crosswind landing.

51. Fields with livestock should also be avoided, unless there is no safe alternative. Often farmers have several fields, and at any time only a few are used by animals.

52. Fields should be inspected for evidence of a colour change, which might indicate the presence of an electric fence. Avoid landing across a colour change, path or obvious mark

running across the field, as it may be caused by a fence or a deep rut. Tram lines, long metal fixtures used for the watering of crops are also very dangerous.

Figure 9-10 Furrows

Figure 9-11 Ruts in Field

Figure 9-12 Consistent Shading

Figure 9-13 Height of Crop

53. Another major factor that must be considered is the slope of the ground. Fields near to rivers and lakes should be avoided when possible as they typically have a slope towards the location of the water. Fields with areas of darker green often indicate a slope towards waterlogged areas. Any slope that can be seen from 1000 feet is probably too steep for a safe landing. Landings should always be made upslope or across a slope, regardless of winds. Although not recommended, gliders can be landed up fairly steep slopes without damage, unless they slide down slope after landing. Even a slight downhill slope will make it almost impossible to make the glider touch down, and the glider will tend to roll onwards without losing speed.

54. Beginning at a height of 2000 feet AGL, if lift is failing during a cross-country flight, or the chances of returning to land at an airport are poor, suitable areas to land should be identified. By 1500 feet AGL more details of the selected fields should be clear, and two or three promising nearby fields should be chosen. At this point, the slope, surface, stock, length, obstacles and wind should be considered for the final choice. By 1200 feet you should be positioning yourself for a circuit that is as close to normal as possible in the circumstances. If

the field appears short, consider a diagonal final approach and ground roll in order to have more length, though ensure that this doesn't place additional obstacles in your path.

55. In general, bad approaches occur through getting too close to allow enough adjustment of height with spoilers and the glider being in a poor position to land. The tendency is always to get much too close to the field, especially if you are used to landing at an airport. The land surrounding the chosen landing area is typically unsuitable for a safe landing, though it is necessary to fly the circuit over these areas, many pilots are naturally uncomfortable doing so, and may fly too close to their intended field.

56. Choosing points on the ground as guides for base and final turns that are based on current altitude and wind condition will help in flying a circuit as close to normal as possible. As in any circuit, adjustments may need to be made for conditions and the unexpected as the actual approach occurs.

DOWNWIND LANDINGS

57. The wind direction and strength are vital factors to consider when choosing a landing area. For this reason, you must always be aware of the direction of the surface winds. Smoke is the best wind indicator. Flags, ripples on trees, crops, and large areas of water are also useful. It may also be possible to note the amount of drift across the ground when at lower levels. Although upper wind is rarely from the same direction as the surface wind, the direction of movement of the shadows of the clouds can also give a general indication of the wind.

GROUND LOOP

58. High winds and associated mechanical turbulence also make control of a glider difficult as it slows after touch-down. The tendency to weathercock may be uncontrollable and result in a ground loop. Pilots should always choose landing areas clear of personnel or equipment when landing under these conditions.