Soaring Society of America, Inc.

Cross-Country Handbook for Pilots

Third Edition January 2023

CROSS-COUNTRY HANDBOOK FOR PILOTS

Introduction

The SSA initially instituted the Cross-Country Instructor Program (CCIP) in 2002. It was developed as a guide for pilots wanting to expand their flying into cross-country soaring. This *Handbook* is supplemented by the Instructors Pilots Supplement and the Cross-Country Instructor Program Guide.

This *Handbook* will provide a foundation for cross-country flying and will help migrate into sailplane racing/contest flying. It summarizes the knowledge and skills needed to successfully fly cross-country. Basic information such as National Airspace System (NAS), radio phraseology, medical fitness, airport procedures/protocol, basic glider operations are areas not covered in this *Handbook*. Cross-country flying is the ultimate expansion of the skill and knowledge already developed.

This *Handbook* is not intended to replace any training manual or series of manuals. The SSA and SSF have developed this manual to provide an aid for glider pilots to reach basic goals in cross-country flying.

Competitive, Racing, & Contest

Once a pilot has become proficient in flying cross-country, he or she may want to expand into becoming a racing/contest pilot. Proficiency in basic cross-country skills is used as a "building block" in acquiring additional learning skills. Cross-country, either general or racing, utilizes the same basic skill set; however, the racing/contest pilot needs a different mindset. The racing/contest pilot needs to fly faster and further than the local cross-country pilot. The difference is that a local pilot may want to fly a 300 km triangle in 5 hrs., but the racing/contest pilot may fly that same course at 3.5-4.0 hrs.

Today's modern glider contest/competitions usually consist of a pre-described course of specific turn-points with predetermined start and finish points. The competition is flown under the rules established by the Fédération Aéronautique Internationale (FAI). A pilot flying in the race/contest should reasonably be able to complete the outlined tasks, with the fastest pilot gaining the most points for the day's race.

A basic foundation of general cross-country flying pays dividends.

Off-field landings are a fact of life for the cross-country pilot. Proficiency in the skill set is vital to safely flying cross-country and competing in sailplane competitions.

All ground and flight instruction must be administrated by a current and qualified Certified Flight Instructor–Glider (CFIG) who is designated by the SSA as a CCI in accordance with the FAA Glider Flying Handbook (*GFH*)(FAA-H-8081-13) and the FAA Practical Test Standards (*PTS*) (FAA-S-8081-22/23).

The CCI will provide the required training and guidance to enhance the glider pilot's cross-country skill and knowledge. In some cases, a highly qualified cross-country pilot/contest pilot designated as a SME Advisor will be used. The SME has vast experiences and will assist the CCI during the course or training session. When a SME is attending a cross-country session, a current CCI must be present during the entire session to provide SSA oversite.

The *Handbook* is intended to contribute to the confidence building process and help break down psychological barriers that may inhibit successful cross-country flying. This includes landing at new fields and the ability to find another thermal down a chosen route.

What skill/experience levels does a pilot need before taking instruction in cross-country flight? The SSA A, B, C, and Bronze Badges are a good start. Before making a first cross-country flight, the pilot is highly recommended to have completed the height and duration legs of the Fédération Aeronautique Internationale (FAI) Silver Badge.

CCI are required by Federal Aviation Regulations (FAR) 61.51 & 61.189 to endorse the pilot's logbook when providing either ground or flight training. During cross-country training/instruction sessions, the CCI shall make the following endorsement when the pilot is competent in cross-country procedures:

> ***"I certify that {Name}, {Grade of Cert}, {Number}, has satisfactorily completed a course of sailplane cross-country instruction including ground and flight training in accordance with the SSA CCIP and has demonstrated proficiency to perform cross-country flights in a glider."***

Appendix D provides a Cross-Country Flight Log to aid in tracking a pilot's progress. The *Handbook* establishes standards for completion at the end of each section.

Before beginning this course, the pilot ***must be current and proficient in glider operations***. He or she must have a complete understanding of the equipment in the glider/sailplane to safely conduct a cross-country flight. Proficiency, planning and knowledge are essential to fostering the in-flight decision-making skills necessary for a safe and successful flight.

This *Handbook*, while it contains a large amount of information, is just a fraction of the information that is available in various publications, articles, etc. The pilot is encouraged to study these additional publications to expand his or her knowledge base.

This *Handbook* is a work in process. Please pass on any comments or suggestions for improvements or additions to the SSA Soaring Safety Foundation so that others may benefit. The idea is to keep this program enjoyable and educational and to help produce safe cross-country pilots!

Safe soaring and welcome to the next exciting step in soaring!!

Cross-Country Flight

Cross-country soaring is fun, exciting, and rewarding.

The cross-country pilot needs to have proper equipment, both in the glider and the trailer, which must be ready so that the glider can be safely retrieved in the event of an out-landing. Adequate knowledge of weather patterns and weather planning is a must. Both the pilot and glider need to be fit for the task. The task must be defined along a safe route.

Equipment Requirements

- Selecting a glider for cross-country flying is outside the scope of this *Handbook*. The glider must be properly equipped, with personal items *safely secured*. (See Appendix C.)
- Ensure the aircraft has the required inspections. (FAR 91.409/FAR 43)
- Ensure the aircraft has the required documentation on-board: Airworthiness Certificate (FAR 91.203), Current Aircraft Registration (FAR 91.203), Operation Limitations (FAR 91.9), and Weight and Balance information (FAR 23.2620).
- Ensure the aircraft complies with the Minimum Equipment List if required, as specified in the Type Certificate Data Sheet or Glider Flight Manual/Pilot Operating Handbook (*GFM/POH*).
- An audio variometer is essential so that a good external visual scan can be maintained while thermalling.
- VHF radio is a safety item as well as a comfort tool (handheld is acceptable if it has at least a 20 nm range).
- A Soaring Navigation System will provide better situational awareness and make the cross-country experience more enjoyable.

- A Data Logger records flights and will allow the pilot to analyze flights. If the goal is a badge, contest or record certification flight, a certified logger is required for verification.

- Parachutes in good condition with a current pack and inspected is an essential equipment item for a cross-country flight, as it should be for local soaring. Mid-air collisions with another thermalling glider is always a possibility. (See "Use of Parachutes".)

- An out-landing is always a possibility when soaring cross-country. A retrieve vehicle, with keys immediately available, should be attached to the appropriate trailer. There should be gas in the tank, air in all the tires, spares included, and electrics connected and all trailer lights working! It can be helpful to let the airport operator know the make/model and location of the retrieve vehicle.

- A crew should be prepared to drive the retrieve vehicle if necessary. Inform the airport operator the identity of the crew and where to find him/her/them. A common practice is to affix a Contest Letter/Number to the window of the retrieve vehicle.

The above items must be completed *before a cross-country flight begins*.

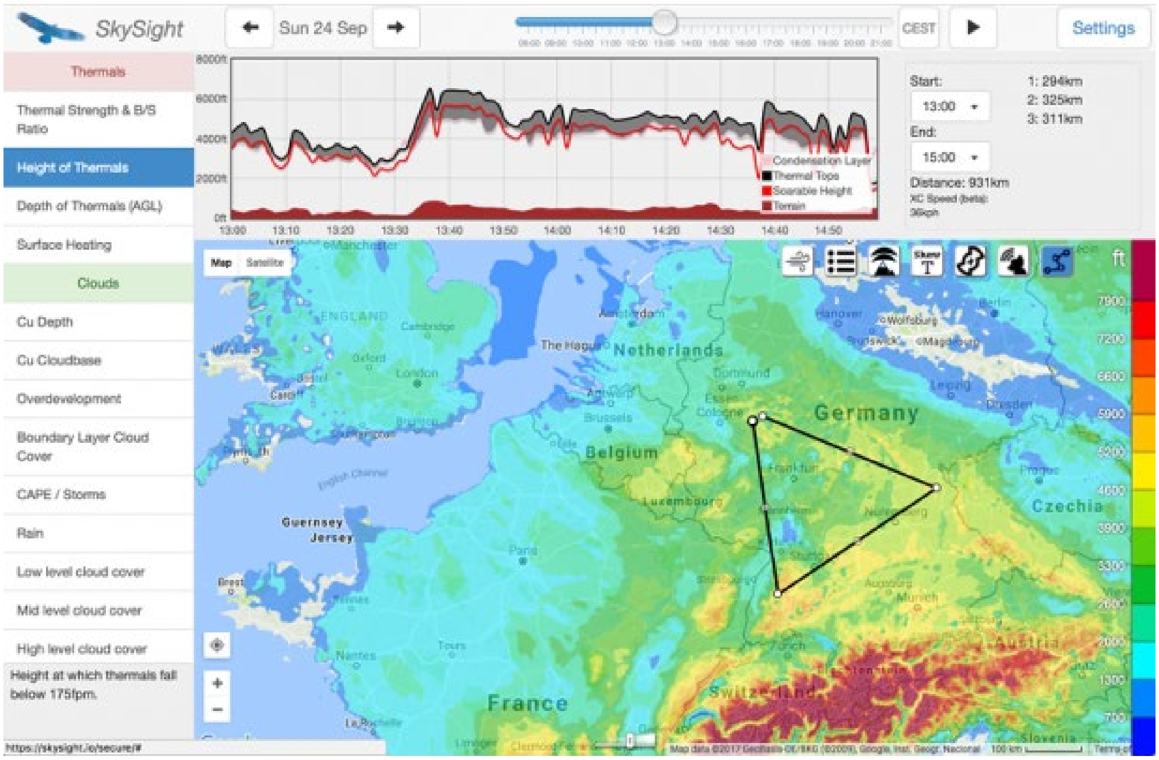
Weather Planning

Cross-country soaring is the art of mastering the vertical motion of the atmosphere. Most individuals refer to this as weather. The better a pilot understand how the atmosphere behaves, the better he or she will be able to soar.

FAR 91.107 requires the pilot to obtain information necessary for a safe flight. Necessary weather predictions can be obtained from a combination of sources such as TV weather broadcasts, The Weather Channel, weather pages found on the web, and the local FAA Flight Service Station (FSS), or the telephone automated weather briefing service on 1-800-WX-BRIEF (992-7433). Though helpful, none of these sources address to any real degree the prediction of soaring conditions.

The internet offers a variety of soaring specific weather sites including:

- Sky site - https://skysight.io/secure/
- XC Soar - https://www.xcsoar.org/
- Dr. Jack's - http://www.drjack.info/BLIP/RAP/index.html
- Soarforecast.com



Soaring meteorology can fill a book! The pilot needs to be familiar with the conditions which give rise to convection (thermals) and other forms of lift. (See Appendix G for an overview discussion about atmospheric properties.)

Pilot Health and Safety

FAR 61.53 requires the pilot to be fit to safely conduct a flight. The Aeronautical Information Manual (AIM), Chapter 8 has additional and detailed information on pilot safety of flight.

Cross-country soaring is demanding, both physically and mentally. It is necessary to be at a high level of fitness and health if the flight is going to be successful.

While athletic fitness is not an essential requirement, the pilot must be in good health and be able to maintain top performance for the duration of the flight, which will likely last several hours. “Wellness” is a word often used in preventive health care. A pilot must be well, in the sense that there is no condition, impediment or sickness that inhibits wellness.

Part of being well is to be properly rested. Fatigue from lack of sleep, involvement in other activities, or just as the consequence of a long drive to the airport followed by a struggle in the heat to rig the glider impairs a pilot’s ability to make good decisions.

Hunger and dehydration may also cause decreased mental acuity and may inhibit good decision-making (SRM) skills.

Dehydration is insidious and debilitating, especially in a sailplane cockpit. Proper and timely fluid intake is essential to mitigate the resulting problems of headache, dizziness, fatigue, cramps, loss of concentration, faintness – all of which substantially reduce a pilot's ability to fly safely. A pilot must drink water throughout the day, preferably in small quantities taken frequently. Modern sport drinks are a bonus here--not caffeinated drinks. This method of small and frequent fluid intake allows the body to absorb the liquid and maintain hydration. Following this technique of hydration reduces the amount of urine the body makes.

The FAA IMSAFE checklist can help assess a pilot's fitness to fly. (See Appendix E.)

The pilot needs to be aware of his or her fitness during the course of the flight. The pilot should be prepared to terminate the flight if he or she becomes impaired.

Route Planning

The key to a safe and successful cross-country flight is good route planning.

There are several considerations to bear in mind, some of which may be contradictory. Route planning should take into consideration:

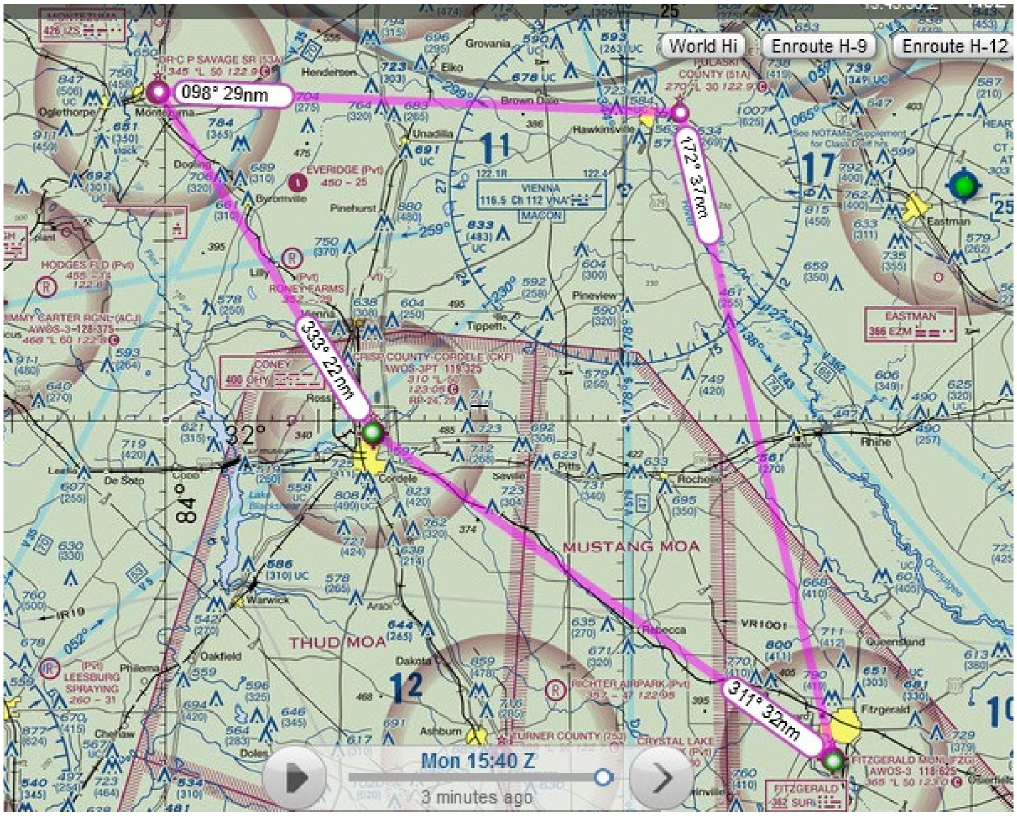
- Airspace. In general, the route should avoid Class B, C and D airspace, and keep clear of Victor airways and crossings and of active MOAs and military training routes with activities incompatible with a cross-country soaring flight. Have local ATC frequencies and remember the standard FSS frequencies, 122.2 & 122.4.

- Soaring Band Height. Establish the likely operating height band. If the top of the lift is expected to be at 3000 ft. AGL, a conservative route will be substantially different than if the lift is expected to go up to 6000 ft. AGL.

- Land-Outs. Plan appropriately to always have a safe land-out location available in case the need arises. Unlandable terrain should be avoided based on the glider's performance and the top of the forecast operating height band. Any area where a safe off-field landing cannot be accomplished should be considered "Unlandable Terrain". Mountains, cities, dense forests, etc. are all Unlandable Terrain.

- Prepared Landing Strips. Identify prepared landing strips on the intended route. Identify other reliable landing possibilities.

- Route. A route needs to be planned on conservative assumptions so that the glider will remain within gliding distance of a safe landing area, initially keeping within gliding range of an airport. Annotate charts with distance rings and altitude required for airports along the route if so desired.



- Off-Field Landing. Always be identifying suitable landing areas during a flight because the glider will end up in a field someday.

Critical Assembly Checklist

Cross-country soaring necessitates frequent sailplane assembly. A Critical Assembly Check (CAC) is a recommendation of the SSA, SSF, and the manufacturer. Follow the manufacturer's recommendations.

Prior to flight, the pilot-in-command of each glider shall inspect the glider to ensure that it is airworthy. The CAC should be a part of this procedure. A CAC is a short list of steps mandatory for safe flight. It should be developed from manufacturer's requirements and recommendations.

A pilot-in-command should develop and use a CAC for each glider.

It is recommended that the CAC should include an independent verification of the procedure by another person.

Cross-Country Techniques

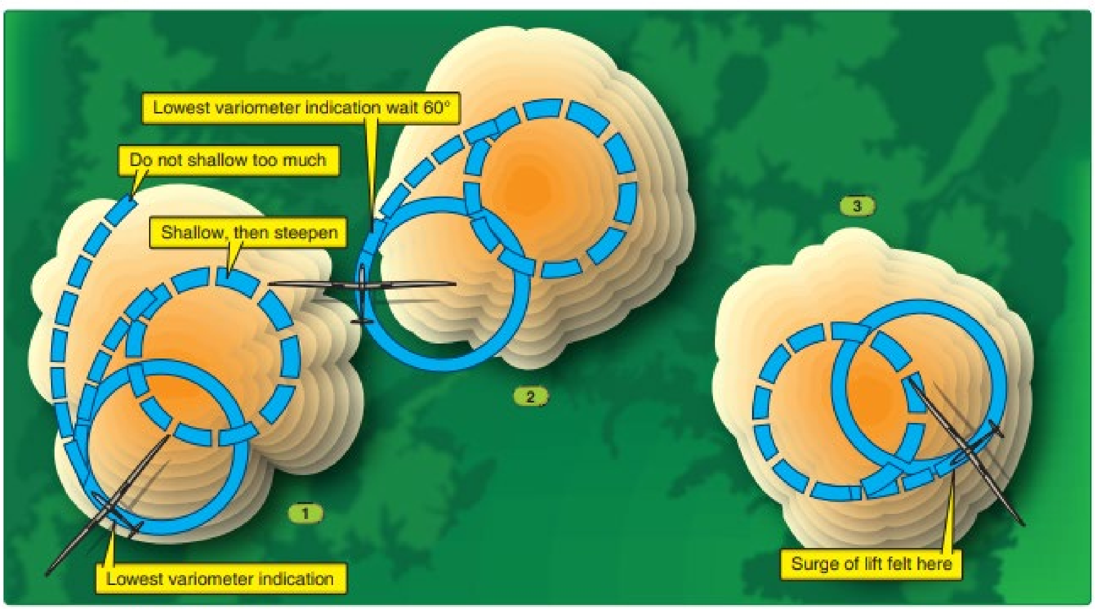
Training Objective

Thermalling on a cross-country flight is different than a local flight. On a local flight, the objective may be to just stay up. On a cross-country flight, the objective is to maximize the height gained and minimize the time doing it.

The three most common factors counter-productive to good cross-country technique are:

- Failure to circle tightly or bank steeply enough. Pilots accustomed to low wing loaded sailplanes are able to climb using big shallow banked turns. Generally higher climb rates can be achieved with higher bank angles, reducing turn circle radius, and staying close to the thermal core.

- Flying too slowly between thermals. Pilots accustomed to flying a low performance sailplane are wary of the high sink rates and decreased performance as speed is increased above best L/D airspeed. (See "Speed-to-Fly".)



- Circling in all available lift. This is fine if the objective is to stay up without need to progress over the ground. To progress cross-country, the pilot must spend as little time as possible circling and as much time as possible on course. Circling should be in the chosen height band, and only thermals of minimum acceptable strength or better should be used.

Exercise Prerequisites

Complete the training required in the Thermal Acquisition and Centering and Speed-to-Fly Section of this Handbook.

Training Exercise

Perform this exercise within gliding range of the home field or another field from which the glider can be towed out.

- Plan an Out-and-Return or Triangle course. Annotate a chart with distance and altitude rings to enable for recovery to the home field or alternate. Experience has shown that a triangular route is better than an out and return. The route should be displayed by computer or on the chart. Known safe landing places should be marked. The forecast wind should also be known.

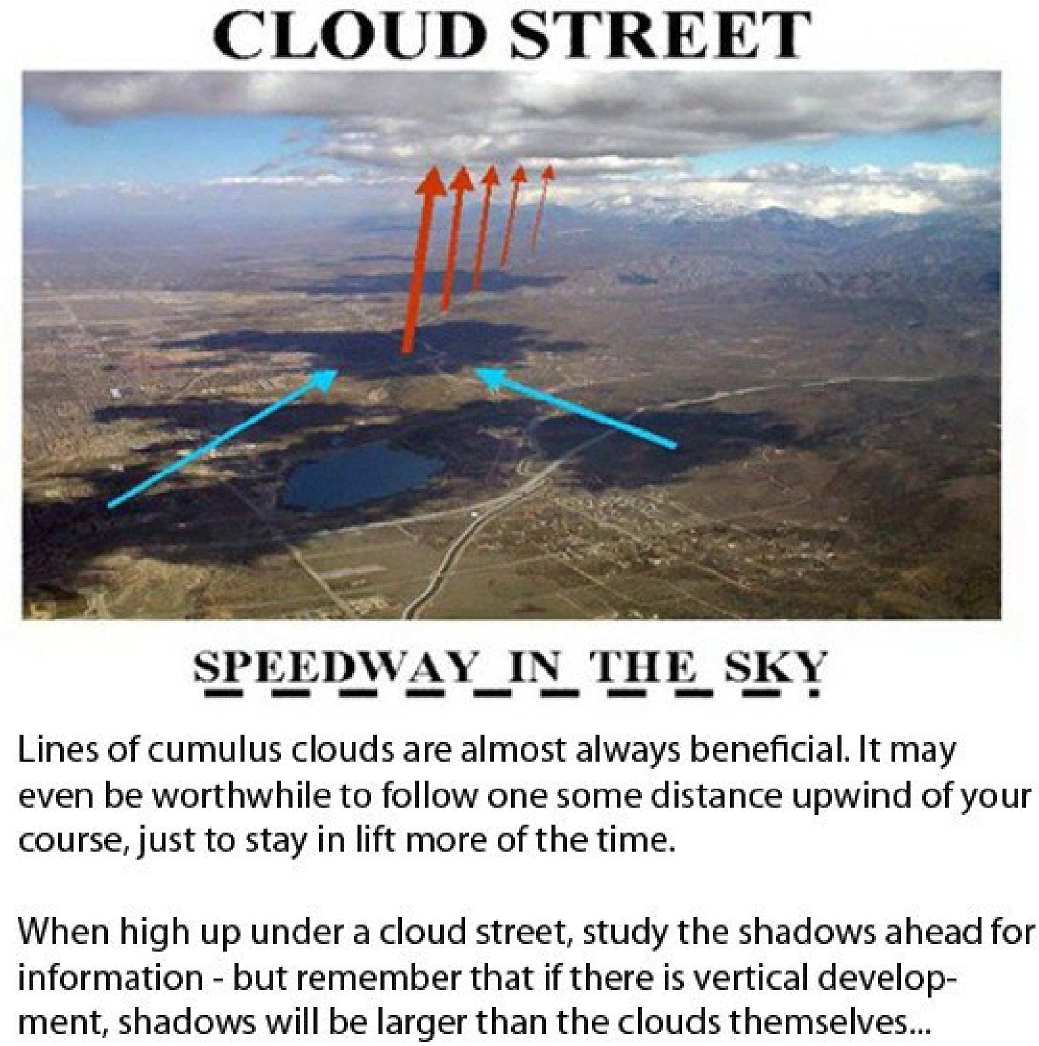
- Once established in an acceptable thermal, the pilot, with instructor input, determines height bands based on the prevailing conditions, determines thermal strengths to be accepted or rejected, and determines initial McCready speed to be used. The forecast wind direction and strength should also be verified.

- When climbing, the instructor will monitor the pilot's thermal acquisition and centering technique to better the average rate of climb and help to verify chosen thermal strengths. When not climbing, the instructor will monitor use of correct speed-to-fly, good navigation, and situational awareness. Assessing the clouds and lift will help determine the course to fly to the next thermal. Throughout the flight, the pilot must observe good airmanship practices, particularly those relating to lookout, and entering, using, and leaving thermals. (Appendix B, Thermal Soaring Protocol).

- Except where necessary for safety of flight or to demonstrate a technique, the candidate performs all the flying, with prompting as necessary by the instructor.

Training Specifics

Thermal Streets



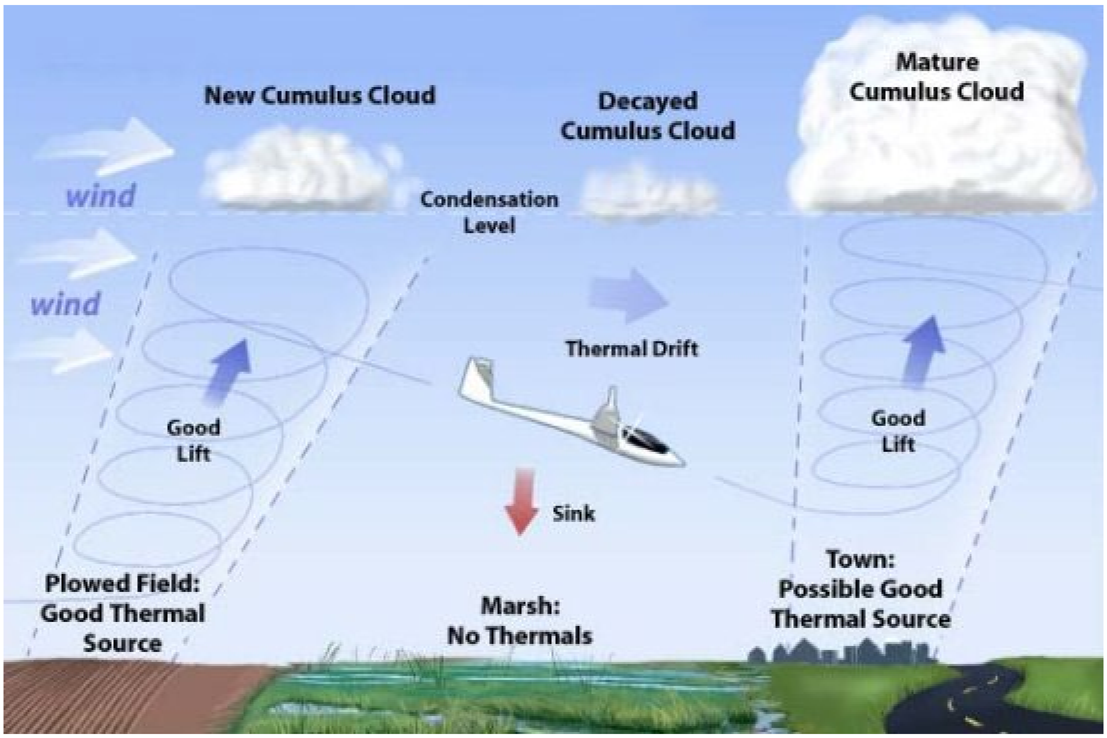
Dale Masters

- Thermals often organize themselves in fairly predictable patterns, so knowing about such patterns and what to look for to find them is very useful. Wind tends to organize thermals in lines parallel with it, resulting in a long line or "street" of consecutive thermals. Streeting will occur regardless of whether the thermals are forming cumulus clouds. When clouds are present, the clouds take on an oval shape, with the longer axis parallel to the wind.

- Sink lines up parallel with the lift streets to form sink streets in between.

Spend as much time in lift as possible, following a lift (or cloud) street, and as little time in sink and sink streets as possible. The instructor will provide techniques if a course crosses the streets. When turning and maneuvering, ***CLEAR THE AREA*** by using good scanning techniques!

Which Way to Go



- Establish as early as possible the relationship of lift to clouds - upwind, downwind, etc. This relationship usually remains the same throughout the day.

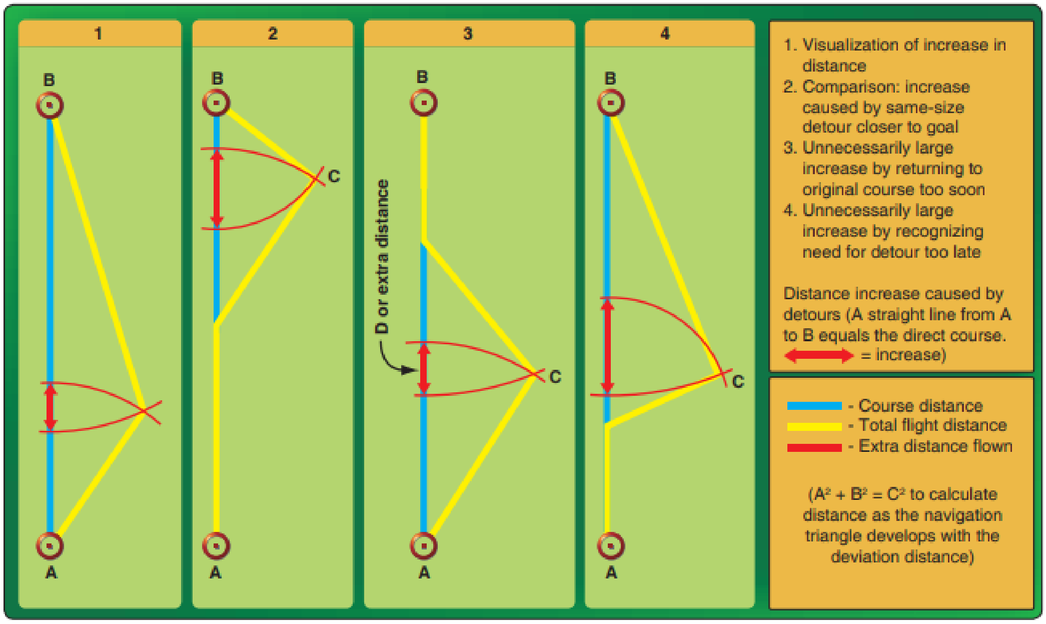
- Use gentle zig-zag on course. This increases the probability of finding thermals and is especially helpful in blue conditions.

- Stay upwind of course line. Go downwind only if necessary to avoid landing.

- In a long period of heavy sink, a glider may be in sink street between two cloud/lift streets. Make a deliberate turn away.

- Even if no clear cumulus clouds are present, follow the short cycling cloud wisps (haze domes), even if they disappear before arrival.

- Follow lift/cloud streets even if up to 30° off course line, but don't get too far off course. If blue, look for lift streets and head directly upwind or downwind on leaving a thermal to check. Perform gentle zigzag until lift streets are found. Use the same principle as for cloud streets.



- Plan ahead. Select the next thermal source before leaving the existing thermal. Use expected performance instead of guesswork to assess potential range. Rule of thumb for sailplanes of L/D of 30 to 35 (assuming wind is around 15 kts) should be 5 nm/1000 ft. loss of altitude in still air, 3½ nm/1000 ft. going into wind, and 6 nm/1000 ft. going downwind.

- Avoid areas likely to have sink i.e., downwind of lakes, downwind of ridges etc., sandy areas, wet/irrigated/low ground, and forests. Use higher/dryer ground if available and forests *late* in the day.

- Try to use areas likely to have good lift – baked bare ground, industrial sites, large areas of concrete/asphalt, higher ground, especially when the slope is oriented at right angles to the sun.

- Keep track of wind direction as it may change. Knowing the direction for landing is important. Direction can be assessed by drift, smoke, large flags, ripples, and wind shadow on lakes; cloud shadows (but be wary – the surface wind may not be the same as at cloud height).

- When leaving a thermal, proceed on a pre-selected course, then confirm the direction is correct.

How Fast to Fly

- The primary objective upon leaving the top of the present thermal is to get to the top of the next one as fast as possible.

- Optimum speed should be based on the performance of the glider, the rate of sink, and the strength of thermals. The McCready (RING) is calibrated for the glider's performance, the rate of sink is shown by the variometer, and the strength of thermal is set by the pilot.

- When setting the McCready, base the setting on the observed average rate of climb in the last thermal. Use an average or stop watch. Use half the perceived rate of climb e.g., if the thermal could be described as a '4 knotter', then the average is probably about 2 kts.

- The change in performance resulting from an increase or decrease of the McCready setting (i.e., a change of airspeed) is not linear throughout the range of settings used. At a high McCready setting (near the average achieved rate of climb), a small reduction of McCready setting (and speed) reduces achieved cross-country speed by a relatively insignificant amount but increases the distance covered significantly. When using a McCready setting of near zero, a small change in setting will affect cross-country speed substantially but only have a small effect on distance achieved. Inexperienced cross-country pilots should probably start by using an intermediate McCready setting—about half of the average achieved rate of climb.

- The McCready setting should be adjusted depending on the height band in which the glider is operating—the higher the setting, the more aggressive; the lower the setting, the more conservative. Absent other indications, a reasonable rule of thumb is height in thousands (AGL) minus one = McCready setting, e.g., flying at/descending through 4000 ft. AGL, use McCready setting of 3 (kts). In many conditions, this will be too aggressive.

- Be prepared to alter the McCready setting if conditions appear to be changing. If clouds ahead appear to be down-cycling, slow down. If a couple of clouds in succession reveal no lift, this may signal deterioration, then slow down. If conditions improve such as clouds become more widely-spaced, increase speed.

When to Thermal

- Circle as little as possible. While it is circling, the glider is not progressing on course. It is, however, less detrimental to speed achieved when the course is downwind, worse when upwind. When approaching a turn point before turning onto an upwind leg, try to reach the turn point high to minimize the need to circle during the leg. Conversely, when the next leg to be flown is downwind, it is acceptable to risk reaching the turn point low and then thermal while the wind carries the glider downwind.

- After the first climb, determine the minimum acceptable rate of climb for use in normal operating height band. This should be the same as the chosen McCready speed, e.g., if a McCready setting of 2 (kts.) is chosen, only accept thermals of at least 2 kts.

- Minimum acceptable rate of climb should increase with altitude—the higher/closer to cloud base, the stronger the minimum acceptable rate. At that height, it may well be possible to proceed just by S-turning through lift of less than the minimum acceptable rates for circling.

- Spacing of thermals is generally proportional to the height of the convective layer. The higher the thermals go, the more widely apart they are spaced and vice versa. The normal operating band is usually accepted as the top two thirds of the convective layer, e.g., if the maximum achieved altitude is 6000 ft. AGL, the band is between 2000 ft. and 6000 ft. AGL. Until confidence is gained, the new cross-country pilot may use the top half of the convective layer as the normal operating height band. Below the normal operating band, any lift should be used.

- The sink rate often increases immediately before a thermal is encountered, probably caused by cooler subsiding air descending to take the place of the rising thermal air. Keep flying straight for a few seconds to see whether the thermal is present.

- Soaring birds are great thermal markers; circling gliders may not be. Don't chase another glider unless it is clearly going up. Even then, if it is materially higher, the lower glider may have difficulty finding the lift or may discover there is none because it is below the bottom of the thermal bubble.

- Leave the thermal when the climb rate drops to two-thirds of the average.

- Always think ahead of the glider, checking conditions ahead, and modifying plans accordingly.

- Below 3000 ft. AGL, the likelihood of having to land is increased. Plan for the possibility of a land-out. (See Section 2.) Pilot workload will increase substantially. Reduce distractions and devote full attention to flying/planning/airmanship.

Final Glide

The final glide begins when the pilot has sufficient height to glide directly to the goal without the need to use further lift. Remember to factor into the calculation the height at which the glider needs to arrive above the goal.

- All previous calculations of speed-to-fly have been based on maximizing performance within the airmass the glider is flying. On final glide, groundspeed is important because the goal is a fixed point on the ground. On final glide, the best speed-to-fly must compensate not only for lift and sink, which the glider is flying through, but for the effect of the wind, whether headwind or tailwind.

- There are several ways to make this speed-to-fly computation. The easiest way is to use a final glide computer like an Oudie, LX-4000 through 9000, Cambridge L-NAV, ILEC SN 10, etc. The pilot can program in the distance to fly and an estimate of the wind, and the instrument does the rest, indicating how fast to fly. A GPS linked to the final glide computer will provide speed-to-fly information automatically!

- The simplest way is to use the rule of thumb, mentioned earlier, of increasing the airspeed by half the calculated headwind. Again, this should be added to the McCready speed. If there is a tailwind, fly a little slower than the best L/D airspeed but a little faster than the minimum sink airspeed. If sink is encountered, increase speed.

- Thus far, the final glide has been calculated so that the pilot can fly most efficiently towards the goal. Pilots seeking to maximize their cross-country speed seek to optimize their speed, typically fly as fast as possible consistent with just reaching the finish line. This carries the penalty, if the conditions are more adverse than calculated, or the pilot has not calculated accurately, of failing to reach the goal and being committed to an off-field landing.

- Initially, a pilot's objective should be to arrive with a safe height margin at the goal. After gaining experience, attention can be turned to speed tasks, making compromises between speed and the risk of landing out.

More on Final Glide

- The final glide is defined as the portion of the flight from which the current height is sufficient to allow the pilot to safely arrive at the destination. Final glide height is calculated based on the glider's performance, the distance to be flown, the elevation of the finish point, and wind.

- Modern flight computers continuously make this calculation and display the required height to glide to the destination. Always be aware of the glider’s current position and height in relation to a landable site.

- The final glide portion of any cross-country flight can, to a large extent, affect the overall achieved cross-country speed for the flight. This is because this section of the flight has virtually no circling.

- Consider the glider's performance and distance to the destination. The glider's performance is measured by the L/D ratio or how much height is lost due to the forward motion of the glider. As a rule of thumb, modern sailplanes can use an L/D of 30:1 for planning purposes. For every 1000 ft. of height lost, 30,000 ft. or 5.7 statute miles can be covered over the ground. Round down to 5 SM to keep it simple. Each statute mile requires 200 ft. of height. Using this rule of thumb, from 5000 ft. AGL, the pilot will glide 25 miles before the glider will touch the ground.

- The elevation of the finish point is critical when calculating the MSL altitude to begin the final glide. Take the field elevation, add the desired arrival altitude AGL , and add the rule of thumb altitude calculated above. From 30 SM away, a field at 600 ft. MSL and a desired arrival altitude of 800 ft. AGL the glider would require 7400 ft. on the altimeter [1400 ft. plus 6000 ft. (30 miles/5 miles per thousand ft.).

- Modern flight computers take the MacCready setting into account when calculating the required glide height. As the MacCready setting increases, the computer will calculate that a higher altitude is required because the glider will be flying faster and, therefore, at a lower L/D.

- Wind can significantly affect the glider's performance. A headwind will effectively decrease the current L/D. A tailwind will effectively increase it. Since the rule of thumb is based on an L/D ratio of 30:1, assume this occurs at 50 kts IAS. Essentially, the wind has an almost linear effect on glide calculations. If the wind is a direct head wind at 10 kts, its effect will be 10/50 = 20%. This means the glider will require 20% more altitude. Above, we calculated 6000 ft.to cover 30 miles; now with a 10 kt wind, this must be increased by 20%. Calculating 20% of 6000 ft. gives 1200 ft. Now it will require 7200 ft. to cover 30 miles plus ground elevation of 500 ft. plus arrival height of 1000 ft. for a total of 8700 ft. Conversely for a 10 kt tailwind, 1200 ft. can be subtracted from the required 6000 ft. yielding 4800 ft. plus ground elevation of 500 ft. plus arrival height of 1000 ft. for a total of 6300 ft.

- It is not always effective to climb to the required height in one climb when flying towards a destination. Several climbs in stronger lift will get the glider closer and are better than one long slow climb further away.

- The final glide calculation is an optimization problem that MacCready (MC) solved as he developed the speed-to-fly theory. Important *known* values are needed for a final glide: the distance to go, the wind speed, and current climb rate. Based on the current climb rate, there is one optimum speed-to-fly. This leads to an optimum height to climb. In the final climb, adjust the computer MC setting to the currently achieved average climb rate to allow the computer to calculate the optimum height. If the climb rate increases, increase the MC, and the computer will indicate to climb higher. This points out an important consideration when selecting the MC value for the final glide. The higher the MC value selected, the higher will be the calculated height required. More height gives more options and a larger safety factor for the unknowns, such as stronger headwinds or more sink. Selecting a setting of 0 MC is the least safe option and will calculate the minimum height required at the best L/D that can be achieved. The pilot can no longer make it to the destination if he or she drops below the calculated glide. Low ring settings should never be used for safe final glides. A safety factor such as the 1000 ft. arrival height and a higher MC setting reduce the likelihood of having to drop below the required height for a safe arrival at the destination.

- Continually assess progress during the final glide. This assessment includes determining if the pilot is gaining height on the required glide height, holding steady, or losing height. If the pilot is gaining height, then increase airspeed, lose more height, and arrive sooner. If the pilot is losing height, then reduce speed even to best L/D to increase glide range. If at best L/D, the pilot continues to fall below the required height, then he or she must find lift to get back above the required height to safely arrive at the destination.

- Done properly, final glides can help improve overall cross-country speed by optimizing height.

Additional thoughts:

- Don't take the last remnants of the top of a thermal to get to final glide altitude. Stay with the usual thermal selection and departure parameters used until intercepting the final glide slope.
- If the pilot needs to pad the altitude due to deteriorating conditions ahead, turn up the McCready setting to a higher number rather than tacking on a fixed number of feet. This will avoid an inefficient dive off of the extra altitude near the finish.
- If there is obvious good lift on the last leg (cloud streets), start the final glide lower than necessary and gather the needed altitude while flying straight.
- Pay more attention to visual lookout for other gliders as there may be several gliders all converging on one spot/altitude.

The above comments and techniques were gratefully submitted by Canada Glider Champion, David Springford and World Record Holder Karl Striedieck.*

Completion Standard

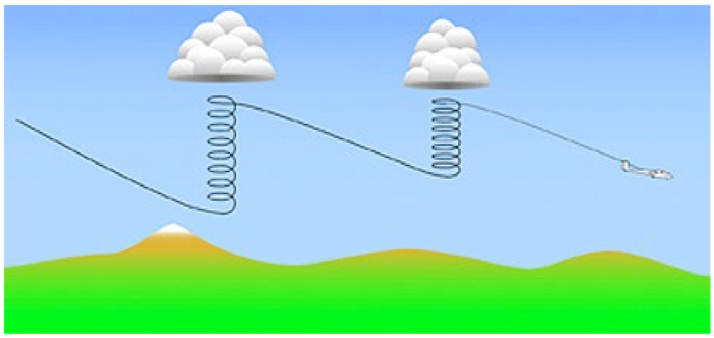
A pilot will be able to demonstrate abilities to satisfactorily assess conditions, pick a route, select speeds-to-fly and, show acceptable decision-making based on the conditions encountered.

*Dave Springford, competed in the World Championship in 2008, 2010, 2012 and 2014. In 2009, 2012 and 2015 he was the Canadian National Champion and he scored 92% at the 2012 World Championship in Uvalde. Karl Striedieck is a world record holder (9 times), member of the U.S Soaring Hall of Fame and US National Soaring Team (12 times).

Thermal Acquisition and Centering

Training Objective

Effective cross-country soaring requires the ability to make the most efficient use of the prevailing thermal conditions. Centering thermals efficiently and climbing quickly are two of the most fundamental skills a pilot needs to soar successfully. This section details the knowledge and skills needed to acquire proper thermalling.



Suggested Text

Be familiar with the theory and practice of a system for thermalling. A good resource is Bob Wander's book, *The Art of Thermalling … Made Easy*.

Successful thermalling is part science, part art. There are many methods used in attempting to make best use of thermals, some even apparently contradictory. The two most important criteria for a thermalling system are that it works and that it is simple to learn and use. Wander's text meets both criteria. A pilot may use other systems as long as they meet the above criteria equally well. Remember, practice!!

Minimum Equipment

Safe thermalling requires constant, careful, outside visual scanning. To facilitate this, the glider must have a working audio variometer and all the required equipment as per the manufacturer.

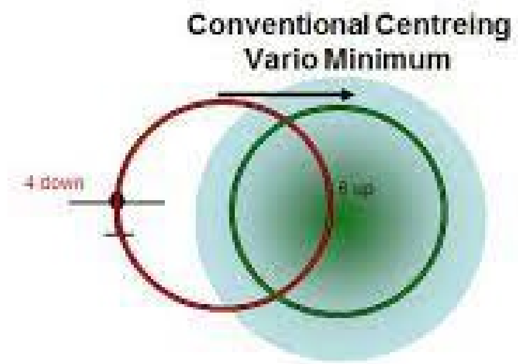
Safety

Joining, sharing. and leaving a thermal all require care. The pilot must keep a careful continuous scan, observing, and continuing to see every glider that is or may become a collision factor or risk. Any time spent looking inside the cockpit reduces the safety margins both for the pilot and all the other gliders in the proximity. ***Keep eyes outside the cockpit***. Anticipate where each other glider is going and what course alterations they might make to maintain good separation. Observe the Thermal Soaring Protocol in Appendix B. Don't make sudden or unpredictable maneuvers.

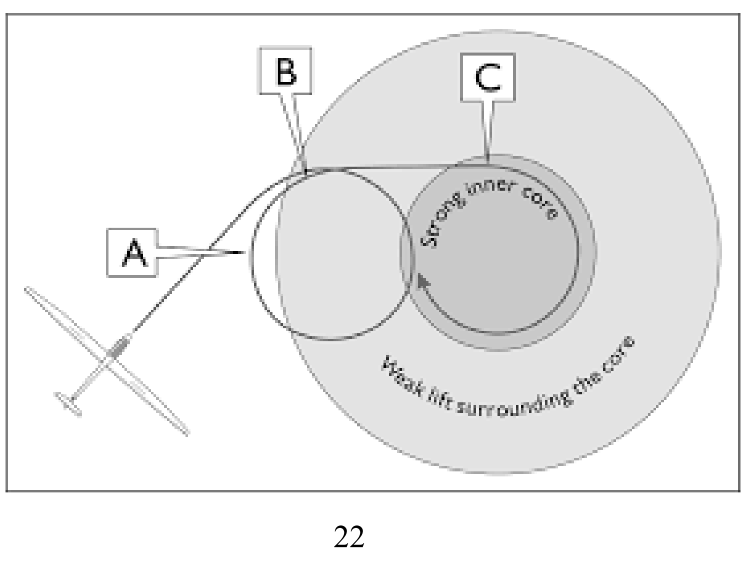
Practical Considerations

In using the chosen thermalling system, the pilot should keep the following in mind:

- Good thermalling requires accurate and consistent flying. For a classic, regular, round, perfect thermal, this means flying true round circles requiring constant airspeed, constant angle of bank, and coordinated turns. It is difficult to make assessments of thermal strength, extent and location unless the glider is being flown accurately. ***Remember, once established in the thermal, control inputs should be minimized. The control stick should be almost stationary! Every control input causes drag and degrades performance of the glider***.

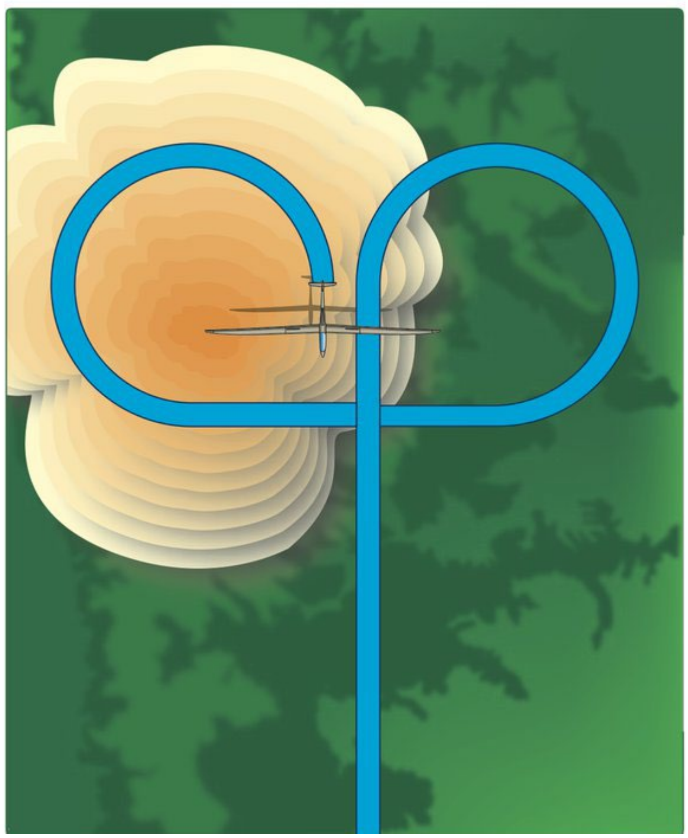


- Theoretically, a thermal is strongest at its center (core). The longer the glider can stay in the core, the faster it will climb. Theoretically, as the pilot moves away from the core, the slower will be the climb. Inexperienced pilots tend to make their turns in thermals too shallow. Initial turns should be at around 40° angle of bank. If turning insufficiently steep is a persistent problem, draw a temporary mark on the canopy showing 40°. Once established in the thermal, bank angle can be adjusted to ascertain whether doing so increases the climb rate.

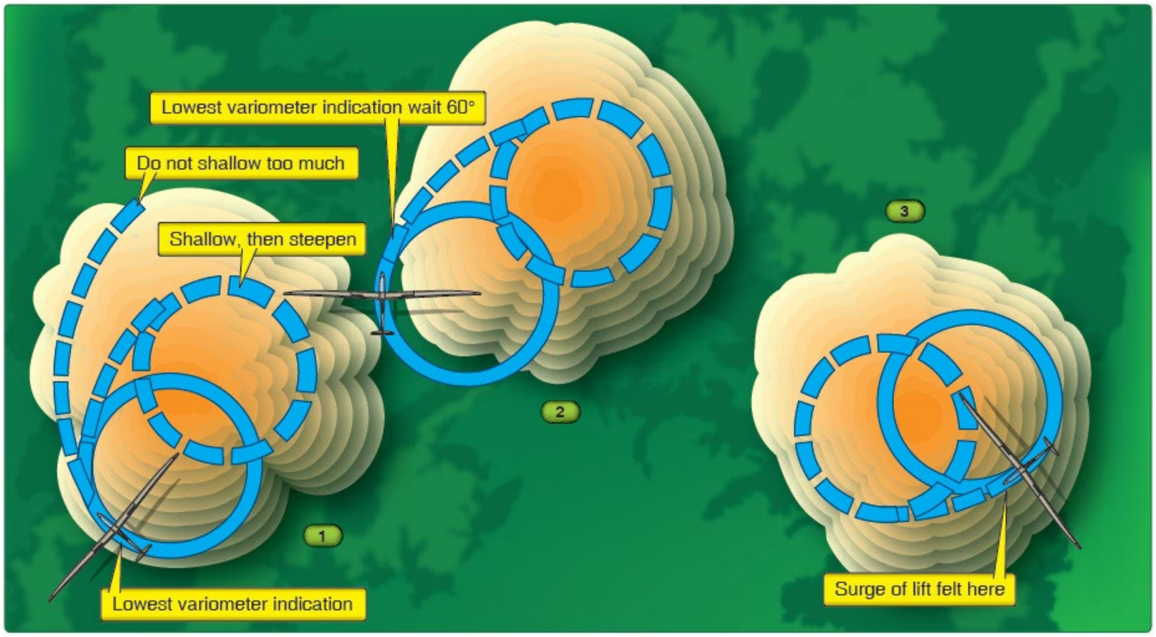


- Build a mental picture of the thermal in relation to the glider's position. Variometer indications may lag up to 5 seconds while seat-of-the-pants surges are be felt in real time. This mental picture should be used as an aid to moving the circle to center the glider in the core. The successful soaring pilot knows at all times where the thermal core is in relation to the glider.

- When lift is first encountered in the thermal, the course is initially elliptical as the pilot establishes the rate of turn and reduces speed to the optimum. If the thermal is lost, maintain the turn through 270°, roll wings level for a count of three, and then resume turning. This should get the glider back close to where the thermal was first encountered.



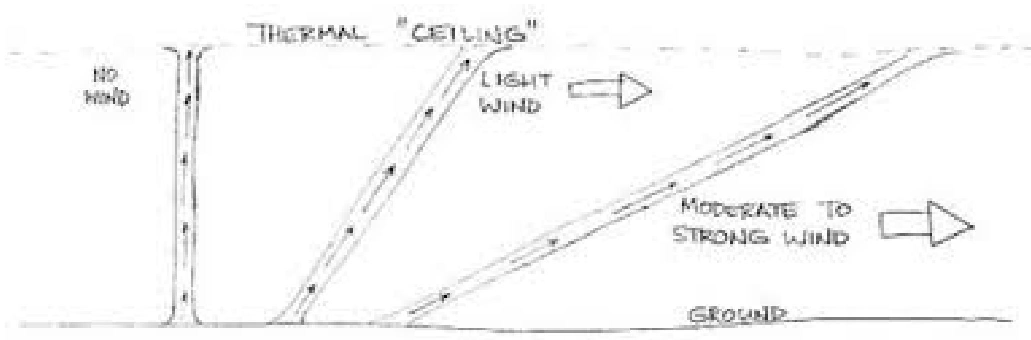
- When attempting to move the circle to center in the core of the thermal, the pilot should move the glider in two or three small shifts rather than in one large one. The latter risks losing the thermal entirely if made in the wrong direction.



- The closer to the ground a thermal is, the narrower it is likely to be, hence, the need to achieve a smaller radius of turn.

- Don't keep on circling in sink. Widen the search area to see if the thermal moved. If, after a couple of turns, contact is not re-established, stop circling and search for another thermal.

- In any wind, the thermal will tend to lean downwind. As the glider is always descending in the thermal, the glider will fall out of the thermal on the downwind side. Constantly correct for back into the wind to remain in the thermal.



- If low, don't leave the current thermal for something better unless drift is unacceptable. Stay with it.

- The weaker the lift, the more accurately the glider needs to be flown.

- If uncertain which way to turn on entering a thermal, turn either way. Do not delay the turn just because the correct direction can't be determined.

- Thermal at minimum sink speed <u>for the angle of bank chosen</u>. Minimum sink speed increases with angle of bank/load factor in exactly the same way as stalling speed. [The increase is the square root of the load factor, thus in a 60° banked turn, where the load factor is 2g, the minimum sink speed will increase by 1.4. If wings level minimum sink at a given weight is achieved at 40 kts., at 60° of bank, it will be 56 kts.] Know the relationship between the calculated wings level minimum sink speed for the glider and the onset speed of the pre-stall buffet (assuming there is one). Approximately the same relationship exists at any bank angle. For example, if the calculated minimum sink rate with wings level is achieved at 42 kts, and the onset of the buffet occurs at 39 kts, establishing the buffet onset at any bank angle and adding 3 kts will give an approximation of the minimum sink speed at that bank angle. The following table illustrates minimum sink speeds at representative bank angles.

Bank Angle	**0°**	**30°**	**45°**	**60°**
Load Factor	**1.0g**	**1.2g**	**1.4g**	**2.0g**
V min. sink	40	44	48	56
V min. sink	42	46	50	59
V min. sink	45	50	54	63
V min. sink	48	53	58	67
V min. sink	52	57	62	73
V min. sink	55	61	66	77

Some additional thoughts on thermals as seen by Adam Wooley. We all like a light to moderate wind day because it is beneficial for the generation of thermals and it is relatively predictable. On strong wind days, we tend to leave the hangar doors closed because the winds break up the thermals and can be harder to find, especially near the ground! The good thing is that even on these days, the hot air still sticks to the ground as they move downwind during the growing process. Finally, an obstacle is encountered, and the thermal separates from the surface. The obstacle can be a group of trees or tree line, a farmhouse, a cool dam, vegetation change, neighboring scrub, a car driving down a country road, or even a change in slope. *(Editor's note: I recall my grandfather telling a story of his imminent outlanding in a new Ka-6 when flying over a field with a tractor plowing it. The moving tractor helped separate the warm air from the ground allowing a thermal to take him away.)*

Thermal Genesis

The warm air is continually being pooled and continues to be pushed along the ground, drawing it in, feeding the thermal, even after the thermal has fully established itself. Under the center of the thermal, a lower pressure is developing with a positive side effect. It causes more warm air to be sucked off the ground along the thermal's path of the ever so gradually shrinking hot air reservoir, prolonging the life of the thermal on windy days. What does this mean? Simply, a pilot may be wasting time looking for thermals overhead the trigger source as he or she would normally do on light wind or calm days. Pilots must look downwind of the trigger point!

Leaning Thermals

Thermals drift over the ground in relatively flat terrain. In mountainous terrain, the trigger source and thermal will remain relatively stationary. Over the flatlands, clouds drift always in the direction of the upper wind! Thermals apparently lean over as they drift downwind. The warm air primarily is ascending in a vertical column within the air mass.

Drifting Thermals

Thermals drift downwind in a vertical column of air, rather than lean. Thermals also seem to generate from the same position on a semi-regular basis in this situation. But older clouds downwind don't dissipate? This is usually because they are drawing in air from nearby decaying clouds or still have warm air feeding them in general. Supporting the vertical column of air theory rather than a leaning thermal occurs when a pilot joins a gaggle of gliders. The pilot often joins them from immediately below or above them, even on moderate to strong wind days and thousands of feet apart from the already established glider.

On windy days, it takes some practice to find thermals quickly without wasting too much time. It is useful to always look down to try to find the trigger source when low from around 2000-3000 ft. AGL, as there is less ambiguity around where the thermal came from. The higher up, the more imagination a pilot will need! Once the pilot is able to identify where the thermals are coming from, he or she is able to fly from one thermal source to another, greatly increasing the chances of finding lift, then centering quickly to stay in it. Soon this process or thermal finding ability will become subconscious. The pilot's success rate in finding thermals on windy days will increase, resulting in more motivation and enjoyment for this wonderful sport.

Training Exercise and Completion Standard

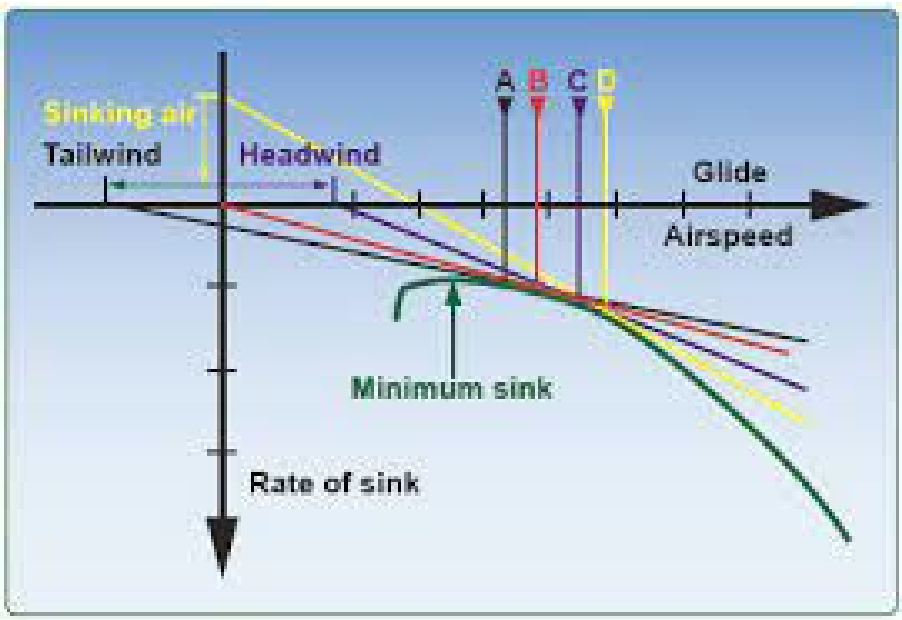
The pilot should be able to circle with reasonable precision and center the thermal quickly and reliably.

Speed-to-Fly

Training Objective

Effective cross-country soaring requires an understanding of the best speed-to-fly in the prevailing conditions. This section sets out the knowledge that the pilot needs to fly at best speed-to-fly.

Please refer to additional publications, articles, and study guide manuals available commercially, including the GFH.



Suggested Text

Be familiar with the concepts discussed in Bob Wander’s book, *Glider Polars and Speed-to-Fly … Made Easy*.

Practical Considerations

With regards to Wander's text, the following should be kept in mind.

- Never fly slower than the wings level minimum sink speed—to do so results in lower performance.

- In achieving best speed-to-fly in medium and higher performance gliders, it is normally sufficient to fly within 5 kts of the optimum speed as the polar curve gradient gradually changes—better a little too fast than a little too slow.

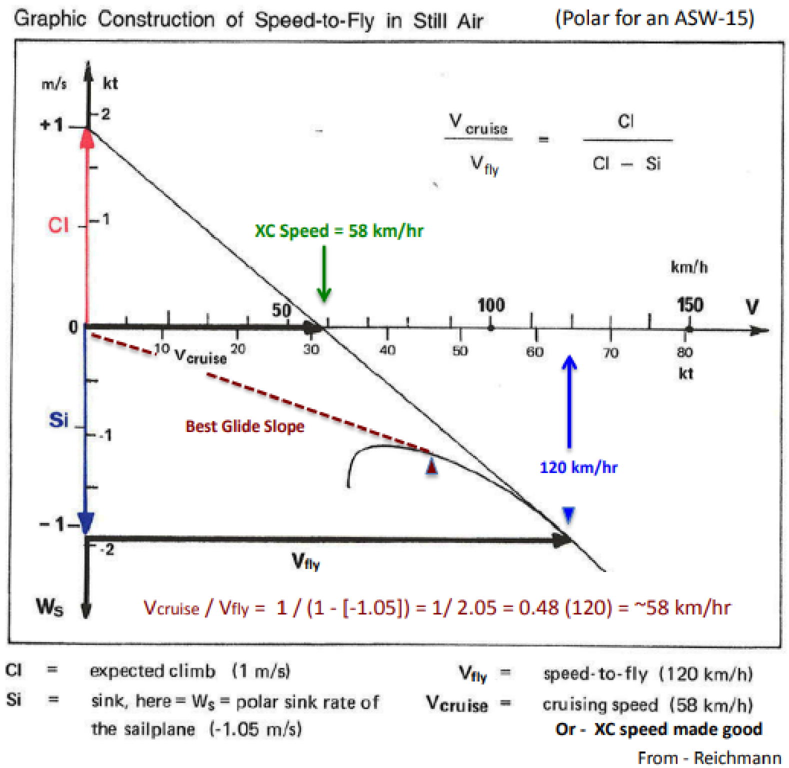
The Equation and the Sailplane Polar

Note how the V_{cruise} and Speed to Fly (V_{fly}) depend on the strength of the lift (Cl).

Also note how the polar of the sailplane determines performance (the slope of the tangent)

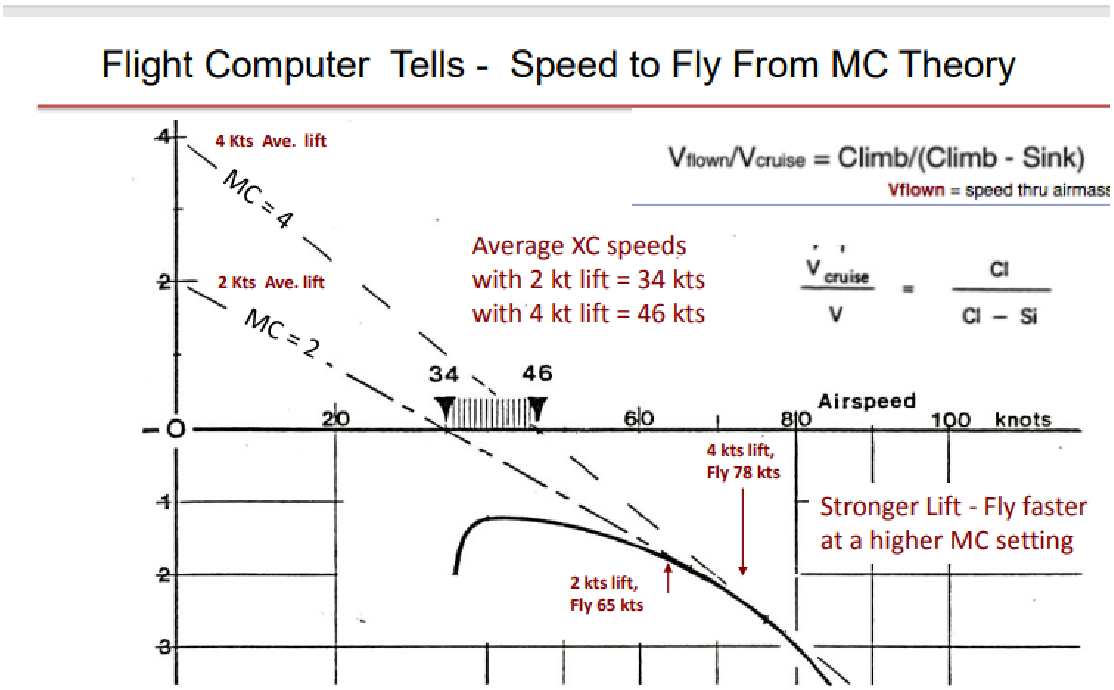
Thus - for any expected value of lift on course, there is a defined speed to fly between your position and that thermal.

This is the MacCready Speed (V_{fly})



- Inter-thermal speed: Inexperienced pilots may use a MacCready setting of 0 until confidence is gained. Optimum is probably a MacCready setting of one quarter the best rate of climb in the last thermal or one half the average rate of climb, unless conditions ahead warrant something different.

- The change in performance resulting from an increase or decrease of the MacCready setting (i.e., a change of airspeed) is not linear throughout the range of settings used. At a high MacCready setting (near the average achieved rate of climb), a small reduction of a MacCready setting (and speed) reduces achieved cross-country speed by a relatively insignificant amount but increases the distance covered significantly. At the other end of the range with a MacCready setting of near zero, a small change in the setting will affect cross-country speed substantially, but only have a small effect on distance achieved. Inexperienced cross-country pilots should probably start by using an intermediate MacCready setting—about half of the average achieved rate of climb.



112. Increasing the achieved rate of climb from 2 to 4 knots can give an increase in average speed of over 10 knots.

Strict MC theory argues that you spend ½ time cruising and ½ time climbing – If you have programmed MC 4 into your computer, it will tell you to fly faster (78 kts) than if you set MC 2 (65 kts) as shown above

- The MacCready setting should be adjusted depending on the height band in which the glider is operating (The higher the setting, the more aggressive; the lower the setting, the more conservative). A reasonable rule of thumb to determine initial MacCready setting is height in thousands (AGL) minus one. Flying at/descending through 4000 ft. AGL, use MacCready setting of 3 (kts). An inexperienced pilot might start by using half the calculated number, for example 1.5.

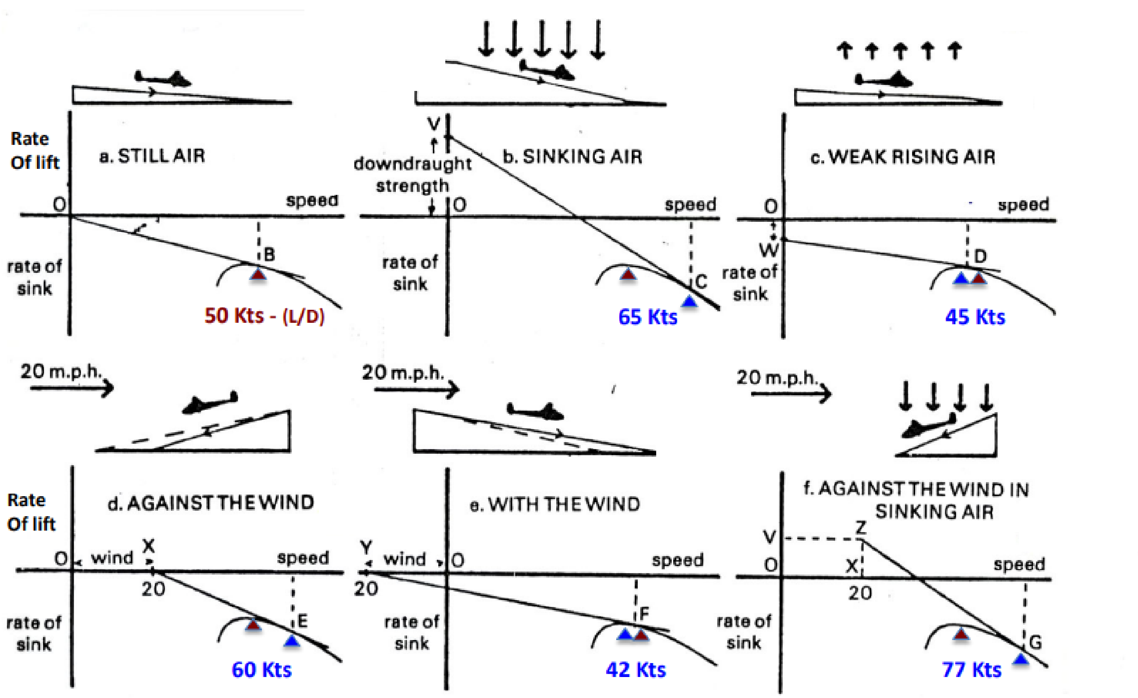
- Height bands. Spacing of thermals is generally proportional to the height of the convective layer. The higher the thermals go, the more widely apart they are spaced and *vice versa*. The normal operating band is usually accepted as the top two thirds of the convective layer, e.g., if the maximum achieved altitude is 6000 ft. AGL, the band is between 2000 ft. and 6000 ft. AGL. Until experience is gained, the new cross-country pilot may use the top half of the convective layer as the normal operating height band. Below the normal operating band, any lift should be used.

- Minimum acceptable rate of climb should increase with altitude. The higher/closer to cloud base, the stronger the minimum acceptable rate. At that height, it may well be possible to proceed just by S-turning and (if flying conservatively) slowing down to minimum sink speed through lift of less than the minimum acceptable rate.

- Anticipate the onset of sink on leaving the thermal—increase speed after rolling wings level and ensuring the heading is on course. However, care must be exercised to ***check and clear the area below*** before leaving the thermal.

- Make speed compensation for wind only on final glide. Headwind rule of thumb is to increase speed by half the estimated headwind. For a tailwind, slow down to minimum sink speed.

The Sailplane Polar Can Be Used to Find Best Speeds for Distance



118. Determining the speed to fly for maximum distance in various conditions by means of the performance curve.

Speeds are for an ASW-19 - Note the sailplane is flown between ~ 45-80 kts - Rarely is 50 kts (Best L/D) selected

From - Piggot

- Keep eyes out of the cockpit and maintain a good external scan. A working audio variometer is an essential item of equipment. A knee-mounted GPS is not acceptable. This decreases situational awareness of what is happening outside of the cockpit.

  Note: The pilot must be fully familiar with the operation of the GPS and all other instruments before using them in flight. Get to the top of the learning curve before leaving the ground!

Training Exercise and Completion Standard

The pilot should be able to fly at appropriate speeds for the atmospheric conditions, wind, and final glide considerations. Good lookout practices must be maintained with minimal watching of the instruments.

Use of Parachutes

The use of a parachute by the pilot is a personal choice, depending on the type of flying. A parachute is not required for normal glider operations. However, parachutes are required during all official sanctioned glider events. The SSA and SSF recommend the wearing of parachutes for cross-country flights.

Cross-country flying and thermalling with other gliders bring increased risk of mid-air collisions. It is recommended that all pilots wear serviceable parachutes and be familiar in their care and use. Some parachutes have a static line installed on a parachute. This is usually installed on the rear portion of the parachute and connects to the static line ring installed in the glider. This static line provides an extreme safety advantage when bailing out. If the pilot is rendered unconscious due to striking part of the glider during the bail-out, this line will open the parachute when the pilot is approximately 35-40 feet away from the glider without any pilot's action.

Parachutes are effective only if the parachute is serviceable, correctly fitted, and operated correctly. Before wearing a parachute, the pilot must be familiar with inspection of parachutes, correct fitting of parachutes, and proper operation including exiting the glider during a bailout.

Training for Use of the Parachute and Inspections Guidelines

Preflight inspection of the parachute:

- A general external examination looking for any untoward conditions (e.g. stains, loose parts, exposed parachute canopy, etc.). If it does not appear right, check with a parachute rigger or other knowledgeable person before wearing.

- Checking for proper stowage of the ripcord handle and re-seating it if out of its elastic, Velcro, or pouch stowage.

- Inspection of the pins to ensure they are not bent, nor seated improperly - i.e. not jammed into the shoulder at the top of the pin, nor pulled almost all of the way out of the loop (located midway is ideal).

- Checking that the red break thread is intact and that the three-character code on the lead seal matches that noted on the packing card. Ensure that the packing card indicates a current parachute pack within the preceding 180 days IAW FAR 91.307.

- Check the static line (if installed) is stowed properly.

- Optional: If no static line is installed on the parachute, connect a static line to the static ring located in the glider and parachute "D" ring. Cord breaking strength must be at least 300 pounds according to Strong Parachute.

Care, carrying and storage of the parachute:

- Particular care should be taken keep the parachute free of external contamination. In the event of contamination, a parachute rigger should be inspecting the parachute for damage prior to any subsequent usage.

- Parachutes should not be left out in the sun.

- Store the parachute in a carry bag to provide protection.

- Connection of the parachute straps, adjustment of such straps, and proper wearing of the parachute:

  "Parachutes are adjustable to fit a large range of body sizes. An improperly fitted parachute will be uncomfortable, and may be dangerous. In general, the shoulder straps should be used to bring the parachute pack to an appropriate level on the back; once this is done, the leg straps should be made to fit snugly."

Wearing of the parachute:

- Normally, the parachute is put on and adjusted before entering the glider. Exercise care not to damage the glider with the straps or other parts of the parachute. Some pilots install the parachute after they enter the glider. Either way is acceptable.

- Ensure the parachute does not inhibit usage of canopy locks, harnesses, or access to jettison controls.

- Know the procedure for jettisoning the canopy prior to bailing out and that the pilot has full range of movement and access to all levers, locks, etc.

- Ensure the static line, if used, is properly connected and does not to interfere with the pilot's movement in the cockpit.

Emergency Egress

Know and practice the glider's emergency egress procedure.

The physical condition of the pilot is very important. If the pilot cannot egress the glider on the ground, he or she will be unlikely to be able to egress in the air.

Operation of the parachute after exiting the glider:

- Be able to locate, grasp, and pull the ripcord handle without looking at the handle. Practice this on the ground until the procedure is second nature.

- The pilot will grasp the ripcord handle and pull it forward away from the body as soon as he or she is clear of the glider.

- Parachutes are steerable using their design forward speed of around 5 kt. Steer with the steering toggles attached to one of the rear risers. Know how to turn the parachute.

- Use the forward speed to avoid dangers, such as power lines, fences, etc.

- Land facing into the wind.

- As the ground approaches, slightly bend knees, make legs as firm as possible, and look at the horizon.

- After landing, release the parachute. If being dragged, pull on a riser until the canopy collapses.

Completion Standard

The pilot must know how to inspect, locate the packing card, make adjustments, and strap on and operate a parachute. Refer to numerous bail out videos available from the internet.

APPENDIX

Appendix A

A: SSA Cross-Country Guidelines

Application. These guidelines apply both to dual flight (CCI and Pilot) and/or solo flight ("Observe and Follow/Lead and Follow") where the CCI follows the Pilot in another glider and establishes communications during the flight by radio.

Planning. When conducting pre-flight planning for a flight, a goal, reasonably capable of attainment, should be chosen. Careful and thorough pre-flight planning and briefing are important. A post-flight debriefing is paramount if the Pilot is to gain the maximum benefit from the flight. Consider using the "Building Block" technique and the "Expanding Course" method as proficiency is gained.

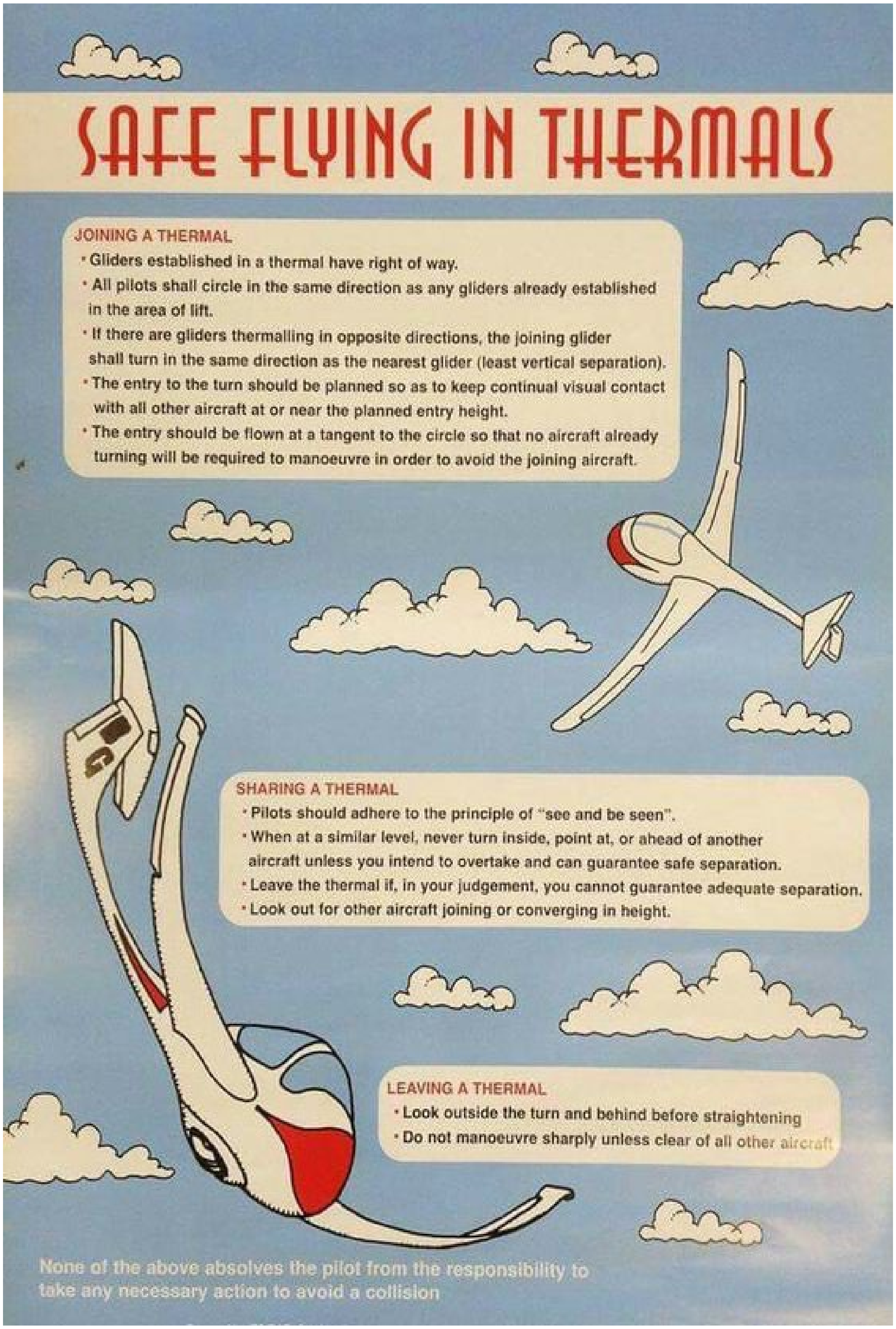
Two-place gliders. Before making a dual flight, the CCI and the Pilot must agree who is to be the pilot-in-command ("PIC"). By default, the CCI will be PIC unless otherwise agreed. Dual flight should have the Pilot taking the role of PIC as much as possible. The CCI should discuss with the Pilot the relevant elements involved in decision making (e.g., where to go next; what McCready value to set, topography, etc.) and let the Pilot execute the decisions. Please remember the Pilot is learning and some decision-making processes maybe flawed. **BE PATIENT!** In an emergency or when necessary to demonstrate a technique (thermally techniques, entering or joining with other gliders, etc.), the CCI should take control and fly the glider. Be sure to follow the positive exchange of control procedure.

Observe and Follow/Lead and Follow. The Observe and Follow/Lead and Follow method is preferred. Experience has shown that when the Pilot follows the CCI, little is learned other than the ability to chase another glider. The objective is for the CCI to observe the Pilot's real-time cross-country decision making and provide timely and appropriate feedback.

The CCI should observe the Pilot, letting the Pilot experience the conditions, assisted, if necessary, by advice from the CCI. Communication by radio must be limited to what is necessary; it is unacceptable to clutter the frequency with the sort of conversational exchanges that might be made if flying together in a two-place glider. Use of a discreet frequency is recommended for instructional communications. The CCI should try and maintain visual contact with the Pilot throughout the flight.

Appendix B

B: Thermal Soaring Protocol

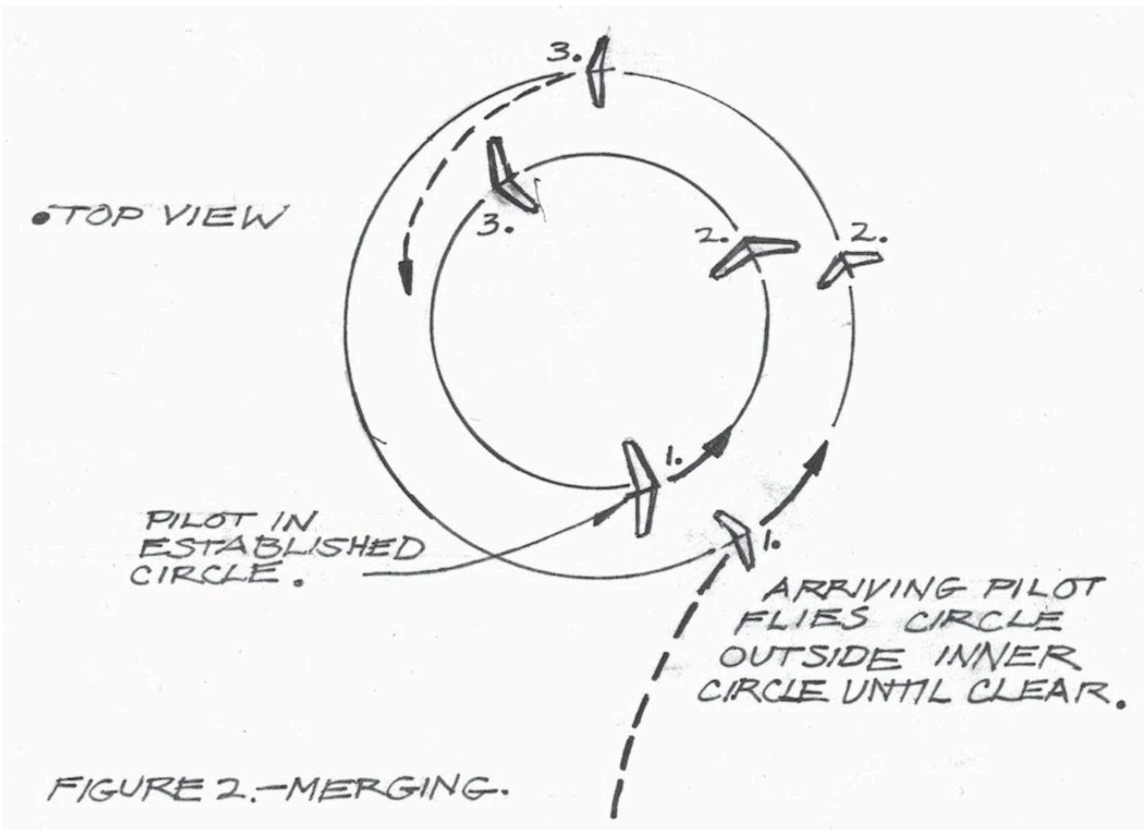


Joining the Thermal

Gliders established in the thermal have right of way. The glider entering the thermal should yield to any glider already established in the thermal.

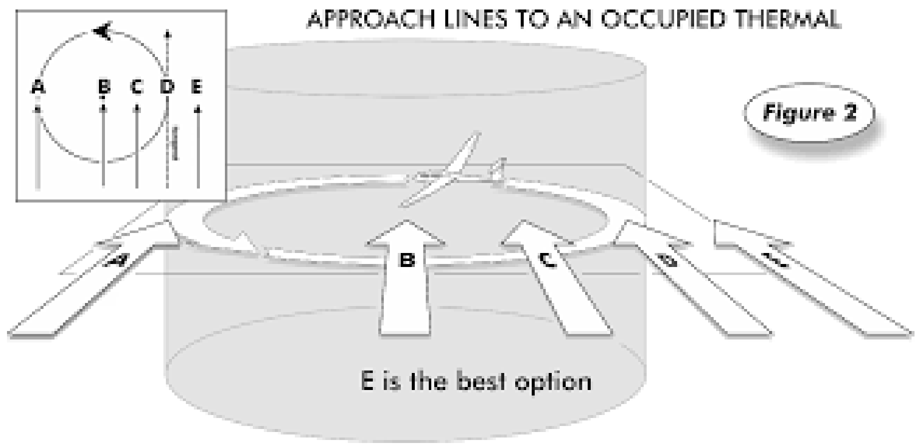
Do not pull up into a thermal unless absolutely sure that there is no other glider above or in front which could possibly be a collision risk.

All pilots must circle in the same direction as any glider already established in the lift.



If there are gliders already thermalling in opposite directions, the joining glider must turn in the same direction as the one nearest/with least vertical separation. A polite radio call on the local soaring frequency could help to re-establish proper direction and protocol. Sometimes a glider may not have seen or is aware of the direction of turns.

The entry to the turn should be planned to enable visual contact to be maintained with all gliders at or near the pilot's entry level.



The entry should be flown at a tangent to the circle so that no glider already turning will be required to take avoiding action.

Sharing the Thermal

Pilots should adhere to the principle of 'see, ***be seen*** and avoid'.

When at a similar level, never turn inside, point at, or ahead of another glider unless able to overtake with certain safe separation.

Leave the thermal if uncertain of maintaining safe separation.

Maintain lookout for other gliders joining the thermal, or converging in height.

Leaving a Thermal

Look outside the turn before straightening out.

Do not maneuver abruptly unless clear of all other gliders.

Appendix C

C: Glider and Personal Equipment for Cross-Country

<u>Personal/Glider</u>
Sunglasses
Gloves
Soaring hat
Stout shoes
Proper clothing for season, expected conditions
Food – apple, granola bars etc.
Pilot certificate
Cash
Credit card
Driver's license
Soaring & general weather forecast
Emergency phone numbers
Chart(s) of task area, marked appropriately
Water bottles (2 – one for after landing)
Pee bags or other relief system
Cellphone
First aid kit
Space blanket
Parachute

<u>Retrieve Vehicle</u>
Spare key for retrieve car
Vehicle documents
Toolkit
Flashlight
Spare wheel
Jack
Lug nut wrench
Correct size tow ball
Crew properly briefed
Additional water/refreshments

<u>Trailer</u>
Spare wheel
Jack
Lug nut wrench
Keys plus spare
Spare bulbs
License tag
All glider fittings
Wing stands
Tail dolly
Tow-out gear

Appendix D

D: CCIP Flight Training Log

							NAME:
FLIGHT LESSON #	1	2	3	4	5	6	INSTRUCTOR COMMENTS
ACCURACY LANDINGS							
OFF-FIELD LANDINGS							
THERMAL ACQ/CENTER							
SPEED-TO-FLY							
NAVIGATION SYS							
CROSS-COUNTRY TECH							
OTHER							

Appendix E

E: IMSAFE

- The foregoing relates largely to assessment of your fitness to start a flight. While being fit to fly cannot always be reduced to a single checklist, but the use of the **I'M SAFE** list covers most of the bases.

Familiarity: Are you really current? Read the flight manual recently? Ready for an emergency? Done a thorough Critical Assembly Check (CAC)? Don't let familiarity divert your attention elsewhere.

Eating: Lack of food can reduce your blood sugar causing loss of concentration; dehydration can incapacitate you. A favorite question of accident investigators is 'when did the pilot last eat?'

Appendix F

F: Cross-Country & Badge Flying

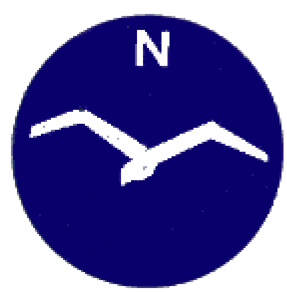
The SSA ABC Training Program was developed at the prompting of Society members to have a standard of training available. It is designed to provide a basic approach to flying for the student glider pilot as well as to give the accomplished power pilots the necessary points unique to soaring so that the transition may be made safely. This program is administered by designated SSA Instructors who must have 50 hours of glider time with 100 flights and hold a current CFI-Glider. The SSA Instructor is responsible for ascertaining that the training requirements have been met. The appropriate pins and blue cards are awarded to the students who achieve the level indicated by A, B, C, and Bronze, each designated to develop skills and experience necessary for future safe flight and FAI Badge attempts. **Applicants must be current Soaring Society of America Members.**

A Badge

"A" badge requirement
Preflight phase: The applicant has knowledge of:

1. Sailplane nomenclature
2. Sailplane handling procedure

Pre-solo phase
Applicant has completed the following minimum flig training program:
1. Familiarization flight
2. Cockpit check procedure
3. Effects of controls, on the ground and in flight
4. Take off procedure, cross wind takeoffs
5. Flight during tow
6. Straight and level flight
7. Simple turns
8. Circuit procedure and landing patterns
9. Landing procedure, downwind and crosswind landings
10. Moderate and steep turns up to 720 degrees in directions
11. Stalls and stall recovery
12. Conditions of spin entry and spin recovery
13. Effective use of spoilers/flaps and slips
14. Emergency procedures
15. Oral exam on FAR's
16. Solo Flight



B Badge

"B" Badge Requirements
Practice phase:

1. Demonstration of soaring ability by solo flight of at least thirty minutes duration after release from 2000' tow (add 1.5 minutes/100' tow above 2000')

C Badge

"C" Badge Requirements
Pre-cross-country phase:

1. Dual soaring practice, including instruction in techniques for soaring thermals, ridges, and waves (simulated flight and/or ground instruction may be used when suitable conditions do not exist)
2. Have Knowledge of:

cross-country procedure recommended in the American Soaring Handbook
Glider assembly, disassembly and retrieving Dangers of cross-country flying

3. Solo practice
4. Demonstration of soaring ability by solo flight of at least sixty minutes duration after release from 2000’ tow (add 1.5 minutes/100’ tow above 2000’)
5. While accompanied by a SSA instructor, demonstrate the ability to:
make a simulated off-airfield landing without reference to the altimeter, perform an accuracy landing from the approach, touching down and coming to a complete stop within an area 500’ in length.

Bronze Badge

Bronze Badge Requirements

1. Complete the ABC program with the C badge awarded

2. Log at least 15 solo hours in gliders, including 30 solo flights which at least 10 are flown in a single place glider

3. Log at least two flights each which have two hours duration or more

4. Perform three solo spot landings in a glider witnessed by a SSA instructor. The accuracy and distance parameters are based upon the glider's performance, current winds, runway surface condition, and density altitude. As a guideline, a minimum distance of 400' would be acceptable for a Schweizer 2-33. (This is a land and stop in a specified zone requirement.)

5. Log dual time in gliders with an instructor during which at least two accuracy landings (same as above) were made without
reference to an altimeter to simulate off field and strange field landings.

6. Pass a closed-book written examination covering cross-country techniques and knowledge. This test can be taken online. Minimum passing grade is 80%.

Appendix G

G: Atmosphere

Here are some of the basic principles:

- The air at any level must support the air above it, so air at lower altitude is more compressed than the air above. Consequently, atmospheric pressure decreases with height. A thermal is a parcel of air which starts next the ground by becoming warmer than the surrounding air – the result of differential surface heating or other causes. By becoming warmer, the particle also expands and becomes less dense, and tends to rise. Instability is the tendency of the parcel to continue rising without any energy being added to it from the surrounding atmosphere. As the parcel rises, if the surrounding air is cooler and denser, it will keep on rising – the atmosphere there is 'unstable'. The parcel continues to rise while the instability remains. Its upward movement ceases when the parcel's temperature reduces to that of the surrounding air.

- The process of expansion causes the air within a rising parcel to cool. If the ascending parcel is cooled to the dew point, water vapor within it will condense, causing cumulus cloud. The rate of cooling of unsaturated ("dry") air is 5.4°F/3.0°C per 1000 ft. This rate of change is called the dry adiabatic lapse rate (DALR). Adiabatic means that the rate of change (the lapse rate) applies to air which does not exchange heat with its surroundings - the physical process is internal to the parcel. The DALR tells how much a rising parcel of air will cool adiabatically as it ascends. So a parcel which had a temperature of 80°F/27°C at the surface will cool down by approximately 54°F/12°C to 26°F/-3°C if it reaches 10,000 feet AGL.

- Thermal Index (TI) is a measure of the atmosphere's stability or instability. To determine the TI, calculate the temperature of a lifted parcel of air (which cools at the DALR). Next establish the temperature of the surrounding air (by weather forecast, or direct measurement by an airplane). Subtract the calculated temperature of the lifted parcel from the predicted/measured ambient air temperature at the same altitude. The resultant is the TI. If it is a negative quantity, there is instability; the higher the negative value, the greater the instability and the better the likely lift. If the TI is positive, then the air is stable at that altitude, and the thermals, if any, will not reach that height. You may be able to obtain the TI directly as part of a soaring forecast from an FSS briefer.

- Assuming cumulus cloud formation, the height of the cloud base can be calculated from the temperature/dew point convergence rate, which, in a parcel of rising air, is 4.4°F/2.4°C per 1,000 feet. Cloud base height is calculated by deducting the dew point from the surface temperature, dividing it by the convergence rate, and multiplying the result by 1,000, or:

$$1{,}000\,\frac{(ST - DP)}{(4.4)}$$

In some cases, the calculation can be expressed in a simple table as shown below. For more precise values, the actual calculation must be used.

Surface Dew Point Temperature (°F/°C)	**Cloud base forms at (feet AGL)**
5.0/2.7	1,100
10.0/5.5	2,300
15.0/8.3	3,400
20.0/11.1	4,500
25.0/13.9	5,700
30.0/16.7	6,800
40.0/22.2	9,100
50.0/27.8	11,400
60.0/33.3	13,600
70.0/38.9	15,900
80.0/44.4	18,200

Appendix H

H: Accuracy Landings

The ability to land accurately is essential to safe cross-country flight.

This involves flying the glider on a pre-planned path to an aim point where you would hit the ground if you didn't flare (Center of Action (CoA)) and subsequently accomplishing a safe landing. Your touchdown point should be approximately 3-5 glider lengths beyond the CoA dependent on the approach speed. The recommended approach speed is 1.5 time the stall speed of the glider plus ½ of the wind. (A good rule of thumb is best L/D speed plus 5kts) Excess speed will cause extra distance in landing. Until you can land consistently in all conditions, you lack an important element for flying cross-country with proficiency and safety.

Training Objective

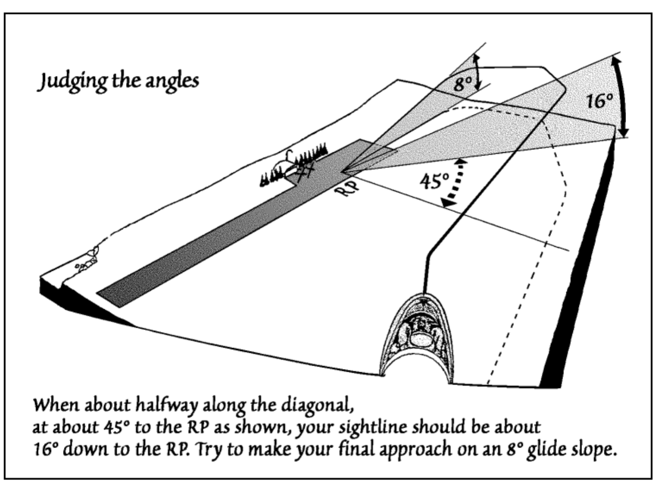
The CCI will evaluate your knowledge and skills for accurate landings. The SSA "C" and Bronze Badge are excellent starting points for this requirement. All rated pilots need to practice accuracy landings. Consistency is the key!

Please refer to other publications, articles, and other study guide manuals available commercially, in addition to the GFH.

Techniques

General Principles

- A successful accuracy land begins with an accurate pattern. Keep the CoA continually in sight and use it to reference your energy state in relationship ("Safe Relationship") to the CoA.



- Try to make minor adjustments throughout the pattern. When the glider has turned onto the final approach, the pilot should be continuously evaluating the energy state and be ready to adjust for wind gradient, etc.

- Once you have turned final, fly the glider keeping the CoA in view so that the glider flies down the final approach at the desired speed until ready to make the landing flare.

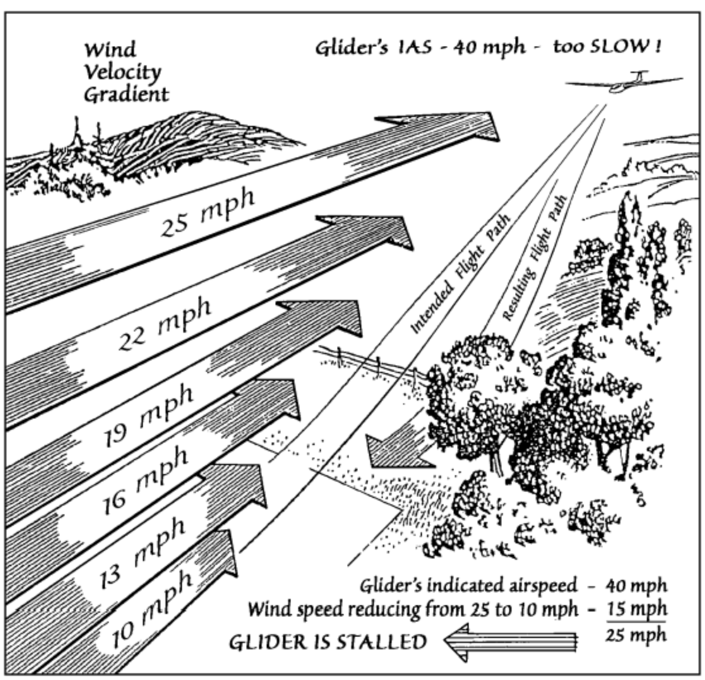
- Establish and maintain a stabilized approach.

- Maintaining a stabilize approach through the arrival is critical for a safe outcome. FAA GFH, chapter 7, addresses the criteria for a stabilize approach:

  The stabilized approach is when the glider is at the proper glider path/angle with minimal spoilers/dive brakes deployed/ extended, at the recommended approach speed for the current conditions (winds, gust, sink, etc.) and able to make the intended landing spot. The stabilized approach should be established no lower than 100 feet AGL.*

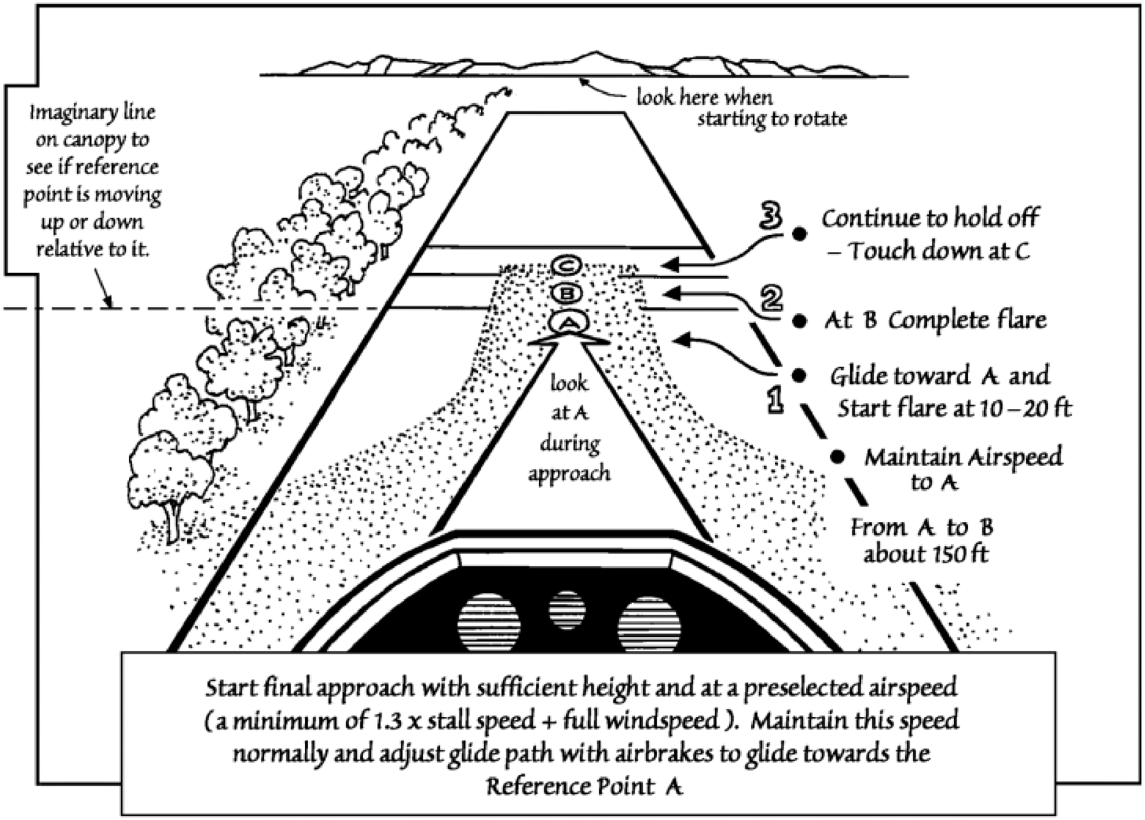
  **Refers to as no less than ½ deployment of spoilers (up to ¾)*

- *If a slip is needed, the slip should be terminated at 100 feet AGL, to then establish the stabilized approach.*



The effect of a strong wind gradient on a glider approaching to land is to cause a rapid drop in airspeed as you near the flare point. This is particularly noticeable if the air-

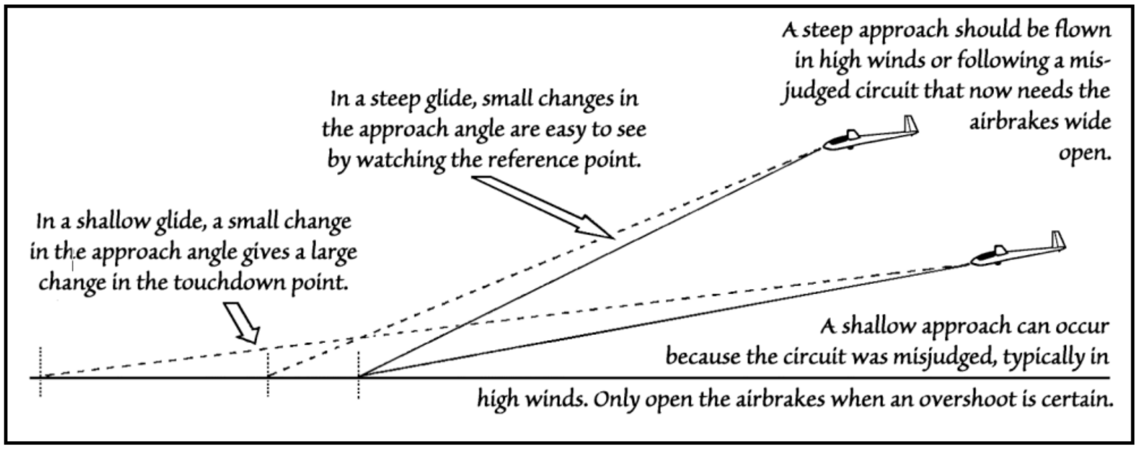
Center of Action (CoA) Technique



Approach control using CoA technique involves judgment and decision making.

- Judging whether the glider is overshooting or undershooting from the apparent movement of the CoA in relation to the canopy and making any necessary corrections.

- Judging the steepness or shallowness of the approach and how to obtain the desired glidepath.



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

- Use of CoA technique enables you to land the glider precisely every time.

  Movement of the CoA either up or down the canopy shows how the glider is moving in relation to a path targeted on the Reference Point.

  If the CoA appears to move down in relation to the canopy, then the glider is overshooting (going high). This is only true if the pitch attitude, airspeed and airbrake setting are constant. (GFH Chapter 8 has detail information.)

  If the CoA appears to move up in relation to the canopy (going low/below selected glider path); then the glider is undershooting. This is only true if the pitch attitude, airspeed and airbrake setting are constant. Ensure that this situation is corrected promptly.

- If the CoA appears stationary in relation to the canopy and the pitch attitude, airspeed and airbrake setting remain constant, then the glider is approaching the reference point correctly (on glide path).

Once the flare/round out has begun, the CoA is of no further use.

- When approaching through a wind gradient, turbulent (or any other unplanned reduction of airspeed) a more nose-down attitude is required than if the airspeed had remained constant. This will result in undershooting the CoA. If this happens, then, it is practical to reduce the amount of airbrake (as well as regaining the correct airspeed). Fly recommended approach speed by manufacture/wind correction added if needed (GFM).

- Once the glider is established on final approach, you may discover the glider is undershooting substantially requiring you to close the airbrake almost completely. This should be avoided if possible. This is usually caused by misjudging the glider's position in the safe landing cone and opening the airbrake too soon, e.g., in a strong headwind. The correct recovery procedure is to close the airbrake fully (if flaps are used, do not adjust your flap settings), let the glider progress forward towards the CoA until it is possible to complete the approach with normal (two-thirds) airbrake position. Using this technique avoids arriving at the flare with little or no airbrake, giving substantially increased risk of a PIO because of the glider's reduced pitch stability. Remember we want to have established the "stabilize approach" profile by 100 feet. Fly recommended approach speed by manufacture/wind correction added if needed. (GFM)

Pattern Flying

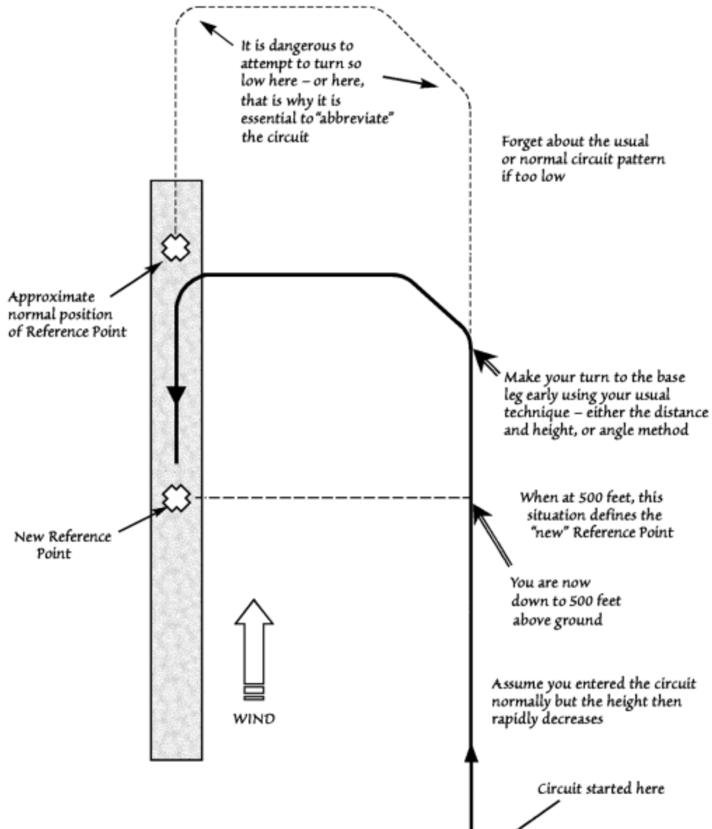
Theoretical Background

Recent accident reports highlight that experienced pilot, as well as students, continue to experience difficulty in safely accomplishing approaches leading to landings at the point of intended touchdown (landing goal). Undershooting accidents continue to occur. Experience has shown that the focus must always be on taking whatever action is necessary to achieve a safe landing, this includes flying a proper pattern, adjustment for wind and the landing area selected. The entry into the "traffic pattern" is considered the first portion of the stabilize approach concept.

Pattern Flexibility (Normal and Off Field)

Primary Purpose. The primary purpose of flying any "pattern" is to enable the glider to arrive safely using a systematical approach in the arrival phase to a landing and to reach that goal the ***first time, every time*** in a systemic series of turns. Unlike airplanes, gliders do not offer the option of going around and making another attempt if the first is unsuccessful. That is why it is critical that you have selected an adequate field at an adequate altitude commensurate with your position. If your primary training was to enter the IP at the bridge, then turn downwind at the barn, well, we will have a problem in pattern flying, especially when landing comes to unfamiliar field and/or off-field landings. Your bridge/barn, etc. may not be there! This type of training MUST BE AVIODED!

- You must acquire judgment and other piloting skills so that you can, without fail, achieve this result every time. Some sort of systematic traffic pattern should be flown to allow the pilot adequate time, spacing, landing and field reconnaissance to assess the landing area.



The Abbreviated Circuit
flown when very low or when excessive height is lost

- Left, Right, Overhead or extended bases and maybe finals. The last two should be avoided at all costs due to the shortness of time spent preparing and establishing a stabilize approach concept and field reconnaissance. Hopefully this has already been accomplished during the field selection. Give yourself more time in a reconnaissance of the landing area. Passing the abeam point of your selected landing area and CoA is when the transition begins. Adjustments are made from that point. **DO NOT GET IMPATIENCE/MAINTAIN COMPOSURE!**

DO NOT THERMAL BELOW 1000 FEET AGL! *

- Safe Height Band. The primary purpose will be achieved by keeping the glider within a safe height band so that a Safe Relationship is maintained while using the performance of the glider to best effect. This will result in neither being too high nor too low in the pattern at any time. This will normally be accomplished by keeping the airbrakes closed (and thus maintaining maximum performance) until it is absolutely certain that the glider will make good the CoA. There is a relationship between altitude, airspeed, airbrakes and pattern position. Once absolute certainty has been ascertained, the glider can enter a safe landing cone (the traffic pattern could be referred to as the safety landing cone) for the final approach towards the CoA, through the landing flare, to touchdown.

*Developing more experience and proficiency may allow change to a lower altitude if needed

- Safe Landing Cone. The top of the Cone (traffic pattern) is represented by the approach angle/path of the glider with full airbrake, while the bottom is represented by the approach angle/path with airbrakes almost closed. (It is undesirable to approach with airbrakes fully closed–if the glider gets below the glidepath in these conditions, there is nothing that can be safely done to get back up to it.) Preference is to be high rather than low at all costs, but prefer to be right the first time. The minimum approach angle retains a margin for error and so the Cone represents a comfort zone which guarantees safe arrival. Utilizing the stabilize approach concept and ensuring to be established by 100 feet AGL. The ideal, or target, is a conservative point between the two, represented by two-thirds airbrake. (The setting that gets approximately two-thirds (deployed) of the maximum rate of descent, not necessarily a two-thirds lever setting or airbrake paddle position). It is very important to note that the stronger the headwind on the final approach, the more steeply the Cone is inclined up from the horizontal and the closer the base leg.

  If you are constantly slipping on a majority of your base/final, then pattern needs adjusting!

Pattern and Landing Considerations

Experience has shown that the human eye is unable to gauge distance, horizontal or vertical, with any great degree of accuracy. Conversely, it is able to perceive angles with a greater degree of precision and a *change* in an angle even more accurately.

- The altimeter can only show actual height if the elevation of the ground below is known.

- This is not likely in the case of an off-field landing.

- Instrument error in the altimeter becomes more critical the closer to the ground the glider is, an error of 150 ft. at 3000 ft. above ground level (AGL) is only 5%; at 700 ft. AGL this error becomes 21%, and

- at 350 ft. AGL it is 43%. To this error needs to be added inaccuracy caused by change in the pressure datum (pressure change since the altimeter was last set and terrain location change) and by inaccurate information on the height of the landing terrain. **Near the ground, no dependence should be placed on the accuracy of the altimeter. Do not refer to the altimeter once you are in the pattern!**

- Ground objects such as houses, trucks and automobiles appear larger the lower (and closer) you are to them. Below 500 ft. AGL, judging height by the apparent size of objects works fairly well. This method of assessment is useful when judging the height of the final turn. . (For further discussion on learning angles, see *Learning Glide Angles* in the chapter on "TLAR" (that looks about right) in *Glider Basics from First Flight to Solo* by Thomas L. Knauff).

Knauff's method, that looks about right (TLAR) is very useful here.

- Lift and sink have a substantial effect on the achieved performance of the glider in the pattern (as elsewhere), and even may place in doubt the ability to make the CoA. Monitoring the variometer provides information on the actual conditions, hence the likely progress of the glider to that point, and the need to take corrective action. You need to know the glider's still air sink rate at pattern airspeed (normally best L/D speed/Yellow Triangle) before meaningful use can be made of information derived from the variometer.

- Recommendation: **DO NOT TURN THE VARIO DOWN IN THE PATTERN**

The foregoing mean that height and distance estimates, even when assisted by an altimeter reading, are likely have a poor level of accuracy, and greatest reliance should be placed on your ability to perceive an angle, and a change of that angle, assisted by the lift/sink information provided by monitoring the variometer, to maintain a Safe Relationship. TLAR.

<u>Maintaining a Safe Angle.</u>

To reliably maintain a Safe Relationship, you must be able to estimate the correct angle for the circumstances (which requires knowledge of the performance of the glider and the prevailing wind conditions) – the vertical, or dip, angle looking from your position in the pattern to the CoA, recognize it in practice and fly the glider in the pattern so that it is maintained. If the correct angle is maintained while correlating height and distance from the CoA, a Safe Relationship will be maintained and the glider will arrive at the start of the Cone and make the CoA goal every time. When lower down, height and distance can be best judged by reference to and comparison with known objects on the ground. Staying within a Safe Relationship translates into the glider maintaining close to a constant angle (viewed in a vertical plane) relative to the CoA. For an off-field landings;
this means placing most reliance on the angle to achieve a Safe Relationship until shortly before turning final.

It should be noted that if any two of the criteria (angle, distance, height) are correct, the third has to be correct. Conversely, if any two are wrong, the third can't possibly be right.

- If the glider is to maintain the correct angle relative to height and distance (i.e. maintain a Safe Relationship), the path followed must be flexible – turning towards the field if the angle decreases (flattens) (e.g. if in sink), and maintaining your current track (downwind) if the angle increases (e.g. if in lift or reduced sink). Additionally, if in strong sink, the airspeed needs to be increased to penetrate efficiently through the area of sink. If no lift or sink in the air mass is encountered, to maintain the angle constant will require the glider to be flown parallel with the landing direction.

- Shortly after passing abeam of the CoA going downwind there needs to be no turns made towards base until you are approximately at the 45 degree point from the CoA (approximately the no-wind position, wind will adjust this as needed). As you approach the abeam point, deployment of spoilers can be initiated, dependent of the performance of the glider. Then the base is turned. On the base segment maintain careful view of the CoA; adjusting the gliders approach speed to the manufactured recommendation. The base is considered the most important leg for the approach when landing anywhere. The base, when flown properly, will allow the glider pilot to make adjustments by utilizing the airbrakes/spoilers and by making small pattern adjustments if needed for height control. This turn is maintained until the glider is on the base leg to the landing direction. Doing this also allows sight of the CoA to be continuously maintained. Approximately altitude for the base leg is approximately 500 feet AGL according to the GFH. Note that the rate at which this turn is made determines the distance the glider has to fly from the start of the final approach to the CoA. Remember keep the **YAW STRING STRAIGHT** (applying rudder for adverse yaw is paramount). Thus, in a strong wind, when the Cone is inclined more steeply up from the horizontal, the turn rate should be greater. In light winds, it should be less. The final approach should be initiated by an approximately 45-degree bank turn (up to) and establishing the stabilize approach concept shortly thereafter. Final approach altitude should approximately 300 feet AGL (GFH). Apply CoA techniques here for glide path control. If your pattern is too close, then the turn from downwind to base is missing, your turn will be approximately a 180 degree turn to final. Avoid this type of condition. There is little time to plan, adjust and interpret the final under these conditions.

- Flexibility is Essential to Deal with Varying Conditions.

- **Throughout the pattern, the emphasis must be on doing whatever is necessary to make a safe approach and landing, flying a specific pattern is not the goal. Keeping turns to a minimum is the best choice; control the rate of decent with the spoilers/airspeed. Stay ahead of the glider. Downwind to base to final should be only two (2) turns. The pilot's main goal is aircraft control and to avoid numerous maneuvering/turns while so close to the ground while trying to look and control could have a disastrous outcome. Concentration on the CoA is highly important. Avoid tunnel vision. Fly the GLIDER!**

This is why the stage of flying gliders at this point must be the highest level of proficiency and competency of the pilot.

Before-Landing Checks.

An essential prerequisite to every safe landing is completion of appropriate before-landing checks. These are basically simple checks, but even today numerous elements are missed. The before-landing check should be accomplished just prior to entering the traffic pattern. This "check" should be in accordance with the manufacture's recommendations. Refer to your gliders GFM for what is required. It allows the checks to be carried out in a sequence that provides least interruption to safe operation and permits maximum attention to be given to maintaining good lookout while joining and actually in the pattern. Remember, all this is going on at the same time. Ensure you maintain the highest degree of situational awareness.

REMEMBER THE LANDING GEAR!

Practical Implementation

General requirement – staying where a Safe Relationship can be maintained (**airbrakes closed if needed, energy conserved, best performance maintained, unless in strong lift**) until absolutely certain the CoA can be made (usually late on base leg, or on final), when the Cone can be entered.

- Start at representative pattern height
- No fixed position of Initial Point/High Key area
- Before-landing checks complete. Usually, 800 to 1000 feet AGL is normally a normal pattern. Some Open Class gliders may select 500 AGL for downwind. It's all based on energy management.
- Ignore the altimeter.
- Select safe dip angle (i.e., angle in vertical plane) between ground and straight line between glider and CoA.

Ensure correct/safe angle selected (suitable for glider performance and wind conditions)

- Maintain a Safe Relationship to the CoA.

- Fly maintaining selected angle, monitoring variometer to check vertical speed - strong lift may require correction by use of airbrakes, however the proximity of sink next to the lift must be remembered. Relate height and distance to the Reference Point – it is still necessary to turn final at a safe height – absolute minimum 300 ft. above the ground. Once past CoA point going downwind, select final approach speed; turn in to base leg. The turn onto final should be made with a bank angle up to 45 degrees.

- Once absolutely certain landing goal will be made and Cone entered – adjust airbrake at correct time to accomplish two-thirds airbrake approach to CoA. This means you must delay opening airbrakes in stronger winds as Cone is inclined more steeply up from the horizontal. Fly recommended approach speed by manufacture/wind corrected added if needed. (GFM)

Completion Standard

1. Exhibits knowledge of the elements related to an accuracy approach and landing procedures.
2. Adjusts flaps, spoilers, or dive brakes, as appropriate to maintain proper CoA.
3. Maintains recommended approach airspeed, ±5 knots based on existing conditions.
4. Maintains crosswind correction (crab/alinement) and directional control throughout the approach and landing.
5. Makes smooth, timely, and positive control application during the round out and touchdown.
6. Touches down smoothly within the designated landing area, with no appreciable drift, and with the longitudinal axis aligned with the desired landing path, stopping short of and within 100 feet of a designated point.
7. Maintains control during the after-landing roll and awareness if a ground loop needs to be accomplished.
8. Completes appropriate actions/checklists.

You must be able to fly a safe pattern, approach and landing using the techniques set out in this Section with the safe and successful outcome never in doubt. Establish constancy on every landing.

Appendix I

I: Off-Field Landings

<u>Training Objective</u>

The purpose of this section is to provide you with adequate ground instruction and flight training so that you are able to complete successfully a landing at an unfamiliar field.

Please refer to additional publications, articles and other study guide manuals available commercially, to include the GFH.

<u>Ground instruction should include:</u>

Recognition of the height bands and heights so field selection is adequate and reasonable to complete a safe approach and landing to it.

Assessment and selection of suitable off field landings.

Evaluation of other factors relevant to a safe approach and landing. This will include review of *Accuracy Landings* in this *Handbook*.

Flight instruction will include training until the completion standard has been achieved. Experience has shown that the completion standard is unlikely to be achieved if you are not already proficient in accuracy landings, crosswind landings and precision use of airbrakes during the pre-landing flare. If you lack such proficiency, training in these areas should be given first. You must be thoroughly familiar with the requirements for *Accuracy Landings* in Appendix H of this *Handbook* and consistently able to achieve the completion standard in that section.

Suggested Text

Wander – *Landing Out…Made Easy*

Knauff - *Off Field Landings (paperback)*

Planning

At any time before the Initial Point/high key area is reached in the pattern to land at the selected field, attempt should be made to use any lift to avoid an off-field landing. Such an attempt should be made only if the lift is workable and not to the detriment of making proper planning for approach and landing. Below 1,500 feet [All heights used in this Section are estimated heights above ground level (AGL) - you should be aware of the effect of pressure changes on accuracy of altimeter readings, and difficulty of determining exact height from charts, even if the precise position is known] the search for lift should be discontinued, although it can be used if found by chance. While attempting to soar, care should be taken neither to lose sight of the selected field nor to be drifted downwind out of range of it.

At no time during flight should you fly over unlandable areas unless there is sufficient height to overfly them, taking account of the possibility of encountering unusually heavy sink.

At 3,000 feet.

- Select a generally landable area (prefer 3 fields) and fly towards it.

- Identify hills likely to create surface wind or lee turbulence problems.

- Avoid areas which slope visibly.

- Note cell towers, power poles and other tall obstacles.

At 2,000 feet, look for suitable fields (2). Using basic criteria for evaluation the field. If possible, this process should be carried out by flying a wide circle around the fields while making the assessment.

By using:

- Suitability (size, shape, slope, surface, surroundings and stock (cattle, etc.)

- Effects of wind

- Barriers

- Suitability - check for adequate length: minimum 7-800 feet, comfortable 1,000 - 1,500 feet; however, requirements vary depending on glider type, wind speed, slope, etc. Assessment of apparent size may be colored by size of surrounding fields. Small fields make adequate field look large, large fields make adequate field look small. [2 lane roads are 25 - 30 feet wide, typical small houses 50 feet long, wooden phone and power poles are usually 150 - 200 feet apart, football fields 300 feet long.] Shape - if greatest length has a strong crosswind and little headwind component, determine if use of the width (into the wind) is better - depends on wind strength.

- Slope - any visible slope unacceptable - most easily identified if viewed from a distance, not overhead; darker areas are probably wetter, and thus lower; if slope is apparent from surrounding topography and no flat alternatives available, plan to land uphill. Uphill landing requires more pitch-up in the flare, thus 5 - 10 kts more airspeed is needed. Landing uphill also gives an optical illusion of the glider being higher than it actually is. This risks an undershoot, and can be countered by aiming to land a little deeper into the field.

- Surface - adequate and clear of obstructions - requires familiarity with crops, seasons [planning ahead]; you need to be familiar with the crops in the area you are proposing to fly, and at the relevant time in the growing season. Land parallel to rows/furrows. Generally, crops of lighter color are better; but watch out for straw colored corn stalks, which is much too high for a safe landing. Check for fences, hay bales, ditches, irrigation equipment etc. [Exercise - practice picking fields from the air, making an evaluation of them, then going and actually walking them to check out your assessment.]

- Surroundings - obstructions on approach [buildings, trees, cables (look for poles, not wires), etc.] - reduce effective field length by 10 times obstruction height. For example, a 30-foot tree on the approach boundary of the chosen field will make the first 300 feet of the field unavailable for landing. Large obstructions can generate severe turbulence, especially on the downwind side.

- Stock (livestock) - avoid fields with animals, if possible.

- Surface wind - strength and direction - assess direction by drift, smoke, large flags, ripples and wind shadow on water, cloud shadows – but be wary as the surface wind may not be the same as at cloud height. Unless wind very light, plan to land with substantial headwind component. Consider topography of approach and landing area and possible effect on wind. Wind in valleys may be different from hilltops or at glider altitude.

At 1,500 feet, select a landing field (and backups); carry out further evaluation of the fields using the above evaluation criteria, keeping them in clear sight. Note guide pointers to find them again in case field(s) temporarily lost from sight. One major difference between landing at a strange field and landing back at your familiar home airport is that here the decisions are left to you. Probably the most important of these are choice of landing direction, and choice of pattern direction (which side of the field to make the pattern).

Once you are sure of the wind direction, you need to make a decision on the best approach direction. Consider the wind, approach obstructions, field length, and surface. The order of priority is difficult to determine as most of these factors are inter-related; however, the wind, slope, and field length combine to give a general direction, with approach obstructions and surface possibly refining it.

Having selected the line of approach, you need to select from which direction to make the final turn. The base leg direction can be critical for a successful landing. The base leg should be long enough to give time to alter height/position before the final turn; on the side which gives the better option for an early turn onto final should this become necessary; and in a position at which you can arrive with sufficient height.

Having decided on the approach direction and the base leg direction, pick out location of IP/high key area, planning to be there at estimated 1,000 feet AGL. **It is vital to get the IP/high key area in the correct general location. After picking a good field, this is probably the most important decision you have to make.** This needs to be well upwind and well off to the side if the Safe Relationship with the CoA is to be achieved. Beware of illusions caused by 'scale' effects - if a pilot is accustomed to landing on a rectangular field, when faced with a long narrow strip (e.g. a ribbon asphalt strip of same length and 20 ft width where the proportions may be 200:1) an inexperienced pilot will likely over estimate length and pick an IP/high key area too far downwind and too close in; a pilot accustomed to landing on a long asphalt strip, when faced with a rectangular field is likely to pick an IP/high key area too far out and upwind.

1,500 feet to 1,000 feet - fly around chosen field(s) - a complete circle enabling observation from all directions is best - continuing the evaluation of the field criteria, aiming to arrive at IP/high key area at 1,000 feet heading downwind, having completed pre-landing checks. (See Annex C.). Make your seat belts as tight as possible. Ideally the complete circle should be started above 1,500 feet so that it can be of large radius and completed before arrival at IP/high key area and permit better scrutiny for the presence of slope in the chosen field. If landing uphill, plan to use higher airspeed.

At 1,000 feet [in strong winds, this figure should be increased] - no further attempt to use lift - now committed to landing - on downwind, select and maintain Safe Relationship to Reference Point. [Accuracy Landings - Section 1 of this Handbook]. If strong sink encountered, fly faster and maintain/regain safe angle. Continue to evaluate field using ‘7 S’ criteria; concentrate on trying to see things that may have been too small to recognize from further away, particularly obstructions on the approach and in the field. Don't cramp pattern, in particular **leave room for long/high final approach**. Increase airspeed to final approach speed when going downwind opposite Reference Point and re-trim the glider.

Plan for a two-thirds airbrake approach; in the middle of Cone. Maintain Safe Relationship throughout. Remember, the stronger the wind, the more the Cone is inclined up from the horizontal.

On final, check correct airspeed, adequate height margin to clear obstructions, CoA a safe distance into field using reference point technique and two-thirds airbrake approach after Cone has been entered. Reconfirm the high reconnaissance and confirm suitability, barriers and the effect of the wind. [If field of adequate length, Reference Point should be one-third of way down field.] Ignore factors for simple derig e.g., rolling out close to a gate or habitation. Once approach obstructions have been cleared and field made, full airbrake (remember that some gliders have the wheel brake at the fully open position of the airbrake handle) and hold off during flare to touch down at minimum speed with minimum energy. [Energy (airspeed) increases as square of speed].

At touchdown, use full airbrake/wheel brake for shortest ground run. Remember to ignore factors for simple derig.

After landing - safeguard glider from wind, livestock and humans; keep onlookers away so further damage to field avoided, contact crew and advise location; contact landowner, explain what is involved in retrieve and get permission to do what is required. Be polite! Don't admit liability for damage, but don't cause any; give insurance carrier particulars. Leave gates etc. how found (and avoid cutting stock off from water by closing a gate which was open).

Typical pitfalls/mistakes -

Decision to land made too late.

Wind direction misjudged.

Unsatisfactory field selected.

Cramped pattern (usually caused by failure to pick the correct place for the IP/high key area) resulting in approach too high and fast.

Last minute change of mind usually is the result of poor planning.

Attempting to soar away from too low altitude.

With experience, the field selection process can be made more quickly, and from a lower altitude, however still plan to be at IP/high key at not less than 1,000 feet.

Training Exercise

A typical practical training exercise will likely use another airport with which you are unfamiliar which is relatively close to the home field.

Unless you are experienced in the exercise, your instructor will first demonstrate an off-field landing going through the planning items. **You should note that the technique does not require accurate height information AGL**, and uses the same principles as a pattern at home field. After the demonstration, your instructor will likely let you fly the second off-field flight, prompting only as necessary for safely accomplishing the landing. While experience has shown that many students can meet the completion standard required after one demonstration and one student flown practice, if this has not clearly been achieved, the exercise will be repeated.

Further Considerations

These considerations may not apply to the primary off-field landing training exercise, but are vitally important in the event you get something wrong.

The Inadvertent Off-Field Landing – Will I Make It Back to the Field?

The discussion in this Section has thus far assumed you are well away from your home (or any) airfield. However, a substantial proportion of off-field landings are made close to the home field – sometimes very close to it. The pilots involved can be generally categorized as those who misjudged their position and/or the conditions, and discovered they couldn't make it back. They include pilots who had no intention of flying cross-country, but did so inadvertently by getting out of gliding range of the field. Typically, this scenario results in the decision to land off-field being made much too late, leaving very little time for planning and preparation.

- While clearly it is better to make a safe landing back at the home (or any) airfield rather than in a strange pasture, being forced to land in a strange pasture with little or no preparation or choice is likely the worst possible situation. Accordingly, it is very important to decide early and in good time whether or not you will make it back to the field. That way, if the possibility of recovery to the home field appears remote, you can and should start your preparation and planning for an off-field landing while there is still adequate time left to do so.

- How do you decide whether you will make it back to your home field? Assuming that the field is in clear sight, this is not too difficult. First, the glider needs to be pointing towards the home field, if you aren't heading that way already, flying at best speed-to-fly, with a constant pitch attitude and airspeed. Look at the field through the canopy (remember Reference Point Technique), does the field appear to be moving up, down, or staying in a constant position in relation to the canopy? If it is moving up, you will not make it. **If it is constant, you may just make it – but you will be arriving straight in with no margin for safety or height for a pattern – this is *not* the Safe Landing**

Cone! If it is moving down, your situation is improving and you will likely make it. Remember, however, that this analysis depends for accuracy on the air mass being stable, without lift or sink, or with sufficient lift to compensate for the sink encountered during your progress back toward the field. The effect of the wind (assuming it remains constant) is automatically taken into account.

- This method gives you a tool for making an early decision whether you can make it back or not. If the probability of making it back appears low you must discontinue what is likely a vain attempt and concentrate on the planning and preparation for your off-field landing. The earlier (and higher) you make this decision, the safer the likely outcome will be. Running out of height, ideas and options while stretching the glide in an unsuccessful attempt to get back leaves the outcome to chance and, if you have it, dumb luck.

- Don't delay making a decision – make the call while you still have time and height to plan and prepare for a safe off-field landing.

Overshooting and Undershooting

The primary causes of off-field landing accidents are failure to reach the chosen field, being unable to land in the chosen field because you are too high to get into it, and encountering something adverse once you land in it. The whole purpose of Section 1 – Accuracy Landings – is to prevent overshooting and undershooting from happening; if you are successful in maintaining a Safe Relationship, these two problems will most likely be avoided.

Undershooting

- If the correct/safe angle is not maintained, and the angle becomes too flat, so that a Safe Relationship is not maintained, then the sooner that you take corrective action to bring the angle back to an acceptable value, the less likely an undershoot is to occur. The performance of the glider gives a substantial margin of safety and allows a reasonable amount of time and opportunity to make corrections. The sooner the problem is identified, and corrective action taken, the less the safety margin is eroded. The primary lesson is clear – you must establish and maintain a Safe Relationship throughout. Don't open the airbrakes unless and until you are absolutely certain you have the field made.

Overshooting

- Overshooting is the result of being too high and close in during the latter stages of the pattern, putting the glider in a position where even use of full airbrake will not prevent it overshooting the chosen field. It is of the greatest concern when a short field is chosen. As with undershooting, the sooner that you recognize that a Safe Relationship is not being maintained - that the angle is too steep, and the sooner you take corrective action, the more time will be available for the corrective action to be effective.

- Assuming that the corrective action is not effective, there are a few things that may help. All of them, however, require time to be effective – you can be too high and close in at 800 ft. AGL, and also at 100 ft. AGL – in the former case, you should still have time for the remedial action to be effective; in the latter, you will not. In principle, you should always plan to have a normal pattern (i.e., IP/High Key area at 1000 ft. AGL) – if you elect to have a very small pattern (e.g., an IP/High Key area at 500 ft. AGL) *and* get too high, the chances are great that you will have insufficient time for any remedy to work. You should understand that all the suggested remedies are radical solutions for an emergency, and carry some risk, and are not things which are, or should be, used routinely, even though you should be in current practice in using them.

How can you lose height quickly and safely?

- The Forward Slip –

- These are alternatives, depending on the presence or absence of a crosswind) which, when added to full airbrake/flap, will appreciably increase the descent rate, *but only* if properly executed. Allowing the nose to be considerably below the horizon will result in airspeed build up, much of the benefit may be lost on what you just tried to accomplish. This maneuver, if not properly performed, may result in increased airspeed, with reducing effectiveness. If the action is taken in a flapped glider, the flap limiting speed risks being exceeded if not carefully monitored and controlled. You must be in current practice if this remedy is to be safe and successful. **Practice this maneuver at altitude.**

- Turning Slips are very effective, particularly when used along with full airbrake/flap; by definition, they must be executed in a turn. If you are already on final, it is too late; again, you must be in current practice.

- Increasing Drag: Drag increases as the cube of the airspeed. Especially with a glider with effective airbrakes, height can be lost rapidly by lowering the nose to increase airspeed and drag. Additionally, acceleration inertia with a heavy glider increases the ability to lose height rapidly for a short time. Starting at normal approach speed, it’s possible to lose an additional 100–400 ft. on final by diving the glider steeply at the ground with full airbrake/flap selected before the airspeed starts to increase materially.

The above are discouraged for landing. The above maybe used during a need to get down rapidly and safely. These maneuvers are high discouraged in the traffic patter!

The inertia of the glider results in a substantial loss of height in the first couple of seconds before the airspeed starts to increase. Once the airspeed rises materially, drag continues to increase, but the increased speed will make the procedure progressively less effective because of the need to dissipate the speed again before touchdown and landing. **Once the airspeed starts to rise, you must resume the normal approach attitude and speed.**

Clearly, this procedure must only be attempted while and so long as you have safe clearance above the ground. Once again, this procedure requires you to be in current practice with the maneuver. **Practice it at altitude**.

- "S"-Turns with Airbrake Open can be used on final approach to extend the distance flown, and thus achieve greater height loss compared with straight line flight between two points. It is vitally important that you **maintain a safe airspeed and good coordination** while the S-turns are executed. Practice doing good clean S turns at altitude.

Warnings and Other Comments

- Other possible methods of using up height which have not been mentioned – a 360º turn on final – have been omitted because they are not recommended.

- Slips – some pilots are reluctant to slip for fear that their glider will stall and spin. The slip, however, uses top rudder during turns, opposite to the lowered wing, making a spin a remote possibility; however, it is always unwise to stall on final approach. Maintain the nose of the glider at or slightly below the horizon and the spin chance is diminished.

- Practice – none of the suggested maneuvers should be attempted if you are not in current practice using that maneuver. ***IF YOU ARE UNFAMILIAR WITH A MANEUVER, FIRST PRACTICE IT WITH A QUALIFIED INSTRUCTOR***. If you are familiar, but not current, you should practice it at a safe height.

- Lastly, as in most things, avoidance is better than cure – being in current practice doing accuracy landings should avoid the need for any extreme remedies. Remember that the superior pilot uses his/her excellent judgment to avoid situations which would require use of his/her outstanding skills!

Emergency Action on the Ground

If, despite all the foregoing including, especially, having been in current practice to do what is necessary, you find yourself touching down in a field with insufficient distance and braking effort to stop before the end of the field, what must you do?

- First, if there is a wire fence on the boundary, or if there is any doubt at all that there isn't and then you must make every effort possible to avoid this hazard. **Wire fences are lethal**, having the capability of shearing through the canopy or other structure of the glider and garroting the hapless pilot. Preservation of the glider is secondary to avoiding this hazard to life. While time and space still remain, turn the glider away from the fence – if necessary, by inducing a ground loop. To do this, put one wingtip firmly on the ground, and apply full rudder deflection in the direction of the grounded wing. With this maneuver, there is always a risk of damaging/breaking the rear fuselage during the ground loop. This risk can be reduced by using the elevator to keep the tail off the ground while the ground loop is performed (stick full forward).

- Second, if there is no wire, or it is not possible to turn the glider away, pick a gap between obstructions – e.g., between two trees – steer the nose towards the gap so that, if necessary, the wings bear the brunt of the impact. While doing so, lean forward and lower your head below the cockpit edge to minimize the risk from outside objects penetrating the canopy. This, however, is a very poor second to turning away from the obstruction.

Completion Standard

Exhibits knowledge of the elements related to a simulated off airport landing, including selection of a suitable landing area and the procedures used to accomplish an off-airport landing.

Performs a simulated off-airport landing without the use of an altimeter.

You must be able to select a field, and fly a safe pattern, approach and landing to it with the safe and successful outcome never in doubt.

END OF DOCUMENT