FLYING FASTER
and
FURTHER

PART 1

EXTENDING THE BASICS

Of

CROSS COUNTRY GLIDING

Version 2.8

Soar with confidence, like you were born to it.

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from

Original and numerous other sources

Foreword

A little history

Flying Faster and Further and the Gliding Sporting Coach's Manual have a long development history.

Initially notes were developed from and for various discussions about many aspects of cross country gliding and instructional skills in the period, 1956 to 1965. I was first a member of the Leichhardt Soaring Club at Mount Isa and later with Darling Downs Soaring Club when it was based at Oakey. In the 1965 Easter State Championships at Oakey. I flew in the club Kookaburra, mainly to give training to other pilots. Max Howland flew the Kingaroy Kookaburra for the same purpose and it was a competition of great fun and rivalry.

From 1965 to 1971, I was with Southern Cross gliding Club at Camden. The instructional notes particularly were developed in this period as I was CFI and RTO/Ops NSW for a few years. However, cross country was not neglected.

The Eleventh Australian Nationals at Benalla in 1970/71 was a watershed for competitive gliding in Australia. The GFA was able to arrange for Helmut Reichmann, the new standard class 1970 world champion, to fly "hors concours" in those nationals. He alternated between standard class in a standard Libelle and open class in a Kestrel 17. His team manager, clubmate and friend, Hartmut Lodes, flew the gliders on Helmut's off days.

Helmut beat us convincingly except for two days, when he showed he was capable of simple errors like the rest of us. Helmut was most accessible and gave advice in a most friendly and helpful manner. He gave lectures at Benalla and at other sites around the country. I still have some tapes from Helmut's lectures.

In November 1971 I arranged a week of "Competition Training" for myself and a few other Southern Cross pilots at Tocumwal with Ingo Renner. While I made a program of topics to discuss, most of the discussion was done very informally over dinner in the dining room of "Kelly's" pub after each day's flying.

From that camp, and Helmut's notes I developed a relatively formal Cross Country Course that I ran at Waikerie from 1971 to 1990. This contained most of the basics of "Flying Faster and Further" part 1.

Around 1978, I began to fly a two seater in the Waikerie Orange Week competition and offered "in competition training". This was popular, and in most of these competitions the two seater finished in the middle of the field. Notes developed for this aspect of flying formed the basis of "Flying Faster and Further part 2" and the "Gliding Sporting Coach's Manual."

With the concept of coaching and a Performance Coach the GFA gave impetus to collecting these various notes and forming them into a follow on book to "Basic Gliding Knowledge" and a companion book for "The GFA Instructor's Manual."

Also, since 1990, we have been able to get glider pilots to The Australian Institute of Sport, in Canberra. From the presentations given there I have considerably added to the areas about competitive gliding with items on Sport Psychology and the various aspects of the physiological needs of glider pilots.

As these notes were developed over a long period, they were rarely static, with revisions most years. The styles of presentation varied as some were written as preparation briefing material, some as notes supportive to a lecture or directed group discussion. Some were written for publication in Australian Gliding.

This variation of style is still reflected in some of the chapters. It remains for me to get them to a more cohesive style and add the illustrations that would originally have been added on a chalkboard or sketched on paper for a small group during a lecture or discussion.

Acknowledgments

Ingo Renner for lectures about Thermal structure and Thermal waves.
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Chris Madden on feedback.
Hans Werner Grosse on many areas of weather analysis and development of lift patterns.
Don Stewart for seeing the need to develop clear concepts about what we are doing.
Nial Hart for setting me on the path of cross country gliding.

Pilot Needs

As training flights are rarely more than 40 minutes long and early solo soaring flights are usually less than two hours there are no extra needs for those pilots beyond basic sun protection. A good practical hat with no badges to scratch the canopy, and sun screen on exposed parts.

When flights extend to longer than two hours then rather more consideration must be given to looking after the pilot. Sun protection must be extended to the whole body.

Flying at higher altitudes increases the amount of UV exposure. The perspex canopy screens out UVA quite well, but does nothing to stop UVB which causes deep burning in the skin. UVB is a major cause of skin cancer.

An insidious aspect of UV exposure is that it is the total amount of UV absorbed that affects the whole body. Melanosis is a form of skin cancer that results from excessive UV exposure and may occur on any part of the body, not just those parts that have been exposed to the sun.

With the reclining seating position in most gliders the legs and arms are fully exposed. They need to be covered. The hands are always in the sun and need protection too. Sun screen is not practical on the hands, but light cotton gloves such as fruit pickers use are cheap and readily available. They are also useful for pilots who get sweaty hands.

Drinking water is a must for longer flights. There is now plenty of evidence to show that dehydration has been a major causal factor in many accidents. It would be foolish to allow any such risk. Some experimentation may be needed to find suitable containers that fit in with the pilot and are easy to use. For a full day's flying three litres is needed. Two bottles (not glass) may be easier to handle than one large one. Cyclists use a flexible backpack container that can be fitted into very tight cockpit spaces and can be used as a backpack if you have to walk.

One of the problems of drinking adequate water to prevent dehydration is the need to urinate as well. Many gliders have a Pilot Endurance Extender tube fitted. If not, then a reasonably useable system is to use the inside container of an empty wine cask. This has a double benefit as you can also have the enjoyment of emptying it **first!**

Neither of these systems are easy to use for women, but it really is necessary to devise something that works. The need to urinate can intrude on concentration to the extent that a promising flight may need to be terminated. Urgent, perhaps, but not the best reason to give up on a certificate or record flight.

With flights longer than two and a half hours there is also the need to eat something. Fortunately this should not create any elimination problems although some care is needed in the choice of foods. Simple, portable, easy to handle foods are what is necessary.

The purpose of the food is to try to keep the body blood sugar level reasonably constant. If this is not done concentration may lapse, coordination may deteriorate and decisions are likely to be less than the highest standard. Typically this latter can show up as indecision, which, in some situations, can lead to an accident.

Food needs to be mostly carbohydrate with complex sugars. These are contained in fresh and dried fruit which are both easy to handle. A small amount of protein (nuts, pita bread or bread) taken with them will slow the rate of release of the sugars into the bloodstream and make their effect last longer. The breakfast bars are suitable. Some of the muesli bars may be too high in sugar to be useful. Take care to check on these if you like to use them.

Avoid glucose and foods high in sugar. These get into the bloodstream very quickly and generally cause a body over reaction that produces insulin. That then quickly lowers the sugar content of the blood for some hours afterward. Quite the reverse of what we want!

This effect has been recognised and now most of the "sports " foods and liquids are low in glucose and sugars. This makes them more suited to our needs than they were a few years ago. However, for our purposes it is best to mix them at half or one third of the recommended concentration.

If you use an additive to water take care to sterilise your drinking container every day as the glucose in them also provides food for micro organisms in the water. Well fed in a warm container they can increase to plague proportions rapidly. Another opposite to the desired effect. It can be useful to put your "sports" drink in a smaller (half to one litre) container that is easy to clean every day and reserve your larger container for pure water only.

For cross country and longer flights there is also the need to consider footwear. Not only are the shoes going to be worn for several hours, but they may also be called upon to walk several kilometres! Good quality shoes that can be comfortable in the glider as well as on a good walk are what is necessary.

A problem of longer flights and varying altitudes is that feet can sweat a lot when low and hot. (The brow and hands may sweat too!) But when high the sweat can become cold and make feet very uncomfortable. Shoes that have some ventilation can help alleviate this problem. Thick cotton or wool synthetic mix socks may help also.

Sun glasses are a must. Australian skies are generally clear. The glare of a full days flying can easily induce a headache or sore eyes. Polaroids work well and to some extent assist in seeing faint columns of dust.

The yellow tinted "Sun Tigers" are good for reducing UV and assisting seeing gliders at a distance as well as clouds at the very wispy, formation stage. They also give good haze penetration. They do not cut out glare. Modification is at the expense of reducing light transmission, but is worthwhile. The red or pink tints used to reduce snow glare work well, and do not significantly reduce total light transmission.

These tints are available for prescription glasses and some of the major prescription firms are aware of gliding needs and have suitable colour tint formulas on file.

The serious pilot needs to have a kit of these items conveniently available for a gliding session and they should be in the personal check list. They are as important as the correct cushions to get comfortable for a six hour flight.

Another consideration once longer flights are the norm, is to avoid cramps and discomfort caused by sitting in the one position for many hours. A program of stretching and flexing the neck, spine, lower body and legs can be most useful. About 10 minutes a day three days a week is adequate.

Stress and Flying

Early cross country is rife with psychological problems, real and imagined. The person concerned often takes a long time to find appropriate answers to this stress and consequently progress is slow, or it may even become so difficult that the pilot gives up gliding. Help from outside can be of the greatest assistance. Attention by the coach, instructor, or whoever can give new pilots help will considerably speed progress and may even retain many people who otherwise will be lost to gliding..

Gliding is mostly a cerebral sport. Once the basics of good health, and in flight care of the body and brain are taken care of, then it is a matter of making good decisions.

Unfortunately, another factor of the human psyche interferes with what should be a logical process. This is our emotions. The chain of events that cause this are:
1. Environment - the pilot encounters a situation.
2. Cognition - a multitude of thoughts occur relative to that situation.
3. Emotions - feelings generated by those thoughts.
4. Behaviour - a decision is made and acted upon.
5. Consequences - the results of this decision.

The problem comes from 2 and 3 in this chain.
Automatically, emotional responses come to mind, mostly through earlier experience. These can be positive or negative. Obviously it is the negative one that cause our concern. They are in opposition to a logical thought chain and analysis. Quite often they are so strong that they take over, and we make non logical decisions.

These emotional intrusions are internal factors of our performance, and so we can do something about them. They can be identified, and with some practice, can be guarded against.

While they may be described under a variety of names depending on which paper you read, the sports psychologists have identified six basic forms which are:

1. **Irrational Fear:** "I am getting low and may have to make decisions about outlanding. I am afraid that I will make an error, and damage something."
2. **Unwarranted Anxiety:** This is similar to irrational fear, but is concerned with some prediction, rather than here now. "I've missed two thermals, if I miss two more I will have to outland."
3. **Self Doubt:** "Everyone got that strong thermal but me. I must be a rotten pilot." This is closely associated with the feeling that nobody else is having the problems that you are. This can be very persuasive and destructive of logical thought.
4. **Inadequacy:** "I can't take these big gaggles. I need to go and find my own thermal."
5. **Resentment:** "They are all doing better than me because they have better gliders." "These pilots are all thermalling left because they know I'm not so good to the left." etc!
6. **Guilt:** This is always a problem if a mistake is made. Unfortunately, it compounds the effects of the mistake, and is very counter productive. There is a ready made, quick remedy - "What's done is done! The future is yet to be done and I now that I know about that error I will avoid it."

As they occur so subtly, you may not even recognise that these emotional intrusions are there destroying your performance. The way out is to train yourself to recognise and then counter these negative emotions as soon as they occur. There is a sequence to doing this.

Decide that you do have a problem.
Identify the problem.
Decide if it can be ignored or you need to do something about it.
If necessary, do something!

An excellent aid to this is to have a small tape recorder and talk into it as soon as you feel any negative emotion. You can then play it back at your leisure, make some analysis and devise a cure. You will probably laugh at how you could have such irrational thoughts.

Scanning

Despite almost exclusive emphasis on the use of *Attitude* as a *Speed* control in basic training, almost all pilots are highly dependent on the *ASI* and give insufficient attention to attitude. This gives poor speed control, which in turn results in irregular circles and poor thermal performance or even an inability to work any thermal but the largest and strongest.

Instructors and coaches need to accept that there is something about the instruments that irresistibly draws the pilots' eyes and attention to them. It is a mental attitude problem and can be solved only by treating it that way.

This is a threefold problem which has a degree of circularity:

- One is that there is an information overload, which the pilot resolves by ignoring or discarding a large amount of the information.
- The second is that the new pilot has not learnt what information is needed.
- The third follows, in that not knowing what is needed, what is gathered is not done in any systematic manner.

Because of its nature, all flying provides an information overload. The human brain being an essentially single channel processor needs some tricks in order to cope. These are rapid time sharing, automation of as many skills as possible, prioritising and selectivity.

Developing scanning is learning a specific type of time sharing skill. Most of the sequences involved, such as reading an ASI or altimeter, can be automated. This then frees time on our single channel to consider what we see and to make decisions about it rather than being fully used up in the process. It is a skill to be learned and practised until it is automatic.

Experience gives the new pilot insight on what information is really useful and what can be discarded. This process can be speeded up by the new pilot being trained to gather the information in the most efficient way. However, in coaching, this area is often remedial work.

Most poor soaring performances are the result of inadequate or slow information gathering.

A starting point to overcome this is to get the pilot to use a ***system*** of ***scanning*** that deliberately ***moves*** the eyes after one or two seconds. With practice the time will become even less. The sequence may be individual as long as it cross checks the nose/horizon relationship and speed.

Once the pilot is scanning there will be a quantum level improvement in control precision and most importantly, ***lookout***.

A good sequence is to **start from outside** and then look from the Nose Horizon Relationship ***(NHR)*** to the **ASI** and then the **Vario**. **Outside** again to Check for other Aircraft or other useful information and the **yaw string** on a continuous scan. Commence the Outside Check by looking at one wingtip. Then move the eyes across to the other, scanning both above and below the horizon line. Then check the Yaw String and recommence the sequence again.

This will require movement of the head. Eye movement only will not be nearly sufficient. The basic sequence is: Outside - NHR - ASI - Var - Outside - Yawstring.
The sequence cannot be made completely unvarying, as the priorities change with the situation. Temporarily one set of information becomes more important than the others. While thermal centring, the centring vario needs more frequent reference. In cruise, especially with a good audio, the inside may be almost totally neglected. In circuit and landing the planned landing area and speed control become more significant. However, throughout all, good use of the NHR/ASI cross reference will give best performance.

Conversion to a new type will require learning the appropriate NHR over the glider's speed range. This will demand greater attention for the first few hours on the type.

In order to scan effectively first we must find out what we are looking for.

Outside we are looking to see that our glider is flying level, or banking at the amount that we desire. We are checking the sky for other aircraft. We are also examining all the signs that may tell us what the air is doing. These signs are the clouds, wind effects, dust, smoke, birds and other gliders. We are noting the position of the nose of the glider relative to the horizon and checking the yaw string. We must also keep track of where we are.

Inside we are checking the speed, variometer and other instrument displays. This is such a mass of information that it may seem impossible to take in.

As with any complex problem, this is done by developing a system to examine a small part at a time and then move on to another section until all have been checked and you find yourself back at the first position.

Initially we must link the scanning with control of the glider. As skill develops, the two will seem to become independent of each other. When this happens you have become unconsciously competent with the basic control of the glider.

The glider in flight is quite stable. Unless we move the controls to make it change it will continue on as it has been doing for some time before the air disturbances require us to make some correction. The glider will not fall out of control, or do any strange thing rapidly. There is plenty of time to look around and gather the necessary information.

First, what are we looking for? Speed control is important. For each speed the glider will have a position of the nose relative (generally below) to the horizon. By cross referencing the nose position, the horizon and the airspeed indication, we can soon learn just where the nose should be for any speed that the glider can fly.

We need to develop a series of pictures in our mind of where the nose positions relative to the horizon are for each speed. Initially this will be for a few frequently used speeds. Later we can expand this to cover the glider's complete speed range.

To do this we must get used to moving the eyes so that every time we check the nose, horizon relationship, we check the speed on the ASI. Initial work at making the habit of always checking the ASI against the nose/horizon relation (NHR) will pay off in freeing time for all the other things we would like to check.

We must learn to check the speed with just a quick glance. We don't have to stare at the instrument. Spend a little time in the cockpit on the ground. See where the airspeed indicator needle should be for the most commonly used speeds.

In the air, we just need to see that the needle is near the correct position and it is not moving rapidly. If it is moving, discern the direction of the movement, to discern faster or slower. If faster, move the eyes out to see the nose, horizon relationship and raise the nose a small amount. If slower, look outside to check the nose horizon relationship and lower the nose a small amount. Once the movement is made hold the control steady and check another item. Then look back to the speed.

By the time that you get your eyes back to the airspeed indicator the control would have had time to take effect. Make the same observation. Is the needle in the correct place and is it moving? If so, which way and make a further correction using the same process.

On no account watch the airspeed indicator while you make the change. If you do so, the correction will always be too large and you will get caught in an endless series of correcting the corrections - and become ASI oriented.

By following this process you will soon learn the correct amount to move the controls to get the desired effect. Further, after a while it will become automatic. After that, you will be astonished how easy speed control then becomes.

When you check outside to see if the wings are level, check how far one wing tip is above the horizon and then quickly check if the other is the same distance. If not, make a correction with the aileron. It is not necessary to watch the wingtip as you do this. You can move the eyes on to another item and then recheck both.

After checking one wingtip, scan around, above and below the horizon, to behind the other wingtip. It is important to start at a wingtip as this changes the focus of the eyes from near to far. If you simply look up from the panel to scan, as there is nothing to focus on, (the yaw string is too close) the eyes remain on near focus. Unless another aircraft is frighteningly close, you will not register distant aircraft. If there are clouds these will also shift the eye focus as will sighting ground features in the middle distance, 15 to 20 kms away.

Even worse, those aircraft which are on a collision course will appear stationary to yourself. As our eyes are geared to noticing movement, this makes seeing them even more unlikely.

If you do see another aircraft nearby rock your wings slightly. This will increase the chances of the other pilot seeing you. The variation of the light reflection from the highly polished wings will greatly exaggerate the movement and there may even be a light flash from the canopy to attract attention.

When you are flying straight, always look into the middle distance (15 to 20 kilometres) and find a marker (town, hill, lake, road, patch of trees or similar) and from time to time check that you are still flying towards it. If not, make a small turn (balanced, with not much bank) towards it. Initially, you will find flying straight quite difficult. It will consist of a series of wandering turns. With practice these will reduce until you find that the glider does fly quite straight.

Once you have mastered speed and directional control, you will find that there is plenty of time available to look outside. That is where most of the information necessary to improve performance is to be found.

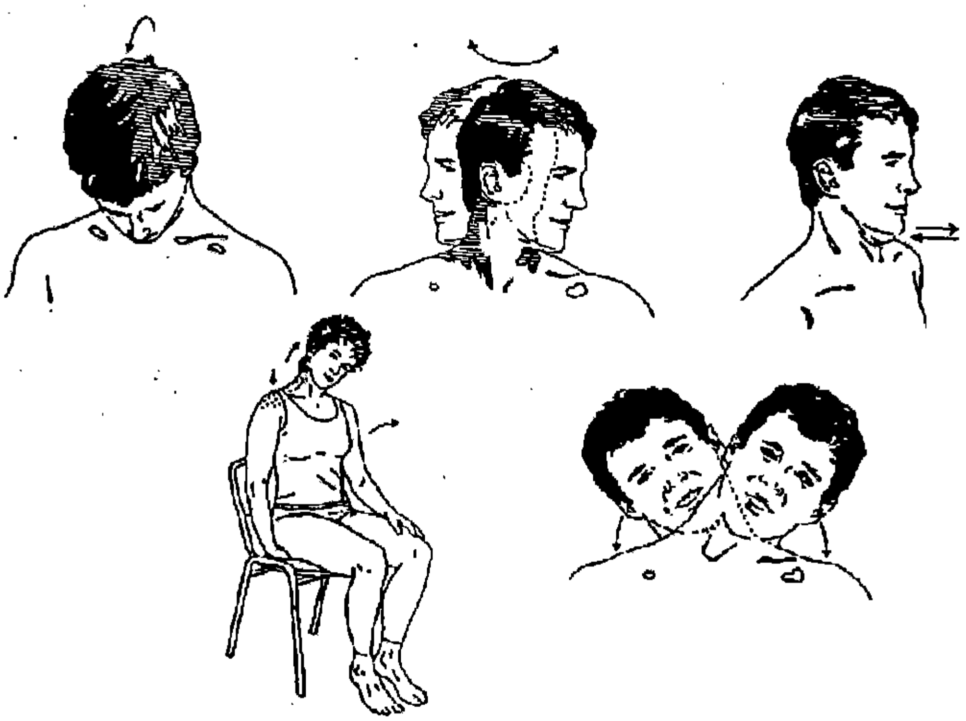
When thermalling, there is a need to increase the attention to the primary centring vario. This is to seek out the very best of the lift core. With good speed control this can be handled with no loss of lookout capability. A good audio can assist greatly, especially in a crowded gaggle.

In cruise, the audio also can be useful. There is no need to follow the speed director precisely. 5, or even 10 knots off the optimum for a brief period is immaterial in the overall performance. ***It is far more important to be scanning outside for information.***

Modern instruments, presenting ever more information can be seductive. Even a small time spent clicking through pages of a computer display can cause you to miss the thermal you need to stay up or the one best thermal that can make the difference between first place and the rest. ***The point of more sophisticated instrumentation in the cockpit is to reduce the pilot's workload and allow concentration on the tactical situation.***

Spend time on the ground studying instruments, learning to operate them, and what information they can show. In the air, use only the information you need for the task at hand. Good instrument use will help you keep attention where it is most useful - ***outside.***

Here are some neck flexibility exercises that you can practice almost anytime



Joining Other Gliders

It is necessary to be able to thermal efficiently in company with other gliders. Sometimes there is only one thermal within range and the only alternative to joining them will be to land. On blue days all the better thermals will be marked by gliders, so that to avoid them would be to impose a severe handicap on yourself.

From a distance of 3 to 5 kilometres, aim directly at what you can eyeball to be the centre of the common circle that the gliders are making.

As you approach the others ***Reduce Speed!*** If you are carrying water ballast, this will take much more distance and time than when empty. The speed to adopt is 5 to 10 knots faster than your normal circling speed. This will give a crisp rate of roll and allow maximum manoeuvrability when you decide to turn.

In order not to frighten the people you are joining or yourself, you should aim at conformity with the gliders that are already established. Ignore your own vario readings and concentrate on positioning your glider in the same circle as those already established.

After reducing speed, sight the glider which will be near your level. Make small "S" turn manoeuvres so that after it passes in front of you, aim your glider at the tail of that glider as if you were going to shoot it down. Roll into the same angle of bank and follow the glider around the turn. This will put you into the ideal position between one third and one half a circle behind the other glider. You will both be able to see each other easily.

You should not be closer than 10 wingspans (500 feet)as the glider passes across your path. This is the distance that you will travel in 5 to 6 seconds, while at the same time the circling glider will make one quarter of a turn.

Initially use only the other glider for positioning, do not take any notice of your own vario until you are following around in the turn. If the lift is not up to expectations you can then consider whether to leave or to make some centring adjustments.

This system will cope with joining up to three other gliders at the same level in a normal thermal core. If there are more you may have to join from below or find another core.

If you can talk to the gliders that you are approaching on the radio do so, if not, give a wave of the hand when you are near to indicate that you are watching them.

If you fly around the outside of the others and try to join by cutting in front you will frighten everyone and possibly get rammed by a glider that cannot manoeuvre fast enough to avoid you!!!

If you really must join them, after about a circle on the outside you will be below them and can join easily using the same system.

Once established in the thermal with other gliders you will find that to centre the thermal you will be able to use variations of bank. Straightening up and turning again usually makes too much conflict with the other gliders.

However, you will find that a good gaggle will be climbing at the maximum rate. Learn who will be in every glider, so you will know when you are in the best company.

You will sometimes find that you are climbing much better than the other gliders. Perhaps because you are empty and they have full ballast still. In these situations you will want to work around those gliders to climb above them.

On *No* account cut inside of any glider in front of you. You ***Must*** go around the outside or wait until that glider is just behind you and can ***keep you in sight*** as you change your circle.

Another problem is when you find that gliders may be making the same diameter turn, but are travelling at different speeds. As the pilot of the glider being overtaken cannot see the overtaking glider, responsibility for doing it safely must rest with the overtaking glider.

Most of the time gliders will be making circles less than 200 metres diameter. See the tables below. The size of the circles in the shaded area are too large to be in most thermal cores.

CIRCLE TIME in SECONDS									
SPEED	Bank Angle in Degrees								
KTS	20	25	30	35	40	45	50	55	60
40	36	28	23	19	16	13	11	9	8
45	41	32	26	21	18	15	12	10	9
50	45	35	29	24	20	16	14	12	10
55	50	39	31	26	22	18	15	13	10
60	54	42	34	28	24	20	17	14	11
65	59	46	37	31	26	21	18	15	12
G force	1.06	1.10	1.15	1.22	1.31	1.41	1.56	1.74	2.00

CIRCLE DIAMETER in METRES									
SPEED	Bank Angle in Degrees								
KTS	20	25	30	35	40	45	50	55	60
40	237	185	150	123	103	86	72	60	50
45	300	234	189	156	130	109	92	76	63
50	371	289	234	193	161	135	113	94	78
55	448	350	283	233	194	163	137	114	94
60	534	416	336	277	231	194	163	136	112
65	626	489	395	326	272	228	191	160	132
G force	1.06	1.10	1.15	1.22	1.31	1.41	1.56	1.74	2.00

When within 100 to 200 feet, above or below other gliders, take extra care not to get into a position where you cannot see the other glider and they cannot see you. This "double blind" position has been responsible for several collisions in Australia, and has resulted in the deaths of at least three pilots. Remember you are not immortal!

Turn Point Photography

Providing the correct turnpoint photographs could be considered one of the most critical aspects of any certificate or competition flight. Unless they are acceptable, the flight may not as well have been made.

Many flights have been lost for this reason, yet the procedure for producing a good photograph of a turn point is quite simple and easy to execute. Of course, nothing but chance will save it if it is the wrong place! That is a navigation rather than photography problem.

Commence preparation for turn points on the ground at the flight planning stage.

There are two systems in common use:

1. The FAI system which is used for certificate flights and usually the FAI class nationals.
2. The Target system which is usually used for POST type tasks, the Sports class nationals and may be used for a World competition as an alternative to the FAI system.

The FAI system:

The FAI system is that the photograph must be taken from the bisector of the outside extensions of the inbound and outbound tracks at a turnpoint. For a start point the line along the initial track to the first turn is used. Start photographs are not needed for certificate flights.

Draw in the bisector on the map. You are allowed 45 degrees each side of this line, so there is some margin for error. Competitions are more generous, they allow 90 degrees each side, but the extra 45 degrees gets you a penalty relative to how far you are out from the initial 45 degrees.

For the first few attempts it may be useful to draw the allowable limits until you get used to the system.

Check on the map if there are landmarks that align with the photo line. An easily identifiable feature that can be used to aim at when positioning to take the photo can be very helpful.

The Target system:

With this system the glider must be positioned over the turnpoint on a specified heading and a photograph taken of a specified target.

It is a very easy system to use and on POST type tasks ensures that everyone's photo will be the same (assuming that they do a good one) regardless of which direction they came from or are going onto. Apart from the positioning the application of both systems is the same.

If you are not familiar with the camera setup in the glider, check what the camera view is through the viewfinder. It should be set to photograph a wingtip in the centre or preferably in the top, rear one third of the frame. If not, adjust the mount until it does. Remember to allow for the usual wing flex of the type. Either wingtip is acceptable for a certificate and in competitions this is specified either for the whole competition or on each day.

For a FAI photograph, as you approach a turnpoint, (about 15 kilometres out) look from the turn along the photo line direction for a feature to guide you. To be in the correct place you must fly onto this line. Then, look at right angles to this line from the turnpoint to find a feature that can give you guidance when to turn. When this feature is behind the wingtip, you must then be past the turnpoint and thus in position to take the photograph.

Also, sight up some guidance for the track along the next leg out from the turn.

Make sure the camera is wound on and cocked.

Fly directly over the turnpoint. ***Make no allowance for any radius of turn.*** From the turnpoint, fly away from it along the photo line. Easy to do if you drew the line on the map and found a feature to guide you.

Then, when your selected turn feature gets behind the wingtip, set the speed about 5 to 10 knots faster than you would use for thermalling, place your finger on the shutter release and roll into a slightly steeper turn than you would use for thermalling. ***As you commence the turn, keep looking over the nose of the glider.*** This will help you to get a good balanced turn. If you look down at the turnpoint the glider will dive towards it, lose height rapidly and very quickly get into the wrong position. Then you will have to position again!

Once the turn is established, ***then*** look down towards the turnpoint. You will find that you have a few seconds while the wingtip moves ***backwards*** relative to the turnpoint. When the tip gets slightly past and above the turn, press the button. Continue the turn until you come to the direction for the track out. Roll back to straight flight and stabilise the speed.

Wind the camera on.

This to ensure you really did fire the camera. It is easy to be pressing the wrong button or make some other such fumble. It is as well to find this out while you are still in the vicinity of the turn, rather than 50 kilometres down the track!

For a Target photograph, from about 5 km out from the turnpoint, sight the target and consider what direction changes you will need to make to be flying on the correct heading over the turn. If you have to reverse direction to do this you will need to fly a half a kilometre or more past it to allow room to turn and get established on the correct line.

As you come over the turnpoint turn onto the correct heading, dip the wing until it is just above the target and fire the shutter. Targets are set such that rarely more that 40 degrees of bank is needed to have the target correctly in the frame.

It may be useful to practise this, preferably with film, on some local features, before you try an important task. You will find that after a few attempts it is very easy, takes minimal time and height loss, and will give an acceptable photo every time.

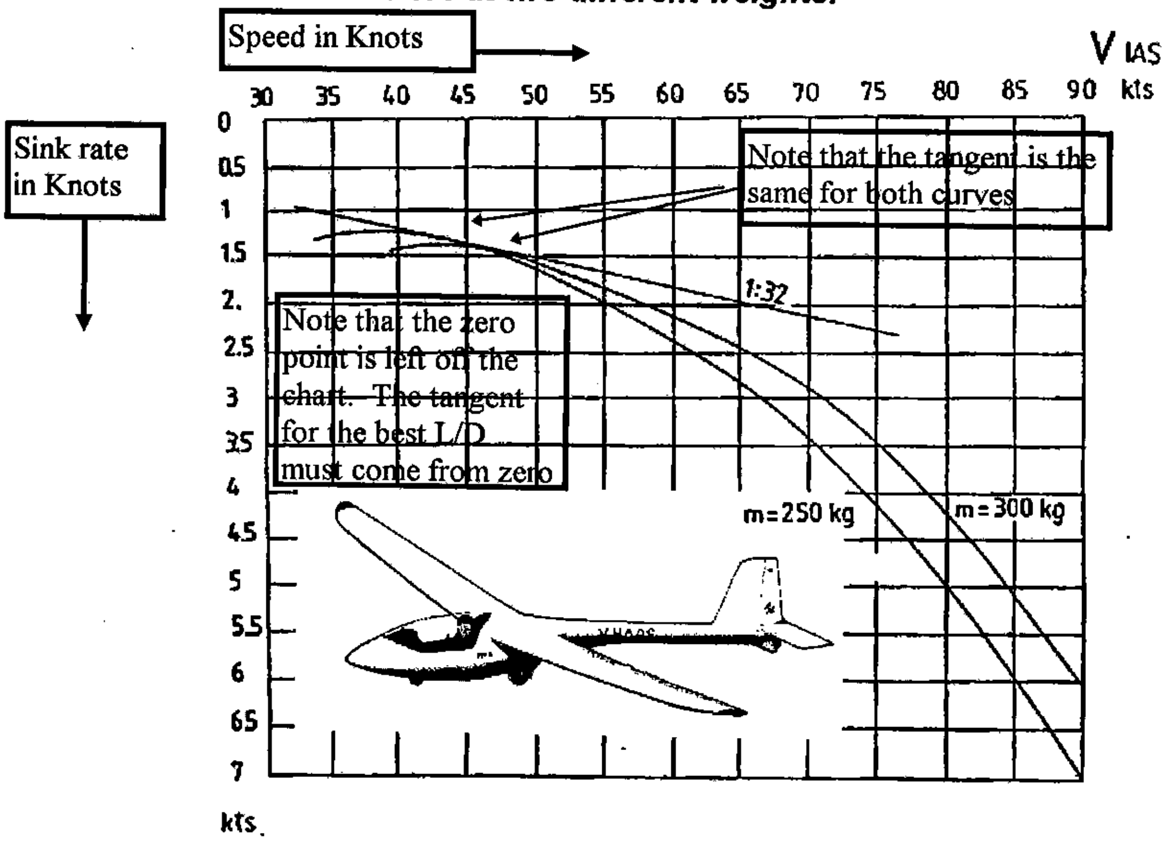
Using the MacCready Speed to Fly System

Dr Paul MacCready (World Gliding Champion 1956) is credited with the system that bears his name. Similar systems had been advocated by pilots of many countries from as early as 1938. However, MacCready was the first to present it as a graphical analysis and show that it was practical by winning competitions using it. This is published in "American Soaring Handbook volume 6".

The concept is that there is an optimum speed to fly between thermals that when combined with the next thermal climb will result in the fastest average cross country speed. This carries with it ***the assumption that there will be a next thermal that the pilot can work.***

The calculations are derived from the performance of the sailplane. This is established by measuring the loss of height the sailplane makes at each speed in its normal speed range. This plotted as an xy graph provides the initial information.

Performance chart for the PW5 at two different weights.

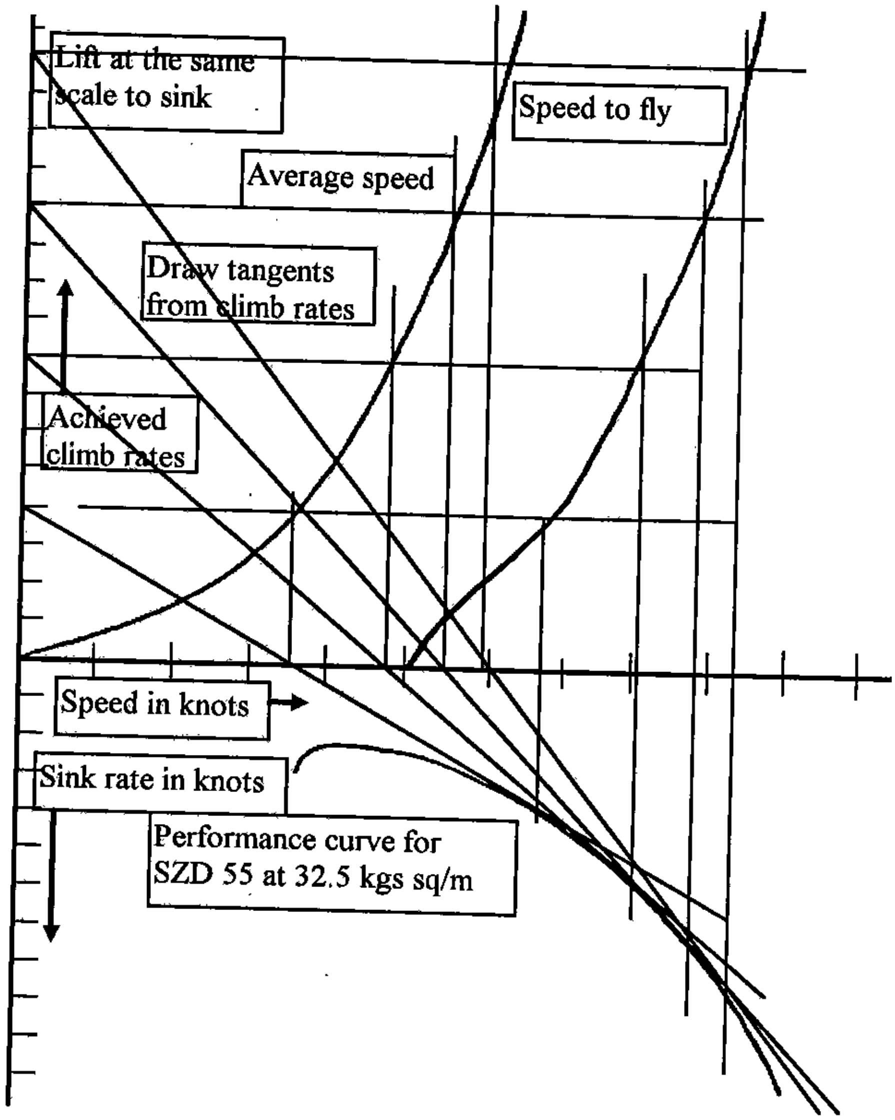


Some care must be taken to obtain accurate information. Actual test results are usually more realistic than manufacturers brochures. Dick Johnson in the USA and the Akaflieg groups in Germany have published results for most sailplanes produced in the last 50 years. Not surprisingly these tests are often up to 10% less than the manufacture's results.

Initially, pilots flew at the best gliding angle speed between thermals. MacCready's system shows that by flying faster a better average speed will result. How much faster, is the maths of the system and, of course, is specific to each sailplane type.

The system is to relate the speed to fly between thermals to the ***achieved rate of climb of the next thermal. A nice demand in guessing the future!***

The graphical method below is easiest to obtain the figures from but I think that the arithmetical analysis plotted as Average speed against Speed between thermals can be used to show better how variations affect the result.

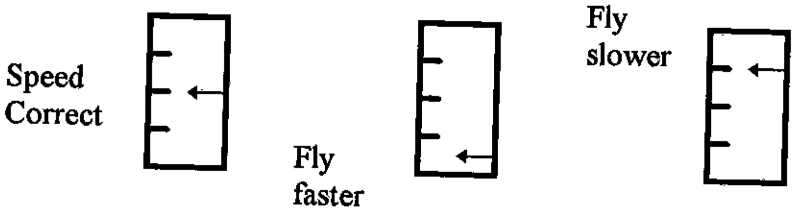


From the graphical analysis it is easy to make up a table that relates average speed obtainable to thermal strength. This can be useful for flight planning and analysis.

For the Discus without ballast								
Thermal Climb, Knots	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Speed between thermals, knots	**62**	**68**	**75**	**78**	**83**	**84**	**86**	**88**
Average Speed, Light, kph	**46**	**70**	**80**	**94**	**102**	**110**	**114**	**121**

The initial instrumentation to put the system to use known as the MacCready ring was very simple but fairly demanding to use.

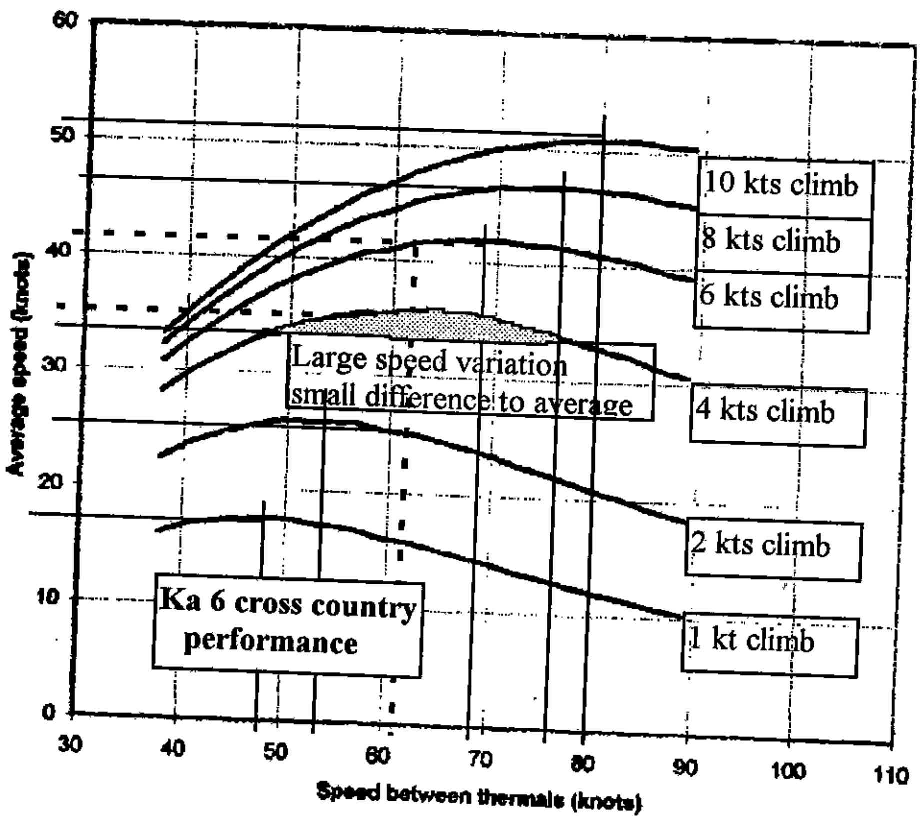
Modern instruments do the maths inside and present it as a speed director which indicates to fly faster or slower. Audios give different tones to the indications so the instruments do not have to be watched. Most have an adjustable silent band around the optimum speed.



Most instruments have settings to adjust the MacCready for ballast, and for degradations of performance caused by bugs or rain. If not, using 2 knots up as a zero point is a reasonable approximation for full ballast, and setting it down 1 knot will allow for bugs.

An examination of next set of graphs created from a mathematical calculation for the effect of not being at precisely the optimum speed shows that a surprisingly wide range of speed variation will make little difference to the overall result.

Average cruising speed for different expected climb rates



As the speed flown is not critical over a band of at least 10 knots, the speed director should be used as a trend indicator, rather than to be followed precisely. As the thermal cores are quite small, ***following the director up for slower speed needs to be done more quickly*** than down for faster speed.

The initial calculations allowed for 20% of the lift strength as sink between the thermals. This is now left out, as it is felt that the gains in thermals sampled between those that are actually used to climb in, will cancel out any sink between thermals.

Flight using a speed director will give undulating flight as the pilot responds to the lift and sink flown through.

Using visual (clouds, gliders, terrain) or instrument (netto) clues the pilot may also alter direction. Thus the sailplane is being truly three dimensional in its flight path. This will give the maximum chance to find whatever thermals that are available.

Notice in the previous chart, a faster average speed can be obtained by improving climb from 4 to 6 knots, than any possible variation of speed between thermals! By selecting ***only the strongest thermals*** the fastest speeds will be obtained.

A "pure" MacCready flight will consist of climbs and glides at relatively constant speed in a series. Such flights are more likely on blue days, but it is not often that such a flight is made. Many factors cause variations. Some pilots simply use a constant speed, ignoring the minor variations. This is termed a "block" speed system.

Thermal strength is usually, although not always, proportional to height. Typically, on days after a cold front, an inversion limits height to 4000 or 5000 feet. On these days thermal cores of 6 knots or better can frequently be found.

With that height limit it is not sensible to set MacCready 6. That drives the sailplane too low to catch the next 6 knot thermal. Some lesser setting must be used.

I find that 7000 to 8000 feet must be available for "pure" MacCready flight to be used consistently.

There are other complications.

On current standard class sailplanes (Discus, LS4, ASW 24) a MacCready of 5 or higher frequently tells the pilot to fly at speeds well into the sailplanes yellow caution range. For 15m and Open Class this is even more so.

As the air will obviously be rough, this is not healthy practice. To avoid over stressing the sailplane the MacCready can be set lower than the thermal strength, or the speed limited into the green range, or both.

The reduction in average speed from the optimum by using a lesser MacCready setting is not great except for setting zero. This is not on the table and is around 20%.
For a standard class sailplane:

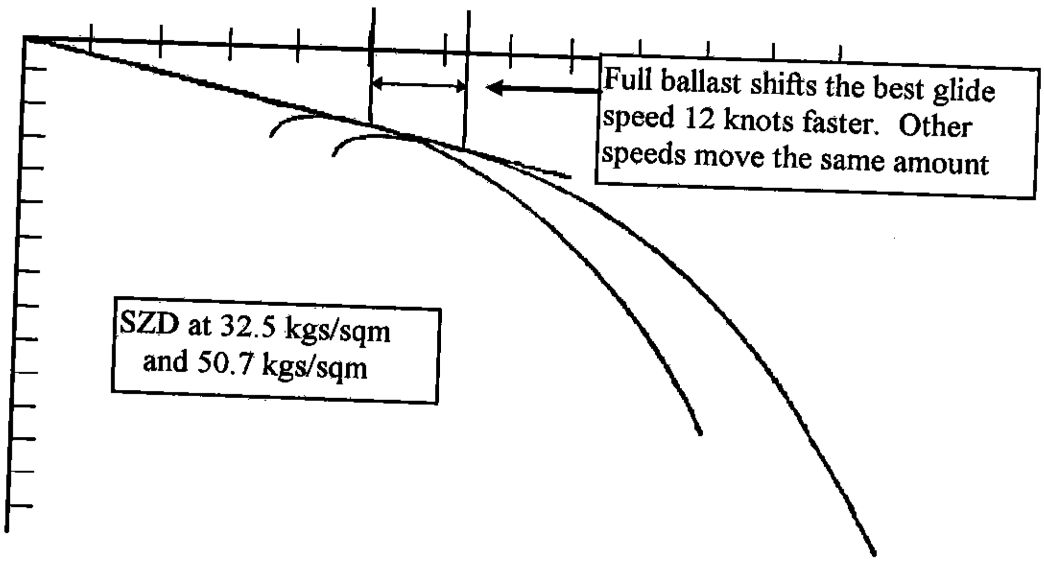
Thermal Strength knots	**4**	**6**	**8**
Set MacCready 2 Loss	**3%**	**6%**	**9%**
4 Loss	**0**	**1%**	**3%**
6 Loss	**1%**	**0**	**1%**

Notice there is also a loss from setting the MacCready too high. That is, flying too fast. There is also an increased possibility of landing out from the greater height loss.
One way to achieve a faster average than the MacCready system indicates is to use streets.

To be able to fly at 65 knots and maintain height averages 120 kph. This is faster than most sailplanes achieving 8 knots climb can average with a "pure" MacCready system.!
Finding streets, up to 40 degrees off track, for just a part of the task can make large differences in speed.

Similarly, in tasks around 300 kilometres getting just one 8 knot core, when most thermals are 4 knots, will make a significant increase in speed.

Modern sailplanes can carry water ballast. This has the effect of moving the whole performance curve along the best glide tangent to a higher speed range. The curve keeps its particular characteristics and shape.



To calculate the effects of this on cross country performance it is best to draw additional average and speed to fly curves for the new weights.

Speed directors have this built in, so that it is only a matter of entering the new weight or wing loading. Usually it needs 40 litres to make any noticeable difference.

In most sailplanes, wing loading can be varied from 30 to 50 kilograms/square metre.

The higher the wing loading, the faster it glides and the better the potential for high speeds.

However, the higher the wing loading, the harder it is to make it climb in a thermal. So, the pilot must always compromise between the two factors.

Sailplane handling characteristics must also be considered. Some handle better than others at high wing loadings.

For optimum speed, from experience, I have worked out a relationship between thermal strength and wing loading for standard class sailplanes.

Climb rate, knots	1	2	3	4	5	6	7	8
Wing loading, kgs/sqm	light	32	35	38	41	44	47	50

15m sailplanes can be 2 kgs/sqm. and open class 4 kgs/sqm. heavier.

In competition flying, if the pilot is positioned to be able to make consistent use of gaggles so that there is minimum centring to do, then the wing loading can be 2 or 3 kgs/sqm. heavier.

Obviously, this is a tactic to plan!

The decision to lighten the sailplane is always a difficult one. Knowledge of the drop rate can help the pilot drop in increments until the climb rates are satisfactory. Generally, strong but rough thermals need lighter loadings than my table indicates.

This is necessary as the manoeuvrability of the sailplane is slowed by the extra weight. It can be that with faster response a lighter sailplane can achieve climbs 3 to 4 knots better average than at the heavier weight. Improving the climb rate to that extent will result in a better average cross country speed than that with the slower climb with ballast.

Only the extended average climb rates should be used in making judgements on MacCready settings. Even then, there is usually an impression that with good rates for part of the climb, that the overall rate is better than it actually is. This is particularly so with rough thermals.

Many modern varios compute the overall flight average rate of climb. This should be consulted at intervals during the flight.

The final glide is just an extension of the same system. In the final glide case, as there is no future thermal or need to regain height, the analysis for optimum is different. The optimum speed is that MacCready speed related to the final thermal.

So, you should simply continue on using the MacCready speed that you have been using until you come in range of the destination at that speed. Monitor the height/distance readouts as you get near to the final thermal. When you have sufficient height, with allowance for circuits or whatever is necessary for the arrival, set off at the same MacCready setting.

Carefully monitor this glide. There is a period as you come through 25 to 15 kms out when the chances of finding another strong thermal are reduced. It is better to top up before this than risk falling below the path and having to work weak lift or even land out!

If you have been flying above 5000 feet, it is often possible to commence a final glide 500 to 1000 feet below what is necessary and get this from pullups in good air. This is a matter for fine judgement and will depend largely on whether the thermals are still in the main phase or not.

If you get more height than is necessary, then increase the MacCready setting until the height that you have equals the height required on the glide calculator.

Another problem is that the GPS or DR wind that you have obtained at height almost certainly will not be the wind in the last 3000 feet of height. The ground wind at the destination will be useful, and when combined with your estimation of the flight wind can give a reliable guess.

If you cannot obtain a final glide and are forced to glide out your height to an outlanding, then put in the likely wind and scroll through the MacCready settings until you get the greatest distance shown. You will generally find that a MacCready less than 1 (kt) will give the best distance up to around 20 kts headwind. If you have a tailwind, the best speed will be between the best glide speed and the minimum sinking speed for the sailplane. This will be a negative MacCready if your speed director allows it.

Tactical Considerations for Task Flying

When planning your task there are many task options that achieve the same purpose. Select the one that the terrain and weather for the day can help you most. In distance flying you will almost certainly be flying alone. This is demanding on thermal finding and knowledge of thermal patterns that may help you is essential. The long distance flyer must cultivate these skills.

We have only a limited mental capacity to handle all the in-flight tasks. The more capacity that can be kept available for the thermal climb and speed tasks the faster will be the speed and the likelihood of task completion. The more tasks that can be pre organised, pre planned or eliminated by automatic functions the greater will be our opportunity to improve performance.

Make a flight plan. Even the most basic plan should show if there are any critical areas of time, place or weather. Examine the map at this stage and consider if there are any reasons for major diversion. If there are, it may be better to change the task, rather than accept the handicap of extra distance.

Having performance information is necessary for planning and for checking how you are going. By applying the principles described in the MacCready system, a table of performance can be prepared for any glider.

For the Discus without ballast								
Thermal Climb, Knots	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Speed between thermals, knots	**62**	**68**	**75**	**78**	**83**	**84**	**86**	**88**
Average Speed, Light, kph	**46**	**70**	**80**	**94**	**102**	**110**	**114**	**121**

A well prepared flight plan and a through study of the maps of the route can reduce the navigational load, even when you are using a GPS. A systematic preparation of all equipment so that it is easily accessible in flight will help as well.

Have as much of the preparation done the day before as possible. Many flights have failed because the pre flight preparation on the day took so long that the flight became impossible in the amount of thermal time left.

Some pilots wile away their off season time making flight plans for likely winds and weather conditions from their favourite sites. They have a small library of them and only have to make a selection to suit the weather of the day.

The longer the proposed flight is, the earlier the take off needs to be. Even proceeding cautiously 30 kms in the first hour is better than falling 30 kms short because you took off too late. If you are trying for a flight longer than 750 kms, you will need to take off just as the first thermals begin working. This may have you below 3000 feet for longer than the first hour. Skill at using this lower level efficiently is necessary for the long distance flyer. Some practice at it before you make your first serious 1000 km attempt will be useful.

If there are other gliders flying use their thermals as well as your own. To do this you must be proficient at gaggle joining and flying. When you leave your thermal fly directly to the next glider that is thermalling near your track. Frequently you will find other thermals or weak lift along this route. This way you may find the thermal pattern of the day.

Keep radio talk to the absolute minimum. ***Flying efficiency is inversely proportional to the amount of radio talk.*** A position report each half hour is enough.

If you are consistently getting low, set the MacCready back. If you are consistently getting higher set it up more. A balance between achieved climb and MacCready setting will have you flying in definite height band.

Check progress against your plan. If you are falling behind consider abandoning the flight. It will be more productive to treat the flight as a practice run, and return home, than to go on to a certain out landing. By returning home you can be fresh to try again the next day. If you land out, the retrieve may be so tiring as to lose the next day entirely.

Look for a good climb at least 10 kms before a turn point where you go from a tail wind to a head wind. Ideally, drift onto the turn as you top the thermal. Remember to turn to the side the camera is on.

On a leg which goes from head wind to tail wind the ideal place for the thermal is just after you round the turn. Some height may be sacrificed to make this turn, but to get very low may risk the whole flight. If a very strong thermal is encountered just before the turn, it usually is better to gain some height then, rather than pass it up in the expectation of finding it after the turn.

Be cautious after rounding a turn point. The change of direction means that the frequency which you strike thermals will change. If you have been hitting them at short intervals on one leg, this will change on the next one. It may shift to very far apart so that you must use a lower MacCready setting to reach them.

If you can be confident about the forecast winds, this may be a consideration for the planning stage in selecting the task. For winds of stronger than 15 knots these tactics may be a decisive factor. For lesser winds they will make little difference.

Do not be too anxious to get onto final glide. Continue on in the way you have been flying until you fly onto it at the MacCready setting you have been using. Then if you gain extra height, you can increase the MacCready and make the final glide faster.

Remember, when you get home you still have to land. From about 15 kms out make a plan of how you will join the circuit pattern, and where you will land.

Cross Country Checklist

Checklists are one of the greatest inhibitors of stress. Use them wherever possible.

This is a check list of all the necessary items that go to making a well organised cross country flight. Start with it and add any extras that you find are necessary.

PERSONAL NEEDS: Hat, Glasses/Sunglasses, Skin Sun Protection, Gloves, Drinking Water, Food, Urination Needs, Medications, Watch. Landout Bag with Phone Numbers and Necessary gear. These can all be prepared in advance.

DO NOT ALLOW YOUR SELF TO GET HURRIED OR HASSLED!

CALM, CAREFUL PREPARATION HELPS MAKE A SUCCESSFUL FLIGHT.

SAILPLANE NEEDS: Daily Inspection, Clean (Chamois), Control seals, Gap seals,(tape, meths, knife), Bug Wiper?, Battery, (charged? is there a second one or spare?) Check radio, Parachute, Cushions, Back support, Balance ballast, Tie down kit, Derigging tools, Retrieve car (fuel full & extra fuel?), Crew, KEYS with crew?, Trailer OK?
Barograph (Set, Sealed, Signed?), Camera(s) (Loaded? Mount OK?)
Water Ballast - How much?

PRE FLIGHT PLANNING: Route/task, Met forecast, Maps, Airspace, Radio frequencies, (make a list) Planning gear (protractor, scale, calculator/computer) MacCready tables, Pencil,

FLIGHT PLAN! Information into flight computer.

DECLARATION: (if needed) The Official Observer must sign it and also put his mark on the canopy in front of the camera lens. The mark(s) need to be heavy to show up at all.

PHOTOGRAPH the DECLARATION and OFFICIAL OBSERVER WITH THE CAMERAS ON THEIR MOUNTS IN THE COCKPIT!!

YOU SHOULD NOW BE READY!

SAILPLANE TO TAKE OFF AREA: Towing gear, Still enough time for flight? Does sailplane need to be parked level?

Walk around for a few minutes before getting in and do some exercises to stretch the legs and lower body area. This will help delay the physical effects of a long sit in the cockpit.

IN SAILPLANE: Check you are **COMFORTABLE!** Everything necessary stowed and switched on. (Barograph, Cameras) **PRE TAKE OFF CHECK.!**

LAUNCH: Drop off in a thermal, if you find no thermal take the maximum allowable height.

AFTER INITIAL CLIMB: Orient yourself, Look at initial tracks and start point, Search for Thermal wave? Wind directions at various heights. Compare with the forecast.

REASSESSMENTS: Weather, Ballast, Start time?

START: Note time. Set Nav computer. Report start?

EN ROUTE: Navigation - Map reading - time - flight plan time comparison, Airspace, Frequencies, Diversions? Thermal climbing, Wave, Cloud streets, On/Off course? Speed director setting or Block speeds?

REASSESSMENTS: Thermal strengths, Ballast, Diversions, Achieving flight plan? Time, Abandon task? Anxiety?

DRINK, EAT? Remember to do this at regular intervals.

TURN POINTS: Correct position? Shoot! Wind camera on, Set the next leg on nav gear.

LOW?!! DON'T PANIC! Carefully work up to height again. Race when you have height.

FINAL GLIDE: Tighten harness, Map reading, monitor glide path.

HOME! DROP BALLAST! PRE LANDING CHECK!

FINISH: The flight is not over until you are stationary on the ground.
Make a nice circuit and landing.

Now you need to spend 5 minutes looking after yourself. Drink water or sports drink. Walk back to the tie down area or hangar. If you cannot do that spend 5 minutes stretching and light exercise before doing anything else.

FORMALITIES: Photograph tail, Declaration, Barograph to Observer? Photograph clock? Camera (or?) Film to observer or to contest collector.

PACK UP: Glider away, Cleaned, Covers, Battery charge?

Resolve to work on weaknesses but Relax Now!

At your leisure analyse the flight. Use the GPS readout, barogram, map and other notes to help recall the detail.

The Daily Thermal Cycle

Almost every day, there is a regular pattern of atmospheric cycling. The passage of fronts and other large weather disturbances are the major factors to interfere with this.

To achieve good task flying this must be examined so that the task may be placed in the best possible part of it to achieve the fastest speed. If the task is short enough (less than 600 kms) not to need the whole day, this becomes the selection of the start time.

This is more than a planning exercise. Once in the air assessment must be made as to whether the forecast corresponds with actuality. Allowing sufficient margin for modifying the planned time is also part of the planning.

The start time is probably the most important decision to make in competition and speed record flying. The weather is the main (but not the only) factor to influence this.

What we need to know to make these decisions are:

- **TEMPERATURE, WET and DRY at specific times**
- **TEPHIGRAM to above all likely thermal activity**
- **WINDS, at all suitable levels. (Cirrus level too)**
- **HEATING RATE and the MAXIMUM TEMPERATURE EXPECTED**
- **FREEZING LEVEL**
- **WEATHER CHANGES EXPECTED**
- **CLOUDS, including any HIGH CLOUD**

The weather forecast can give us most of these.

The tephigram is of great importance as a number of relevant factors can be deduced from it.

If the forecast balloon flight or other source is not close enough in time or place to the soaring site then for a reliable result there is no alternative but to obtain it locally. This may be done by a tug, ultralight or model aircraft equipped with an accurate thermometer.

It is best done before thermal activity starts (7 to 8 am.) to a height above any inversions found. If there are none then 8000 feet is usually sufficient.

The altitudes should be plotted above ground level (QFE). If there is any need to work in height above sea level (QNH) it is best to plot the trace and then move it to the new base height.

From the tephigram and the maximum temperature the maximum thermal height can be calculated. Small kinks in the tephigram will usually indicate where any wind shears will be.

In combination with a heating table and some local knowledge, a time/height/thermal strength diagram can be drawn. This can also take account of the task route as well as the local situation.

This latter is more in the art form rather than science. Some may put it into the voodoo class of prediction.

The relationship between the tephigram and the maximum temperature line will also give a good indication as to how the day will develop and finish. It will show whether there will be a sharp or gradual cut off of thermals. This is very significant in planning our start time.

There are tables to calculate the cloud base from the wet and dry bulb temperature readings. These are not precise and some local knowledge is helpful to get these accurate. In tropical areas a wet bulb of 12 or more will almost certainly indicate that the day will develop thunderstorms by mid afternoon. 14 is needed in more temperate climates.

When flight planning I always work back from the latest good thermal time to a start time. Some pilots like to place their flight evenly around the best part of the day. I feel that there are some problems with this last system.

Thermal Structure

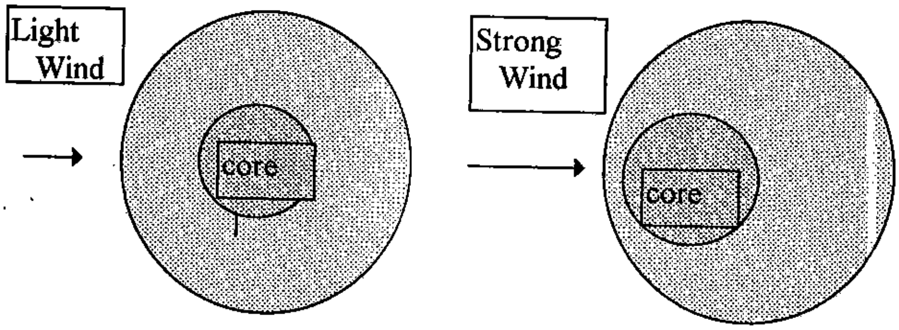
From a lecture given by Ingo Renner, adapted from German research material.

Thermals are like fingerprints. They are all different but at the same time have sufficient common features to be all in the same class of events. Thus if we draw the structure of one thermal then it will be unique. However there will be sufficient common features to say that most other thermals will be similar.

The structure of the thermal illustrated was established by simultaneously flying a number of aircraft equipped with recording instruments through the thermal. As well as up and down current strengths, temperature and humidity measurements were taken.

The thermal shown had one core. Other thermals observed in the same way were found to have many. Some had as many as 12! The form was slightly asymmetric. This was attributed to the effects of wind.

In cross section stronger winds tended to move the weaker lift surrounding the core more than the core.



The super adiabatic layer near the ground is usually 100 to 300 ft. high. On very hot days this may extend up to 600 or 800 ft. This area is very chaotic.

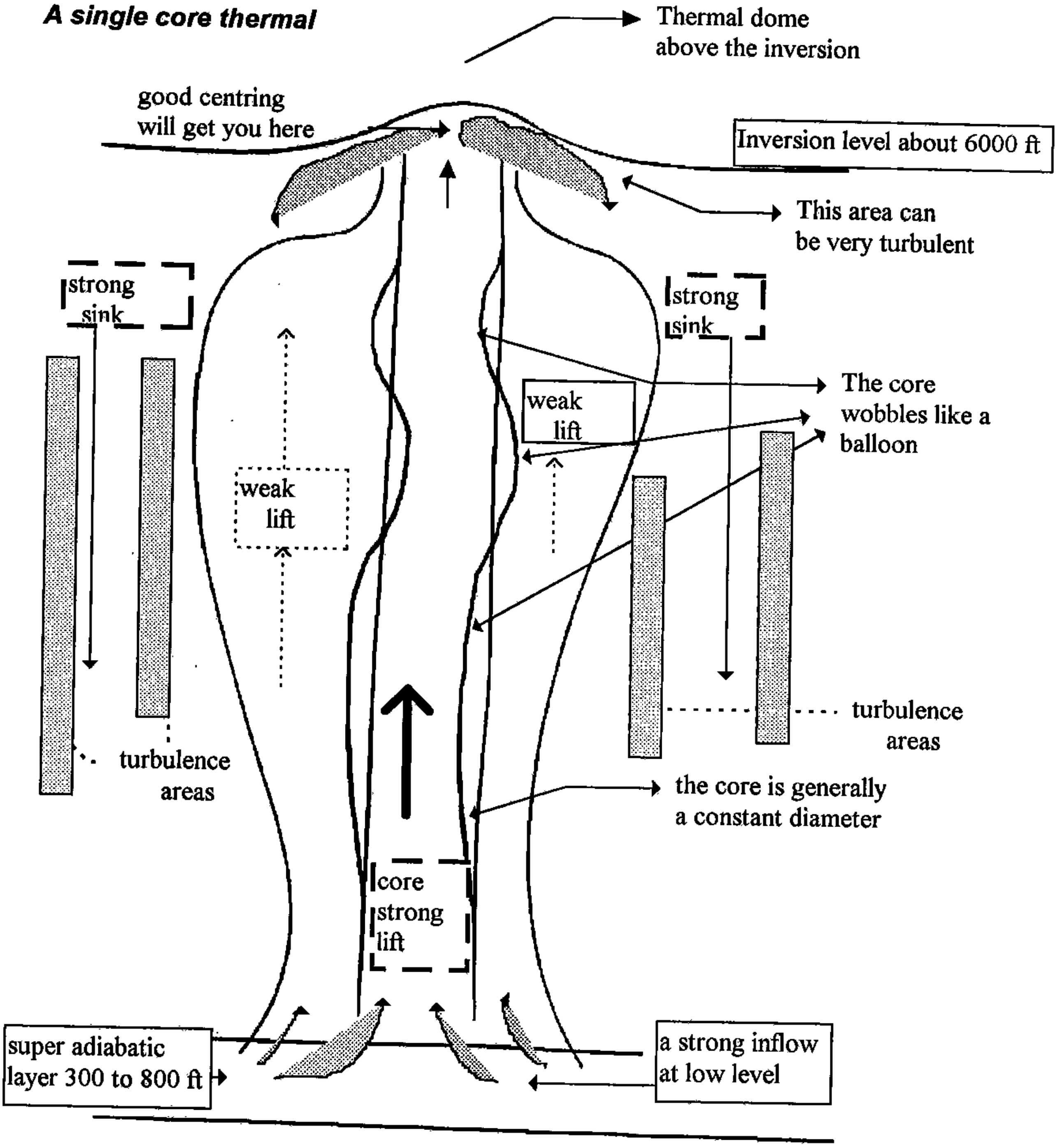
In this layer the thermal is made of gusts and is not organised into a steady stream which it becomes higher up.

At low heights (1000 ft.) there is a strong inflow of air which will drift the sailplane into the thermal. ***Very little centring action is needed by the pilot and the glider will be drawn into the strong core.*** Once the sailplane gets into the lift for more than a quarter of the turn, simply keep it turning and let the inflow help you into the thermal core.

The core will have the same strength all the way up and generally will be of constant diameter. Average diameters are 500 to 600 metres.

A bank angle of 40º is necessary to keep the sailplane in the core. 45º may be needed for 15m sailplanes and 50º for open class. With adequate bank and correctly positioned the circle can be completely inside the core.

A single core thermal



A sailplane circling at a 40º bank angle and 46 knots will make a turn of 136 metres diameter. 45º is needed to achieve the same diameter at 51 knots. If the speed is increased due to a higher wing loading then the bank angle must be increased to achieve the same size circle.

The thermal tends to weaken at all levels at the same time. That is, if there are many sailplanes in the thermal, they will all leave about the same time regardless of height.

The sink area around the thermal at the levels where it is organised is quite strong.

Sinking air spreading out from the top spreads over a large area and is relatively weak.

There is a wind shear and turbulence in the top section near the inversion layer.

Temperature measurements indicate that by half the height of the thermal the temperature has equalised to that of the outside air. That is, theoretically the thermal should stop!

It does not do so because the mass of moving air has considerable inertia. A thermal column 200 metres across going to 6,500 feet will contain over 80,000 tons of moving air! Such a mass cannot stop or change direction quickly.

We can conclude from this that the strength of the thermal is more closely related to the height that it goes to rather than other possible factors. The table of thermal strength compiled by Mike Hancy in 1973 based on likely height and temperature has shown a good correlation with results.

The cross section of the thermal indicates that the sailplane will pass through two distinct areas of turbulence before encountering the core.

The first between the more or less neutral air and the strong sink surrounding the thermal should alert the pilot that a thermal is near. The speed director will indicate to fly faster in this sink.

The feel of the sailplane is very important to the pilot in this situation. If it feels appropriate the pilot should ***ignore the speed director***. As the sink area is comparatively narrow by the time the sailplane has accelerated it will have passed through the sink and the second area of turbulence and into the weak lift surrounding the core.

Horizontal gusts in this area may also complicate the indications showing lift or sink that isn't there! A good gust filter in your vario system will help keep it honest.

Once in this area it is of the ***greatest advantage to be at good speed to make a decision***.
This should be about 5 to 10 knots faster than the usual circling speed. That is for most sailplanes 55 to 65 knots depending on their wing loading.

This allows good aileron response to roll into a turn the moment a decision is made. If the sailplane is not slowed to this speed, then many good thermals will be missed altogether as the sailplane will have passed through entirely before any good indication shows on the vario.

It needs practice to develop the skill and anticipation necessary. A good, well set up speed director on medium response should have indicated to slow the sailplane to these speeds. It is necessary to respond to speed director up indications much faster than down indications. The feel of the sailplane on coming into the weak lift area should be the best guide to there being a likely core sufficiently close to catch.

While the thermal core is substantially vertical, many factors will cause it to snake about with height. This is similar to the wobbling of a tethered balloon. Wind shears may even break the thermal into two. ***Generally a strong core will punch straight through most wind shears.***

Because of this snaking, it is necessary to continually work to keep the sailplane in the best part of the core. Pilots who do that well consistently hold strong lift right up into the top neck of the thermal.

They may even get lifted into a thermal dome well above the general inversion layer. From this position an excellent performance can be obtained until the sailplane sinks into the thermal layer again.

If, when you are near the top of the core, the lift becomes irregular, but still with very strong gusts, it is better to leave it than persist. By staying on you will find that the average becomes only half of what it previously was and thus you have been working a thermal that you would not have stopped for at some lower height! Much time (and speed) can be lost in this way.

It is best to try to stay above half the convection height. Thermals are well established by that level and easiest to work. Also, at height there is no anxiety about outlanding so full concentration can be applied to making the best decisions, flying efficiently and working thermals effectively.

Set the speed director to that which you are happy to take when low. That is, 2000 feet. But ***take a good thermal at any height. It is a mistake to ignore thermals until you are at the lower part of your height band!***

Thermal Waves

From a lecture given by Ingo Renner.

Thermal waves are very variable. They can form over single cumulus as an isolated wave, or they can be in a system over an extensive area.

To form, they need a change of wind direction or speed at or near an inversion. They are quite frequent when the wind increases markedly in speed with a 90 degree direction change just above a strong inversion.

As the wind above 10,000 feet is usually westerly over the whole of southern Australia, waves are more frequent when the lower wind is South West through East to North West.

To contact a thermal wave first climb as high as possible under a cumulus cloud. Then from that position fly towards the edge of the cloud directly into the wind at that height. Remember this may be quite different to the wind at ground level or even that of the wind very near the cloud base.

The major difficulty of getting into the wave is to get this wind direction correct!

It may need many attempts, making small variations in the direction each time.

If there is a second cumulus cloud upwind at the right spacing for wave formation, this may give a good indication of the correct direction. Look around for this, even in some unlikely directions.

This combination is also likely to give a strong wave. Remember, you fly as if in hill lift of your nearest cloud but the same lift might be the primary wave of the next upwind cloud!

Often the down flow of the wave can be clearly seen in the shape of the upwind cloud.

The combination should be searched for in all directions.

If the cumulus is towering and sloping at 45 degrees this indicates a wave is likely and also the direction to fly.

On coming from under the cloud use the inertia of the glider to pull up above the cloud base. It is essential to pull up smoothly to the maximum amount and reduce speed to that of the minimum sink for the glider. The wave at this level is usually very weak. If the wave is contacted the air will feel extremely smooth. Possibly the only sign of it will be the vario.

A figure 8 pattern should then be used treating the cloud as if it were a hill. Initially, when just above the cloud base, this will need to be close to the cloud. This will be as much as 4 or 5 wingspans out. As height is gained above the cloud base the pattern will need to be moved further out in to the wind from the cloud. If great heights are obtained this lift is often in the centre between two clouds.

On a day of 7/8 cloud the gaps provide a good indication of wave.

On 1/8 cloud days, the lift may be one kilometre or more upwind of the cloud.

On days when there is a wave system superimposed over cumulus, the thermal under the visible cloud may be displaced well upwind.

If you are having great difficulties centring or finding the thermals under cumulus clouds, it is most likely that there is a wave system above the thermal convection.

On some 6/8 cloud days the waves form a herringbone pattern in the sky. This is caused by two different wave systems. Sometimes both can be worked.

A similar situation can be developed from a single large cumulus cloud.

The wave system can pulsate. It will move slowly downwind, collapse suddenly, and then reform in its original position.

It often takes many attempts to get into a wave overlaying a thermal sky. The lift at the top of the thermal can be very weak and it may take a long time to climb that extra few hundred feet necessary to contact the wave.

Sometimes the wave will extend below the cumulus cloudbase and the wave may be contacted very easily.

However, as the former is more often the case, such waves are of very little use once you have started in a race. The time spent to get into them is rarely made up with their height advantage.

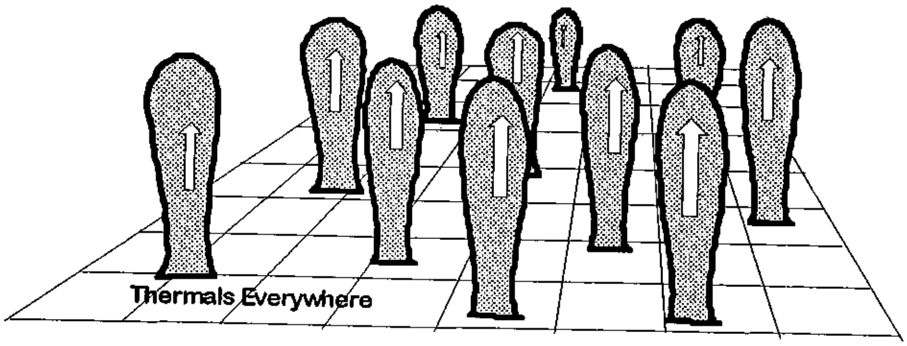
The main advantage is to contact them before the race starts. So long as it does not make your start too late, time does not count at that stage. It can give you a winning bonus for the day.

Thermal Patterns

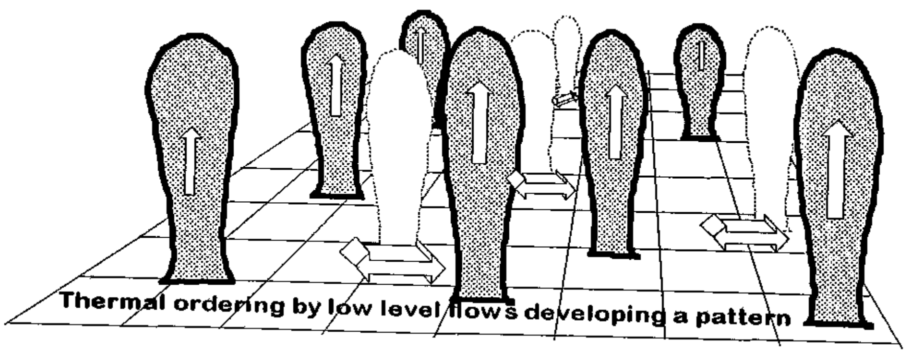
Daily Thermal Development

In an airmass where there are no fronts to make major changes, each day the thermal development goes through four distinct phases.

1 An initial development phase when the low overnight inversion breaks and there are many closely spaced thermals. These are closely linked to their sources and have no regular pattern. In unstable air on the day after a cold front when there is usually a strong wind, this phase matures very quickly, but in more stable situations with little or no wind it may lasts one to two hours. These thermals are usually easy to work, but often restricted in height to 3,000 to 5,000 feet. As the convection height increases this develops into the next stage. There may be an apparent pause in thermal activity while the second stage matures.



2 A secondary development where the stronger thermals take over and form into patterns. The stronger and more rapidly producing sources create ground flows to steal warm air from the weaker sources. A 10 to 15 knot wind will expedite this process. This rapidly develops into the main phase for the day. Usually the distance between thermals or streets equals 2.5 the convection height. This height includes clouds too. This pattern typically lasts three to five hours and the height slowly increases with time. Clouds or blue, there is almost always a pattern to the lift.



3 Around 4 to 4.30 pm (or 5.30 in summer time) the pattern remains similar, but the distance between thermals doubles. The stronger sources steal the warm air from the weaker sources by low level ground flows and eliminate the weaker thermals. In this period there are occasional very strong thermals.

4 The final dying phase which can take four main forms. (1) A sudden stop to thermals as if someone had thrown a switch. This is common in areas closer to the tropics such as Queensland. (2) The thermals space out to only a very few, but these still go to the previous convection height. Once a glider makes this climb, there are many large areas of weak lift that can double the expected glide distance. (3) The other form is the thermals become only half the previous strength, at around the same distance apart and gradually weakening over about one hour. Sometimes on very hot days with no sea breeze influence these weak thermals continue after sunset. (4) The arrival of a sea breeze or some similar strong influx of cooler air.

There are many influences that make variations on this development cycle. Apart from frontal changes or thunderstorms, the primary one is a sea breeze influence.

Within 300 kms of a coast with no blocking hills this may be a direct influence as a sea breeze front which steadily progresses inland. This has a definite frontal band of lift between the sea air and land air. If there are sizeable hills the sea air may stop there and cause only a little influence further inland. However the results are usually more subtle with sea air flowing up valleys and through passes into the hot inland area with few distinct signs between the two air masses. Like railway lines and cattle tracks, these flows follow the contour that provides the lowest grades.

As most of our tasks are flown in the secondary development phase in which the lift almost always develops into patterns, the pilot who can get in tune with that pattern will be able to make a very good speed. Sometimes this may be possible on only one leg of a task, but even that may be sufficient to make the best overall performance.

If thermals are found at regular intervals, as shown by a consistent distance or height loss between thermals, this is a certain indication that there is some pattern in the thermal field.

Modifications to the main phase to form thermal patterns.

A number of interacting factors influence this with the main ones being:

Wind.
An Inversion
Overlaying wave systems.
Sea breezes.
Geological features. (hills, mountains, rivers, lakes, dams)
Large areas of vegetation or irrigation.

We see one pattern easily when the clouds form streets.

Streets are mostly formed by the wind aligning the thermals in the secondary development phase. The minor lift sources have their warm air incorporated into aligned thermals by low level flows or by travelling thermals. Even when there are no clouds these patterns form. This can give us a very difficult flight if we ignore the pattern.

From a thermal you should fly up or down the wind line, depending on your track.

On light wind days the streets may form cross wind. Usually, this gives a chequerboard pattern of lift and sink.

Wind variation with height will profoundly affect the patterns of lift. It is most important to discover this factor. When you commence to thermal, take note of a feature below and note the direction and speed you drift. You can find the winds at the levels you climb through.

Drifting 1.5 kilometres in 5 minutes is 10 knots of wind. Learn to estimate 1.5 kilometres.

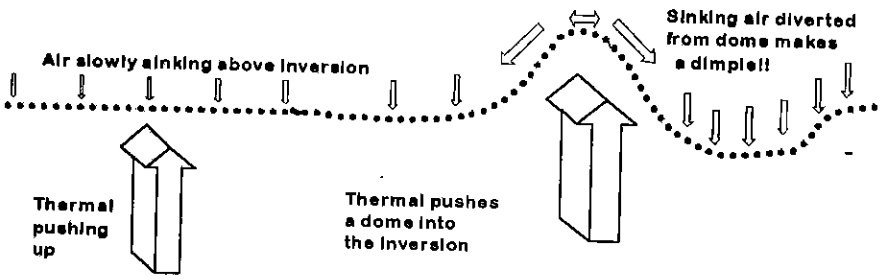
If you have a GPS, it can be set to show the wind drift as you thermal. The precise commands vary a little with the types of equipment, so it is worthwhile learning to do it pre flight.

If you have a distance/height computer, then, by using it on each leg a head or tail wind component can be obtained. After two or more legs, from this information a good assessment of the average wind in the height band used can be made.

We can also use our knowledge of the wind at the planning stage of our flight. Select tracks that are close to the wind lines. The modern zig zag tasks suit this concept admirably.

The presence of an inversion in the 5,000 t0 12,000 height area is strongly influential in producing a regular thermal pattern. Almost always above such an inversion there will be a significant increase in wind speed or change in direction or both.

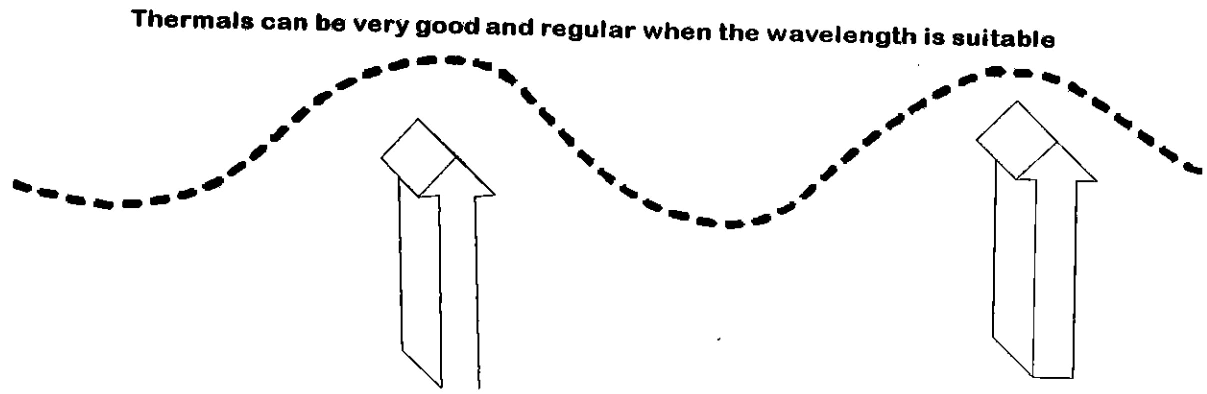
As the initial thermals of the primary phase push up push up into this higher air, because they are prevented from mixing by the inversion, they make domes into the upper layer. Initially, the upper air will flow around rather than over the domes. But as more develop there will be some flow over the dome and down the other side. The upper air is prevented from mixing with the lower air and it will deflect up again to make a mirror hollow in the lower air.



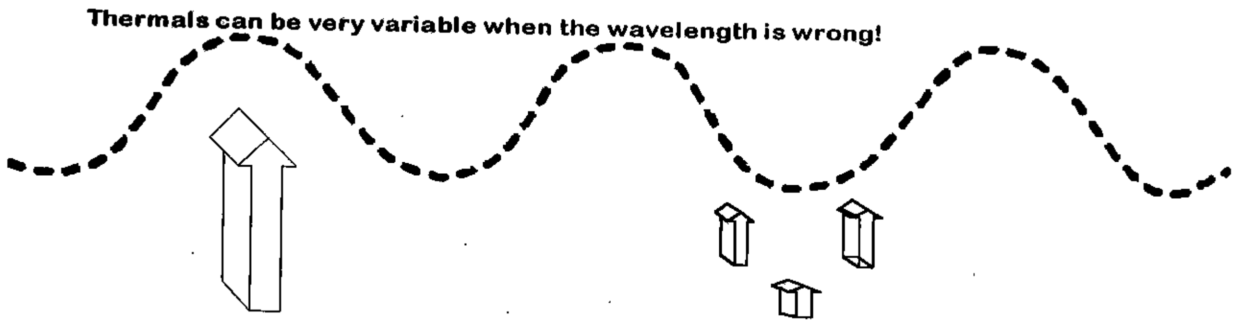
Once started, this action seemingly reinforces itself. The winds above forming some wave like action and the thermals below forming streets.

If there is already a wave system over the thermal layer this will influence the thermal pattern greatly. It may displace the cloud from the thermal producing it by more than a kilometre.

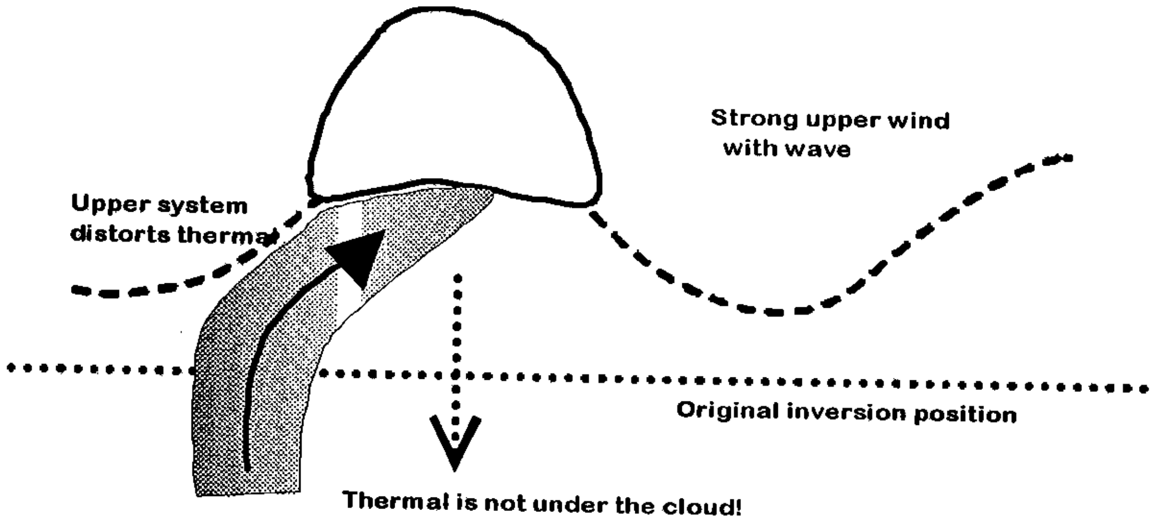
If the wave length is near to that of the thermal distance and both are in phase, the thermals will be strong and easy to work.



.If they are out of phase thermals will be depressed and chaotic.



If the thermals break through the original inversion and penetrate well into the wave system, it will be quite easy to transit from the thermal into the wave system. In this latter case the clouds are displaced from the thermal and the lift will not be directly under the clouds. However, once the position of a cloud relative to its thermal has been discovered, it will repeated for other thermals.



Even 300 kms or more from the coast, a sea breeze can set up a weak wave system that goes like a ripple over the thermal area. In light winds this can set up thermal streets parallel to the coastline. Similarly, a line of quite low hills can set up an overlying wave that patterns the thermals below it.

Detail inside the pattern.

The average life of a small to medium sized fair weather cumulus is 20 minutes. Bear this in mind when you fly to a cloud. If you choose one too far away it will decay before you get to it. You may see that, although the cloud dissipates, it forms again in the same place. This will show that it is related to a good thermal producing site. In this case you are safe to expect a new cloud to form. Perhaps, if the timing is right, just as you come to it.

Frequently the cloud that reforms is not from the original site that started the thermal. As the thermal has drifted with the wind it can capture new sources of hot air. This can give it a much longer life that it would have had from just one source.

On blue days you should climb up to the inversion to find the height and profile (strength/height relationship) of the thermal.

Will the inversion move during the flight? A good forecast will show if this is likely. Inversions will affect the pattern. If the heating is sufficient to break through an upper inversion, it is very likely that there will be a wind shear where the inversion was. Forecast winds may indicate if this is likely.

If there is no inversion, and the wet bulb thermometer reads above 13º there is likely to be a thunderstorm. As thunderstorms go to great heights, the distance between them opens out to 20 or 30 kilometres. This makes tasks very difficult.

Strong thermals will usually go straight through a wind shear. Weaker thermals will become broken and difficult to work at the shear. Usually once above the shear the reformed thermal is stronger.

Once above a shear, you should consider flying slower than the optimum MacCready to avoid coming down through a wind shear before finding the next thermal. ***Using a lower MacCready setting and cruising slower may result in a faster average speed if the glider is kept in the height band of stronger thermals.***

Ground features

There are many ground features that indicate good thermal sources. However, except in mountain areas, these are only of use when below 3000 feet. Thermals that have reached that height have broken from their original source and travelled some distance with the wind. With appropriate winds some mountain sources can be totally reliable. In flat or gently undulating land only occasionally do thermal sources produce so regularly that a thermal is nearly always there.

Consider that we frequently see Willy-Willies moving across the ground for considerable distances. We know that the clouds drift with the wind. So, similarly, most thermals will also move.

A good thermal source will produce a thermal and then the thermal will move downwind. Experience and theory tell us it will move slightly slower than the wind. As the thermal travels it will take in energy (in the form of warm air) from the fields it moves across. This will sustain it for a far longer time than the energy of its original source. One such thermal could last all day, but more often it runs out of new sources of energy and dies out.

A good thermal source will produce a new thermal at regular intervals. The thermal will then move away from its source influenced by the wind.

Because of the moving nature of thermals, flying from one likely thermal source to the next is often not as successful as it should be.

This is particularly noticeable when above 3000 feet. It is more productive to fly straight on track. It is even better to follow the wind line after leaving a thermal. Diverting up to 30 degrees from the track line for this can be worthwhile.

Thermal production can vary greatly. A power station will produce a continuous thermal from its cooling tower. A slow heating site may produce only one per day.

With light to moderate winds, typical good sources in open country make a thermal each 20 minutes. Remember, this is the average life time of a cumulus cloud!

The difference in thermal production rate, and movement of thermals are factors in the development of the daily cycle.

Better Thermalling

Getting the turns right:

When thermalling, the ***ASI*** and the prime ***Thermal Centring Vario*** are the two key instruments. Others are secondary. For ***SAFETY and to use whatever visual signs of a thermal there may be,*** we must have ***eyes out of the cockpit*** most of the time. A good audio is a useful aid to this. It cannot guide you on the subtle variations of the thermal. Only a good analog vario can do this. So we must use it often.

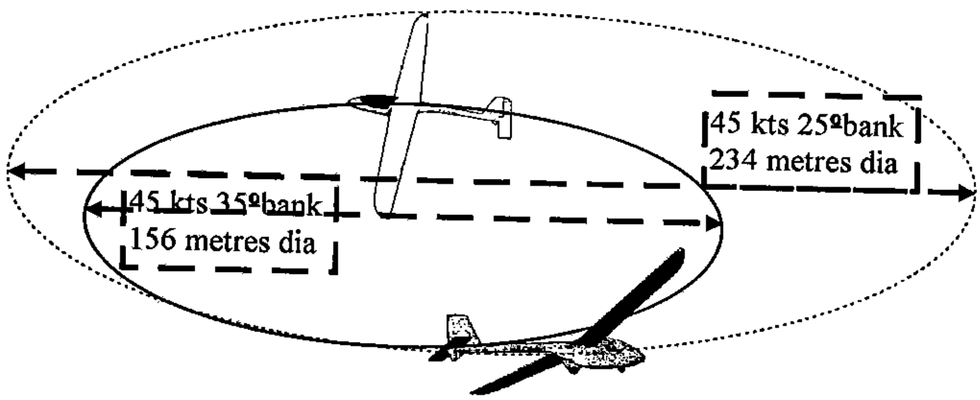
To thermal efficiently, scanning needs to be well developed. Similarly, the skills of making a reasonably accurate turn (consistent speed, bank and slip/skid control) must be automated. Think turn and you find you are doing it. This is necessary so that we can have sufficient analysis capacity free to work out where the better lift is and move the glider into it.

I believe in thermalling at a constant speed. Or as near constant as I can get it!

Although we are trained to equate attitude with speed this is not entirely the case. The gusty nature of the edges of thermals can cause large variations of both. Using a combination of both ASI and attitude works best

To keep speed constant in the thermal may require large, but temporary changes of attitude. This is important to keep the circles as true circles and not some irregular ovoid. The pilot who has well developed scanning will find that this is quite easy. However, once the glider is circling entirely in the core it will be quite smooth and quiet. If there is still some noise or roughness you will not be completely in the core.

Experience has shown that to get into the core of a thermal and to stay in it you will need to make a turn smaller than 200 metres diameter. In order to achieve this, most gliders will need to be circled at greater than 30º angle of bank.



The difference in circle size is in the ratio of 1.5 diameters!

For gliders at the same weight that ratio of the difference between 25º and 35º of bank remains constant over the speed range. Turn size reduces still further with more bank, as in the table below. A glider using the same speed and 45ºbank makes a circle less than half the size of one at 25º bank!!

Bank angle used	25	30	35	40	45	50
25ºbank turn is larger by ➪	1.0	1.24	1.5	1.8	2.14	2.54
or the turn diameter size compared to 25ºbank is ➪	1.0	.80	.66	.56	.47	.39

Circle diameter or size, is dependent on three factors:

1. Angle of Bank. *2. Speed.* *3. Slip and/or Skid.*

Bank angle is in effect the directional control. With the wings level or no bank the glider will fly straight. Bank the glider and it will change direction.. Speed has a direct relationship to the size of the turn. that results.

Slip or skid, if kept to 10 degrees or less makes no difference to turn size. Rudder used coarsely to slip the glider can considerably increase the size of the turn or prevent it altogether!

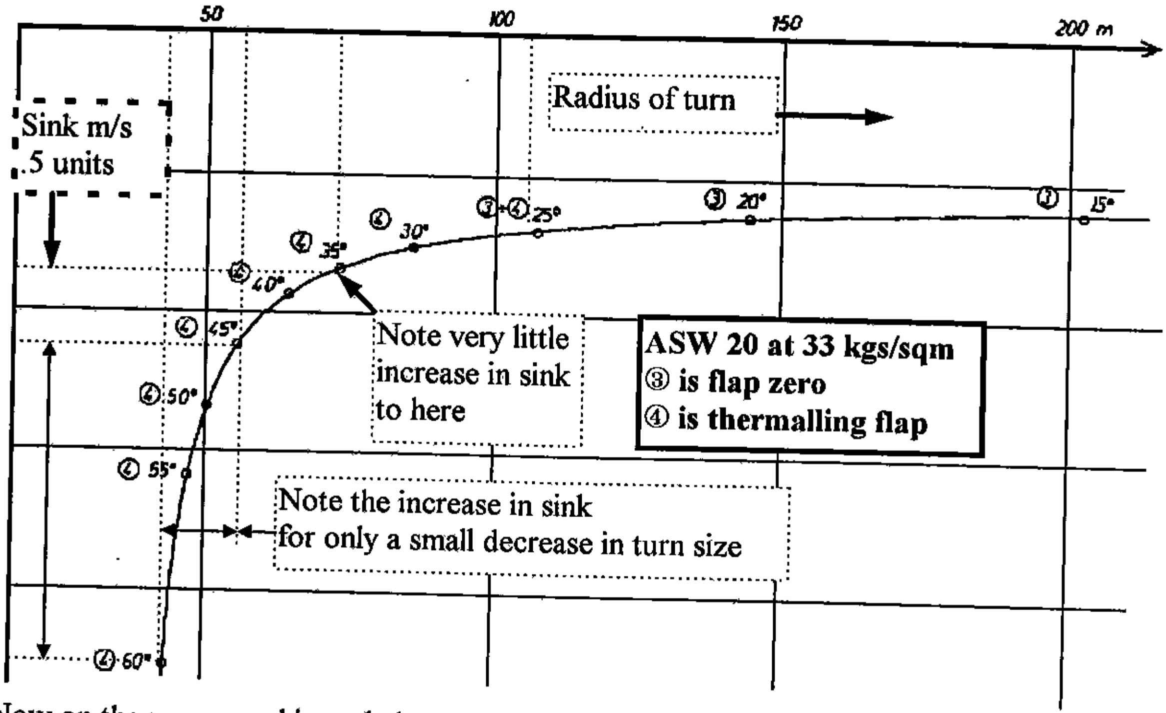
The table gives the size of circles at various speeds and bank angles normally used by most gliders when circling

CIRCLE DIAMETER in METRES									
SPEED	**Bank Angle in Degrees**								
KTS	20	25	30	35	40	45	50	55	60
40	237	185	150	123	103	86	72	60	50
45	300	234	189	156	130	109	92	76	63
50	371	289	234	193	161	135	113	94	78
55	448	350	283	233	194	163	137	114	94
60	534	416	336	277	231	194	163	136	112
65	626	489	395	326	272	228	191	160	132
G force	1.06	1.10	1.15	1.22	1.31	1.41	1.56	1.74	2.00
√G	1.03	1.05	1.07	1.10	1.14	1.19	1.25	1.32	1.41
45	46	47	48	50	52	53	56	59	64

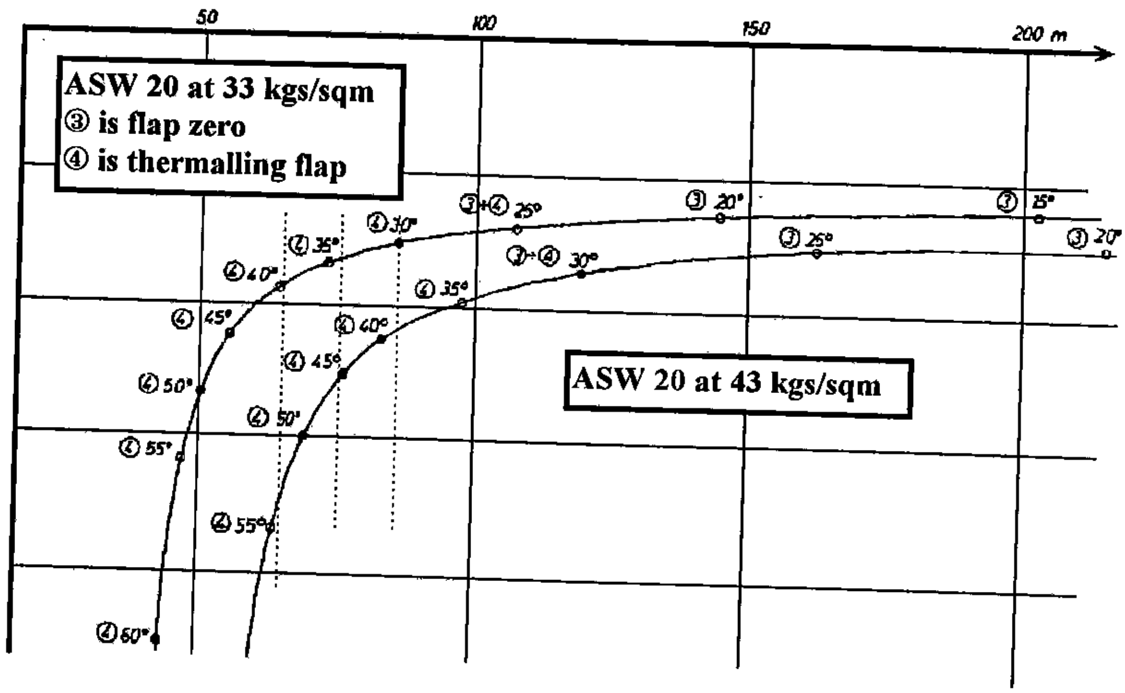
However, there is a further consideration. As the glider is banked more steeply, notice that the G load increases. This has a similar effect on performance as an increase in weight. The glider sinks faster and it must be flown at a faster speed.

With increasing bank and G loading, the stalling speed increases and so do all the other significant speeds. However, this increase is at the rate of the square root of the G loading. This is shown on the table and the next line down gives the increase in speeds to be used for a glider that has a minimum sinking speed of 45 knots in straight flight. The increases are not very great up to 35º of bank and then increase more rapidly.

These factors can be shown in a graph along with the turn size. In this case the flaps reduce turn size by reducing the increase in speed made necessary by the G loading



Now on the same graphic scale here is the effect of carrying ballast and turning put together. Notice that between 5 and 15º more bank is required to get the same radius of turn. This is due to the faster speed necessary at the heavier weight. There is also a higher sink rate penalty.



Being able to thermal well at heavier weights requires quite a lot of practise to match the best pilots at competition level. Gliders vary greatly in handling characteristics at heavier weights. Generally, the most modern gliders are least affected.

Putting good turns to use in thermalling:

By keeping the speed constant, having no slip or skid and varying only the bank angle it is possible to make a series of logical and sequential shifts of the circle. However, making perfect turns will be of little use if they are not in the best lift area. The aim is to move into the area of strongest lift in the shortest time.

Practice is needed to develop a consistent system. If either of the other two factors are varied, the combinations cannot be repeated with any consistency. ***If all three are varied the results may as well be random. You will not be able to thermal consistently.***

All shifts from turning to straight flight and the reverse must be done as fast as the sailplane can do it, consistent with trying to maintain balanced flight. With some sailplanes this is not possible. Some types run out of rudder at any attempt to change direction quickly. It is more important to move into the best lift quickly than demand perfect balance all the time. This does not excuse the pilot, just the glider!

Also, so we can see how the shifts are working, make only one shift each 360 degree turn.

Making small variations of the bank angle without completely straightening up is suitable only for very small shifts of the circle. The amount of shift that it makes is not sufficient if the vario is indicating more than 2 knots difference around the circle. Good aileron and rudder coordination is needed when making variations of bank.

Initial training is to use the rudder to keep the yaw string centered. Most pilots have discovered that it is possible to use the aileron to do this as well. This is so but I have noted that the pilots who do this, rapidly move the sailplane out of the thermal!

Always use the aileron to control bank and rudder to centre the yaw string.

For all thermalling use between 35 and 45 degrees of bank. Very rarely does more or less bank give better results. If you have difficulty gauging bank angles, try timing your turns. For the speeds between 45 and 55 knots, which most gliders will thermal at, depending on wing loading, a complete turn should take between 24 and 20 seconds. If your turn takes longer you are using less than 35º of bank which is not enough to stay in most thermal cores. See the table below and compare it with the circle size table.

CIRCLE TIME in SECONDS									
SPEED	Bank Angle in Degrees								
KTS	20	25	30	35	40	45	50	55	60
40	36	28	23	19	16	13	11	9	8
45	41	32	26	21	18	15	12	10	9
50	45	35	29	24	20	16	14	12	10
55	50	39	31	26	22	18	15	13	10
60	54	42	34	28	24	20	17	14	11
65	59	46	37	31	26	21	18	15	12
G force	1.06	1.10	1.15	1.22	1.31	1.41	1.56	1.74	2.00
√G	1.03	1.05	1.07	1.10	1.14	1.19	1.25	1.32	1.41
45	46	47	48	50	52	53	56	59	64

Most sailplanes have more than one vario. Decide which is the most suited to thermalling and use it exclusively. Trying to use more than one at a time is too confusing.

Variometers are not instantaneous! They all have some time lag. You need to get used to the response rate of the vario. Mechanical ones (Winter, PZL) take 3 to 5 seconds. Electric and Electronic varios have adjustable rates. I think it is better to use 1.0 or 1.2 seconds response rate. Most human responses cannot cope with the faster rates that are available. However if your scanning is very good, being able to relate the positions of the gusts to sectors will be helpful.

You can check the time lag of your vario by joining at or near the same height, another glider that is well established in a thermal. Preferably one about 4 to 6 knots so that the height gains are obvious each turn. As you approach the other glider, note your own vario reading but ignore it and simply join by formating on the other glider. Check the time it takes from the time of commencing to circle to the time it is when the vario has a steady reading. It may take a few tries, but knowing the real lag of your vario is a valuable aid to efficient thermalling.

When to roll into a thermalling turn is dependent on each situation. If the sailplane is at thermalling speed you may have to wait several seconds before commencing to turn. If you have been travelling at speed and are still decelerating, then the turn may have to be commenced quite rapidly. At 70 knots the sailplane will travel the same distance in 3 seconds as it will in 4 seconds at 50 knots.

When rolling into a thermal try to do so ***just before*** the vario shows the ***peak*** reading. To do this well needs practice with the glider and vario system. After the vario peaks is too late and you will have passed the thermal.

"Feel" is a major aid to thermal centring. This is mostly vertical acceleration or variations of the G load on the glider. However, it can also be connected to change of pitch of the glider. Change of sound can also be noticeable in some gliders. We can feel these before the vario can respond, so that combining what you feel with the vario response can allow you to develop a good sense of the particular thermal. Gusts that try to bank the glider are also a part of the ***"Feel."*** Gliders vary considerably in the feedback of the air movements that they give to the pilot. This is a major reason why it is necessary to fly a glider frequently to develop any real thermalling proficiency in it. 40 hours is a minimum for easy to fly types and high experience pilots. 80 hours is necessary in most types for pilots with less than 1000 hours.

To develop thermalling technique and skills, select two systems and practice these. When you have developed good, reliable proficiency with these, then add new systems, or variations one or two at a time. Most pilots find that they do not need more than four systems with minor variations on some.

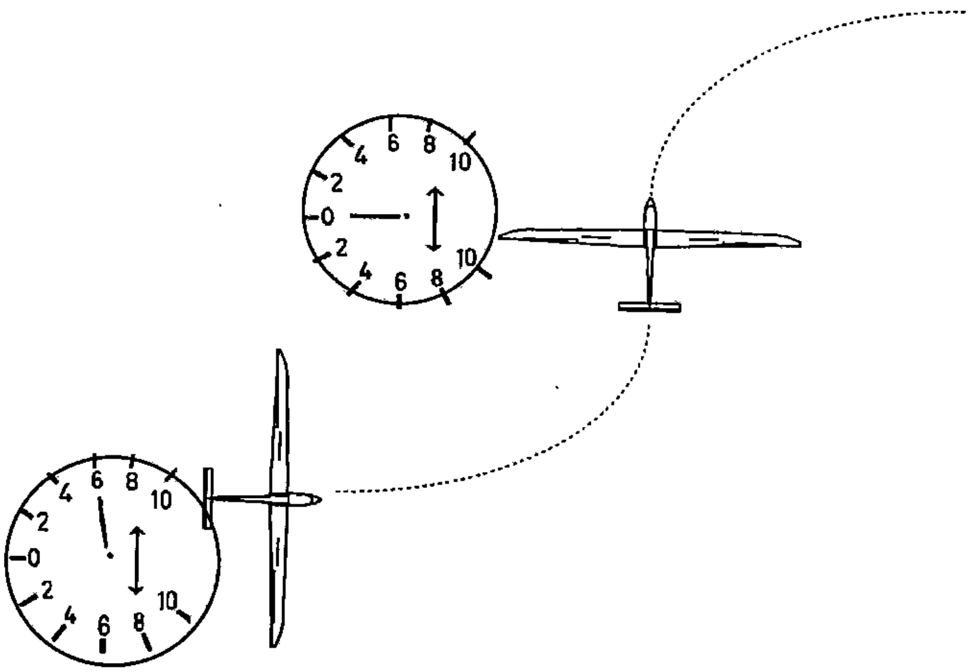
Thermal Centering Methods

The following are systems that I have found to work very well. In the diagrams I have shown the vario readings as the basis of corrections. ***This needs to be combined with "Feel" and your own knowledge of the particular sailplane and instrument combination to get the best results.*** Only experience and practise in the sailplane can provide this knowledge. In particular, you need to know how much lag the thermal centering vario has.

First Turn Correction

If, as you turn into a thermal, the vario stays up or increases, maintain the turn. Then plan to use one of the other systems to work into the core of the thermal.

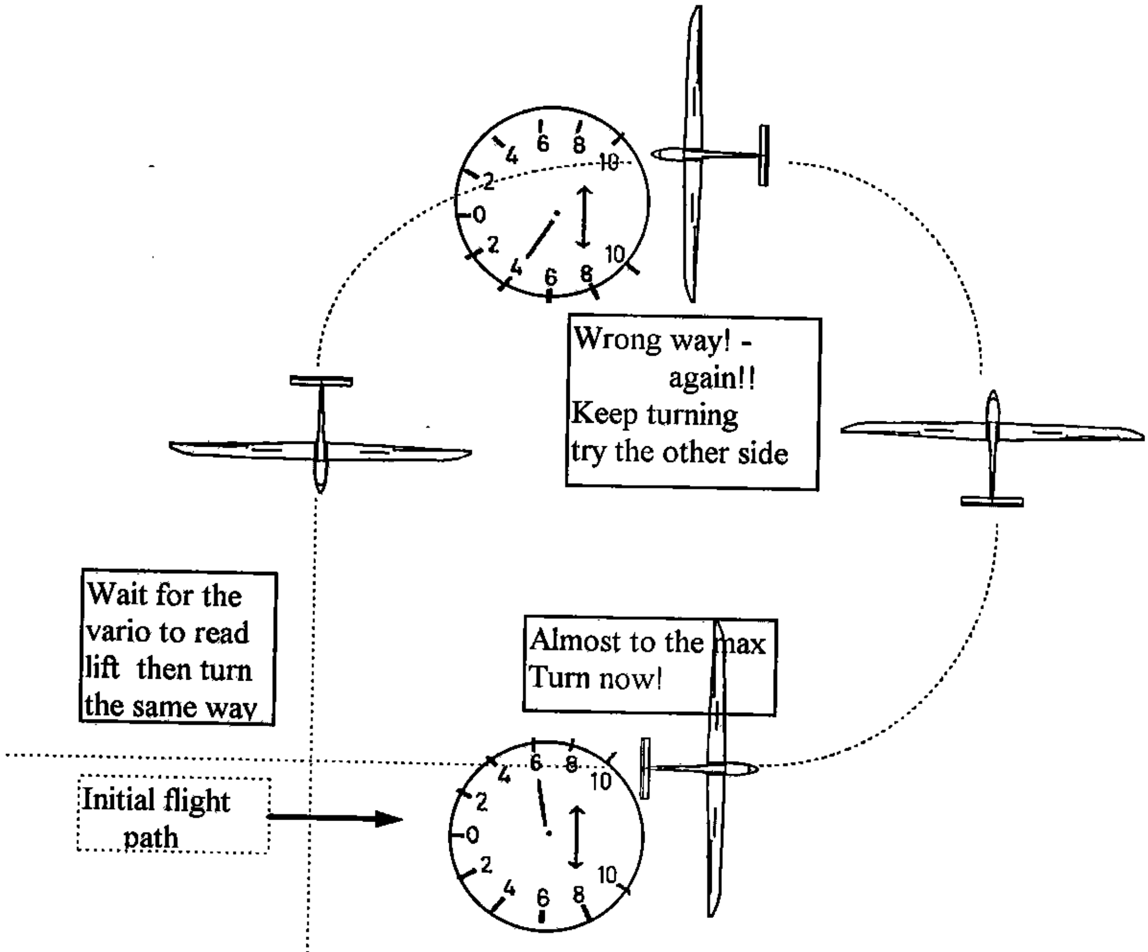
If, before you have turned 90 degrees, the vario shows down, roll immediately out of the turn to the track direction. Fly on and discard the thermal.



This must not be done if you are below 2000 feet. Almost certainly it will be too far to the next thermal.

From that height or lower you will have to persist with one of the other systems to work into the thermal. You will have to accept that this may result in a slow initial climb. It will be better to spend time to work this thermal and if it is less than the rate that you need, climb high enough to get you to the next thermal.

If the vario indicates up for more than 90 degrees of turn but goes to sink before 180 degrees, maintain the turn for 270 degrees from the initial heading. Then straighten up for 3 seconds or longer.

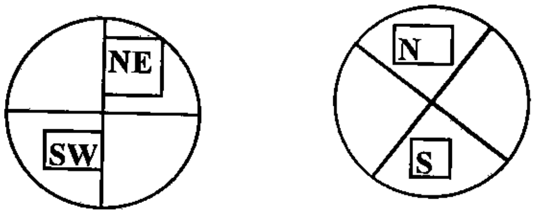


You may have to wait 5 or 10 seconds for the lift to increase. As it does, roll into the ***original direction*** of turn again.

This will explore the area you would have flown in if you had turned the other way. If this puts you in the thermal then use the other methods for further correction. Do not reverse the direction of turn.

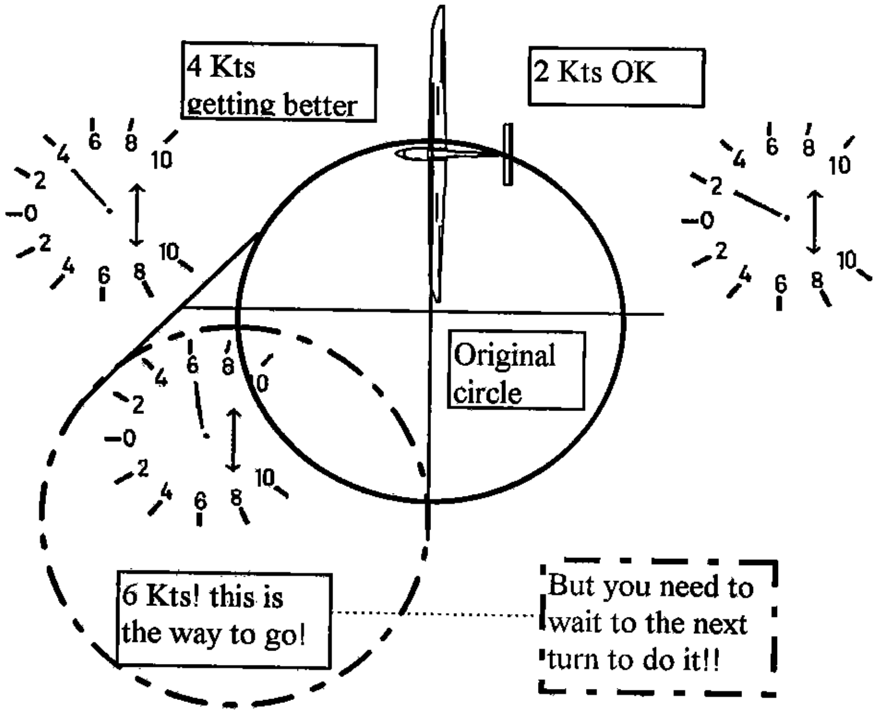
Best/Worst Sector Method

Use this method when you have completed the first turn correction or after you have been established in a thermal. Think of your circle as if viewed from above. Divide the circle into four sectors. Base these on visible features or compass directions. If you are making 20 second turns each sector will take 5 seconds.



Do not attempt to use the actual compass reading. The compass has a number of turning and acceleration errors that make it useless for direction except in steady straight flight. However, you may be sufficiently familiar with the terrain to know the cardinal points from minimal outside reference.

From the vario, remembering to allow for the lag of the particular system, decide which sector gives the best lift. You must move the sailplane towards this sector. ***On the next circle*** straighten the sailplane in that direction for at least 2 seconds. Keep straight for longer if it feels like the lift is increasing. Then roll into the ***original*** turn direction. Do not reverse the turn direction.



Analyse the vario around the circle and decide which is the best sector. Correct on the next turn. ***Continue to do this on every turn making one shift each turn***. If you get confused make no corrections and analyse the vario for a turn or two. Then start the system again. If you are within 500 feet of the top of convection, once the lift decreases, discard the thermal and fly on.

If the best sector is not clearly defined, then use the same system to work away from the worst sector.

Small Adjustments

In a good thermal where one sector is one knot better, use the best/worst sector method. Instead of straightening, shift the bank from 40 to 20 degrees and back again.

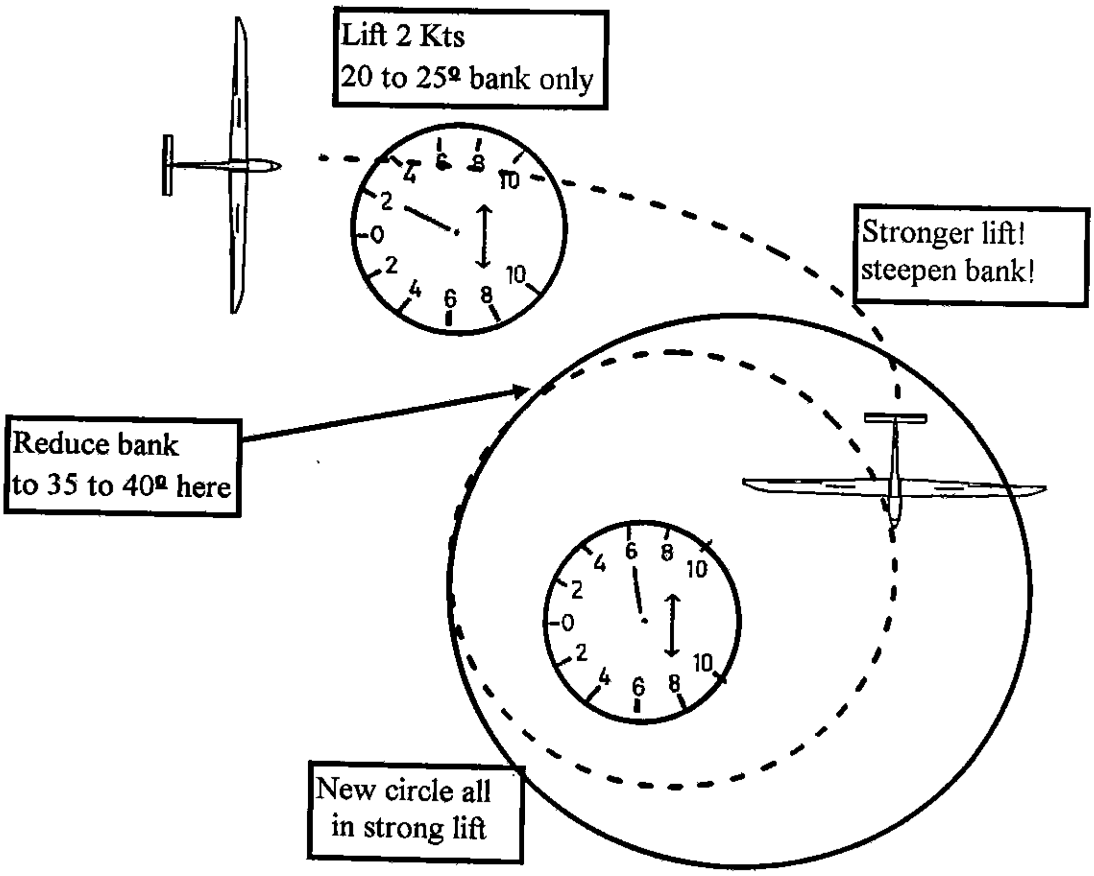
Surge Method

When in a good thermal, if you feel a strong surge of lift, very rapidly straighten up. After one or two seconds, resume the original turn. This works well when the thermal has a strong, large and well defined core.

Huth Method

This was devised by Heinz Huth, who twice won the World Standard class championships flying a Ka6.

This is completely opposite to the previous method. It works well if the initial turn is 25 to 30 degrees of bank rather than a steeper angle. If a strong surge is felt or seen on the vario, immediately tighten the turn to 50 degrees of bank. Hold this for 300 degrees of direction change and then resume the original bank angle.



This is a good method when low. Often at 2000 feet or less the thermal core is not well defined but like a series of bubbles. You may have to make many corrections before a good climb rate can be achieved.

Area Search

This starts out as a variation on the Huth method and works into the sector method. Often it happens that you fly into an area of weak (1 to 2 knots) lift such as surrounds the stronger thermal cores that we want to use. In this case it can be useful to try searching for the core with a gentle turn of about 20 degrees of bank. If a core is found it is easy to steepen to a steeper angle and then use the sector method to work into it completely. This can also be used if a core is suddenly lost with no indication which way to move to relocate it. Sometimes a wind shear or some action (or lack of action) by the pilot can cause this effect.

Each method has its particular situation of application. All of these can occur in the course of working one thermal! You should try to be proficient at all and be able to recognise the situation most appropriate.

When you get stuck

Probably more often than you would like you find that you have become stuck. At a low altitude and getting to the point where you cannot go anywhere.

Concentrate on finding a thermal. Use all the knowledge that you have and as far as possible explore these possibilities to find any lift that will keep you airbourne. There may have to be some compromises as you must allow that you still have somewhere to land safely.

Once you have found lift or can just maintain height, then concentrate on using it as efficiently as you can.. If you have built your climb rate into as good as you might expect for the day, there is no further decision. Stay with it until you are back at racing height. If your rate of climb remains slow, depending on the glider you are in, and your position the next decision comes about 2,000 to 3,000 feet agl. Stay with it or move to find a better climb? Certainly try some exploring moves by opening out your circle to see if there is a better core embedded or attached to the weak lift that you have. Even a half knot improvement can help.

You must keep working the lift, but divert some of your attention to the next possible source. Are there gliders close? It can be surprising that when low a whole gaggle can form up nearby quite unnoticed. Perhaps they have a better core that is a part of the same thermal? A gaggle, even if somewhat higher, would be a good chance to improve a poor rate of climb.

Other positive signs, such as dust or soaring birds may be sufficient reason to leave your lift and try for a better climb. Certainly below 3,000 feet you will need something positive before breaking off even a very low rate of climb.

Recall the met information and your experience so far on the flight. Was there a wind shear and at what height? Usually, once thermals move above a wind shear they strengthen considerably. It may be worthwhile patiently working up through a shear. Staying above it will be advantageous. This may mean using a slower cruising speed so as not to use so much height between thermals and get below the shear again.

The other possibility is to keep sampling thermals until you crack a good one that will take you through the shear quickly. That is a characteristic of strong cores when there is a shear. However, this may have been what you did to get stuck in the first place!

It is one of the signs that you can use to avoid getting stuck. If you find you have passed up a number of weak thermals, before you get below 2,000 feet, assess what might be happening.

⇒ Have you got below a wind shear?
⇒ Is the day dying?
⇒ Is some sea air or katabatic wind altering the thermal pattern?
⇒ Have you flown into a thermal shadow area?
⇒ Have you got tired or thirsty and lost concentration?

Any one of these things and possibly some other negative factors may have happened. The key to avoid getting stuck is to recognise that conditions are or have changed while you still have enough height to alter your tactics and counter it.

Maps - and Some Things About Them

The normal map to use in Australia for aerial navigation is the World Aeronautical Chart (**WAC**) series. This is on a one million scale and conveniently makes a millimetre equal a kilometre.

For overseas pilots this is something of a surprise. All other countries use the half million scale series called Sectional Charts. These usually have the airspace marked as well as the topographic features. Only one chart is needed to navigate over the country.

There is a half million series for Australia. These are Operational Navigational Charts (**ONC**) They are used by the defence air services and are generally available. However, they do not show many more topographic features than the WAC series and are not as useful as those of other countries. They do not show airspace. This is unfortunate as they could be more suited to our needs than the WAC charts. However, they do show sufficient extra detail to be a more useful map for some areas. They are worth looking at to see if they suit your needs.

The services also use a one million series. The Tactical Pilotage Charts. (**TPC**) These show vegetation and in some areas are much more useful than the WAC chart. If areas of vegetation are significant in your area consider using these. This chart series is available for any part of the world.

The other useful series is the quarter million scale Survey charts. These have a very good display of features and now show forest areas. Unfortunately they make too large a map for glider cockpit use for a task longer than 300 kilometres. They are very good for final glides and also to measure the latitude and longitude of places. They are the smallest scale acceptable to the FAI for this purpose.

They are currently produced from two different sources, Army Survey Corps (Joint Operations Graphic **JOG**) and National Mapping. They are not duplicated, each chart is either from one or the other. They produce different displays which makes an odd appearance if maps from the different sources need to be joined. Gliding competition sites always seem to be in the corner of a map which then requires four maps to be joined to get an all round coverage.

The chances are that one will be different to the others. It works that way for Dalby/Jondaryan/Kingaroy!

The other maps to use are the CASA's VEC or VTC charts to check airspace. Unless you are operating from an airfield with complex airspace it is as well to mark the relevant information onto your WAC or Survey chart.

While it is imposable to display a spherical surface like the earth exactly on a flat sheet, there are a number of map projections that approximate this very well. The main ones in aviation use are Mercator (Survey and WAC in equatorial regions) and Lambert's Conical (WAC).

To be of use for navigation the maps need to show features in the shape that they will appear from the air, distance on a constant scale and direction in an easy to use manner.

With some limitations these projections do this. The scale actually varies slightly, but over any single chart the variation is less than 1%.

A straight line between any two points will cross lines of longitude at the same angle. This is a rhumb line. It is not the same as a great circle which is the shortest distance between two points on a spherical surface. In Australia the great circle will be only slightly curved on the polar side of the rhumb line. It will be slightly further. The distance that you measure on the map with a rule, will be slightly less than the "real" distance that you will be credited with from a great circle measurement that is used for certificates and records.

For practical purposes the rhumb line is all we need. If we are to claim certificates or set records, then the FAI wants to work on the shortest distance between points, the great circle.

Most methods of calculating a great circle distance start from the latitude and longitude of the places involved. Once it was quite an involved business with books of tables and lots of calculations. Few people other than professional navigators could calculate it quickly.

Now with computers all that is needed is to enter the positions in a small purpose made program and the calculations are done. Even a small hand held can do this. Be careful though, the FAI uses its own figure for the size of the earth and many commercial formulas use a different value.

The WAC chart also shows isogonal lines. These are lines of equal magnetic variation. Variation is the amount your compass will read different to the true North or South direction. It is shown as East or West and is easily remembered from; "Variation East, compass least, variation West compass best!" That is, subtract East variation from the true bearing and add it on for West variation.

Variation comes about because the earth's magnetic and true poles are in different places. Even more complex, the magnetic poles are slowly moving. This is only a small amount each year and except for a few places (not in Australia) not a sufficient amount to make a 20 year old chart useless on that account alone. A 19th century chart might have you in trouble.

Map Reading

Even with the advent of GPS for navigation there will still be some need for maps and map reading skills. Possibly further GPS developments that have their own map display may replace the map, but it will be some time before they become common enough for everyone to have. Further, with electronics in the glider we are dependant on fallible power supplies. A simple, non power dependant back up can be a great reassurance - if we know how to use it!

For aerial map reading it is essential that we use only those types of map intended for navigation. There are maps made for many different purposes and to use the wrong type will give you great difficulties if it does not actually get you lost. Most road maps do not have a constant scale and usually do not allow direction to be measured correctly. Unless you know that their projection type is suitable for navigation do not use them.

The WAC series is made specifically for navigation and is the most commonly used map for this purpose in Australia. The Survey series is often used for final glides and in the area close to the base airfield.

The colouring and symbols used are shown on the side key. Study these so that the ones you need are instantly recognisable. After you know them well you may want to cut the unused areas off the map to make it more convenient to use in the cockpit.

Many fine details are left out of the charts. Those that are used are the ones most visible from the air. The Survey series shows more detail and are more useful for final glides or for establishing an outlanding position.

For navigating, the features are most useful in the following order:

TOWNS: Usually best, but many small towns close together can be confusing. The shape of a town may have changed since the map was made.

RIVERS, STREAMS, LAKES, MAJOR DAMS: These have bends and shapes that are very accurately shown. Rivers usually have a tree line on each bank that shows up well from a distance.

RAILWAYS: The railway itself is sometimes difficult to see. They are usually straight, joining towns. Grain silos, concrete or steel cylindrical vertical ones and tin shed horizontals are usually alongside railways. They can usually be seen more than 50 kilometres away and sometimes even 100 kilometres. There are a very few places in Australia where these are not on a railway. If silos are a feature of the area you are flying over enquire about this possibility.

ROADS: Main roads are useful, especially now that there are some four lane roads across parts of the country. There are often more roads than are marked on the map and gravel roads show up better than sealed roads. They are accurately shown but care is needed when using them.

RELIEF: This is shown on the map by layer tinting and marking of the height of peaks. General areas of hills are not so useful but an isolated hill or ridge can be useful, especially at a distance.

TIMBERED OR FORESTED AREA: These are not shown on WAC charts. They are shown on Survey charts and are generally accurate in the outline shapes. They can be quite useful as a general orientation feature as they can be visible from a great distance. If they are a feature in your area it will be worthwhile marking them in on the WAC chart.

SMALL DAMS, WATERHOLES: These are not so good as there are usually more than are shown on the map. Sometimes a named one can be used in combination with another feature for positive identification.

A great deal of map reading can be done pre-flight. Study the map with the following points in mind:

AREA ORIENTATION: Select several features and note their relative positions. River, railway, hill country, cultivated country, road. When in the air find these features. Some may have to be discarded as their appearance from the air may not be suitable for quick, easy identification. If others are, then add them into the list. Later, finding just one of these features will give you an immediate positive position.

DIRECTION ORIENTATION: Use the compass to check the direction of line features such as roads, railway lines, tree lines or rivers. Remember the compass is only accurate in straight steady flight.

DISTANCE ORIENTATION: Measure the distance between a number of selected features. When in the air sight them and establish the appearance of the various distances. Try this at different altitudes and note the way that they vary. Remember most airfields are about one and a half kilometres long.

Combine these when determining position. Use combinations of line and spot, natural and man made features to establish a position.

Hold the map so as to look along your track line and work from the map to the ground.

When thermalling look back along the track you have flown. This can be very useful when travelling into the sun in hazy conditions.

Try to keep a continuous idea of your position and direction of travel rather than being concerned about your precise position.

While thermalling it is useful to note your exact position relative to a spot feature and then recheck it 5 minutes later. A drift of one and a half kilometres (airfield length) equals 18 kph or 10 knots. If you do this a few times during the flight you will have an accurate assessment of the wind strength and direction.

The Compass

The compass is a much neglected instrument. It is rarely swung (checked to see that it is indicating correctly) and it is frequently mounted such that it cannot read correctly because of interference from radios or other electrical instruments.

That pilots do not get lost more often is an inditement on how easy it is to navigate here rather than any navigational prowess of the pilots.

Easy navigation is also the reason that we can get away with neglecting the compass. When pilots go to the Northern Hemispheres they soon find they need navigational skills and a working compass. GPS may help to solve that problem. But like any power dependent piece of equipment its weak point is the power supply. Batteries fail. And as gliders fly high where the air is cold batteries fail more often then they would on the ground.

In addition to a back up battery it's a good idea to have a backup navigational skill and a working compass. That way you just might save yourself from getting lost and as a minimum some embarrassment. If you get lost in Australia you almost certainly have to pay for the cost of the search. This can run into many thousands of dollars!!

It is astonishing how a very cheap simple item can be such a useful instrument - if it is set up and used correctly.

Make sure you have a Southern Hemisphere compass. If you change Hemispheres you need to change compasses as well. At least that is so for small cheap types we use. Globe roving aircraft and ships can go up market with their compass. The reason for the change is an effect called **dip.** This is reversed in each Hemisphere and can cause some of those strange movements you may see the compass make.

When you mount a compass place it where it can be easily seen. Usually this is on top of the instrument panel. Check that when you turn instruments or radio on that the compass doesn't read only one heading whichever way you point the glider. If it does you need to shift it further from whatever electrical is affecting it. I have seen a simple exchange of an electric vario for a mechanical one cause a complete instrument panel rebuild.

To swing a compass first get a compass that you know is correct. Then use it to mark out on the ground a compass rose about the length of a glider across with a centre point. This is the cardinal points and each 30 degrees in between. You will notice these points are the only ones on the compass that have figures. The in between ones just have marks.

Better if you can get a surveyor to do it for you. Make sure that this is at least 100 metres from any building or other metal object. Even cars can influence a compass from nearby. If you have some way of marking it permanently it will be available for the next twenty or more years.

When you are flying you will have all the electrical things turned on. So turn them on before checking the compass. Set the glider on each point and note the reading. If it is within 5 degrees then that will be near enough.

If it shows a larger error, then you need to correct it.

Most compasses have two adjustment screws marked N-S and E-W beneath a small cover plate at the top or bottom of the compass. When on N or S turn the N-S screw to remove ***half*** of the error. Do the same on E or W and then check again.

This may have to be done a number of times before the errors are reduced to a satisfactory amount. When you have done this then go around the compass rose 30 degrees at a time and make a correction card listing the errors. Write then as: For 030 steer 025 or whatever it is.

Then when you fly you can be sure your compass is reasonably correct.

The compass will only give a correct reading in steady flight. It is useless if you are turning or diving or climbing. Rather limiting but a glider can spend a surprising amount of time just flying straight. Its not too difficult to hold the glider steady for 30 seconds or so to check the compass reading.

There are a few varieties of compasses that are useable in turning flight. These are Bolhi, Schantz, and Cook if gimbal mounted. To do this they have a different method of suspending the compass magnet that eliminates the effect of dip. Cook have been out of production for years and the others cost a packet more.

It is an aid to navigation to compare the direction of major line features like roads and railways with the compass direction. Just that simple step now and then can help keep you oriented.

Similarly, a comparison between the compass and the GPS can reassure you that the GPS is still working.

These are simple steps but they may save you a lot of grief later on.

The GPS System

The Navigation Satellite Timing and Ranging (NAVSTAR) Global Positioning System (GPS) is a highly accurate navigation system, developed and controlled by the US Department of Defence (DoD) for military purposes, which is now available for civilian use. For civilian applications the normal system accuracy is 100 meters in azimuth and 150 meters in elevation, although for security reasons the US DoD can, without warning, significantly degrade the accuracy of the system for civilian users to the order of many kilometres.

GPS is based on a constellation of 21 satellites, with 3 operational backups, in high orbit (around 20,000 km out) that give out coded signals based on time. The number of satellites ensures that four are always above the horizon from most places on earth. Each satellite has four atomic clocks on board to ensure reliability and accuracy.

To use GPS a receiver must receive signals from at least three satellites, although at least four are preferable. Three are sufficient to work out a position by triangulation but since three satellites result in two possible positions for the receiver, the pilot must either enter the height of the GPS receiver or the receiver must already 'know' its approximate position. The fourth satellite removes this ambiguity and is also used to determine any errors in the receiver clock.

The system has tremendous potential for a myriad of uses. In addition to professional users, they are being used for recreation purposes by bushwalkers, fishermen, yachtsmen, motorists, prospectors, etc.

Most receivers access four or more satellites. The cheaper ones access four and the better ones can access more. A computer does all the necessary mathematics and presentation of the information to the operator.

GPS receivers are fairly high in power demand. This means larger or more batteries in a glider. It is at present a weakness. The batteries in the earlier generation of hand held GPS' would not last for the time of an average glider flight. They needed to be attached to a larger power source. The current generation, (1997) will last perhaps two flights. Development for the enormous market that these are in is very rapid and will certainly help with this problem.

Displays are available from simple digital read outs of track to fly to a point, to a moving map display. Other data is dependent on the power of the attached computer and display possibilities.

After a read of the handbook and becoming familiar with the knobs, it only needs a flight or two to get used to them and to begin to use their possibilities.

GPS is not and should not be used as a sole navigation source. It is **an aid to visual navigation** and should be used to confirm your visual position. Used correctly, GPS will allow you to confirm your visual position and to determine any navigation corrections very quickly and efficiently. Therefore the major advantage is to **reduce the time spent navigating and to allow more time to finding better lift** and using it more effectively.

A potential disadvantage is that having another computer to play with can divert the pilot to the point where the time saved in navigating is wasted in fiddling with the GPS instead of flying. Flying better will get you home faster. The machine is only an aid, it cannot make decisions for you.

Remember, there will still be a need for you to carry out ***some basic navigation*** to ensure that the machine is working correctly. Otherwise it may direct you off into the boondocks mindlessly like only machines can. After all, it is only a computer and if you have programmed it incorrectly it will faithfully take you to the (incorrectly) programmed position.

"Garbage in - garbage out!" Furthermore, in the event of a GPS malfunction, (either satellite or receiver) or deliberate system degradation, then you still must know where you are and be able to effectively use the map for visual navigation.

The GPS can be used to find an actual wind. When you commence to thermal store your position as a way point. Then when you go to move off tell the GPS to "goto" that position. The track it gives you will be the wind direction and the distance will be what you drifted in the time thermalling. If you know the time (even approximately) you can calculate the speed.

A GPS can be of great assistance on a final glide, as it will give you a constantly updated accurate position. Coupled with any of the glide height distance varios it removes the guesswork and need for fine map reading for position. It also allows accurate wind calculation.

The new generation of computer variometers allow coupling with a GPS to do this and many other calculations for you. The information is available at the flick of a switch or twiddle of a knob.

The International Gliding Commission (IGC) now allows verification of certificates, records and competitions by GPS feeding a datalogger to make a file that can be verified. They refer to this as Global Navigation Satellite System verification (GNSS). A special IGC format has been created for such files and dataloggers must be approved by the IGC and/or the national control body to be used this way.

For world records and international competitions, only GNSS units that are integrated GPS and datalogger are acceptable. That is separate GPS and datalogger connected by a cable are not accepted. These are acceptable for national records, certificates to gold c and national competitions.

Development of units and standards is continuous in this area.

Radio Use

Radio procedure and terms are quite well covered in the GFA Publication; "**AIRWAYS and RADIO PROCEDURES for GLIDER PILOTS**."

It does need practise to understand what is said and to become reasonably fluent on the radio. The use of standard words and phrases will help. However, once you have the general idea do not get carried away and over use it.

Flying efficiency is inversely proportional to radio use

So do be sparing and keep your messages useful and to the point.

Positions using Latitude and Longitude are possibly useful for a tug with a GPS to find you but they are rarely useful to another glider flying in company.

Give position as a direction and distance from an easily visible feature. This also works well when using GPS. Use the home airfield when close and on route have an agreed series of features or GPS reference points to use. Always include a height as this greatly aids others to spot you.

A glider circling is much, much easier to spot than one flying straight. If flying with others, this is a good time to call. Some glider aerials are quite directional, so a call given while turning may fade out or vary in strength around the circle. Check your glider out for this problem.

If you are flying alone report position to base at agreed times or about each half hour. ***You may not be able to hear or read their reply but give your message anyway.***

One of the most useless and irritating calls to everyone else on the frequency is the pilot repeatedly asking someone if they can read him. It surprises me that pilots who do this are not strangled if and when they ever get home.

The call "do you read me?" is a test call and should be answered by "reading you 1 to 5", whatever is the case. It is not a call to be made in flight. ***Always give your message.*** It is more likely that a glider call will be read by a ground station than the reverse. For ground stations, terrain is much more limiting on transmission than reception. If the station reads you it will reply. Quite often the glider will not be able to read this reply. This is particularly so for hand held radios which are limited by low power and aerial efficiency.

If you are flying in company with another glider, you will find that after a while you can recognise the voice of the other person(s). If this is the case, call signs may be left out for this type of communication. However, remember to use your call sign for other messages or reports. Do not treat the radio like an intercom. Although you may hear few calls, on any good day there will be many gliders flying. Good radio discipline is necessary to avoid cluttering up the airwaves. ***Keep messages brief, to the point and useful.***

Oxygen Use

The need for oxygen in normal thermal gliding is not frequent. However, for pilots who fly regularly there would be three or four times each summer when it would be useful to have it. On one weather study, I found that over four summers 10,000 feet was exceeded about once each 10 days between November and March. That is about 12 times per summer.

In addition, we have now learnt that thermal wave occurs far more frequently than we once thought. At some sites this could be as often as 100 times per year. On days of lower cloud base this wave may not extend over 10,000 feet. Quite often its activity is brief, so that finding it is a chance encounter rather than a planned attempt.

Standing (mountain) waves generally go to great heights, so that anyone planning to use them without oxygen would be extremely foolhardy.

CAA rules stipulate that all flight planned above 10,000 feet will have oxygen available. This is a precautionary rule that is made to cover most persons needs.

Many doctors have said that if a person is in ***good health*** then they can cope with 30 minutes at 10 to 12 thousand feet without permanent ill effect. This needs to be interpreted on a personal basis. Everyone is different and their need for supplemental oxygen will be different.

Good health needs to be seen as more than an absence of illness. It means at a level of fitness of an active athlete relative to age. Even then, most people older than 50 show a decrease in lung capacity.

Smoking not only reduces lung capacity, but replaces oxygen stored in the blood with carbon monoxide. This severely reduces reserves of oxygen. Pilots who smoke only moderately may need oxygen above 7,000 feet!

What is little considered is that in summer most of inland Australia (where most soaring is done) has a ground density altitude of 5,000 feet! That is, compared with a "standard atmosphere" the high temperature produces the same density of air on the ground that would be encountered at 5,000 feet.

This will have little effect on a person who normally lives in those places and is acclimatised. A person who normally lives in a coastal area where temperatures never go so high will be affected. Those who rarely move out of an air conditioned regime will be affected even more. Similarly, someone arriving from the Northern Hemisphere where it is winter will be badly affected for some time. All of these people should consider using oxygen from 7,000 feet up.

The effect of altitude on athletic performance is recognised. Now training at a high altitude base is used as a means of increasing lung performance for a wide range of sports. Like many other things that affect the body overall, three months is needed for a full acclimatisation.

Fortunately the glider pilot has a minimal athletic performance requirement. Precision of movement of controls does depend on good body condition.

Good decisions are dependant on brain work. The brain is particularly sensitive to reduced oxygen. Any reduction below a person's required flow will result in poor decisions.

In retrospect you may be able to recall some situations where you made poor decisions when flying at a good height. Might these have been caused by reduced oxygen?

An insidious thing about oxygen reduction is that the initial effect is a mild feeling of euphoria. As the person is usually very pleased to have got so high this symptom usually goes unnoticed.

Oxygen lack is one thing that we ***cannot trust ourselves*** to remedy. The only real way is to use it whenever we come to a particular height - like 10,000 feet!

If through testing or even suspicion that you may need it at a lower height then set your turn on height lower.

Most of the major Air Force bases have altitude chambers that can hold 10 to 15 people. With some contacts it is usually possible to get a group accepted for a high altitude simulation. A doctor must be present. As you ascend, tests are conducted to check the individual effect. It is worth the effort to do such a test. Some surprising results usually happen. I have known no one who came away from such a test who thought they could safely go above 14,000 feet. Even then some adverse symptoms were shown.

The simple constant flow systems are good to about 25,000 feet. Above that a pressure demand system is needed. These are more complex and more expensive. If wave soaring is your thing then you need it.

A nasal cannula is a very simple type of oxygen mask that works well and allows the mouth to be uncovered to speak into a microphone, drink or eat.

Oxygen is like a parachute. When you need it nothing else will do!

Physical Fitness and Gliding

Gliding competitions last one or two weeks. The higher the level the longer the competition. World competitions have a practice week as well which really makes them three weeks. At that level and at the nationals level too, sailplane pilots are in an endurance event. If the weather is good for flying there may not be any rest days.

A pilot undertaking a one, two or three week gliding package or spending one or two weeks at a club summer camp is in a similar position. However, this pilot can take rest days when they are needed.

Nevertheless, it would be unfortunate to miss the best day of the period simply because you were tired. In this situation where the pilot has a choice it would be a sensible consideration to take a rest day when the weather was somewhat doubtful.

In addition to the flying we need to be prepared for the chance of long retrieves. This can happen to even the best pilots if the task setters make an error. This happens at least once in each competition and can easily happen many times.

To be fully competitive, or to make the best use of the opportunities available, pilots must prepare on that basis or accept that they will frequently miss opportunities.

There is no sport that is directly comparable with a world championship event. We do not require the strength or endurance of a "Tour de France" rider. Probably, championship golf is the nearest sport that has a similar amount of exercise, coordination and decision requirements. That is played over 72 holes, taking 4 days. To equal a two week gliding competition it would have to go for 216 holes! Players in a golf tournament of that length would need to be very fit indeed.

Essentially gliding is a mind sport. There are no demands on physical strength. (unless you do lots of rigging and derigging!). Fitness is not only about the body. It is largely about the mind. Nutrition and exercise directly effect memory in particular. Everything the pilot does depends on the ability to retrieve information from the memory. The unfit pilot lessens this ability.

However, gliding is stressful and this has a similar effect on the body as exercise. While there are considerable individual differences, heart monitor testing shows that most glider pilot's heartbeat rate increases to about the same as it would for a fast walk all the time they are airborne! There are brief periods when it goes to the equivalent of fast running and in an emergency (near miss or difficult outlanding) may go to a maximum rate. In addition to a general small increase, the rate is related to decision making. Difficult decisions such as to continue a fine cut final glide past the last available landing field put it near the maximum rate!

This adrenalin driven heart rate results in the same amount of fatigue as the equivalent exercise. The glider pilot who has flown 5 hours is the same amount fatigued as if they have just walked for that time. It may be even worse. If the pilot tends to become tense in the legs, arms or shoulders, which is typical, this will raise the level of fatigue even more.

Unless you are quite fit, do this every day for just one week and you will be quite worn out.

A simple definition of fitness is the ability to delay fatigue. This suits our situation admirably. Also, by working on recovering from the effects of the flight each day, a pilot can hold the level of fitness and delay fatigue for a much longer period.

There are three major advantages in being at a good level of fitness:

⇒ One is that body metabolism seems to work more rapidly and more efficiently. What you eat and drink gets into the system more quickly and is more efficiently used.

⇒ The second is that fit people have better memory recall.

⇒ The third is that fit people have greater emotional stability.

All three of these are useful in themselves and can greatly assist everything we do in gliding.

We should not mistake the lean muscularity of an Olympic athlete as the only form of fitness. The glider pilot does not need that level of fitness and gliding is suitable for those whose genetic make up does not allow that leanness. Being at the high end of the weight table for the body frame size is not really important.

The 12 minutes Fitness Test.

This is to see how far you can run, jog or walk in 12 minutes. This has been adapted from Dr Kenneth Cooper's "The New Aerobics" (Bantam Press). It has been used by the US Army and is a well tried general guide. Most people will have to run or jog to get above the bottom level.

Now, before you rush out and give yourself a heart attack trying to prove you really are very fit, **STOP** and **THINK!** This test is just to establish a starting point.

TAKE IT EASY, AS IF YOU WERE GOING TO GO ON FOR TWICE AS LONG.

If you are over 30 or have had any illness (ever) that could affect performance, **SEE A DOCTOR ABOUT YOUR PLANS FIRST.** After that, if it is all go, try it.

Do 5 minutes of stretching, light exercise or walking as a warm up before the test.

Men				
	Distances in Kilometres			
Fitness for Age	to 30	30 - 39	40 - 49	50 +
Very Poor	<1.6	<1.5	<1.4	<1.3
Poor	1.6 ~ 1.99	1.5 ~ 1.79	1.4 ~ 1.69	1.3 ~ 1.59
Fair	2.0 ~ 2.39	1.8 ~ 2.19	1.7 ~ 2.09	1.6 ~ 1.99
Good	2.4 ~2.79	2.2 ~ 2.59	2.1 ~ 2.49	2.0 ~ 2.39
Excellent	2.8+	2.6+	2.5+	2.4+

Women				
	Distances in Kilometres			
Fitness for Age	to 30	30 - 39	40 - 49	50+
Very Poor	<1.5	<1.4	<1.20	<1.0
Poor	1.5 ~ 1.79	1.4 ~ 1.69	1.2 ~ 1.49	1.0 ~ 1.39
Fair	1.8 ~ 2.19	1.7 ~ 2.09	1.5 ~ 1.79	1.4 ~ 1.69
Good	2.2 ~ 2.59	2.1 ~ 2.49	1.8 ~ 2.29	1.7 ~ 2.19
Excellent	2.6+	2.5+	2.3+	2.2+

If you test as **Excellent** you are almost certainly doing some exercise or playing sport at a high level. If you test as **Good**, then you need to do nothing more. At **Fair** or the bottom level of **Good** you might consider some programme to maintain that as you age. If you test below that and you want to get into competitive gliding, then you need to do something to improve your fitness level.

There are plenty of options. The simplest is walking. "Power" walking gives the same aerobic result as jogging and has a much lower chance of leg injury. The only special equipment required is a pair of good quality shoes. Do not skimp on them as damage to feet, heels or knees would be counterproductive.

Cycling and swimming are good, with little chance of injury except that cycling may have some road risks. These may not be possible to continue when away from home.

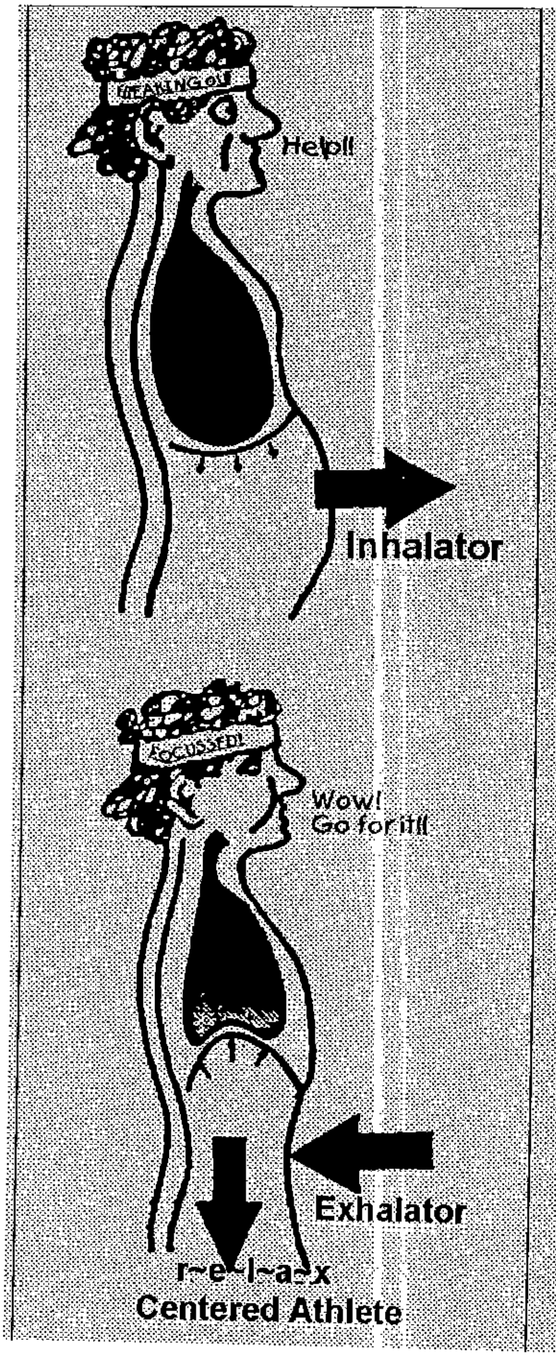
3 to 5 kms (40 to 50 minutes) walk/jog 3 to 4 times a week will work wonders. The only ***essential*** is that ***the exercise is continuous for at least 40 minutes***. Six months of that and the improvement will be permanent. This is not a weight reduction programme. Half as much again is needed for that! Once that you have improved your fitness level, a walk or exercise 2 or 3 times a week will maintain it.

If you have trouble exercising outdoors, the 5BX/XBX programme can be almost as useful. It is particularly good as an off season (when it is snowing outside) "keep in trim" programme. ("Physical Fitness"- Penguin Press).

Another exercise regime is "Resistance Training" Working your arms trunk or legs against some fixed object. This is suitable for older people (60 plus) as a means of improving and maintaining a fitness level.

Centering Procedure

1. Stand comfortably with your feet shoulder distance apart and your knees slightly flexed. This is similar to a seated cockpit position!
2. Consciously relax your neck, arm and shoulder muscles. Smile slightly to release the tension on your jaw.
3. Focus on the movement of your abdominal muscles. Notice your stomach muscles tightening and relaxing.
4. Take a slow, deep breath using the diaphragm. Notice you are extending your stomach.
5. Consciously maintain the relaxation in your chest and shoulders. There should be minimal chest movement and absolutely no hunching or raising of the shoulders.
6. Exhale slowly. Let yourself go. Feel yourself get heavier as all your muscles relax.
7. Do this two or three times.
8. Focus on your job right now. Use your training to find your correct focus point.



Looking at the Weather Forecast

First you must get the forecast.

The newspaper and TV forecasts are very good, but are general forecasts only and have no specific aviation items. The satellite cloud pictures can be very useful, particularly if there is some unusual weather. You need to obtain aviation specific forecasts.

You need access to a fax machine. Most clubs have a code and account number (it is free at present) that allows them to access the AvFax service at the cost of a local phone call. This service is also available to all licensed pilots. Details of how to go about getting this and the codes for the various items are contained in the *ERSA* publication put out by Airservices Australia. The *WEATHER for GENERAL AVIATION* booklet by the Bureau of Meteorology provides explanations of each type of forecast.

This same forecast may also be obtained with a computer and a modem via the GFA and AOPA home pages. It may be available from a few other sites as well.

With the correct code selections, the forecast will give you:

1. The current surface isobar chart.
2. The prognosis chart 12 hours later than the current one.
3. A satellite photograph which will show clouds or infrared imagery. The infrared will be one taken during darkness. Most clouds will show up on this.
4. The aviation forecast for your area.
5. A terminal (site) forecast for your field if it is a licensed airfield. If not a nearby place will usually be adequate.

The aviation forecast will have over a stated period of validity (usually 12 hours):

1. The winds for 2,000, 5,000, 7,000 and 10,000 feet.
2. Likely clouds and cloudbase. This is not often reliably predicted and cirrus cloud is not usually on the forecast at all! However, it may be on the satellite picture.
3. Likely weather; rain, cold fronts and the like. Warm fronts are very rare in Australian latitudes.
4. Freezing level. With a surface temperature, this may give some guidance on likely thermal heights.
5. Area QNH.

The terminal forecast will have:

1. Period of validity
2. Surface winds
3. Clouds. The CAVOK for Ceiling and Visibility OK is used if no cloud is expected below 5,000 feet. This is not a very useful item for gliding.
4. The temperature and dew point at the commencement time of the forecast. This can be used to forecast cloud base later in the day.
5. Four QNH and temperature figures expected throughout the time period. The temperatures can be very useful, but you need to ascertain a good track record of accuracy for them before believing them too implicitly.

The significant information that is missing for gliding is the tephigram. The temperature variation with height. This will allow prediction of thermal commencement, height and strength. Combined with wet and dry temperature information at your site you can accurately predict cloud base or the lack of cloud.

If you are near a major airport you can obtain the tephigram from that area as taken by airline aircraft going in and out. MetFax can supply that information, but you will need to make contact with the local met people to arrange that it will be available. You will need a fax machine capable of polling to get this.

If you are further than 100 kms away from the site of this tephigram, then only the figures from 5,000 feet upwards will be reasonably useful for your site.

You may have to arrange for a tug, ultralight, microlight, or local aircraft to obtain these figures if you feel that they will warrant the cost of obtaining them. Certainly for a major camp or competition they are necessary. You will need them each 500 feet and preferably to half a degree Centigrade of accuracy.

Interpreting the forecast:

Always keep in mind that, the only consistent thing about Australian weather is that it is inconsistent. If you have someone skilled in doing this, good. If not you can learn to do it for yourself. Making some guesses about the weather and then flying in it is a very effective way of learning how accurate the forecasts and your guesses are.

The isobar chart gives the over all weather pattern. Unfortunately, the computer program that draws these charts is set to ignore or remove minor disturbances. Many local effects due to hills, changes of vegetation, large lakes, coastline and some unknown factors are averaged out or ignored when the overall charts are drawn. Such variations can only be examined on a daily basis with the addition of local experience.

Thus, there could be a small low or high imbedded in the larger overall pattern that is not shown. Winds and weather related to these macro patterns will not be forecast

Probably because of this and the greater reliance on machine rather than human data gathering, in the last 40 years, forecast accuracy has become quite good for large scale and long term effects, but has become less accurate in macro weather effects.

Local knowledge of these macro patterns is invaluable in making guesses about the weather. Anyone who has a weather dependant occupation (farmer, pilot) and has lived in the area for 20 or more years will be able to make good guesses about these.

Weather cycles for most gliding areas.

Most gliding in Australia is conducted between the latitudes 27° to 37° South (Dalby to Bacchus Marsh). In this area the weather is dominated by sub tropical high pressure systems. In summer, tropical air bringing instability enough for large thunderstorms frequently comes as far south as 34° mostly in the eastern coastal area, (Sydney) but sometimes extending well inland (West Wyalong).

Most cross country is done from clubs and centres inland of the Great Dividing Range which are situated in the grain growing belt that extends from south east Queensland in an arc into Victoria and onto Adelaide in South Australia. Gliding in Western Australia is also conducted in the grain growing country. All of inland Australia has a low rainfall.

While there are a number of gliding clubs in coastal locations, cross country from them is limited by airspace, topography, forests and sea breezes. Only a few such clubs have a reasonable cross country capability.

The west and central part of the Australian south coast has a Mediterranean type of climate. This has a long hot dry summer. Most rain falls in winter. The small amount of summer rain comes in quick sharp falls from frontal thunderstorms.

The more eastern and northern areas get more summer rain as the fronts move up the western slopes of the Dividing Range often with some interaction with the moist south east winds from the warm Pacific Ocean.

The dominating high pressure systems move with the season to be centered around 39° south in summer and 33° south in winter. The summer position of the centres is over the Southern Ocean, to the south of Australia. This is a cold ocean, so air from over that ocean contains little moisture. There generally has to be an inflow of moisture at middle to high altitude from the tropical sea to the north west of Australia to meet with a front for there to be any significant rainfall.

Cloud: Due to the dryness of the air in the anticyclones (highs) there is generally little middle level cloud except near fronts. The frequency of cloud varies throughout the summer. In the southern Mediterranean climate area, in November and December about 60% of days have cumulus. In January and February only about 40%. In more northern areas, due to the influence of south east winds penetrating well inland, clouds are more likely on 60% of the days for the whole summer.

Cirrus is occasionally in patches dense enough to affect convection. However, the radiation penetrating a complete cover of Cirrostratus or thin Altostratus can give good soaring conditions over very dry country.

On rare occasions the extensive cloud associated with tropical rain systems over northern Australia may extend to the area for a week or more. This is about once each 10 years.

The highs form west of Australia in the Indian Ocean and move east on a fairly regular six day cycle. Further south, in the Southern Ocean around 60° lows are generated. These interact with the highs and fronts are formed between them. The northern part of these are usually cold fronts which extend onto the Australian land mass. The coastline of the Great Australian Bight tends to reinforce these fronts.

In summer the lows and associated fronts move further south so that only the extreme end of the front crosses the Australian southern coast line. These show as very weak fronts or extensions of a front to the south and are called troughs.

The regular movement across the area of highs, fronts and troughs gives a consistent wind movement pattern. A front moves through with a change of wind from the north west to south west. The sequence of winds after a front is:

South west to south
South east
South east to east
East to north east
North to north west

Often the change is so weak as to be noticeable only by the change of wind and recommencement of the cycle.

Warm fronts are rare in the 30° - 40° south latitude area, but very occasionally occurs (perhaps once a year) when a tropical low moves further south or an antarctic low moves further north than usual.

For gliding use the weather may be analysed by the wind flow associated with this cyclic pattern.

NW Flow: The wind ahead of a front. This starts at 15 kts and steadily increases to about 25 kts. With a deepening trough to the west. As a new front approaches, winds freshen from the NW. This may occur quite rapidly, and the wind may become strong and gusty, raising dust and reducing visibility. The source of the air is the interior of the continent and it is very hot and dry. Very deep convection may occur with north westerly flow with cloud bases above 12,000 ft. These are often very good gliding days. However, thermal start is often late, and the wind can be so strong as to prevent closed circuit tasks. Close to the front the cloud tops may build to great heights giving showers and thunderstorms. Rain falling from these clouds into very dry air may evaporate before it reaches the ground. Soaring conditions on these days are very variable. Thermals can be very strong but medium cloud spreading over the area from the west may bring convection to a premature conclusion.

Tasks for these days vary greatly and are mainly dependent on the wind strength. Tasks up to 300 km at fast speed are very likely. Alternatively, a long straight task using the strong tailwind is a possibility, but will of course give a long retrieve. As the alignment of the front is usually north west - south east, a southern destination may be cut off by frontal weather.

S-SW Flow: Usually 20 kts reducing to 10 kts within 24 hours but sometimes within 12 hours. Immediately after the passage of a front there can be deep cumulus clouds and possibly a few showers. Conditions for soaring are usually very good on the day following a front. Subsiding motion in the advancing ridge of high pressure usually limits the convection layer to 5,000 - 8,000 ft. There may be extensive low cloud in the early morning, which becomes well broken before midday. Although thermals are limited in height by the inversion, they are quite strong and very consistent.

The initial strong S/SW stream is not conducive to tasks longer than 300 kms. Streets are clearly defined and progress into wind can be made using them. This makes excellent practice if there is no assigned task. The cloudbase lowers towards the south and may restrict travel in that direction to about 80 kms. A 300 kms zig zag task on the wind line is usually possible.

SE-E Flow: Light winds not often stronger than 15 kts. By the second day after a frontal passage the new high pressure centre is usually well established in the Great Australian Bight with a ridge extending to Bass Strait. The air arriving in the flying area now has a trajectory from the ocean, over several hundred kilometres of heated land. The subsidence in the advancing anticyclone is usually still strong at this stage, with an inversion at 5,000 - 6,000 ft. Soaring conditions are usually good, with moderate thermals, often with cloud streets. Extensive early morning cloud breaks up rapidly to become shallow cumulus which often disperses completely in the afternoon. This airflow may persist for several days, becoming more easterly, with the lighter winds each day. The convection layer deepens and becomes stronger and more consistent.

These days often start very early and are active almost to sunset. While restricted in height, the combination of length of day, consistency and light winds make tasks of 1,000 kms possible.

NE-N Flow: Light winds about 10 kts. If a strong pressure rise continues over the Tasman Sea, the air reaching the area is drawn increasingly from the NE. It originates from the warmer sea areas of the Western Pacific and is consequently moister and much hotter after several days' passage over the land. The convection layer is much deeper, extending to 8,000-10,000 ft and thermals are large and strong. There are often large cumulus clouds with high bases in the afternoon and scattered evening showers or thunderstorms may occur.

These are excellent days for almost any task. However, thermal activity sometimes starts too late for the very long ones. Overdeveloped areas can usually be diverted around, but this can add excessive distance.

Frontal Passages & W Flow: Fronts vary greatly in intensity, but should not be under-rated. There are many very mild fronts, when only the northern tip of a front, called a trough passes through. It is usually shown by cloud marking the convergence line and a wind change from WNW to SW. With good forecasting and planning such lines can be put to good use.

A strong front has a heavy squall with winds of 40-60 kts from the SW-W, with visibility badly reduced by dust. There may be showers or thunderstorms with associated strong down-draughts, but the cloudbase is seldom low.

This passage takes from 20 minutes to 1 hour. Occasionally a front will break into a series of minor 15 minute fronts passing at 2 hour intervals. After the front the strong wind may blow for some hours and continue to back. (Change direction more from south to north) With some fronts there may be a marked wind change without cloud. With others a wind change with little or no cloud may be followed several hours later by a band of thick middle level cloud and rain rather like a warm front!

The air immediately after a front is quite stable and takes several hours to become thermally active. If a front goes through during the night or early morning, this effect is not noticed. If it goes through late in the day, often sufficient heights can be obtained on the front to final glide to the destination. The important thing is to recognise the situation and take the most appropriate action.

Tasks on days where a front is due through the site are very difficult to plan as what is possible is determined by the time the front is due. If this is after 2pm there is tendency for the front to hold on any hill line to the west and then move through just before dark. When this occurs, quite long tasks are possible. Over plainlands fronts move at a steady rate.

Sea Breezes: Sea breezes occur on almost every summer day. Inland temperatures of 30° and above will have sea air penetrating hundreds of kilometres inland. This takes many forms and is frequently not recognised. Sea air is cool and stable so that its movement is governed by topography. It will always take the minimum surface gradient when moving.

If the topography and prevailing wind allows, it will form a mini front. This front is often visible as a whitish haze and sometimes with cloud that has two levels of cloud base. The sea air is usually between 1500 and 4500 ft deep and tends to increase its rate of progress as it moves further inland. Thermals that have been going to much higher altitudes will be cut off from their sources and collapse.

If the sea air travels along narrow valleys, or its movement is close to that of the prevailing wind, it is noted by an increasing brokenness of previously well formed thermals.

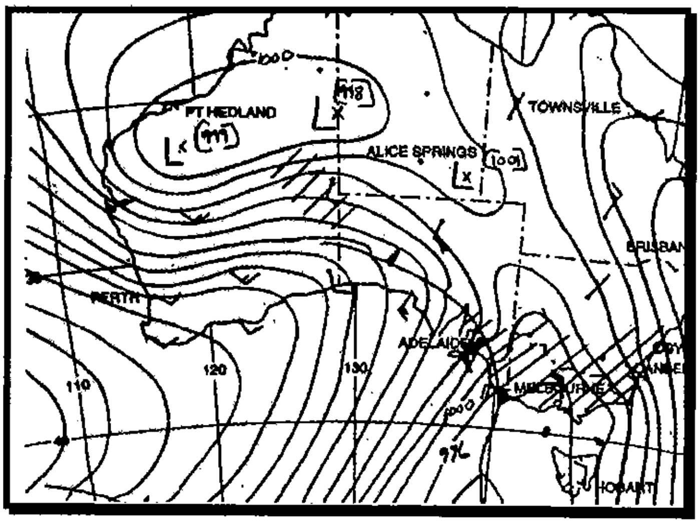
An advance sign of its approach is that about an hour before its arrival, thermals, which had been weakening off in the late afternoon, start becoming stronger again. Careful task choice can make good use of this effect.

Once a sailplane is flown into the sea air unless the active side can be reached again, it will be on a final glide. Occasionally tasks are set such that a glide to and from a turnpoint covered by the sea air needs to be made. This needs great caution, as the sea air will continue progress and may put the escape beyond the range of the glider.

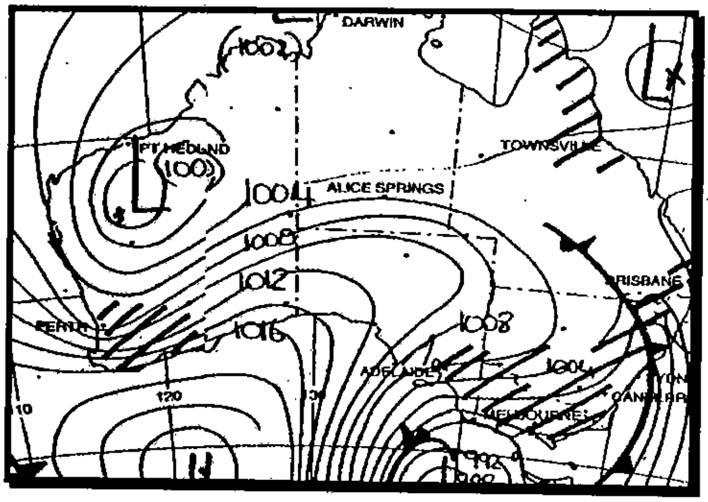
A frequently unrecognised effect of sea air is that it puts a gentle pressure wave parallel to its frontal movement that aligns clouds into streets much further inland than it will penetrate. This effect is quite regular in many areas and can be used to good effect to plan and achieve tasks.

Look at some typical summer weather charts from the period of the sports class competitions, 1995/96 and 1996/97.

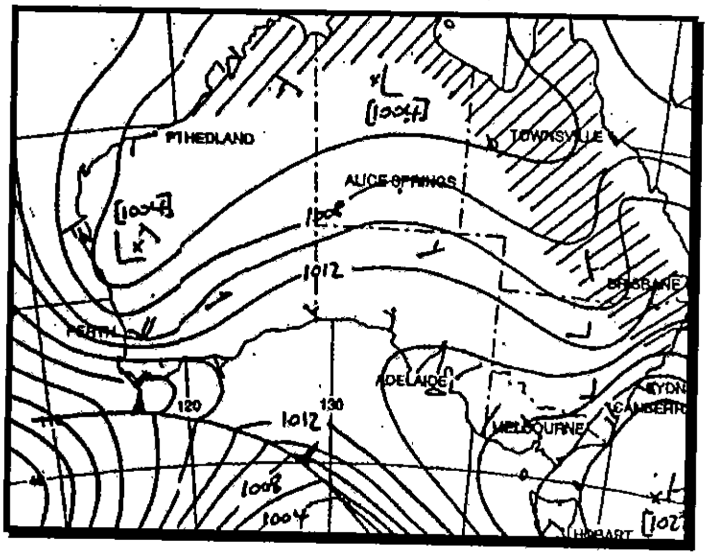
Summer Charts 1



A cold front has just passed through Adelaide. The winds to the east are northerly and the winds to the west are south west. A large high is in the southern Indian Ocean and has a ridge of high pressure towards the front. There is some rain ahead of the front. There is rain in the mountain areas of NSW and Victoria

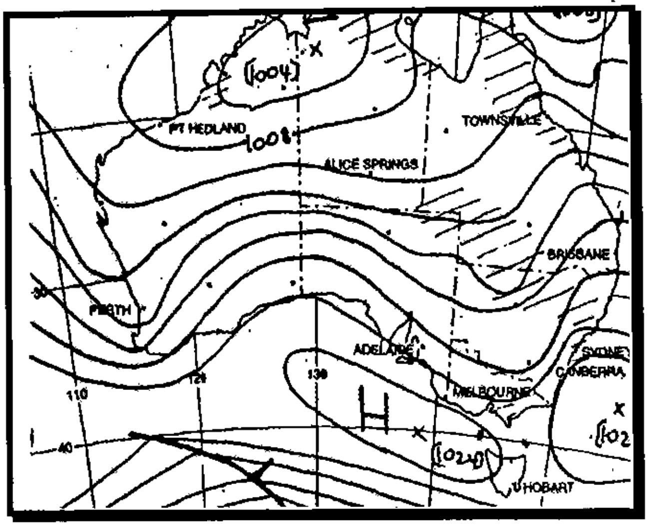


The cold front has moved through and there is a south west wind over the south east of Australia. This is very unstable air that provides thermals on the smallest amount of heating. However, the approaching high will make an inversion between 5,000 and 8,000 feet to restrict the thermal height. The winds in the southern parts are too strong for closed circuit tasks.

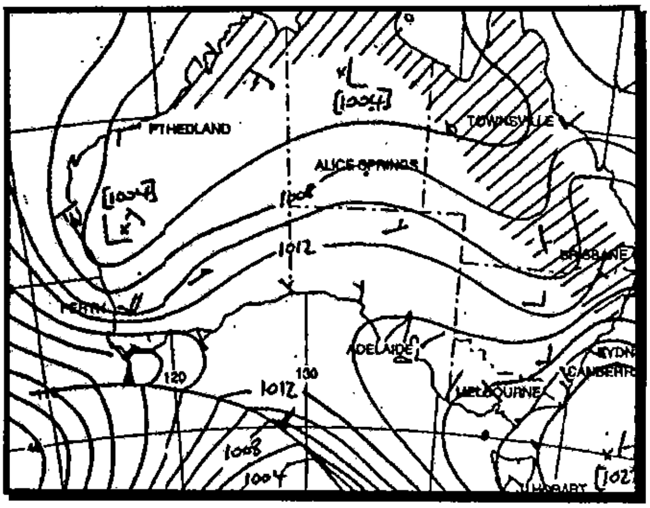


The cold front has moved across to New Zealand and the high is now centered in the Tasman Sea. The winds are now light east to north east in northern NSW. Good gliding conditions, but probably blue in the western part of the area. The next front is south of western Australia, but is well south and will probably come through the mainland as a wind change.

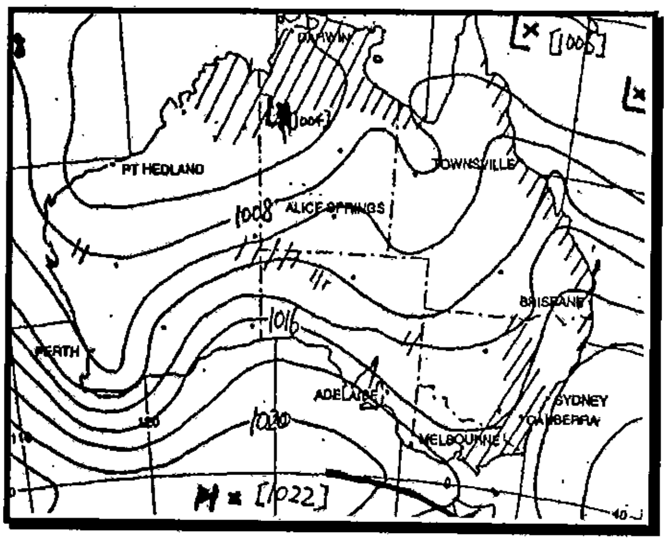
Summer Charts 2



The high has moved further east and broken into two centres. The winds have become more easterly and lighter. They are now north east in the eastern areas. (Narromine, Lake Keepit) Cumulus will be well developed in the east but probably it will be blue in western Victoria and SA. A good soaring day, but the inversion will still be present.



A trough has now developed in the easterlies from the pacific Ocean as the high moves further away. This has drawn in some rain from the tropical north. The gliding area will have high based cumulus that may develop into thunderstorms in the east and north east. Usually an excellent gliding day. The next front is south of Western Australia, but may keep south of Australia.



The front has been forced south as the next high moves in quickly. It will probably only affect southern Victoria as a wind change to the south west. Excellent gliding conditions, but a strong possibility of thunderstorms in central NSW to finish the day early. The trough over WA should give good gliding conditions there.

Companion Flying

This is the quickest way for new pilots to improve their skills. However it does require some skills before it can be attempted. Preferably, the basics can be learnt by doing some lead and follow flights with a coach. If this is not possible, it is reasonable that pilots with adequate experience can conduct such flights.

Find a flying partner, or gather a small group of pilots who will agree to fly with you whenever it is possible. This will improve your flying progress at more than double the rate that you can by flying alone. Find a coach to assist you if there is one available in your club. Unfortunately there are not many of these, but the coaching numbers are slowly expanding. You may even consider using a coach from a neighbouring club.

Coaching has not been a part of gliding until recently. However, almost every other sport thinks that the coach is indispensable! It is simply that gliding has had to mature as a sport to be aware that there are better ways of doing things.

If possible go to a coaching or team's challenge week to get a good start with companion flying. If your companion(s) can attend as well it would be a good start to what can be a rapid progress period.

Unless you are with a coach, fly only with one other glider. This will keep the extra workload of communication and keeping together (without meeting) to a reasonable level.

For any pilot to take part in companion flying they, and their CFI, must all be satisfied that they will not run into each other! Both must have sufficient flying skill to handle the glider type, keep a good lookout, and have a sense of positional awareness. That is the ability to judge moving relationships and where gliders will move to when circling or making other manoeuvres. (See; Joining other gliders.)

Pilots need to be reminded of the correct technique of joining a gaggle and the double blind situations that they must avoid. (also Joining other gliders) Companion flying is best flown as an "**open cooperative gaggle**". It is well suited to two gliders and does allow some individuality. When cruising gliders are positioned 10 to 15 wingspans (about 450 to 700 feet) abreast so that they can each search different air. It will not matter if one is 300 feet or more ahead, as the other can call it back if a thermal is found.

This way two gliders can effectively search more air than two separate gliders. If one finds a thermal they both work it. If a glider falls behind, and finds a thermal the other must be called back. This may slow them a little, but the speed will still be much faster than individual gliders can achieve. Further, there is much more to be learnt by keeping together than flying separately.

However, a coach may use "close coupled" lead and follow for a few flights.

It is imperative that when thermalling that both pilots maintain a tight discipline and keep in the same circle. Cutting in or across cannot be tolerated. If a pilot insists on doing this, then that pilot or the task should be abandoned.

Initially, it is dependant on good radio communication. The gliders involved need easy to use reliable radios. It is best if a pair can use their own frequency, but this may not always be possible. If a normal gliding frequency is used then radio use should be kept minimal. Some variations on standard procedures can be made to help this.

After the initial few calls, call signs are left out. The people involved get to recognise the voices. No acknowledgments are needed Microphone clicks will do. A number of standard words or phrases are used such as, "turning" when starting a thermal and "pressing on" or “going” when leaving a thermal. These may be personal and need to be a part of the pre flight agreement.

With only a little practice pilots will recognise a large degree of predicability in their companion pilot and this will allow reduction in the radio work and better integration of the two flight patterns.

Positions should be given as height, distance and direction from an obvious (or pre decided) reference point. This suits GPS as well as visual use.

The following is a check list of items that must be covered and understood before any flying is attempted.

Radio procedure, pre task marshalling area, on task regrouping, how close to fly, where to position in cruising flight, how to join a thermal, which way to turn, likely reference points, final glide, landing circuit, break off height.
The first tasks attempted should be simple and short. Something like a 20 km out and return or a 50 km triangle. Longer tasks should be left until skills have been established.

Once some skill has been developed, this flying lends itself favourably to the POST, POT or TOP type task. Now generally being called a pilot selected task (PST). The flexibility of these tasks is very suitable for training as they allow the exploration of interesting weather and terrain. This freedom to make use of opportunity can give a wider spectrum of experience than is possible with an assigned task (AT).

Once you have made a couple of flights, and feel that you have the basics in hand, then try loading both gliders to the same wing loading. Even dissimilar gliders will glide similarly at the same wing loading. However, their handling qualities may become very different. A glider that was easy to fly and quite well behaved when empty can become a dog when full. This will have a major effect on that gliders ability to climb.

You may have to experiment with various weights, but with a little work should be able to find a weight that you can handle reasonably well. With practice you will find that you can increase this.

It is essential that both gliders be close to the same height and position to start. Otherwise companion flying will either not be possible or just a matter of chance. Initial assembly is the most difficult part of the exercise. The first glider airbourne should establish in a thermal within range of the launch and as the other glider is launched, call it across. If thermals are not available close then it may be a drawn out business using a number of thermals to get together.

This is a learning exercise for both pilots, so one should not be tempted to explore separately. It will be better for both to explore off track or even change the planned task, rather than separate. Also it is not a race. There is more to be gained by staying together, even if one has to delay sometimes. Nevertheless, pilots should try to achieve the best possible rates of climb in thermals and to find the most favourable path through the air.

If one glider gets 1000 feet or more below the other, the best way to get together again is for the high glider to airbrake down when the lower glider has established in a thermal. If this becomes necessary, the high glider must let the other know what he is doing. Try to sound cheerful about it!

It is best to advise before height differences become more than 300 feet. Otherwise, if a leading glider does not turn for some time the follower may get far too low and force a rejoining exercise.

In this exercise, a safety height (the height at which companion flying is broken off to concentrate on staying up) is best set around 2000 feet or even higher. At this height both should concentrate on finding a thermal. It is better to be a little conservative at this stage to regain height so that the exercise can be continued at its original purpose.

At around 1500 feet, or possibly higher, the exercise must be discontinued and the pilots allowed to make their own decisions about outlanding.

This break off height must be established before any flying.

If pilots find that they are going from one potential outlanding to the next, then it is far more useful to call the exercise off and return home. The intention is to improve cross country techniques, not outlanding practice.

Practice for Cross Country when Local Soaring

Quite often we find that a day has quite good soaring possibilities, but is unsuitable for cross country. Some of the reasons can be: Wind too strong. Too short a soaring period. Restrictions on the sailplane for club or other reasons. Site not suitable.

Rather than just milling about for an hour or so, some of the following items could be practiced so that when cross country is possible you are better prepared. Remember, you cannot develop skills without practice.

1. Work at centring all thermals rapidly. Use a small number of systems and develop them to a high standard. Always use 35° of bank or more. Practice using the turn direction you least prefer. After working the thermal leave it and see if you can find it again lower down. Near the airfield is a very good place to practice picking up a thermal from low down. Take care when doing this not to interfere with normal circuit traffic.

2. On days which have an inversion, leave the thermal as soon as it weakens off or becomes broken. Do not try to go to the maximum height possible. This will probably be within 500 feet of the inversion.

3. Select clouds and fly to them. Note your successes and failures and try to develop recognition of the best working clouds.

4. If cloud streets develop, practice using them. Try this at different MacCready settings. Note the results.

5. On blue days lift will usually form streets the same as it does when there are clouds. Usually they will be along the wind line, but on light wind days or when there is overlying wave they may be cross wind. Look for them and use them if they are there.

6. Practice flying a line and make a suitable allowance for drift. Learn to estimate the wind strength and direction. Use this in conjunction with the previous factor to go as far as possible without thermalling.

7. Practice final glides. Remember to arrive at circuit height. You don't want the CFI to put an end to all your practice. Alternatively, make an arrangement with the instructor of the day for you to practice a competition finish in an acceptable manner.

8. If other sailplanes are thermalling, practice joining them. Try not to frighten them or yourself.

9. Practice using the MacCready ring and estimating the strength of the next thermal. Try setting it too high over a run of three or four thermals and see the result.

10. Select a line and fly along it from one likely thermal source to another. Minor diversions may be necessary. This is a good one to try when the thermals are not going very high. Note your successes. This is also good to try with other sailplanes. See who can do it with the least height loss.

11. Look for waves. Check out every possible source. Note the appearance of the clouds where you have found waves. They will also occur on blue days. Visualise the method you used successfully on clouds and apply them in the blue.

12. Practice turn point photography or GPS use on local features. Both are easy, but do need a certain skill that will come with practice. Remember to get the results checked.

These are some skills to try rather than just a take off and landing. They need not make the flight any less enjoyable, and may make it memorable.

And when you do come into land make it a spot approach and landing, just as if you were landing into a difficult field.