Gliding

Coach's

Manual

July 2006

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Foreword

In a sports system the athlete is the most important person.

Of the least important people the coach is the most important.

1 The coach's role in the club

The coach has a number of roles in the club. The main ones of these are:

1 To provide guidance for all pilots who qualify for cross country.

2 To work with the CFI or instructor's panel to set up a programme of ground training for all pilots.

3 To do the flying coaching, either as lead and follow, two seater flying or a mixture of both.

4 To identify promising new talent and direct them to the best possible way of developing that talent

The coach will need to liaise with the instructors as they will have the best knowledge of the new pilots. It would be best if in each club the coach and instructors can develop a team approach. The instructors take a pilot to the cross country stage and the coaches help the pilots develop skills from there on.

While it is easy to define a hand over point on paper, in practice, this will probably be a variable area dependant on the club and all the personalities involved. That will be for each group to work out.

Off the airfield the coach should be arranging an information programme for new pilots. This can take many forms. From discussions over the club bar, to a major seminar with many top people to talk or demonstrate in their specialist field.

It is a function of the coach to ensure that these things will be available on a regular basis. The coach need not do these things personally. Just organise that they are available. For major events it may be better to combine with a number of nearby clubs or to handle it at Association level.

There are many areas of sport science that can be useful to gliding. Sport psychology and nutrition are two obvious ones. Some general fitness instruction can be useful, and some information on how to handle stress may be beneficial even at the pre solo stage. The field is far broader than specialised gliding topics. Some doctors who are also glider pilots may be able to contribute in these areas.

The coach will need to establish contact with sports psychologists and physiologists.

The coach must be like a career adviser and be able to chart a gliding career for each new pilot. Of course, there will be as many varieties as there are people.

The coach must be able to supervise pilots' attempts on the FAI certificates. To that end the coach must have a sound knowledge of the certificate requirements. If the coach is not an FAI observer then he should at least have the current rule books available and discuss the requirements with the observers in the club.

On the flying programme one of the points of separating the coach from instructing is to have a person who is not saddled with the wider responsibilities of the instructor and be able to concentrate on flying with one or two people for a day.

2 Being a good coach

Probably the best two attributes of a good coach are the ability to give a superior performance and to get across how it is done to the aspirants. These two help to create a third one which is respect.

Unfortunately it is all too easy to lose that respect. Respect and credibility must be maintained for the coach to have any value to the trainees.

The following attributes all assist in maintaining that respect and credibility.

Example

Example is not only the best way to teach. It is the only way.
These words have been attributed to Derek Piggott and Albert Einstein, but I suspect that the first one to say that was well before Confucius. It is still true.

Self Discipline

Remembering the previous item the good coach must not be tempted into showy displays, especially those which are done on the spur of the moment.

Integrity

If the coach is to be believed then integrity is indispensable.

Empathy

It helps to remember that learning complex skills and concepts is not easy. The frustrations of learning and lifting performance are many and need sympathetic, patient assistance.

Knowledge

Knowledge of the game is important but the coach cannot know all things. If a question cannot be answered then say so. Then either find the answer or lead your students to the finding of it.

Ability

The coach may not be a world champion, but must always display a competent performance that can give the impression that, but for the chances of fate then there may have been a champion.

Consider how many of these attributes you have or can cultivate

ARE YOU?	ALWAYS	SOMETIMES	NEVER
Confidence building			
Constructive			
Curious			
Encouraging			
Enthusiastic			
Good Communicator			
Honest			
Knowledgeable			
Likeable			
Motivator			
Organiser			
Patient			
Polite			
Positive			
Potential Developer			
Respectful			
Sense of Humour			
Sensitive to Needs			
Showing Interest			
Understanding			

There is no "score" on this table. The use of the various attributes should be obvious. By making an honest assessment of your attributes, you will get an indication where you can improve.

If you have "always" for all of them then you will be close to the Confucian concept of the attributes of humanity that we should all aspire to!

These are:

Benevolence, Justice, Courtesy, Wisdom, Sincerity.

3 Improving pilot skills

As pilots already have the skills to stay up and do outlandings if necessary, it may be thought that the coach will have very little teaching to do. That should be so, but you will find that you will need to do some teaching and occasionally, may have to take people back to the beginning and start again on some basic skills.

It is as well to have a knowledge of how people learn to help understand the process.

The tenets of teaching a new skill are:

Demonstrate, Instruct, Student Practice, Error Correction.

Demonstrate many times. Once is never enough. Similarly, instructing once is not sufficient. Possibly using different wording on repeat performances. People frequently fail to understand something put one way but may understand it with different wording.

With student practice never allow the student to repeat an error more than twice. If you do it will be learnt with the error. Then the process of replacing that incorrect skill with the correct one is long and tedious.

Most skills can be thought of as information processing skills. The human receives information through the senses. This information is processed and results in some response behaviour.

One of the basic questions about how we process information is whether a person is a single or multiple channel processor? That is, do the stimuli from various senses get processed simultaneously or does each signal get cleared through the channel one at a time?

We may be led to think that a human is a multiple channel system. We can drive a car, eat a sandwich, and carry on a conversation at the same time. Notwithstanding, evidence is accumulating that, at least for fairly complicated tasks, ***the human is a single channel being and this channel has a fairly limited capacity.***

The ability to perform several actions at once can be explained by two concepts:
(1) rapid time sharing, where a person alternates between information sources; and/or
(2) the automation of sub-routines of responses through practice.

These concepts fit very well with how you cope with being in a crowded gaggle.

According to one view of human information processing, the nervous system is hierarchal in organisation (Fitts and Posner, 1971). There are higher "executive" levels and lower "carry out instructions" centres. Each level has certain responsibilities or functions.

Yet some autonomy is retained in the lower levels. For example, reflexes can occur without involving the higher centres. Early in learning, the higher centres are involved. As response patterns are learned, they may be initiated by the higher centre but carried on automatically by the lower centres, with only occasional monitoring and supervision by the higher centres. (What I have called "unconscious competency" elsewhere).

The prime factors influencing learning are:

Primacy, Vividness, Frequency, Recency.

Primacy is the first presentation of something new. Occasionally, a very good first presentation results in the item getting straight into the long term memory. The unforgettable experience!

With **Vividness**, we have a problem with flying in that all experiences in the air are vivid. Our pilot may have difficulty in sorting out what is relevant. Sometimes a pilot misses the point of an exercise as his attention was taken by some other vivid impression.

Frequency of an exercise (just plain repetition - keep doing it until you get it right!) may overcome problems with the previous two factors. However, practising it incorrectly creates a long lasting problem needing great patience to remove. Care is needed monitoring that the practice is being done correctly.

Recency brings us back to consideration of how the brain works. To understand how things are learnt we need to know about **Short Term Memory** and **Long Term Memory**.

The short term memory is seemingly like a blackboard that is frequently written upon and erased. (or white board, if you want to be more fashionable). Possibly that characteristic is a protection against cluttering up our brain with a myriad of information that has only a limited relevance.

If you have ever looked up a telephone number, been distracted and then realised that you have to look up the number again because you have forgotten it, you have experienced the limitations of short term memory (**STM**).

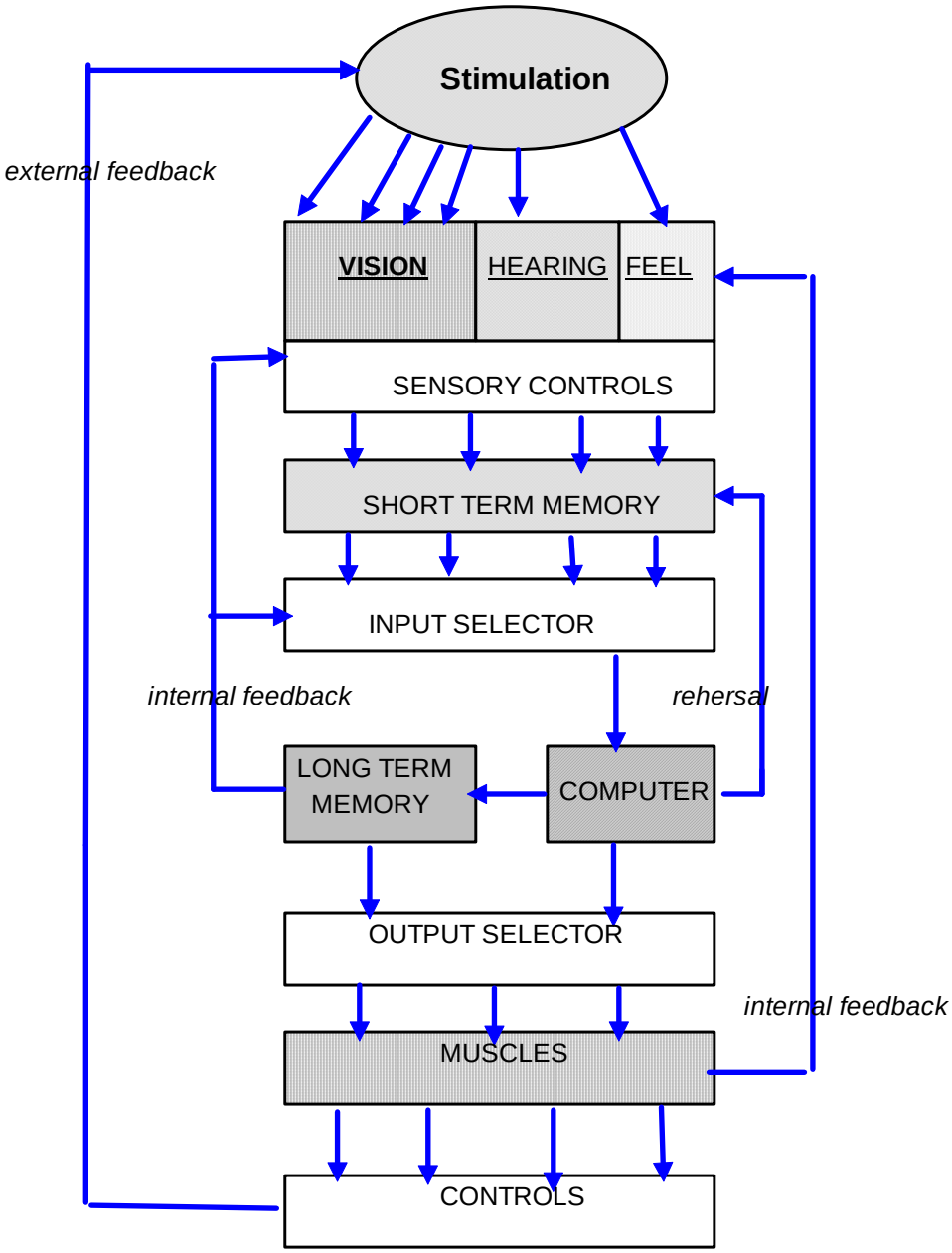
While STM is limited to a capacity of 8 to 10 items, it is not greatly influenced by the type of information. Information is rapidly forgotten if not given sustained attention.

Continuous attention and rehearsal (Recency and Frequency) seem to be necessary for new information to be placed in the long term memory. This rehearsal occupies the central processor and limits the processing of other information.

If information coming in exceeds the capacity of the system, then some of it is lost, even if no interruption occurs. We apparently just discard some of the overload. An important thing to remember when teaching complex skills.

Information lost from the short term memory is totally lost and there is no possibility of recall. This accounts for why people often deny having been told something when we can be quite certain they have been informed because we have told it to them ourselves! Coaches need to keep this in mind when tempted to criticise a student's previous coaches or instructors for an apparent failure to put some important information across.

James Reason, a Doctor of Psychology at Manchester University has produced a conceptual schematic of an information processing system. The following is an adaptation of his model. The "Feel" in the diagram is that which is felt by the whole body and is termed proprioception. Vision is by far the most significant, capable of overriding conflicting signals from other senses, and I have tried to indicate that in the diagram.



The manner in which the input selector (the focuser of attention) operates is probably the single most important difference between the skilled and unskilled operator (Reason, 1974). As a result of experience and training, the skilled operator learns that much of the incoming information is neither new nor important and can be ignored.

Experience (long term memory material) allows the person to be highly selective in information gathering. This is a major difference between the novice and the expert and is something that you, as coach, will be trying to get across. Select and use what is important now!

Once useless or redundant information can be filtered out, the skilled operator may anticipate future actions which can further reduce load. This then opens up capacity for new material.

In contrast to a modern computer, man's "computer" is very slow. For simple tasks, the maximum processing rate is approximately 2 to 3 decisions per second. Even in continuous tracking tasks, ***the human computer performs intermittently, not continuously***. The output may appear to be smooth, but the process is intermittent. If the task becomes more complex, processing time increases.

Tests measuring reaction time to the onset of a light when the person is expecting it, for example, may take 0.3 seconds. This is a well established average human reaction time. Increasing the number of alternative lights that may go on increases reaction time

Uncertainty can also increase the time required to make a decision. There will be times when you say (or want to say) to your student, "Do something! ~ anything!"

If a particular situation is anticipated and highly practiced, speed of action can be increased. Typists, piano players and other skilled workers can make many discrete responses extremely quickly. Anticipation, pre programming and automating make this possible.

If there is a basic plan to initiate an action on an initial stimulus, then much of the information processing capability is free for individual and detailed variations to be applied.

With repeated attention and practice an action or set of actions which originally required central processing becomes more automatic. Something like an automatic response has been placed in long term storage.

This is analogous to computer executive programmes and sub routines. The executive programme defines the goal to be achieved and determines the general plan of individual actions. Sub routines consist of relatively unchanging sequences of movements that are called into play at appropriate stages. At the learning stage each subroutine was probably an executive programme.

This can be paralleled with learning to work thermals. The skills of turning and shifting from one turn to another must become sub routines. Then there will be executive capacity to analyse and make decisions about where to make the turns.

Although slow and often difficult to acquire, some skills can be lost quickly if not practised. A study found that instrument flying skills were reduced approximately 20% after 4 months without practice. Similar skills are used for thermal centring.

Procedures were the most affected. Basic skills of holding a heading, altitude and speed suffered a smaller loss. The time required to regain the skills was directly related to the amount of original training.

Thus it seems that total experience may have some bearing on the effect of a break in flying. The pilot with a lot of experience will rapidly regain skills, while one of low experience may even act as if they were learning a new skill.

Skilled tasks are learned by isolating one phase, concentrating on learning it, and letting other parts be poorly performed. When sufficient of the first phase is learnt to create spare capacity, learning of other phases may start.

An example of this is illustrated in a study by Reason (1974). In learning to drive a car, speed control and direction control are separate sub tasks. Novice drivers worked very hard at steering but didn't vary speed. As they progressed, steering variation was reduced, but speed control varied from very slow to very fast. Only in the final stages of learning did the two subtasks become integrated. This can easily be related to learning gliding tasks.

Stress is defined as the demand the environment places on the individual. Included within stress are workload, anxiety, boredom, heat, noise, humidity and other similar factors and conditions.

Two types of overload are recognised.
(1) Speed stress, when the rate of information coming in is excessive, and
(2) Load stress, when there are many different sources of information.

A glider pilot in a big gaggle is very likely to be under both forms of stress!!

Some typical reactions to overload are:

- Omission — Ignore some signals or responsibilities.
- Error — Process information incorrectly. Make mistakes.
- Queuing — Delay responses during peak periods; catch up during lulls.
- Filtering — Systematic omission of certain categories of information according to some priority scheme. (A likely response of an experienced person.)
- Approximation — Make a less precise response. (Another experienced response.)
- Escape — Give up. (Get the hell out of here!)

One significant characteristic when under excessive stress is that people tend to degrade performance gradually. Even when faced with excessively high requirements, they can keep on going somehow. Often the person does not recognise (or accept) that the degradation of performance has occurred. This is something that a coach must learn to recognise.

The effects of underload are not so dramatic and are often not apparent. However, they can still cause similar effects.

The significance of stress to coaching is that if overstressed, our students cannot learn. If under stressed, they probably will not learn either! As far as possible the coach must keep sufficient pressure on the trainee to ensure likely learning but not allow so much to occur as to slow it to a trickle or stop it altogether.

4 Providing feedback

Gliding is an athlete driven sport. Until recently the coach has had no part to play. Perhaps that is why gliding is a long way behind the development that has been occurring in most sports over the last 20 years.

Can we actually add anything by coaching? That is something of a challenge to see if we actually make any difference. I feel that what we can do is speed up the development of all pilots by a matter of many years. In ten years time the average age of our international team is likely to be 10 years less than it is now, and they will be doing better.

The coaching concept provides a network for the exchange and cross fertilisation of ideas. We should have no coaches who work in isolation. This exchange should not be confined within our own sport. There is a great deal of information, research and expertise that we can adapt, often with minimal change to gliding.

The coach is also a field scientist. By observing as they work, coaches are opening the way for areas of possible improvement that we have not yet thought of.

One of the most useful aids in coaching is in providing feedback to pilots.

A number of sources of information are available for providing feedback relating to past performances. These include performance indicators such as personal best distances and speeds, competition placing's and days won in competitions and regattas.

Another source of feedback is the subjective performance ratings or evaluations from a coach, or from peers. The coach is the most likely person to be discussing this with the pilot.

It does need care to do this well. The coach is not in the same authoritative position as an Instructor and needs to adopt a different tone and method. In many cases the pilot being assisted will have greater experience and attainments than the coach. What the pilot needs from the coach or other observer is an opinion from a different perspective. The coach needs to develop acute observation as well as a top knowledge of what is needed in each situation.

As far as possible personal bias must be isolated from the observations. The coach cannot afford the luxury of moods.

Some principles for giving feedback effectively

Begin the feedback session with positive comments

Remember, if you begin a communication exchange with negative statements about the pilot (eg. criticism), the person is likely to become defensive, "closing down" the communication exchange by distorting, devaluing, or simply "not hearing" (repressing) the information given.

Use specific information

It is important to refer to the particular element you wish to have the pilot modify. Statements such as "you flew badly" do not suggest solutions. If feedback is specific it will help the pilot to understand exactly what is required in order to perform better.

Focus on behaviour which can be changed

In order to bring about change, the astute coach will focus on providing feedback on a behaviour that the pilot can realistically achieve an improvement in or is "ready" for. The coach can provide alternatives.

Feedback for its own sake (in the absence of solutions) can be detrimental to the confidence of the pilot. If feedback is to be given, some suggestions relating to preferred behaviour ought to be given, and the pilot be allowed some scope to select an alternative behaviour (eg. tactic, style of play).

Use language that is descriptive rather than evaluative

Describing the behaviour to be changed rather than making a judgement on the athlete themselves avoids "labelling" the pilot in some way (eg. incompetent!).

Messages which convey impressions about the pilot themselves suggest that there is a problem with the pilot, and that the behaviour therefore cannot be changed.

Place the feedback in context

Convey to the pilot your awareness that the feedback is limited by the nature of its source. For example, if feedback is based on someone's judgement, it is likely to reflect their bias. And we all have a bias of some sort.

Promote a sense in which the feedback can be useful

Encourage the pilot to choose how to respond so they can select a way to modify their behaviour based on the feedback received.

You choose what the source of the feedback will be and, therefore, what the content will be. This choice reflects your values, biases, prejudices, motives, and personal goals.

Therefore, you should consider the extent to which these factors might have determined your choice, how they might differ from those of the pilot, and whether the feedback is in the best interests of the pilot rather than serving your own interests.

The other side of feedback, how your pilot should view and respond to it, is described in Flying faster and further Part 2 "Improvement Programme".

5 Course structure for coaching

The following structure and programme has been evolved from over twenty years of cross country courses, individual coaching and competitions with a strong training element. It is easily adapted to a 5 or 4 day programme, such as may be run in a five day week or over two weekends.

It is a generic programme to show the basics and some of the considerations. I have indicated the needs for a new group. For an experienced group the talk periods may all become group discussions rather than lectures. Change the topics to suit the needs of the particular group.

It is useful if the organisation can have the facility to develop photographs the same day or at least on the following day. If there is a local photo processing machine, it is usually possible to make arrangements (at a moderate cost) to have films done as soon as they are available. It is easy to develop your own. All that is needed is a developing tank, some little skill, somewhere to load it, and the required developer and fixer.

The programme assumes that the required gliders are rigged, clean and otherwise ready, so that a daily inspection and movement to the take-off point can be handled in the lunch break period. If this is not the case then people need to start earlier to handle this, or allocate some of the programme time for this activity.

Daily programme for course

Morning

8.30-9.10 Lecture - 40 minutes. Unless you have a wonderful speaker, do not go longer than this time. It may be divided into two shorter lectures.

Break 10 minutes. Time to handle some of the small items that get forgotten, particularly in the first few days.

9.20-10.00 Group discussion -.40 minutes. This can run away with time. There must always be someone to direct discussions and keep people on the topic.

Break 20 minutes. Most people will need some relaxation by this time and will also need to prepare for the next stage.

10.20-10.40 Weather forecast - 20 minutes. This may be as broad or detailed as you like. Probably the detail can increase as the course proceeds. There may be a need to explain some of the terms in the first few days. If the weather indicates a late start to thermals, it may be better to handle another topic in the lecture room and get ahead there, rather than sit on the grid for an hour. Everyone will be a little slow getting going on the first day, so some allowance needs to be made for that.

10.40-11.20 Set task, flight plan - 40 minutes. On the first day new pilots to the area will need additional briefing. Initially the flight plan need be no more than lines on a map or ensuring that everyone has a map and knows where they are to fly. As the course proceeds this can become more developed. The tasks must be set with this in mind. Turn point photographs may be left out on the first day or two if pilots have little experience in this area. However, gliders should be positioned correctly for every turn.

Break 50 minutes. Enough for lunch, daily inspection and move to the take-off point if people do not have to leave the airfield. It is not enough to do more, such as rigging or washing. It may be possible have a crew to do this during the morning lesson time.

Afternoon

12.10-17.00 Flying. Commence launching by 12.10 if the weather is suitable. Allow sufficient time for launching all gliders and for them to climb to a suitable height and starting position. This will affect the task size. If there are delays it may be better to shorten the task, rather than to risk having everyone land out trying to complete a long task. Keep this in mind when setting a task.

Complete task, secure gliders, stow equipment.

Break. If there is plenty of time; clean up, shower and attend to personal needs.

18.00-18.40 **Flight analysis**. The club bar is a good place for this discussion. Everyone needs to wind down after the flight. It does not matter if this discussion goes overtime. If the bar is noisy with others they may be persuaded to listen in.

The flight analysis should cover:

- comparison of the forecast and actual weather; winds, thermal heights and strengths, wind shears and the heights that they were found, temperatures, clouds, cloud or lift streets, sink streets, wave, thermal and wave interaction, terrain effects.
- comparison of individual flights by barograph charts and observed features.
- observations by the coaches or leaders.
- checking of turn point photographs.

Evening

At this level of activity it is better not to conduct any formal subjects in the evening. Suitable videos, or passive type information sessions are all that should be attempted.

The course director will need to review the lecture and discussion programme after the flight analysis session. This may reveal that topics need to be brought forward or even additional topics added. The standard or level of achievement of pilots may not be as planned and the course can be adjusted to suit.

If a day is not suitable for flying, then the afternoon can be used for two lectures and two group discussions with a break between each. If the group is of a high skill level, then sufficient topics may be covered to devote the whole day to a long task. It is not usually productive to set a long (more than 4 hours) task for relative beginners.

Lecture and discussion programmes

This programme would suit a group of pilots at stage one and two of cross country training.

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Lecture 1	Better thermalling	Turn point photos and/or GPS verification	Thermal structure	Using the McCready speed to fly system	Tactical considerations for task flying
Discussion 1	Joining other gliders	Scanning	Pilot needs	Maps and map reading	Thermal waves

If pilots are using **lead and follow** there will also be a need to **brief trainee pilots** on whatever system is being used. This will need at least 30 minutes and probably 60. If two seat training is being used, the briefing will need 10 to 20 minutes.

If the group of pilots is more advanced, some of the following topics may replace others in less demand. However it is strongly recommended that **joining other gliders** and **scanning** be kept in any programme for all but at the highest level of attainment.

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Lecture 1	Cross country checklist	The daily thermal cycle	Ballast use	Flight planning	Sport psychology
Discussion 1	GPS and/or barograph	Thermal patterns	Meteorology Australian general or local area	Make a flight plan	Making a training programme for an event.

As people book for the course I usually supply the programme, lecture notes and any local information. This gives the students a chance to prepare and perhaps provoke them to ask some questions.

If the group is competition pilots, while some of the previous items will be useful as revision, the following topics should be included.

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Lecture 1	Joining other gliders	The daily thermal cycle	Analyse your strengths and weaknesses	Sailplane preparation	Sport psychology
Discussion 1	Using the gaggles	Thermal patterns	Competition Tactics	Instrument preparation	Making your own competition training programme

6 Coaching in the two seater

Although some of our new coaches may be instructors, all will need to remember that the two disciplines are different.

The instructor commences with an unskilled person and by instruction transfers the necessary skills and responsibilities to the point where the person can fly solo. At all stages the instructor is in charge and may take over at any point.

The coach is working with a pilot who can make the flight solo. The coach is there by invitation rather than necessity.

The pilot has an adequate level of skill for safety. The coach is there to try to improve the skill level for efficiency.

The coach will not necessarily have more hours of experience. An instructor with thousands of hours may for various reasons have only the minimum of cross country. This is quite a likely person to want (and need!) some coaching.

Take care to build up an understanding before going flying so that it is clear always who is in command. This will vary greatly with the combined skills, needs and qualifications of the two pilots.

Agreement will need to be reached on who flies when. As circumstances can (and probably will) change in the air an agreement on how this will be handled is necessary.

I have made flights, where at the student's request I have done all the flying. I have made flights where the student has done all the flying. This is a good process for relatively short flights when both can be done in the same period, or one each weekend.

Lack of familiarity with the type can be a problem for the student. Even those pilots who are very current on their own single seater may find the handling of a two seater that they have not flown for many years or perhaps never before, quite difficult.

Usually, I plan to do about fifty percent of the flying. If the student is not familiar with the type, it may be convenient for him to do most of the flying pre start. This is especially so if the flight is in a competition. This scheme gets the student some practice when poor performance does not count, but does have some flaws. If time is short or the student is not getting the height needed to start at a reasonable time, it may be necessary for the coach to take over to get started.

I call a glide followed by a climb a sector. (This is the unit of the McCready analysis.) I try to hand over or take over at the beginning of a sector. That is, each pilot starts from the high position. This sequence will get broken if you get low but it can easily be recommenced.

I usually do the start to demonstrate the positioning for a start photograph. I then fly for one or two sectors to demonstrate my flying. After that the flying can be evenly divided.

Demonstrating is of prime importance. Do not pass over or skimp on it. Unless there is some overall plan to prevent it, demonstrate at least thirty percent of every flight.

Whenever it occurs, relate things to the discussion topics. The student will often fail to see what you think is an obvious example. Do not miss an opportunity to relate experience to theory.

Most people expect far too much of what can be achieved in one flight. To be more than a demonstration of what may be possible I recommend that any coaching be planned over two or more flights. These will work better if the pilot has the opportunity to do a number of solo flights between coaching sessions.

As the coach has a superiority of achievement, the student will tend to defer to the coach in areas of difficulty. This often needs some fine judgment to decide whether to take over or to let the student work out of the problem. If it is near the end of the flight and the day will last out any delay, the latter may be preferable.

A skill that the coach will need to develop is to avoid difficulties by planning ahead. By judiciously selecting some sectors this can be done unobtrusively. When this is sufficiently well done as to be invisible to the student it can give the impression that the whole business is far easier than it really is!

Cross country coaching is ***not about out landing***. The coach must work so that it does not occur and also that it is not likely to occur. A tricky business but a skill to be developed. Keeping in the "out landing is unlikely" area will greatly help the student to concentrate on the finer points. This may result in the flying style being conservative, but with practise the coach will find that it can be worked up to result in flying that is only very slightly below a competition standard.

If the coaching is being conducted in a competition environment, then the flying must be conducted as totally competitive.

Even so, the coach **MUST NOT** be involved in low thermalling or risky flying. Out landings are an inevitable part of cross country flying. They should be treated as we treat the chance of getting a common cold in the normal course of living. It is just part of the business.

I found that initially in two seat coaching, out landings happened about once in twenty flights, but with experience it is less frequent.

As an aid to avoid out landing I find it is better that the coach does not let his student go "too deep" as the Germans put it. Digging sailplanes out of holes is time consuming and can often drive far more beneficial things that occur on the same flight out of memory. It also can lose so much time that completing the course becomes impossible.

While 2000 feet AGL is not low, I usually do all flying from there. This is to use better search and initial pickup skills. Generally this avoids the falling into holes problem.

It also can allow the student to put time into examining the out landing possibilities and plan one should it become necessary. This "coach's height" can vary with the conditions and the student's ability. Some care is needed as even good pilots will drive too deep.

If the weather is such that you are going from one imminent out landing to the next, unless it is a competition flight, it is better to abandon the flight rather than persist. Coaching cannot be conducted under those conditions.

Diversion to clouds or for ground reasons should be discussed sufficiently in advance to become real decisions. If the coach waits to see what his student will do, a possible diversion often becomes impractical.

Similarly, do not wait until the student points other sailplanes out. If you see them say so. ***The flight is a cooperative effort, not a test.***

The main purpose of the flight is to expand the student's knowledge and experience.

If you think the student has some mechanical or coordination fault, discuss it and try to replicate it yourself. Some faults are very difficult to analyse.

Consider skills at two levels. At a mechanical, coordination level and a more complex decision making level.

Be sure that both you and your student take drinking water. If the flight is more than two and a half hours long, take some food too. If your student does not, be prepared for a lapse of his concentration or a loss of coordination around that time in the air. Unless he is a seasoned competition pilot this will certainly happen.

You may need to let this happen to make the point.

Always take a barograph. This is an extremely useful tool for post flight analysis. Our memories can be selectively defective. An accurate record of time spent during the flight is invaluable to get an honest analysis.

If a number of sailplanes are flying the same task, using the same type and scale of barograph is worthwhile, even though more sophisticated equipment may be available for some. Some excellent comparisons and contrasts can be seen immediately. Take both if you can.

Take turn point photographs and make analysis of these. A good turn point technique is worth at least a minute a turn point. The need to reposition to take a second photograph can cost three minutes! A poor technique can lose the whole flight!

A quality that the coach will find vitally necessary is **PATIENCE**. The coach can never have enough of it! When you are about to explode with frustration remember to say the word as many times as necessary to remain **CALM.**

If you have not considered meditation before you soon will after a few flights as coach.

Also necessary is the ability and willingness to replan frequently. Many times you will find that the original aims become impossible and workable alternatives need to be found.

7 Single seat lead and follow

This is an excellent way to coach. An advantage is that the student can be very familiar with the glider and instrument system rather than having to fly an unfamiliar type of two seater. Flying faults are harder to spot, but some can be seen. Those that can't just show up as lack of performance. If performance doesn't improve after two flights, a flight in a two seater may be worthwhile.

It is very dependant on good radio communication. All the gliders involved need easy to use reliable radios. Each pair or team must have their own frequency. However, it is useful to know the frequencies of all the teams flying, so that, if two teams come together they can cooperate. Alternatively, a common frequency could be available for the same purpose.

It is necessary to have a radio roll call before every lead and follow flight

It is helpful to adopt a number of radio conventions particularly for this type of training. These are: No call signs are used; the people involved get to recognise the voices. No acknowledgments are given. A number of standard phrases are used such as, "turning" when starting a thermal and "pressing on" when leaving a thermal. These may be personal to each coach and need to be a part of the pre flight briefing.

Only the coach navigates. (Trust me!) For position reports a standard reference point set by the coach is used. All positional references must use this position with distance and direction relative to it. Adding height makes it easier to spot a glider. This reference position is changed as the flight proceeds. This is suitable for visual or GPS navigation.

It also lends itself favourably to the POST, POT or TOP type task. 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 training than is possible with a fixed course task.

Lead and follow can be made competitive between a number of teams with a Team Challenge type of event. In this competition format, as it is only the slowest of each team that is scored. The emphasis is on the coaching rather than competing.

Before any flying it is important to establish what are the students' aims for the flight. These may be quite different for each student in the same group. If the student is uncertain, the skills most in demand are: Locating, climbing and leaving thermals, finding lift lines and avoiding sink lines. Only one or two aims can be achieved in each flight.

For any pilot to take part in lead and follow the coach must be satisfied that the students will not run into him! The coach must establish that the student has sufficient flying skill and can handle the glider type, keeps a good lookout, and has a sense of positional awareness. This is the ability to judge moving relationships and where gliders will move to when circling or making other manoeuvres. (See Flying faster and further pt 1, 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.

It is not really practical to do a lead and follow from a two seater with a training student unless the coach does all the flying. There is a need for the coach's performance to be of the highest standard to be of real use to the follower. This will not happen if the student flies.

There are two distinctly different techniques of lead and follow.

The **close coupled** is to have the followers keep ***close enough to fly through the same air as the leader***. This needs them to be line astern one to two hundred metres maximum and not more than two wingspans off to the side. This is suited to one on one training and to pilots who are not very experienced.

It is difficult with two but still possible. A leader with two followers can easily get caught with the "yoyo" effect of his followers each getting low in turn. With this situation so much time is spent getting them up again that the cross country aspect of the flight is lost. If skill levels are low then one on one only must be used. It may be better for a pilot to spend some time in the two seater than persisting with difficult lead and follow situations.

The second technique is for the followers to be one to two hundred metres off to the side and only a small way behind the leader. This has ***each glider in different air*** and increases the chance of finding a thermal.

This means that any pilot may find a thermal first and leader and follower can easily change positions. The pilot behind may have to call the leader back.

This is an "**open cooperative gaggle**" and is suited to more experienced followers. It works well with two followers. It does allow some individuality which is impossible with close following.

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

If the close following team gets low, it will pay to change to the open gaggle in order to find a thermal and get up and running again.

The leader needs to know about his student's glider. Type of vario, radio, ballast amounts and systems. These may impose some limitations that need to be allowed for in flight.

If the gliders are of the same class they should be loaded to the same wing loading. This will bring the performances as near as possible to equal.

If they are very different it is better that the leader has the higher performance type, and use airbrakes now and then to cut out the difference. Perhaps fly with the wheel down. This may impose some limitations on how a group is split up into teams.

The team leader must very thoroughly brief the followers before each flight. This is an extensive briefing and may take two hours on the first occasion. Time must be allowed for it in planning.

The following points need to be quite clear. Both leader and follower should have a check list of these items and ensure they are covered.

Radio procedure, pre task marshalling area, on task regrouping, what style of following, how close to follow, 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.

Initial assembly should be done by the leader taking off first and establishing in a thermal. As each glider comes up the leader calls it across. This can get a group together in the minimum of time and able to set off on task.

If the leader makes a change in direction, the followers should be advised about the reasons for this change. A new thermal indicator has been seen, the previous line seemed to be a sink line, or whatever.

Generally a team leader will always be out in front. After a few days it may be useful for a follower to take the lead for a leg or two. This gives the leader opportunity to watch the follower's style of flying.

It may be useful to have a set direction of turn for the day. This will need to be done for all the teams for the day. If this is done, unless there is a problem, another day should be flown in the opposite direction.

If a follower gets 1000 feet or more below the leader, often the only way to bring him up is for the leader to airbrake down and find a thermal at the follower's level. If this becomes necessary the leader must let the follower know what he is doing. Try to sound cheerful about it!

It will be necessary for the follower(s) to tell the leader if they are falling significantly below; about 300 feet. Otherwise, if the leader does not turn for a thermal for some time the followers will get far too low and force a recovery exercise.

As this is an exercise in cross country, a safety height (the height at which following is broken off to concentrate on staying up) is best set around 2000 feet or even higher. At this height the leader should concentrate on finding and marking a thermal within range of his student. 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 1200 feet, or possibly higher for an inexperienced group, the exercise must be discontinued and the pilots allowed to make their own decisions on out landing.

This break off height must be established at the first briefing.

If the team leader finds that the group is going from one potential out landing 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 out landing practice.
Final glides should be made conservatively. Arrive back at the airfield at 1000 feet. This allows fitting into any traffic and adequate time to plan circuits. If the lead and follow group are the only gliders flying then the finish may be taken lower. Coaches should consult the training instructors about this.

Frequent problems

A follower will watch the leader to the exclusion of all others. This can sometimes become dangerous to others.

Circling with too little bank is probably the most common. A pilot may take some time to be persuaded to get to the correct angle. The leader can check this when all are at the same level in a thermal. If, when on the tail of a glider, the leader has to continually open out to

avoid cutting inside or getting into a double blind position, then the other glider is not banking steeply enough.

A secondary effect of the pilot, who uses just not quite enough bank, is that the team leader is continually having to adjust to avoid this pilot. Most often this takes the leader out of the best lift and creates the need to recentre. Quite the reverse of what the leader wants to do!!

Pilots quite often refuse to believe that the bank angle they use is different to that of the leader. "Our circles were not based on the same centre" as a reason for not matching. Get these pilots to time their circle (When there is no chance of running into someone else) and compare that with the leader. The tables relating bank angle, time, and circle size in "Better Thermalling" is useful for this.

Poor speed control. This is particularly noticeable once a pilot who has not been banking enough gets to banking steeply. The consequent need for better speed control can sometimes get out of hand. Keep a good lookout on these pilots.

Overtaking; with the leader ahead and below, the follower will often push forward and soon find himself overtaking the leader. Get the follower to fly slower.

Pilots who turn or pull up immediately they see the leader do that. Even with close following it is surprising how much further the followers must go before getting to the air that caused the leaders action. A warning on this is needed in the briefing.

Instead of leaving the thermal immediately the leader does, a follower takes a turn or two more. This always gets the follower too far behind and in different air. Regrouping becomes necessary. If this is done more than a few times progress becomes slow and the purpose of the flight is lost.

Fatigue, "a thermal too far." This is noticeable after two and a half to three hours in the air. Check through the notes on pilot preparation for the remedy to this problem.

The "eternally unlucky" pilot is really one who cannot work a thermal at all. This can need anything from an instrument installation rebuild in his glider to complete retraining for the pilot. These pilots need sorting out in the two seater before trying to use lead and follow.

If the follower is not climbing as quickly as the leader it is tempting for the leader to ease off a little and accept a slower climb rate. This is a mistake. It will give the follower the impression that he is matching the leader's rate of climb. The leader must always work to achieve the best possible rate of climb.

If the difference is only 200 to 400 feet at the top, then air braking down that amount on leaving is the easiest way keeping at the follower's level. If the difference is greater then the leader may have to leave the thermal, airbrake down and rejoin at the follower's level. Then try again to work both gliders into the best climb rate. This can be frustrating but after a few flights it usually results in an improved climb performance by the follower.

8 Common problems

The most common problem is **LOOKOUT**. No one ever seems to be doing enough of it. This is interconnected with a number of other errors.

The best way to improve this is to start pilots on learning to use efficient methods of **SCANNING**. If they develop this well, then lookout will also develop to a reasonable standard.

This is fairly easy to check from the two seater but usually only becomes obvious in lead and follow training through some dangerous situations. Never fully trust your followers until you have established that their lookout is well proven!

Despite the fact that basic training concentrates on attitude control, most pilots use the ASI far too much and the nose/horizon reference far too little. This shows up as poor speed control. It also interrelates to a reluctance to bank steeply enough to keep all the circle in the thermal.

To stay continuously in the core of most thermals requires a bank angle between 35° and 45°. At these angles of bank the pilot needs to use a small amount of elevator continuously (or adjust the trim) to maintain a steady speed. This increases the need to scan at a faster rate or more frequently to maintain a steady speed.

Many pilots try to thermal at lesser angles of bank because they know they cannot maintain a steady speed which ultimately puts them out of the thermal. The **speed control problem** comes from them **not using the nose/horizon reference**. They use the ASI instead, which results in all corrections being too much, too late. The chasing the speed situation. This is painfully obvious in the two seater and can even be seen quite easily from another glider in the same circle.

If they adopt the scanning sequence of checking the nose/horizon reference (**NHR**) every time they check the ASI they will eventually learn the nose positions for the usual range of speeds and the ASI use will reduce to a minimum.

Not only will this solve the bank angle problem but it will go some way to improving the lookout skills.

To improve lookout get your pilot to first look out to the wingtip. Then scan up and down around to the other wingtip. Sighting the wingtip will change the focus of the eyes from near to far and allow gliders and other things to be seen at some distance.

Simply looking up ahead when the only item of focus is the yaw string is likely to keep the eye focus on near. Even though the pilot looks the objects to be seen are not registered. Usually if a glider is large enough to register with the eye focus on near it is much too close for comfort.

A common problem with using the McCready system is that the pilot does not slow quickly enough on approaching a thermal. All too often the beginner arrives at the thermal still at 80 to 90 knots and then frightens everyone in the gaggle with a zoom up through the middle of them!

Using McCready it is necessary to pull up more quickly than to push down. This takes a little while to learn.

Even some very experienced pilots do not slow sufficiently. This is not obvious in their flying, but a common feature is that they often make excellent average speeds until they then miss two or three thermals in succession and then get low. If this is a pilot's problem, then look at the thermal entering technique.

Ingo Renner maintains that because of the nature of thermals the McCready system will indicate the opposite to what is really necessary in the immediate vicinity of thermals. He advocates that once the initial signs of the thermal are indicated or felt, the glider should be slowed to a speed that is 5 to 10 knots faster than the optimum circling speed for the current wing loading. For most gliders this is around 65 knots and that speed maintained until the decision is made to circle or to continue on.

An extremely subtle error to spot is that, when turning, the pilot uses bank angle to control the yaw string instead of the rudder. The small variations of the bank angle are enough to shift the glider out of the thermal very quickly for no obvious reason! While basic training is to use the rudder only to control the yaw, all pilots soon realise that the bank angle can also be used to achieve the same thing. What the pilots who continue to use this do not realise is that every time the bank is varied, so the centre of their circle shifts too. Some pilots may even be quite unaware that they are doing this.

Another sometimes subtle problem is that the pilot always manages to focus on something that is inappropriate at the time. Like being concerned about a final glide with 200 kms to go or positioning for a turn point when it is imperative that a thermal be found and some height gained. These pilots may respond well to a good organisational list or even some game play on making a good flight.

One item which can help all pilots is a good cockpit organisation. Creating a place to conveniently store water, maps and other gear can change a chaotic flight to a well organised pleasant one.

9 Individual coaching

At present, most coaching has been done as a part of team challenges, cross country courses or some other group activity. There has been some individual coaching done on an informal basis on task flying.

As we get more coaches in the clubs, it is likely that this will move to coaching of small groups or individual coaching.

The material in the programme for courses can easily be adapted for this by spreading it out over a suitable period, say one day each two weeks. The background material will have self testing sections attached, so that it may be used for home study and require minimal input by the coach.

I would assume that most individual coaching would be of a **lead** and **follow** nature. It would still be useful for the coach and student to make an occasional flight in the two seater, particularly if they wanted to examine the detail of some feature of flying technique. A single demonstration can save a season of misunderstanding.

After a few flying sessions the coach should be able to make a detailed analysis of the weaker areas of his student's flying and a specific remedial programme can be made.
In similar gliders on local tasks, I would expect that a promising student who already has some cross country experience would be matching the coach's performance by the middle of the second season. If not, there should be some searching as to why.

Students starting from the initial cross country level will take many seasons to catch up.

Individual coaching also gives opportunity to extend coaching very effectively into the competitive area. Apart from practice flying, gliding pilots have not been involved in much personal preparation for competitions.

It is becoming more obvious that there are some improvements yet to be made in performance by appropriate physical and mental preparation as well as flying practice.

4 to 5 hours flying a day over a 10 or even 4 day period makes competitions endurance events.

Landing out when almost everyone else gets home is a hard blow to the ego. The will to keep competing can be seriously damaged. Most athletes go through physiological training to allow them to cope with this and be ready to compete at the top again.

If a pilot wishes to make a personal training programme, consult the section on this in FF&F, part 2. All the relevant steps and factors are set out in detail.

10 Goal setting

Goal setting is a very useful tool to employ for any improvement programme. It is better to have a series of minor goals that can be met rather than to have one major end goal. If the end goal is failed, but most of the minor goals are met it allows some sense of achievement to be maintained, and may prove a useful analysis tool.

Goals must be:
⇒ **S**pecific
⇒ **M**easurable
⇒ **A**ffirmative
⇒ **R**ealistic
⇒ **T**arget timed

Take care to make goals that do not external features that you can not have any control over. If these must be part of your goals, then some allowance for luck or fate must be made to accommodate them.

Informal coach and pilot interactive sessions

With a group 3 to 15 people, there can be a lot of value achieved by conducting an informal discussion, rather than providing a lecture. The coach will need to provide guidance and sometimes direction, but in general, pilots will attack any reasonable topic with relish. The results can be beneficial to all.

It is essential that a board be available to put a summary of the group's findings.

Suitable topics are:

- What are your worst and best cross country experiences?
- Where do you get information from in flight?
- List one or two difficulties that each pilot has overcome and get them to explain how.
- Discuss one or more of the emotional responses that interfere with in flight decisions.
- Dissect a possible scenario - a what if situation.

Appendix 1 Glider data

WING LOADING TABLE FOR TWO SEAT SAILPLANES									
TYPE	Wing Area	Empty. Wt	2 @ 90kgs	Max Wt	Min W/L	Max W/L	LDSp	L/D	H/cap
LW KOOKA	15.00	220	400	393	26.67	26.20		24	
K7	17.50	280	460	480	26.29	27.43	45	26	
ASK13	17.50	290	470	480	26.86	27.43	45	26	
BLANIK	19.15	292	472	500	24.65	26.11	50	27	
BOCIAN	20.00	342	522	540	26.10	27.00	40	26	
T53	18.02	360	540	580	29.97	32.19		29	
BERGFALKE 4	17.50	300	480	505	27.43	28.86	55	33?	1.05
BLANIK L23	19.15	310	490	510	25.59	26.63	50	27	
GROB 109	20.40	620	800	825	39.22	40.44		28	
PUCHAZ	18.16	370	550	570	30.29	31.39	50	30	
ASK21	17.95	360	540	600	30.08	33.43	50	34	0.95
TWIN ASTIR	17.80	340	520	650	29.21	36.52	58	37	0.86
SF 34	14.80	290	470	490	31.76	33.11	55	34	
IS28	18.24	330	510	590	27.96	32.35	55	32	
IS32	14.68	350	530	590	36.10	40.19		46?	0.85
TWIN 2	17.50	370	550	600	31.43	34.29	55	33	
JANUS (18.2M)	16.60	380	560	620	33.73	37.35	60	38	
JANUS CM (20M)	17.40	365	545	700	31.32	40.23	60	42	0.81
TWIN 111 Acro	17.50	370	550	600	31.43	34.29	55	38	
MDM Fox	12.33	320	500	520	40.55	42.17		36	
PUCHATEK	19.44	350	530	580	27.26	29.84		27	
DG 500	16.60	390	570	615	34.34	37.05	60	48	0.72
Stemme S10	18.72	570	750	850	40.06	45.41		50	
DUO DISCUS	16.40	401	581	701	35.43	42.74	60	45	
ASH 25	16.31	582	762	750	46.72	45.98	60	56	
NIMBUS 3D	16.85	486	666	750	39.53	44.51	60	57	
NIMBUS 3DT	16.85	531	711	802	42.20	47.60	60	57	
NIMBUS 3DM	16.85	577	757	802	44.93	47.60	60	57	

WING LOADING FOR STANDARD CLASS SAILPLANES									
TYPE	Wing Area	Empty Wt	90kg pilot	Max Wt	Min W/L	Max W/L	LDSp	L/D	H/cap
KA6	12.40	190	280	300	22.58	24.19	45	28	
S ARROW/ES60	12.87	222	312	347	24.24	26.96	48	31	1.00
Foka 4	12.20	245	335	386	27.46	31.64	50	34	
Foka 5 ??	12.16	256	346	386	28.45	31.74	50	36	0.98
PILATUS B4	14.04	230	320	350	22.79	24.93	45	34	1.00
PW5 Wld Class	10.16	190	280	300	27.56	29.53	50	32	0.98
ASTIR CS	12.40	266	356	450	28.71	36.29	55	36	0.88
SALTO	8.58	180	270	310	31.47	36.13		35	
SZD Junior	12.51	225	315	380	25.18	30.38	42	34	
LIBELLE 201B	9.80	195	285	350	29.08	35.71	50	38	0.88
CIRRUS STD	10.00	220	310	390	31.00	39.00	50	38	0.86
ASW15B	11.60	230	320	408	27.59	35.17	48	38	0.88
LS1F	9.75	246	336	390	34.46	40.00	50	38	0.86
HORNET	9.80	254	344	420	35.10	42.86	55	38	0.85
ASW19B	11.00	256	346	454	31.45	41.27	58	39	0.85
DG100/101	11.00	230	320	418	29.09	38.00	58	38	
HORNET C	9.80	220	310	450	31.63	45.92	55	39	
JANTAR STD1	10.66	255	345	466	32.36	43.71	60	38	
JANTAR STD2	10.66	255	345	520	32.36	48.78	60	39	0.82
JANTAR STD3	10.66	274	364	540	34.15	50.66	60	40	0.82
LS4A	10.50	270	360	525	34.29	50.00	55	40	0.79
DG300	10.80	255	345	525	31.94	48.61	60	40	
DISCUS	10.58	230	320	525	30.25	49.62	58	41	
LS7	9.74	235	325	525	33.37	53.90	60	42	
SZD 55	9.60	226	316	500	32.92	52.08	55?	43?	
ASW24E	10.00	312	402	525	40.20	52.50	55	42	
LS8	10.60	240	330	525	31.13	49.53	60	42	

WING LOADING TABLE FOR 15M, 18M and OPEN SAILPLANES									
TYPE	Wing Area	Empty Wt	90 kgs Pilot	Max Wt	Min W/L	Max W/L	LDSp	L/D	Hcap
PIK 20B	10.00	240	330	450	33.00	45.00	55	40	0.83
PIK 20E	10.00	290	380	470	38.00	47.00	55	41	
LIBELLE 301	9.50	180	270	300	28.42	31.58	58	39	0.86
MINI NIMBUS	9.86	240	330	450	33.47	45.64	60	41	0.78
MOSQUITO	9.86	250	340	450	34.48	45.64	60	41	
LS3	10.20	270	360	472	35.29	46.27	60	41	0.78
ASW20	10.50	263	353	454	33.62	43.24	58	42	0.74
SPEED ASTIR 2	11.47	265	355	515	30.95	44.90	60	39	
VENTUS	9.51	233	323	431	33.96	45.32	65	44	
LS3A	10.50	245	335	472	31.90	44.95	60	41	0.78
G304	9.88	235	325	450	32.89	45.55		41	
ASW 20B	10.50	285	375	525	35.71	50.00	60	43	0.74
DG200	10.00	230	320	450	32.00	45.00	60	40	
DG202 (15M)	10.00	248	338	450	33.80	45.00	60	42	
LS6B	10.50	240	330	525	31.43	50.00	60	44	
DG 600M/15	10.95	310	400	525	36.53	47.95	60	45	
VENTUS 2/15	9.67	250	340	525	35.16	54.29	60	44	
ASW27	9.00	225	315	500	35.00	55.56		48	
DG 800M/15	10.68	326	416	525	38.95	49.16	60	48?	
PHOEBUS C	14.06	240	330	375	23.47	26.67	50	42	
OPEN CIRRUS	12.60	260	350	460	27.78	36.51	60	42	
KESTREL 17	11.60	260	350	400	30.17	34.48	55	42	0.81
DG202 (17M)	10.57	251	341	480	32.26	45.41		45	
NIMBUS 2	14.40	360	450	580	31.25	40.28	60	48	
ASW 17(20.5)	14.84	420	510	570	34.37	38.41	56	48	
ASW 17 (19)	14.43	428	518	630	35.90	43.66	60	48	
JANTAR 2	14.25	355	445	645	31.23	45.26	48	45	
KESTREL 19	12.87	330	420	472	32.63	36.67	55	44	
LAK 12	14.68	362	452	652	30.79	44.41	55	46	
DG600/17			90				60	49	
VENTUS 2/18	11.00	258	348	501	31.64	45.55		49	
ASW26 E	11.70	325	415	585	35.47	50.00	55	50?	
NIMBUS 3	16.20	460	550	750	33.95	46.30		55	
ASW 22 (22M)	14.90	420	510	750	34.23	50.34		55	
ASW 22 (24M)	15.50	440	530	600	34.19	38.71		56	
ASW 22B (25M)	16.31	455	545	750	33.42	45.98		60	
ASW 22B (26.4M)	16.67	465	555	750	33.29	44.99		62	
NIMBUS 4	17.88	470	560	750	31.32	41.95		58	

Appendix 2 Glider circle sizes

These tables show the relationships between turn size, tangle of bank, glider speed, G loading and the time it takes the glider to make a complete 360 turn. Time a turn to establish the other factors.

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

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