24 - THERMALLING

Entering and centring techniques

Unlike most other exercises thermal soaring doesn't have a specific place in the syllabus. Nevertheless, the general principle of 'earliest taught, best remembered' applies. On two-seater training flights good soaring opportunities are sufficiently rare that they should be taken, even if it means dropping previously briefed exercises from the flight.

Using a thermal poses no great risk, but joining and sharing a thermal with other gliders certainly does. Trainees, or solo pilots who are overconfident and unimaginative (two qualities which often seem to be welded together) will enter thermals in any way they think convenient, which usually means straight in anywhere, regardless. This direct injection method hugely increases the likelihood of a mid-air collision and needs firmly discouraging right from the start. Those trainees apart, most are understandably nervous about entering already occupied thermals. The same is true of many solo pilots.

Chapter 5 covered some of the reasons why the aerial environment is hardly the ideal place for humans. Trainees find that suddenly there is no obvious fixed plane of reference against which they can measure the movement of their glider, never mind any others. However good their situational awareness on the ground, in the air it will start poor to awful. It's not unusual for the instructor to be aware of a potential collision risk long before the trainee realises there's even a problem. Learning the necessary skills is made far harder for the trainee if everyone nearby is waltzing around at continually changing relative velocities, as is usually the case.

No soaring pilot, dual or solo, should be without:

- ☐ **A parachute.** The overwhelming majority of collisions in gliding occur between gliders, so the reasons for always wearing a parachute are fairly obvious, even if most of us don't know how to use them correctly. Statistics show that prior thought and, if nothing else, mental preparation, make a big difference to a successful outcome. When one military pilot who had to bail out recently was asked at what point he finally decided to 'bang out', he replied, 'twenty years ago'. Encourage trainees to think about how they would bail out. This is better discussed on the ground than during the hectic course of a real emergency!
- ☐ **an audio variometer** ought to be mandatory. It reduces the amount of time you need to spend looking into the cockpit, thus making more available for 'out of cockpit tasks' such as lookout.

JOINING A THERMAL

BRIEFING POINTS

Joining and sharing a thermal is one of a small set of exercises where you can't demonstrate what can go wrong without standing a very good chance of having the related accident, so the pre-flight briefing is important. Failing that, give a very thorough post-flight debrief. You will need to explain the basic principles of relative movement, and how things will look from your trainee's point of view, by using models, or your hands, or by drawing what happens in various scenarios. If you happen to be very good at joining thermals but have never analysed exactly what it is that you do, then you'll need to give it some thought if you want to be of any help to trainees.

Make sure they know and understand the rules about joining, sharing, and leaving thermals (see box opposite). A discussion of why the rules are as they are is helpful, but they are largely common sense. Take rule one. When several gliders are occupying the same thermal their pilots will (one hopes) spend quite a lot of time watching each other, regardless of the advice given by rule nine. Any glider approaching the thermal will have the best view of the overall situation, and, theoretically at least, ought to be the best placed to manoeuvre safely into position. Despite that, if you are one of the gliders already established, keep an eye on any that are joining.

Assuming the trainee can fly reasonably well and keep a good lookout, emphasise any points that give clues to imminent collision [chapter 5]. For example, you WILL collide with any airborne object that maintains the same relative position to you, and gets bigger. You won't collide with an object which stays the same size and maintains the same relationship to you. The difference is crucial.

If your trainee seems over-anxious about joining other gliders in a thermal, probably best for you to do it. Alternatively, if the option is there, go and find an unoccupied thermal. Either way, don't take too much for granted or expect miracles of adaptation and competence.

Thermalling rules

Joining a thermal

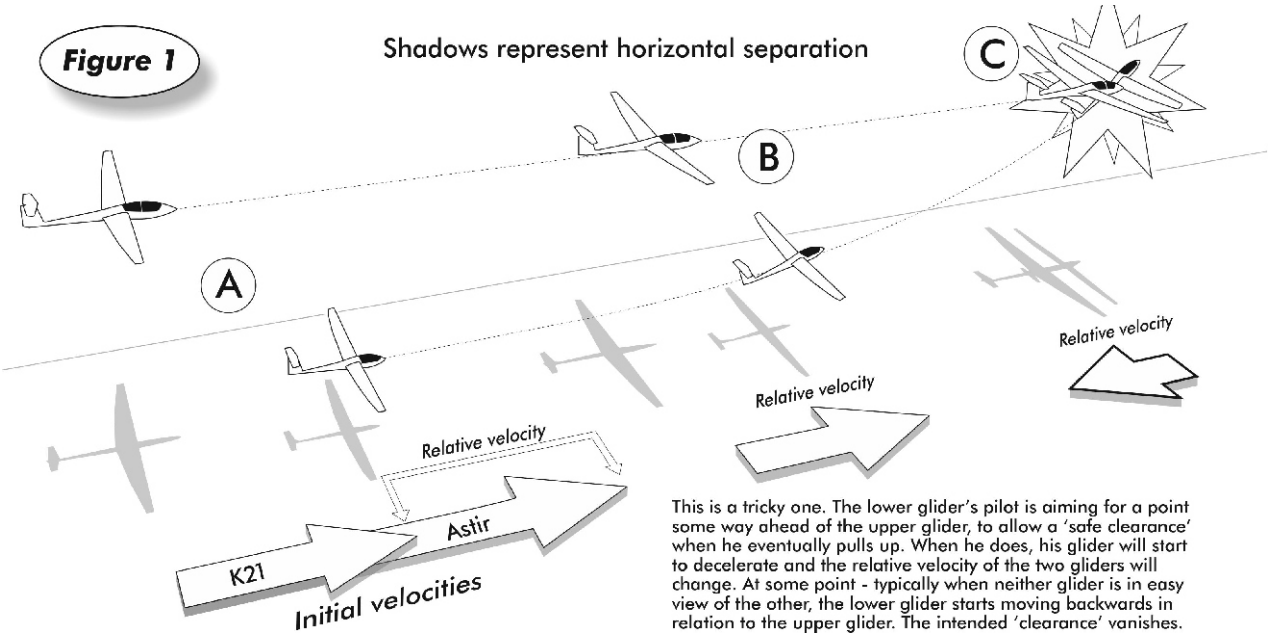
- ☐ (1) Gliders already established in a thermal have the right of way
- ☐ (2) All pilots shall circle in the same direction as any glider(s) already established in the area of lift
- ☐ (3) If there are gliders thermalling in opposite directions, the joining gliders shall turn in the same direction as the nearest glider (least vertical separation)
- ☐ (4) The entry to the turn should be planned so as to keep constant visual contact with all other aircraft at or near the planned entry height
- ☐ (5) The entry shall be flown at a tangent to the circle such that no aircraft already turning will be required to manoeuvre to avoid the joining aircraft

Sharing a thermal

- ☐ (6) Pilots shall adhere to the principle of see and be seen
- ☐ (7) When at a similar level to another aircraft, never turn inside, point at, or ahead of it, unless you intend to overtake and can guarantee safe separation
- ☐ (8) If, in your judgement, you cannot guarantee adequate separation, leave the thermal
- ☐ (9) Look out for other aircraft joining or converging in height

Leaving a thermal

- ☐ (10) Look outside the turn and behind before straightening up
- ☐ (11) Do not manoeuvre sharply unless clear of all other aircraft



There are four general points which are worth making:

- (1) it's much easier to deal with risks about which you know than those you don't
- (2) the level of risk is perfectly manageable given the application of a simple set of basic rules and some common sense
- (3) good lookout is vital, but not to the detriment of the flying. Is there any point in knowing everyone's position, being in exactly the right position, and then spinning down through the whole lot?
- (4) if you are not sure that what you are about to do is safe, don't do it; better to be saying 'I could have done it', rather than 'I wish I hadn't'.

Entering an occupied thermal

The only problem when entering an unoccupied thermal is how to centre in the lift as quickly as possible. When gliders are already there, you need a), to have seen them, and b), to join without wiping anyone out. In most cases you'll enter with sufficient vertical separation between you, so fancy flying isn't required, nor anything more brain taxing than remembering to circle in the same direction as everyone else.

It can happen, of course, that you join a thermal with two gliders already in it, and not only are they are circling in opposite directions, but you find yourself forced to join somewhere in between. Rule three (box on page 1) suggests that you circle in the same direction as the nearest glider, vertically speaking, but you may find that whatever you decide you'll be going in the wrong direction. In tricky cases like this continue on to the next thermal, if practicable.

When you are approaching a thermal you can only guess your eventual vertical separation from already established gliders, if only because you don't know exactly what the air in between is going to be doing. Low performance gliders are more affected by the ups and downs of the air, so it's harder to guess where you'll arrive. With more efficient gliders the problem is not so much the air movements as proper management of the pull-up into lift. Converting speed into height has a number of 'gotchas' that can't be all that obvious, judging by some of the dangerous flying that tends to occur at this point.

It's what you do just as you arrive that counts. If there's someone there already at about your height, then the appropriate joining technique is more about optimising life by avoiding a collision, than it is about optimising lift and having one. Frustratingly this can mean that if the other glider(s) aren't properly centred, then you shouldn't be either.

There are two related points here. First; if you approach a thermal at high speed, intending a zoom climb to make the best use of the energy available, you MUST have a really good lookout ahead and above **well before** you're likely to pull up. The reality is that you'll probably be in such a hurry to avoid flying straight through the lift core, that you won't bother with more than a cursory glance ahead at the last moment. This isn't theoretically dangerous, it is really dangerous.

The second point is that, as always, relative velocities can mean life or death. Initially, when you start a pull up into an occupied thermal, you'll be flying straight and the other gliders will be turning (figure 1, above, assumes both gliders are flying straight). Relative velocities in the circling case will be altering in three, not two dimensions, and working out what everyone else is doing and where they are all going to be in, say, five seconds time - even in two -, is a lot more complicated than it would be on the ground, and most of the clues we'd use 'down there' are missing 'up here'. There's a very high chance that we'll arrive at the point for which we were aiming - initially well clear of the glider(s) we saw - only to find a glider there already, or far closer than we either expected or wanted (figure 1, A-C).

It's worth pointing out that if you pull up steeply enough you can stop dead - horizontally speaking - in relation to almost everyone else (compare figure 1(B) and 1C)), and then effectively go backwards. Few people seem to understand exactly how this works, so make sure that you do, and then take the time to explain it to your trainees.

Horizontal separation

Whether you are zooming up or merely ambling into an occupied thermal, the horizontal line which you take is of vital importance. The following comments assume there is ONE other glider there already, and that, whatever your initial speed, you will end up at exactly their height. It is assumed also that you will circle in the same direction (rule two, box on page 1).

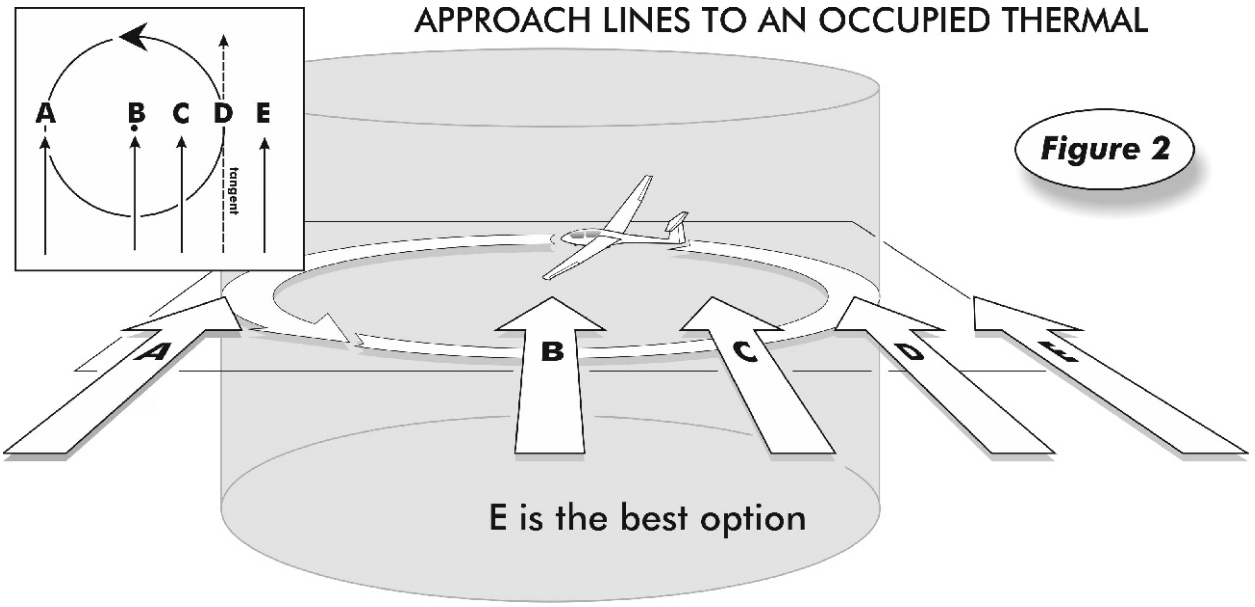


Figure 2

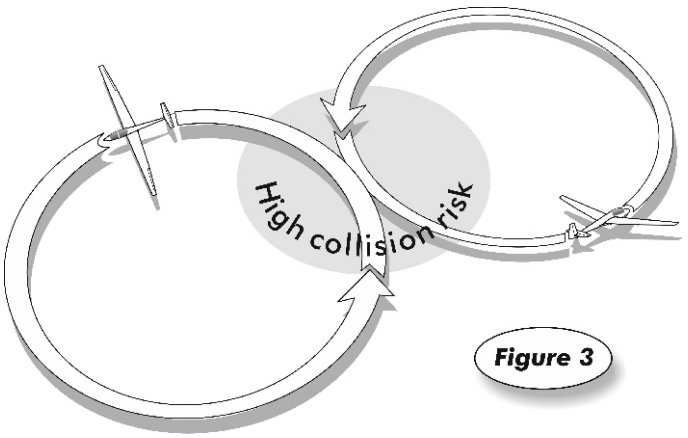


Figure 3

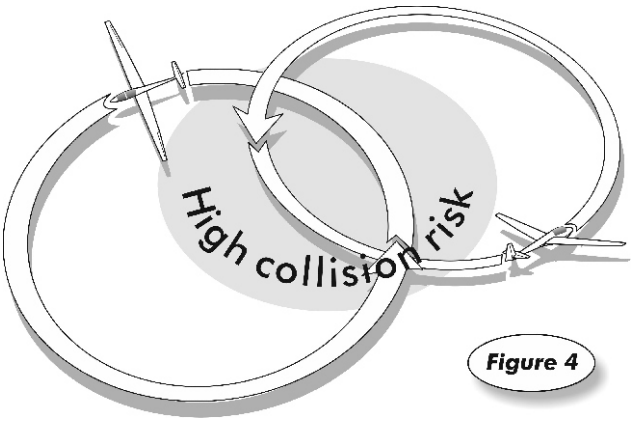


Figure 4

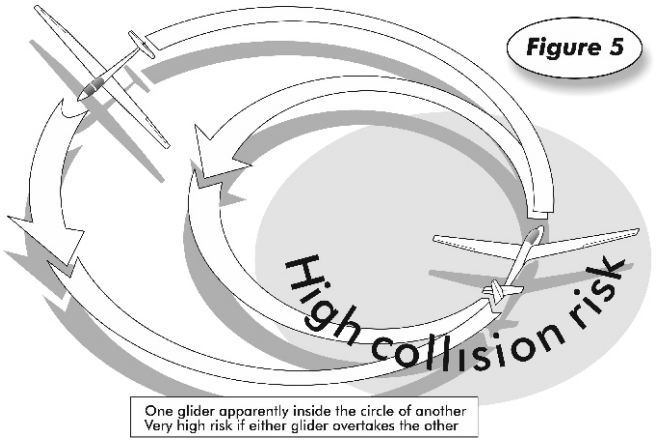


Figure 5

One glider apparently inside the circle of another
Very high risk if either glider overtakes the other

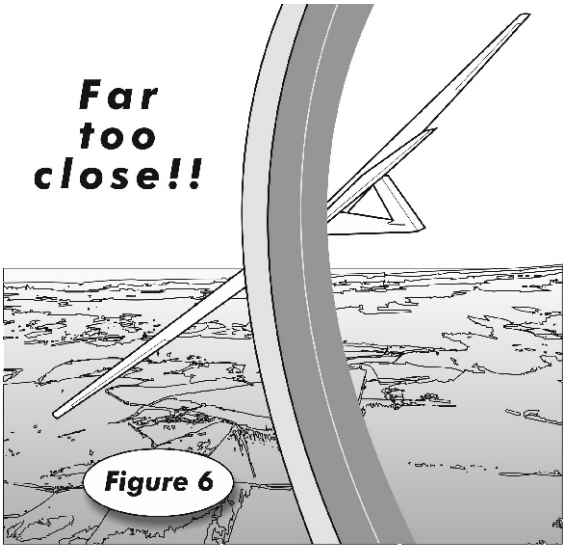


Figure 6

View from back seat of two-seater. The view from the front seat may be better, but the other glider is far too close (see text)

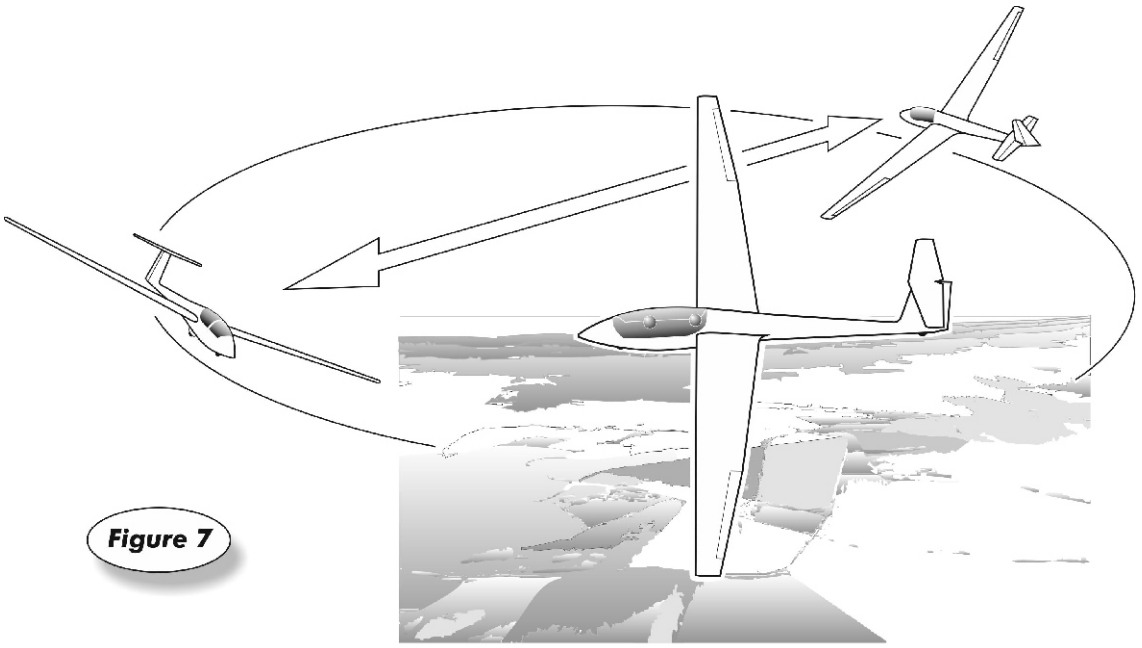


Figure 7

This is the view of the K21 from the K13

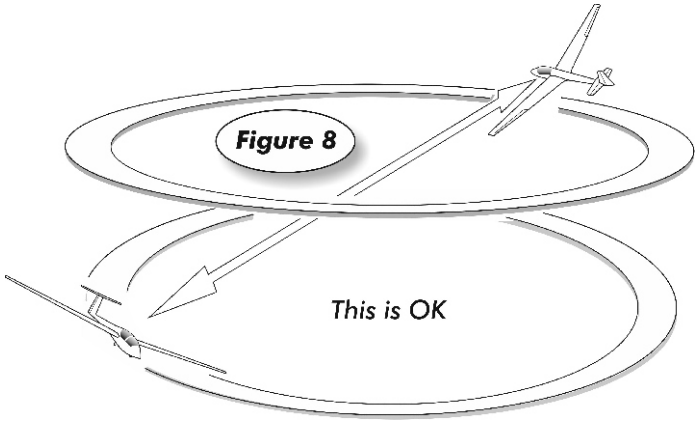


Figure 8

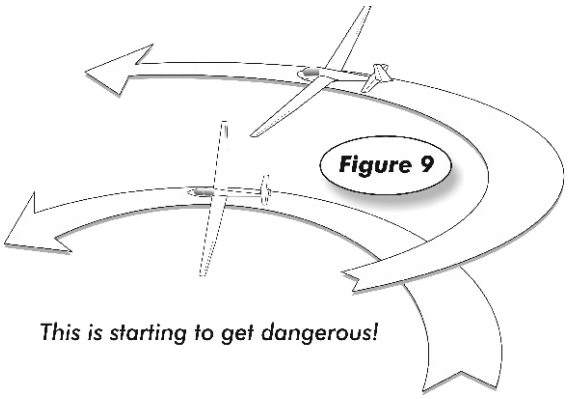


Figure 9

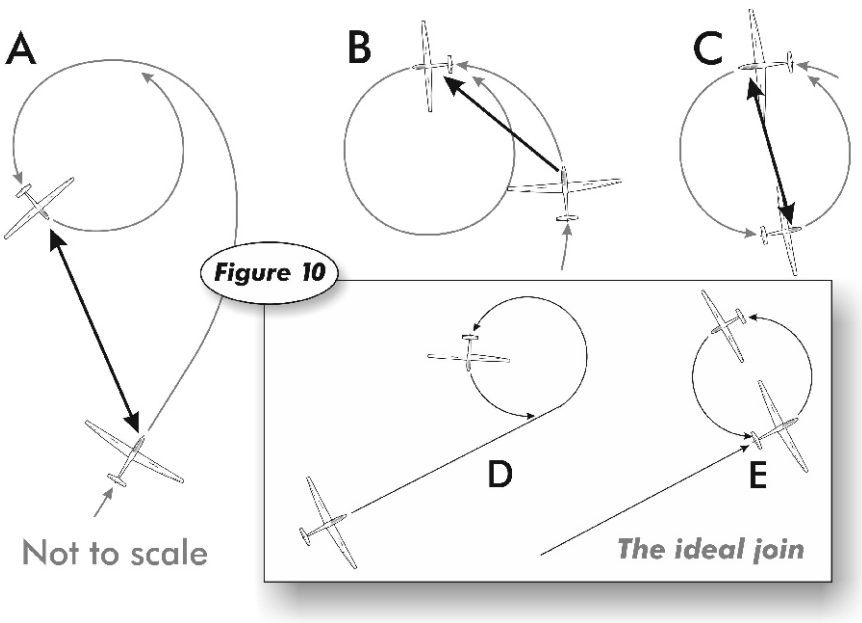


Figure 10

Broadly speaking there are five possible ways to join, three of which ask for trouble:

- approaches A, B and C (figure 2, previous page) are high risk. A is the 'suicide route' because of the serious risk of meeting the other glider head-on at very high speed. You may both be doing only 50kt, but head-on your closing speed will be double that
- heading towards the centre of the other glider's circle, as indicated by approach B, leads invariably to two overlapping circles; the shaded circles in figures 3-5 represent the danger area. The airspeeds of both gliders almost certainly won't match once the joining glider has established its own 'private' circle, and their relative positions will change constantly. The practical result, should both pilots fail to lookout and adjust their circles to match, is that they WILL eventually collide)
- entry via C is a subtle variation on B, with the centres of the overlapping circles much closer together. This increases the area of potential risk, and there will also be longer periods where one glider is out of sight of the other
- option D is the ideal, but has the drawback of most ideals. What is it that you, the instructor, are actually asking the trainee to do? You are asking someone a good deal less expert than yourself to arrive at exactly the right moment, in the right position on the opposite side of the other glider's circle. This ideal join can be and is done by many pilots, but not every time, despite their best intentions. In practice, you either arrive too soon, or too late
- approach E avoids the above problems by displacing the tangent, and allowing the joining glider to follow an adjustable and spiralling path (figure 10, A to C), facing page) into the 'correct position'.

The correct position is on the opposite side of the circle to the established glider (figure 7). You should then have a view of the other glider more or less as illustrated, UP through your canopy. The important point about the correct position is that regardless of the background antics of the ground and horizon, the two gliders remain stationary in relation to each other, without either appearing to get bigger or smaller. If your individual circles don't have exactly the same centre, then the other glider will drift across your field of view.

- The tangent should be offset approximately two wingspans to the side of the circle where the established glider is going away from you. If the offset is too large the joining spiral will be unduly prolonged, or the gliders will again end up with overlapping circles. If the offset is too small you will at some point lose sight of the other glider.

Figure 10 shows how spiralling in ought to work. It is more flexible than the ideal join (see inset) because, if you aren't in the 'correct' position, you can continue turning outside the other glider's circle until you are. Nevertheless, spiralling in to match circles, speeds, and stay in the correct position, is difficult to do well, so don't expect too much of inexperienced trainees.

The spiral's plus point is that if it's done more or less correctly - and there's a good deal of leeway - the joining glider always has the other in sight. The arrowed lines in figure 10 show who can see who. For example, in A both pilots can see each other, whereas in B only the joining pilot has a clear view. There is almost always some point where the established glider loses sight of the one joining, and during this phase it's up to the joining glider to keep the other in view.

Where relevant, the vertical separation between your glider and the closest should be at least 100'. If you're both flying 15m gliders and are steeply banked, one above the other (figure 9), the separation between your nearest wingtips could be less than a third of that, which is close! Once again, you're better off on the other side of the circle (figure 8)

Remember not to concentrate exclusively on the glider(s) you are trying to avoid as you could easily hit somebody for whom you haven't been looking.

The view illustrated in 'Far too close!' (figure 6) is one with which competition pilots seem all too familiar, judging by the photographs. Again, if the relative speeds are zero and both pilots know what's going on (and what they're doing), it wouldn't be true to say the situation was all that unsafe.

Any join can be modified by speeding up or slowing down before you arrive at the thermal.

Avoid turning inside other gliders at your level (figure 5). Occasionally you just have to accept that a glider is in your way. Be patient, or go and find another thermal.

Leaving a thermal is straightforward. Gradually straighten up and fly away. Two points to watch out for:

- as you leave make sure you're not going to conflict with someone who's about to join (rules ten and eleven)
- don't manoeuvre violently when leaving; this includes precipitous dives to gain speed before hitting the sink. Pilots sometimes dive away with the airbrakes open if they are trying to register their displeasure at you staying resolutely in their blind spot. Silly of you to be there, silly of them to react like that. If you really were in their blind spot (and it is a very large area), they couldn't possibly have known exactly where.

THERMAL CENTRING EXPLAINED

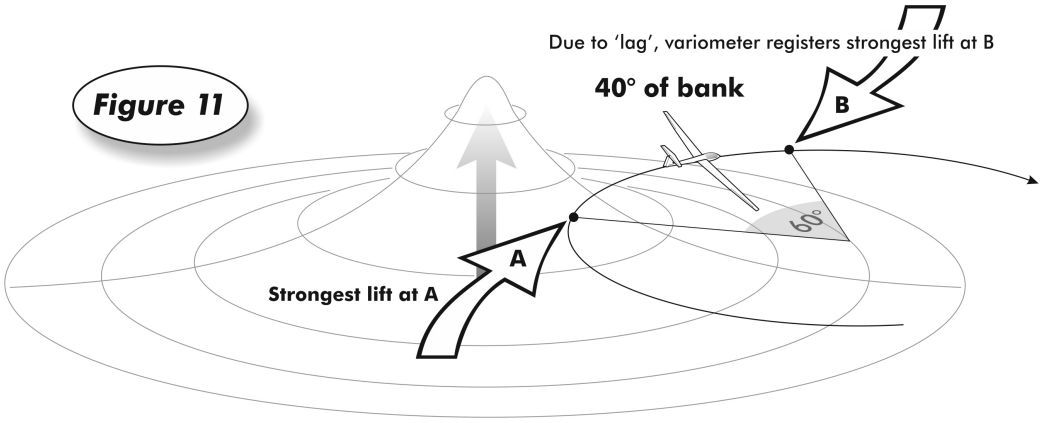
Once in the thermal, it's time to think about making the best of the lift. Bear in mind that any centring method has to take into account gliders already established, which doesn't always lead to optimum rates of climb.

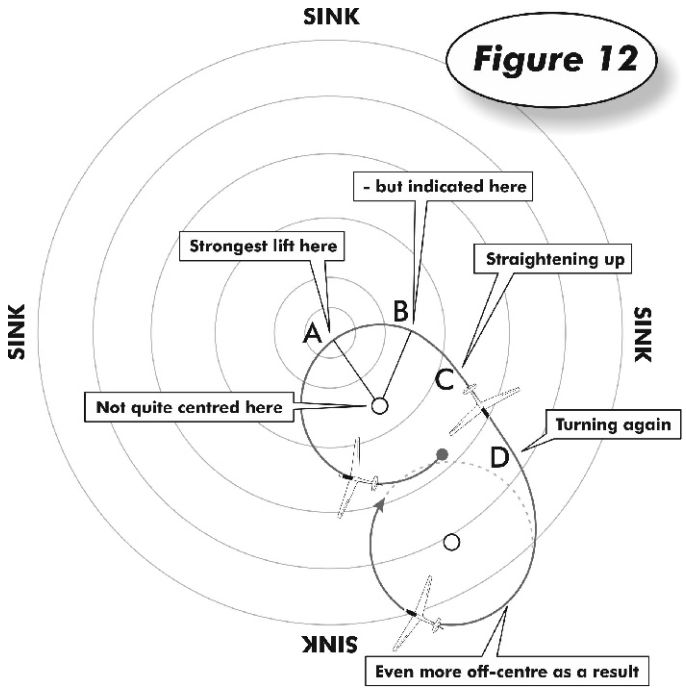
The technique described below is simple to use, easy to understand, and works in British weather. There are quicker ways to centre on thermals, but none so easy to teach or to apply.

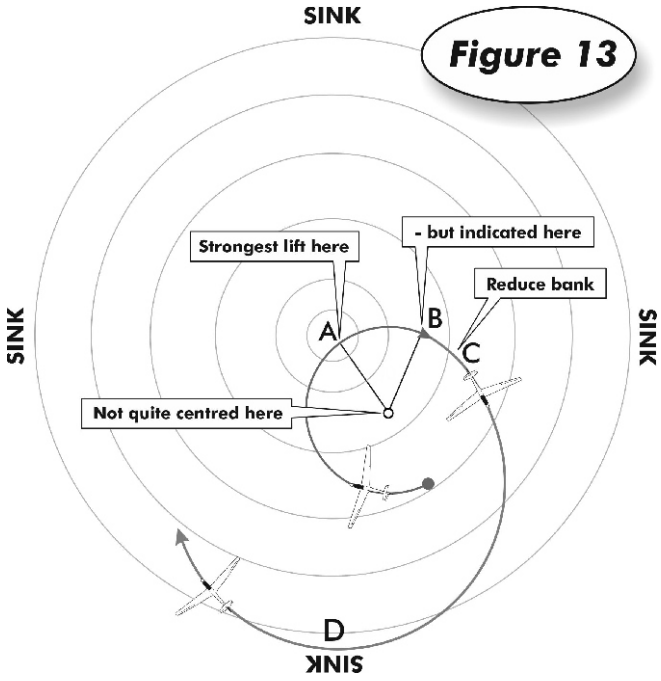
To understand thermal centring using this method we need to know two figures:

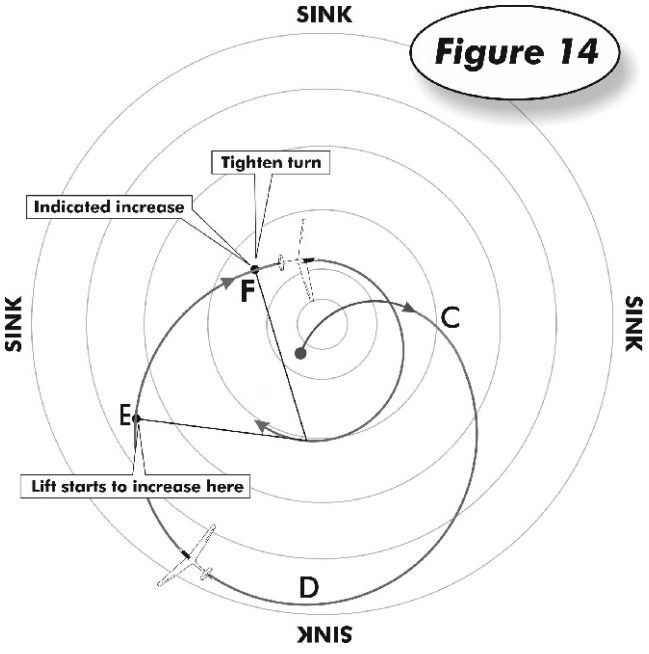
- the time taken for a complete 360° turn in a thermal - this is (or should be) about fifteen to twenty seconds
- the variometer's 'lag'. The average mechanical variometer is about three seconds too late! In this case, the 'lag' is approximately 1/6 of a 360° turn, or about 60° (figure 11, overleaf).

With a lag of 60° it is important that you don't straighten up when the variometer indicates maximum lift, as by then the glider is already well into the core. Straightening out at this point may well fly you out of the lift (figure 11). The recommended method is to fly a properly banked thermal turn (40° of bank gives between fifteen and twenty seconds for a complete 360°) when the variometer indicates maximum lift. Reduce the bank if, or when, less lift is indicated, and increase the bank again as the lift improves. Figures 12 through 14 show how the technique works.









The lift core is at A. Variometer lag means that the strongest lift isn't indicated until point B. If the pilot then straightens up ©), the glider will be heading almost directly away from the core. The mistake has already been made, so whatever method of counting the pilot uses to decide when to turn again at, say, D, he will be worse off than he was before.

In this case, rather than straightening up shortly after the strongest lift has been indicated on the variometer, the pilot reduces the bank by, say, 15° at C, and continues the turn.

As the indicated lift begins to increase at F, the pilot tightens the turn and should now be closer to the centre.

The Flying

THERMAL CENTRING EXERCISE

Stage 1, first thermal

The trainee (who could be at any stage from early pre-solo to advanced solo) flies the glider in the thermal and simply responds to the instructor's prompts to increase or reduce the bank. At this stage no explanations or reasons are given. It is also important to minimise variations in speed, which should be kept at around that required for the 40° banked turn used in the centre of the thermal. Most trainees will allow the speed to reduce as bank is reduced and to increase as bank increases. These speed changes counteract any changes in the radius of turn that the changes in angle of bank are intended to produce. Frequent prompting and if necessary re-demonstration are required to control this tendency.

Stage 2, second or third thermal

Once the trainee has achieved some proficiency at frequently altering the angle of bank whilst maintaining a reasonably constant speed in the turbulent air of a thermal, the reasons for these changes can be pointed out to him. The instructor should then demonstrate them in a thermal, explaining as he does so that *the rate of climb has increased so I am increasing the angle of bank*, or, *the rate of climb has reduced so I am reducing the angle of bank*.

After a brief demonstration the instructor hands over control to the trainee and thermalling continues as in the first thermal except that now the prompts become *the rate of climb is increasing - increase the bank*, or, *the rate of climb is reducing - reduce the bank*. Fast talking and some degree of anticipation are required here.

At this stage a fine balance must be achieved between lookout and monitoring the variometer and ASI. Too much emphasis on the instruments and the level of lookout becomes too poor. Too much emphasis on lookout and the trainee is unable to monitor the instruments well enough to be able to soar at all. The instructor must prompt frequently - *lookout - check the variometer - check the air speed - check the bank angle* -, so that the trainee builds a soaring technique that devotes enough time to each of the tasks.

Stage 3, third thermal onwards

The instructor begins to withdraw by not prompting to increase/reduce the bank - leaving only the hint that the rate of climb is increasing/reducing. In other words, acting as a sort of audio-variometer. A little later even these prompts can be withdrawn and the trainee should be able to soar successfully unaided. Prompts should still be made if the trainee is not responding correctly to changes in lift or if lookout or speed control are inadequate.

Post flight debrief should include showing the trainee the diagrams included here and ensuring that he understands and 'believes in' the method taught. It is also important that he understands the necessity for good speed control.

Finally, it must be stressed that while lookout is vital, there must be a balance - too much emphasis on lookout will render the trainee incapable of any other task.