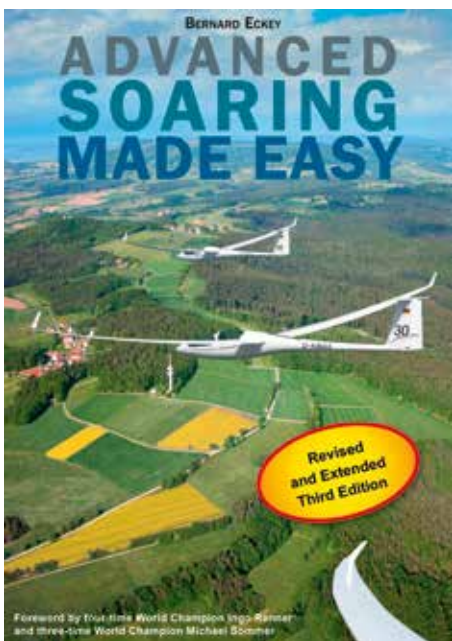




THERMALLING: THE SECRETS OF SUCCESS



A revised and extended third version of Bernard's best-seller is now available. At 432 pages, it has almost 100 additional pages compared with the second edition and costs €49.90 plus P&P. To purchase, contact eckey@internode.on.net

In the first article in a new series, aimed mainly at the beginner, Tony Cronshaw asks Bernard Eckey for top tips on how to enter and centre thermals quickly

TONY Cronshaw seeks answers from Bernard Eckey, who learned to glide in Germany before moving 'Down Under', where he became Head Coach in South Australia. The article includes extracts from Bernard's best-seller *Advanced Soaring Made Easy*, now in its third edition.

TONY: *The best pilots seem able to enter and centre quickly. How are they achieving that?*

BERNARD: The more pilots we ask about their preferred method of thermal centring, the more answers we get. This is not surprising given that thermal diameter and thermal characteristics vary considerably throughout the year and different parts of the world. What holds true for stronger and larger diameter thermals in the more

arid parts of the globe doesn't necessarily apply for small diameter thermals in Central Europe or more temperate areas.

The chosen method often comes down to personal preferences and the type of glider we fly. And yet, finding and successfully working lift has little to do with good luck. It's about your skill and your ability to get as close as possible to the centre of the lift.

TONY: *How do we decide which way to turn?*

BERNARD: Once we have crossed the sink near the thermal and the vario starts to indicate better air, but not yet strong lift, we need to keep a light touch on the controls, look for visual markers and edge towards the side where the best lift seems to be. If our eyes are glued to the variometer, our chances of turning towards the core are 50 per cent at

best and our chances of turning into sink are the same. We will often notice a wing slowly lifting while closing in on the core. The rising wing travelling through more buoyant air is a good indication. By gently banking towards the lifting wing and doing the exact opposite of what our glider tends to do, the chances of entering the best lift are increased and the risk of flying through the heavy sink normally found nearby are much reduced.

However, this means we must be able to thermal to the right and to the left. If we, like many other glider pilots, have fallen into the habit of thermalling in the same direction all the time, we simply must gather all our willpower and force ourselves to thermal in the opposite direction for half an hour or so every time we fly. Within a few weeks we will lose our preference for a particular direction of turn.

TONY: *When should we initiate the turn?*

BERNARD: When the lift starts to become obvious, we need to initiate a well banked turn, but the problem is one of timing. Sometimes we need to roll into the turn very soon after we feel the vertical acceleration, but on other occasions we should wait for a few seconds for the lift to build to something more reliable. Usually a swift turn is the right course of action at low altitude, but when high it is almost always best to delay the turn for a while. There are no firm rules here, we need to keep practising thermal entry and make a conscious effort to refine this important skill. Experience counts for a lot and as time goes by we will find it a lot easier to get it right.

TONY: *What is the best way of centring the lift given there are different and apparently contradictory centring techniques, for example, “dig the wing into the lift” method versus “open out a bit in the lift” method?*

BERNARD: First of all, it's important to be consistent and not change method from one moment to the next, unless you are a real expert. Once we are circling, probably with part of the circle in stronger lift than other parts, we want to **shift the circle towards the stronger part of the thermal**. Be patient and don't give up on the thermal too quickly. Even the best glider pilots do not get exactly into the core on the first turn and need to perform some thermal centring.

A popular method is to **increase the angle of bank as the lift decreases and decrease the angle of bank as the lift increases**. If we repeat this on each orbit, we



will close in on the core. Once centred, the air tends to become smoother and turbulence decreases markedly. Often this coincides with improved control responsiveness and a reduced noise level within the cockpit.

For smaller diameter thermals, for example at lower altitude, it often pays to **tighten the turn when intercepting the core**. It is unlikely that this will result in a steady rate of climb and therefore it needs to be repeated on each orbit. Applied a few times, we should find ourselves staying steeply banked in the narrow core. Naturally we must fly smooth circles, keeping the nose coming round, despite the thermal trying to throw us out and the demands of flying a tight turn.

TONY: *What angle of bank should we use?*

BERNARD: The single most important issue in terms of extracting the maximum rate of climb from a given thermal is the optimum angle of bank. Thermals are strongest at their centres and the optimum bank angle is ↗

Andy Bardgett demonstrates how to thermal successfully at Borders Gliding Club (Rich Abercrombie)

FINDING AND SUCCESSFULLY WORKING LIFT HAS LITTLE TO DO WITH GOOD LUCK. IT'S ABOUT YOUR SKILL AND YOUR ABILITY TO GET AS CLOSE AS POSSIBLE TO THE CENTRE OF THE LIFT

IF WE FIND PROBLEMS MAINTAINING BANK ANGLE WHILE THERMALING STEEPLY, THE REASON IS THAT OUR WINGS TRAVEL AT DIFFERENT AIRSPEEDS IN A BANKED TURN

TABLE 1 - CIRCLE DIAMETER IN METRES

AIR SPEED	BANK ANGLE IN DEGREES								
	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

✎ the one which maximises the glider's climb rate.

Circling at too shallow an angle of bank means that we will fly around the core and work very weak lift. On the other hand, an angle of bank too steep for our thermal is also detrimental to our rate of climb due to the significantly higher sink rate of our glider.

At 30° angle of bank the required lift is 1.15 times the weight of the glider. If

angle of bank is increased to 45° the wings need to produce 1.41 times the amount of lift compared to level flight and in order to fly at an angle of bank of 60° we need to generate lift equal to twice the weight of the glider. Also note that the stall speed increases by 8 per cent at 30°, 20 per cent at 45°, and 40 per cent at 60°. Also note in Table 1 (above) how the circle diameter increases with speed.

So, rather than using 30° bank, it's clear there is only a small penalty for using 40-45°

approximately 50 x 50mm. This cheap gadget can easily be affixed to the top of the instrument panel with some masking tape. While circling at 45° angle of bank, one of the wires will stand perpendicular to the horizon.

If we find problems maintaining bank angle while thermaling steeply, the reason is that our wings travel at different airspeeds in a banked turn. The outer wing travels further in the same amount of time and the resultant faster speed produces slightly more lift. The slower inner wing generates less lift and wants to drop. Having different amounts of lift is hardly noticeable at shallow bank angles, but becomes a complication while circling steeply. Without correcting control inputs, the outer wing keeps rising and the inner wing keeps going down. As a result, our angle of bank increases steadily and soon we find ourselves banking much more steeply than intended. The resulting higher g-loads quickly reach uncomfortable levels, the speed builds up rapidly and newer pilots get overloaded in more ways than one.

To prevent these unwanted effects, we simply apply and hold a small amount of opposite aileron – just enough to ensure that our chosen angle of bank is maintained. In other words, we don't allow the bank angle to exceed a self-imposed limit, which very much depends on our skill level and the handling characteristics of the glider. If you have ever wondered why you have trouble maintaining a steep angle of bank, I suggest you put the theory to the test and perform steep turns in neutral air when next the opportunity presents itself. Soon you will develop a pretty good feel for the amount of opposite aileron required and the exercise will be of tremendous help whenever confronted with narrow thermals in future.

TONY: *What speed should we thermal at?*

BERNARD: I'm sure it will come as no surprise that the airspeed for minimum sink

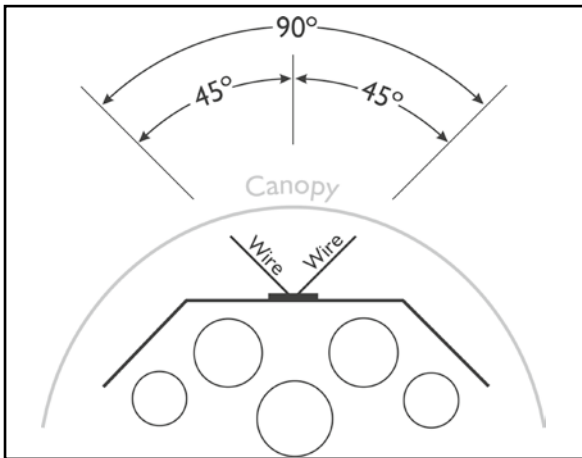


Figure 1: Bank angle gadget



Tony Cronshaw is an Ass Cat instructor at Cambridge Gliding Centre with over 1,000 hours gliding. His enthusiasm for helping the next generation of pilot includes running courses for visitors and members, and leading CGC's recruitment and retention sub-committee

bank, enabling us to achieve a much smaller radius of turn and stay near the core. We are then in a position to re-centre our thermal just by variations in the angle of bank.

TONY: *How do I know how much bank I am actually using?*

BERNARD: It is not easy to judge the angle of bank accurately. Most pilots thermal at a much shallower angle than they think. Experience suggests that newcomers tend to circle at less than 30° when they think they are banking the glider 40° or more. To help pilots fly near the optimum bank angle, I personally prefer the method shown in Figure 1. This provides instant feedback and requires nothing more than a piece of wire, a bit of plywood and some masking tape.

The wire is bent as shown and is then glued onto a piece of plywood of

is best for thermalling. However, contrary to popular belief, the speed for minimum sink is NOT just above stalling speed, nor is it the minimum sink point on the glider polar. The polar tells us what happens with 1g loading, not with the wings banked and pulling g. Consider the polar curve (Figure 2 – right).

Point A represents the minimum speed at which the glider will still fly. Any slower and the aircraft stalls.

Point B is the rate of minimum sink, the optimum if the aim is to sink as slowly as possible.

Point C is the speed for best glide ratio.

Flying at speeds between points A and B results in a higher than necessary sink rate. However, we must not use the polar curve directly to determine optimum thermalling speeds because the accelerations due to turning change everything. Say your glider stalls at 37kts and the pilot wants to thermal at 45° angle of bank (which results in a g-force of 1.41). We can now apply the knowledge that the stall speed increases by the square root of the g-force as shown for various bank angles in Table 1.

For example, 37kts times the square root of 1.41 (approx 1.2) equals 44kts. The minimum sink speed similarly increases from, say, 41kts to 49kts. These figures are purely illustrative. You must consult the actual polar for your glider, including how it varies according to pilot weight and ballast.

So the question is one of how much extra speed is required. Circling just above the stall can be dangerous, uncomfortable, inefficient and far from ideal from a performance point of view.

Thermalling at higher than minimum speeds means the control response is much better, enabling us to manoeuvre the glider quickly into the best part of the thermal, feel where the best part of the thermal is and fly at the right speed, decreasing our reliance on

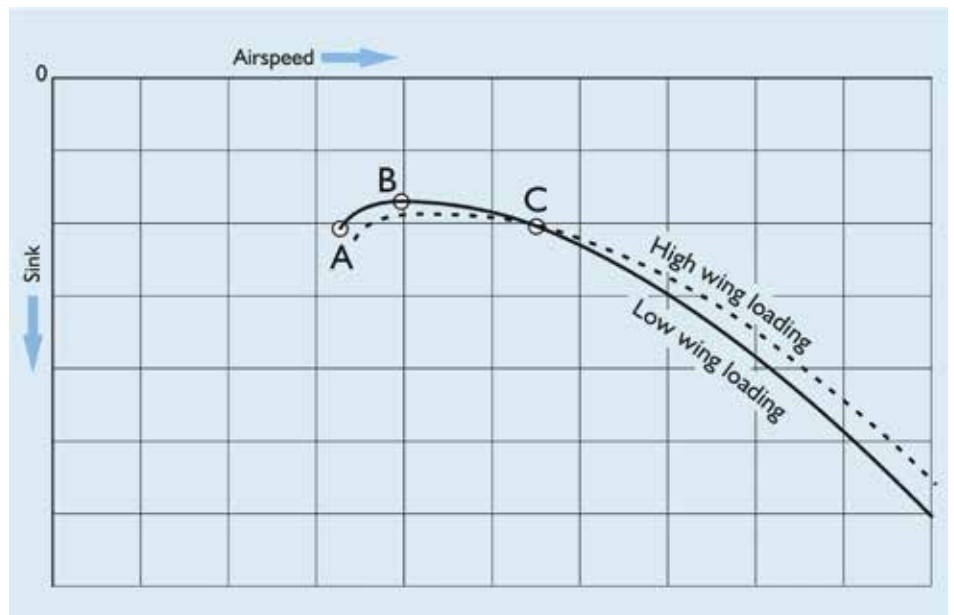


Figure 2: Polar curve

the instruments. The higher speeds increase safety margins. If we hit a severe gust, or have inadvertently washed off some airspeed, we are less likely to drop a wing or even enter a spin – a very important issue in a crowded thermal.

On the other hand, the radius of turn varies with the square of airspeed and therefore it is important not to fly faster than necessary. If pilots need to keep an eye on the airspeed indicator while thermalling they are not yet ready to fly in close proximity to other gliders. Experienced pilots only glance at their airspeed indicator from time to time, but take far more notice of these secondary indicators. By doing so, they can observe the airspace around them, watch other gliders and spot potential new sources of lift.

TONY: *What should we do if the circle takes us through sink?*

BERNARD: Centring a thermal by varying the angle of bank is only advisable when

IF PILOTS NEED TO KEEP AN EYE ON THE AIRSPEED INDICATOR WHILE THERMALLING THEY ARE NOT YET READY TO FLY IN CLOSE PROXIMITY TO OTHER GLIDERS

Winch and aerotow launches seven days a week?
Bookable training seven days a week?
2:1 trainee to instructor ratio?
All glass fleet?
Where else? 01767 677077 www.glide.co.uk

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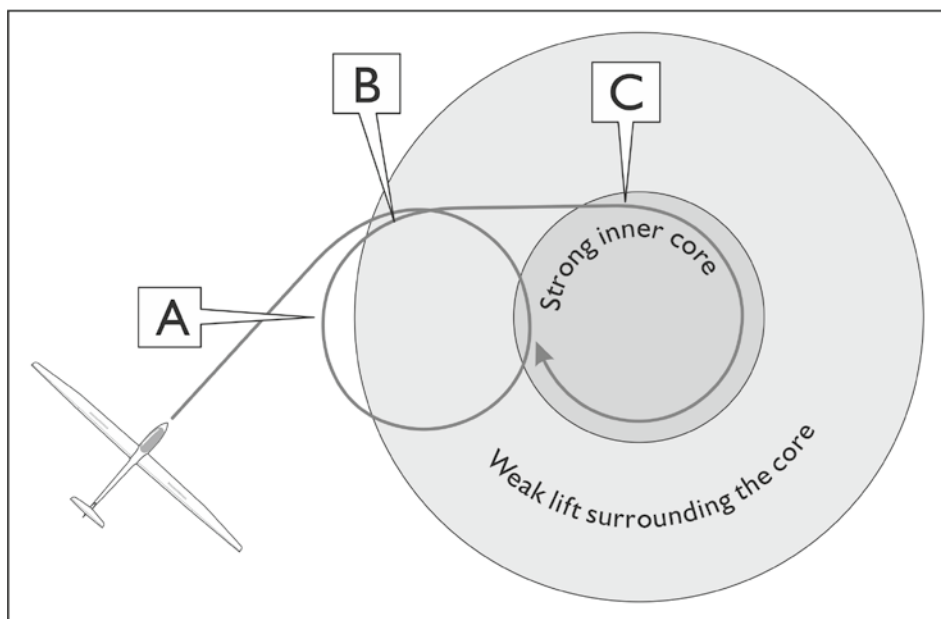
✎ just slightly displaced from the core. If our turn is partly in sink, we have to take more drastic measures. A major position change is called for, which involves a short-term levelling of our glider.

This leads us to the so called “Worst Heading” method (figure 3). The method requires that we make a mental note of our worst position in the thermal (Point A), and wait for almost a quarter of a turn before we level our glider completely (Point B). After a short while, we roll the glider back in the same direction (Point C) and should now be positioned substantially closer to the core. Whatever levelling time we decide upon depends on the diameter of the thermal, our speed and our distance from the core, but the manoeuvre needs to be repeated as long as subsequent turns are still partly in sink. A good indication of being in the core is an even and relatively smooth climb relatively free of turbulence.

While flying at 50kts we travel at a speed of 26m/s which means that levelling the wings for two seconds theoretically shifts our position by 50 metres plus the distance covered while rolling out of and back into the turn, which, dependent on the roll rate of our glider and our speed, can easily account for the same distance again. A two-second levelling of the wings results in a position change of approximately 100 metres. Significantly bigger changes are very rarely required unless we are dealing with a monster of a thermal and/or have drifted a fair distance away from the core.

The timing of our control inputs is just as important. Levelling our wings too early or too late makes the glider point in the wrong direction and possibly towards sink. For this reason, most experienced pilots use a reference point and form a mental picture of the thermal. The reference point may be the position of the sun or some feature on the ground.

It is very important to establish a mental picture of the lift distribution in the thermal. By paying careful attention to the “feel” of the air we get useful clues about the location of the core. A short moment of smooth air should make us shift our position towards this smoother patch of air. Equally, sudden turbulence indicates a position close to the edge of the thermal and a need to move towards the opposite side of the circle. In other words, we must update our estimate of the position of the core all the time using firm and precise control inputs.



TONY: *Are there any further suggestions to help improve thermalling?*

BERNARD: First of all, here is a golden rule when it comes to moving the glider closer to the centre of the lift: **never ever fly twice through the same patch of bad air.** This may seem obvious, but this basic mistake is repeated time and again. If you find yourself doing this, there is only one piece of advice I can give: **DON'T DO IT.** Once you have passed through bad air, take action to avoid going back through it.

Secondly, we must monitor the average rate of climb being achieved in a given thermal. The vario averager function, or the display from our flight computer, will tell us the average rate of climb over the last 30 seconds or for the thermal as whole. If we are not achieving a satisfactory rate of climb compared with our earlier climbs, or climbs reported by others, we need to change how we are tackling the thermal or find a new one.

Thirdly, improving thermalling involves many different issues. My advice is emphatic: **work on one particular aspect of thermalling only and take one step at a time.**

Finally, some gliders are not as manoeuvrable as others, which brings control responsiveness into the equation as well. If a chosen method works well for you, stick with it. But if you are frequently left behind in a thermal, then the above discussions and talking to your club coach/instructors will help diagnose the problem, devise a plan to improve your skills and put you on a fast track to future success.

Figure 3: The “Worst heading” centring method

(Illustrations enhanced by Steve Longland)

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Bernard Eckey is a pilot, instructor, record holder and head coach for South Australia. He flies an ASH 25 and has 3,500 hours (including multiple 1,000km flights and one 1,116km FAI triangle)