Air Sailing

Thermalling for Dummies

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Finding Thermals

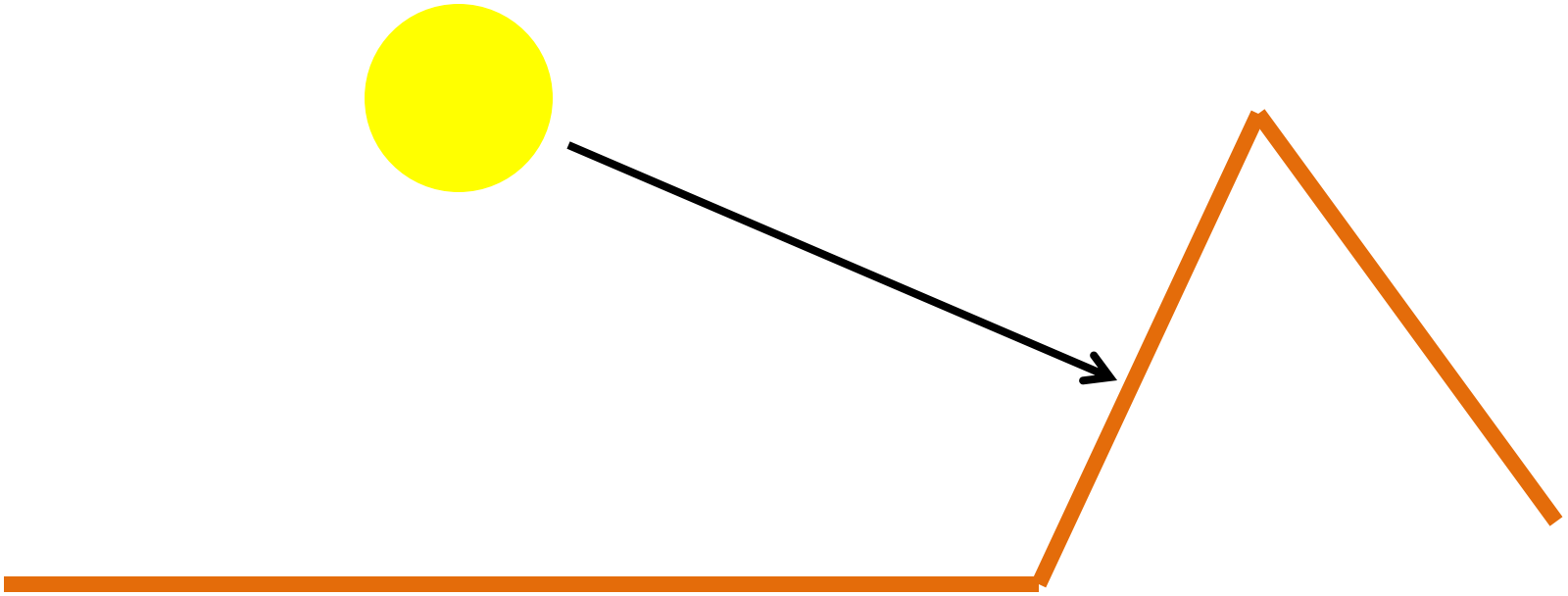
Where to Look:

Remember how thermals develop.
The suns UV rays heat the ground by radiation absorption and the ground then heats the air by convection.

Look for areas that that would be hot and miserable if you were down there.
Think black asphalt. Think dark rocks and dirt.
Look for areas that face directly into the sun.

Finding Thermals

A mountain surface that faces the sun will absorb more UV energy per unit area than the valley floor that sees the sun at an angle.



Finding Thermals

If a wind is blowing, flatland (valley) thermals can be pushed up against a mountain surface where they can then rise.

Naturally occurring mountain bowls or canyons can act as “stew pots” and hold captured air and heat it until it’s hot enough to make its escape.

“Dust Devils” are forming thermals.
These are often easily seen.

Finding Thermals

Once in the air, rising thermals can sometimes be seen by the material they may carry aloft. This can include dust, smoke, debris, circling birds or themalling gliders.

Cumulus clouds can be a dead giveaway. The clouds are formed by the condensing moisture carried aloft by a rising thermal.
Start your search beneath the cloud. If you don't find the thermal there then head into the wind.

Finding Thermals

Where <u>not</u> to look:

- *Over water, lakes, or irrigated crops*
- *Over vegetation, trees, or grass*
- *Over areas in shade*
- *Downwind of these areas*

Water absorbs radiation thru vaporization.

Green vegetation absorbs radiation for photosynthesis.

The problem with shade is obvious.

Anatomy of a Thermal

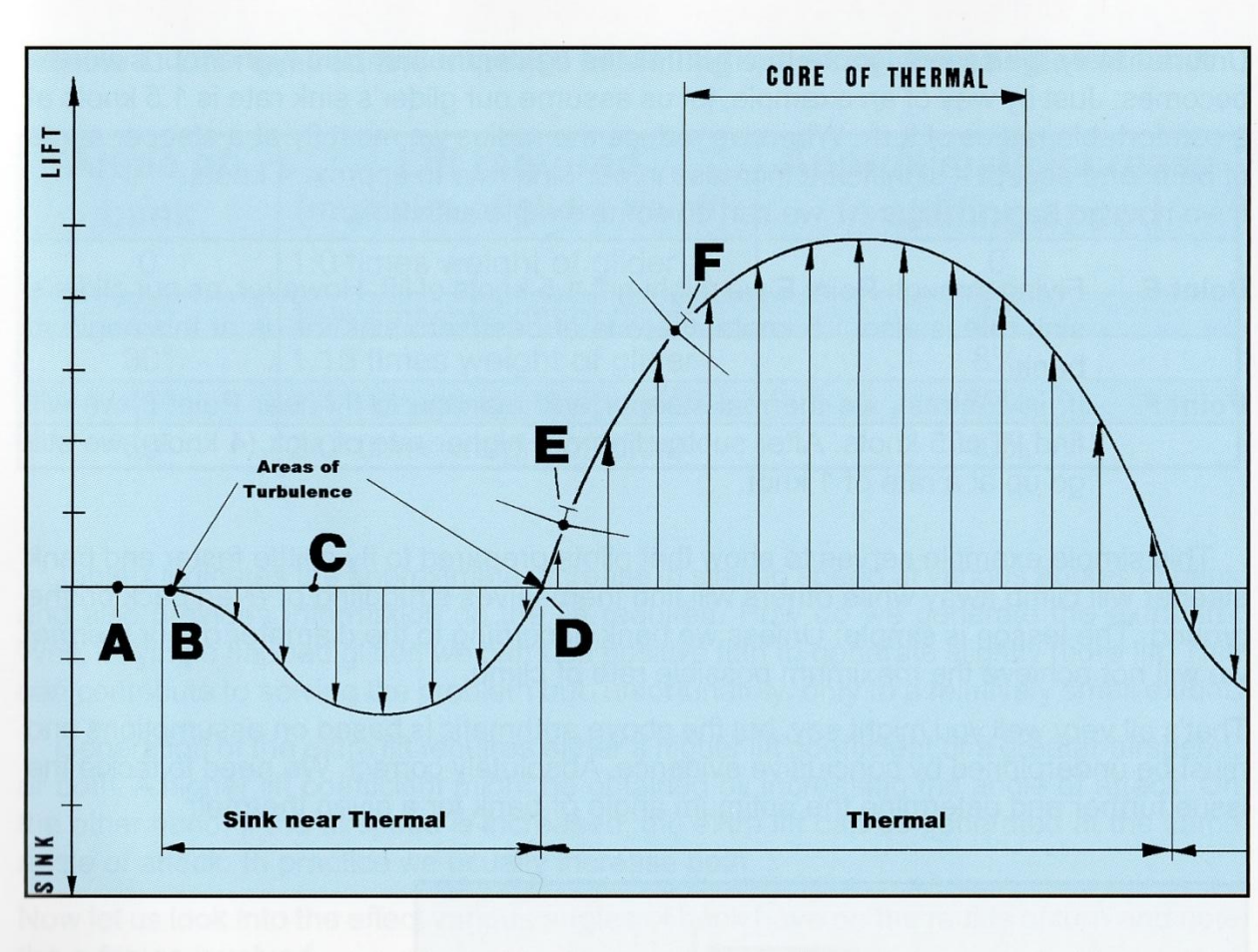
A rising column of hot air.
Center is hottest and rises faster than the perimeter.
This is why you want to center yourself.

Perimeter of the thermal is an interface between rising air and sink. This area is often very turbulent.
The outside annulus is sink.
Conservation of mass suggests that the volume of rising air is equal to the volume on sinking air.

Anatomy of a Thermal

Flying thru "Sink" may be the price you pay to get to lift.

This is all theory!



Capturing Thermals

“Capturing a Thermal” means inserting yourself into lift sufficiently deep that you can begin the centering process.

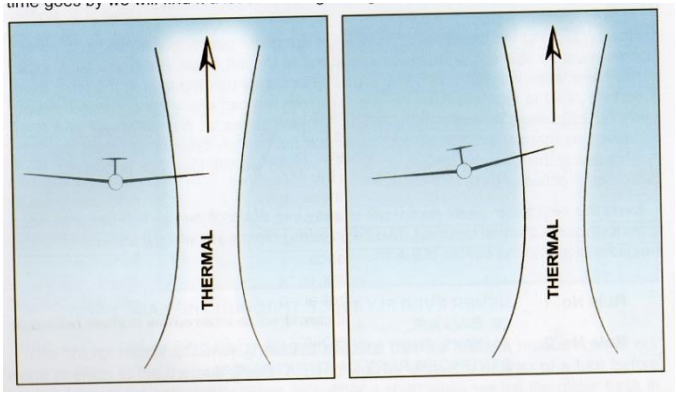
Capturing Thermals

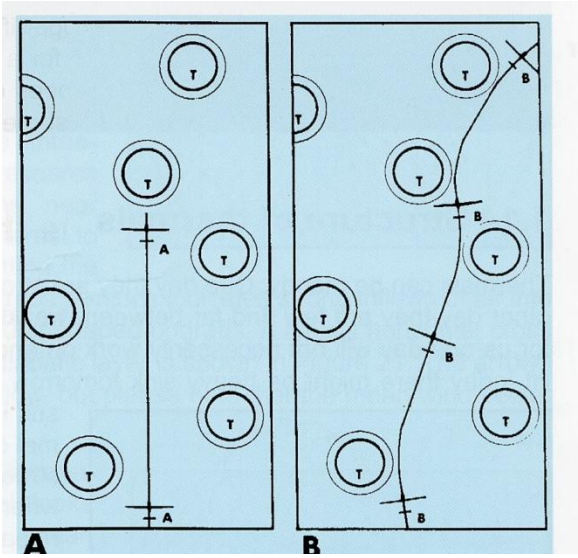
The Big Mistake:

Sometime, when you encounter lift, one wing will get lifted more than the other. The banked wings will turn the glider away from the thermal.

Going “with-the-flow” will lead you away from the thermals.

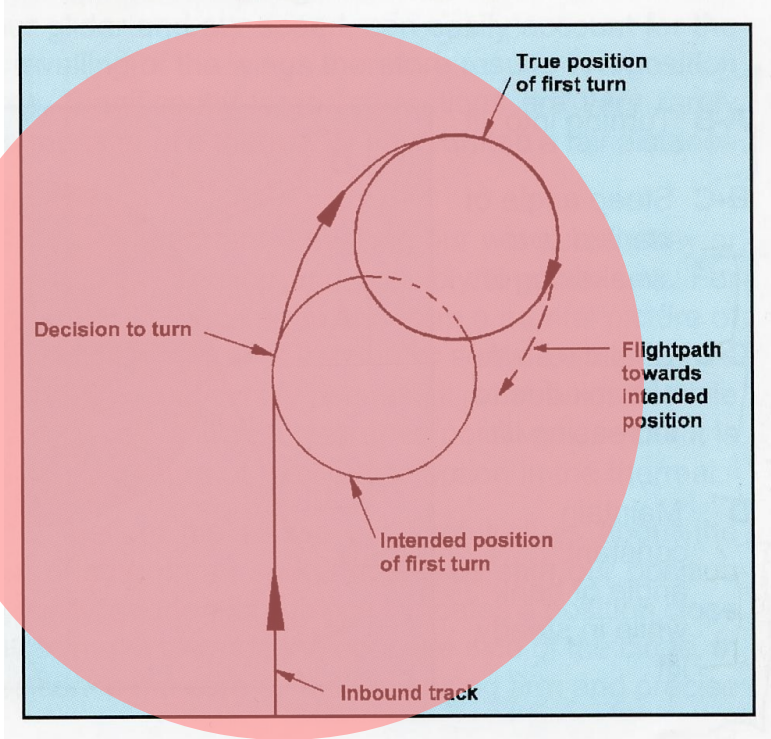
The correct response is to turn towards the rising wing.





Capturing Thermals

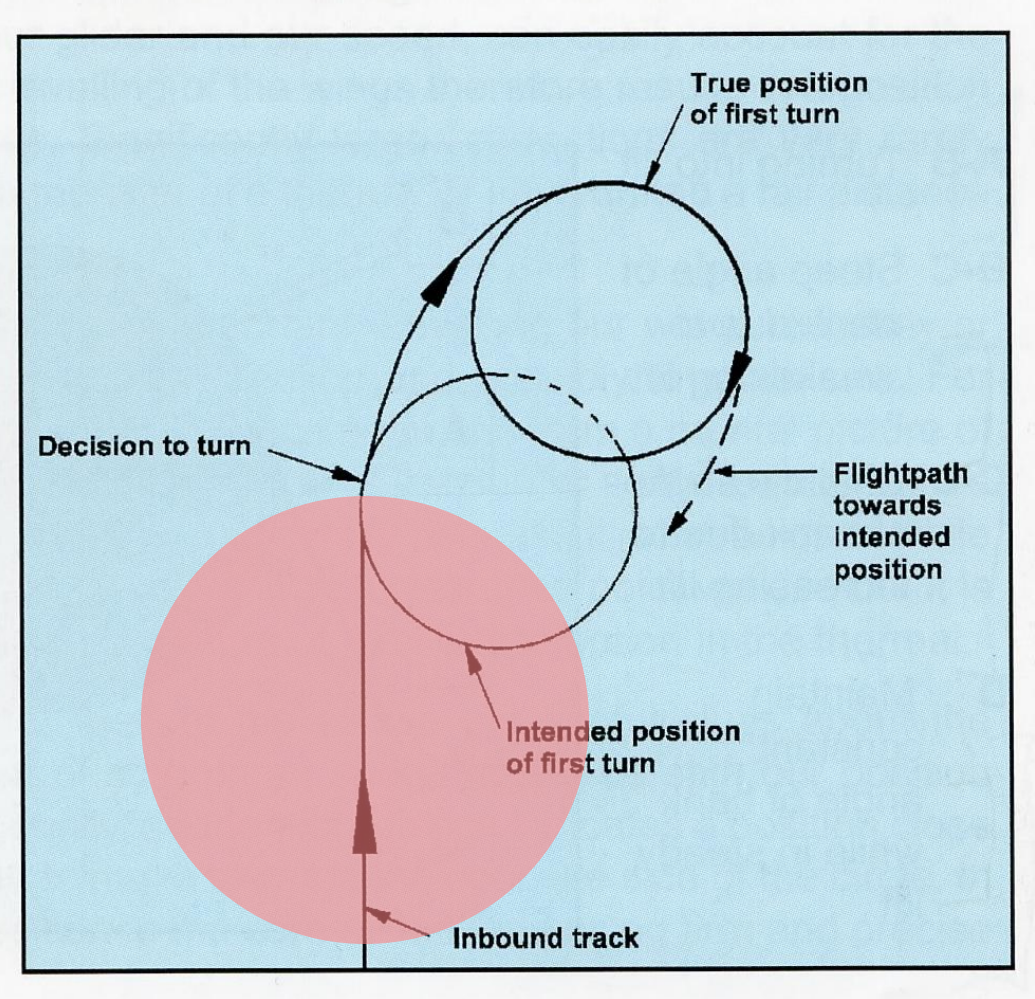
With luck, your thermal will be large enough that you'll make your turn and be circling in lift.



Capturing Thermals

The Overshoot:

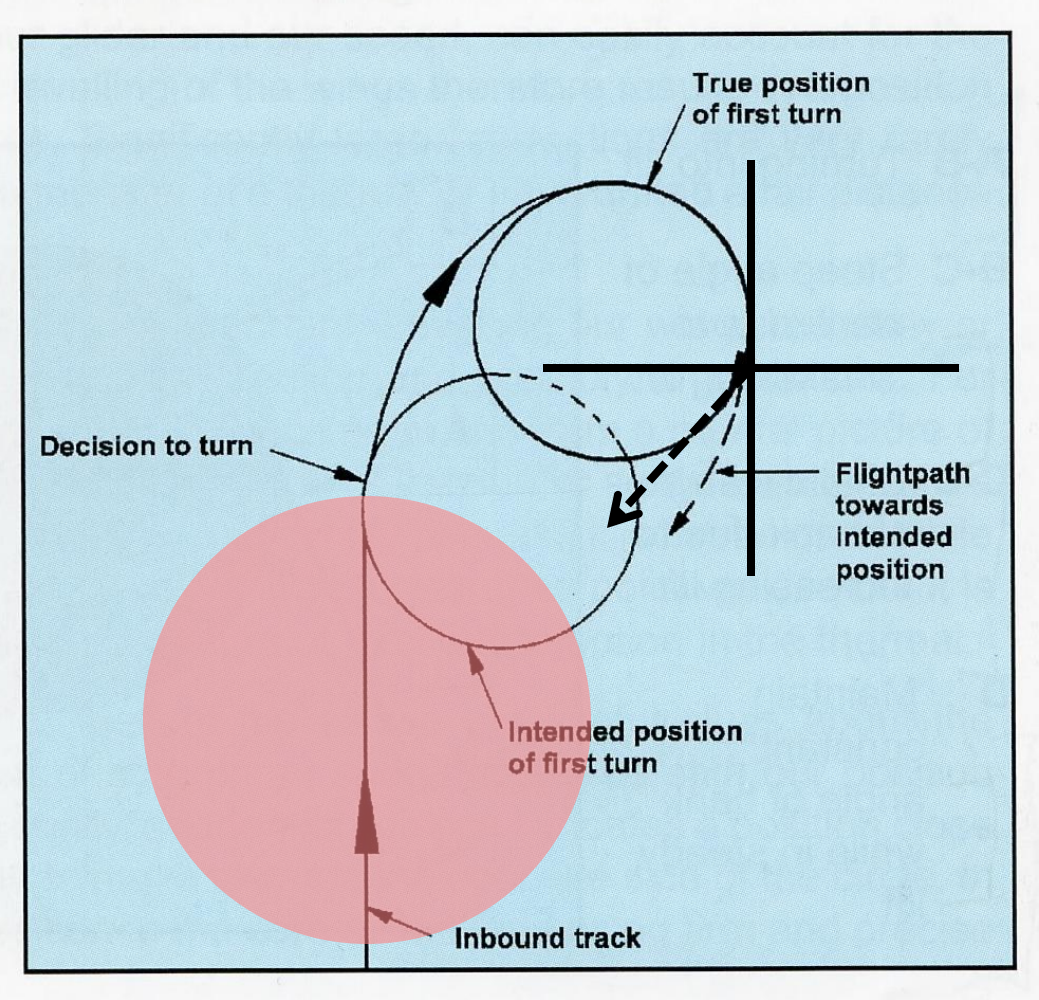
If your thermal is small, and you use the 5 second rule, you may find yourself circling in sink.
You probably went all the way thru the thermal.



Capturing Thermals

The correction is to level your wings after ~ 225 degrees of turn and fly back to the thermal.

Start your turn after encountering ~ 3 seconds of lift.



Bank Angle

Before we talk about centering techniques, we need to discuss the mechanics of circling.
The first consideration is bank angle.

What Bank Angle do you use?

The answer is 45 degrees.
And we can prove it!

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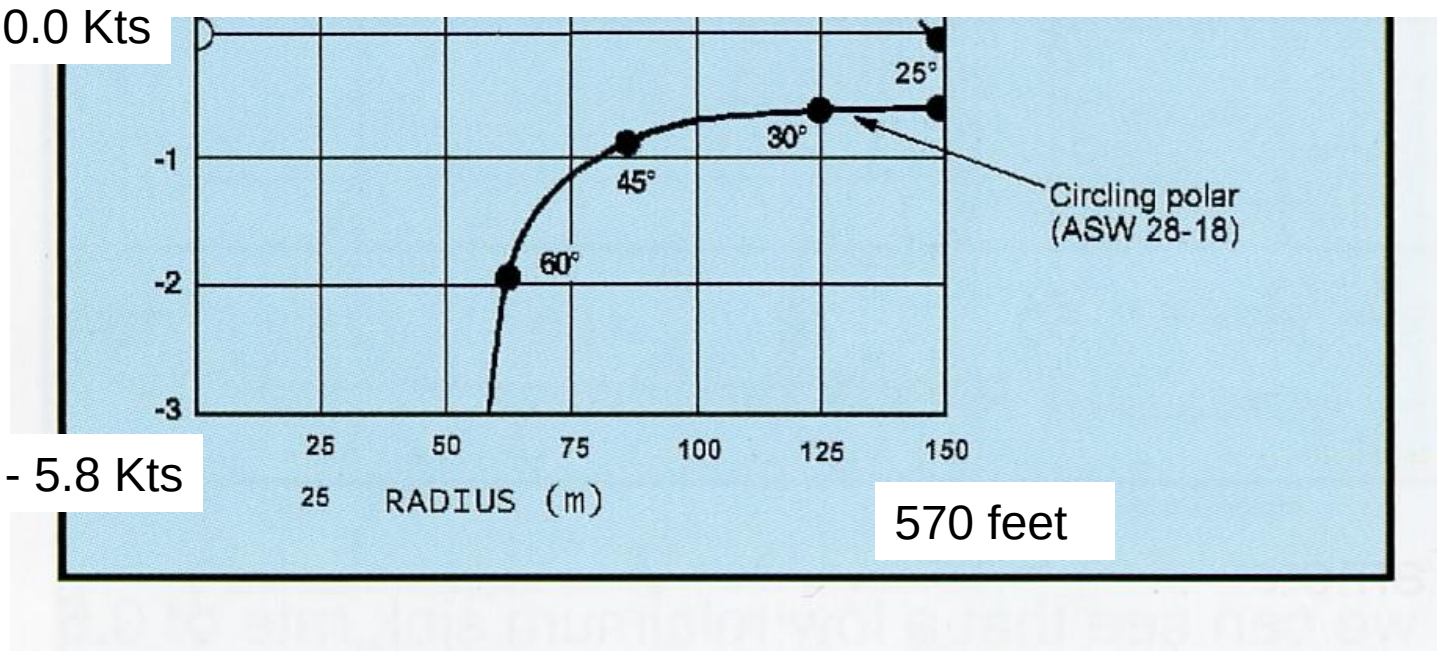
Bank Angle

The “Circling Polar” is a plot of sink rate versus turning radius as a function of angle of bank.
The airspeeds flown are V (minimum sink) times the required multiplier for load factor.



Bank Angle

German data on thermal shape and strength predicts the lift distribution of a "Strong and Narrow" thermal.

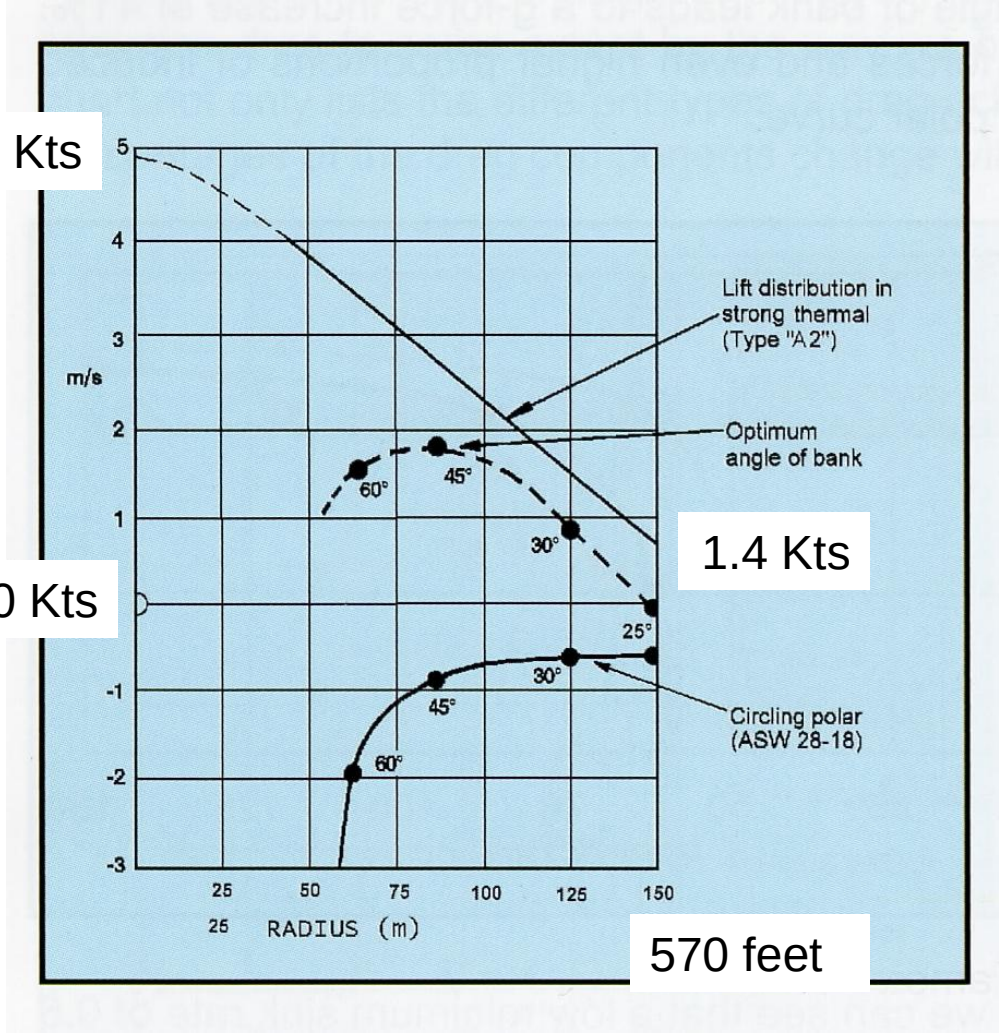
Core velocity	5 m/s (9.7 Kts)
Perimeter velocity	.7 m/s (1.4 Kts)

Bank Angle

Narrow Thermal

The summation of the Circling Polar curve and the Lift Distribution curve yields the net climb rate.

45 degrees is optimum.



Bank Angle

German data on thermal shape and strength predicts the lift distribution of a "Strong and Wide" thermal.

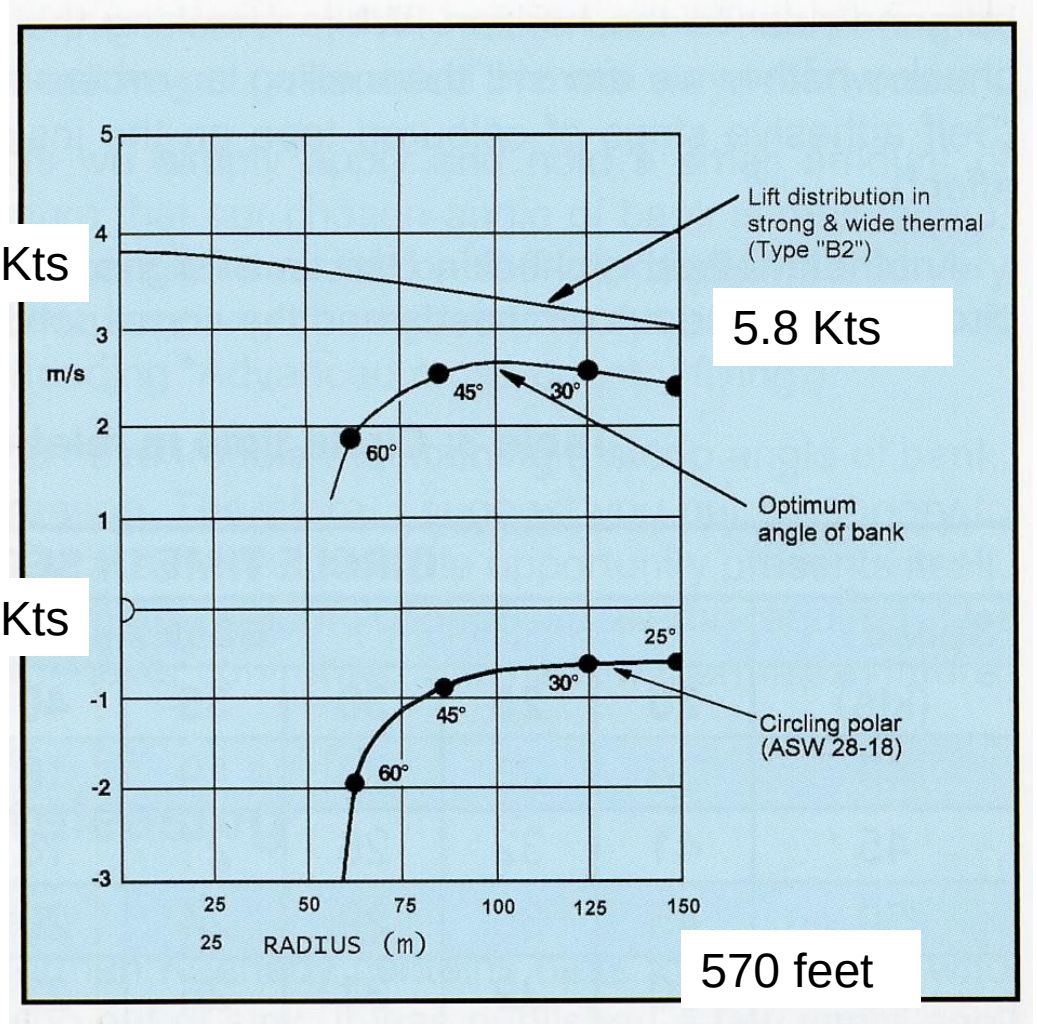
Core velocity	3.8 m/s (7.4 Kts)
Perimeter velocity	3.0 m/s (5.8 Kts)

Bank Angle

Wide Thermal

The summation of the Circling Polar curve and the Lift Distribution curve yields the net climb rate.

30 - 45 degrees is optimum.



Bank Angle

45 degrees is always the right answer!

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As an added bonus, the screws that secure your instruments are mounted at 45 degrees. Line up 2 diagonal screws with the horizon to confirm 45 degrees of bank.

Airspeed

What Airspeed do you use?

You want to fly at the slowest possible speed to minimize the diameter of your themalling circle.
You also want to fly at a speed that results in minimum sink. V (min sink) meets both of these criteria.

This is easy. V (thermalling) = V (min sink)* 1.2

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Airspeed

	Kts	
Glider	**V (min sink)**	**V (min sink) * 1.20**
SGS1-36	40	**48**
LS4	42	**50**
Discus B	42	**50**
ASW19	42	**50**
ASW20	42	**50**
L23	42	**50**
L33	42	**50**
SZD55	42	**50**
DG300	42	**50**
G102	42	**50**
Libelle	43	**52**
G103	43	**52**
PIC20	45	**54**
ASK21	46	**55**
ASW27	46	**55**

For most standard class ships and 2-place trainers, this is around 50-55 Kts.

Note that all of these thermalling airspeeds are less than 60 Kts.

Thermalling Math

Bank angle = 45 degrees

Airspeed = 54 Kts

$$F = ma = m\left(\frac{V^2}{R}\right) = W = mg$$

$$R = \frac{V^2}{g}$$

Thermalling Radius ~ 250 feet

Thermalling Diameter ~ 500 feet (basis of 5 second rule)

Circle Transit Time ~ 17 seconds

Centering Prerequisites

You need to fly perfect circles.

If airspeed or bank angle varies, you will fly ovals.

Ovals will make your estimate of the “maximum lift” direction inaccurate which will cause you to correct in the wrong direction.

You might even fly right out of the thermal.

Centering Prerequisites

“Glance” at your instruments, don’t “Stare”.

Control your glider by controlling the visual image of your glider relative to the horizon.

Glance at your instruments to see if your visual image is giving you the desired performance.
If not, modify the visual image; don’t chase the instruments.

Centering Thermals

The easiest and most reliable method is the circle displacement method.

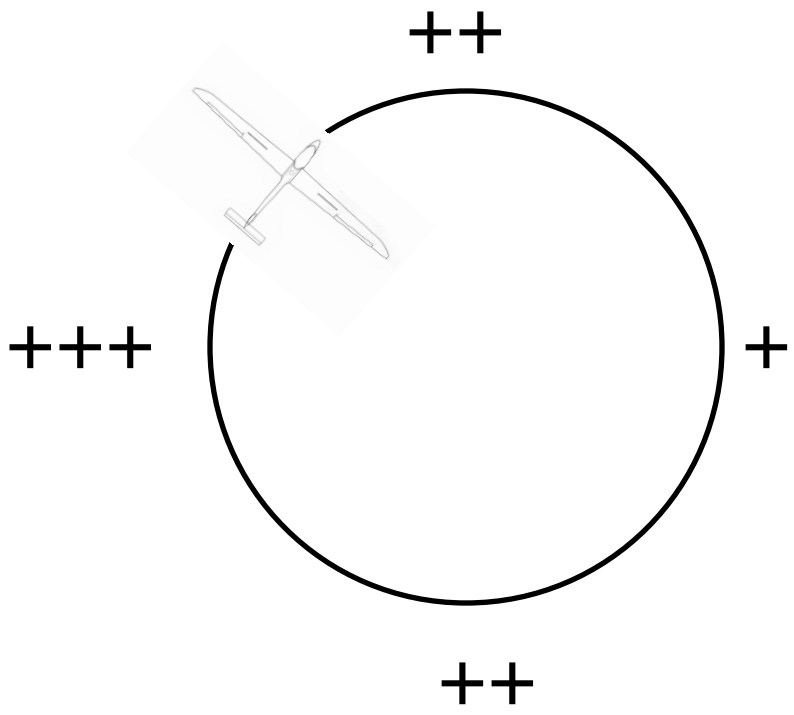
Fly a full 360 degree and notice where maximum lift is located. The upward wing will be pointing at a landmark.

After 270 degrees, when the glider is pointing at the landmark, roll level and fly towards the landmark.

After a short dwell time, roll back into your turn.

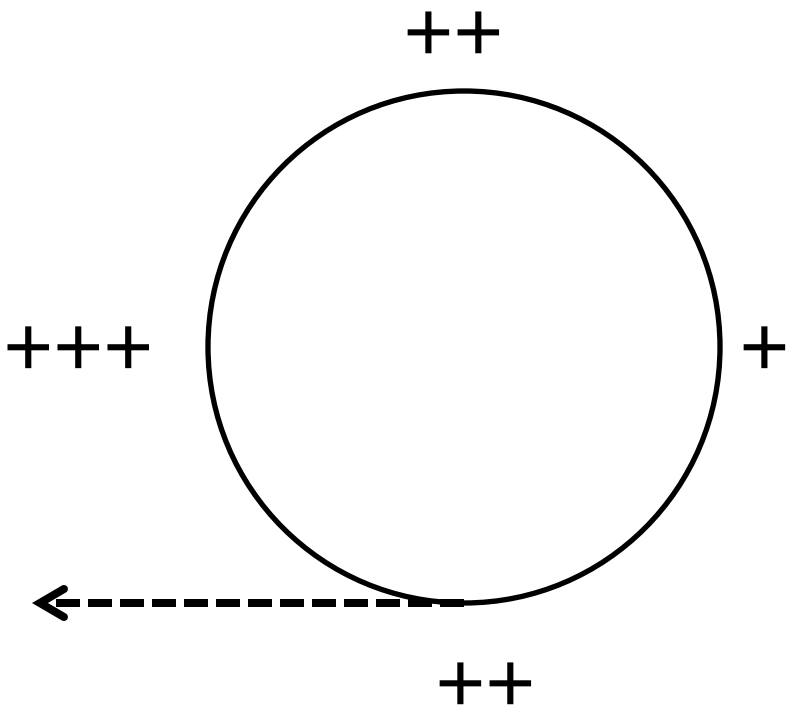
Centering Thermals

Landmark



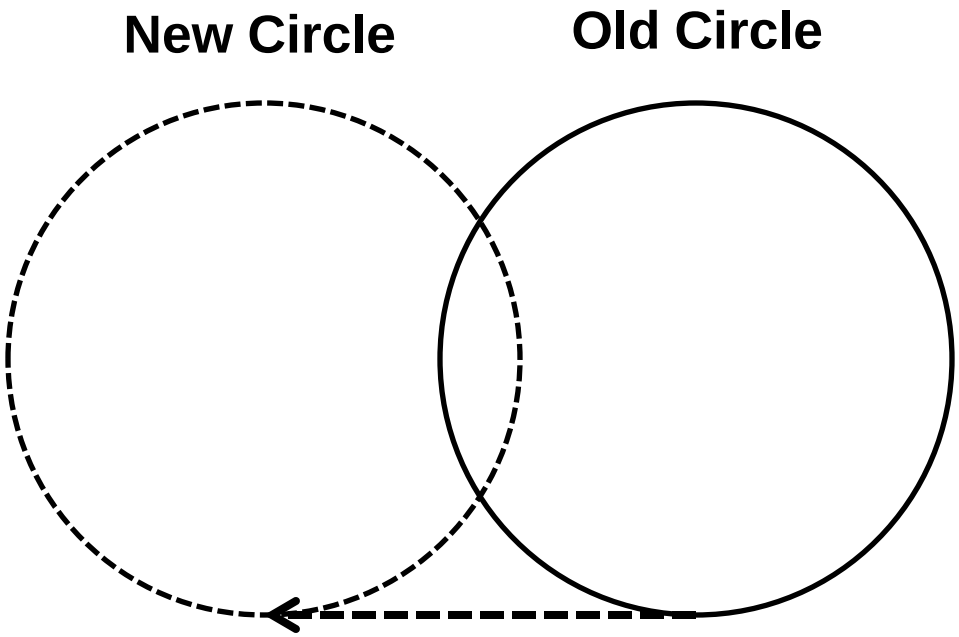
Centering Thermals

Landmark



Centering Thermals

Landmark



Centering Thermals

If your previous circle had you surrounded by lift, your wings level dwell time should only be 2-3 seconds.

If your previous circle had you in sink, your dwell time might be 3-4 seconds.

Your dwell time should never exceed 5 seconds for fear of losing the thermal.

Centering Thermals

There are other centering techniques that involve varying the airspeed or the bank angle.

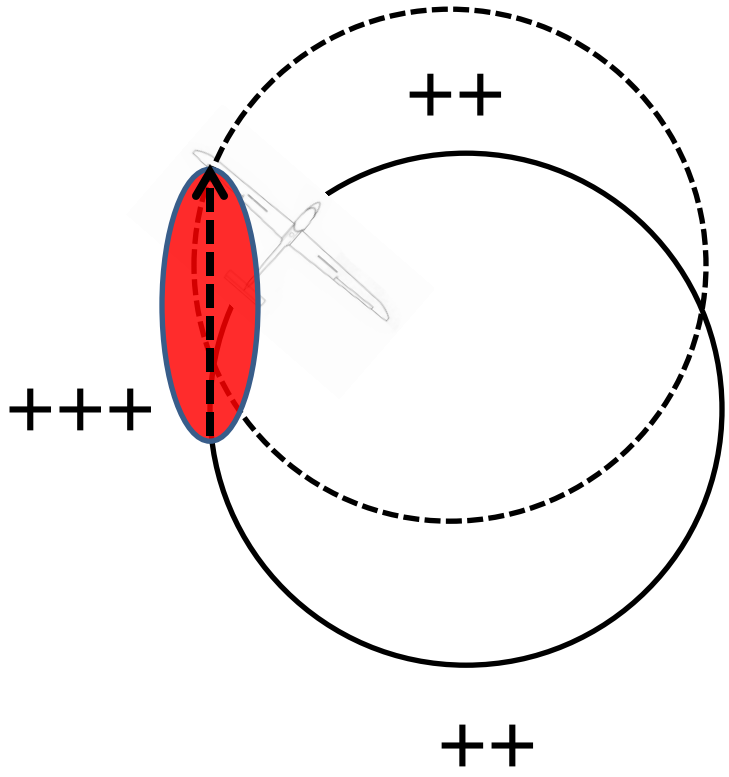
It is very doubtful that these techniques would work well for a beginner.

It is better for you to concentrate on flying perfect circles and use the displacement method.

Centering Thermals

If you find the temptation irresistible, you may level your wings in a surge (sensation of upwards acceleration).

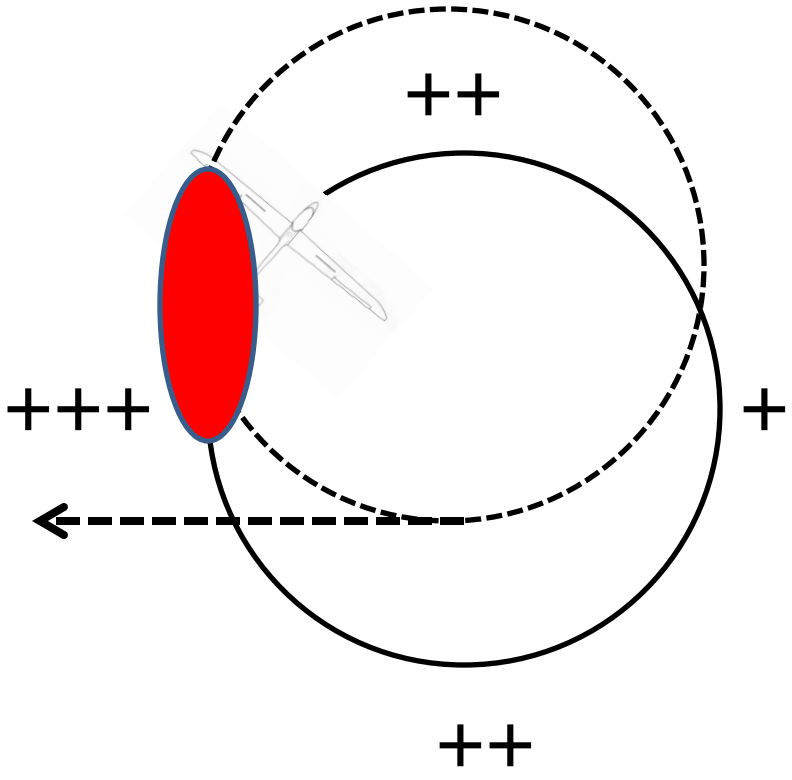
Be sure to re-establish your turn as soon as the sensation ends.



Centering Thermals

The “surge correction” moves the circle up.

Landmark



The “best lift” correction moves the circle left.

Remember

Oxygen on above 12,500 feet.

Don’t exceed 18,000 feet.

Don’t worry, the spoilers will eventually get you down!

Thermalling for Dummies

THE END