BRISBANE VALLEY FLYER

SEPTEMBER- 2019

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A Pitts S1-E, Aero's at Watts

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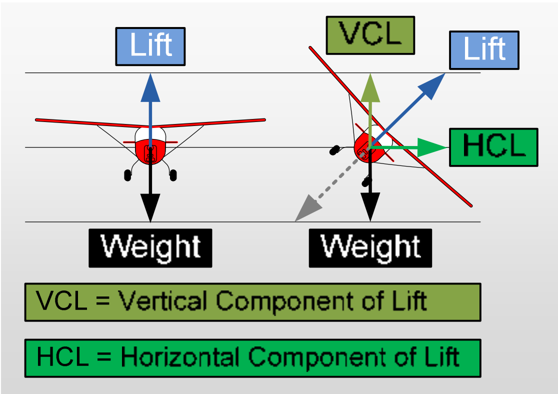
Your Angle of Bank – Does it Grow on You?

By Rob Knight

Listening to recent hanger talk illustrated clearly a dearth of relevant knowledge about turns, one of a pilot's most basic manoeuvres. In particular, the tendency for an aeroplane to increase its angle of bank (over-bank) without pilot input when established in a turn.

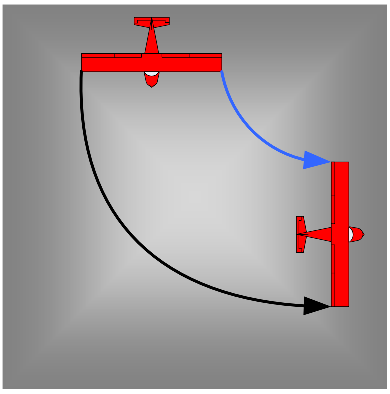
To understand over-bank, first we must look closely at the mechanics of a turn.

As Newton once said, "An object will continue in a state of rest or uniform motion unless acted on by an outside force." So, to turn an aeroplane that is flying straight, we need another force and this force is provided by the wings when they are inclined in a banked attitude.

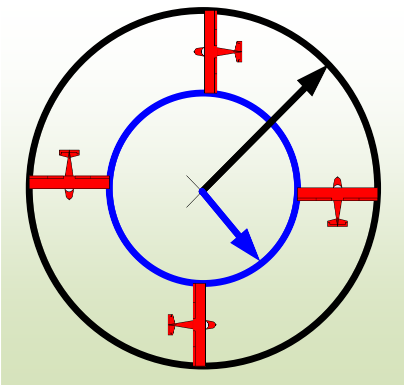


The sketch on the right shows the forces required to make a level turn. In the turn lift is increased because it now carries out two tasks – the VCL supports the weight of the aircraft and the HCL provides a horizontal force to turn it, exactly as Newton said. In the turn the lift line is slightly longer than it was in straight flight, and this extra lift provides the energy necessary to carry out both tasks.

Assuming that the airspeed remains constant, for the period that the aeroplane is banked and is exposed to these forces the aeroplane will continue to maintain height and change its direction at a constant rate. A pilot wanting to change the turn rate changes the angle of bank which changes the HCL which changes the rate of turn. The steeper the angle of bank the greater will be the HCL and the higher the resulting rate of turn. When the pilot wishes to stop turning they just level the wings, the HCL disappears, and the turn ceases.



In a turn each wing scribes a different arc around the sky. The outer wing travels a greater distance than the inner wing because its arc is greater but it does it in the same time. Therefore the outer wing must travel faster (has a greater airspeed) and MUST, therefore, provide more lift than the inner wing. This causes a tendency for the bank angle to steepen (overbank) which must be countered with slight out of turn aileron if the angle of bank is to remain constant.

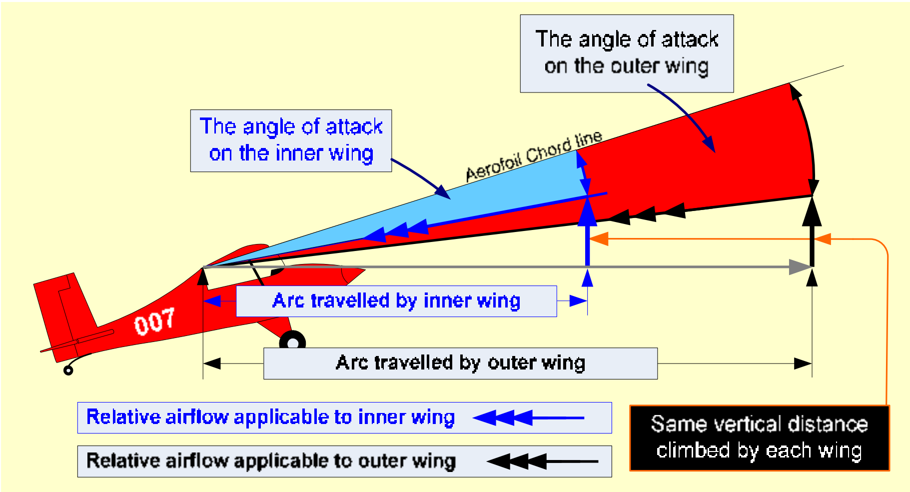


The sketch on the left shows an example of distances that cause different speeds on each wing. If the aeroplane is climbing or descending, there will also be a variation in the relative airflows on each wing which has a direct influence on their individual angles of attack.

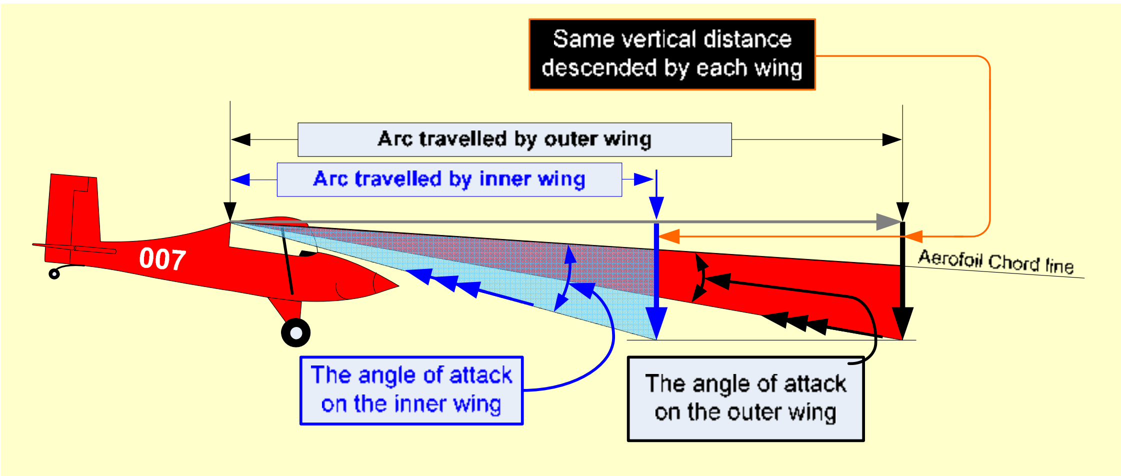
To some this is hard to imagine but we see it every time we use a spiral staircase – the inner steps go up and down at a different angle to the outer ones. The inner ones are short and steep while the outer steps are long and, although the same step height, are further apart.

The sketch below shows graphically this very point but in different distances travelled by the wingtip and the consequent differences in the angles of attack on each wing on an aeroplane in a climb. Note that the sketch is correct for effect but not scale.

The sketch shows that the outer wing has a higher angle of attack than the inner wing whilst in a climbing turn. To counter the now increased tendency to overbank more out-of-turn aileron must be applied with appropriate rudder to balance any adverse yaw caused by the aileron use.



In the case of the descending turn, as the sketch below shows, the inner wing has the higher angle of attack which offsets, at least in part, the additional speed of the outer wing. Therefore, in a descending or gliding turn, there may be little or no overbanking tendency.

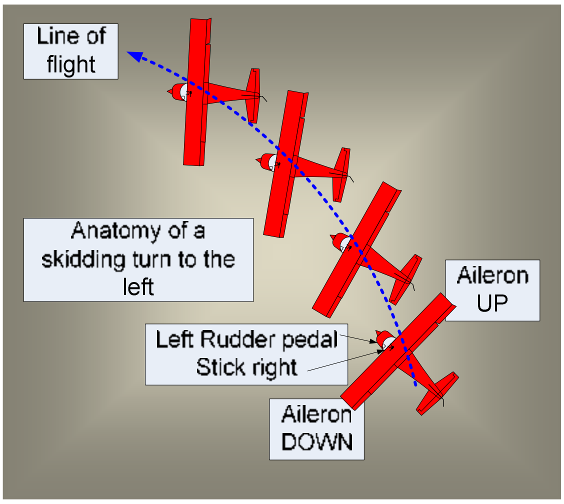


So what does all this mean to a pilot? It means that in a turn the lift on each wing may not be the same and, in such cases, some aileron must be applied if the bank is to be kept constant. Aeroplanes with a symmetrical aerofoil will suffer least from overbank in turns and those with “high lift” aerofoils, the most.

What about the rudder? A good question with a simple answer! Rudder is only necessary in a balanced turn to stop adverse yaw caused by aileron drag. When aileron is applied, to prevent adverse yaw rudder must be applied in the same direction as the applied aileron. If out of turn aileron is necessary to keep an angle of bank constant, then an appropriate amount of out-of-turn rudder is necessary to offset the adverse yaw caused by that aileron use.

Some aeroplanes have ailerons such as frise ailerons, or differential ailerons, designed to minimise aileron drag and these will suffer less adverse yaw than others so there cannot be a one-rule-fits-all on this topic of how much rudder is necessary to balance adverse yaw. You must fly the aeroplane that you are strapped into, and balance whatever adverse yaw it suffers.

But what about flat turns? Does an aeroplane over-bank in a flat turn? A flat turn is a turn where the nose is forced around the horizon with excessive rudder with little or no bank applied. In a flat turn, the angle of bank is inadequate for the rate of turn so any such turn is, by its very nature, a skidding turn. See the sketch in the right.



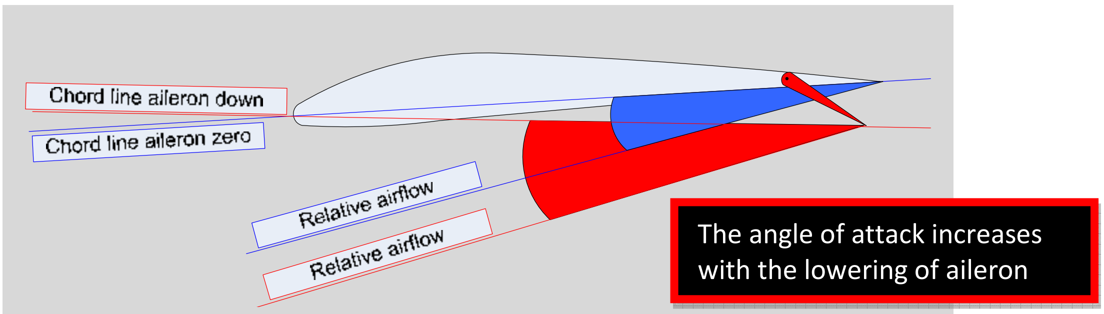
Generally, to achieve a skidding turn, the rudder is applied aggressively in the direction of the turn, whilst opposite aileron is held to stop or limit the bank angle. For example, in the sketch, a heavy application if left rudder is applied whilst holding right aileron.

As the aircraft is now flying partly sideways, the drag rise is substantial and the nose must be lowered to maintain adequate airspeed. Thus, if the aeroplane is gliding, the angle of glide will increase markedly.

This is called "crossed controls". It is very uncomfortable and, particularly if the aeroplane is descending, makes it even prone to unexpected stalling because of what is happening to the angle of attack on the inner wing.

We saw in previous sketches that when the aeroplane is descending and turning the airspeed of the inner wing is lower AND the angle of attack of the inner wing is higher than the outer wing. This pro-stall condition is further aggravated when aileron on the inner wing is lowered to prevent the aeroplane from banking.

Let's also have a look at the aileron situation on the inner (in this case, the left) wing.



As the sketch above indicates, under all normal conditions of flight, when aileron is lowered, the angle of attack is increased. If lowering the aileron to control the bank causes the angle of attack to exceed the stalling angle, the result is likely to an abrupt stall and savage autorotation towards the inner wing coupled with the drag on the dropping wing aggressively yawing the nose towards that stalled wing This is exactly the same as applying aileron to raise a wing during a stall recovery. Because the stall is unanticipated and without prior symptoms, pilot surprise is a factor in the recovery time and subsequent height loss. Such inadvertent stalls, especially when occurring in the circuit or at low level, have been the recognised cause of a number of fatal accidents.

Happy Flying

The Ubiquitous PA28 Cherokee

From Plane and Pilot Magazine

The very nature of Cherokee 140s wouldn't seem to lend itself to speed. After all, the airplane made its reputation based on a docile stall and some of general aviation's most benign flying qualities. The littlest Cherokees have always been regarded as among the gentlest of trainers, so universally respected for their predictable manners that some instructors actually criticize them for being too easy to fly.

Keep in mind, any performance increase in a Cherokee 140 would be an improvement. Cherokees were their marquee's entry-level 2+2 machines, and none were designed as high-performance airplanes. In fact, Piper hoped the original Cherokee 140 would compete as much with the Cessna 150 as the 172. The company even considered a Cherokee 115, a version with a 115-hp Lycoming O-235A engine to make the airplane more price-competitive with the 150. Performance didn't meet its expectations, however, so Piper abandoned the idea.

It's more than coincidence that all the 150-hp, entry-level, fixed-gear 2+2s offer similar performance. That's because the drag signatures of all the models is similar, despite aesthetic differences in configuration. A Cherokee or Beech Sport don't have much physical resemblance to a Skyhawk; yet all three airplanes climb and cruise at similar velocities....

...In stock configuration, that is. The Cherokee on these pages belongs to James Rhoads, a professional pilot out of Wabash, Ind., and as you've probably noticed, it's not exactly stock. In fact, P&P flew the airplane three times for this report, twice on the west coast for a before-and-after evaluation of the Power-Flow-tuned exhaust system and again at the annual Sun 'n Fun Fly-In in Lakeland, Fla., for an evaluation of the Laminar Flow Speed mods. Just as you shouldn't believe everything you read on the bottom of wax cans, speed mods are always a little suspect, and we wanted to see for ourselves what the airplane could do with and without the mods.

Cherokee N140HC started as a totally stock airplane, and for some pilots, that would be enough. The basic Cherokee 140 represents what many aviators regard as aviation's ultimate pussycat (with apologies to the Tiger, Cheetah and Lynx), an exercise in simplicity. That's always been perhaps the primary attraction of Cherokee 140s. They're inexpensive to buy and operate, can carry 2+2 in a pinch (no pun intended), and most of them have depreciated as much as they're going to and are starting back up in value.

Every feature of the airplane was aimed at simplicity. Designers John Thorp, Fred Weick and Karl Bergey concentrated on creating an airplane that was easy to build, easy to fly and easy to service. The flaps were manual, activated by a Johnson bar that pulled up from the floor in three clicks. Engine cooling was so good, there was no need for cowl flaps, and the first Cherokee 140 made do without toe brakes. (Braking was via a lever mounted beneath the panel). Pitch was the only axis of trim, and the control was mounted on the roof and activated by a horizontal crank. The Cherokee used a low wing, so Piper did mount an electric fuel pump to deliver fuel to the engine in case of an engine-driven pump failure.

There was only one cabin door at right front. Baggage had to go aboard from the front and manhandled into the back. The Cherokee airfoil, unlike the semi-tapered Warrior wing, was a constant-chord, laminar-flow design. It used large, one-piece skins that wrapped around the leading edge and were riveted into place at the trailing edge. Just as the nickname suggests, the Cherokee wing really did resemble a Hershey bar. The empennage carried the theme of simplicity to its logical conclusion. The horizontal tail was a single-unit stabilator rather than a conventional stabilizer plus a movable elevator.

Apparently, Piper got it right. They sold over 10,000 of their PA28-140s, and in some respects, the model is still with us, although the current 2004 New Piper Warrior III has very little resemblance to its 1964 ancestor. There were very few 140-hp Cherokee 140s produced (most were 150-hp models), but the name was to identify Piper's entry-level airplane until the advent of the Tomahawk in 1978.

I first flew Jim Rhoads' airplane in Long Beach, Calif., in stock trim, then a day later, at the same temperature and weight after Tom's Aircraft had fitted the Cherokee with the Power Flow exhaust. The Power Flow system requires five to seven hours for installation, costs $3,675 and modifies the airplane's exhaust to significantly reduce back pressure, optimize induction airflow and improve horsepower.

Power Flow's Robin Cook and Darren Tillman discovered long ago that many aircraft exhaust systems are relatively inefficient, often failing to evacuate burned gases in the exhaust cycle. The result is that a portion of the following power stroke is wasted, trying to burn already deoxygenated exhaust.

The Power Flow unit is more efficient at scavenging exhaust gas from the cylinders, so the engine burns a more volatile mixture of fuel and air, rather than trying to reburn a portion of the previous combustion cycle. The bottom line is more horsepower at all altitudes and a higher altitude for 75% cruise. That translates directly to more cruise speed, since thinner air offers less drag.

Although the company hasn't directly measured the power improvement on the Cherokee, a similar mod on a Skyhawk (that uses the same engine) was tested on a dynamometer and scored 23 additional horsepower. That's a 15% power increase.

A little boost in climb and cruise goes a long way. Think three to five knots better cruise from the exhaust system alone. That may not seem like much, but it's a significant performance margin for an airplane in the 115-knot cruise range. Specifically, I saw a 50-rpm power increase at the same density altitude, worth a four-knot speed improvement to 119 knots. This followed a 20% improvement in climb performance. All this was with the Power Flow system alone. Rhoads' Cherokee is one of some 250 PA-28s flying with Power Flow's tuned exhaust systems installed, and it's a safe bet that most realize the same benefits.

But wait. Power Flow and Laminar Flow of Daytona Beach, Fla., are sister companies dedicated to the premise that speed isn't only for Mooneys and Bonanzas. The two companies have specialized in extracting uncommon performance from unlikely candidates, and Rhoads' Cherokee is the poster airplane for their efforts in the PA28 line. I flew the Cherokee again at the annual Sun 'n Fun show, this time, fitted with the gamut of Laminar Flow mods, and the performance improvement was even more dramatic. The Laminar Flow mods included flap and aileron gap seals, flap hinge fairings, main-gear speed pants, a nose fairing and fuel tank fairings.

Collectively, all the mods, including the Power Flow system, cost about $8,000 plus installation. That might seem a sizeable investment, especially in an airplane typically worth less than $35,000, but consider what it buys you.

Rhoads' airplane turned in a max cruise effort of 127 knots, a solid 12 knots quicker than its original speed and eight knots ahead of the pure Power Flow mod. Perhaps equally important, more so if you live out West where the rocks meet the sky, climb improves by probably 200 fpm over the stock airplane, a combination of more power and less drag. In fairness, Rhoads reports that he's done some additional tweaking and squeezed another three or four knots out of the airplane since our tests, but we haven't seen it, so we'll take his word for it.

Like most Cherokee 140s, Rhoads' airplane wasn't designed as a weight-lifter, and all the mods probably add a little to the empty weight. The result is that, sitting on the ramp, empty of fuel and people, N140HC weighs in at 1,353 pounds. That leaves a 797-pound useful load or 509 pounds of payload after filling the tanks.

Piper does offer a hedge if you need to carry more weight inside the cabin. Full fuel is 48 gallons, but if you stop at the bottom of the filler necks, you'll be hauling only 36 gallons. That will save you 72 pounds that can be allocated to the cabin, boosting payload to 581 pounds, a more realistic 2+2 allowance.

Few owners use a Piper Cherokee 140 in a full, four-seat capacity, but there are exceptions. Dave Jackson, now president of King Schools in San Diego, used to own a Piper Cherokee 140 that he used primarily to commute back and forth to work, flying from Torrance Airport south of Los Angeles to Van Nuys Airport, well north of the city in the San Fernando Valley. On a few occasions, however, Dave, his wife and two kids went traveling in his Piper Cherokee 140, deliberately downloading fuel to the 36-gallon limit. "At only about 8.5 gph," says Jackson, "I could still fly for over three hours with a reasonable VFR reserve, and that was about as long as most of us wanted to sit in a Piper Cherokee anyway. We did have to ship our baggage by United Parcel Service in order to make the trip work. The rear seat area is the baggage compartment, and if you use it for people, there's really no place left to carry bags."

Stalls in a Cherokee 140 almost aren't stalls. Pull the power off, ease the nose 15 degrees above the horizon, and the airplane's eventual reaction will be a little more than a gentle nose-bobbing up and down as the wing alternately stalls and unstalls. If the airplane is properly rigged and symmetrically loaded, you can sit there with the yoke against the back stop, mushing slowly downhill with good rudder control and even a semblance of aileron response until you run out of altitude.

Landings deserve credit for making the Cherokee legendary. Like the airplane itself, they're sheer simplicity. A full-flap stall is well below 50 knots, so a 65-knot approach speed works well. The wing is so predictable and the gear so forgiving that the Cherokee may be the easiest-landing airplane in general aviation.

The owners of Power Flow Systems continue to pursue the same goals on a variety of other Lycoming O-320 and O-360-equipped airplanes, and so far, they've delivered nearly 1,500 systems. In addition to the Piper Cherokees and Cessna Skyhawks, the system is now approved on the Cessna Cardinal, Grumman-American AA-5 series and 180-hp Mooneys. By the time you read this, Power Flow Systems hopes to have approval for the 200-hp, IO-360 engines installed in Mooney Chaparrals, Executives and 201s. For its part, Laminar Flow products are currently installed on Piper PA28s, PA32s and PA34s.

Modified or not, Piper Cherokees continue to soldier on. Despite the advent of modern, composite designs, such as the Diamond Star and Cirrus SR-20, New Piper's Warrior III and Archer III have carried the basic Piper Cherokee idea into a new century, proving, if nothing else, that simplicity does sell.

The cockpit and control panel as presented below is of a particularly well instrumented, early model Cherokee 140. These early models had a key for the mags and a push-button start whereas later versions presented a key start so the left mag (with the impulse coupling) was correctly set and a common starting error could be eliminated. These models did not start when BOTH mags were selected.

Also, the throttle is a push/pull knob near the centre of the lower edge of the panel. Later versions had a quadrant throttle but the change was cosmetic as the throttle knob functioned perfectly well.

FLY-INS Looming

6/7 September 2019	YSHR, Shute Harbour	WHITSUNDAY AIRPORT SHUTE HARBOUR AIRSHOW
9 September 2019	YGDI, Goondiwindi	FLY IN Gondiwinidi Breakfast
13 September 2019	YRED Redcliffe	Redcliffe Aero Club 50th Anniversary BBQ and 50th Birthday Celebration
20 September 2019	YWCK Warwick	QRAA Jumpers & Jazz Fly-in Brekky
12 Octoberr2019	YMRG Murgon	Brekkie with the Burnett Flyers

Mystery Aircraft (This Issue)

What's this?

Mystery Aircraft (Last Issue)

The **Nord NC.850** (originally produced as the **Aérocentre NC.850**) was a light aircraft developed in France in the late 1940s for use by French aero clubs, but which also saw military use as an airborne observation post.

Congratulations to David Ratcliffe for identifying it. Well done.

Jokes

My wife's grandfather killed 50 German pilots in WW2. He wasn't a very good mechanic.

If you are being interviewed for a job as a pilot, don't describe yourself as being, "Down to earth".

You start flying with an empty bag of experience and a full bag of luck. The trick is to fill your bag of experience before you empty your bag of luck.

Keeping up with the Play (Test yourself – how good are you, really?)

1. An aeroplane is established in a steady right turn. The bank is constant, the ball centred, and height is being maintained. Which of the following is the most likely placement of the ailerons at this time?
   A. Both ailerons central.
   B. Left aileron fractionally up, right aileron fractionally down.
   C. Left aileron fractionally down, right aileron fractionally up.
   D. Either A or B depending on pilot preference.

2. Considering an aeroplane in a steady climb after take-off. The ASI reads 65 knots but the pilot wants 60 knots. In the simplest terms, what should this be telling the pilot?
   A. The aeroplane's nose attitude is incorrect.
   B. Too much power is applied.
   C. The trim is incorrect.
   D. The aircraft is experiencing a wind gradient.

3. From the following select the most correct statement.
   A. A coarser pitch on the prop will provide a better cruise speed.
   B. Lower aircraft weights give better cruise speeds.
   C. Increased weight increases the stalling speed.
   D. All are correct.

4. An aeroplane is climbing with full throttle at its best rate of climb airspeed. In theory, which of the following would increase the rate of climb further?
   A. Decrease the airspeed.
   B. Lower flaps.
   C. Reduce weight.
   D. Increase the airspeed

5. The stalling speed when flying into wind compared to when flying downwind:
   A. Remains the same.
   B. Increased as the square root of the changing wind speed.
   C. Decreases as the square root of the changing wind speed.
   D. Is dependent upon the changing stalling angle of attack.

See answers overleaf

ANSWERS: 1. B, 2. A, 3. D, 4. C, 5. A.

If you have any problems with these questions, See Notes overleaf or call me (in the evening) and let's discuss it. Rob Knight.

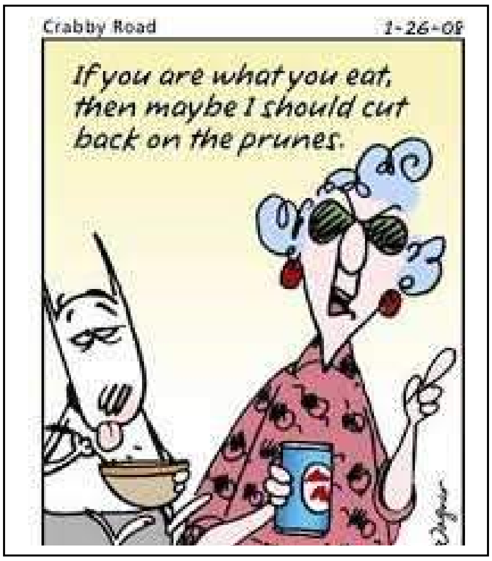
1. Almost all aeroplanes have an inherent tendency to overbank in turns due to the speed discrepancy between the wings. Therefore slight out-of-turn aileron will be needed to stop the bank increasing, Thus, in a right turn, the left aileron will be up a little and the right aileron down a little. NOTE: With differential ailerons, the left aileron is likely to be up more than the right aileron is down.

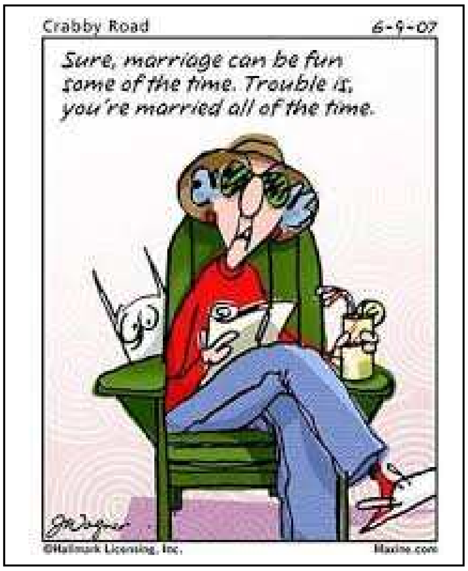
2. Airspeed is the result of power and attitude. In a climb after take-off full power is normally applied so the attitude must be incorrect.

3. All are correct

4. Changing the airspeed either way from Vy will damage the Lift/Drag ration and worsen the rate of climb lowering flaps will also damage the lift/drag ratio with, again, the same result. Only reducing weight will see an increased rate of climb.

5. Airspeed is what we use in reference to stall speed. Groundspeed has absolutely no relevance to stall speed. The aircraft will have a lower ground speed at the stall when carried out into a headwind at the altitude being flown, and vice versa, but the knowledge has no real application.





Aircraft Parts and Tools

Item	Condition	Price
SAAP Oil Pressure Gauge &Dedicated Sender	Brand New (in original box	**$100.00**
VDO Volt Readout instrument	Brand New	**$70.00**
EGT sensors (2 of)	Brand New	**$30.00 (each)**
Skystrobe Strobe light for Ultralight	NEW – IN BOX	**$75.00**
Altimeter – non-sensitive with subscale in "Hg.	Brand new	**$50.00**
Brand New ¼ drive Torque Wrench (SCA)	Brand New 60.00	**$60.00**

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Contact Rob Knight at either kni.rob@bigpond.com, or call 0400 89 3632.

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Instruments and radio. Registered and ready to fly away. Currently at Forest Hill. Could consider delivery for fuel cost.

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The Lockyer Valley from the Colby