Brisbane Valley Flyer
November - 2017

Brisbane Valley Sport Aviation Club Inc

www.wattsbridge.com.au
www.bvsac.org.au

Watts Bridge Memorial Airfield, Cressbrook-Caboonbah Road, Toogoolawah, Q'ld 4313.

Brumby 600, running up at Biddaddaba.

.

Sandy Walker(President)	0424 958 173	Peter Biddle (Secretary)	0402 403 469
Priscilla Smith (Treasurer)	07 3206 3548	Rob Knight (Editor)	0400 89 3632

The Sneaky Stall – Part 2

By Rob Knight

In Part-1 of this trilogy we looked at the cause of the stall and demonstrated that it is purely a function of the angle of attack on the aerofoil. In this part, I'd like to look at the various responses of the aeroplane to a stalled condition and to perhaps provide an understanding of why these various responses occur.

Firstly, though, let's look at the factors that are producing the lift our aeroplane is experiencing. The formula for lift in level flight looks confusing in its normal form:

Lift = weight = $C_L {}^1/_2 PV^2 S$ and, yes, this used to make my eyes water, too.

So let's simplify it. It is saying that, in level flight, lift must equal weight which is surely understandable. Then we have the factors in designer talk. Let's see what they mean.

C_L	The co-efficient of lift. The angle-of-attack-factor which is the amount of lift being provided by the aerofoil. **C_{LMAX}** is the maximum lift the aerofoil can produce and occurs at the stall.
${}^1/_2 P$	This factor is pronounced, "half Rho", where Rho represents the ambient air density. As far as we are concerned, on its own, it is a constant (K). See Note below.
V^2	This is True Airspeed (TAS) the factor representing the effect of airspeed on the lift the aerofoil is developing. See Note below.
S	The "surface" or "plan" area of the wing

Note that when the two factors **${}^1/_2 P\ V^2$** are taken together, their combined effect is indicated airspeed – IAS – the speed on the IAS dial (excluding instrument errors, of course).

The equation below represents the formula after this change.

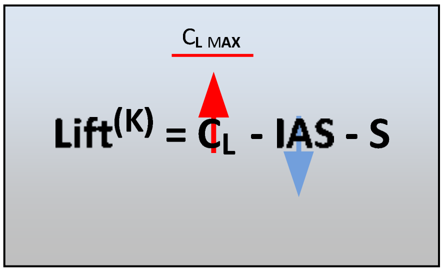
$$\textbf{Lift = weight} = C_L \times \textbf{IAS} \times \textbf{S}$$

This means that, in its simplest form, a pilot can modify the lift being produced by an aeroplane's wing by changing just three factors :–

- The angle of attack,
- The indicated airspeed, and
- The wing area (only by applying certain types of flaps (when fitted)).

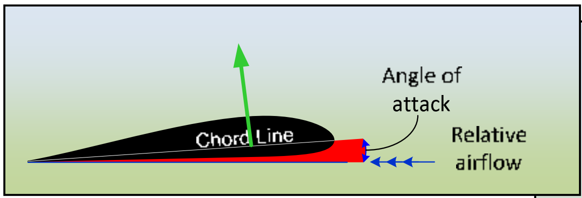
An aeroplane may stall at any speed but only one angle of attack.

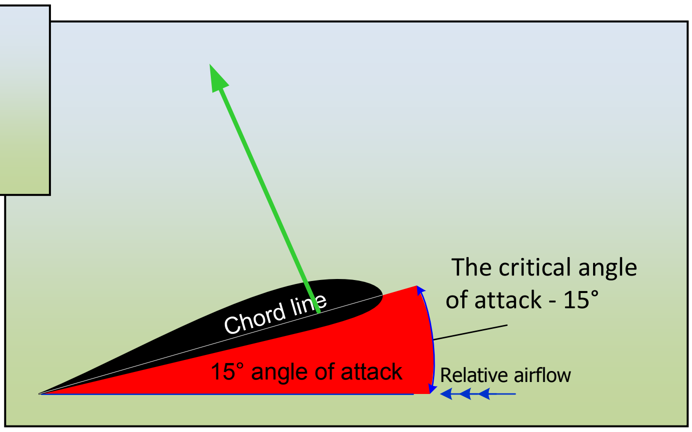
Let's begin with a basic stall – no power and no flap. We simply select a reference point on the horizon in front of us to keep straight on and apply full carburettor heat (if fitted) and gently close the throttle. With the closing of the throttle, the reducing slipstream will see the aeroplane yaw slightly - we must keep straight on the reference point using just sufficient rudder. Our wings are level so no aileron input is required. Drag reduces the airspeed and thus the lift it produces so we will need to gently and progressively ease the stick (or yoke) back to increase the angle of attack just sufficient to keep the lift constant and thus maintain height.



As the sketch on the right indicates, as the lift from the airspeed diminishes, we are replacing it by increasing the lift from the C_L by increasing angle of attack. That is, until we reach $C_{L\ MAX}$, the stalling angle of attack.

However, as the speed is decaying and the angle of attack is rising, the symptoms of the level flight stall appear – a loss of noise, a rising nose attitude, the controls becoming lighter and less effective, and the stall warning if one is fitted. But with the rising angle of attack another occurrence is taking place that we cannot see, hear or feel - the centre of pressure, the point on the aerofoil chord through which all the lift may be considered to act – moving up the chord line.





The sketch above depicts the position of the centre of pressure in normal flight. Notice that, in the sketch on the right, the centre of pressure has advanced forward along the chord. It is this advancement with increasing angle of attack that makes flying with a Centre of Gravity aft of the aeroplane's limits so dangerous. If the angle of attack advances to a point forward of the Centre of Gravity, all the forces acting on the aeroplane will be pitching the nose up and there is no way a pilot can regain control.

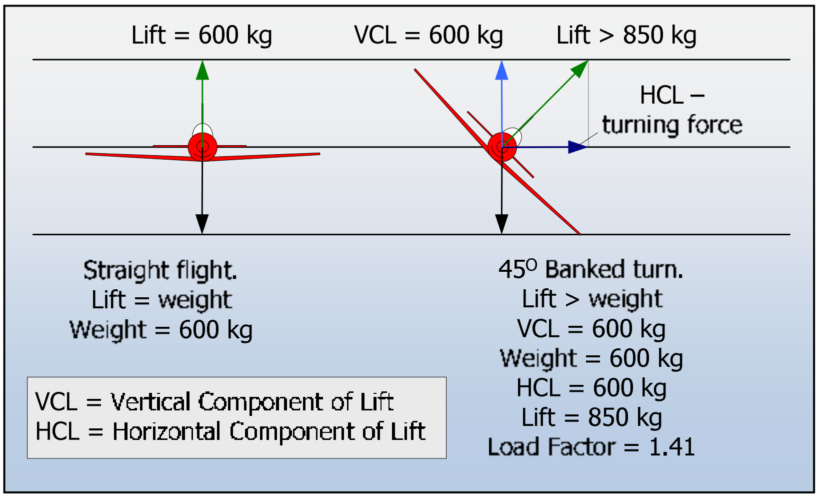
We now reach a very important point in our depiction of the aerofoil stall. If we can imagine for a moment that we are flying level with the aerofoil at 15 ° the aerofoil is providing all the lift that it can from its C_L (current shape and angle of attack). Should the angle of attack be increased any further the airflow across the upper surface will break away into turbulent flow and the lift produced will diminish greatly and the drag will rise substantially. So, if we needed more lift it could only come from either increasing the IAS or increasing the wing area. As the wing area is a fixed quantity in this part of the discussion, we have only indicated airspeed to play with. More weight would need more IAS at the stall: i.e., our aeroplane would have a higher stall speed.

So what factors can modify the IAS at the stall, the V_S? There are six.

1. Changing the aeroplane's operating weight, or loading it by changing direction.
2. Flaps.
3. Slats/slots.
4. Power applied or otherwise.
5. Flying with slip or skid (crossed controls) and
6. Using aileron close to the critical angle.

If we take off at a heavier weight, then the stalling speed will be greater than if we took off at a lower weight. Remember, if we are heavier, then for any given angle of attack we will have to be flying faster to maintain height. Over the period of a flight, fuel is burned and thus weight is reduced. It is a fact that, all other things being equal, the aeroplane will have a lower stalling speed at its destination than it did at departure. It may not be much, but, nevertheless, the principle applies.

Is there anything else that can change the weight of an aeroplane during a flight? The answer is both a yes and a no. Yes, weight can be reduced by dropping mass from it such as a crop duster spreading fertiliser or spraying liquid, or parachutists playing, “Race-you-down”, and leaping from the opened doors. OR, and this is a BIG OR, we can increase the loading (apparent weight) by changing direction, either by turning, or pulling the nose up. And the faster the rate of change of direction the greater will be the apparent weight increase. The sketch below relates to turning.



The sketch left is a vector diagram displaying the increasing forces required to turn an aeroplane when it is in balance – i.e.–***<u>NO SLIP OR SKID</u>***.

Of particular interest to us is the apparent increase in weight with angle of bank increase. The left image on the sketch shows no bank and here the wings just support the 600 kg aircraft weight. The right side image shows an aeroplane in a 45° bank. For us, the importance lies in the last line of the details – the load factor of 1.41. From this we can calculate the stall speed of this aeroplane in this banked turn. The calculation is simple. The new stalling speed will be the level flight stall speed in this configuration, multiplied by the square root of the load factor. In other words, if the aeroplane has a stall speed of 45 knots, the new stall speed is 45 X √1.41 (or 45 X 1.187). This equals 54 knots, a 9 knot increase which is notable. As all aircraft in a 45° turn will have a load factor of 1.41, this is a calculation available to everyone. Following on, because the load factor for all aeroplanes in a 60° turn is 2, so, in a 60° banked LEVEL turn, it will stall at 45 X √2 (or 45 X 1.414.) The new stall speed during the turn will be 64 knots, an increase of 19 knots. Now THIS is worth knowing!

$$\textbf{Weight} = \textbf{Lift} = \overset{\text{At } C_{L\,MAX}}{C_L} \times \textbf{IAS} \times S^{\text{Fixed}}$$

If the weight or loading is increased, then, to maintain height…

The lift must be increased, so, ..

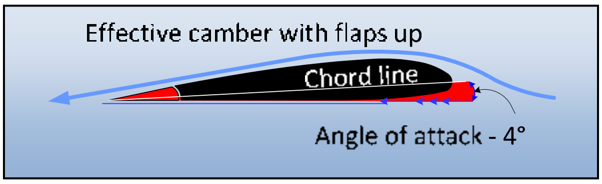
With the angle of attack at its MAX, ..

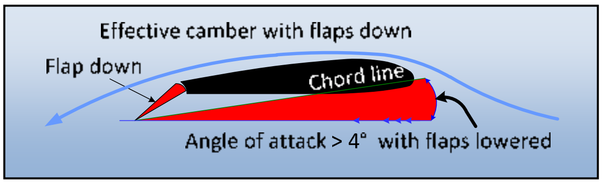
The IAS must be increased to provide the extra lift.

From the previous illustration, we can see that the combined effect of the angle of attack and the indicated airspeed is providing sufficient lift to counter the weight and, if one is diminished, the other must proportionally increase to maintain a constant value of lift. However, as we now can see, this mutual arrangement stops at the stall because we cannot get any more lift from the C_L, the aerofoil has reached its $C_{L\ MAX}$.

However, the C_L is also influenced by two other devices which may be fitted to the aerofoil. These are the trailing edge flaps (when fitted and are lowered), and slats forming slots, (also when fitted). Let's see how these two devices can lower the stall speed. Note that heavy aeroplanes may also be fitted with leading edge flaps but these are outside this discussion

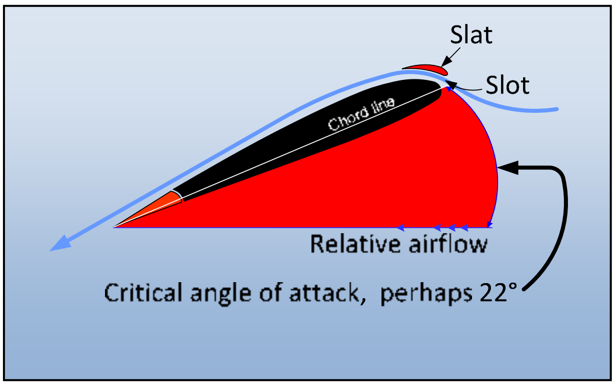
Trailing edge flaps are hinged surfaces that form part of the inboard trailing edge of a wing. They vary in design and effectiveness and, when lowered, change both the amount of lift (C_L) and drag the aerofoil generates at any given air speed. The C_L increase is due to the camber increase experienced by the aerofoil. Note, also, that lowering flaps increases the angle of attach at the time of lowering.





See the sketches above to explain the change in angle of attack when flaps are lowered.

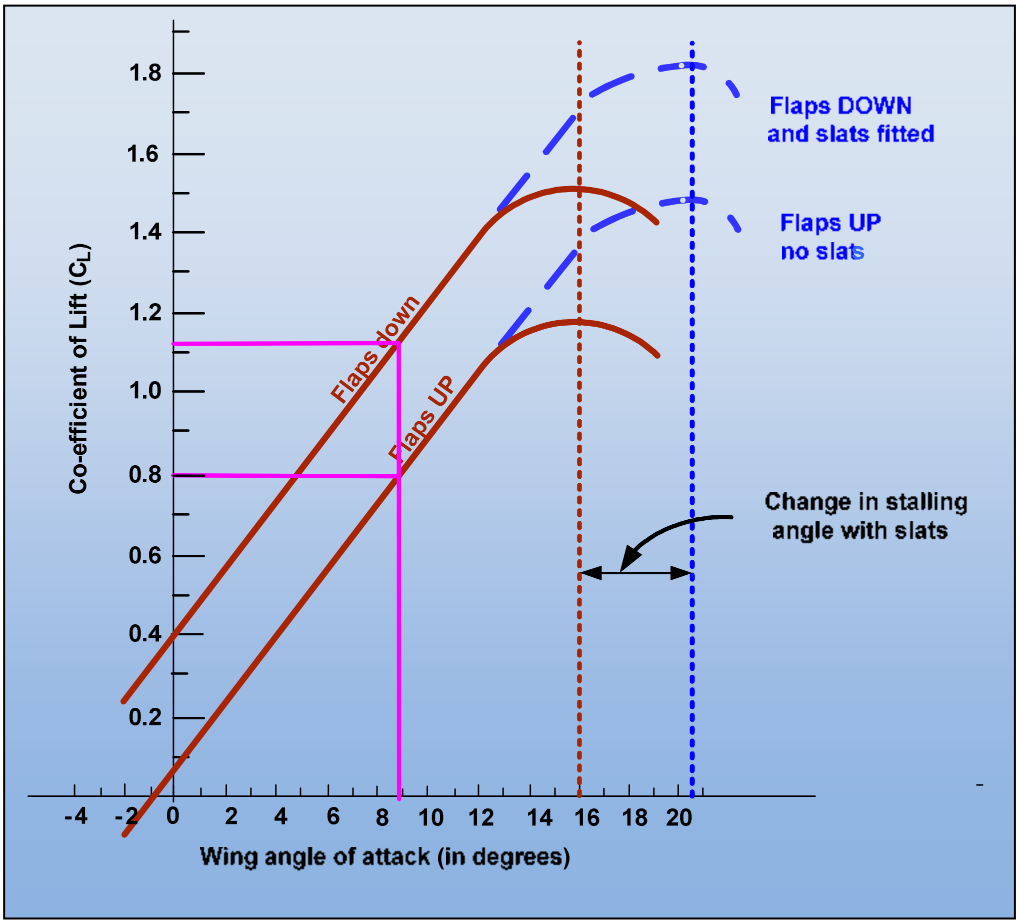
Slats, on the other hand, are fitted above and forward of the leading edge. Their function is simple – they are a mechanical/physical guide or fence that forces the air passing between the lower surface of the slat and the upper surface of the leading edge to change flow direction and pass over the upper surface of the Aerofoil instead of breaking away. The term slat is sometimes interchanged with slot. In truth, the slat is the added physical device, and the slot is the passage created between the device and the aerofoil surface. In other words, slats create slots.



The upside of slats is that they delay the stall until a higher angle of attack is achieved, their downside - they almost inevitably cause a permanent and considerable drag increase. So lets see a table of the beneficial effects of flaps and slots

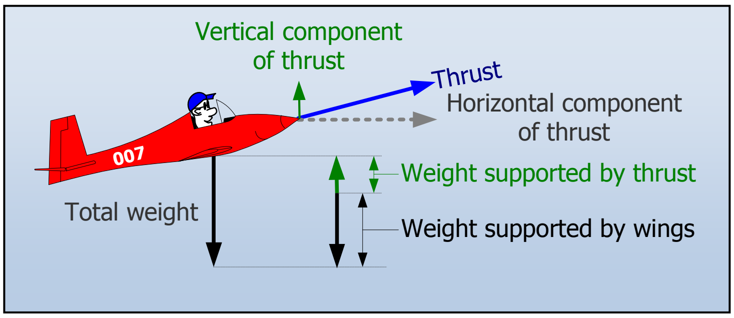
Device	Effects	Result(s)
Simple flap	• Same stalling angle, • Increased camber	Stalling angle unchanged, Lowers stall speed a little and increases drag
Fowler flap	• Same stalling angle, • Increased camber, • Increased wing area	Stalling angle unchanged, Lowers stall speed considerably, & substantially increases drag
Slats	• Increased stalling angle of attack (increased C_L).	Lowers stall speed considerably. Adds substantial drag in all stages of flight.

The comparative effects of flaps and slats can best be realised in a graphic comparison



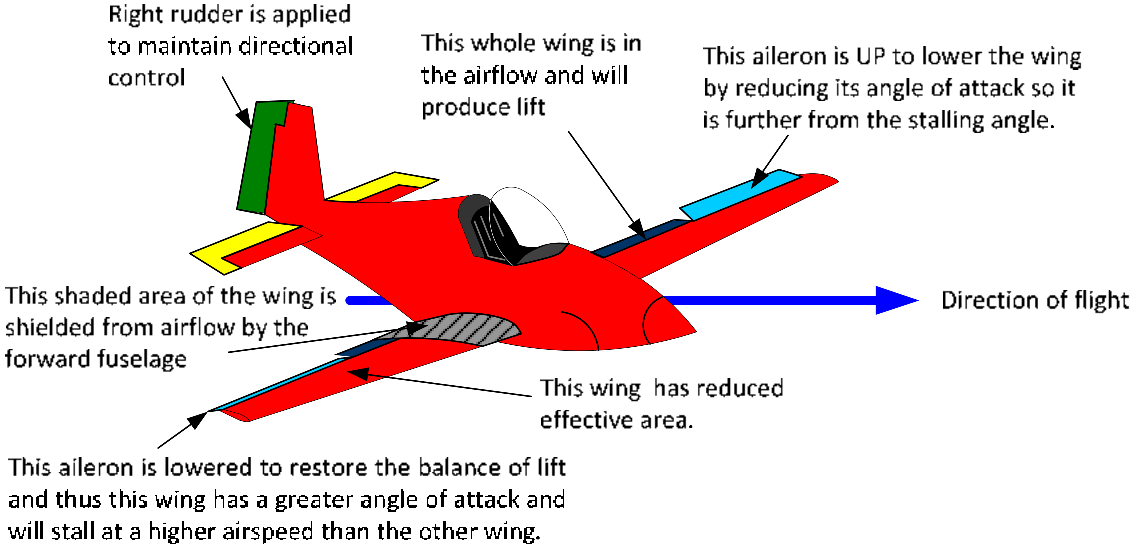
The graph shows that our C_L value is 0.8 at 8.8° angle of attack with the flaps UP, but notice that this improves to C_L 1.12 at this same angle of attack with the flaps DOWN.

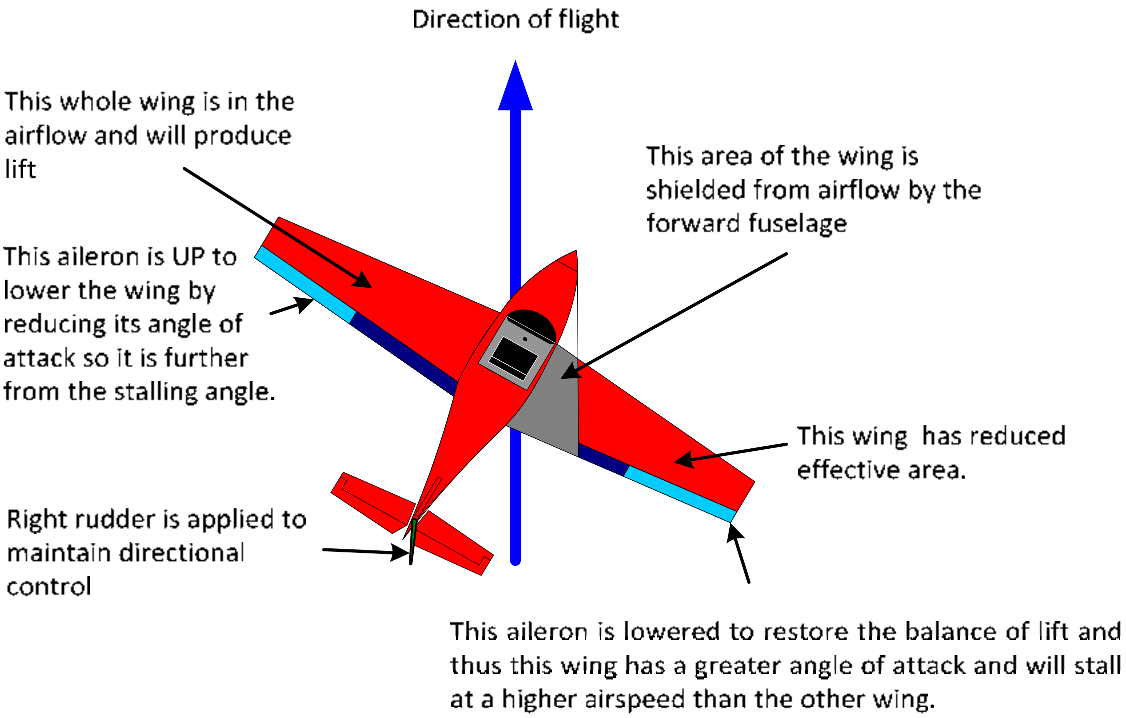
Adding power decreases the stall speed. As the illustration to the right depicts, power will support some of the weight. In our last few paragraphs we have determined that adding weight (or loading) raises the stall speed so if something decreases the weight the wings have to support the stalling speed will decrease. The reason that the wings sense a decrease in weight lies in the inclination of the aeroplane's longitudinal axis causing the propeller's thrust to pull both forwards and upwards. The forward thrust opposes drag, and the upwards thrust supports some of the weight. With the weight reduction comes a stall speed reduction. In theory, with enough power an aeroplane could hang vertically, its thrust supporting all its weight. However, the power is coming from the rotating propeller and the torque from the prop is trying to roll the aeroplane away from the propeller's direction of rotation. To stop the roll, aileron must be applied so one wing will have a higher angle of attack just to stop the roll from prop torque.



In conclusion, note that that the reverse also applies and decreasing power will INCREASE the stall speed from what it was before the power was decreased.

How does flying out of balance (with slip, or skid, or the ball not in the middle) change the speed at the stall? This is of primary concern by its very insidiousness. An aeroplane that is flying out of balance will have a higher stalling speed than if that aeroplane was being flown without slip or skid. The reasons are twofold. To fly out of balance but without roll, one aileron must be raised to hold a wing down whilst the other lowered to hold that wing up. This means that one wing has a higher angle of attack than the other so will stall first, before the wing with the up aileron. Also, the wing with the down aileron is shielded to some extent by the fuselage and so has less effective area to carry its share of the weight so it will require further down aileron.

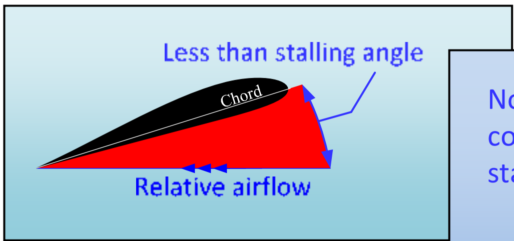


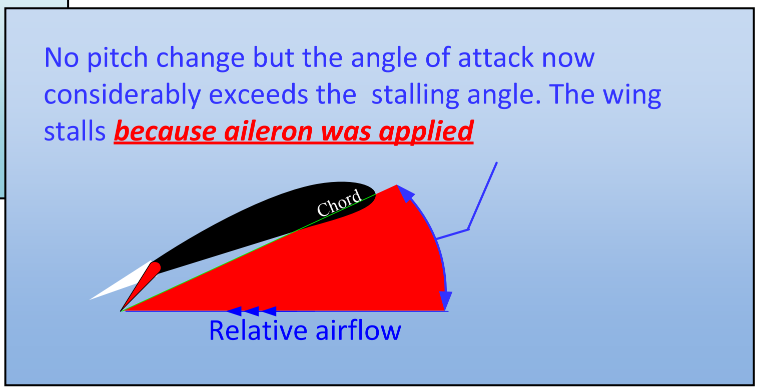


In this situation, the pilot is holding right rudder and left stick and, if the angle of attack is raised because the speed decays, the right wing will stall before the left, at a higher speed than the left wing. The reasons for the right wing stalling first are that the wing area around the right aileron has a higher angle of attack because of the lowered aileron.
Flying out of balance, may be the result of several things including deliberate control inputs as when doing a slipping turn to lose height on approach, poor flying skills resulting in a lack of coordination entering and exiting turns, failing to correct yaw with rudder when changing power or airspeed, or failing to stop yaw when one wings stalls before the other.

The primary use of aileron is for roll control and we develop the natural response of rolling level whenever our wings are not level. HOWEVER….. this is NOT an ideal response when our aeroplane is stalled or even close to the stall. Let's see again how ailerons work.

When we want to raise a wing we put the aileron down. This increases our camber and this provides us with more aerodynamic lift and the wing rises. However, moving the aileron down, also increases our angle of attack because it changes the line of the chord – the chord line. Thus, applying aileron close to the critical angle can induce a stall in one wing whilst moving the other wing further from the stall. Obviously, in this event, we have induced a complete reversal of stick/aileron control and left stick no longer provides left roll.





We can induce a stall by applying aileron at a high angles of attack such as when flying slowly in level flight. So, the slower one flies, the more gentle on the controls one needs to be.

Next month we will be looking at what the aeroplane does when the stall occurs and how they can influence the best technique for restoring the aeroplane to unstalled flight, If you have questions relating to this piece on stalling, please don't hesitate to email me on kni.rob@bigpond.com.

Happy Flying

Committee Contacts

Sandy Walker	President	0424-958-173
Peter Ratcliffe	Vice President	0418-159-429
Peter Biddle	Secretary	0402-403-469
Priscilla Smith	Treasurer	3206-3548
Peter Ratcliffe	WBMA Delegate	0418-159-429
Rob Knight	Editor Brisbane Valley Flyer	0400-893-632

DeLorean's DR-7 Prototype Could Fly in Late 2018

Moving on from DeLorean's car, this two-seat aircraft could park in a home garage.

By Rob Mark August 16, 2017

DeLorean Aerospace unveiled the design for the DR-7, an electric VTOL aircraft.

The DR-7 will manoeuvre with a pair of 360 degree thrust-vectoring electric ducted fan units the company says will make the aircraft extremely stable. The DR-7's carbon composite body is a monocoque structure, similar to a Formula 1 race car, and will accommodate two passengers in a fighter-jet style tandem seating arrangement. The VTOL aircraft uses an autonomous flight control system that will also allow manual operation for the performance flying enthusiast. DeLorean says the aircraft is expected to be flown with minimal pilot training.

DeLorean hopes to put the DR-7 prototype in the air in 2018.

With its centreline twin vectoring propulsion system (CTV), drag is greatly reduced, while the fuselage functions as an airfoil to improve efficiency and increase low speed stall resistance. The thrust vectoring fan system eliminates the need for a rudder, further reducing drag and allowing higher cruising speeds.

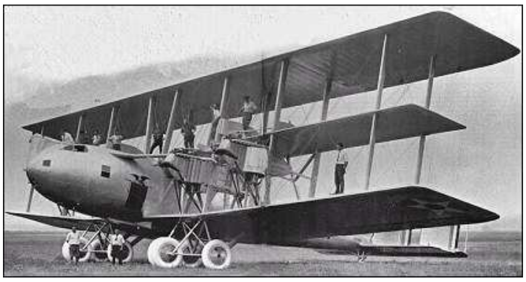
Preliminary specifications released by DeLorean Aerospace, founded by carmaker John DeLorean's nephew Paul, show the DR-7 will be just under 20 feet in length, short enough to fit in most home garages. When the 18.5-foot wings are folded, the resulting aircraft is just 7.5-feet in width. DeLorean expects the two-seat aircraft to fly 120 miles on a single charge and cruise at 150 mph with a top speed of 240 mph. The DR-7 prototype is expected to fly by the end of 2018.

FLY-INS Looming

Sat 04 Nov	Watts Bridge (YWSG)	BVSAC Monthly Meeting and Lunch RSVP
Sun 05 Nov	Gympie (YGYM)	Gympie Aero Club Brekkie Fly-In
Sun 12 Nov	Watts Bridge (YWSG)	Watts for Breakfast Brekkie Fly-In
Sat 18 Nov	Dunwich (YDUN)	Straddie Fly-In & Grand Breakfast
Sun 19 Nov	Caboolture (YCAB)	BVSAC to visit SAA Caboolture

Mystery Aircraft (November Issue)

What's this?



Mystery Aircraft (Last Issue)

Short Sturgeon. A torpedo bomber that first flew in 1946. Only 26 were built before production was stopped by the post WW2 British Government in its austerity drive.

Keeping up with the Play

(Test yourself – how good are you, really?)

1. If the dynamic vent of an aeroplane became blocked in a climb, what likely effect would this have on the altimeter?.
   A. The altimeter would under-read.
   B. The altimeter would over-read.
   C. The altimeter would read zero.
   D. No Effect - The altimeter would read normally.

2. The chord line of an aeroplane's wing is usually set at an angle to the aeroplane's longitudinal axis. What is this angle called?
   A. The angle of incidence.
   B. The longitudinal dihedral angle
   C. The angle of attack.
   D. The angle of inclination.

3. Which of the following correctly describes the fundamental cause of an aerodynamic stall?
   A. Airspeed too low.
   B. Angle of attack too high.
   C. Climbing too steeply.
   D. Generated lift is less than the aeroplane weight

4. In an aeroplane in a steady power-off glide:
   A. Lift is less than weight.
   B. As there is no thrust, drag is unopposed.
   C. Aircraft loading is reduced because of the rearward inclination of the total reaction.
   D. Lift = Weight.

5. Increasing an aeroplane's dihedral would likely increase which of the following?
   A. Dynamic stability.
   B. Lateral stability.
   C. Longitudinal stability.
   D. Static Stability.
   E. Directional stability

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

If you have any problems with these questions, call me(in the evening) and let's discuss it! Ed.

BRISBANE VALLEY SPORT AVIATION CLUB Inc

MINUTES OF THE OCTOBER 2017 GENERAL MEETING

MEETING LOCATION: Watts Bridge Memorial Airfield – BVSAC Clubrooms
MEETING DATE: 7 October 2017
MEETING OPENED: 1010hrs

MEMBERS PRESENT: 13
APOLOGIES: Ian Ratcliffe, Peter Ratcliffe, David Ratcliffe, Liz Cook, Glenda Faint, Mark Purdie. Richard Faint, Vern Grayson, Peter Biddle

VISITORS:
NEW MEMBERS:

MINUTES:

September meeting of the BVSAC Inc.
Proposed: Sandy Walker seconded by Mike Smith, Acceptance motion carried.

BUSINESS ARISING:

- Nil

PRESIDENT'S REPORT:

Discussion on the Past Months activities
September 4th Focus Meeting
September 9th Impromptu SAAA fly-in and BBQ lunch
September 28th Homebased Group Information Q&A Night
Scott Meredith providing a tipper to WBMA to aid in watering airfield runways
Home based groups providing WBMA with volunteer helpers

SECRETARY'S REPORT:

Correspondence in

Date	From	Subject
29 Sept	Liz Cook	BVSAC mailing address
2 Oct	Bruce Layt	Resignation

Correspondence out

Date	To	Subject
22 Sept	Dale Meyer	New member welcome
29 Sept	Liz Cook	BVSAC mailing address
29 Sept	Stephen Graham	New member welcome

TREASURER'S REPORT:

The President read the Treasurers report for August 2017.

- BVSAC ING account - $7570.07
- BVSAC NAB account - $3890.71

.
WATTS BRIDGE REPORT
Peter Freeman advised

- Watering continues on both new access gate 8 and on the second runway
- New Tank to be fitted to Scotts truck to help in watering runways

GENERAL BUSINESS:

Sandy Walker Proposed that we complete the Clubhouse electrical and sheeting Mike smith was asked to assist and provide dates and times to organize volunteer assistance

Sandy Walker propose that a roster be developed to assist in organizing volunteers to assist Peter Freeman with WBMA Airfield maintenance .

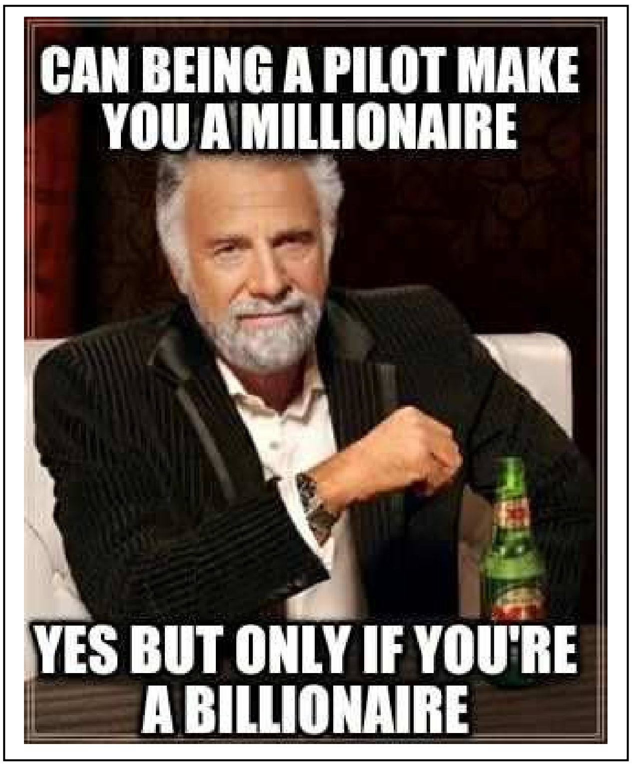
Mike Smith suggested we repair the tank stand at the Hanger and a roster is to be provided so that work can be scheduled

Mike Smith – led discussion on the questions in the September Newsletter

NEXT MEETING: The next meeting will be on Saturday 4th November 2017 in the BVSAC Clubrooms at Watts Bridge immediately following the Annual General Meeting. A BBQ lunch will follow the meeting.

MEETING CLOSED: There being no further business, the meeting was declared closed at 1110 hrs.

--ooOOoo--



¼ Share for sale - $4500
A share in a WB Drifter 582 is being offered. The aircraft is based at Lynfield west of Brisbane.
¼ share price of $4500 (includes hangarage
Contact Kev Walters Tel 0488 488 104

Aircraft for Sale - SLING
Year of build. 2016. Hobbs meter shows 53.2 hours but exact engine hours I will have to check as it is currently being flown. Complete with factory drawings and a large number of photos showing various stages of completion.

Cruising at 5450 RPM gives 108 knots, burning 18 litres per hour. With a total fuel tank capacity of 150 Litres (75 Litres per side) it has a maximum range of 900 nm.
The aeroplane is currently hangared at Gatton Air park

I also have a significant quantity of clecos for sale.
$115,000 (neg)
Call Geoff Scott on 0435 248 483

Aircraft Offered for Reluctant Sale

My Colby-503, a single-seat, one-off aircraft, based on the highly successful American Pioneer Flightstar. Currently flying most weekends, it has around 200 hours airframe total time and under 30 hours on a rebuilt Rotax 503 power plant. STOL, this aircraft cruises at anything between 45 and 60 knots, depending on the power setting and can comfortably exceed its VNE in a climb. It holds 40 litres in a belly tank and a further 10 behind the seat. A 95-10 aircraft, its rego is 10-1918, valid until July 30 2018.

A sale would include a purpose-built trailer (uncovered and unregistered), a spare 503 engine (disassembled), and a ground handling tow bar. There are some other assorted spare parts such as a strut, control surface tubing, fuel pump, spark plugs etc.

I currently use a hand-held radio mounted in the cockpit with a head set and PTT fitted on the side-mounted stick.

I am putting my aeroplane up for sale only on the advice of my health professional.

$5,800.00

So, if you fancy owning and flying a totally unique aircraft, the ONLY one of its type in the world, contact Rob Knight, on 0400 89 3632, or email me at kni.rob@bigpond.com.