Stalling and spinning notes for solo pilots

What happens when the glider stalls

In slow motion…

The maximum lift that can be achieved

occurs immediately before the stall.

As the angle of attack is increased,

the airflow across the upper surface of the wing

becomes turbulent at the trailing edge.

With any further increase in angle of attack,

the centre of pressure moves forward,

and the turbulence spreads forward

towards the leading edge.

The turbulent flow prevents the production

of low pressure over the upper surface

and the lift collapses.

The centre of pressure moves rearwards,

causing a pitching moment,

and the nose drops.

Pulling back on the stick is fruitless…

the elevator cannot raise the nose

whilst the wing is stalled.

The glider remains stalled because the angle of attack is still high, even though the glider is apparently nose down. The wing is not providing sufficient lift to support the weight of the glider, and the overall path through the air is more vertical.

The stall is caused by too great an angle of attack. To recover the angle of attack must be reduced.

Other considerations

It takes a lesser increase in angle of attack to make a wet wing stall. Water, bugs, dust and ice on the upper surface of the wing act as miniature interruptions to what should be smooth airflow. Inevitably they accumulate on the leading edges, turning the airflow turbulent behind them, just where the laminar flow is most critical, thereby reducing the amount of lift that can be produced by the upper surface of the wing.

Therefore the speed at which the contaminated wing stalls will be higher than the stalling speed of a clean wing.

Ice tends to accumulate relatively evenly across the leading edge and can, in addition to spoiling the laminar flow, build up in thickness, subtly changing the profile of the aerofoil, (for the worse, of course!).

Loading the wings

Any manoeuvre that increases the loading on the wings will also increase the stall speed. The stall speed increases by the square root of the load factor.

The stall speed increases in the turn because the wing has to not only support the weight of the glider, but also counteract the centrifugal force, or, if you like, provide a force in the direction of the turn. Pulling 2g, (for instance in a 60 degree banked turn), increases the stall speed to 1.4 times the 1g stall speed.

A high speed stall occurs when you are pulling a lot of g, for instance, when pulling up too fiercely from a stall recovery! Pulling 4g will double the 1g stall speed.

When the airbrakes are opened, the lift distribution across the wing changes; the part of the wing affected by the airbrakes no longer contributes to the lift. Therefore the stalling speed is increased.

Spin entry

Stall the glider asymmetrically, even only a little asymmetrically, and one wing will stall before (or more) than the other, leading the glider to a curved path around the (more) stalled wing. This wing has more drag, slowing it further, and deepening the stall across the wing. The outboard wing, which is flying faster, generates more lift. So the bank increases and the inboard wing becomes more deeply stalled. The nose drops. The glider is now spinning. All this happens in a split second!

After the initial nose drop, the nose can rise again, giving the pilot the illusion of the normal gliding attitude but remains unmistakably a spin, thanks to the very noticeable ongoing rotation. The flat spin is caused by centrifugal force, and can make the spin more difficult to recover from. It is more likely to happen in tail-heavy aircraft, or if the pilot is lightweight and close to the minimum cockpit weight.

Misuse of the rudder and ailerons are not the only means of stalling the glider asymmetrically; turbulence within the parcel of air the glider is flying in will also do the trick, as will unequally opening airbrakes.

If the wing unstalls immediately after the wing drop, (that is, during the very early part of the spin), then the glider will enter a spiral dive.

The wet wing spin

Play around close to the stall and what do you get? A SPIN.

Try to pick up a stalled wing and what will you get? A MUCH BETTER SPIN!

But try picking up a contaminated, stalled wing and even the most reluctant, “unspinnable” glider might bite!