Stalling made easy


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Phil Unicomb

UNFORTUNATELY, stalling remains an issue that many experienced pilots and flight instructors still don't fully understand. Each year there are several fatal accidents in general aviation which could have been avoided if the pilots involved had had a better understanding of the basic concept of stalling.

Stalling is easy. That's not to say that getting into a stall is easy, but the subject itself, why stalls occur, how to avoid them, and how to get out of them if you don't (avoid them), is much more straightforward than most people think.

Why do stalls occur? An aerofoil will stall when it takes too big a "bite of the air". That is, when it reaches a situation called the critical angle of attack. So what's that? Angle of attack is not nose attitude. It is the angle formed between the chord line of an aerofoil and the relative airflow or relative wind.

If you consider the chord line as an "upper jaw", and the relative airflow as a "lower jaw", then the stall will invariably occur when those jaws are opened up to an angle of about 16 degrees. This will happen regardless of attitude or airspeed. Now, if you close the bite just a little, say back it off by a couple of degrees, then there is no more stall. And that's all there is to it. Simple.

(While most general aviation aircraft stall at an angle of attack of about 15 or 16 degrees [the critical angle], the figure is usually higher for jet aircraft and aircraft fitted with certain high-lift devices. The same principle applies though: the aircraft will stall at the critical angle of attack and stop stalling when the angle of attack is reduced.)

Remember that long distant pre-solo stalling lesson? The instructor reduced the power, raised the pitch attitude up above the horizon, and the airspeed fell away. "That's the stall," he or she said as the altimeter started to wind down.

Five hundred feet later you recovered. Was it something like that? The message many people take away from this lesson is that stalling only happens when you go slow with the nose high. You will stall in that configuration, but the reason is that you pulled to the critical angle of attack (or bite). That can happen lots of ways – any speed, any attitude.

We should now ask ourselves, "What controls this bite or angle of attack?" The answer is only one thing: the elevators. You'll find that because the stall happens at a constant angle of attack, this will relate to a fairly constant elevator position at the stall. People call this the "stall stick position". If you don't jerk the control column beyond this position, you will not stall, again, regardless of speed or attitude.

You can find the stall-stick position in your aeroplane by simply turning at a moderate rate and pulling firmly at a moderate rate until you just touch the pre-stall buffet. (Don't experiment on your own. Try it with a specialist flight instructor.) Back off just a little, and the buffet stops. As you see, there's not much in it , is there? You recovered that stall with no real change in speed or attitude and no height loss.

People can become confused about stalling and this confusion creates fear. This is because it is often made to sound so complicated by the introduction of other factors. Power, weight, flap and load factor will affect the speed at which the aerofoil will stall, but not the common angle of attack or bite at which it occurs. It stays the same.

No matter what the attitude or airspeed, if you pull on the stick to the critical angle, you will stall. To recover, just back off on the stick a little. You don't need to go diving off hundreds of feet! It was not the attitude that caused the stall.

Although most people associate stalling with high attitudes and low speeds a stall can occur in a 45-degree descent at 200kt, and yet an aircraft can be unstalled in a vertical climb at 5kt as long as the angle of attack is less than the critical angle.

Power and flap reduce stall speed but, for all intents and purposes, the stall still occurs at about the critical angle of attack. Weight and load factor increase stall speed but, the stall still occurs at the critical angle of attack.

What about bank angle? Bank angle has no effect on stall speed. Think about a steep turn, say 60 degrees. To maintain altitude you need to pull back on the stick (which increases the angle of attack). It is the increase in angle of attack, not the bank, which increases stall risk. Make the same turn, but this time don't worry about maintaining altitude. If there is no load on the wing there is no increase in stall speed.

If bank could make us stall, how would it ever be possible to do a roll? In the course of my daily work I roll aeroplanes through 360 degrees regularly. A roll is the ultimate bank, we bank through 360 degrees. There's no stall, nowhere near it, only if we pull too far.

Climbing and descending turns: Late last year a Cessna 172R carrying four people crashed near Gisborne in Victoria killing everyone on board. Witnesses reported that after completing two 360 degree left turns in the vicinity of the accident site, the aircraft adopted a nose-high attitude before entering a steep turn to the left. Most of the witnesses, including an experienced pilot, described seeing the aircraft's bank angle steepen and then the nose drop such that the aircraft was heading approximately vertical, in a nose-down attitude. However, one witness described seeing the aircraft roll in a right-wing-over-left manoeuvre before it pitched nose-down. Another witness reported seeing the aircraft spiral to the ground however most witnesses saw it descend straight to the ground in a nose-down, near vertical attitude.

In a climbing turn, the outside or upgoing wing is meeting the relative wind at a slightly higher angle of attack than the lower wing. If we pull on the column to the stalling bite, then the upgoing wing will reach it first. It will stall before the lower wing. The rate at which the stick is pulled will dictate the severity of the reaction. It can be quite violent.

The upgoing wing suddenly drops and the aeroplane quickly rolls away from the original direction of turn.The nose falls.

High-wing singles are particularly susceptible to this type of event.The amount of bank is not the issue either, it will happen as easily at 30 degrees as it will at 60.

Recovery is very simple when learned, but the "knee jerk" reaction is to quickly move the stick in the opposite direction to the roll, and to pull. This has the effect of:

• Increasing the drag on the wing that is more stalled.
• Increasing the angle of attack by changing the chordline (lowering it) and thus deepening the stall.

This is not a problem if we are not pulling toward the stall position on the stick. The proper recovery is to back off on the stick and level the wings with rudder. (You don't have to throw the stick fully forward, just centralise the controls – and don't reduce power unless the aircraft is spinning.)

A similar situation can occur in a descending turn. The difference is that the downgoing wing meets the relative wind at a higher angle of attack and stalls first, meaning the aircraft will drop a wing into the turn. But this will only happen if you pull to the critical angle of attack. Remember, it's related to how far we pull the column. The recovery is the same as any other stall – reduce the angle of attack and level the wings with rudder.

And the same recovery can be applied to the inverted stall. We simply stall the other side of the aerofoil. Once again, back off on the stick – move it backwards to a central position – and level the wings with rudder. Remember, it's simple. A stall is just a pull (or push in the case of inverted stalls) to the critical angle of attack or bite – regardless of attitude or airspeed.

In order to gain the proper benefits and to study efficient recoveries from advanced stalling configurations, spinning and mishandling etc. instruction from a suitable specialist flight school is thoroughly recommended. Don't experiment on your own.

Phil Unicomb is a grade one flying instructor who specialises in emergency manoeuvre and aerobatic training. He has won five national aerobatic titles, and was the world Tiger Moth aerobatic champion in 1992.

Stalling myths

Impress your friends with these simple stalling one liners.

1. Friend: "Don't bank too steep! You increase the risk of stalling!"
You: Bank is unrelated to stalling. Stalling is a function of angle of attack. Pulling, in the turn causes the stall.
2. Friend: "What speed does she stall at, mate?"
You: Any speed you like! But always at the critical angle of attack.
3. Friend: "If you cross the controls you will increase the danger of stalling!"
You: Crossing the controls cannot possibly, on its own, stall the aeroplane. If that was the case sideslipping approaches would be impossible. However, if you increase the angle of attack to around 16 degrees, you will stall and that's where there's trouble: yaw + stall = spin.
4. Friend: "How can you tell me that you can pull the nose up 45 degrees above the horizon when it stalls at a lower angle?"
You: Angle of attack and nose attitude are not the same. Think about a loop. We point in every direction in pitch, but we do not stall unless we pull to the stall position.
5. Friend: How fast do you have to go to get into a high speed stall?
You: A high speed stall occurs any time when you pull to the stalling angle above the published power-off 1G stalling speed. So, how fast? Just about any speed you like up to and beyond Vne.