# Stall Speed?

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Stall and stall-spin accidents continue to be the most frequent cause of fatal glider accidents in all phases of flight. Loss of Control In-flight (LOC-I) continues to be the leading cause for all general aviation accidents as well.

We should all recognize that a stall occurs when the wing, or a section of it, exceeds the critical angle of attack. This is defined as the angle between the relative wind (which is simply opposite the direction of movement) and the chord line of the wing – which connects the leading and trailing edges of the airfoil.  If you knew that, great – you'd have passed the first question on any oral exam covering aerodynamics of flight.

That only gets us so far because we don't have direct indications for any of the items that make up the angle of attack nor are we aware of exactly what angle the critical angle of attack is!

So, we are often left with an indicated airspeed to define when the wing is likely to stall.  In simple terms, the more load the wing is asked to support at any given speed the higher angle of attack will be required to provide the needed lift. The airspeed at which it takes the critical angle of attack to create the desired lift is the stall speed.  The stall speed for maximum weight at 1 G is published in the POH, and possibly at other weights.  Some manuals also include the speeds at a variety of bank angles.

It is essential to fight safety that we understand that those published stall speeds are only valid under those given conditions.

So, what else can affect the stall speed? Let's explore that knowing that there are some we can control and some we can't.

I mentioned bank angle. This is the most common way to increase the stall speed. Perhaps you've even memorized the factors by which the stall speed will increase in a typical 30° and 45° bank turn. These are 7.5% and 18.9%, which can be safely rounded up to 10 and 20% for easy math. That relationship is not linear, it changes by the square root of the load factor, meaning if the load factor doubles, the stall speed goes up by 41%. Did you correct for a nose drop and increase the pitch in that turn? You've increased the load factor, the angle of attack, and thus the stall speed. So, that's the pilot increasing the load factor directly.

But even those increased factors are only valid in a turn in smooth air with no additional g-force applied. If you provide any pitch up during the turn whether to try to tighten the turn or just correct for the nose dropping a bit, you'll be increasing the angle of attack to do so, and therefore closer to stall at your current speed.

Did you encounter a wind gust from below like when entering the thermal core? That upward gust changed the relative wind and thus increased the angle of attack, again pushing you closer to the critical angle of attack and stall at your current speed. You'll feel that increased load factor too. That gust could have resulted in the wing stalling with no action on your part.

We know that a spin is "an aggravated stall" where one wing is stalled more than the other. One of the most common elements that turn a stall into a spin is skidding the turn, using too much inside rudder. When we skid a turn we bring in some additional complications of yaw, spanwise flow, and aileron position.

In the skidding turn the air flows a little sideways from around the fuselage onto the inside (down) wing. This creates a disturbed airflow over the lower-inside wing: strike one.

The inside wing will have a slower airspeed: strike two.

With the rudder yawing the aircraft, the aileron on the inside wing will have to be displaced downward to prevent further roll, this increases the angle of attack in the aileron portion of the wing. This can put that portion of the wing past the critical angle of attack. The resultant loss of lift and added drag on the already slower, and lower wing, allows it to fully stall and drop even more. The yawing motion gets rotation started, and that's strike three, and over you go into the spin.

Slipping turns, on the other hand, have undisturbed flow on the lower wing and the aileron will be raised – lowering its angle of attack for much more benign stall behavior.

The point to bring home here is that simply being above "the stall speed" does not assure you a margin above stall. G load, gust factors, skidding turns, spanwise flow, and displaced ailerons all contribute additional factors than simply being too slow.

Maintain a safe margin for your bank angle (remember count on a 20% increase in typical 45° thermalling turn), take it easy on the pitch ups when slow, add extra speed when gusty, and never skid a turn.