FAQ's: Stalls
By Tom Johnson

During the last couple of issues, writers and readers of this magazine have been discussing stalls and various topics associated with them. We, at the Soaring Safety Foundation, resoundingly applaud informed discussion among the membership, especially on a topic as fundamental and important as a well-informed understanding of stalls. As the "Safety Guys", we also have to occasionally act as referees and try to keep the discussion "in-bounds". We attempt to do this be separating fact from opinion, and procedure from technique.

When discussing stalls, there is one fact that is paramount. The wing, or any aerodynamic surface, will stall for one reason, and one reason only: the critical angle of attack (AOA) has been exceeded. Let me say this again: The wing will only stall when the critical angle of attack has been exceeded. It does not stall because you got too slow, or pulled back too hard, or felt mushy controls. It stalls because you put the wing, or section of the wing, into a situation where the total or local AOA exceeded the critical AOA.

It is important to understand that if you stall a section of the wing, say at the aileron where you are trying to lift a wing, you have, for all practical purposes, stalled the entire wing. (More on that in a bit.)

Once you understand and digest this important concept, you can now have a reasoned and informed discussion about stalls.

Can I stall the glider by slowly increasing back pressure on the stick and slowing down until I have a nose high attitude and slow airspeed? Yes, you can. This is the way we normally practice stalls in the training environment. The important lesson to take away from the training is the onset of the stall and the aircrafts behavior after the stall happens.

What happens when I put in lateral controls inputs? When we move the control stick to the left, we are attempting to raise the right wing and lower the left wing. We do this by increasing the local AOA on the right wing, and decreasing the local AOA on the left wing. (Remembering, of course, that AOA is defined as the angle between the relative wind and the local chord line of the wing.) If the entire wing section is close to the critical AOA prior to the lateral control input, the input can be enough to increase the AOA at the downward deflected aileron to cause a stall. Be aware that you DID NOT pull back on the stick, or raise the nose, or decrease the airspeed.

When this type of stall occurs, you will roll the OPPOSITE direction from that which you intended. I want to roll left, and put in left stick, but the local AOA stalls the right wing, and away we go to the right.

This concept is important, because in the landing pattern, or when thermalling with other sailplanes in a gaggle, you can inadvertently stall the glider while trying to roll the aircraft. If you are trying to decrease the angle of bank close to the ground, and you stall the wing you are trying to lift, the resultant roll and spin entry will tax the abilities of even the most proficient pilot.

What happens when I encounter a vertical gust? When the glider flies into a vertical gust, the AOA of the wing will change because the relative wind is changing. When you encounter rising air, the AOA on the wing will increase. When you hit sinking air, the AOA decreases. A basic rule of thumb is that a one knot vertical gust will affect the local AOA by one degree.

We all realize that thermals close to the ground are choppy and gusty. The gust induced stall is most dangerous when thermalling at low altitude trying to affect a save. Remember that in a constant angle of bank turn, you have to displace the stick against the turn to counter the overbanking tendency of our long wings. The aileron on the wing on the inside of the turn will be down and create a higher local AOA in that section of the wing. This area of the wing is most prone to the effects of a gust induced stall.

There are many videos available on the internet that show pilots stalling the aircraft from a gust. It is important to note that the pilot does not make a control input, the airspeed remains basically constant, and the pitch attitude of the aircraft is unchanged as the glider encounters the gust. But the gust causes the wing to stall, and the stall break and auto-rotation is plainly evident.

What happens when I encounter a lateral gust? We normally refer to a lateral gust as a wind shear. We normally encounter a decreasing headwind on final as a consequence of the wind gradient near the ground. But what happens to the wing AOA as we go through a wind shear. The AOA on the wing momentarily increases because the pitch attitude of the glider does not change, but the glider begins to fall from the lack of lift on the wings from the decreased airspeed. This causes the wing AOA to increase.

Once again, the aerodynamics of the situation can cause the wing AOA to approach or exceed the stall AOA without any action by the pilot.

This leads us to the final point.

Why does the glider spin? The glider spins because both stall AOA and yaw are present on the glider. If the glider is not stalled, it will not spin. If there is no yaw at the stall, the glider will not spin. This is partly why we emphasize a coordinated turn close to the ground.

So where does all of this take us?

We have to develop an awareness of the regime of flight that we are in, and what kind of stalls we can encounter. The mitigation strategies for flying in a thermal at 10,000 FT AGL are different from those involving the traffic pattern.

For me personally, if I am in my Mini-Nimbus by myself at altitude, I will thermal very close to the stall. If I am with another sailplane in a thermal, I will pick the speed up by 5 knots or so. And if I have to thermal at low altitude (under 700 ft AGL), I don't, I set up for a landing.

In the traffic pattern, the Glider Flying Handbook recommends flying at 1.5 times the stall speed plus a wind additive. Since on most gliders 1.5 times stall speed and best L/D are about equal, we recommend an approach speed of best L/D plus 5 knots. This gives a stall margin of about 20 knots above stall speed. It also puts you on the positive side of the performance curve. That is, if you encounter a wind shear and a decreasing headwind, your airspeed will decay toward increasing performance (better L/D).

Please continue the discussion. Please know your aircraft and its stall characteristics. And please put personal mitigation strategies in place to be ready for your encounter with an inadvertent stall.