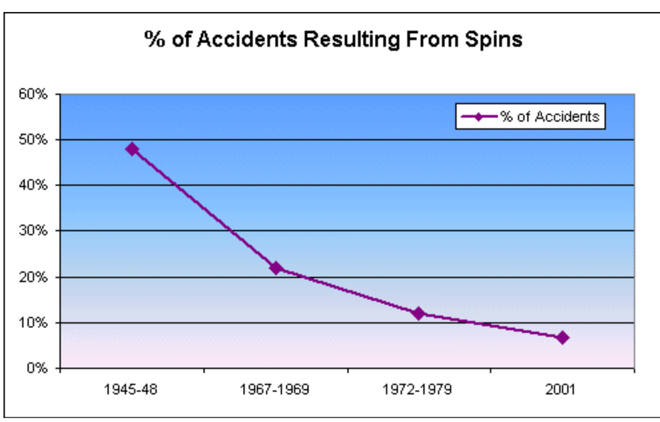
Ground School
Upset Prevention and Recovery Training
Certified Flight Instructor Candidate Spin Training
By Tom Rogers

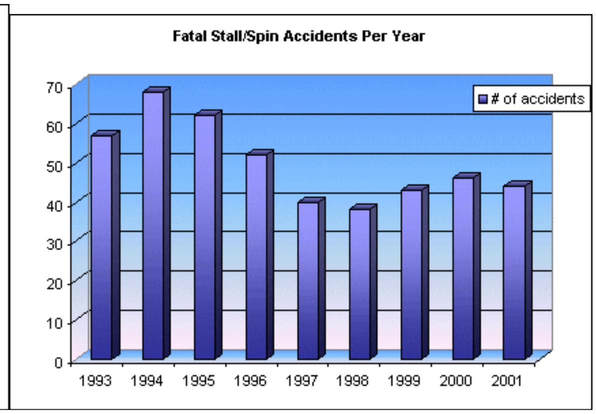
In August 1912, Lieutenant Wilfred Parke, Royal Navy, became the first aviator to recover from an accidental spin when his Avro Type G biplane entered a spin at 700 feet AGL in the traffic pattern at Larkhill aerodrome. Parke attempted to recover from the spin by increasing engine speed, pulling back on the stick, and turning into the spin, with no effect. The aircraft descended 450 feet, and horrified observers expected a fatal crash. Though disabled by centrifugal forces, Parke still sought an escape. In an effort to neutralize the forces pinning him against the right side of the cockpit, he applied full right rudder, and the aircraft leveled out fifty feet above the ground. With the aircraft now under control, Parke climbed, made another approach, and landed safely. Parke had just become the first pilot known to have recovered from a spin, an aeronautical phenomenon not understood to that point. The feat became known as "Parke's Dive", and he gained some fame. Ironically, he was killed later that year following an engine failure and attempted turn back to the field, when he stalled and spun in.

In spite of the discovery of "Parke's technique" spin-recovery procedures were not a routine part of pilot training until well into World War I (1914-1918). The first documented case of an intentional spin and recovery is that of Harry Hawker In the summer of 1914, Hawker recovered from an intentional spin over Brooklands aerodrome, England, by neutralizing the controls.

It took a couple of years before the mystery of the spin was properly understood, but by the middle of the First World War, pilots were trained to spin and recover routinely. Spin training was part of primary flight instruction into the late 1940s. In 1949 spin training was removed from instructional programs by the Civil Aeronautics Administration (CAA) now called the Federal Aviation Administration (FAA). The only people now required to have actual spin experience are those wishing to become Certified Flight Instructors (CFI). The CFI candidate spin endorsement is a logbook entry following ground and flight training which is laid out pretty loosely by the FAA. It is rare for a CFI candidate to actually have to demonstrate spin recovery on a check ride, unless some knowledge deficiency shows up in the oral or they fail the practical test for a spin related issue.

The rationale for removing spins from primary and advanced flight training was that pilots were getting killed in instructional spin accidents. The emphasis was shifted to "Awareness" of stalls and "Avoidance" of spins. The US is one of the few countries that take this approach. So, has it worked?





Reading NTSB reports, the percentage of spins as compared to total accidents is down no doubt. However, the number of stall-spin accidents are still occurring with alarming regularity, as often as weekly. Most are fatal. These data show that the actual number of spin related accidents has plateaued in the US. Annual spin accidents have not gone down in 20 years since 2001.

Another fact is also true, we now have a population of CFIs , many of whom have received perfunctory spin training at best. In fact, I have flown with a number of instructors who openly admitted they were not really comfortable teaching stalls, let alone spins. My personal experience, when I went through my Commercial and Instrument, I had only spun once when a friend took me up in a Cessna 150 Aerobat. When I began my CFI work I switched from primarily Piper aircraft to Cessna. The C-150/C152 and C-172 all could do spins. The flight school I took my CFI and CFII training at was run by a group of ex-USAF fighter pilots. We spun and spun often during my CFI training. I became very comfortable with spins, a bit too comfortable. It was about this time I met my future wife. When I took her up for a sight-seeing tour of Phoenix I said "Hey watch this…." She still married me and 41 years later she often doesn't let me forget that first flight date.

After a stint as a CFI in the Phoenix area I graduated from College (BS Aeronautical Technology from ASU) and was commissioned into the USAF. They sent me back to square one for "real' pilot training. There we used the T-37 (another Cessna) for primary jet training and not only had to spin but show proficiency in spin prevention and spin recovery before solo. Because of my experience as an instructor, I returned to become an instructor in the T-37. In my spare time I began teaching aerobatics in a Great Lake at the Chandler Airport near where I was stationed. Eventually, I became the 82d Flying Training Wing, Spin Pilot for my day job. Each Instructor had to go up annually with me and show complete mastery of any spin a ham-fisted student could get him/her into including flat, inverted, and oscillating spins. I finally was reprieved from training and flew the F-15 for the remainder of my active duty time.

After 25 years in the USAF and AF Reserves followed by a 31-year career as an airline jockey I have "retired". Now I'm back to being a CFI at the local aerodrome. I began teaching tail wheel endorsements. I noticed a need for upset prevention and recovery training (UPRT) for general aviation pilots and have put a course together in a Decathlon. I have now branched that course off into providing CFI candidates the required spin training needed for the certificate. The following discussion is the aerodynamic portion of the ground school for both UPRT and Spin training courses.

Aerodynamics

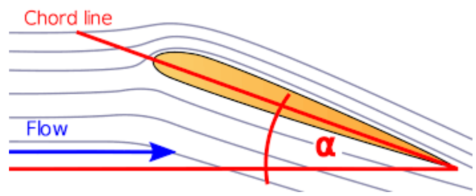
As it related to stalls, spins, and loss of control

Aerodynamics seems to be relegated to the realm of rocket science for many pilots. Let us together try to break everything down into bite-sized pieces, set our standard terms, and hopefully simplify learning. As I discuss a subject I may ask you to hold a thought. I have numbered them and when I fully explain the thought I'll put the hold number next to it so you can keep track.

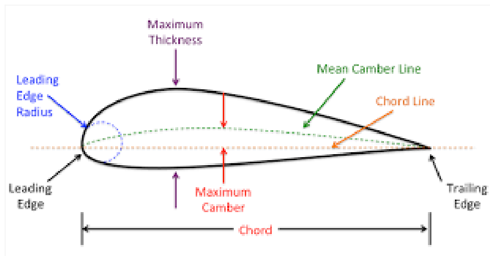
Lift production: Grab a piece of paper, bring it to your lips and blow across the top of it. The paper will rise. The stream of flowing air deceases the pressure of the air and the paper rises into this low pressure. Lift is produced when the pressure on top of the wing is lower than the relative pressure of all the other air especially below the wing. However up and down is not the way to think of lift…so hold that thought **(Hold 1)**.

Chord line: Simply the line drawn from the leading edge to the trailing edge of an airfoil. An airfoil in our case is the wing and the blade of the propeller.

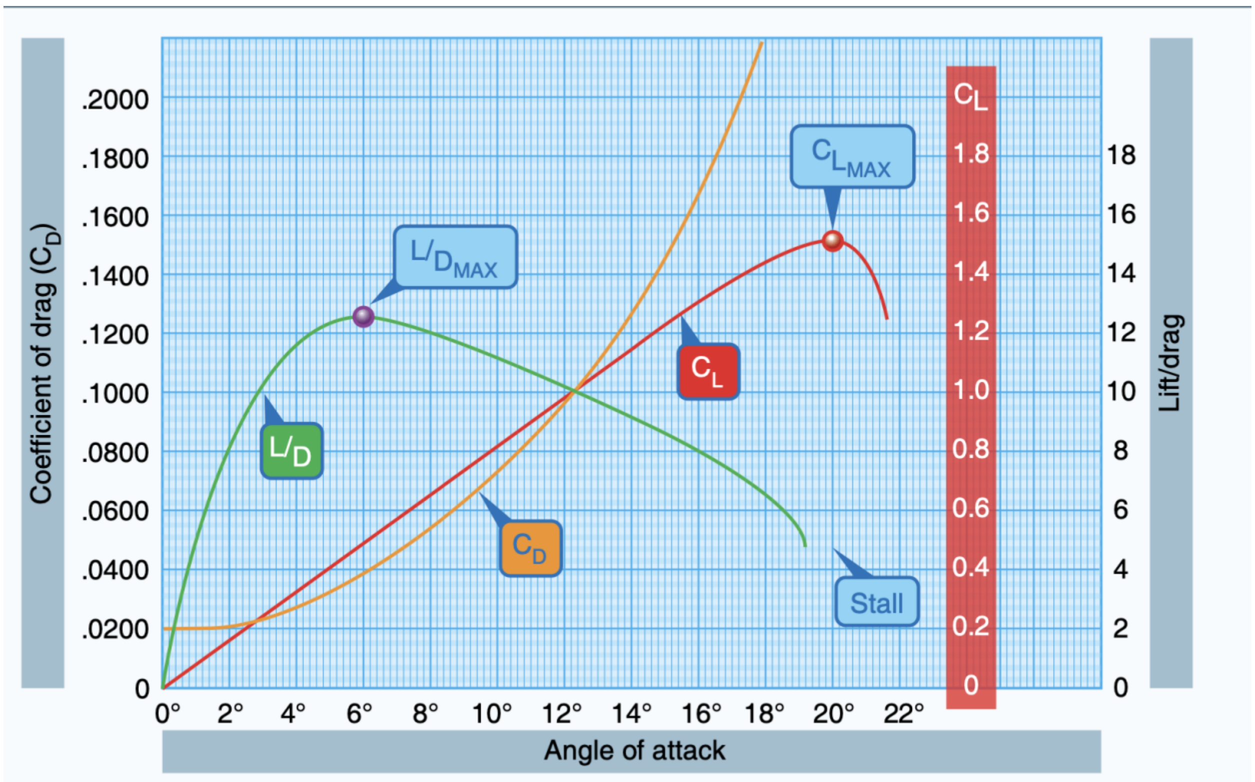
Angle of attack: also call AoA or $\propto$. The angle between the cord and the relative wind (direction of flight).



Camber: The average curvature of the wing.

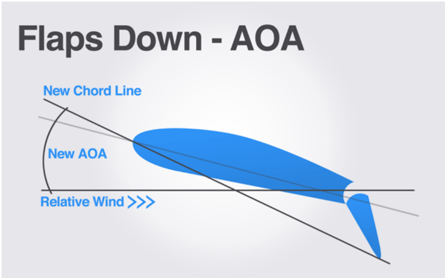


Lift-drag curve: Shows the pilot graphically; lift vs AoA, critical (stalling) or CL Max, lift production beyond critical AOA, and the exponential increase in drag at high AOA. Remember that induced drag (drag created because of lift, orange line below) increases as the square of lift. For you non-engineering types that means as you create greater lift, drag is created more and faster.

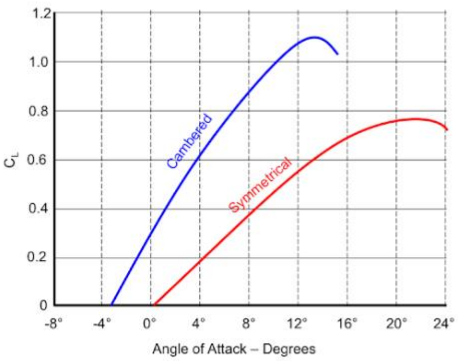


Many pilots assume that once the wing stalls it quits producing lift. However, note that the red line doesn't just stop at the critical AoA (CL Max). Lift production continues on the back side of a stall. Remember this for a discussion later in this article **(Hold 2)**.

Next lets gain an understanding of the effect changing camber has on angle of attack. Dropping or raising the trailing edge of the wing moves the chord line down or up, increasing or decreasing AoA When you increase the AoA you also increase greatly the induced drag and vice versa.



Back to a more simplified CL chart (The red line in the previous chart) we see the difference between a cambered (most general aviation (GA) wings) and a symmetrical wing, which produces lift down to about -5 degrees, as opposed to a symmetrical one which only produces lift at positive AoA.



Applying our new Aerodynamics knowledge

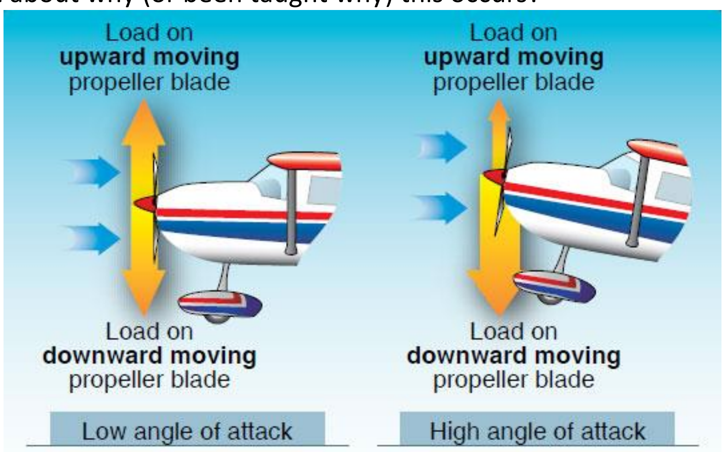
Questions to ponder

How does an airplane turn? The Elevator is really a pure AoA control. Pull and AoA increases, push and it decreases. Every time. The Rudder is a pure yaw control, left rudder always makes the nose go left, right rudder always makes the nose go right. Ailerons produce differential camber and lift, usually causing bank in the direction of stick deflection- but not always, depending on where the wing's AoA. More on this later. **(Hold 3)** Then the question arises, which one actually makes the airplane turn?

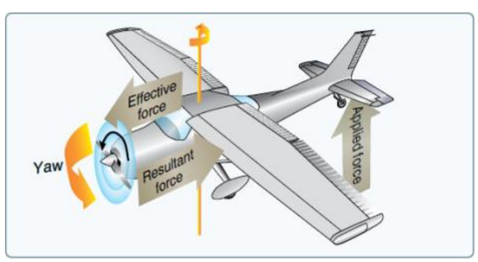
About 50% of pilots polled say ailerons, 30% say rudder or both, but very few (20%) say elevator. The few are correct in this case. It is the horizontal component of lift which actually makes the airplane turn **(Answer to Hold 1)**, if we don't have any lift we can bank the airplane but it won't turn until we pull. In aerobatic aircraft and fighters with symmetrical wings you can fly a straight path for extended periods in 89 degrees of bank as long as you don't "pull".

Turning gets us into thinking about G loading. We need to increase lift in a turn to account for the loss of vertical component of lift and increased weight due to inertia. This inertia is created when the aircraft is trying to go straight, to overcome inertia we have to pull it offline. This is the g load we feel in a steep turn. The analogy of a kid spinning a bucket of water is helpful to visualize, the water is trying to go straight but the bottom of the bucket is in the way (Newton's first law of motion). When you do this you also feel the weight in your arms. As mentioned above, we are also trading some of our vertical lift (which keeps the airplane level) for horizontal lift (which makes the airplane turn). To increase total lift, we generally have to increase AoA. This increase in AoA moves the wing closer to critical angle, which is why stalling speed increases with bank angle. With increased AoA comes increased induced drag so we either have to add thrust or we slow down. Most pilots know that 60 degrees of bank will produce a 2G load and 40% increase in stall speed, but very few have any idea what the numbers are for 30 or 45 degrees (8 and 18%, respectively). To keep it simple, I say to think 10 and 20%. Many pilots are afraid to bank much steeper than 25-30 degrees in the pattern because they have been told that stall speed increases and that is dangerous, but when we break it down to real numbers, if you are approaching at 1.4 Vs, a 45 degree (coordinated) bank still leaves a good (1.2) margin above the stall. Military pilots routinely use 60 to 90 degrees of bank in the pattern. Far more dangerous is a shallow bank trying to yaw the airplane around (uncoordinated) with rudder (more on this later, **Hold 4**).

The next question is, **"who understands P Factor and Gyroscopic Precession?".** Short answer, not too many pilots. These are poorly understood by many pilots, and frankly, have been poorly taught. The FAA lists both of them in the Airplane Flying Handbook as "left-turning tendencies" which they sometimes are but not always. A simple demonstration with a model propeller shows the effect of thrust line vs relative wind on blade angle of attack. Pitch up for a climb, blade angle on the down going blade increases while the upgoing one decreases, thus more lift on the right causing yaw to the left. But get the thrust line below the relative wind and the aircraft will yaw to the right. Cruise descent in a C182 will leave one with a tired left leg if rudder trim is not used, a lot of pilots intuitively know this but haven't really thought about why (or been taught why) this occurs?

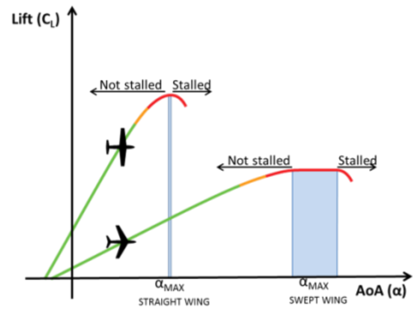


Similarly, gyroscopic precession is simply demonstrated with the little wheel on a stick. Spin the wheel and then pitch the wheel up it will move right, pitch it down and it will force your hand left. Remember that with a gyro spinning (any wheel) resultant force is 90 degrees in the direction of rotation. The amount of movement depends on the mass of the gyroscope and the <u>speed at which it is moved</u>, move it fast and you get a rapid and large effect left or right, slowly, not so much. This also works if you move the gyro left and right (gyro moves 90 degrees to force so it would move up and down) but most pilots will not feel this effect. The few who perform aerobatics feel it in a hammerhead and have to compensate with forward stick and right aileron on the pivot hammer-heading to the left.



As a former fighter pilot, I think about those intrepid aviators of World War I. In the early days the aircraft were built with stationary camshafts and the prop was bolted to the engine. The whole engine and prop rotated. This is the original rotary engine. Those engines had a massive gyroscopic effect- every time you move the nose the airplane goes somewhere different. The average longevity for those first fighter pilots was 3 months and most were not killed in combat.

Next up, **what actually happens when the wing stalls?** Most (but definitely not all of us) understand that the stall on a straight-wing airplane starts at the root and progresses outward, the tip is the last to stall. By design, roll stability is maintained to an extent in a stall until all of the wing is stalled, the point that weight exceeds available lift. Most pilots will identify pre-stall buffet as an aerodynamic warning, but very few know what causes it. The buffet is turbulent airflow from the wing root which strikes the horizontal stabilizer. While common this isn't the case with all airplanes. The Citabria and Decathlon I am currently flying have no buffet warning. Swept wing aircraft have a wholly different reaction to stalls. This was first noted with the F-86 and even given a name called the saber dance. Swept wings tend to stall tip first resulting in being unstable laterally at and near stall, and no buffet. This gets written off initially as irrelevant to the average piston GA pilot, "I am flying a straight wing C172 or PA28, so why do I care?" Once again, hold the thought for later **(Hold 5)**.



Straight / Swept Wing

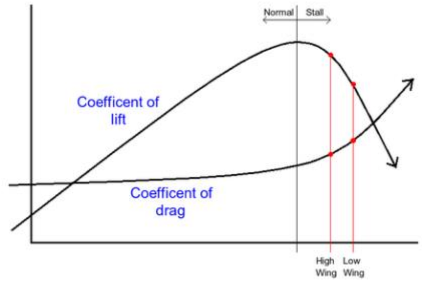
So now we understand the stall, what about a spin? We first need a stall, then some situation where the wings are producing asymmetrical amounts of lift commonly caused by adverse yaw. So a stall compounded with yaw will eventually lead to autorotation or a spin. But why?

In normal flight, rolling motions are very heavily damped because of wing dihedral and keel effect. Even though the static stability of the bank angle is small or even negative, you cannot get a large roll rate without a large roll-inducing maneuver; when you take away the roll input, the roll goes away.

Near the critical angle of attack, the roll damping goes away. Suppose you start the aircraft rolling to the right. The roll rate will just continue all by itself. The right wing (low wing) will be stalled (beyond max lift angle of attack) and the left wing will be un-stalled (below max lift angle of attack).

Finally, at a sufficiently high angle of attack, greater than the critical angle of attack, the roll will not just continue but accelerate, all by itself. This is an example of the "departure" that constitutes the beginning of a spin or even an intentional snap roll. The resulting undamped rolling motion is called autorotation.

At a high angle of attack beyond the maximum coefficient of lift (CL), the ailerons lose effectiveness. At some point they start working in reverse. Comparing the CL and coefficient of drag (CD) charts shows how this reversal occurs. Suppose you deflect the ailerons to the left. The right aileron moves down increasing the AoA of that wing tip while the left aileron moves up deceasing the AoA of the left-wing tip. Normally, this would increase the lift on the right wing and lower it on the left creating a rolling moment toward the left. Near the critical angle of attack and referring to the CD chart, raising or lowering the angle of attack has about the same effect on the coefficient of lift**, so no rolling moment is produced.**



Lift and Drag at Departure

At this excessive angle of attack, anything that creates a rolling moment will cause the aircraft to roll like crazy, and indeed to keep accelerating in the roll-wise direction. There will be no natural roll damping, and you will be unable to oppose the roll with the ailerons. However, rudder opposite the roll will force the low wing forward increasing the lift and countering the roll. So, rudders roll the aircraft at very high AoA not the ailerons. **(Answer to Hold 2 and 3)**

Incipient Spin:
The common method of intentional spin entry is to pull up to a stall, then apply full rudder and full back elevator. The yaw accelerates the outboard wing and decelerates the inboard one. So, we have two wings at different AoAs. Most airplanes will roll almost inverted with the wing at the lower AoA riding up and over the fully stalled wing. Because of the yaw and differential AoA of the wings the aircraft begins rotation, and the "incipient" phase where the spin development is complete. Applying opposite rudder any time during this phase will usually stop the rotation immediately. Then if the pilot applies forward elevator or "unloads" the wing to reduce AoA to break the stall the aircraft will quickly transition out of spin and into flight at the attitude you applied the "Prevent" controls.

Developed Spin:
If the inputs are held, the spin will develop fully (about 1 turn in the Decathlon). At that point, the rotation rate increases and stabilizes. If you hold everything in place, the spin will continue indefinitely, it is actually a stable flight condition, that is, nothing is changing. In fact, the aircraft is descending but relatively slowly. One important note to the developed phase is that up to this point we have discussed holding the controls full aft. The spin is stable. However, in most aircraft If you release the control wheel or allow it to creep forward in this phase unlike the incipient phase, the drag will be reduced and the spin will accelerate very markedly. In the military a recovery step is added, "Stick abruptly full aft". This is to slow the spin down. It isn't added to the following discussion because of three things: not holding the stick/control wheel full aft may take longer to recover but it isn't necessary to the recovery, some aircraft will recover if you let go, just not jet fighters, and people usually remember only half of what you tell them. If you only remember the hold stick aft it could have devastating results. So on to stopping the spin, you need to first stop the rotation, then allow the wing to start flying again. This needs to be done in a specific order.

Recovery Phase:
The best known memory aid, popularized by Rich Stowell's and used by the FAA is the PARE (D) acronym.

Power- idle (reduce rotational energy and gyroscopic force)
Ailerons- neutral (remove any asymmetrical lift resulting from differing ailerons from the wings)
Rudder- full opposite the direction of rotation
Elevator- forward(reduce angle of attack below critical)
Recover from the **D**ive (I add, which should be obvious)

Spin recovery can be complicated or even precluded if you don't do all this, in that order. First order of business, as in any loss of control situation, is to close the throttle FULLY.

Neutralizing ailerons seems like a simple step, but if they are not absolutely neutral the wings continue to produce asymmetrical lift. Over the years I have seen more than one student unconsciously try to help the spin recovery by adding aileron opposite the rotation in addition to rudder. It doesn't take much to keep the spin going or even accelerate it. Some very experienced spin pilots ask me what is an oscillating spin? In the T-37 and I suspect many other aircraft the nose will oscillate up and down if you move the ailerons out of center because of the differential lift. This can be a very rough ride. If in doubt, let go of the stick and the ailerons will assume aerodynamic neutral. Zlin built aircraft have a white stripe in the center of the panel (quite common in Eastern European and Russian acrobats) at which you point the stick to neutralize the ailerons. known as the "spin stripe", if you don't get this step right the plane will not recover.

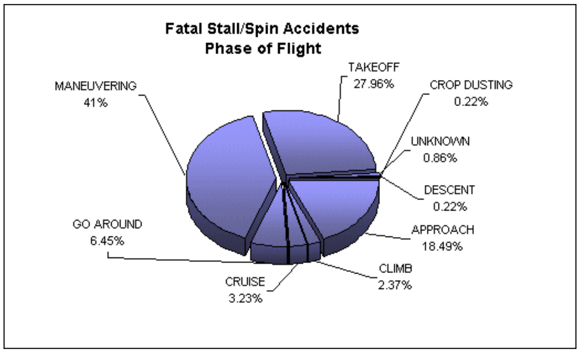
Opposite rudder seems like a no-brainer, if you have entered a left spin intentionally, right rudder to stop it. But what if you spun the aircraft unintentionally, it may not be immediately apparent which direction you are rotating. An upright spin to the right and an inverted spin to the left are actually rotating in the same direction as seen from the ground. Fortunately, there is a good way to sort this out, thanks to aerobatic pilot John Morissey. Look directly forward over the spinner and see which direction your shoulders are moving relative to the ground. Shoulders moving right, need left rudder to recover. Works every time. In the USAF we were taught to look at the turn coordinator: "Needle Left-Spinning Left, Right rudder." I have discovered that if the turn coordinator is in the back seat of some tandem aircraft this may or may not work only in the back seat depending on the location of the vertical axis of the aircraft, but in most cases, it works perfectly if you decide to do this in instrument conditions. When you put the rudder in, it should be all the way to the stop until the rotation slows or stops. Depending on the airplane and the spin mode, it may take 2-3 turns for recovery, although most GA airplanes (Decathlon included) will stop within one turn.

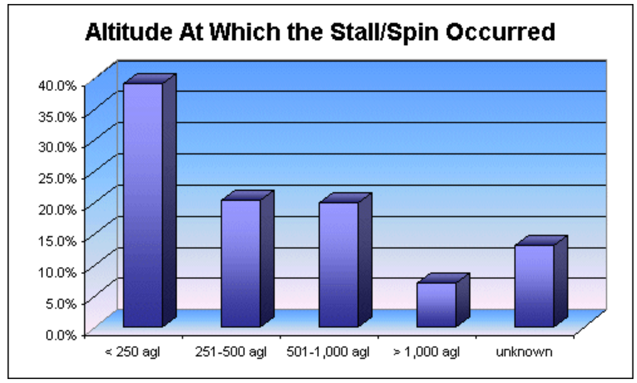
Finally, elevator forward the break the stall. Some aircraft require a "brisk" movement and some all you have to do at this point is release backpressure. This has to do with the relative size and effectiveness of the elevator. Aircraft with small trim tab sized elevators will require a more abrupt forward movement than large, generally more common elevators in GA aircraft.

At this point please remember to recover from the dive. Because of the relatively slow speed you will not need to pull a lot of Gs to recover unless you delay the dive recovery. It is not uncommon to find yourself in the dive accelerating and then reef back on the control wheel and accelerate stall the aircraft again. How do you say "Repeat the stall recovery?" The sooner you begin the dive recovery the less you will accelerate. A light but firm recovery will prevent additional stalls on the way up.

Putting it together for the Real World

Now we get to the real world. People killed in stall-spin accidents rarely are so as a result of a wings-level, power-off, pull up to stall and step on the rudder entry. This is usually done at altitude and safely recovered. Even an inadvertent spin from a botched power-on stall doesn't result in an accident unless the ground intervenes, but frequently results in an attention-getter for the pilot. I have had more than one show up on my doorstep after being frightened by such an event.



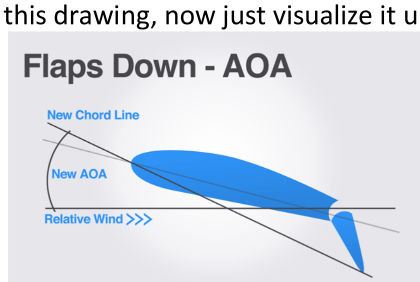


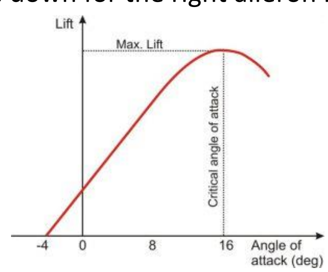
It would appear that the majority of stall-spin accidents (other than from low-level aerobatics, 41%) happen around the traffic pattern at 52.90%. Not too surprising, maneuvering close to the ground at relatively low airspeed. My interpretation of the numbers is that the two trouble spots are on initial climb out (departure stall) and on base to final approach, both below 500 feet AGL. Very few stall-spins occur while flying downwind or out in the practice area.

Departure Stall

Let's think about the departure stall. This may happen due to pilot distraction. Perhaps the dog threw up, kids fighting, or maybe ATC just gave you direct to some fix you never heard of and you bury your head in the technology. For whatever reason, the aircraft stalls at climb power. Two things will happen, the nose will drop, and most probably also a wing. It is likely going to be the left wing due to gyroscopic precession, particularly if not enough right rudder is being held to compensate for P factor. Instinctive response to pick up the wing; right aileron. This is really not a great idea, and here's why. Look at the L/D curve and visualize the effect of right aileron on the "good" side i.e. below critical AOA.

Remember this drawing, now just visualize it upside down for the right aileron in this case?





Stick right, right aileron goes up, camber decreases, AOA decreases, so lift decreases on the right, increases on the left. Left wing picks up, all good. But look what happens if the wing has passed the lift peak and is now on the "dark side". **The same input produces the exact opposite effect, (application of answer 2 and 3) lift now increases on the right, decreases left.** And significantly, the increase in induced drag on the left would compound the problem, the result being a spin to the left. What, why? Now we get to an interesting phenomenon, I have spoken about this to more than a few pilots over the years, and I can always see a few wheels turning- "Wait a minute, I have done power-on stalls, and picked up the wing with ailerons and the airplane didn't spin". Absolutely, but not due to your superior piloting skills, but the engineer that designed the wing! Have you ever heard of "washout"? Humm, thought so. At this point, go out and look at C172, there is usually one at every airport tied down outside. Look at the trailing edge of the wing. The wing sweeps upward at the outboard end, reducing the chord line, and significantly lowering the angle of attack. You can also observe this design feature by looking down the leading edge of the wing from the wing root. The tip continues flying below critical AoA to the bitter end, maintaining roll control. But if you get deep enough into the "dark side," and have stalled the wing tips, applying right aileron will cause the right wing to produce more lift and less drag, and obviously the opposite on the left. If there is a conveniently located Cirrus usually tied down next door, they took a different approach by adding a cuff to the outboard section of the wing which droops the leading edge and reduces the AOA similarly. In such, the engineers can save you for a while, but if you really stall the wing completely anything but neutral ailerons will greatly add to your problems. Practice nailing the ailerons at neutral. Use of rudder to keep wings level in stalls. It could be the last thing that keeps you from entering that spin.

Engine failure on climb out , especially if the pilot attempts to turn back to the runway without sufficient altitude, brings up my next point, "How high do you need to be to safely turn back to the airfield if the engine fails on climb out?". The answers usually vary, from 5-600', 1000', never, and "I hadn't really thought about it". The teaching point is, it is pilot and aircraft dependent. As a glider pilot, you are trained to make a 180 degree turn back to the runway at 200' following a rope break. I know some that can do it from 100'. The optimal bank angle seems to be 45 degrees, which gets you round efficiently but does not increase stall speed enough to be dangerous (18%).

What I recommend is the following exercise. Set up a Vy climb using climb power. At 3000' AGL (or higher), close the throttle, count 3 seconds to account for the startle effect (what just happened?), then pitch to best glide speed (usually a pretty good shove forward), start an immediate 45 degree banked turn (into the wind if you have any crosswind), and see how much altitude you lose through 180 degrees of turn. Add 100' and this should be your personal minimum for YOUR aircraft. Remember this will get you pointing back at the airport but you may need another 30 degrees of turn to get lined up on the runway. If you haven't practiced this (I include this on every flight review), probably not a good plan to be a test pilot on your first real engine failure. The Airman's Information Manual (AIM) tells us to turn crosswind 200 to 300 feet below pattern altitude. This suggested best practice is primarily a measure to prevent traffic pattern conflicts. Some CFIs teach turning earlier rather than climbing away from the airport straight ahead. This cuts off 90 degrees of the turn in case you lose an engine and, equally importantly, you can see the runway and what is coming up behind . You don't want to land downwind head-on to a departing aircraft. Of course, aeronautical judgement must be used because this also puts you closer to the 45-degree entry to the downwind.

Last, we'll talk about the base to final overshoot. This usually starts on downwind, say you have left traffic and what will be a left crosswind on final. Pilots have a habit of setting up where they want to be relative to the runway and then getting preoccupied with pre-landing checklists. If the right crosswind (which will certainly be stronger at pattern altitude than reported at the surface) is not corrected for, the aircraft will drift closer to the runway. Base leg is shortened, and groundspeed increases due to the relative tailwind, making it is easy to overshoot the turn to final. The airplane winds up past the runway centerline and flying into a headwind. The initial response is to steepen up the bank, but then the little warning light goes off- my instructor told me not to bank too steeply close to the ground. So shallow bank is maintained but the runway is still off the the left. You then add some left rudder to bring the nose around (a skid). Remember what the rudder does? It always makes the nose go left or right. Therefore in a left bank, left rudder drives the nose down. The sight picture shows the horizon rising up the windshield, so back stick to maintain attitude. And we all know back elevator increases AOA. Skid enough, pull enough, and a spin to the inside will result. This is the same input aerobatic pilots use to enter a snap roll. The other aerodynamic quirk is that, in a skid, the <u>wing is actually functioning as a swept wing</u>, which stalls tip first with no buffet. It also has the added benefit of making your ailerons work opposite of the direction intended. **(Answer to hold 4 and 5)** Who could have more fun than that! It's like being a fighter pilot. It takes anywhere from 800-1200' to recover! If you do this turning final at 500' you are probably going to die.

An ounce of prevention is worth your life

Departure Stalls: Eliminate distraction. Brief passengers that it is a critical time similar to the way airline crews use push back to 10,000 feet as a sterile cockpit time. Only flight duties and flight relevant talk is permitted on the flight deck. You could set different altitudes and may use from taxi to say 3000 feet.

Practice and set your turn back altitude in the case of an engine failure. Review the airport map and terrain prior to each departure and have a plan. As bad as it might be, the safest plan may be to land straight ahead at or near stall speed but in control. Listen to traffic prior to departure, if it is not congested and relatively quiet, announce on CTAF or request from Tower an early turn to crosswind.

The "Final Turn:" The key to prevention is, first, pay attention to the crosswind ahead of time. Keep your spacing on downwind, anticipate an early turn to final (if you undershoot the wind will drift you to the centerline), and if you do find yourself overshooting it is safe to increase bank angle a small amount as long as you are coordinated. But the safest solution, as Budd Davisson famously says, "extend your left arm (Assuming the throttle is on the left) and add 5 minutes to your logbook"- go around!

Take a General Aviation oriented Upset Prevention and Recovery training course. It will help you gain experience in SEEING the errors and avoiding them. Know that you can not spin unless both stall and yaw are present. Prevent either and at least you won't spin.

For CFIs, add the explanation behind why we practice the stalls that we do to pass that FAA check ride. Make up realistic scenarios prior to the actual "Maneuver" and make sure the trainee understands that in a stall the rudder is used to level the wings not the aileron. First gain experience in, and then demonstrate a falling leaf: with the airplane stalled, use rudder to keep it coordinated and it will not enter spin. Do realistic departure stalls. Start the maneuver at near takeoff speed, add takeoff power and rotate the nose up to stall. Note the entry altitude and the recovery altitude.

For every technique discussed and every recovery step spelled out here-in, know that they are predicated on ONE absolute. **The airplane is loaded in accordance with the Pilot Operating Handbook (POH)**. If you decide to load the airplane aft of the aft CG and then throw in an anvil none of the flight test proven aerodynamics apply. The procedures may or may not work. Stall speed is unknown. Literally, we just have no idea. Simply put you become a test pilot without any training as such. In addition to being dead, probable outcomes include insurance not covering any of the accident outcomes. Load the aircraft in accordance with the POH friends even when nobody is looking.

Lastly Practice and stay proficient my pilot friends and fly safe!

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Designated pilot Examiner (DPE) Captain Larry Taylor KPHX Arizona,
DPE, Retired Captain/Dr. Johnny Summers KSEA, Washington
DPE and National CFI of the Year 2014 Howard Wolvington, KRNT Washington

NTSB, FAA, and AOPA Air Safety Institute for the accident numbers.

Author: Tom Rogers, CFI-Airplane, Instrument, Multi-engine; 23,000 plus hours, 3000 as CFI,
FaaSTeam Representative Seattle, NW Region
Alaska Airlines Captain, Retired (31 years)
Lt Colonel USAF, Retired (25 years)
Float Plane, Tail Wheel Endorsements, UPRT, and Spin training for CFI candidates out of KPWT, Washington