Normal Upright SPINS

A mechanical approach to recovery

By Rich Stowell, MCFI-A

Warning: The spin environment places unique demands on both airplane and pilot. Do not be cavalier about spinning. Never intentionally spin airplanes not approved for spins, or outside an airplane's spins-approved envelope. Performing the intentional, incipient spins described in this article has little bearing on how you or the airplane might behave during unintentional, aggravated, or prolonged spins. Dual instruction from a qualified instructor who is experienced in teaching spins from unusual attitudes is considered mandatory.

Pilots of homebuilt airplanes beware: Treat each and every homebuilt airplane as one of a kind when it comes to spins. You cannot predict how your homebuilt might act in a spin based on the purported spin behavior of a similar type. Spin dynamics are far too complicated for such cursory treatment. The tipping point between an airplane that displays benign and recoverable spin characteristics and one that doesn't literally could come down to the shape of the wing root fairing, or a few pounds of weight located in a slightly different location. The spin behavior of any given homebuilt can only be known after a thorough spin test program has been conducted in that airplane. If spin tests were not performed during the flight test phase of your homebuilt, realize that you will be acting as a test pilot should you elect to spin it. Be careful. Be very, very careful!

Thousands of words can be written about spin dynamics (and numerous different spins experienced) and still not cover the subject entirely. Fortunately for us, we'll just be dipping our toes into the spin pool here with the most rudimentary upright spin. Spinning requires two main ingredients: yaw and stall. Since rudder and elevator are our primary yaw and stall controls, we'll rely exclusively on these two controls throughout our intentional spins. We'll also set up our spins to be as docile as possible. We'll add a precision element, too, which gives a much better sense of control over what can sometimes appear to be a melodramatic and random maneuver.

No matter where we are or what we perceive to be happening during our spins, we will adhere religiously to the following formula: rudder followed by elevator. Whether it's the moment of spin entry, or the initiation of spin recovery, or the post-recovery cleanup (that's cleaning up the airplane from an aerodynamic standpoint…cleanup of the cockpit should not be necessary!), we will always make a rudder input before we make an elevator input. Preserving this critical sequence of events can be difficult, especially since many of us were taught early in our flying careers to shove the elevator control forward when something bad happens (i.e., a stall). Unfortunately, this reaction by itself is inappropriate when spinning. The rules are different in the spin environment; the push-only response, therefore, must be replaced with the rudder-then-elevator reflex.

Idle & Other Checks

Before spinning, here are a few things to check: Aircraft engines have four idling modes (throttle against the aft stop), two on the ground and two in the air. On the ground, cold idle is the rpm registered after starting up a cold engine. Hot idle, by comparison, is the rpm you see once the engine has thoroughly warmed up. In the air, flight idle is the rpm you see when gliding with the throttle closed. Flight idle rpm generally decays as you dissipate airspeed. Lastly, we have "fright idle," where a tense pilot's death grip on the throttle can cause the engine and prop to stop during a spin! (Engine and prop stoppage can occur without any pilot inducement during multiple turn spins in some airplanes, too, but prolonged spinning is beyond the scope of this article.)

Experience has shown a correlation between the potential to attain fright idle and the hot idle setting. If the hot idle is too low then a white-knuckle grasp of the throttle could choke off the engine. If this should happen, you must still perform the required spin-recovery actions. Attempt engine restart only after spin recovery is complete. Better yet, don't hang on so tight to the throttle.

If the hot idle is set too high, on the other hand, the spin entry attitude may be abnormally nose-up, the rate of rotation noticeably faster, and the recovery delayed. Be sure your hot idle is set properly, usually in the 500-700 rpm range. Also be sure you have full and unrestricted use of the controls, especially the rudder. And if it's been a while since the cable tensions have been checked, be sure they are within published specifications. The airplane should be reasonably well rigged, too.

Finding V_{SPIN}

We need to establish our spin entry speed, or V_{SPIN}. To find this speed, perform a power-off, wings-level, flaps-up stall. Hold a general heading with small, quick rudder inputs as you pull the elevator control aft. Trade your airspeed to hold a constant altitude. You'll find that the aft stick movement will initially need to be relatively slow and subtle. But as airspeed diminishes (and along with it, control authority) you must pull a bit faster, harder, and farther to hold your altitude as you approach the 1*g* stall speed. Although altitude remains constant, the nose of the airplane will necessarily rise.

Note the indicated airspeed at the instant the airplane exhibits stall behavior. In a Pitts S-2B, that may be slightly faster than 60 mph IAS; it may be as slow as 40 knots IAS in a Cessna 150. Whenever the indicated stall speed is somewhat fast, use that airspeed as V_{SPIN}; thus, we'd use around 60 mph as our entry speed in the S-2B. Whenever the stall speed is relatively slow, simply add five to that number ($V_{SPIN} = V_{STALL} + 5$); thus, we'd use 45 knots or so for spin entry in the Cessna 150.

In our featured airplane, a Zlin 242L with two people and 20 gallons of fuel, the first signs of separated airflow occur at 62 knots IAS. This will be V_{SPIN}. The classic nose-down pitch change, however, doesn't occur in the 242L until 58 knots IAS. Even though this style of spin entry will not meet the competition standard, entries will tend to be more consistent and more predictable, both of which are desirable from a learning standpoint.

Upright Spin Mechanics

Our intentional spins will be entered from a wings-level, power-idle, ailerons-neutral, constant-altitude, constant-heading configuration. All of the physical actions we'll take are sequential, deliberate, disciplined. Your brain must consciously command your body to apply the specific input called for at the moment—no more, no less. No simultaneous inputs, no throttle jockeying, no wiggling of the ailerons—just the controls moved exactly as choreographed. After clearing the area, the spin sequence proceeds as follows:

Pre-Entry

Power – Idle
Ailerons – Neutral
Hold altitude; pitch to V_{SPIN}

Don't rush. Take your time decelerating here. Hold your altitude and heading as you actively bleed off the airspeed.

Spin Entry

Rudder – Briskly Full In
Elevator – Full Aft
Hold these inputs!

As the airspeed needle touches VSPIN, briskly press the rudder pedal to the firewall. As soon as the rudder hits the stop, pull the stick the rest of the way aft. Practically speaking, the elevator control will almost be full aft at VSPIN. Nevertheless, put the rudder in and then pull the stick that last inch or two into your stomach and pin it there. The cadence should be 1, 2, 3-rudder, elevator, hold. Continue to hold these inputs until you consciously decide to effect recovery (more on when to decide this in a moment).

Spin Recovery

Rudder – Full opposite
Elevator – Forward

Avoid slowly feeding in the opposite rudder, or applying it in increments. Swing that rudder from full in to full opposite in one quick action. Once the opposite rudder hits the stop, it is now appropriate to move the elevator control. Don't sit there holding the stick back; push it straight forward to finish off the rotation. Avoid haphazardly shoving the stick or deflecting the ailerons. Displace the elevator control just far enough forward to lock the nose onto a point on the ground. How far forward will depend on the airplane. It might only be a couple of inches off of your stomach in a 7ECA Citabria or as far forward as the neutral elevator position in our Zlin 242L.

Rotation Terminated

Rudder – Neutralize
Elevator – Pull to straight and level

The urge will be to snatch the elevator control aft as soon as rotation stops. Even though this is a natural instinct—after all, we are pointing at the ground—it can trigger a secondary stall/spin. We must override the urge to pull too soon in favor of neutralizing the rudder first. Positively move the rudder to neutral, and then wiggle your feet a little to make sure you're truly there. Done? Okay, now return to level flight. The pull-out should feel like a steep turn (about 2g).

Post-Spin

Get your bearings
Add power
Check for traffic and climb

Courtesy Rich Stowell

Left **Spin Entry** in the Zlin 242L.

The Zlin 242L **Post-Spin Attitude** is 60-65 Degrees Nose-Down

Courtesy Rich Stowell

Spin Orientation

The mechanics of the intentional spin develop discipline with the controls. For the precision element, we need to develop our sense of vision. Unlike the instantaneous on/off characteristic of rolling and looping maneuvers, spinning has a certain amount of lag to it when trying to stop the rotation. Knowing when to apply recovery inputs is the key to stopping on the desired heading. It's all about timing. For example, to stop a one-turn spin on the original heading in a Decathlon, the recovery process begins 90 degrees early; in a 7ECA Citabria, it begins with slightly less than 90 degrees to go; in a Cessna 150, it begins a mere 20 degrees ahead. But in our Zlin 242L, the recovery must begin when the nose of the airplane cuts through the half-turn point almost 180 degrees prior to the original heading for a one-turn spin.

This knowledge now allows us to select two ground references: the landmark that will trigger the application of full opposite rudder, and a marker representing our original heading. As part of your pre-spin traffic check, take a moment to orient yourself by selecting your references. Not only should the landmarks be prominent, they should also be as close to the airplane as possible. This ensures that the references will be within your normal field of view during the nose-down spin.

With landmarks chosen and pre-spin actions under way, lock your head forward for the rest of the maneuver. Move only your eyes from here on to gather information. Focus not on the nose of the airplane, but extend your vision down to the ground below. It's not uncommon to want to turn your head in the direction of rotation in an attempt to locate the recovery reference. And with the panoramic view offered by bubble canopies in airplanes such as the 242L, pilots sometimes will look up near the top of the canopy and swivel their heads to see the recovery landmark. Avoid these temptations. Look directly over the nose and let the recovery reference come to you! Be sure not to lean away from the spin, either; sit relaxed in your seat throughout the maneuver.

Even though we're seeking a particular exit heading, don't get so carried away with trying to hit the mark that you forget to follow the scripted control actions. In fact, maintain whatever heading the spin stops on. Do not correct the heading post-spin. Consistently exiting on the heading of your choosing typically won't happen until your movements become consistent and you begin to see clearly during the spin. The only thing you can vary in the entire process is the time delay between holding your pro-spin inputs and initiating spin recovery. Everything else is constant.

When the indicated stall speed is somewhat fast, as in a Pitts, then use that speed for spin entry.

Follow the script no matter what, even if the actual exit heading isn't the one you wanted, the spin isn't behaving itself, or if you lose your orientation. You still must go through the same recovery process nonetheless. Consistently undershooting the one-turn heading? You need to be a little more patient before kicking the opposite rudder. Consistently overshooting? Apply opposite rudder sooner.

Following the above recommendations results in the slowest, steadiest spins possible with the quickest, most precise recoveries. Change any of the conditions presented and you introduce unwanted variability into the mix. Descending prior to spin entry, for example, can result in a labored departure with sluggish rotation initially, followed by a sudden, rapid rotation rate at about the half-turn point. Sticking to the script without deviation will smooth out such behavior. Remember, no input can occur until the preceding action in the list is completed first.

Get some dual instruction, give yourself plenty of altitude, and practice the basic spin until you can control every aspect of it. Integrate your vision with the step-by-step physical actions. You'll quickly find that the intentional spin is equally as controllable and as satisfying as other well-learned aerobatic maneuvers. Advancing from the basic spin to a competition-style spin is then easily accomplished with a few adjustments to the above technique, but that's a subject for another time.

Courtesy Judson Bartlett

Every homebuilt airplane must be considered as one of a kind when it comes to spins.

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