Spins – What every pilot should know about them

Wayne L Pratt CFI ASMELI

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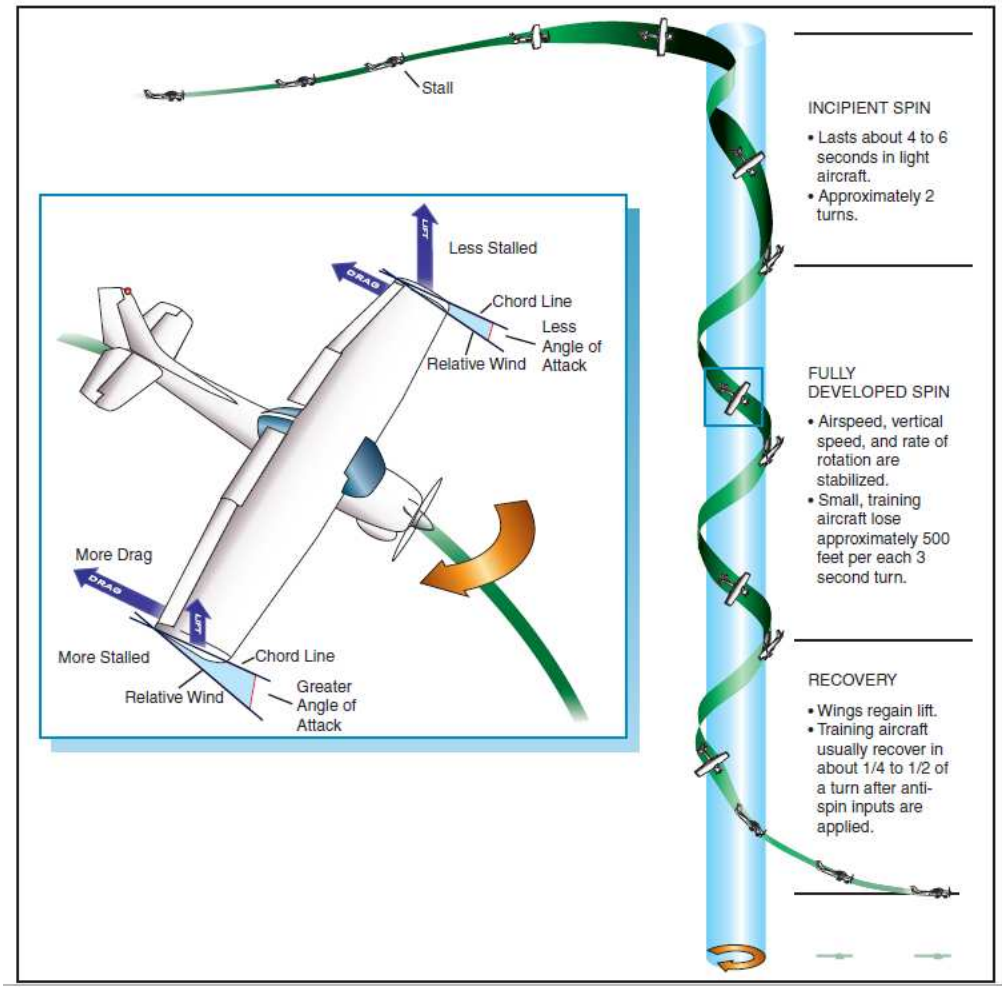
INTRODUCTION – The FAA's Airplane Flying Handbook has a very good picture of a spin showing the various phases.



The first think you should take note of is a stall occurs first. In fact, you cannot spin an aircraft without first stalling it. The main characteristic of a fully developed spin is that one wing is more deeply stalled (creating more drag and less left) than the other wing. That is what a spin is, but not all aircraft will spin, should be spun, or if spun may not recover. Here is a video of a Cessna 150 doing a spin. http://www.youtube.com/watch?v=h2rm7n9Vz3c&feature=related

AIRCRAFT CERTIFICATION - First, you should be aware of the FAA's aircraft certification process (CFR 14 part 23.221) classifies airplane certification as *Normal*, *Utility*, *Aerobatic*, and *Commuter*. Most General Aviation airplanes will be certified as *Normal*, and when loaded

inside a small loading envelope as *Utility*.

There is **no fully developed spin requirement** for an aircraft certified as *Normal*. However, single engine *Normal* category airplanes must demonstrate a one turn spin. This demonstration is from entry point to the first complete turn at which time the recovery is started. Recovery must be complete in no more than one additional turn or 3 seconds. Therefore the spin will not be fully developed. Multi-engine aircraft do not have to demonstrate spin recovery. If you spin a *Normal Category* aircraft consider yourself a test pilot.

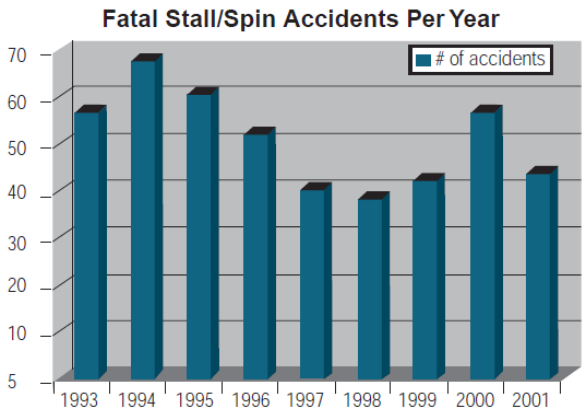
An aircraft certified in the Utility category must be able to demonstrate recovery from a 3 turn spin and Aerobatic aircraft from a 6 turn spin.

The obvious question here is why do airplanes, like the Cessna 172, which are approved for spins in the Utility category, are not approved for spins when operating in the Normal category. It is partially the load factor. During the spin the g load is essentially one so there is no excess loading. But during the recovery you can generate 2 of more g's depending on how aggressively you pull out of the dive. Reduced weight protects the airplane in the case of an overly aggressive recovery.

More important is the CG location. As the CG moves aft more centrifugal force developed in the spin. The centrifugal force is dependent on the rate of rotation and the distance from the spin center and the aircraft center of gravity. The rudder is the only control surface that can counter act this force and stop the rotation. At some point as the CG moves aft the rudder will be unable to overcome the centrifugal force and stop the rotation.

One would think in this day and age of computer modeling and sophisticated engineering the dangers of spins in modern aircraft would be non-existent. But Cessna lost a Cessna 162 *Skycatcher* in 2008 during flight test because it would not come out of a spin. They redesigned the vertical fin and rudder and a year later lost another one. A Piper Tomahawk was tested by NASA and shown to only be able to recover if it had opposing rockets on each wing tip to stop the rotation.

STALL/SPIN ACCIDENTS – There have been 450 fatal stall/spin accidents during the period 1993 to 2001 involving fixed with aircraft weighing less than 12,500 lbs. The chart below is from Air Safety Foundations accident database www.aopa.org/asf/ntsb/index.html



Stall/Spin accidents account for about 10% of all accidents, but nearly 14% of all fatalities.

The study also showed that most of the fatal stall/spin accidents entered the spin phase at 1000 ft AGL or less. A NASA study in the late 70's concluded that for a Piper Arrow, and a Grumman American Yankee 1200 ft were required from the spin entry point to recovery.

Unless you are a better pilot that these NASA test pilots you are not going to recover from a stall/spin from pattern altitude or below.

See the following link http://www.akaflieg.tugraz.at/stall_spin.pdf for an excellent AOPA article on Stall/Spin accidents.

TRAINING – Since the FAA only requires a simple spin endorsement for CFI candidates it's not much of a surprise that that very few pilots or instructors understand spins very well. There was a study done in 1993 where questionnaires were sent to 43 flight schools as well as to instructors attending refresher seminars. There were over 500 respondents in total. Some of the more interesting results are listed below:

- 94% did not understand the aircraft certification requirements regarding spins
- 98% had no ground training and no more than 2 spins in achieving their spin endorsement and then only in one aircraft.
- 95% had never received any training on the likely conditions leading to an inadvertent stall/spin

The PTS states that stalls should be conducted at an altitude at which the recovery can be completed at 1500 AGL or higher. The basis for this is that the recovery from a stall during training could be delayed with additional altitude loss. But, if the recovery is delayed and the entry to a spin occurs 1200 additional feet of altitude loss is virtually assured, leaving a 300 ft margin.

What are the conditions that could lead to a stall/spin. The leading cause is a stall with *cross-controlled* aileron/rudder. This means aileron rudder deflection in the opposite direction sufficiently to put the aircraft into a skid or slip. (either one with the ball out of the center position in the Turn Coordinator).

The likely scenario for this can be trying to work into a short field clearing an obstacle, The unsuspecting pilot uses aileron opposing the bank, think he does not want to bank too steep in this situation. But the keep the turn going he applied rudder into the turn. Now the ball slides to the outside of the turn, but no matter, he thinks, just a bit more and I've got it. Then pulling back on the wheel just to clear the obstacle, and in an instant there is a stall/spin accident, most likely a fatality.

It's a little surprising to me that cross-controlled stalls are only a *demonstration stall* for the initial CFI. They are not required by either the private or commercial PTS. Most airplanes will not spin unless they are forced into it with rudder at the stall. Practicing this and being competent in making a quick recovery would not have saved our pilot in the scenario we presented here. But, it would have raised his awareness of the dangers of flying uncoordinated at low airspeed. Hopefully, he would not have found himself in the situation that can produce a stall and spin.

SUMMARY – The stall/spin accident should never happen, but unfortunately they do. An airplane will not spin unless it is first stalled and secondly, it must be forced with into the spin with uncoordinated controls. These accidents don't happen at high altitude so spin practice and recovery will not save the day. But, spin practice along with a thorough introduction into the dangers of cross-controlled stalls will make the pilot aware of the dangers of uncoordinated maneuvering at low airspeeds and prevent him from ever being in that situation in the first place.