Cross-Coordinated

Cross-controlling is often necessary to maintain coordinated flight, but it can be dangerous. It's not whether you cross the controls, but how and when.

BY DAVID ST. GEORGE

There is a growing "terro[illegible] flight training of any cross-controlled flight condition. Many CFIs caution students to "never cross-control," with little or no explanation, as if it were unquestionably and inherently evil. This admonition is especially stressed when flying at any airspeed lower than cruise. But the emphasis on avoiding cross-controlled flight is a disservice to primary students and displays a fundamental misconception of aerodyanimcs and basic airmanship. The most extreme form of this fallacy intones, "Never slip to land; you'll be low, slow and cross-controlled, will stall, spin and die."

The root causes of these cautions is obscure but [illegible] fallacy seems to reside in some fast-track flight schools that never venture far from the maneuvering envelope's center and teach only the minimum maneuvers required on the FAA tests.

"In a normal takeoff and climb, some aileron pressure against the right rudder is necessary to keep the wings level and the ball centered. This is cross-controlled flight!"

There certainly are dangers encountered with some aspects of cross-controlled flight at low speeds. The greatest true danger, fueled by fear, is failure to understand and teach the flight-control pressures necessary for coordinated flight while low and slow. To get comfortable and proficient in this area of flight, you need to spend some time there. Instead, most pilots—and their inexperienced CFIs—demonstrate increased muscle tension just when fluidity, grace and correct control usage are most necessary.

Slipping Turn

Skidding Turn

Coordinated Turn

Since the first step in effective risk management involves clearly identifying the hazards, we need to carefully analyze this flight condition and the source of these rumors to fully understand where the true dangers, if any, lie. Let's first look at two common pattern maneuvers and how crossing the controls actually results in coordinated flight.

Sometimes, keeping the ball centered means crossing the controls.

INITIAL CLIMB

A safe and efficient normal takeoff and initial climb require some aileron input to counter the pilot's right rudder pressure, which is applied to keep the wings level and the ball centered. This is cross-controlled flight!

During the initial high-power, low-speed climb, most singles require right rudder pressure to center the ball. This induces a right rolling moment. Left aileron input against the right rudder is subtle but necessary to keep the wings level as the ball is centered. Once the plane is "subtly cross-controlled" in this manner, it will climb much better because drag is minimized. In fact, I often can achieve an additional 150 fpm in a Cessna 152. This debunks the myth that a 152 only climbs in the summer because the earth curves!

Crossing the controls in this instance results in coordinated flight, and coordination should be the true goal in climb to achieve safe and efficient performance. The important fact is the plane is finally coordinated, streamlined and performing better. You will start to feel centered in the seat, too, with no leaning right and left, as in a slip or skid. This can be strange stuff to those believing cross-controlled flight is an evil bogeyman. Here we are, slow and in a high angle of attack and cross-controlled, but finally coordinated.

CROSSWIND TURN

Upon reaching the turn to the crosswind pattern leg, most training airplanes are still in a climb.

As the pilot rolls into a left crosswind turn, left rudder and aileron are obviously required during the roll. But once a stable turn configuration is established to the left, right (top) rudder—or at least relaxed left rudder pressure—is required to stay coordinated.

(Of course, this presumes a left-hand pattern. If you are turning to fly a right-hand traffic pattern, the rudder and aileron together yield a coordinated roll in that direction. But once the right turn is established, some right rudder pressure must be maintained and left aileron pressure—or at least relaxed right aileron—introduced to stay coordinated and maintain the appropriate bank angle.)

There are some important points to make about coordinating your turns at this position in the pattern.

JUST A MOMENT

First, pilots must distinguish the stabilized turn requiring subtle cross-controlled flight at high angles of attack from the airplane's rolling moment in the climb configuration, which requires rudder and aileron together. Remember also: In the stabilized-turn configuration, the rudder pressure you need is always to the right—due to torque and "P Factor"—and is not symmetrical. In other words, the rudder required to turn right is more than needed to turn left. This, of course, presumes a single-engine airplane with a propeller turning clockwise when viewed from the cockpit.

If any of this is new information, I would recommend finding a good CFI who knows how to use his or her feet and practicing climbing spirals at a safe altitude in both directions. The objective will be to "tune" the aircraft with rudder pressure, based on your "seat-of-the-pants" feel first, then to check the ball and the VSI to verify performance. Before you discovered this rudder pressure, all turns to the left in the pattern were actually skidding turns: the rate of turn was excessive for the bank angle.

In a coordinated descending turn you feel straight up in the seat and the ball is centered. If you are in a turn and want to slip, step on the higher wing with the rudder. This is rudder force away from the turn, reducing the rate, and always results in a slip. Ironically, when this maneuver is first introduced to a student they hate the "feel" of a slip because it is so alien. The sensation is of your butt falling to the inside of the turn or lower wing. Unfortunately, most students seem to love

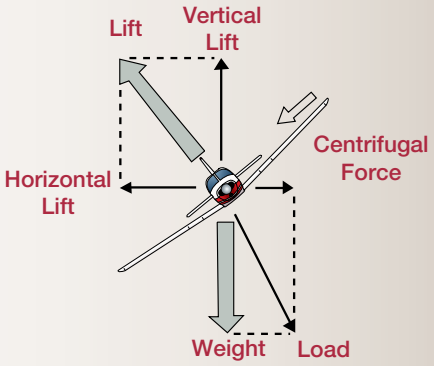
Bank Vs. Rate Of Turn

The basic difference between a slip and a skid is the rate of turn. Both involve cross-controlled flight—or uncoordinated flight, if you will—but the fundamental difference is whether the airplane's heading is changing relative to the bank angle. Here are the basics:

THE SLIP

In a slip or a slipping turn, the airplane is not turning at the rate appropriate to the bank being used, since the airplane is yawed toward the outside of the turning flightpath. Put another way, the airplane is banked too much for the rate of turn, so the horizontal lift component is greater than the centrifugal force.

Slipping Turn

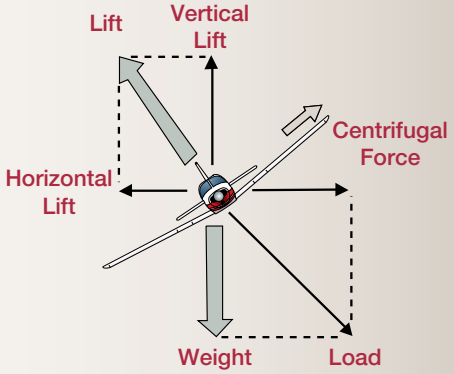


Equilibrium between the horizontal lift component and centrifugal force is reestablished either by decreasing the bank, increasing the rate of turn, or a combination of the two changes.

THE SKID

Remember that the fundamental definition of either a slip or a skid is that the rate of turn is inappropriate to the bank angle. In contrast to a slip or slipping turn, a skid or skidding turn results from an excess of centrifugal force over the horizontal lift component, pulling the airplane toward the outside of the turn. Put another way, the rate of turn in a skid is too great for the angle of bank.

Skidding Turn



Correcting a skidding turn thus involves a reduction in the rate of turn, an increase in bank, or a combination of both.

Quick Tip: Coordinating The Roll

When initiating a turn, look straight out over the nose. If it pivots on a point, you are coordinated. If the nose swings in the direction of the bank, you're adding too much rudder in the direction of the bank. If it swings opposite the bank, you haven't added enough. Don't focus on the ball; it only depicts what already went wrong! Practicing the classic "Dutch roll" exercise—banking left and right on a point—is a good way to achieve a feel for this elusive balance.

the "feel" of a skid probably since that is what you feel in a car going around a turn. Clearly, a lot of training is necessary here to overcome (again) the "automotive paradigm" (see the sidebar on the opposite page).

SLIP TO A STALL

The slip is an entirely safe and a wonderful tool if performed correctly. An excellent demonstration of the stability of the slip configuration is flying the plane into a stall while stabilized in a full slip with power at idle. Amazingly, while maintaining a full slipping stall, nothing exciting happens. This surprises every student and that is why this demonstration is so powerful. In a well-rigged trainer there is not even a significant "stall break:" The plane will just hang in a level flight attitude with no gyrations and indicate about a 1500-fpm descent.

In this configuration, there is no tendency to spin because roll force downward into a turn is opposed by the rudder force against the turn, thus creating a balanced situation.

Before you pick up a pen to write me a nasty letter, let me say that this maneuver is quite different in a climbing turn with the slipstream generated by full power energizing the rudder. A slip in this configuration is not at all benign, and the airplane can spin quickly "over the top." For this reason I always advocate the slip to land as the tool of last resort to create the necessary descent. First add drag, then reduce more power; finally, slip if you must.

THE FATAL SKID SCENARIO

The evil twin of cross-controlled flight that started all the rumors of death and destruction is actually a skid, even though it is often mistaken for a slip. The confusion is not limited to beginners either: I have had CFI job applicants demonstrate the monster skid and call it a "slip to landing." So, the vital question when crossing the controls in a descent is, "Am I slipping or skidding?" The answer is this: If you are ever turning the plane

The Turning Stall

Sammy Mason, in his excellent book, *Stalls, Spins and Safety*, describes the perfect candidate for the stall/spin accident: "More than likely it will be the pilot who seldom, if ever, exceeds a 30-degree bank and hasn't practiced a stall, let alone a spin, in years. Just as physical exercise improves your physical health, proper flying exercises will improve your ability to fly an airplane."

To practice this maneuvering, find a competent, patient, CFI and start back in with some straight ahead unaccelerated stalls. If it has been awhile this will "re-imprint" the feel of releasing back pressure (unloading G force) to recover from a falling nose. This is counterintuitive. It seems to be human instinct to try to "pull" here to get out of trouble and this error needs to be corrected first. Following this with simple coordinated turning stalls gets rid of the universal misconception that bank is responsible or somehow involved in a spin entry. I am always amazed at how few pilots have even done these anywhere in training.

This is, incidentally a maneuver that may be tested on the Private pilot practical test, both climbing with power and descending. If the plane is coordinated entering a turning stall, the nose smoothly and reliably falls away from the lift vector. The stall break is more subtle due to the offset of the elevator force. Just unload, roll level and recover the lost altitude.

The Problem With Today's Flight Training

Many "new age" flight training training courses avoid stressing the need for coordinated flight—at the expense of cross-controlling—since the school's marketing department is often running the show.

For fear of "scaring off" potential students and airplane customers, they don't want to invest the time and effort necessary to teach proper, coordinated use of the controls. Instead, flying is presented as "driving in the sky," and a watered-down flight training syllabus never departs from the center of the maneuvering envelope.

Claims of financial poverty and also the feeling that schools need only "train to minimum standards" also fuels a lot of brevity in flight training.

My "sales pitch" on this issue is simple: "You are investing in your own safety here. If you were shopping for a parachute and had three rigs of differing cost and quality in front of you, would you choose the cheapest?" Usually that gets the attention of the student or hopefully their significant other.

with the rudder, you are skidding. Any hint of "cheating the turn" or increasing the turn rate with rudder results in a skid. At low altitude—as when executing a late turn to final—this can be fatal.

The classic example occurs on a breezy day, when the runway features almost a direct crosswind from the left. Things happen fast on the downwind leg and, by the time we're turning from base to final, the airplane is high and close-in. This is because we flew the downwind leg without establishing and maintaining a heading to compensate for the wind. The result is that we've drifted closer to the runway than normal.

By the time we turn onto the base leg, we're already too high and too close, plus we have a stiff tailwind. The wind pushes us past the runway's extended centerline and, somewhere in the turn, we realize that a simple 20-degree bank isn't going to cut it this time. So, more aileron is cranked in, with too much rudder—a skid—to increase the rate of turn. Usually, the airplane is already in the landing configuration and power is way back.

The FAA's *Airplane Flying Handbook*, FAA-H-8083-3A, has the following description of what happens next: "The addition of inside rudder pressure will cause the speed of the outer wing to increase, therefore, creating greater lift on that wing. To keep that wing from rising and to maintain a constant angle of bank, opposite aileron pressure needs to be applied. The added inside rudder pressure will also cause the nose to lower in relation to the horizon. Consequently, additional back-elevator pressure would be required to maintain a constant-pitch attitude. The resulting condition is a turn with rudder applied in one direction, aileron in the opposite direction, and excessive back-elevator pressure—a pronounced cross-control condition.... This is usually the beginning of a spin. It is obvious that close to the ground is no place to allow this to happen."

As bank angle increases, the vertical component of lift decreases and the airplane's descent rate increases. The result is increased elevator back pressure, and reduced airspeed. As speed bleeds off and the resulting skid achieves a greater rate of turn, the stall break occurs, the airplane snaps over into a spin and there is little altitude with which to recover. This is why it's critical to maintain coordinated flight, especially when close to the ground.

CONCLUSION

Flight in the "cross-controlled" configuration can be necessary for coordinated, efficient and safe flight, or it can induce either a slip or a skid. This configuration is essential in a climbing right turn but completely inappropriate and deadly in a skidding left turn. Think of the slip/skid difference like the two edges of a knife: One side will cut you quickly while the other side is relatively benign.

Accurate knowledge and recent practice in slow flight is essential to allow a pilot the confidence and skill to maneuver safely in the pattern. You need to try the slip and skid to feel and understand the difference. More knowledge and careful training in this is area of flight control is essential and could save your life. That's money well spent!

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