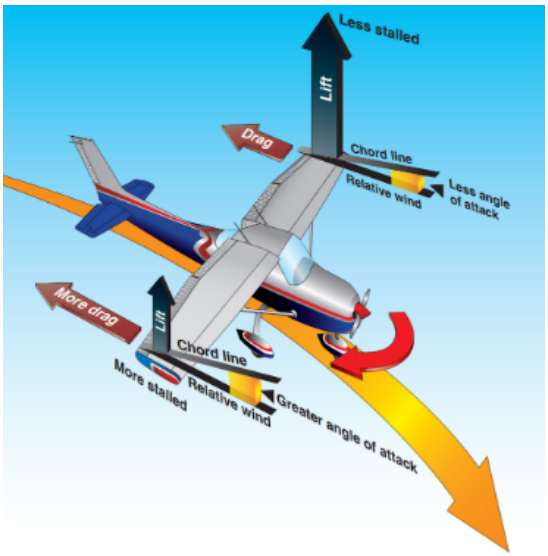
Spins / Spin Awareness

Objective	
To ensure the applicant learns the purpose of and can exhibit a clear understanding of the intentional spins maneuver and how to perform the maneuver properly.	
Purpose	
Spins are one of the most dangerous hazards that affect pilots, and developing an understanding of the causes for them will make pilots more proficient at avoiding them. This lesson will introduce pilots to the aerodynamics involved in spins, as well as the proper recovery procedures, so that uncoordinated stalls can be properly recovered before they develop into spins.	

Schedule	**Equipment**
• **Ground Lesson**: 30 minutes • **Flight**: 1 hour - *Demonstration of Maneuver* • **Debrief**: 20 minutes	• Airplane Checklist • Whiteboard / Markers (optional) • Model Airplane (optional)
Student Actions	**Instructor Actions**
• Ask any questions, receive study material for the next lesson. • Watch linked videos. • Review listed references.	• Deliver the ground lesson (below). • Demonstrate the maneuver in flight. • Debrief after each flight.

Completion Standards

- **Ground**: Student can explain the aerodynamics involved in a spin, when spins are likely to occur, and the proper recovery procedure.
- **Flight**: Student observes the spin or incipient spin demonstration and can demonstrate the proper recovery technique.

References

- MZeroA Flight Training - “Proper Spin Recovery”
  - YouTube - https://www.youtube.com/watch?v=52tPNkBcfmg
- The UND AeroCast - “Spin Awareness Training”
  - YouTube - https://www.youtube.com/watch?v=c4XbkwMdZvY
- FAA-H-8083-3B (Airplane Flying Handbook) - Chapter 4, Page 5-6 [Stalls/Stall Recognition/Stall Recovery], Chapter 4, Page 13-17 [Spin Awareness/Intentional Spins]
- FAA-H-8083-25B (Pilot’s Handbook of Aeronautical Knowledge) - Chapter 5, Page 25-26 [Stalls]
- FAA-S-ACS-6B (Private Pilot ACS) - Area VII Task D (Spin Awareness)
- FAA-S-ACS-7A (Commercial Pilot ACS) - Area VII Task D (Spin Awareness)
- FAA-S-8081-6D (CFI PTS) - Area XI Task G

Ground Lesson Outline

- Spins are ‘Scary’
  - Anxiety factors
- Aerodynamics of Spins
  - Inside wing more stalled than outside wing
- Airplanes Approved for Intentional Spins
  - Airworthiness category and type certificate.
- Impact of CG, Weight, and Coordination
  - Overweight or out of CG -> Recovery may be impossible!
- Situations Leading to Unintentional Spins
  - Base to Final Turn, Power-On Stall Practice
- Basic Spin Recognition and Recovery
  - P A R E -> Power to Idle, Ailerons Neutral, Rudder Opposite, Elevator Forward to Break Stall
- How to Spin, On Purpose
  - Entry from simulated Base-Final turns (Cross-Controlled Stalls) or ‘Kick’ the rudder at the stall
  - Pro-Spin vs. Anti-Spin Inputs
  - Minimum Entry Altitude - 4,000ft AGL, Minimum Recovery Altitude - 2,500ft AGL
- Maintaining Orientation
  - Don’t lose track of heading or altitude, count the spins
- Maneuver Description - step-by-step
  - Clean configuration
  - Entry position, airspeed, etc.

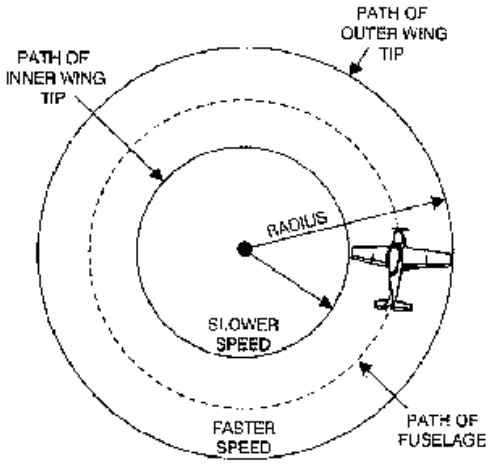
Common Errors

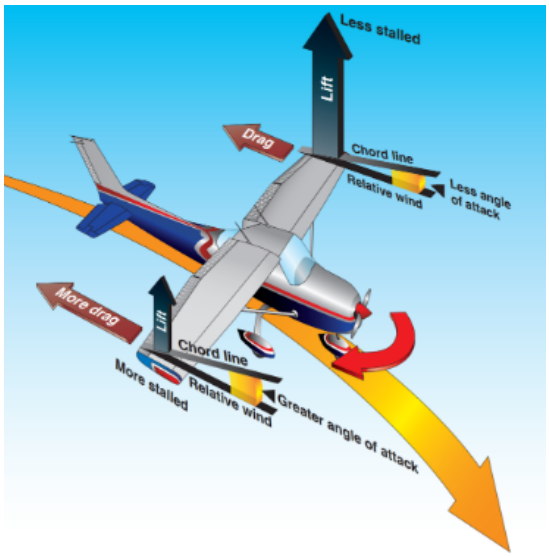
- Failure to establish proper configuration prior to spin entry.
- Failure to achieve and maintain a full stall during spin entry.
- Failure to close throttle when a spin entry is achieved.
- Failure to recognize the indications of an imminent, unintentional spin.
- Improper use of flight controls during spin entry, rotation, or recovery.
- Disorientation during a spin.
- Failure to distinguish between a high-speed spiral and a spin.
- Excessive speed or accelerated stall during recovery.
- Failure to recover with minimum loss of altitude.
- Hazards of attempting to spin an airplane not approved for spins.

Ground Lesson Content

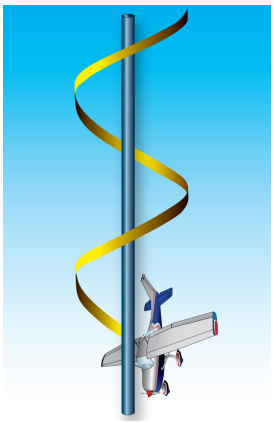
- **Spins are 'Scary'** - Many pilots are intimidated by spins, and because of the danger they pose to pilots, this fear seems justified. However, when pilots are educated about spin entry, spin recovery, and the aerodynamics of spins, it is possible to overcome the natural anxiety and focus more on the elements of the maneuver. Before any lesson involving a spin, or cross-controlled stall demonstration, a thorough preflight briefing should be accomplished outlining exactly what steps will be performed, so the element of surprise is alleviated.

- **Aerodynamics of Spins** - To understand the aerodynamics of spins, pilots must first understand that all spins first begin with an uncoordinated (often cross-controlled) stall. In an uncoordinated, usually *skidding*, turn, one wing is being blanketed partially by the fuselage, as well as flying a shorter path than the outside wing, resulting in the inside wing flying slightly slower than the outside wing. This leads to **an asymmetric stall where the inside wing stalls first**, even when the outside wing may still be flying normally, creating a violent tendency to bank in the direction of the stalled wing. **Additionally, the more stalled wing is now producing *more drag* also, which tightens and increases the rotation.**

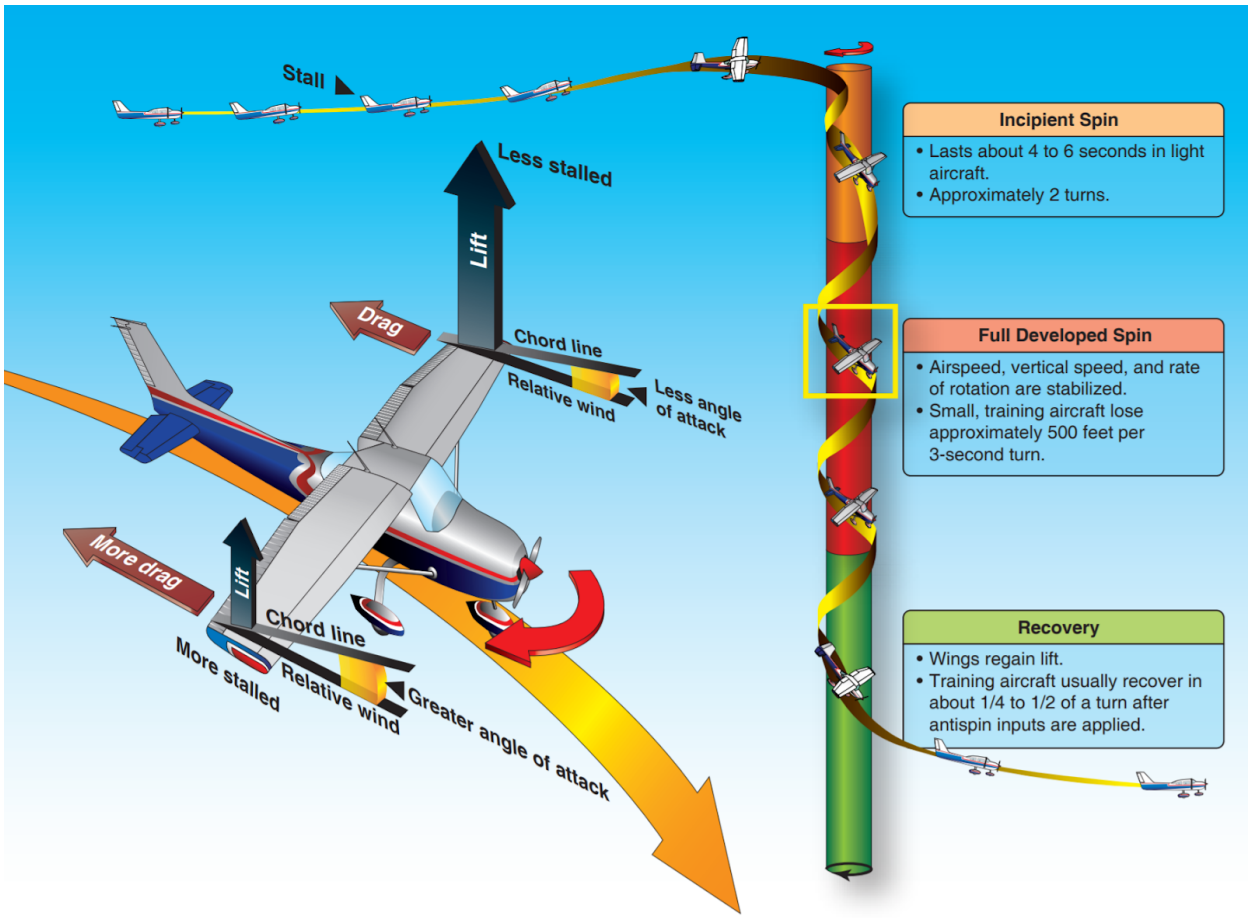




  - **Incipient Phase** - If the asymmetric stalling condition persists, the airplane will continue rolling towards the stalled wing, past the vertical, and enter the *incipient phase* of the spin. The airplane begins accelerating downwards rapidly, and the rotation increases.
  - **Developed Phase** - As the airplane begins a tight rotation in the direction of the original turn, both wings are now stalled, however **the inside wing is flying at a higher angle of attack, and remains more stalled than the outside wing**. Eventually, the spin stabilizes with the airplane at low airspeed, a stable descent rate, and a steady rotation rate. This is called the *developed phase* of a spin. Most small airplanes will be losing altitude at an incredible rate in this phase, often 500 feet per 2-second turn.



- **Recovery** - If the pilot applies anti-spin control inputs by reducing the throttle, neutralizing the ailerons, using opposite rudder, and applying forward elevator pressure, the stalled condition is broken and the wings are now flying again. The opposite rudder counteracts the rotation and allows the spin to develop into a steep, descending spiral dive, from which a normal recovery can be made.



- **Airplanes Approved for Intentional Spins** - Many common training airplanes are not approved for intentional spins. Always consult the *Limitations* section of the POH to determine under which conditions, if any, intentional spins are approved.
  - **Airworthiness category and type certificate** - Some training airplanes approve intentional spins only under the *Utility Category*, which provides higher positive and negative limit load factors.

SECTION 2
LIMITATIONS

CESSNA
MODEL 172P

instructor, certain maneuvers are required by the FAA. All of these maneuvers are permitted in this airplane when operated in the utility category.

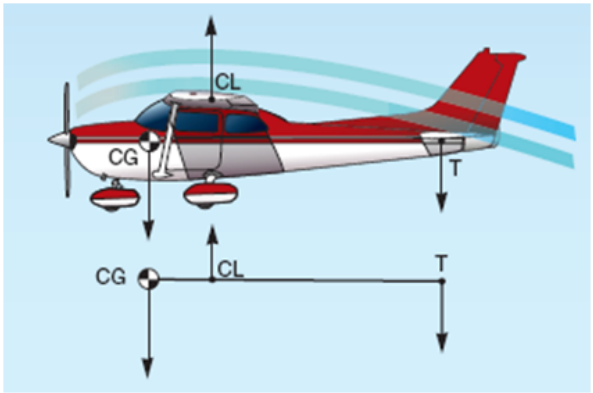
In the utility category, the baggage compartment and rear seat must not be occupied. No aerobatic maneuvers are approved except those listed below:

MANEUVER	RECOMMENDED ENTRY SPEED*
Chandelles	105 knots
Lazy Eights	105 knots
Steep Turns	95 knots
Spins	Slow Deceleration
Stalls (Except Whip Stalls)	Slow Deceleration

*Abrupt use of the controls is prohibited above 99 knots.

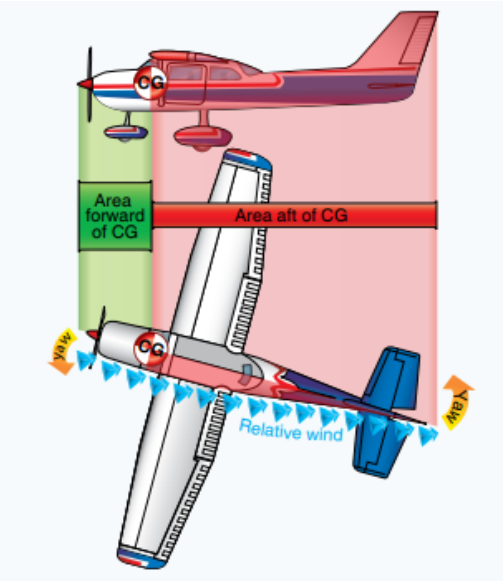
Aerobatics that may impose high loads should not be attempted. The important thing to bear in mind in flight maneuvers is that the airplane is clean in aerodynamic design and will build up speed quickly with the nose down. Proper speed control is an essential requirement for execution of any maneuver, and care should always be exercised to avoid excessive speed which in turn can impose excessive loads. In the execution of all maneuvers, avoid abrupt use of controls. Intentional spins with flaps extended are prohibited.

- **Impact of CG, Weight, and Coordination** - As stated above, many airplanes are only approved for intentional spins in the *Utility Category*, which is determined largely by weight. However Center of Gravity also impacts spin recovery. Recall that spins are just an aggravated stall condition, and so normal stall recovery considerations also apply to spins.
    - **Overweight or out of CG -> Recovery may be impossible!** - Airplanes are designed so that they have a natural tendency to recover from a stall. They are designed so that during flight, they rotate around a point called the *Center of Lift*. The *Center of Gravity* is the 'balance point'. (Imagine balancing an object on a fingertip) **A well-designed airplane's Center of Gravity is always forward of the Center of Lift.**



    - This design causes a natural tendency for the airplane to nose down, reducing the angle of attack. To counteract this, the horizontal stabilizer and elevator surfaces of an airplane are designed to produce a *downward* force, which 'holds up' the heavier nose area by pivoting the airplane around the Center of Lift. **When an airplane stalls, if the elevator pressure is relaxed, the Center of Gravity will fall naturally.**

- When an airplane Center of Gravity is too close to the Center of Lift, or even behind it, a very dangerous situation exists where there is no natural tendency to recover from a stall. **In fact, if the Center of Gravity is too far rearward (aft), a stall may be unrecoverable!**
- Recall also that a spin involves a high rate of rotation, and that the rudder and vertical tail surface are needed to arrest the rotation. Airplane yaw is largely controlled by the vertical tail surface, and to a lesser extent, the fuselage itself. Due to the large distance from the center of gravity, the tail surface is very effective at maintaining directional stability. When the CG moves rearwards, towards the tail, the tail surface is less effective and directional stability is reduced. **An airplane with a CG that is too far aft has limited directional stability and rudder authority may be insufficient to recover from the spin!**



- **Situations Leading to Unintentional Spins** - Spins ultimately begin as uncoordinated (often cross-controlled) stalls, and usually happen by accident. Any uncoordinated stall can develop into a spin entry. They can surprise pilots in the traffic pattern, or in the practice area.
  - **Base-to-Final Turns** - The most common place an unintentional stall and spin would occur is, inadvertently, during a gliding, base-to-final turn. Pilots often have been taught to fear banking too much when close to the ground, and in situations where they have overshot the base-to-final turn, they may try to steepen the turn without increasing the bank. This leads to a skidding ('bottom rudder') turn, where the ailerons are being held opposite in order to fight to overbanking tendency. This cross-controlled stall is a classic spin entry technique.
    - **Anatomy of the Gliding Base-to-Final Stall-Spin** - The typical 'entry' procedure for an unintentional gliding, base-to-final spin is as follows:
      - **Base Leg** - Airplane is flying on a base leg, approaching the turn to final. The airspeed is low for approach and landing, and often allowed to get *too low*.
      - **Overshoot Final** - The airplane overshoots final approach. This often occurs when there is a left crosswind on a left base, with the crosswind providing an unexpected tailwind on base.
      - **Skidding Turn To Final** - The pilot banks the airplane towards final, and not wanting to increase bank any further, applies *bottom* or *inside* rudder to hasten the turn to final.
      - **Bank Increases, Nose Falls** - The pilot notices that the airplane wants to continue to bank towards the turn, so they apply opposite aileron. This cross-controlled, uncoordinated situation increases drag and causes the nose to fall.
      - **Stall** - The pilot attempts to raise the nose with elevator and the airplane begins to stall. The increased stall speed from the banked turn, combined with the

uncoordinated crossed-controls, causes the inside wing to stall first, rolling the airplane towards the inside of the turn.

- **Spin Entry** - If left uncorrected, the airplane will begin spinning in the direction of the turn.

  - **Improper Stall Recovery** - Another place where unintentional stall and spins are encountered is during improper recovery from stalls performed in training. If the airplane is uncoordinated when entering the stall, one wing will tend to drop rapidly. Surprised and inexperienced pilots attempt to raise the falling wing with aileron, deepening the stall, and leading to a *secondary*, cross controlled stall, and subsequent entry into a spin.

- **Basic Spin Recognition and Recovery** - Pilots should consult each airplane's POH for the make and model specific recovery procedures, but for most airplanes the acronym **P-A-R-E** is used to outline the spin recovery inputs:
  - **Power to Idle** - The airplane will be descending extremely rapidly, and engine thrust only hastens the descent, as well as flattens the spin.
  - **Ailerons Neutral** - The ailerons are a major contributing cause to the 'one wing is more stalled than the other' situation, and neutralizing the ailerons reduces this.
  - **Rudder Opposite** - The rudder should be pushed all the way to the stops in the direction opposite of the spin to slow the rotation.
  - **Elevator Briskly Forward to Break Stall** - Move the elevator forward briskly as soon as the rudder reaches the stop. This will break the stall and allow the wings to fly normally again. If done correctly, the airplane will now be in a power-off, steep, descending spiral dive. The dive can be recovered normally, with **smooth and gentle elevator pressure to raise the nose, taking care not to enter an accelerated stall**.

- **How to Spin, On Purpose** - An intentional spin is easily entered in two main ways:
  - **Method 1** - Enter from simulated Base-Final turns (Cross-Controlled Stalls).
  - **Method 2** - 'Kick' the rudder at the stall in the desired direction of spin.
  - To promote the tendency to spin, pilots should apply 'pro-spin' inputs. Opposite aileron to the direction of spin will deepen. Avoid 'anti-spin' inputs, such as relaxing elevator backpressure (to break the stall), and do not apply opposite rudder until ready to recover.

    - **Minimum Entry and Recovery Altitude** - Intentional spins should be entered at **no less than 4,000ft AGL**, and recovery should be made **no later than 2,500ft AGL**.

- **Maintaining Orientation**
    - **Eyes Outside** - Don't lose track of heading or altitude, count the rotations. **Monitor the altitude so that recovery is initiated by the minimum recovery altitude.**

Maneuver Description

- **Entry Altitude** - Spins should always be performed at a safe altitude, in case of a delayed or inadequate recovery, or other problems. The maneuver should be performed such that accounting for altitude loss during spin, the final altitude is no lower than 2,500 feet AGL. Therefore it is best to begin the maneuver **at least 4,000 feet AGL**.
- **Checklists** - Pilots must perform a pre-maneuver checklist before beginning the maneuver. **Because significant altitude may be lost in this maneuver, make sure to clear the area below the airplane as well!**
- **Configuration** - Configure the airplane in the **clean configuration**, to avoid overspeeding the flaps during the recovery.
- **Entry Airspeed and Power** - The power should be reduced and the airspeed allowed to decay to a stall.
- **Stall and Spin Entry** - Either apply cross-controlled stall inputs, or wait for the stall and kick full rudder in the desired spin direction.
- **Recovery** - Promptly **reduce power to idle, neutralize the ailerons, apply full opposite rudder to slow the rotation, and briskly push forward on the elevator to break the stall.** Once the airplane has recovered to a steep spiral, gently raise the nose to the horizon, avoiding an accelerated stall, and apply full power and establish a climb at Vx or Vy to get back to the pre-maneuver altitude.
- **This is a visual maneuver!** Eyes should remain outside the cockpit as much as possible to scan for traffic and to monitor the progress of the maneuver.