

XI.G. Spins

References: 14 CFR Part 23; Type Certificate Data Sheet; AC 61-67; FAA-H-8083-3; POH/AFM

Objectives	The student should develop knowledge of the elements related to spins. The student will learn how to recognize a spin and the proper recovery techniques.
Key Elements	<ol style="list-style-type: none">1. Stall + Yaw = Spin2. Brisk and Positive Recovery3. Ensure Spins are Approved
Elements	<ol style="list-style-type: none">1. Spins and Anxiety2. Aerodynamics of a Spin3. Relationship of Various Factors to Spins4. Possible Spin Situations5. Airworthiness Category and Type Certificate6. Spin Procedures7. Maintaining a Stabilized Spin8. Maintaining Orientation9. Recognizing Potential Spins
Schedule	<ol style="list-style-type: none">1. Discuss Objectives2. Review material3. Development4. Conclusion
Equipment	<ol style="list-style-type: none">1. White board and markers2. References
IP's Actions	<ol style="list-style-type: none">1. Discuss lesson objectives2. Present Lecture3. Ask and Answer Questions4. Assign homework
SP's Actions	<ol style="list-style-type: none">1. Participate in discussion2. Take notes3. Ask and respond to questions
Completion Standards	The student understands the factors involved in creating and maintaining a spin and knows the process to recover from a spin.

Instructors Notes:

Introduction:

Attention

Interesting fact or attention grabbing story

Who WANTS to do a spin? Most people are scared of them, but understanding them will help in avoiding them and remove some of the fear.

Overview

Review Objectives and Elements/Key ideas

What

A spin is an aggravated stall that results in what is termed "autorotation," wherein the airplane follows a downward corkscrew path.

Why

Without an understanding of spins and the proper procedures to recover from them the pilot could be put in an impossible situation. Understanding spins also will increase confidence and help reduce the anxiety associated with spins.

How:

1. Spins and Anxiety

- A. Fear of spins is deeply rooted in the public's mind and many pilots have an aversion to them
 - i. Learning the cause and proper procedure to prevent/recover will remove some of the anxiety
 - a. Increases spin awareness as well as confidence
- B. Spins are recoverable.

2. Aerodynamics of Spins

- A. Requirements for a Spin
 - i. Both wings must first be stalled; then one wing becomes less stalled than the other
 - a. The airplane must be in a stall
 - b. The airplane must be in uncoordinated flight
- B. Basically...
 - i. The autorotation results from an unequal angle of attack on the airplane's wings
 - a. The lowered wing has an increasing AOA, past the critical AOA - lift decreases and drag increases
 - b. The rising wing has a decreasing AOA, allowing lift to increase and drag to decrease
 - The rising wing is less stalled
- C. Specifically...
 - i. Often one wing will drop at the beginning of a stall causing the nose to yaw to the low wing
 - a. This is where rudder is important during a stall - Maintaining directional control to avert a spin
 - ii. If the airplane is allowed to yaw, one wing will drop in the direction of the yaw (the other will rise)
 - iii. Lowered Wing
 - a. Unless rudder is used to correct the yaw, the airplane will begin to slip to the lowered wing
 - Results in a weathervane into the relative wind (to the low wing), increasing the yaw
 - The airplane also continues to roll toward the lowered wing
 - iv. The lowered wing has an increasingly greater AOA due to the upward motion of the relative wind
 - a. It is then well beyond the critical AOA and suffers an extreme loss of lift and increase in drag
 - v. Raised Wing

- a. The rising wing has a smaller/decreasing AOA since the relative wind is striking at a smaller angle
 - The rising wing is less stalled and develops some lift causing the airplane to continue rolling
 - a. Creating the yawing and pitching motion

3. Relationship of Various Factors to Spins

- A. Configuration
 - i. Flaps - will generally increase the lifting ability of the wings and therefore decrease stall speed
- B. Weight
 - i. An increased weight increases the stall speed since it requires a higher AOA to produce the lift necessary to support the additional weight
 - a. The critical AOA will be exceeded at a higher airspeed
- C. Center of Gravity (CG)
 - i. Minor weight or balance changes can alter spin characteristics
 - a. The changes may allow operation within the CG but could affect recovery characteristics
 - ii. As the CG moves Aft – the airplane flies at a lower AOA (reducing back pressure and drag)
 - a. This lowers the stall speed – The critical AOA will be exceeded at a lower airspeed
 - b. This decreases stability
 - iii. An extremely aft CG makes spin recovery hard as the airplane loses its tendency to pitch down
 - a. The shorter the arm from the elevator to the CG, the less force the elevator is able to produce making recovery more difficult
 - b. An extremely aft CG may result in a flat spin and recovery may be impossible
 - iv. A forward CG - the airplane flies at a higher AOA and will stall at a higher airspeed (increased lift and drag)
 - a. But, recovery will be easier as the nose will want to pitch down
 - b. There also is a longer arm from the CG to the elevator which produces more force making recovery from stalls easier
- D. Control Coordination
 - i. Uncoordinated flight is what results in a spin
 - a. Stall + Yaw = Spin

4. Possible Spin Situations

- A. Stall + Yaw = Spin
- B. The primary cause is stalling the airplane while executing an uncoordinated turn
- C. Spins can occur while practicing stalls with uncoordinated controls or aileron deflection at critical AOA
- D. Critical phases of flight include Takeoff/Departure, Approach/Landing, and Engine Failure
- E. **CE** - Failure to recognize the indications of an imminent, unintentional spin

5. Airworthiness Category and Type Certificate

- A. DON'T intentionally spin an aircraft that is not authorized for spins
- B. To determine if spins are approved check:
 - i. Type Certificate and Data Sheets
 - ii. AFM/POH – Limitations section
 - iii. Placard in the airplane stating, “No acrobatic maneuvers including spins approved”
- C. DA20: Utility Category plane - Is approved for spins
- D. Also Check:
 - i. Weight and Balance limitations
 - ii. Recommended entry and recovery procedures
- E. If the airplane is not certified DO NOT attempt spins
 - i. Sometimes people will try to justify the maneuver
 - a. Technicality in the Airworthiness Standards
 - b. The airplane was spin tested during certification

- Normal Category Airplane's only require that an airplane recover from a one-turn spin of not more than one additional turn or 3 seconds, whichever takes longer
 - a One 360° rotation does not provide a stabilized spin, therefore prolonged spins in that aircraft could be difficult or impossible
- ii. 14 CFR Part 23
 - a. There are no requirements for investigation of controllability in a true spinning condition for normal category airplanes
 - The one turn margin is a check of the controllability in a delayed stall (not spin) recovery
 - Therefore, in airplanes placarded against spins, there is absolutely no assurance that recovery from a fully developed spin is possible
- F. **CE** - Hazards of attempting to spin an airplane not approved for spins

6. Spin Procedures

- A. Preflight
 - i. Special emphasis on excess/loose items that may affect weight, CG, controllability of the airplane
- B. Pre-Maneuver
 - i. Checklist - Fuel Pump ON; Mixture RICH; Lights ON; Gauges GREEN
 - ii. Clear the Area - Above and Below
 - iii. Altitude - Above 3,500' AGL so recovery can be completed at or above 1,500' AGL
 - a. Approximately 500' is lost per 3 second turn
 - iv. **CE** - Failure to establish proper configuration prior to spin entry
- C. Maneuver
 - i. Entry Phase
 - a. Where the pilot provides the necessary elements for the spin (accidentally or intentionally)
 - b. Similar to a power off stall
 - Reduce power to idle while simultaneously raising the nose to a stalling pitch attitude
 - As the stall approaches, smoothly apply full rudder in the direction of desired spin while applying *full* (to the limit) back elevator pressure
 - c. Keep ailerons neutral
 - d. Reduce power to idle on spin entry
 - e. **CE** - Failure to close throttle when a spin entry is achieved
 - f. **CE** - Failure to achieve and maintain a full stall during spin entry
 - g. **CE** - Improper use of flight controls during spin entry, rotation, or recovery
 - ii. Incipient Phase
 - a. From the time the airplane stalls and rotation starts until the spin has fully developed
 - b. Incipient spins are most often used in the intro to spin training/recovery techniques
 - c. May take up to two turns for most aircraft
 - d. The aerodynamic and inertial forces have not reached a balance
 - e. The indicated airspeed should be near/below stall speed and the turn coordinator will indicate the direction of the spin
 - f. Incipient Recovery
 - Commence prior to completion of 360° of rotation with full rudder opposite the turn
 - iii. Developed Phase
 - a. Occurs when the airplane's angular rotation rate, airspeed, and vertical speed are stabilized while in a flightpath that is nearly vertical
 - b. Aerodynamic forces and inertial forces are in balance, the spin is in equilibrium
 - iv. Recovery Phase
 - a. Occurs when the AOA of the wings decrease below the critical AOA and autorotation slows

- Then, the nose steepens and rotation stops – may last ¼ of a turn to several turns
- b. Step 1 – POWER IDLE
 - Power aggravates the spin characteristics, resulting in a flatter spin and increased rotation
- c. Step 2 – AILERONS NEUTRAL
 - Ailerons may have an adverse effect on recovery
 - a Ailerons in the direction of the spin may speed the rotation, delaying recovery
 - b Ailerons opposite the spin may cause the down aileron to force a deeper stall
- d. Step 3 – RUDDER OPPOSITE THE ROTATION
 - FULL (to the stop) rudder opposite the rotation
- e. Step 4 - ELEVATOR FORWARD
 - To break the stall apply a positive/brisk, straight forward movement of the elevator
 - a Immediately after full rudder application and hold firmly in this position
 - b This will decrease the AOA and break the stall (spinning will stop when broken)
- f. Step 5 – RUDDER NEUTRAL
 - If not neutral the increased airspeed will cause a yawing or skidding effect
 - Also, if the stall is not broken and full rudder is held in the opposite direction a spin can quickly start again in the new direction
- g. Step 6 – ELEVATOR BACK PRESSURE
 - Once broken, raise the nose to level flight - Be careful of a secondary stall and exceeding load limits
- h. **CE** - Excessive speed or accelerated stall during recovery
 - Once the spin is stopped and the stall broken, smoothly raise the nose to maintain level flight
 - a Avoid aggressive movements resulting in an accelerated stall or a secondary stall
 - Once the spin is stopped and the stall broken, smoothly raise the nose maintain level flight, or establish a climb – do not leave the aircraft in a nose low attitude while altitude decreases and airspeed increases
- i. **CE** - Improper use of flight controls during spin entry, rotation, or recovery
- j. **CE** - Failure to recover with minimum loss of altitude
- k. The engine may stop producing power due to centrifugal force acting on the fuel tanks - Assume power will not be available
 - In the case power is unavailable pitch for best glide speed and make an emergency landing at the nearest suitable landing area

7. Maintaining a Stabilized Spin

- A. Maintain full back pressure, to keep wings stalled
- B. Maintain full rudder in the direction of the turn, to keep yawing
- C. Maintain neutral ailerons
- D. High Speed Spiral
 - i. Evidenced by a nose low attitude, the wings not stalled, airspeed increasing rapidly, and a high rate of descent
 - ii. A spin will have a nose down attitude, continuous rotation, possible buffeting, constant low airspeed, wings stalled, and steady rate of descent
 - iii. **CE** - Failure to distinguish between a high-speed spiral and a spin
- E. **CE** - Improper use of flight controls during spin entry, rotation, or recovery

8. Maintaining Orientation

- A. Select an outside reference point and use the turn coordinator
- B. Gyroscopic Instruments may tumble and be misleading (heading indicator, attitude indicator)

- i. The turn coordinator can provide the best reference as to the direction of the spin
- C. **CE** - Disorientation during a spin

9. Recognizing Potential Spins

- A. Continued stall (and spin) recovery practice
 - i. A spin is dependent on yawing during a stall – Don't let the airplane yaw during a stall

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

Conclusion:

Brief review of the main points

Spins can be dangerous, especially when close to the ground. Understanding the reasons a spin can happen and how to prevent one is extremely important. As long as coordination is maintained during a stall, a spin will not occur. Once in a spin, recovery is accomplished by reducing the power to idle, maintaining neutral ailerons, and applying full opposite rudder along with forward elevator pressure to break the spin. The recovery should be performed with brisk, positive pressure.

PTS Requirements:

To determine that the applicant:

1. Exhibits instructional knowledge of the elements of spins by describing:
 - a. Anxiety factors associated with spin instruction.
 - b. Aerodynamics of spins.
 - c. Airplanes approved for the spin maneuver based on airworthiness category and type certificate.
 - d. Relationship of various factors such as configuration, weight, center of gravity, and control coordination to spins.
 - e. Flight situations where unintentional spins may occur.
 - f. How to recognize and recover from imminent, unintentional spins.
 - g. Entry procedure and minimum entry altitude for intentional spins.
 - h. Control procedure to maintain a stabilized spin.
 - i. Orientation during a spin.
 - j. Recovery procedure and minimum recovery altitude for intentional spins.
2. Exhibits instructional knowledge of common errors related to spins by describing:
 - a. Failure to establish proper configuration prior to spin entry.
 - b. Failure to achieve and maintain a full stall during spin entry.
 - c. Failure to close throttle when a spin entry is achieved.
 - d. Failure to recognize the indications of an imminent, unintentional spin.
 - e. Improper use of flight controls during spin entry, rotation, or recovery.
 - f. Disorientation during a spin.

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- g. Failure to distinguish between a high-speed spiral and a spin.
 - h. Excessive speed or accelerated stall during recovery.
 - i. Failure to recover with minimum loss of altitude.
 - j. Hazards of attempting to spin an airplane not approved for spins.
3. Demonstrates and simultaneously explains a spin (one turn) from an instructional standpoint.
 4. Analyzes and corrects simulated common errors related to spins.

