XI.D. Crossed-Control Stalls

References: FAA-H-8083-3; POH/AFM

Objectives	The student should understand the dynamics of a crossed-control stall and therefore be able to recognize situations which could lead to a crossed-control stall. The student also should be able to safely and effectively demonstrate and properly recover from a crossed-control stall.
Key Elements	1. Too much rudder can hurt us 2. Little or no warning of a stall 3. Intuitive reactions are dangerous
Elements	1. Aerodynamics of Crossed-Controlled Stalls 2. Performing Crossed-Control Stalls
Schedule	1. Discuss Objectives 2. Review material 3. Development 4. Conclusion
Equipment	1. White board and markers 2. References
IP's Actions	1. Discuss lesson objectives 2. Present Lecture 3. Ask and Answer Questions 4. Assign homework
SP's Actions	1. Participate in discussion 2. Take notes 3. Ask and respond to questions
Completion Standards	The lesson is complete when the student understands the unique requirements for a crossed-control stall and can confidently recognize and recover from a crossed-control situation.

Instructors Notes:

Introduction:

Attention

Interesting fact or attention grabbing story
Intro from Crossed-Control Stalls Article

Overview

Review Objectives and Elements/Key ideas

What

This type of stall occurs with the controls crossed - aileron pressure applied in one direction and rudder pressure in the opposite direction.

Why

It is imperative that this type of stall not occur during an actual approach to landing, since recovery may be impossible prior to ground contact due to the low altitude. During traffic pattern operations, any conditions that result in overshooting the turn from base leg to final approach, dramatically increase the possibility of an unintentional accelerated stall while the airplane is in a crossed-control condition.

How:

1. **Aerodynamics of a Crossed-Control Stall**
   SOURCE: http://www.apstraining.com/article5_fci_training_feb03.htm

   A. Here's the situation that will lead to a cross-controlled condition in the pattern:
      i. In a descent, the pilot starts the left turn from base to final late, additionally there's an overshooting wind pushing the aircraft past the runway centerline and potentially into the final approach of a parallel runway
      ii. In order to attempt to fix the problem, the pilot rolls to 30° of bank, knowing that is the limit for safe bank in the pattern, but 30° of bank is not enough to line aircraft up with the centerline, an overshoot is inevitable
         a. In order to correct, and avoid the parallel runway's final approach area, the pilot adds left rudder (trying to force the airplane around the corner and avoid the overshoot), while maintaining 30° of bank
            - The left rudder pushes the nose around, and also increases lift on the right wing (the yaw swings the right wing around, moving it faster than the left, increasing lift)
            - As lift increases on the right wing, the aircraft rolls left, the pilot applies right aileron to maintain 30° of bank
               a The aircraft is now in an uncoordinated cross-controlled situation - Left rudder and right aileron
      iii. Now we'll get a little more detailed:
   B. Rudder is definitely your buddy when recovering from a stall, but just like anything else, too much of a good thing can hurt us.
      i. Let's first look at what rudder input does to as we set ourselves up in a hypothetical traffic pattern cross-controlled stall
         a. Rudder coordinates roll inputs and cancels the yaw effects associated with the engine and propeller in normal flight, so it is a good thing when used properly

b. But, what happens if we enter a skid - uncoordinated flight?
   - If excess left rudder is applied, the nose of the aircraft yaws to the left, and the airplane slows down, the nose drops, and we get some left roll
     - a The left roll is due to the yaw accelerating the right wing; as the right wing is accelerated forward, it generates more lift than the left wing, rolling the aircraft left
   - As the aircraft yaws uncoordinated, the fuselage broadsides (the aircraft is no longer coordinated/streamlined with the relative wind) into the relative wind and we get an increase in total drag
     - a This explains the loss of airspeed and the nose drop

c. In order to maintain the bank angle, airspeed, and pitch angle while skidding, we have to adjust the controls
   - Right roll is needed to maintain bank angle
   - Power needs to be increased to overcome drag
   - Back pressure needs to be increased to increase AOA and maintain pitch

d. The secondary roll due to the yaw input means that the trailing wing (left in this case) has a higher AOA than the advancing/rolling right wing (see diagram C)
   - This means that as we approach critical AOA, the trailing wing (left in this case) will likely stall first
   - What makes this worse is the right roll used to compensate for the secondary left roll that came from applying left rudder
     - a The right roll increases the AOA on the left wing even farther
       1. Right aileron pressure moves the right aileron up and the left aileron down
          a. Lowering the left aileron changes the camber and adjusts the chord line of the left wing, increasing the AOA
          b. The left wing now has two reasons why the AOA is higher and it will likely stall sooner than the right wing
             i. It's the trailing wing and the aileron is down

e. Even more interesting is the fact that the left wing in our left skid can now take on some of the characteristics of a swept wing design
   - Assuming we get overzealous with the elevator in this case, the stall will happen farther outboard from the wing root, maybe even near the left wingtip first
   - Where do you suppose any interrupted airflow from boundary layer separation is going to go if the stall begins near the wingtip?
     - a It really doesn't matter, because it isn't going over the elevator or around the fuselage
       1. There will be no turbulent airflow over the fuselage or tail of the aircraft meaning there will be no buffet to warn you of the stall
       2. Depending on which wing is involved and the placement of the stall warning horn, you may not hear the horn either
   - Making the situation worse is that since the stall is going to occur at or near the wingtip, the left aileron is involved in the stall almost immediately and that means the reverse aileron effect may be involved from the outset of the stall
     - a With a right roll input (left aileron down, right aileron up), we have higher AOA on the left wing (left aileron is down)
     - b Because the wing (including the aileron) is stalled, an increased angle of attack decreases the lift produced resulting in a deeper stall on the left wing and an increased roll to the left
       1. Cross-controlled stalls have a tendency to roll inverted

f. Incorrect instinctive reactions at 500 feet AGL will put the aircraft in the ground
    - When inverted, close to the ground, and approaching the ground quickly the knee jerk reaction is to pull up (get away from the ground)
        - a Since the aircraft is inverted, pulling now points the nose towards the ground and at a minimum maintains the stall, if not making it worse
    - The other intuitive reaction is to attempt to roll the aircraft with ailerons to level the wings (right roll input in this case)
        - a The result: even more roll to the left because of the reverse aileron effect
            1. Like we mentioned before, the right roll increases the AOA on the left wing rolling the aircraft left rather than right
    - Bottom line: intuitive recovery techniques don't work

g. How to Recover
    - Recovery is made by releasing the control pressures and increasing power as necessary to recover
        - a The stall often will happen with little warning
            1. Nose may pitch down, the inside wing may suddenly drop, and the airplane may continue to roll to an inverted position
        - b Recovery must be made before the airplane enters an abnormal attitude

2. Performing Crossed-Control Stalls

A. Safe Altitude
  - i. Before demonstrating it is extremely important to be at a safe altitude
    - a. This is because of the extreme nose down attitude and loss of altitude that could occur
  - ii. Single engine stalls should be recovered by 1,500’ AGL

B. Pre-Maneuver Checklist
  - i. Fuel Pump ON
  - ii. Mixture FULL RICH
  - iii. Lights ON
  - iv. Gauges GREEN

C. Clear the Area
  - i. Perform clearing turns while slowly retarding the throttle

D. Set Up
  - i. Gear down (if retractable)
  - ii. Close the throttle
  - iii. Maintain altitude until reaching normal glide speed
    - a. Re-trim the plane
    - b. Remember, at a reduced airspeed or at gliding speed:
        - Aircraft will be slower and therefore closer to the stall speed
        - To maintain altitude, the pitch attitude must be increased
            - a Therefore:
                1. Higher wing loading
                2. Aircraft is closer to the critical angle of attack
  - iv. Do not extend flaps
    - a. Because of the possibility of the airplane’s limitations being exceeded
  - v. CE - Failure to establish selected configuration prior to entry

E. Performing
  - i. Roll into a medium-bank turn
    - a. This should simulate a final approach turn that would overshoot the centerline of the runway

- ii. During the turn, excessive rudder pressure should be applied in the direction of the turn but the bank held constant by applying opposite aileron pressure
- iii. At the same time, increased back elevator pressure is required to keep the nose from lowering
- iv. All of these control pressures should be increased until the airplane stalls
- v. CE - Failure to establish a crossed-control turn and stall condition that will adequately demonstrate the hazards of a crossed-controlled stall

F. Recovery
- i. When the stall occurs, recovery is made by releasing the control pressures and increasing power as necessary to recover
- ii. Again, the plane may stall without warning
    - a. The nose may pitch down, the inside wing may suddenly drop, and the airplane may continue to roll to an inverted position
- iii. Recovery must be made before the airplane enters an abnormal attitude
    - a. Vertical spiral or a spin
- iv. The pilot must be able to recognize when this stall is imminent and must take immediate action to prevent a completely stalled condition
- v. Do not attempt to correct the roll with opposite aileron - this will increase the roll to an inverted condition
- vi. CE - Improper or inadequate demonstration of the recognition and recovery from a crossed-controlled stall
- vii. CE - Failure to present simulated student instruction that emphasizes the hazards of a crossed-controlled condition in a gliding or reduced airspeed condition
    - a. The pattern is by far the most hazardous area this can occur, simulate a pattern well above pattern altitude (allowing ample recovery altitude) in order to demonstrate the hazards of the cross-controlled situation to a student

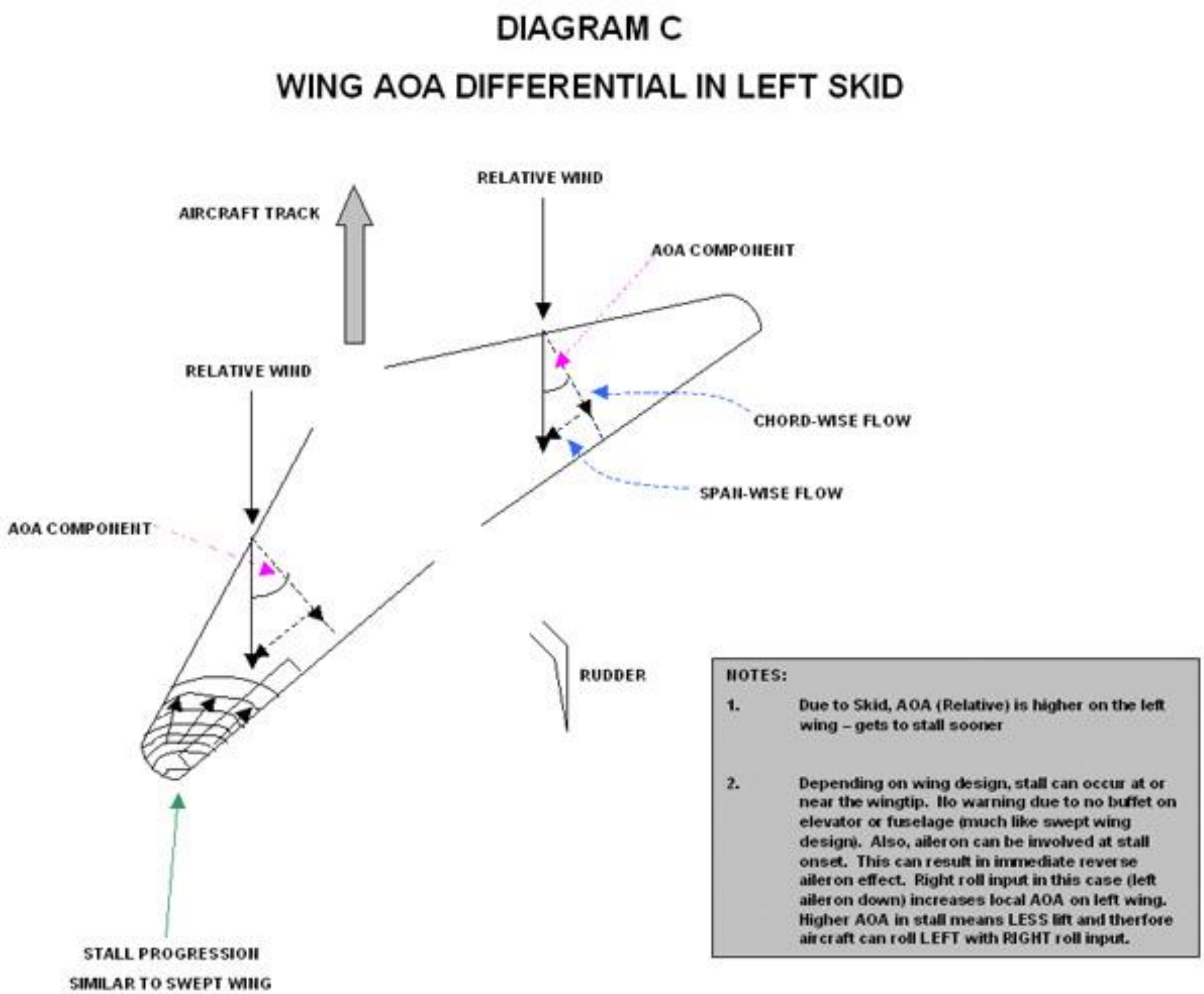
G. Spin Recovery
- i. This maneuver can often result in a spin
- ii. Recovery
    - a. Power - Idle
    - b. Ailerons - Neutral
    - c. Rudder - Opposite
    - d. Elevator - Briskly forward
        - Break the stall
    - e. Rudder - Relaxed
    - f. Elevator - To pull out of stall

H. Bottom Line: Stay coordinated to avoid a cross-controlled stall!

Common Errors:
- Failure to establish selected configuration prior to entry
- Failure to establish a crossed-control turn and stall condition that will adequately demonstrate the hazards of a crossed-controlled stall
- Improper or inadequate demonstration of the recognition and recovery from a crossed-controlled stall
- Failure to present simulated student instruction that emphasizes the hazards of a crossed-controlled condition in a gliding or reduced airspeed condition

Conclusion:
Brief review of the main points
It is imperative that this type of stall not occur during an actual approach to landing, since recovery may be impossible prior to ground contact due to the low altitude. During traffic pattern operations, any conditions that result in overshooting the turn from base leg to final approach, dramatically increases the possibility of an unintentional accelerated stall while the airplane is in a cross-control condition. If overshooting, do not try to correct with rudder, instead initiate a go-around and try again.

PTS Requirements:
To determine that the applicant:
1. Exhibits instructional knowledge of the elements of crossed-control stalls, with the landing gear extended by describing:
    a. Aerodynamics of crossed-control stalls.
    b. Effects of crossed controls in gliding or reduced airspeed descending turns.
    c. Flight situations where unintentional crossed-control stalls may occur.
    d. Entry procedure and minimum entry altitude.
    e. Recognition of crossed-control stalls.
    f. Recovery procedure and minimum recovery altitude.
2. Exhibits instructional knowledge of common errors related to crossed-control stalls, with the landing gear extended by describing:
    a. Failure to establish selected configuration prior to entry.
    b. Failure to establish a crossed-controlled turn and stall condition that will adequately demonstrate the hazards of a crossed-control stall
    c. Improper or inadequate demonstration of the recognition and recovery from a cross-controlled stall
    d. Failure to present simulated student instruction that emphasizes the hazards of a cross-controlled condition in a gliding or reduced airspeed condition
3. Demonstrates and simultaneously explains a crossed-controlled stall, with the landing gear extended, from an instructional standpoint.
4. Analyzes and corrects simulated common errors related to a crossed-controlled stall with the landing gear extended.



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