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Area of Operation **XI** - Task **B**

Power-On Stalls

Content

Key References:

- Airplane Flying Handbook
- Pilot's Handbook of Aeronautical Knowledge
- Stall and Spin Awareness Training (AC 61-67)

1. Introduction

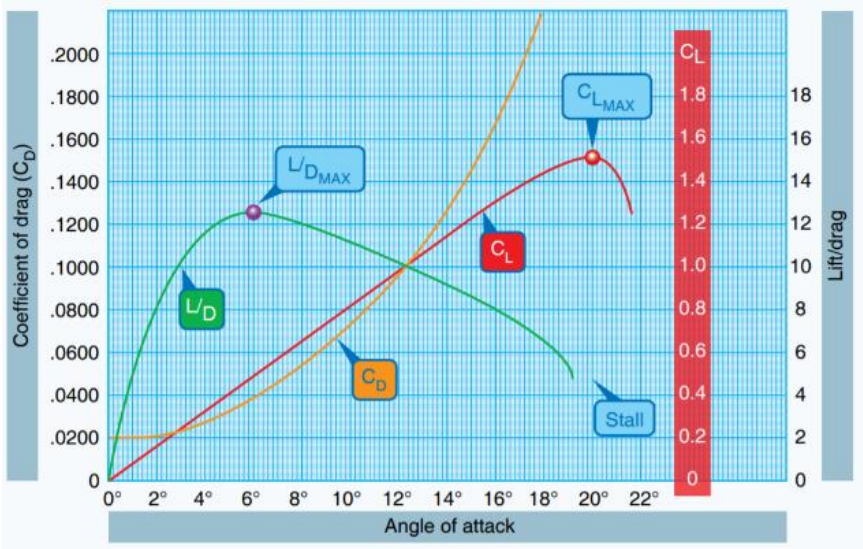
- **What**: A stall occurs when the critical angle of attack is exceeded. When this happens, the smooth airflow over the wing is disrupted resulting in a loss of lift and increased drag
- **Why**: Power-On stalls (departure stalls) are practiced to **simulate stalls in takeoff and climb-out** conditions
- **What to Expect**:
  - You will execute a maneuver to put the airplane in a stall condition, and recover from it
  - Your goal is to identify the clues of imminent stall (horn, buffet), and, once stalled, properly recover
  - Airplane will be in a high-pitch attitude (simulating "too much pitch during take off and climb")
  - Power-On stall will have the engine at full power ➔ Pronounced Left Tendencies at low airspeed
    - Lots of Right Rudder will be required
    - More prone to spin in Power-On because of that (thus coordination is important)
  - Private ACS requires full stall before recovery. Commercial ACS requires recovery at first indication

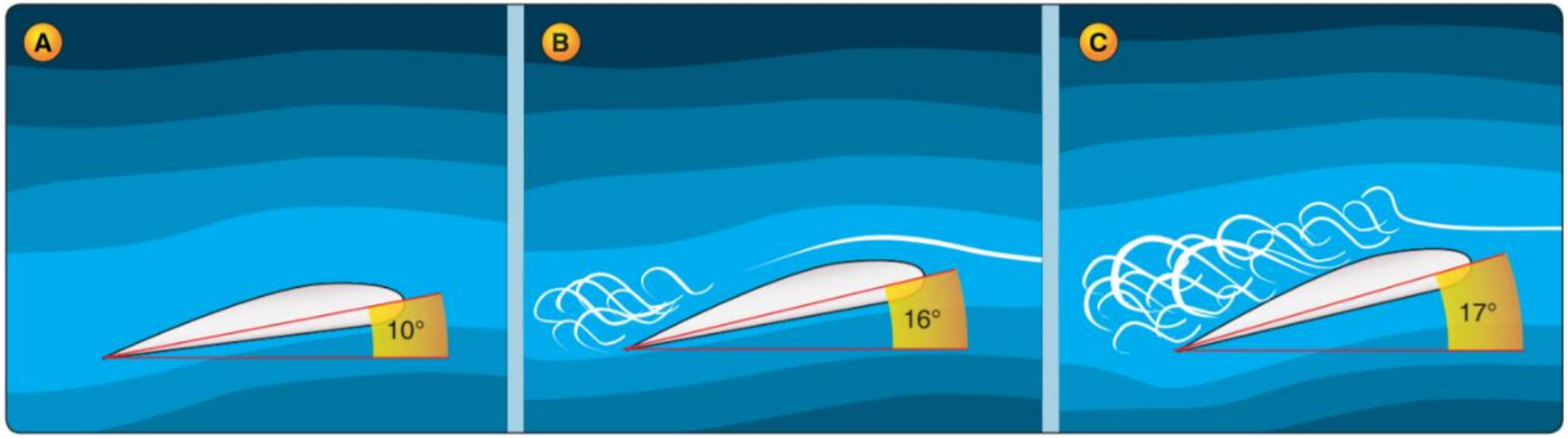
➡ **Standard (ACS):**

- Bank **±10⁰**,(not to exceed **20⁰**), Heading **±10⁰**

2. Aerodynamics

- A **stall** occurs when the **smooth airflow over the wing is disrupted and lift decreases rapidly**
  - This happens when the wing exceeds its critical angle of attack (AOA) – usually between 15-20^0 in GA aircraft
  - Coefficient of Lift (CL): Measurement of lift as it relates to AOA
  - At the Critical AoA the airflow separates ➔ CL_{MAX}

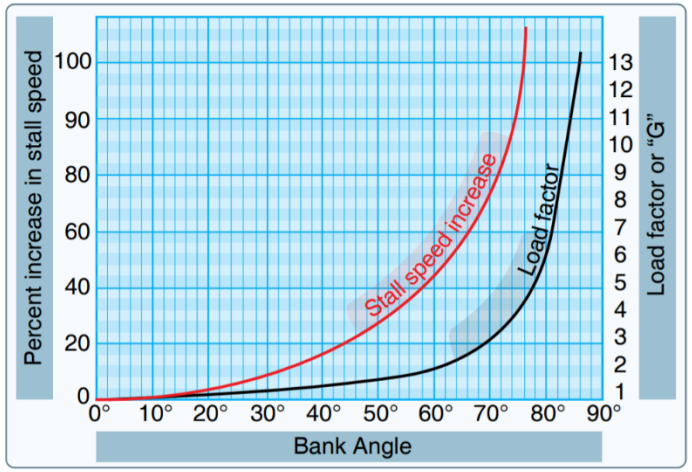




2. Aerodynamics

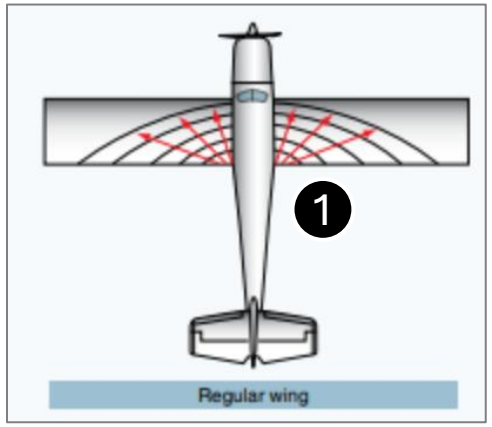
- An aircraft can stall at any speed, attitude, or power setting ➔ If Critical AoA is exceeded, airplane *will* stall
- Most GA aircraft are designed to **stall at the wing root** and progress out to the wing tips
  - Aileron effectiveness is maintained at the wing tips, maintaining control
  - Proper indication of imminent stalls

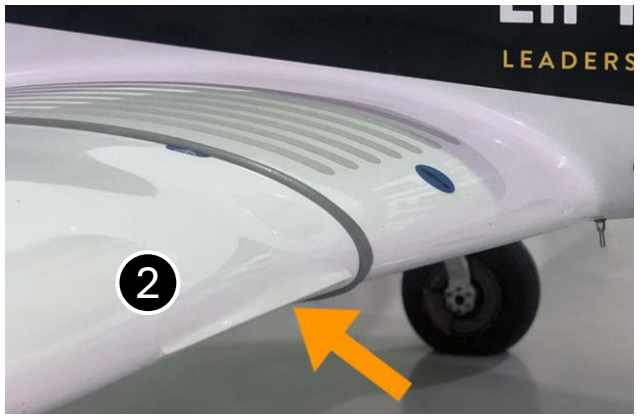
- The concept of "Stall Speed" is just a proxy – it will change depending on:
  - **Turns/Bank/Load Factor**: requires higher lift (AoA) for the same airspeed → less "remaining" AoA: stall speed increases
  - **Weight**: the heavier, the more lift (higher AoA) is needed at the same airspeed → stall speed increases
  - **Configuration**: Flaps makes the stall speed decrease
  - **CG**: Aft CG makes the airplane act as it was heavier → stall speed increases
  - **Snow/Ice/Frost**: disrupt smooth airflow and adds weight → stall speed increases
  - **Turbulence**: sudden changes in relative wind can increase stall speed
  - **Power**: in low-wing, propeller airflow over the wings can reduce stall speed

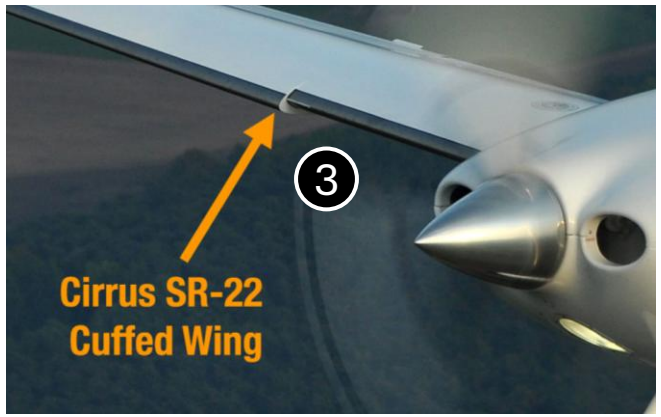


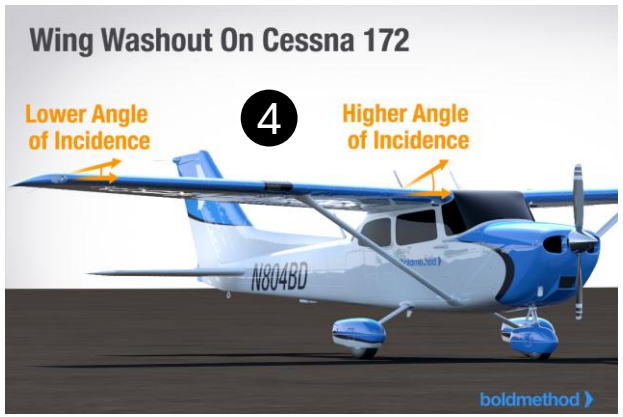
2. Aerodynamics

- Stall Recognition: Most GA aircraft are designed to **stall at the wing root** and progress out to the wing tips ❶
  - First indications will be a **control buffet** (vibration), **stall horn**, and then nose drop as wings stall
  - Wing Strips ❷ , Cuffed Wing ❸ or Wing Washout ❹ make the wing buffet (and horn) even more noticeable
  - Aileron effectiveness is maintained at the wing tips, maintaining control - Proper indication of imminent stalls
- Stall Recovery:
  - If wings are fully stalled (aileron including), usage of ailerons will aggravate the stall, e.g. further increasing AoA
  - Rudder should be used to maintain coordination and avoid entering a spin (opposite rudder to the wing that dropped)
  - **Proper recovery technique from stalls**: reduce AoA → full power → once control is regained, wings level and climb



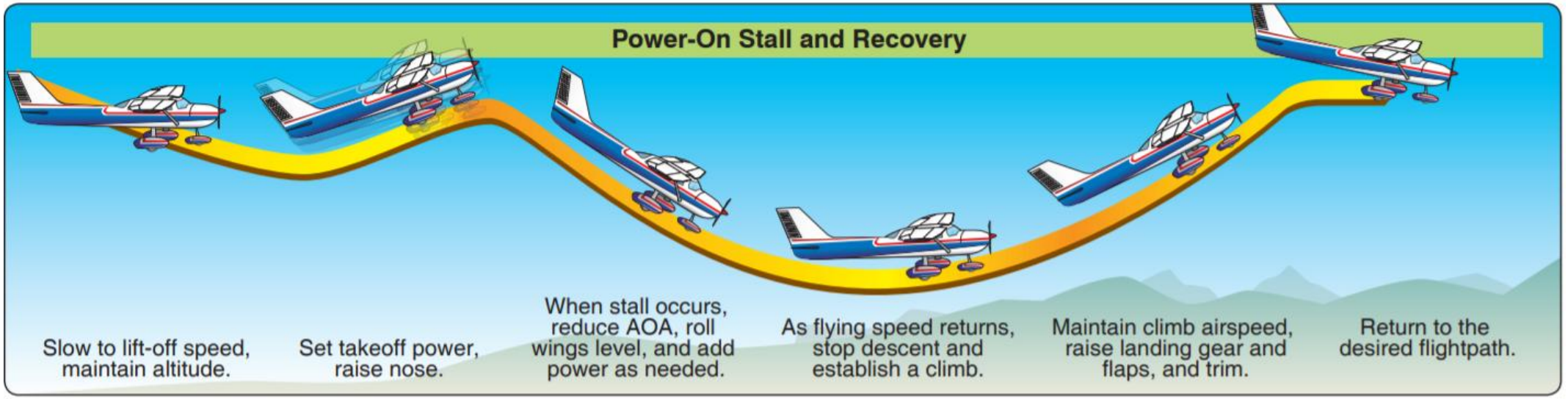






3. The Maneuver

1. **Entering**: no flaps, reduce power, maintain altitude, then at Vr (or 60kts) apply full power and pitch up until stall
2. You will be in a high power / high pitch / slow speed situation
    - Noisy. Horizon not in sight (use peripheral vision + instruments), less effective controls. Very high Left Tendencies
    - Coordination is key to avoid spin and to stay within the ACS heading standards (straight-ahead stall)
3. **Recovery**: reduce AoA and then climb at Vy to original altitude (avoid secondary stalls)
4. **Turning Stalls**: bank maintained (15-20^0). Maintain coordination and adjust aileron for overbanking tendencies



4. Execution

Performing the maneuver in a C172S

1. Perform two 90° clearing turns
2. Select an altitude where recovery can be made above 1500ft AGL
3. Set power to 1500 RPM (maintain altitude by adding Trim slowly)
4. **Clean** configuration
5. At **60 kts**, simultaneously **increase pitch** (slowly) and **apply full power**
6. Increase pitch attitude as needed to induce stall (not above 30^0 pitch up)
7. Acknowledge cues of the impeding stall
8. At full stall (or first indication if Commercial), recover – reduce AoA, level wings
9. Accelerate to Vy and climb to original/specified altitude, heading and then proper airspeed
10. Cruise Checklist

5. Common Errors

1. Failure to establish the specified configuration prior to entry
2. Improper pitch, heading, yaw, and bank control during straight-ahead stalls
3. Improper pitch, yaw, and bank control during turning stalls
4. Rough and/or uncoordinated use of flight controls
5. Failure to recognize the first indications of a stall
6. Failure to achieve a stall
7. Improper torque correction
8. Poor stall recognition and delay recovery
9. Excessive altitude loss or excessive airspeed during recovery
10. Secondary stall during recovery

Questions?