

7.1 The Cause of the Stall

- A stall is a loss of lift resulting from the separation of airflow from the wing's upper surface.
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- ☐ It is caused by exceeding the
- critical angle of attack (AOA), which is typically around 16 degrees.
- ☐ A stall is an aerodynamic phenomenon related to AOA, not airspeed. An aircraft can be
- stalled at
- any speed, in any attitude, if the critical AOA is exceeded.
- ☐ The primary cause is the
- adverse pressure gradient on the rear portion of the wing becoming too strong for the
- boundary layer's kinetic energy, causing the flow to stop, reverse, and separate. 149149149149

7.2 Stall Recognition and Behavior

- As an aircraft approaches a stall, the pilot may observe:
- ☐ Flight controls becoming less effective ("mushy").
- ☐ Speed is low and decreasing for a given power setting.
- ☐ Nose attitude is higher than normal.
- ☐ Aerodynamic buffeting as the separated, turbulent air from the wing root strikes the tailplane.
- ☐ Activation of a stall warning device (e.g., horn or stick shaker).
- At the stall itself, the aircraft may experience a wing drop, a sharp nose drop, and a loss of
- altitude.

7.3 Stall Recovery

- The only way to recover from a stall is to restore smooth airflow over the wing.
- 1. Reduce the Angle of Attack: The primary and most critical action is to move the control

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- column forward to reduce the AOA below the critical angle.
- 2. Apply Maximum Power: Simultaneously apply maximum authorized power to minimize altitude loss and accelerate the aircraft back to a safe flying speed.
- 3. Level the Wings: Use rudder to prevent wing drop on straight-wing aircraft. On swept-wing aircraft, ailerons may be recommended.
- A
- secondary stall can occur if the pilot pulls back on the control column too aggressively before the aircraft has regained sufficient airspeed.

7.4 Factors Affecting Stall Speed (V_s)

- The indicated stall speed is affected by several factors:
- ☐ Weight: Stall speed increases with the square root of the change in weight. A 20% weight reduction results in an approximate 10% reduction in stall speed.
- ☐ Load Factor (g): In a turn, lift must be increased to maintain altitude, which increases the load factor. The stall speed increases with the square root of the load factor. For example, in a 60° level turn, the load factor is 2g, and the stall speed increases by about 41%.
- ☐ Configuration (Flaps/Slats): High-lift devices increase the $C_{L_{max}}$, which decreases the stall speed.
- ☐ Center of Gravity (CG): A forward CG requires a greater tail-down force to maintain balance, which means the main wing must produce more lift overall. This results in a higher stall speed. An aft CG reduces the required tail-down force, resulting in a lower stall speed.
- ☐ Power: Engine thrust has a vertical component that helps support the aircraft's weight, and propeller slipstream over the wing increases lift. Therefore, the power-on stall speed is lower than the power-off stall speed.
- ☐ Wing Contamination: Ice, frost, or even dirt on the leading edge disrupts the airflow, reduces $C_{L_{max}}$, and increases the stall speed.
- ☐ Mach Number: At high altitudes and speeds, compressibility effects can cause flow separation at a lower AOA, reducing $C_{L_{max}}$ and increasing the stall speed.

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- leads to the phenomenon of "coffin corner," where the high-speed buffet (Mach buffet) and
- low-speed buffet (stall) converge.

7.5 Spinning

- ☐ A spin is an aggravated stall that results in
- autorotation, a helical flight path where the aircraft is descending while rotating.
- ☐ It occurs when one wing is more stalled than the other. The more-stalled (down-going) wing
- has both less lift and more drag, which causes the aircraft to roll and yaw into the spin.
- ☐ Spin Recovery: The generic recovery procedure is:
- 1. Power to IDLE.
- 2. Ailerons NEUTRAL.
- 3. Rudder FULL OPPOSITE to the direction of rotation.
- 4. Elevator PUSH FORWARD to break the stall.

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