Maneuvering During Slow Flight

Overview

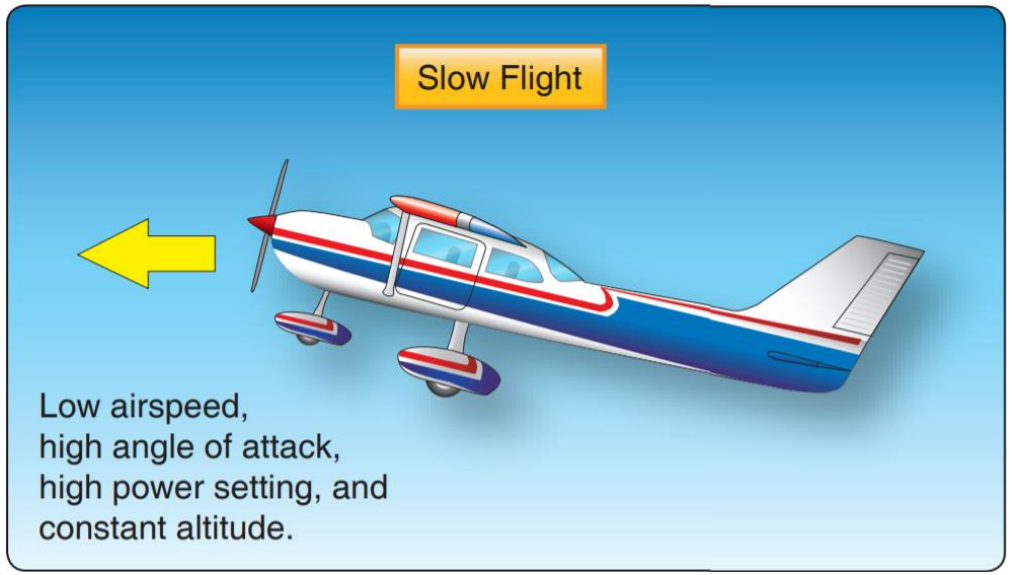
- What
  - Flight at a speed which any further increase in AOA, load factor, or reduction in power will cause a stall - PTS (or stall warning – ACS)
- Why
  - The aircraft performs and is controlled differently at low airspeeds
  - Maneuvering during slow flight demonstrates the characteristics and degree of controllability of the aircraft near the critical angle of attack
  - The aircraft is flown at high angles of attack and slow airspeeds in many phases of flight, so understanding how the aircraft performs and is controlled at reduced speeds is essential

Content

- What is Slow Flight
- Flight Characteristics & Controllability
- Critical Flight Situations & Slow Flight
- The Senses & Slow Flight
- Performing Slow Flight

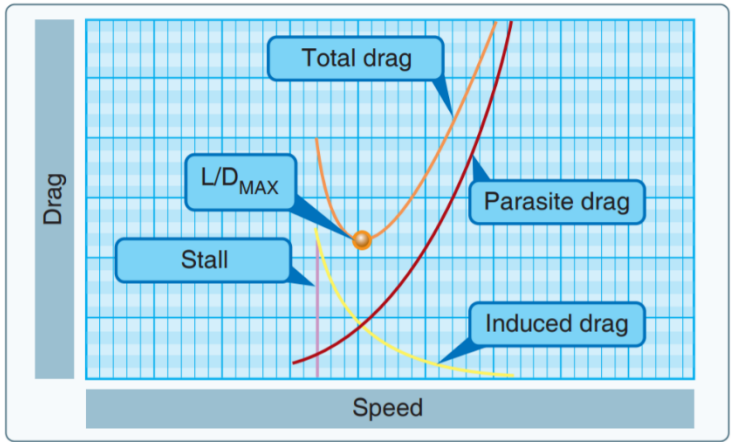
What is Slow Flight?

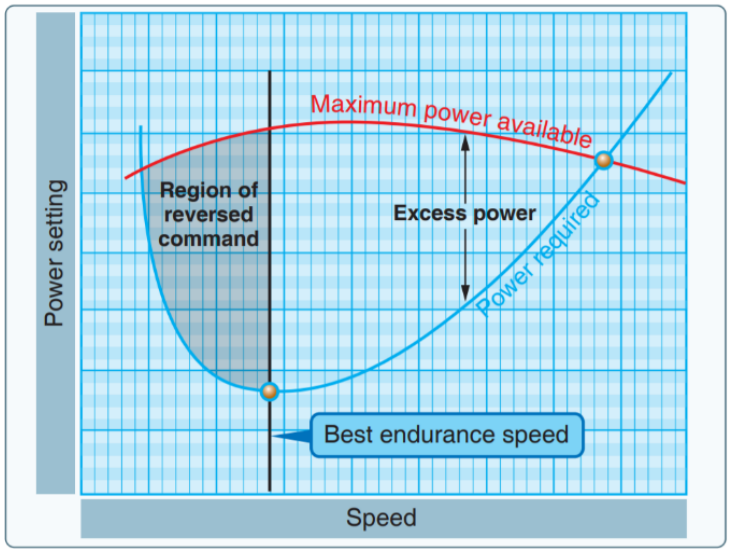
- Technically, any speed that is less than cruise speed
- But, for training purposes:
  - Flight at a speed which any increase in AOA, load factor, or power reduction will cause
    - An immediate stall (PTS definition)
    - A stall warning (ACS definition)
  - Objective is to understand slow flight characteristics and how the aircraft performs near the critical AOA



Power & Slow Flight

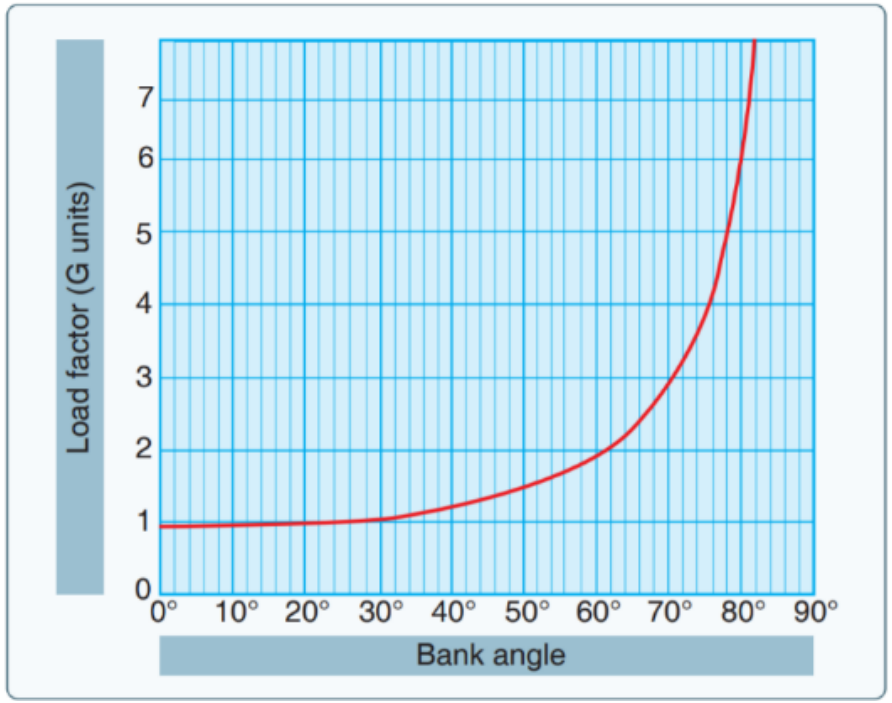
- Region of Reversed Command
  - Normal Command
    - As airspeed decreases, total drag decreases until reaching a point (L/D_{MAX})
    - Higher airspeeds require higher power settings
  - Region of Reversed Command
    - Airspeeds below L/D_{MAX}, where total drag begins to increase
    - Slower speeds require higher power settings
- Controllability
  - Increased power at slow airspeeds and high AOAs results in increased left turning tendencies
  - Anticipate considerable right rudder to maintain coordination





Load Factors, Turns & Slow Flight

- Load factor
  - Ratio of the total load acting on the plane to the gross weight of the plane
  - Expressed in Gs
  - Increased load factor increases stall speed
- Turns
  - Increased load factors are a part of all turns
  - Load factor increases rapidly after 45º-50º bank
- Controllability
  - The increased load factors associated with level turns in slow flight can quickly result in a stall
  - Use gentle, low bank turns
  - Remain coordinated

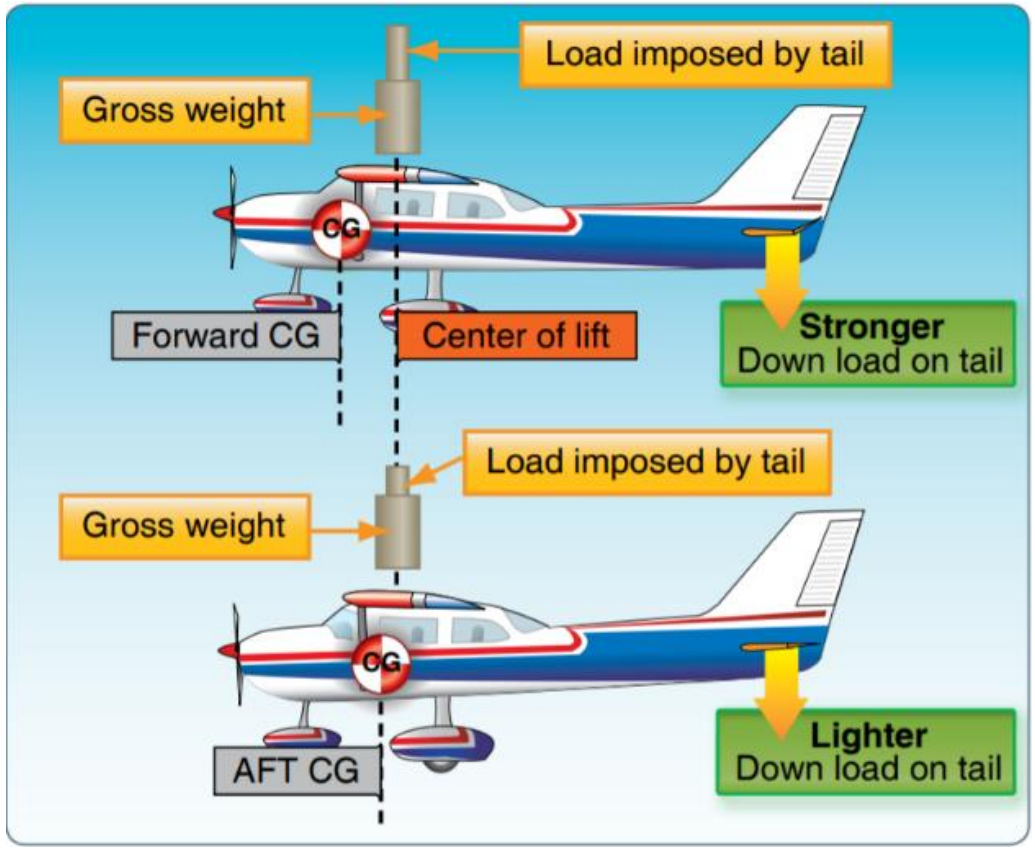


Weight & Slow Flight

- The heavier the aircraft, the more lift needed to maintain altitude & the higher the stall speed
  - As more lift is required, the AOA necessary to maintain level flight increases
  - A heavier aircraft is therefore closer to the critical AOA than a lighter aircraft
- A heavier aircraft is more stable
  - Takes more force to move a heavier object than a light one
- Increased weight and stability can assist in controlling the aircraft

Center of Gravity & Slow Flight

- Forward Loaded Aircraft
  - Acts heavier, and consequently slower
  - Higher AOA results in more induced drag, a slower cruise speed, and a higher stall speed
  - Stall recovery becomes easier as the CG moves forward
    - Longer arm from the CG to the elevator
- Aft Loaded Aircraft
  - Acts lighter, and consequently faster
  - Lower AOA results in less induced drag, allowing for a faster cruise speed and a lower stall speed
  - Stall recovery becomes more difficult as the CG moves aft
    - Shorter arm from the CG to the elevator

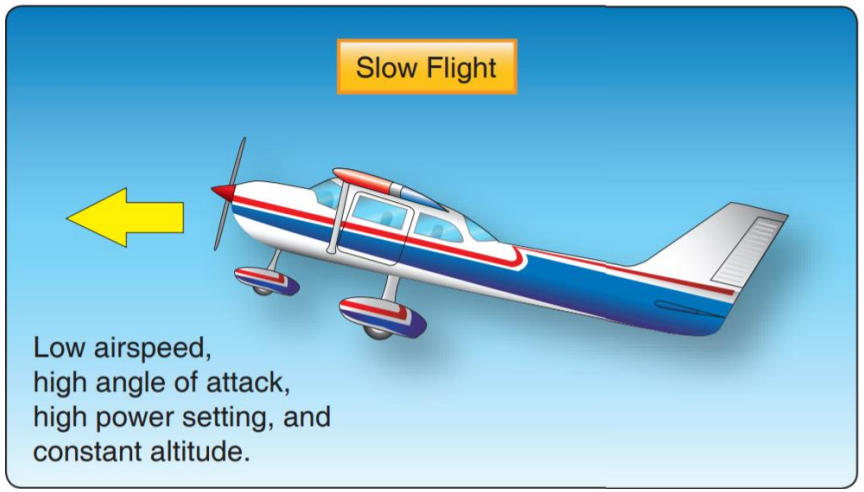


Critical Flight Situations & Slow Flight

- The majority of time that the aircraft is in slow flight is close to the ground
  - Takeoffs, climbs, landings, and go-arounds
  - Anything on the backside of the power curve and close to the ground can be considered a critical situation
- Examples
  - High sink rate during a low speed, high pitch short-field landing
  - Soft-field takeoff – Attempting to climb out of ground effect prior to reaching a safe airspeed
- Precise control of the airplane and airspeed is critical when operating close to the ground and in the region of reversed command

The Senses & Slow Flight

- Sight
  - Nose high
  - More sky than normal
  - Few (if any) ground references
- Hearing
  - Decrease in sound as airspeed slows
  - Stall warning horn
  - Engine noise as power is increased or decreased
- Feel
  - Controls become mushy and progressively less responsive
  - Increase in the amount of right rudder required
  - Buffet



Performing Slow Flight

- Basics
  - Pitch for airspeed, Power for altitude
  - Considerable right rudder is required to maintain coordination
  - Be aware of, and compensate for, the overbanking tendency in turns
  - Use visual references and instrument indications (90% outside, 10% inside)
- Prior to Slow Flight
  - Pre-maneuver checklist and clear the area
  - Select an altitude (no lower than 1,500’ AGL)
  - Configuration – Different configurations can be used to develop a feel for different situations
    - More flaps = slower airspeed
- Establishing Slow Flight
  - Gently reduce power, maintaining altitude as airspeed is lost
  - Lower flaps as airspeed limits are reached
  - Approaching slow flight speed, gently introduce power (and right rudder) to maintain altitude & airspeed
    - Set approximate pitch and power settings and adjust from there

Maneuvering During Slow Flight

- Pitch for airspeed
  - If fast, pitch up, and if slow, pitch down – use small, controlled changes, 1-2^{o} at a time
  - A change in pitch generally requires a change in power to maintain altitude
- Power for altitude
  - If low, increase power, and if high, decrease power
  - A change in power generally requires a corresponding change in pitch to maintain airspeed
- Heading
  - Maintain coordination, keep heading and coordination in crosscheck
- Level Turns
  - Smooth, controlled inputs to establish the desired bank angle (overbanking tendency)
  - Adjust pitch and power to maintain altitude and airspeed
  - Maintain coordination with rudder (Right turn: more right rudder, left turn: less right rudder)
- Climbing / Descending Turns
  - Set power for the climb or descent and simultaneously adjust pitch to maintain airspeed (maintain coordination)
  - Establish bank and rudder for a coordinated turn

Returning to Cruise Flight

- Similar to a stall recovery
  - Smoothly apply full power (maintain coordination with right rudder)
  - Lower the nose to maintain altitude (trim)
  - Clean up the flaps (and gear, if required) as airspeed increases
  - Approaching cruise speed, reduce power, and maintain coordination
  - Establish the straight-and-level site picture, and verify performance on the instruments
  - Trim the airplane for straight-and-level cruise flight

Questions?