

## VII.A. MANEUVERING DURING SLOW FLIGHT

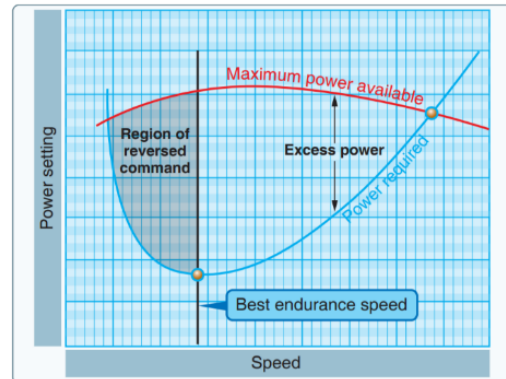
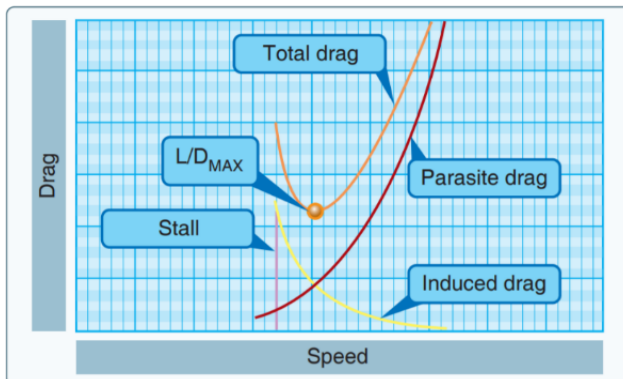
References: [Airplane Flying Handbook](#), [Risk Management Handbook](#), POH/AFM

### KNOWLEDGE

The applicant demonstrates understanding of:

#### 1. Slow Flight Aerodynamics

- A. Airspeed
  - i. An increase or decrease in airspeed increases or decreases lift, affecting AOA and attitude
  - ii. In relation to slow flight, the slower the airspeed, the higher the AOA required (closer to critical AOA)
- B. Airplane Attitude
  - i. To maintain altitude during slow flight, a nose-high attitude is required
    - a. Increases AOA – closer to the critical AOA
  - ii. Relatively small changes in pitch and/or bank attitude can lead to a stall
    - a. More on bank and stalls below
  - iii. Pitch attitude may have to be lowered considerably in combination with power to accelerate
    - a. Can result in a significant loss of altitude
- C. Power & the Region of Reversed Command
  - i. Normal Command
    - a. Normal Command
      - As airspeed decreases, total drag decreases, until reaching a point ( $L/D_{MAX}$ )
      - Higher speeds require higher power settings, and vice versa
    - b. Region of Reversed Command
      - Airspeeds below  $L/D_{MAX}$ , where total drag begins to increase
      - Slower speeds require higher power settings, and vice versa

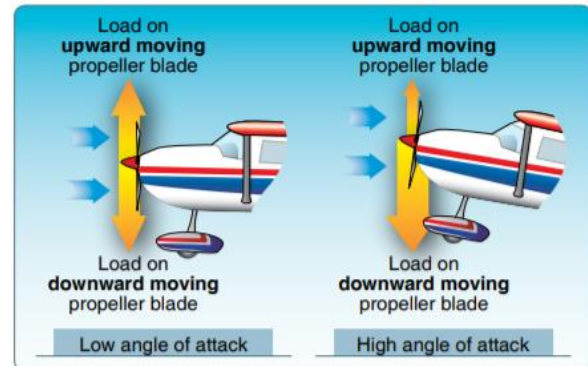
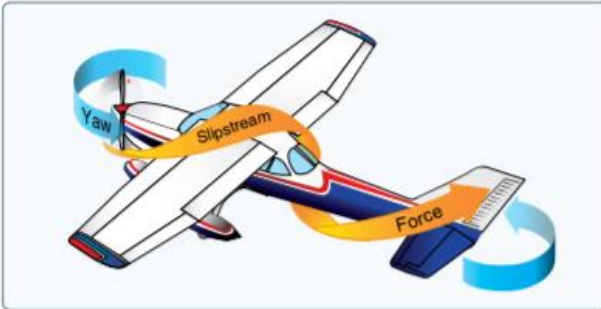
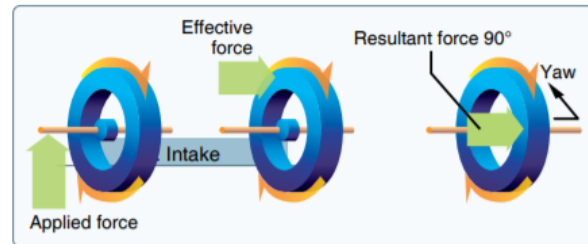
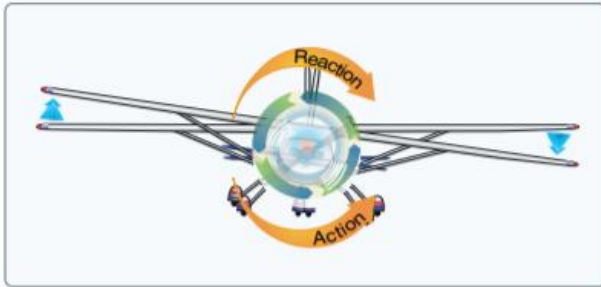


#### D. Yaw Effects

- i. Increased power at slow airspeeds and high angles of attack results in increased left turning tendencies
  - a. Anticipate considerable right rudder to maintain coordination
- ii. Torque Reaction – Based on Newton's 3<sup>rd</sup> Law
  - a. The engine parts/propeller rotate right, an equal force attempts to rotate the plane left
  - b. In flight: left rolling tendency; On ground: left turning
  - c. Corrected by offsetting the engine, aileron trim tabs, and/or aileron and rudder use
- iii. Corkscrew/Slipstream Effect
  - a. Corkscrewing propeller air strikes the left side of the vertical stabilizer - pushes nose left (shown below)

## VII.A. Maneuvering during Slow Flight

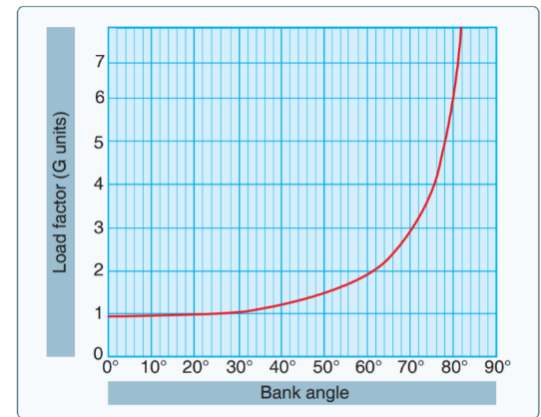
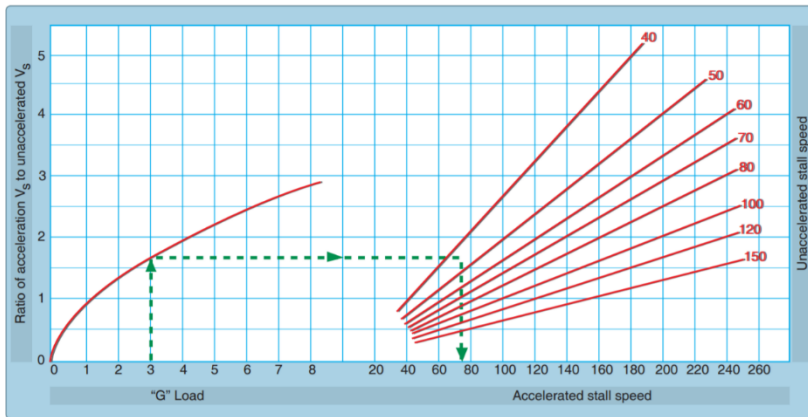
- b. Strongest at high prop speeds/low forward speeds
- iv. Gyroscopic Action
  - a. Precession - Any force takes effect 90° ahead of, and in the direction of rotation
  - b. Pitch results in a yawing moment and vice versa
  - c. Correct with rudder/elevator
- v. Asymmetric Loading (P Factor)
  - a. At high AOAs, the bite of the down moving blade is greater than the up moving blade
  - b. Center of thrust moves to the right of the propeller disc, causing a yaw to the left
  - c. Correct with right rudder



- vi. Big Picture
  - a. Considerable right rudder is required to maintain coordination during slow flight
  - b. A right turn requires even more right rudder
  - c. A left turn requires less right rudder (still requires right rudder)
- E. Maneuvering Loads & Turns
  - i. Load factor: Ratio of the total load acting on the plane to the gross weight of the plane
    - a. Expressed in terms of G's
    - b. Increased load factor increases stall speed
  - ii. Turns
    - a. Increased load factors are a part of all banked turns
    - b. Load factor increases rapidly after 45°-50° of bank
  - iii. Controllability
    - a. The increased load factor associated with a level turn in slow flight can quickly result in a stall
    - b. Use gentle, coordinated, low bank turns during slow flight to prevent a potential stall

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- Right turn = more right rudder; Left turn = less right rudder (still requires right rudder)



### F. Weight

- The heavier the aircraft, the more lift necessary to maintain altitude
  - As more lift is required, the angle of attack required to maintain level flight is increased
    - Brings the aircraft closer to the critical angle of attack
- Heavier aircraft is more stable – takes more force to move a heavier object than a lighter one
- The increased weight and stability can help in controlling the aircraft

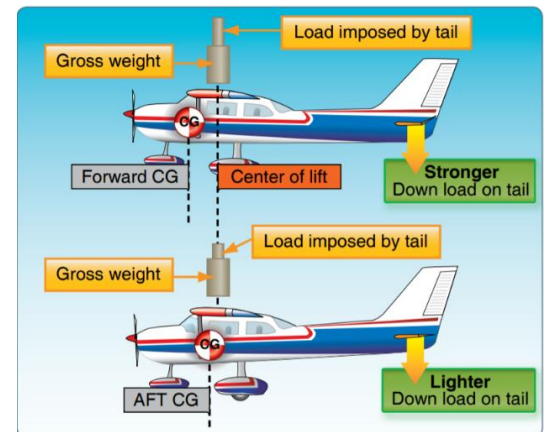
### G. Center of Gravity

#### i. Forward Loaded Aircraft

- Acts heavier, and consequently slower
  - More nose up elevator pressure is required to maintain altitude
  - Tail must produce a greater down load resulting in greater wing loading
  - Added wing loading requires increased lift to maintain altitude
- Higher AOA results in more induced drag and a higher stall speed (like heavy aircraft)
- Controllability
  - More controllable than aft loaded aircraft
  - Due to the longer arm from elevator to CG

#### ii. Aft Loaded Aircraft

- Acts lighter, and consequently faster
  - Less nose up pressure required
  - Lower nose requires less down load
  - Decreased down load reduces wing loading, decreasing lift required to maintain altitude
- Lower AOA results in less induced drag allowing for a faster cruise speed and a lower stall speed
- Controllability
  - Recovery from a stall becomes progressively more difficult as the CG moves aft
  - Shortens the arm from CG to the elevator



## RISK MANAGEMENT

The applicant demonstrates the ability to identify, assess, and mitigate risks, encompassing:

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### 1. Inadvertent Slow Flight

- A. If unexpectedly in a slow flight or stall airspeed situation, proper control & recovery is imperative
  - i. A lack of understanding and/or ability could rapidly lead to a loss of control
  - ii. Specific examples:
    - a. High sink rate during a short field landing
    - b. Climbing out of ground effect too early on a soft field takeoff
- B. Recovery to Normal Flight
  - i. Just like a stall recovery
    - a. Full Power
    - b. Nose Down (forward pressure)
      - Don't dive, apply forward pressure to maintain altitude as the aircraft accelerates
    - c. Clean up the airplane (flaps, gear as necessary)
      - As airspeed increases and the aircraft exceeds  $V_Y$  remove the second increment of flaps
      - Anticipate the changes in lift to maintain altitude
  - ii. As airspeed increases, right rudder pressure will need to be reduced to maintain coordination
  - iii. Reestablish a pitch and power setting appropriate for the phase of flight

### 2. [Range and Limitations of Stall Warning Indicators](#)

### 3. Uncoordinated Flight

- A. Slow flight, by definition, means the aircraft will be operated very close to its stall speed. Any increase in back pressure could potentially result in a stall. This can be hazardous, especially uncoordinated
  - i. A stall & yaw are the ingredients necessary for a spin (basically, an uncoordinated stall)
  - ii. A spin at low altitude may not be recoverable
- B. Spins Prevention
  - a. Maintain coordination
  - b. Do not use abrupt, excessive pressure inputs (especially back elevator pressure)
  - c. Recover at the first sign of a stall
- ii. Generic Spin Recovery (PARE)
  - a. Power - Idle
  - b. Ailerons - Neutral
  - c. Rudder - Full rudder opposite the spin direction
  - d. Elevator - Brisk, positive forward pressure (nose down)
  - e. Once the spin has stopped, neutralize the rudders, and gently raise the nose, being careful not to stall

### 4. [Effect of Environmental Elements on Aircraft Performance](#)

### 5. Collision Hazards

- A. Collision Hazards and Slow Flight
  - i. Slow flight can be mentally taxing and is often performed in the busiest phases of flight (takeoff & landing)
    - a. The combination of these two factors can result in high task saturation & increased risk of a collision
    - b. Divide attention and be aware of terrain and obstacles that may be in the aircraft's path
- B. More Generic Information: [VII. RM Concepts – Collision Hazards](#)

### 6. [Distractions, Task Prioritization, SA & Disorientation](#)

## SKILLS

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The applicant demonstrates the ability to:

1. Clear the area.
2. Select an entry altitude that will allow the Task to be completed no lower than 1,500 feet AGL (ASEL) or 3,000

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feet AGL (AMEL).

3. Establish and maintain an airspeed at which any further increase in angle of attack, increase in load factor, or reduction in power, would result in a stall warning (e.g., aircraft buffet, stall horn, etc.).
4. Accomplish coordinated straight-and-level flight, turns, climbs, and descents with landing gear and flap configurations specified by the evaluator without a stall warning (e.g., aircraft buffet, stall horn, etc.).
5. Maintain the specified altitude,  $\pm 100'$ ; specified heading,  $\pm 10^\circ$ ; airspeed  $+ 10/-0$  knots; and specified angle of bank,  $\pm 10^\circ$ .