Patuxent River Navy Flying Club

HIGH PERFORMANCE GA AIRPLANES

PRNFC

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INTRODUCTION

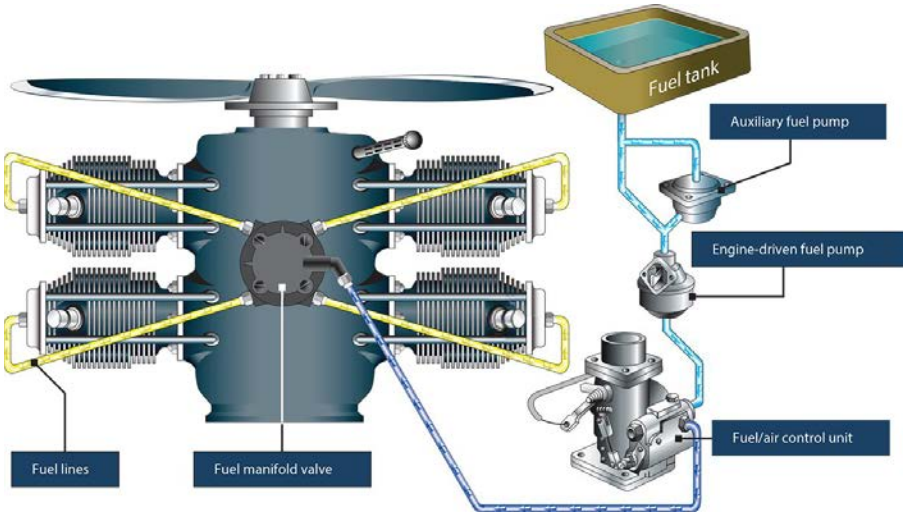
Discussion Topics for High Performance GA Airplanes

- Engines
  - Fuel Injected
  - Turbo Normalized
  - Engine Cooling and Cowl Flaps
  - Engine Monitoring (EGT & CHT)
- Left Turning Tendencies
  - Torque, Slipstream, Precession, and P-factor
  - Rudder Trim
- Heavier Airplanes
  - Loading
  - Pattern Speeds
  - Stabilators and Trim
  - Takeoff and Landing
  - Ground handling
- Passengers
- Physiological Effects at Altitude
  - Hypoxia
- Descents

HIGH PERFORMANCE ENGINES

Fuel Injected Engines

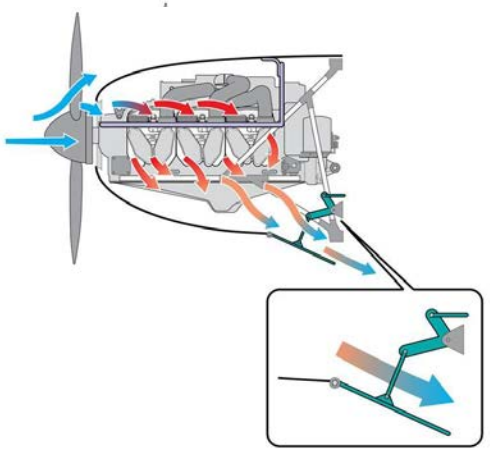
- More efficient than carburetors
- Not susceptible to carb icing
- Induction icing is still an issue.
- Hot, ground starts can be a problem.



Turbo Normalized Engines

- Uses a turbo-charger, but unlike cars doesn't boost above sea-level pressure.
- Critical Altitude – max altitude the engine can produce the rated horsepower.
- Inter-cooler – increases pressurized air density
- Not more fuel efficient, but useful, especially for mountain flying.
- Leaning procedures are very different!

HIGH PERFORMANCE ENGINES (CONT.)



Cowl Flaps

- “Tight cowlings” to reduce drag
- Hotter Engines
- Cowl flaps enable greater airflow.
- Used in high-power, low-airspeed flight

Engine Monitoring

- Exhaust gas temperature (EGT) displays an average of a wildly varying temperature. Most gauges don’t have temp markings. Most often used to set the mixture.
- Cylinder head temperature (CHT) measures how hot the top of the engine is. Much slower to change than EGT, but a better measurement of engine temp than oil temperature. Strangely, most manufactures allow temps higher than owners and mechanics recommend.
- Engine Monitors display EGT and CHT for each cylinder. They can also help fine tune the mixture setting.

LEFT TURNING TENDENCIES

4 Contributing Factors

Torque Reaction from the Engine - Newton's Third Law

- Causes roll in air, but on ground puts more weight of aircraft on left wheel than right, so more friction
- In the air, aileron is used to counter roll, creating drag.

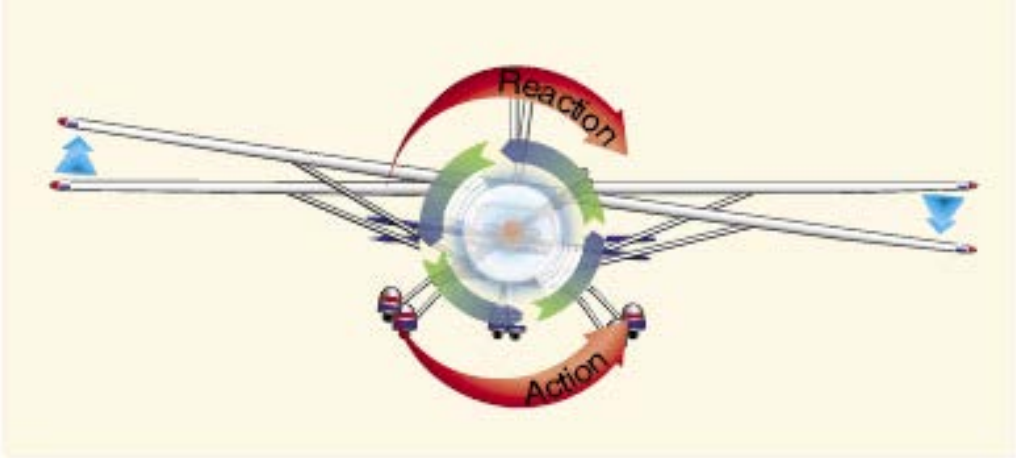


Figure 4-39. *Torque reaction.*

LEFT TURNING TENDENCIES

Corkscrewing Slipstream

- Most prominent at low airspeed, high angle of attack, high RPM

Figure 4-40. *Corkscrewing slipstream.*

LEFT TURNING TENDENCIES

Gyroscopic Precession

- Precession is resulting action of gyroscope when a force is applied to its rim
- Resulting action is applied 90 deg ahead and in direction of rotation of the gyroscope

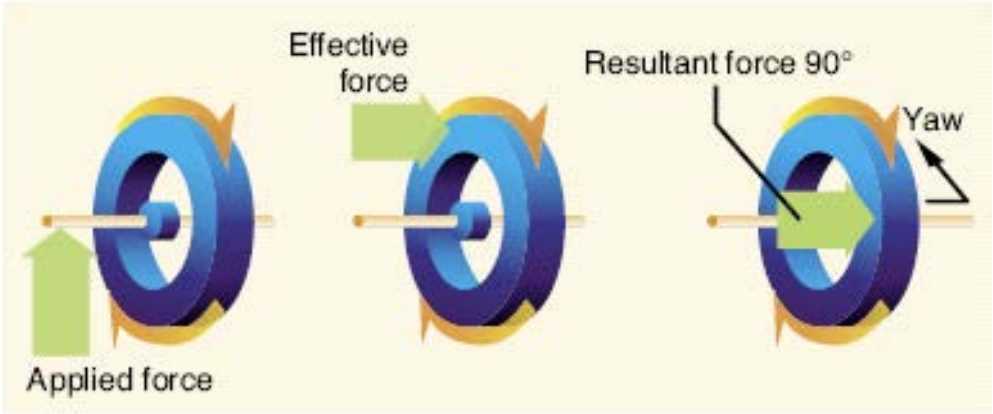


Figure 4-41. *Gyroscopic precession.*

LEFT TURNING TENDENCIES

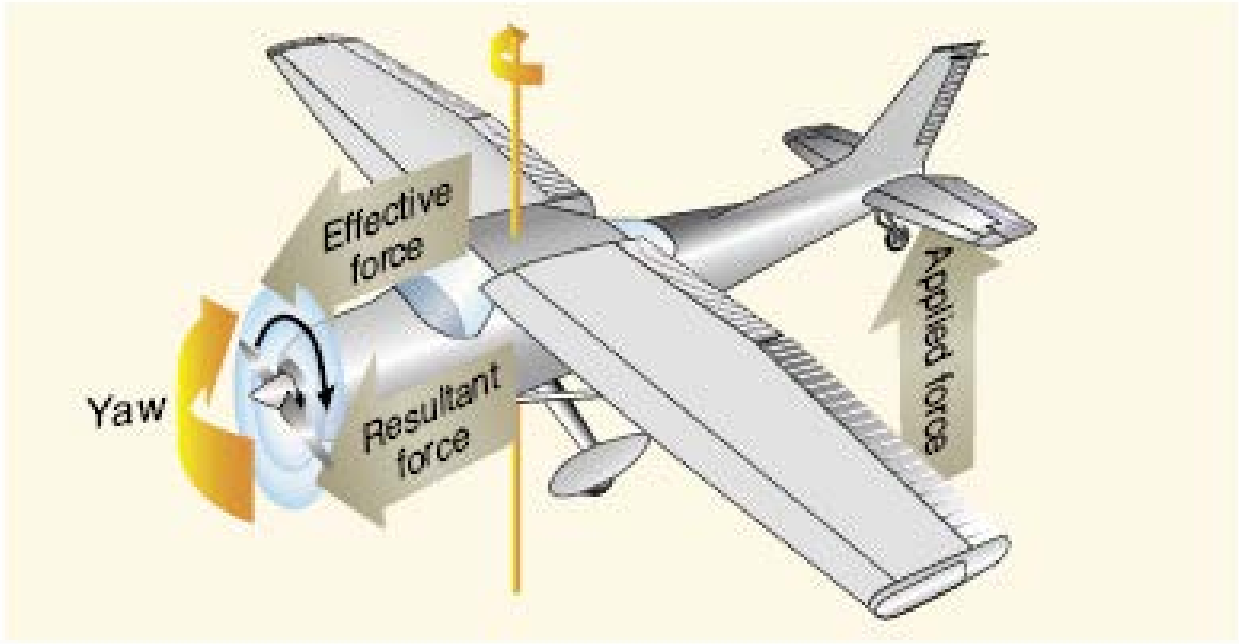


Figure 4-42. *Raising tail produces gyroscopic precession.*

While the diagram above is correct, most single-engine GA airplane engines rotate in the opposite direction (CW when viewed from the cockpit) causing a left turning tendency when the tail is raised.

PROPELLER PRINCIPLES

Prop blades are rotating wings that convert rotational motion of engine into thrust

- Thrust depends on propeller shape and angle of attack of the blade
- Blade rotates and moves forward
- Just like a wing, as air flows over forward surface of propeller blade, pressure is reduced and reaction force is in direction of thrust

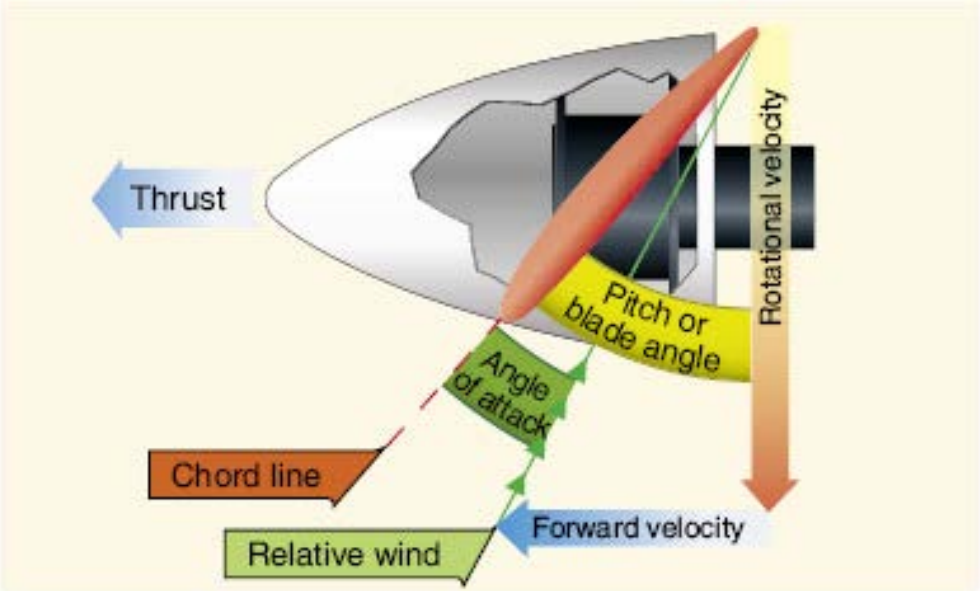


Figure 4-36. *Propeller blade angle.*

LEFT TURNING TENDENCIES

P-Factor

- At high angle of attack, the bite of air of down going blade is larger than the bite of air of blade moving up

• Must compensate for turning tendencies with right rudder during takeoff and flight with higher angles of attack.

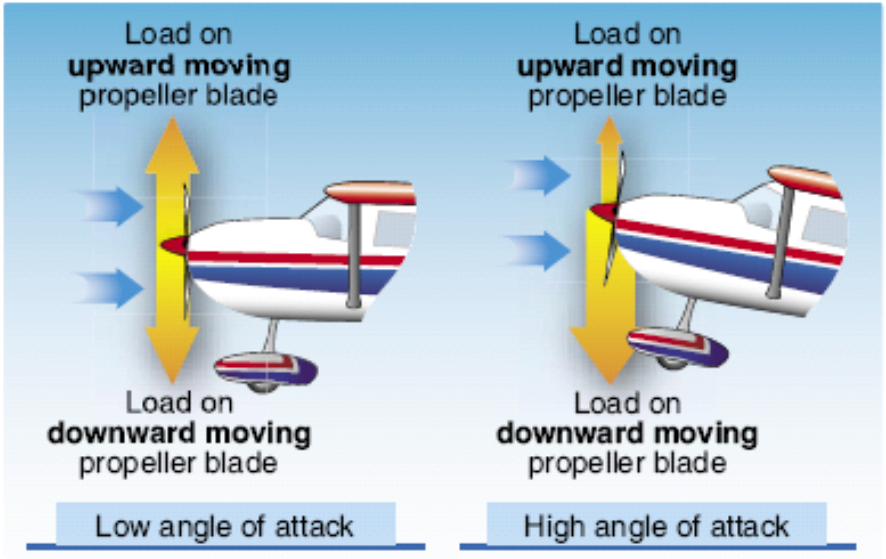


Figure 4-43. *Asymmetrical loading of propeller (P-factor).*

RUDDER TRIM

- **Can be used to offset left-turning tendencies.**
- **On a 300 HP engine, right rudder during climbout can become tiring.**
- **On Pipers, the adjustment sets a spring—it's not aerodynamic.**
- **Trim (setting the spring) will affect taxiing on the ground.**
- **During cruise, if you're not using autopilot, you can use rudder trim to hold a heading.**

HEAVIER AIRPLANES

Loading

- **Longer, six-seat airplanes may have forward CGs.**
  - **Ballast will help, most notably in landing.**
- **Use a spreadsheet or software like ForeFlight to evaluate seating options.**

Pattern Speeds

- **May be 20 knots greater; take time to practice.**

Stabilator and Trim

- **These airplanes are not normally trainers. The stabilator design is used to reduce drag in cruise.**
- **Good pitch authority at slower speeds requires the trim to be set for that speed.**
- **The airplane may have powered trim. Ensure you understand how to use it and disable it, in the unlikely case of runaway trim.**

HEAVIER AIRPLANES (CONT.)

Takeoff

- **Expect to use more right rudder.**
- **Anticipate a wide range of runway required depending on weight.**

Landing

- **Remember: KE = ½ mv^2. These airplanes will have higher approach and landing speeds. This means more runway will be required.**
- **You may be able to fly slower if lightly loaded. Using: $(S_1/S_2) = Sqrt(W_1/W_2)$, flying at 3200 lbs. vs. 3600 lbs. allows you to reduce approach speed from 90 KIAS to 85 KIAS.**
- **The aircraft nose may be long, obstructing your view in the flare.**

Ground Handling

- **The airplane may weigh 1,000 lbs. more than you're used to. Get help.**
- **You can borrow or buy small motors that attach to the nose wheel to tow the airplane.**

PASSENGERS

More Passengers

- **More possibilities for distraction when flying.**
- **Make sure to give a good pre-takeoff passenger brief, especially to parents bringing young children.**
- **Have a plan for unexpected bathroom stops.**
  - **Depends are an option.**
  - **Urine collection devices can be used also.**
- **Don’t forget the airsickness bags!**

If flying over inhospitable surface areas, bring:

- **Survival gear**
- **Life raft, if over water.**

Brief everyone on the effects of high altitude flying.

SYMPTOMS OF HYPOXIA

Euphoria

Cyanosis (blue fingernails and lips)

Headache

Decreased Reaction Time

Impaired Judgment

Visual Impairment

Drowsiness

Lightheaded or Dizzy Sensation

Tingling in Fingers and Toes

Numbness

DESCENTS

Air Pressure Changes

- **Learn how to accomplish the valsalva maneuver and brief your passengers.**
- **Give children something to drink or chewing gum.**
- **Allow babies to feed or suck on a pacifier.**

Air sickness frequently happens just prior to landing.

Arrival is typically the most challenging time for most GA pilots.

- Ensure a sterile cockpit when necessary.

Watch the engine temperature in a long descent; don’t allow it to get too cool.

- Fly faster with added power.

SUMMARY

More power typically means bigger, heavier, and more complicated.

- Know the airplane and its systems.
- Spend adequate time with an instructor to become comfortable with the airplane.