

The following question was received on the Feedback Form from the February 12 seminar.

If we could go into the aerodynamics and discussion on concepts like mixture leaning, V_g , power curve etc.

These concepts only make sense when you see how they *interlock* in real flying: mixture leaning, the power curve, and best-glide speed (V_g). None of these are “rote-memory” topics; they’re all about energy management and how the airplane behaves when you push it toward the edges of its performance envelope.

1. Mixture Leaning — What’s Actually Happening Aerodynamically

Mixture isn’t just “fuel flow.” It directly changes:

- **Combustion temperature**
- **Power output**
- **Detonation margin**
- **Specific fuel consumption**
- **Exhaust gas temperature (EGT)**

1.1. Why leaning increases power up to a point

A rich mixture cools the cylinders but wastes fuel. As you lean:

- Combustion becomes more chemically efficient
- EGT rises
- Power increases

Until you hit **peak EGT**, where the mixture is chemically ideal.

1.2. Why you *don’t* run at peak EGT in most operations

Peak EGT = hottest combustion = lowest detonation margin.

So you operate:

- **Rich of peak (ROP)** for high power

- **Lean of peak (LOP)** for efficiency (if the engine and injectors support it)

1.3. Aerodynamic consequence

Mixture affects **available power**, which shifts where you sit on the **power curve**.

If you lean too aggressively at high power, you reduce available thrust and can unintentionally push the airplane toward the **back side of the power curve**.

This is why mixture management is not just an engine topic — it’s a performance topic.

2. The Power Curve — The Most Misunderstood Aerodynamic Concept in GA

The power curve describes how much power you need to maintain level flight at different airspeeds.

2.1. The two sides of the curve

Region	Airspeed	Drag type	Required power	Handling
Front side	Fast	Parasite drag dominates	More speed = more power	Stable, intuitive
Back side	Slow	Induced drag dominates	Slower = <i>more</i> power	Unstable, counterintuitive

2.2. The key aerodynamic truth

Below a certain speed, **slower flight requires more power**, not less.

This is why:

- Approaches flown too slow feel “mushy”
- Climb performance collapses if you get slow
- Go-arounds from a slow approach feel sluggish until you accelerate

2.3. Where mixture ties in

If mixture is too lean at high density altitude or high power settings, you may not have enough **available power** to climb out of the back side of the curve.

This is why leaning for takeoff at high-DA airports is not optional — it’s aerodynamic survival.

3. Best Glide Speed (V_g) — The Energy Sweet Spot

(V_g) is not magic; it's the point where **total drag is minimized**.

3.1. Why (V_g) sits at the bottom of the drag curve

At that point:

- Parasite drag and induced drag are equal
- Total drag is at its minimum
- You get the best lift-to-drag ratio (L/D_{\max})

3.2. Why flying slower than (V_g) is dangerous

You enter the **back side of the power curve**, where induced drag skyrockets.

In a glide, that means:

- Sink rate increases
- Control authority decreases
- You lose the ability to stretch the glide

3.3. Why flying faster than (V_g) also hurts you

Parasite drag increases with the square of speed.

So you descend faster because you're wasting energy on drag.

3.4. How weight affects (V_g)

Heavier airplane → higher (V_g), but **same glide ratio**.

Why?

Because the drag curve shifts upward and right — you need more speed to generate the same lift.

4. How These Concepts Interlock in Real Flight

Scenario: High-DA takeoff, improperly leaned

- Engine produces less power
- Airplane accelerates slowly
- You rotate near stall margin

- You're on the **back side of the power curve**
- Induced drag is huge
- Climb rate is anemic
- A gust or thermal can push you into a stall

This is why mixture leaning is not an engine-nerd topic — it's a performance and safety topic.

Scenario: Engine failure after takeoff

Your survival depends on instantly pitching to (**V_g**).

If you pitch too high:

- You enter the back side of the curve
- Induced drag spikes
- Sink rate becomes unrecoverable

If you pitch too low:

- Parasite drag eats your energy
- You shorten your glide

Scenario: Slow approach

If you get below the speed where induced drag dominates:

- You need *more* power to maintain altitude
- But you're already slow
- Any delay in adding power can cause a sink you can't arrest

This is why stabilized approaches matter.
