

PRIVATE PILOT GROUND SCHOOL

MODULE 2-3 — PERFORMANCE AND LIMITATIONS (ACS TASK F)

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FACTS TO REMEMBER

KNOW THESE COLD

- Performance numbers come from POH section 5 charts and tables, entered with actual weight, wind, temperature, and altitude — never from memory.

Source: POH/AFM sect. 5

- When conditions fall between table rows, interpolate — and when in doubt, round every input in the conservative direction.

Source: PHAK ch. 11

- The chart's conditions and notes are part of the data (paved level dry runway, flap setting, leaning technique); different conditions void the number.

Source: POH/AFM sect. 5

- Book performance was flown by test pilots in a new airplane; a worn trainer flown by a private pilot will not match it, so margin is added, not hoped for.

Source: AFH; PHAK ch. 11

- Pressure altitude is the altimeter reading with 29.92 set; it is the entry point for most performance charts.

Source: PHAK ch. 11

- Density altitude is pressure altitude corrected for nonstandard temperature: the altitude the airplane thinks it is at.

Source: PHAK ch. 11

- Standard sea-level atmosphere is 15 °C (59 °F) and 29.92 inHg (1013.25 hPa) — the yardstick every performance chart measures against.

Source: PHAK ch. 11

- Hot, high, or humid each raise density altitude alone — all three are not needed; a merely hot day at a low-elevation field has killed airplanes.

Source: AWH FAA-H-8083-28; NWS (1% guide)

- High density altitude cuts performance three ways at once: less lift from the wing, less thrust from the propeller, less power from the engine.

Source: PHAK ch. 11 (1% guide)

- A headwind component shortens takeoff and landing distance; a tailwind lengthens it far more per knot — the POH tailwind penalty always outweighs the headwind credit.

Source: POH/AFM sect. 5

- Only the wind components count: the crosswind chart splits reported wind into a headwind component and a crosswind component.

Source: PHAK ch. 11

- Published short- and soft-field performance assumes the POH technique exactly — speeds, flap setting, braking; sloppy speeds add distance no chart shows.

Source: POH/AFM; AFH

- Takeoff flaps per POH shorten ground roll but flatten climb; landing flaps steepen the approach and slow the

touchdown.

Source: POH/AFM

- Grass, soft, wet, or contaminated runways add roll; where the POH gives correction factors they are used, and where it does not, margin covers the guess.

Source: POH/AFM notes

- Runway slope matters in both directions: uphill takeoff and downhill landing each lengthen the distance that is critical.

Source: PHAK ch. 11

- Ground effect reduces induced drag within about a wingspan of the surface: an overloaded or high-DA airplane can lift off in ground effect and still be unable to climb out of it.

Source: PHAK ch. 5/11 (1-5 principles)

- Forward CG: more stable and nose-heavy — higher stall speed, more flare force needed, lower cruise speed.

Source: PHAK ch. 10

- Aft CG: less stable, slightly faster cruise — and degraded stall and spin recovery.

Source: PHAK ch. 10

- CG behind the aft limit can make spin recovery impossible; it is the deadliest weight-and-balance error.

Source: PHAK ch. 10

- Stall speed rises with the square root of load factor: 60° of bank in level flight is 2 g, and stall speed grows about 41%.

Source: PHAK ch. 5 (1-5 principles)

- Stall speed rises with weight; every stall and performance table is keyed to a weight.

Source: POH/AFM sect. 5

- Weight times arm equals moment; CG equals total moment divided by total weight.

Source: PHAK ch. 10

- The datum is the manufacturer's reference line; every arm in the airplane measures from it.

Source: PHAK ch. 10

- Basic empty weight includes unusable fuel and (in modern GAMA-format POHs) full oil — confirm what your airplane's figure includes before using it.

Source: PHAK ch. 10; POH sect. 6

- The airplane's current weighing record and equipment list — not the POH sample problem — is the legal source of empty weight and moment.

Source: POH sect. 6; PHAK ch. 10

- Useful load is maximum weight minus basic empty weight: crew, passengers, baggage, and usable fuel all come out of it.

Source: PHAK ch. 10

- Avgas weighs 6 lb per US gallon; oil weighs 7.5 lb per gallon.

Source: PHAK ch. 10

- The loading envelope chart is the verdict: plot weight against CG or moment, and the point must sit inside the envelope.

Source: POH sect. 6

- Fuel burn moves both weight and CG in flight: a loading legal at takeoff can leave the envelope later — check takeoff and landing conditions both.

Source: PHAK ch. 10

- The weight-shift formula: weight moved times distance moved equals total weight times CG change.

Source: PHAK ch. 10

- Overweight operation costs everything at once: longer takeoff, shallower climb, higher stall speed, less structural margin — and it voids the performance charts.

Source: PHAK ch. 10/11

- Baggage-area placards are structural limits: the floor and tiedowns are certified only to the placarded weight.

Source: POH sect. 2

- Operating limitations bind wherever they appear: POH section 2, placards, and instrument markings all carry regulatory force.

Source: 14 CFR 91.9; POH sect. 2

- The airspeed limits: Vne never exceed (red line), Vno maximum structural cruise (top of green), Va maneuvering (not marked on the dial), Vfe maximum flaps extended (top of white).

Source: PHAK ch. 8; POH sect. 2

- Vy climbs give the most altitude per minute; Vx the most altitude per distance — obstacle-clearance planning uses Vx numbers.

Source: POH sect. 5; PHAK ch. 11

- Climb rate falls as you go up; service ceiling is the altitude where the best rate has decayed to 100 fpm.

Source: PHAK ch. 11

- The cruise-performance table links percent power, RPM, TAS, and fuel flow at each altitude and temperature — the same table feeds 2-1's fuel plan and 2-2's TAS.

Source: POH sect. 5

- Takeoff and landing "over a 50-ft obstacle" columns include the air segment; the ground-roll column alone understates the runway needed when anything stands off the end.

Source: POH sect. 5

- The performance-chart check is a per-flight event, not a per-airplane fact: a new field elevation, temperature, or load resets every number.

Source: PHAK ch. 11

- Runway and takeoff-path selection is a computed decision — aircraft performance and limitations, distance available, surface, and wind, weighed against pilot capability — made before taxi, not at the hold-short line.

Source: POH/AFM sect. 5; AFH (pin-needed)

- Density altitude follows the airplane around the pattern: a go-around at a high-density-altitude field may barely climb, so the go-around path and obstacle picture are part of the runway decision.

Source: PHAK ch. 11 (pin-needed)

GOING DEEPER

- A standing safety factor on computed takeoff and landing distance (North Aero teaches +50%) turns book numbers into planning numbers.

Source: AFH; internal doctrine

- An abort point is chosen before takeoff: a spot on the runway where, if the airplane is not flying or not accelerating on plan, the takeoff stops.

Source: AFH

- Density altitude rises roughly 120 ft for every 1 °C above standard temperature.

Source: PHAK ch. 11 (1% guide)

- Humidity is the weakest of the three levers — fully saturated warm air is only about half a percent to one percent less dense — real, but temperature and altitude dominate.

Source: NWS High Density Altitude (1% guide)

- High density altitude is not a red light by itself; it is a number you plan runway, weight, and climb around.

Source: 1% guide; PHAK ch. 11

- High density altitude is a landing problem too: the same indicated approach speed means higher true and ground speed, so the runway goes by faster and the rollout is longer.

Source: 1% guide; PHAK ch. 11

- Max demonstrated crosswind component is a demonstrated value, not a limitation — but beyond it you are the test pilot.

Source: POH/AFM sect. 4

- Maneuvering speed V_a decreases as weight decreases: a lightly loaded airplane has a lower V_a , not a higher one.

Source: POH/AFM; PHAK ch. 5

- Where the POH distinguishes ramp weight from takeoff weight, the difference is the taxi and runup fuel allowance.

Source: POH sect. 2/6

- Some types set a maximum landing weight below maximum takeoff weight; when they do, fuel burn en route is part of the landing plan.

Source: POH sect. 2

- Many trainers hold utility-category approval only inside a smaller weight-and-CG envelope, and the steeper maneuvers that category approves are legal only there. The Warrior's placard prohibits spins in both categories.

Source: POH sect. 2; PA-28-151 placards

- V_a promises that a single, full deflection of one control below it stalls the airplane before breaking it — it is no guarantee for repeated or combined inputs.

Source: PHAK ch. 5

- Certified limit load factors, flaps up: normal category +3.8/-1.52 g; utility +4.4/-1.76 g.

Source: PHAK ch. 5; POH sect. 2

- Maximum range and maximum endurance live at different power settings: going far and staying up long are different plans.

Source: PHAK ch. 11; POH sect. 5

- Tracking actual versus computed performance is a habit: an airplane consistently under book is a bigger-margin airplane and a maintenance conversation.

Source: AFH

THE REGULATIONS BEHIND THIS MODULE

14 CFR 91.9 – Civil aircraft flight manual, marking, and placard requirements

No person may operate a civil aircraft without complying with the operating limitations specified in the approved flight manual, markings, and placards.

Where it goes deeper: This module, in the limitations Leg.