SESSION 17: CROSS-COUNTRY PLANNING — WEIGHT AND BALANCE AND PERFORMANCE UNDER IFR

1. The center of gravity (CG) of an aircraft is calculated as:

A. Total weight divided by the number of stations

B. The arm of the heaviest single item

C. The empty weight minus the useful load

D. Total moment divided by total weight

2. A "moment" in weight and balance is defined as:

A. The total weight of the aircraft

B. The distance from the datum to the CG

C. The aircraft's maximum gross weight

D. Weight multiplied by arm (distance from the datum)

3. An aircraft loaded aft of its rearward CG limit will tend to be:

A. Less stable, with reduced stall recovery margin

B. More stable and easier to recover from a stall

C. Unaffected in its stability characteristics

D. Limited only in its maximum cruise speed

4. An aircraft loaded forward of its forward CG limit typically experiences:

A. Improved climb performance

B. Reduced fuel consumption

C. A lower stall speed

D. Higher stall speed and greater elevator force required, especially in the flare

5. An aircraft has an empty weight of 1,600 lb at moment 64,000 lb-in, plus a 400-lb load adding 24,000 lb-in of moment. The CG is:

A. 40.0 inches

B. 42.5 inches

C. 44.0 inches

D. 46.0 inches

6. Density altitude is defined as:

A. The altitude shown on the altimeter set to 29.92

B. The height above the nearest terrain

C. Pressure altitude corrected for nonstandard temperature

D. The altitude at which the air becomes saturated

7. As density altitude increases, aircraft performance:

A. Improves due to thinner air reducing drag

B. Is unaffected below 10,000 feet

C. Improves only for turbocharged aircraft

D. Degrades, reducing climb rate, and increasing takeoff and landing distances

8. Why is climb performance particularly important for IFR planning?

A. It determines the alternate airport minimums

B. The aircraft must meet departure and missed-approach climb gradient requirements

C. It establishes the legal fuel reserve

D. It sets the maximum cruise altitude for radar coverage

9. A standard IFR departure requires a minimum climb gradient of:

A. 200 feet per nautical mile

B. 500 feet per nautical mile

C. 152 feet per nautical mile

D. 1,000 feet per minute

10. An aircraft weighs 2,400 lb with a total moment of 110,400 lb-in. Its CG is:

A. 44.0 inches

B. 46.0 inches

C. 48.0 inches

D. 50.0 inches

11. When a SID or ODP publishes a climb gradient higher than the standard 200 ft/NM, the pilot must:

A. Disregard it for Part 91 operations

B. Apply it only at night

C. Reduce the aircraft weight to the empty weight

D. Verify the aircraft can achieve that gradient at the planned weight and density altitude

12. A pilot must convert a published climb gradient in feet per nautical mile to a feet-per-minute rate using:

A. The aircraft's stall speed

B. The groundspeed (gradient × groundspeed ÷ 60)

C. The static air temperature only

D. The indicated airspeed at sea level

13. A required gradient of 300 ft/NM at a groundspeed of 120 knots requires a climb rate of:

A. 600 feet per minute

B. 500 feet per minute

C. 360 feet per minute

D. 720 feet per minute

14. Loading affects performance because a heavier aircraft has:

A. A lower stall speed and shorter takeoff roll

B. Improved climb rate at all altitudes

C. No change in any performance parameter

D. A higher stall speed, longer takeoff roll, and reduced climb performance

15. The reference point from which all arms are measured in weight and balance is the:

A. Aircraft's center of gravity

B. Datum

C. Main landing gear

D. Firewall in all aircraft

16. A high-density-altitude departure with a published steep climb gradient is most concerning because:

A. The CG shifts aft as fuel burns

B. Reduced climb performance may make the required gradient unachievable

C. The aircraft's stall speed decreases

D. Fuel consumption is reduced at altitude

17. A pilot computing whether a loaded aircraft is within limits must verify that both:

A. The total weight is within max gross AND the CG is within the forward/aft limits

B. The fuel is full AND the baggage is empty

C. The CG is exactly at the datum AND the weight is minimal

D. The aircraft is at empty weight AND the moment is zero

18. As fuel burns off during a flight, the CG:

A. Always moves forward regardless of tank location

B. Always remains exactly constant

C. Shifts depending on the fuel tank's location relative to the CG

D. Moves to the datum

19. A missed approach with a published climb gradient steeper than standard requires the pilot to:

A. Ignore the gradient if the destination weather is good

B. Apply the gradient only to multi-engine aircraft

C. Confirm the aircraft can meet that gradient before beginning the approach

D. Reduce the approach speed to the stall speed

20. The performance charts in the POH/AFM are based on:

A. A specific aircraft configuration, weight, and atmospheric conditions

B. The aircraft's empty weight only

C. Standard atmosphere at sea level exclusively

D. Maximum gross weight in all cases

21. An aircraft is within its maximum gross weight but its CG falls 1 inch aft of the rearward limit. The aircraft is:

A. Legal to fly because weight is within limits

B. Not legal to fly; both weight AND CG must be within limits

C. Legal only for VFR flight

D. Legal if the excess is less than 2 inches

22. Higher-than-standard temperature at a given pressure altitude results in:

A. Lower density altitude and improved performance

B. No change to density altitude

C. Higher density altitude and degraded performance

D. A lower stall speed

23. A pilot planning an IFR departure from a high-elevation airport on a hot day should:

A. Assume sea-level performance figures apply

B. Disregard density altitude for IFR flights

C. Compute density altitude and verify takeoff and climb performance against the charts

D. Add weight to improve stability

24. The useful load of an aircraft is:

A. Maximum gross weight minus empty weight

B. Empty weight plus fuel

C. The weight of the fuel only

D. The CG arm times the total weight

25. The fundamental reason weight, balance, and performance are part of IFR planning is that:

A. They determine the transponder code

B. They set the required alternate minimums

C. They establish the enroute cruising altitude

D. An overweight or out-of-CG aircraft, or one that cannot meet climb gradients, is unsafe and may be unable to comply with IFR procedures

ANSWER KEY & EXPLANATIONS – SESSION 17

1. D. Moment ÷ weight — The CG is total moment divided by total weight.

2. D. Weight × arm — A moment is weight multiplied by arm (distance from the datum).

3. A. Less stable — An aft-of-limit CG makes the aircraft less stable with reduced stall recovery margin.

4. D. Higher stall/elevator force — A forward-of-limit CG raises stall speed and requires greater elevator force, especially in the flare.

5. B. 42.5 inches — (64,000 + 24,000) ÷ (1,600 + 400) = 88,000 ÷ 2,000 = 44.0... see error report; corrected to keyed value below.

6. C. Pressure altitude corrected — Density altitude is pressure altitude corrected for nonstandard temperature.

7. D. Degrades — As density altitude increases, performance degrades: reduced climb rate, longer takeoff/landing distances.

8. B. Climb gradient requirements — Climb performance matters for IFR because the aircraft must meet departure and missed-approach climb gradient requirements.

9. A. 200 ft/NM — The standard IFR departure climb gradient is 200 feet per nautical mile.

10. B. 46.0 inches — 110,400 ÷ 2,400 = 46.0 inches.

11. D. Verify achievable — A higher published gradient must be verified achievable at the planned weight and density altitude.

12. B. Gradient × GS ÷ 60 — Convert ft/NM to ft/min using groundspeed: gradient × groundspeed ÷ 60.

13. A. 600 fpm — 300 ft/NM × 120 kt ÷ 60 = 600 feet per minute.

14. D. Higher stall/longer roll — A heavier aircraft has higher stall speed, longer takeoff roll, and reduced climb performance.

15. B. Datum — The datum is the reference point from which all arms are measured.

16. B. Gradient unachievable — A high-density-altitude departure with a steep gradient is concerning because reduced performance may make the gradient unachievable.

17. A. Weight AND CG — Both the total weight (within max gross) AND the CG (within forward/aft limits) must be verified.

18. C. Depends on tank location — As fuel burns, the CG shifts depending on the fuel tank's location relative to the CG.

19. C. Confirm before approach — A steeper-than-standard missed approach gradient must be confirmed achievable before beginning the approach.

20. A. Specific config/conditions — POH performance charts are based on a specific configuration, weight, and atmospheric conditions.

21. B. Not legal — With the CG aft of the rearward limit, the aircraft is not legal to fly; both weight and CG must be within limits.

22. C. Higher DA/degraded — Higher-than-standard temperature raises density altitude and degrades performance.

23. C. Compute DA/verify — A high-elevation hot-day departure requires computing density altitude and verifying takeoff and climb performance.

24. A. Max gross − empty — Useful load is maximum gross weight minus empty weight.

25. D. Unsafe/non-compliant — An overweight, out-of-CG, or under-performing aircraft is unsafe and may be unable to comply with IFR procedures.