

The exam won't hand you the flight-manual charts, but it will test whether you understand what drives the numbers and how to work a weight-and-balance problem. That's what this chapter builds. The actual planning figures always come from the aircraft's own performance tables — treat what follows as how to *read and reason about* them, never as a substitute for them.

10.1 Reading the performance tables

The flight manual gives performance as multi-variable tables — take-off distance, climb, cruise, landing distance and go-around — each entered with three main variables: **pressure altitude**, **outside air temperature** and **mass**. You interpolate between the printed values for your actual conditions. The qualitative effects are what the paper tests, and they never change:

Increase in...	Take-off / landing distance	Climb performance
Mass	Longer	Reduced
Pressure altitude	Longer	Reduced
Temperature	Longer	Reduced
Headwind	Shorter	Steeper (over the ground)

DENSITY ALTITUDE — THE ONE IDEA BEHIND THEM ALL

Heat, altitude and humidity all thin the air. Thin air means less lift, less thrust and a lazier propeller — so the aeroplane needs more runway and climbs worse. Every "hot and high" performance question is really a density-altitude question. Fix that idea and the tables make sense.

10.2 Single-engine performance

The table you will care about most in real operations is the one-engine-inoperative climb. Lose an engine and you lose far more than half your climb — the drag of the airframe stays while the power halves — so single-engine climb is modest at best and evaporates as weight, altitude and temperature rise. This is the whole reason for the caution about flying a diesel twin at night, in cloud or over unlandable terrain: plan so that reduced single-engine performance is never the thing that hurts you.

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10.3 Mass and balance — the method

Weight and balance on this aeroplane is the same arithmetic you already know, referenced to a datum plane set 2.196 m forward of the wing root rib. For each item — empty aircraft, crew, passengers, baggage, fuel — you take its **mass** × **arm** = **moment**, add up all the masses and all the moments, and then:

$$\text{Centre of gravity} = \text{total moment} \div \text{total mass}$$

You then check two things: that the total mass is within the mass limits, and that the CG falls inside the published envelope. The type provides a loading diagram and a permissible-CG-range chart to do this graphically — plot your loaded point and confirm it sits inside the envelope.

THE LIMITS TO CHECK AGAINST

Maximum take-off mass 1900 kg · maximum landing mass 1805 kg · maximum zero-fuel mass 1765 kg. The CG envelope's forward limit moves aft as mass increases (roughly 2.35 m light to 2.42 m at maximum), with an aft limit near 2.48 m — so a heavy aeroplane has *less* room at the front.

10.4 Watching the CG shift in flight

Fuel burn moves the CG, so a loading that is legal at take-off must also stay legal as the tanks empty. Because the tanks are in the wings, close to the CG, the shift is modest — but on a long flight, and with rear-seat passengers and baggage, always confirm the aeroplane stays inside the envelope for the whole flight, not just at the start.

WHY THE CG MATTERS

Too far forward and the aeroplane is heavy on the controls and may not flare; too far aft and it becomes unstable and, at the extreme, unrecoverable from a stall or spin. The envelope is the band where the manufacturer has proven the aeroplane handles and recovers as advertised. Loading is not paperwork — it's airmanship you do before you ever start an engine.

REMEMBER FOR THE EXAM

Performance tables run on pressure altitude, temperature and mass — all worsen with density altitude · single-engine climb is modest and fades hot-and-high · $\text{CG} = \text{total moment} \div \text{total mass}$

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mass · check mass limits AND the CG envelope · forward CG limit tightens as you get heavier · fuel burn shifts the CG, so check the whole flight.

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