# Performance

| New syllabus text | |
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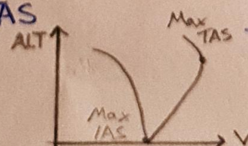
| ***Performance and safety*** | |
| State that aeroplane performance required for commercial air transport may limit the weight of a dispatched aeroplane in order to achieve a sufficient level of safety. | - Jet: Safety factor landing is 67%. Take off is 15% |
| Describe that the minimum level of safety required for commercial air transport is ensured through the combination of airworthiness requirements and operational limitations, i.e. the more stringent airworthiness requirements of CS-25 enable a wider range of operating conditions for these aeroplanes. | - Class A can use contaminated runways because they have the most stringent regulations. |
| ***Performance definitions and safety factors*** | |
| Describe measured performance and explain how it is determined. | - Average of each set of data, new aircraft by test pilots |
| Describe gross performance. | - Average of fleet, techniques in manual |
| Describe net performance and safety factors. | - Gross degraded by safety Factor |
| Describe that the size of a safety factor depends on the likelihood of the event and the range of the measured performance data. | - CAT: probability of an event must be less than 1 in 1,000,000 (Remote probility) |
| Describe the relationship between net and gross take-off and landing distances, and net and gross climb and descent gradients. | - Net landing distance > Gross<br>Net Cimb gradient < Gross<br>Net descent gradient > Gross |
| Define the power available and power required. | - Pg 136 |
| Describe how, for different density altitudes, the thrust and power available vary with speed for a propeller-driven aeroplane. | - Thrust ↓ as alt increases<br>Thrust ↓ as speed increases |
| Describe how, for different density altitudes, the thrust and power available vary with speed for a turbojet aeroplane. | - Thrust is constant with speed<br>Thrust ↓ as ALT increases. |
| Describe how, for different density altitudes, the drag and power required vary with indicated airspeeds (IAS) and true airspeeds (TAS). | |
| Describe how, for different aeroplane weights and configurations, the drag and power required vary with IAS and TAS. | Weight ↑ = Power Required ↑<br>IAS ↑ = Drag ↑<br>TAS ↑ = Power Required ↑ |
| **Level flight, range and endurance** | |
| ***Steady level flight*** | |
| Explain how drag (thrust) and power required vary with speed in straight and level flight. | speed ↑ = Power Required ↑ |
| Describe how the maximum achievable straight and level flight IAS and TAS vary with altitude. | Intersection of thrust avail and thrust required curves.<br>IAS max = Low ALT<br>TAS max = High ALT |

• Power Required = Drag × TAS



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| ***Range*** | |
| Explain the optimum speed for maximum SR for a turbojet aeroplane in relation to the drag curve. | VMD × 1.32 (Tangent) |
| Explain the optimum speed to achieve maximum SR for a propeller-driven aeroplane in relation to the power required and drag graphs. | VMD (Tangent) |
| State how a turbojet engine's SFC varies with temperature and thrust setting. | FF per unit of thrust. SFC is lowest (best) when temp is low |
| Explain how SRG for a propeller-driven aeroplane varies with altitude and under different meteorological conditions. | Optimum alt: Throttle Fully open and power required at VMD |
| Explain the effect of weight on the optimum altitude for maximum range. | Fuel burn = Drag curve moves down & left. VMD 1.32 $\downarrow$ Range $\uparrow$ Opt. ALT $\uparrow$ |
| Describe the effect of wind on SRG and the optimum speed for SRG , when compared to SR, and the optimum speed for SR. | HWC: You want to spend as little time in the head wind as possible so fly higher than VMD 1.32! |
| ***Maximum endurance*** | |
| Explain fuel flow in relation to TAS and thrust for a propeller-driven aeroplane. | - VMP (Minimum power required) |
| State the speed for maximum endurance for a propeller-driven aeroplane and the disadvantages of holding at this speed (e.g. high angle of attack (AoA) and lack of speed stability). | VMP = Speed unstable, must Fly Faster. |
| Explain the effect of wind and altitude on endurance, and the maximum endurance speed for a propeller-driven aeroplane. | Best endurance = Low ALT<br>Wind doesn't affect Endurance |
| Describe the benefits of managing your en-route airspeed to reduce or avoid holding time, and the operational situations when it could be used (commanded by the pilot or air traffic control (ATC), when delays at arrival airport occur). | Holding at low ALT = BAD! (Jet)<br>Adjust speed in cruise to arrive at destination at the optimum time. |
| **Climbing** | |
| **Climbing (climb performance)** | |
| Explain the effect of configuration on climb performance (angle and rate of climb, and Vx and Vy). | Flaps/Gear: Reduce Vx and Reduce angle of climb: Reduce Vy & reduced rate of Climb aswel. |
| **Descending** | |
| ***Descending (descent performance)*** | |
| Explain the effect of mass, altitude, wind, speed and configuration on the powered descent. | Mass/ALT/Wind dont affect glide ratio. The do affect range & speed. Flaps increase glide angle (Reduce glide Range) |
| ***Airworthiness requirements and definitions*** | |
| Describe the limitations on VR, on the speed at 50 ft above the take-off surface and on VREF, and given the appropriate stall speed, estimate the values based on these limitations for a single-engine, class B aeroplane. | |
| Describe the limitations on VR, on the speed at 50 ft above the take-off surface and on VREF, and given the appropriate stall speed, estimate the values based on these limitations for a multi-engine, class B aeroplane. | |
| ***Take-off and landing (definitions and effects)*** | |
| Explain the effect of wind on take-off and landing distances, and determine the actual headwind/tailwind component given the | HWC = TOD $\downarrow$ & LD $\downarrow$ |

Mental XWC : "1 2 3 4 5 rule"

eg. Wind Angle 50°
Speed = 40 Kt

1 2 3/4 5    $\frac{3}{4} \times 40 = 30$ Kts

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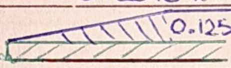
| runway direction, wind speed and direction, by use of wind component graphs, mathematical calculations, and rule of thumb. | Wind Speed x cos W. Angle = HWC<br>Wind Speed x sin W. Angle = XWC. |
| Explain why an aeroplane has maximum crosswind limit(s) and determine the crosswind component given the runway direction, wind speed and direction, by use of wind component graphs, mathematical calculations, and rule of thumb. | Rudder authority / Yaw from OEI. Also pilot skill.<br>Clock : 15° 30° 45° 60° (WA)<br>1/4 2/4 3/4 4/4 (WV) |
| Explain the effects of pressure altitude and temperature on the take-off distance, take-off climb, landing distance and approach climb. | Temp ↑ = Performance ↓<br>Pa ↑ = Performance ↓ |
| Describe the landing airborne distance and ground-roll distance and estimate the effect on the landing distance when the aeroplane is too fast or too high at the screen. | 10% ↑ Speed = 20% ↑ LD |
| Describe the take-off flight path for a multi-engine, class B aeroplane. | TODA (50 ft) => 1500ft (IMC = OEI)<br>Gradient x 0.77 |
| Describe the dimensions of the take-off flight path accountability area (domain). | <br> |
| ***Climb, cruise and descent (requirements and calculations)*** | |
| For a single-engine aeroplane, calculate the expected obstacle clearance (in visual meteorological conditions (VMC)) given gross climb performance, obstacle height and distance from reference zero. | * Calculation *<br>• Gradient x 0.77<br>• Assume OEI in IMC |
| For a single-engine aeroplane, calculate the net glide gradient and net glide distance, given aeroplane altitude, terrain elevation, gross gradient or lift/drag ratio (L/D ratio), and headwind or tailwind component. | * Calculation *<br>• Net Gradient = Gross gradient + 0.5%<br>• Grad% = Climb Grad x $\left(\frac{TAS}{GS}\right)$ |
| Given take-off run available (TORA), TODA and ASDA, slope and surface conditions, calculate the defactored distance to be used for commercial air transport using the appropriate take-off graphs. | Jet = 60%<br>Prop = 70%<br>Wet = 15%<br>Landing<br>Take off: Cap S2 pg4 |
| Calculate the minimum TORA or TODA for commercial air transport given the defactored take-off distance or run, runway surface and slope. | |
| Determine the still-air and flight-path gradients for given IAS, altitude, temperature, aeroplane weight and, if relevant, wind component. | Grad% = Climb Grad% x $\left(\frac{TAS}{GS}\right)$ |
| Calculate, given the landing distance available (LDA), slope and surface type and condition, the defactored distance to be used for commercial air transport using the appropriate landing graphs. | Cap Sec 3 pg 1.<br>Slope increase 5% for every 1% upslope. Down ignored for TO |
| Calculate the minimum landing distance (LD) that must be available for commercial air transport given the defactored landing distance, runway surface and slope. | Jet ÷ 60%<br>Prop ÷ 70%<br>Wet ÷ 1.15 |
| Explain how loss of TORA due to alignment is accounted for. | During Calc by operator. |
| Explain the effect of the interdependency of relevant speeds in 032 04 01 01 (05) and the situations in which these | |

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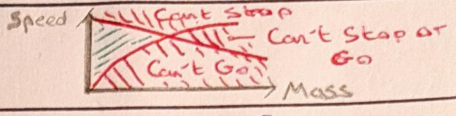
| interdependencies can cause speed and performance restrictions. | |
| Explain the hazards of rejecting a take-off from high ground speed or high take-off mass, and how to manage these hazards. | Tyre burst or brake fire. Use RTO technique and $V_1$ |
| Explain the concept of a 'range of V1' and explain reasons for the placement of the designated V1 towards the faster or slower end of the range. |  |
| Describe the use of RTOM tables or similar to find PLTOM and how this can also be done using an EFB. | See page 594 for EASA ECQB2020 RTOM table |
| Interpret what take-off limitation (field length, obstacle, climb, structural, etc.) is restricting a particular RTOM as it is presented in RTOM tables or similar. | * Table/Graph * |
| Describe why data from an EFB can differ from data derived from RTOM tables or similar. | EFB is slightly more accurate because tables are simplified. |
| Describe a wet V1 and explain the consequences of using a wet V1. | $V_1$ wet is lower but screen height is reduced to 15ft |
| Describe the hazards, effects and management of operating from a contaminated runway. | ↑ ASD. $V_1$ wet is lower and obstacle clearance reduced. |
| Describe displacement drag, impingement drag, and the methods to monitor acceleration. | Displacement: Force through slush<br>Impingement: Water thrown on LG. |
| Explain the benefits and implications of using a derated take-off on a contaminated runway. | $V_{MCG}$↓ = Reduced $V_1$ = ASDR↓ |
| Determine the optimum flap position and PLTOM from given figures. | * Calculation * |
| Explain the hazards of the fast V1 and VLOF speeds associated with the increased V2 procedure and how they can be managed. | $V_{TYRES}$ become limiting.<br>RTO = High brak/tyre energy |
| Describe that the high-speed buffet can occur at speeds slower or faster than MMO. | Buffet speed varies with mass, ALT, CoG & Load Factor. |
| Explain the reasons why a step climb may not be used (e.g. for short sectors, advantageous winds, avoiding turbulence, and due to air traffic restrictions). (To stay at optimum ALT) | Step climb mainly used for Medium/Long haul. Tailwinds etc better for short haul. |
| Describe the effect of cost index on climb, cruise and descent speeds. | $\frac{\text{Cost of Time}}{\text{Cost of Fuel}}$ Cost Index↑ = Fuel burn ↑ |
| Explain the advantages and principle of a continuous descent. | Efficient (Less fuel burn) |
| Describe energy management in terms of chemical, potential and kinetic energy. | Chemical = Fuel Kinetic = $\frac{1}{2}mV^2$<br>Potential = Height |
| Describe the effect of increasing/decreasing headwind and tailwind on profile management. | HWC = ↑ Profile (Angle)<br>TWC = ↓ Profile (Angle) |
| Describe the effect of the Mach number to IAS transition (speed conversion) on profile management. | Nose gets pitched down to maintain mach. Stays constant after transition to CAS |
| Describe situations during the descent and approach in which a pilot could find that an aeroplane flies high or fast, and explain how the pilot can manage descent angle/excess energy. | Failure to manage energy = Drag devices. |
| **CS-25/APPLICABLE OPERATIONAL REQUIREMENTS PERFORMANCE CLASS A - USE OF AEROPLANE PERFORMANCE DATA** | |

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| **Take-off** |
| ***Take-off (performance data)*** |
| Determine from given graphs the field-lenght-limited take-off mass (FLLTOM) and describe situations in which this limitation could be most restrictive for take-off. |
| Determine from given graphs the tyre-speed-limited take-off mass. |
| Determine from given graphs the maximum brake-energy-limited take-off mass. |
| Determine the take-off V speeds for the actual take-off mass. |
| Determine the maximum take-off mass using given RTOM tables. |
| Using RTOM tables, determine the take-off V speeds for the actual take-off weight using appropriate corrections. |
| Determine the assumed/flex temperature and take-off V speeds using the RTOM tables. |
| Calculate the break cooling time following a rejected take-off given appropriate data. |
| **Drift-down and stabilising altitude** |
| ***Drift-down and stabilising altitude (performance data)*** |
| Determine the maximum mass at which the net stabilising altitude with one-engine-out clears the highest relevant obstacle by the required clearance margin. |
| Determine, using drift-down graphs, fuel used, time and distance travelled in a descent from a cruise flight level to a given altitude. |
| ***Landing (performance data)*** |

* All Graphs *