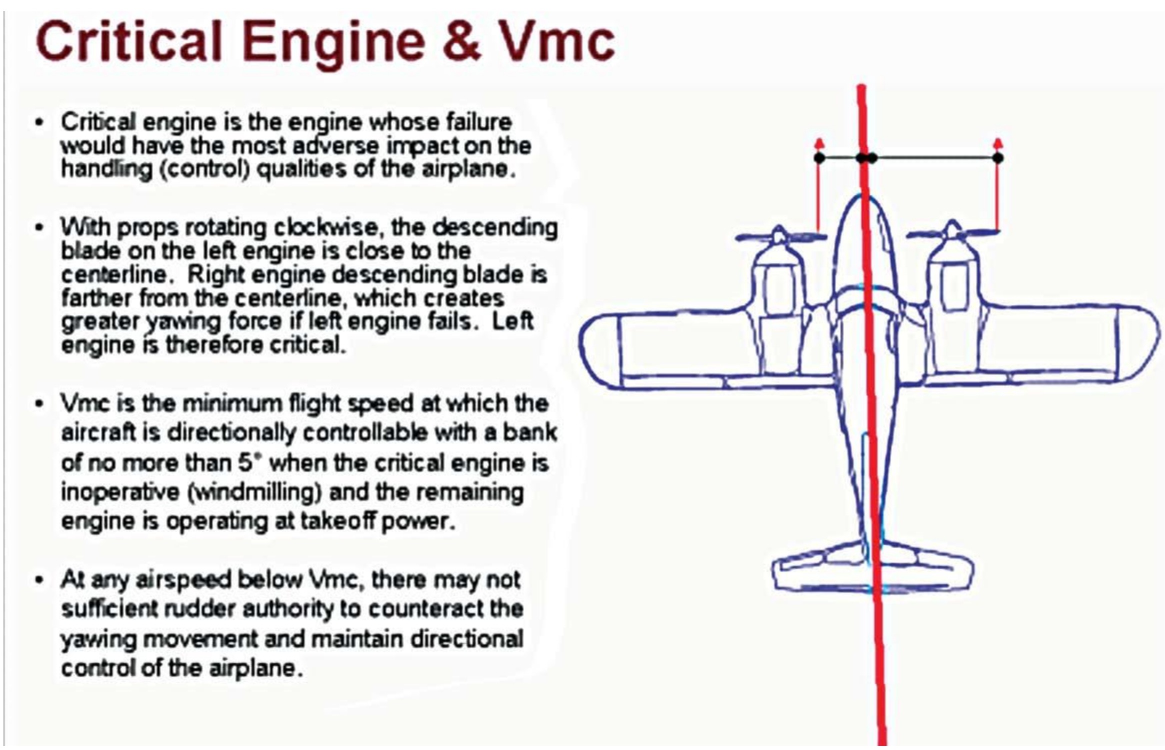
DUCHESS BE-76 AND COMMERCIAL MULTI ADD-ON
ORAL REVIEW FOR CHECKRIDE

The Critical Engine

The critical engine is the engine whose failure would most adversely affect the airplane's performance or handling qualities.

On twin-engine airplanes with both engines turning in a conventional, clockwise rotation (viewed from the cockpit), the left engine is critical. At cruise airspeed, the thrust line of each engine may be considered to be the propeller hub.

At low airspeeds and high angles of attack, the effective thrust centerline shifts to the right on each engine because the descending propeller blades produce more thrust than the ascending blades (P-factor). The more power, the greater the effect. The right shifting thrust of the right engine operates at a greater moment arm (that is, distance from the airplane's center of gravity) than the left engine. Thus, the right engine produces the greatest yawing moment and requires the most rudder to counteract the adverse yaw.



Aerodynamic Results of Engine Failure

- Power on operative engine causes turn into inop engine
- Drag is created by windmilling prop
- Engine stops producing lift on one side while the other is still producing lift causing turn into inop engine.
- Inop Engine wing dips causing turn in it's direction

Zero Sideslip

- Sideslip is the angle at which the relative wind meets the longitudinal axis of the plane
- Coordinated Flight = Zero Sideslip
- Coordinated Flight not possible with OEI
- Full rudder into the good engine counters yaw.
- Engine still produces forward thrust though producing sideslip
- Bank 3 to 5 degrees into good engine counters sideslip

V_{MC} (aka V_{MCA}, aka minimum controllable airspeed)

- Designated by red line on ASI
- Small airplane certified at Vmc, test pilot must be able to:
  - Stop the turn that results with loss of critical engine within 20 degrees of orig heading using full rudder and no more than 5 degrees into good engine

V_{MC} vs Density Altitude

As altitude increases V_{MC} decrease. There is a point where stall speed is reached prior to V_{MC}.

V_{MC} vs Performance

Description	VMC	Performance
Reduced Power in Operating Engine	Decrease	Decrease
Increased Power in Operating Engine	Increase	Increase
Higher Density Altitude	Decrease	Decrease
Heavier weight of Aircraft	Decrease	Decrease
Gear Down	Decrease	Decrease
Feathered Prop	Decrease	Increase
Forward Loading of A/C	Decrease	Decrease
Aft Loading of A/C	Increase	Increase
Zero Sideslip *	Decrease	Decrease

* V_{MC} can be reduced by 3kts for every degree of bank

Single Engine Ceiling

The altitude where an aircraft with OEI can no longer climb at a rate of at least 50 feet per minute with inoperative engine feather and at maximum t/o weight.

Single Engine Absolute Ceiling

No Rate of climb

Accelerate-Stop Distance

Accelerate-stop distance is the runway required to accelerate to either V_R and, assuming an engine failure at that instant, to bring the airplane to a complete stop.

Accelerate-Go Distance

Accelerate-go distance is the distance required to accelerate to either Vr or Vlof (as specified by the manufacturer) and, assuming an engine failure at that instant, to continue the takeoff on the remaining engine and climb to a height of 50 feet. NOTE – IN REALITITY THIS DOES NOT EXISTS WITH MOST LIGHT TWINS. AS AN

EXAMPLE, THE DUCHESS TAKES 6 MILES TO CLIMB 1,000 FEET IN THE BEST OF CIRCUMSTANCES.

ON CHECKRIDE DAY ENSURE YOU HAVE DETERMINED THE FOLLOWING:

- ACCERATE STOP DISTANCE
- ACCERATE GO DISTANCE
- CURRENT WEIGHT AND BALANCE
- TAKE OFF DISTANCE TO CLEAR 50 FT OBSTACLE
- SINGLE ENGINE SERVICE CEILING

SPEEDS

- V_{SSE} – 71 kts - the minimum speed at which intentional engine failures are to be performed
- V_{XSE} – 85 kts - Best single-engine angle of climb airspeed (Vxse) is used only to clear obstructions during OEI initial climbout because it gives the greatest altitude gain per unit of horizontal travel. Vxse is invariably a slower speed than V_{YSE} and may be just a very few knots above Vmc.
- V_{YSE} – 85 kts (blue line) –Best single engine rate of climb.
- V_{MC} - 65 KTS (RED line) – Minimum controllable air speed on one engine.
- V_Y – 85 KT (BLUE LINE) – Best rate of climb
- V_X – 71 kts – Best angle of climb – used to clear an obstacle
- V_r – 71 kts – rotation speed
- V_{LO} – 140 KTS – Max gear extension speed
- V_{LR} – 112 KTS – Max gear Retraction speed
- V_A – 132 kts – Manuevering speed
- V_S – 70 kts – clean stall
- V_{SO} – 60 kts – dirty stall

- V_{FE} – 110 kts– Max flap extension speed
- VBG – 95 kts - Full Gross Best Glide Speed
  83 kts – 3000 lbs Best Glide Speed

SYSTEMS

Fuel

- 2 fuel tanks, one in each wing, each has usable 50 gls
- Burns at a rate of approx 10 gals per hour
- 2 fuel pumps per side, 1 mechanical engine driven pump and 1 electrical
- Heater in nose draws 2/3 gal per hr from right side
- Crossfeed capabilities (set to operating eng to crossfeed and inoperative engine fuel selector to off)
- Engine primer system primes cylinders 1,2,4

Electrical

- (2) 28 volt, 55 amp alternators
- (1) 24 volt Battery
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Engines

- Left Engine:
  - Lycoming O-360 180hp@2700 RPMS
- Right Engine: Lycoming LO-360 180@2700 RPMS
- Horizontally Opposed
- Air Cooled
- Normally Aspirated
- Direct Drive

Landing Gear/Hydraulic System

- Retractable Tricycle Landing Gear
- Magnesium and aluminum
- Fault Protection – Pitot tube switch (59-63 kts)
- Position Indicators (3 Greens, red light for gear-in-transit)
- Time Delay Relay (after 30 secs pump operation stops, pilot must recycle gear lever to reset)
- Electrically actuated power-pack (located in aft fuselage)
- Electrically driven hydraulic pump used for extension and retraction
- Can be manually extended (See Emergency Gear Extension)
- Pressure of 1250-1550 (+/- 100) holds gear up in place
- Warning Horn sounds if flaps below 16 degrees or power is retarded to indicate possible landing

Gear Down cycle

- Current to pump
- Fluid to actuators
- Gear down
- Switches on gear, turn on lights
- Pump off
- System is depressurized
- over-center brace & spring holds main gear down in place
- nose locks down w/ brace & spring holds nose gear down in place
- Landing Gear Retraction Momemt: -1177 in.-lb (per FAA Type Certificate Data Sheet)

Gear Up Cycle

- Check pitot switch for 59-63 knots
- Send electricity to pump
- Pump sends fluid to actuators
- Gear comes up
- Pressure switch at 1550 psi shuts off pump (if pressure drops below 1250, pump back on)

PROPELLERS

- 2 Hartzell, 76” diameter
- Constant speed
- Full Feathering
- Propeller RPM is controlled by engine driven governor which regulates hydraulic pressure to the hub.
- Propeller controls on the consol all pilot to select governor range
- Springs and dome air pressure aided by counterweights move the blades to high pitch
- Nitrogen pressurized accumulators take the props out of feather when controls are brought full forward

DEICING

- Carb heat
- Pitot heat
- Window defroster

Maximum T/O Weight 3900 lbs
Maximum Baggage Compartment 200 lbs
Maximum Wing Life – 20,000 hrs