
# Multi-Engine Training Packet

This multi-engine training course is designed for the Commercial Multi-Engine Rating, MEI and ATP.

This packet, in conjunction with the BE-76 Pilot's Operating Handbook contains all the information you need for the multi-engine course.

Success in this training course depends on your study preparation and your instrument flying proficiency.

## Program Itinerary

This study packet is designed for commercial-multi, ATP, and MEI candidates.
The training schedule is flexible but fairly standard.
*Note* The applicant should be instrument current and **proficient**.

| Day 1 | Day 2 |
| --- | --- |
| Approximately 4 hours of flight training<br>Ground instruction as required for the rating | Prep for oral exam<br>Brush-up/ practice checkride flight<br>Checkride |

Below are training outlines for each specific rating. The key to success and minimal stress is preparation. With the exception of the actual BE-76 flight manual, this packet contains everything you need for the Multi-engine course.

## Airline Transport Pilot

Maneuvers (IR):

- Steep Turns
- Slow Flight
- Approaches to Stalls (3)
- Engine Failure (takeoff, climb, cruise)
- Normal/Crosswind Takeoff & Landing
- Recovery from Unusual Attitudes
- No-Flap Landing

Instrument Approaches:

All approaches will be at KALN & KSET.*

- 2 approaches will be precision, 1 with a landing, 1 single engine
- 2 approaches will be non-precision
  - 1 partial panel, 1 with a procedure turn (or TAA).

* Any approach at any airport in the area is an option for the examiner.

*Note: most commonly used approaches are:

- ILS 29 @ ALN
- VOR-A @ ALN
- LOC BC 11 @ ALN
- GPS 18 @ SET
- VOR 18 @ SET

The approaches above will include:

- Circle-to-land
- Missed approach and hold
- Missed approach- single engine
- Straight-in landing
- Rejected landing

# Commercial-Multi and MEI

Maneuvers (VR):

- Slow Flight
- Steep Turns
- Power off/on Stalls
- Accelerated Stall
- Engine Failure (takeoff, climb, cruise)
- Vmc Demo- Loss of directional control demonstration
- Drag Demo (MEI only)
- Emergency Descent
- Short Field Takeoff & Landing
- Normal/Crosswind Takeoff & Landing

*Note: MEI applicant does all from the right seat.

Instrument Approaches:

- Mandatory for all applicants that are instrument-rated.
- Does not apply to MEI candidates

*Note: Any approach at any airport in the area is an option for the examiner.

Most commonly used approaches:

- VOR 18 @ SET
- GPS 18 @ SET

Approach & landing will be single-engine.

# Flying Light Twins (General)

The most important phase of multi-engine flying is: Preflight Planning
Most critical phase of light twin flying is: Takeoff

FAR Part 23 puts forth certification requirements for light twins with a max gross weight of less than 12,500 lbs.

## Certification Requirements:

At 5,000 ft. international standard atmosphere the airplane performance must be determined by the manufacturer for certification.

6001 – 12,500 lbs. –
Must climb clean at 5,000' ISA
Rate of climb (ROC) = (.027 x $Vso^2$)

6,000 lbs. or less –
If Vso = 61 kts CAS or greater.
Must perform a positive ROC (.027 x $Vso^2$)

If Vso = less than 61 kts
Does not have to do anything. Can be a negative ROC.

Examples:

C-310
5,300 lbs.
Vso = 63.9 kts.
$63.9^2$ x .027 = 110.2 fpm ROC
Reality ROC = 119 fpm

BE-76
3,900 lbs.
Vso = 60 kts.
Reality ROC = 50 fpm

## Climb Performance

Climb performance is dependent on the excess power needed to overcome drag. When a twin-engine airplane loses an engine, the airplane loses 50% of its available power. This power loss results in a loss of approximately 80% of the aircraft's excess power and climb performance.

Drag is a major factor relative to the amount of excess power available. An increase in drag (such as the loss of one engine) must be offset by additional power. This additional power is now taken from the excess power, making it unavailable to aid the aircraft in climb.

When an engine is lost it is essential to achieve optimum single engine climb performance by:

Maximizing thrust- full power
Minimizing drag- flaps & gear up, feather prop

Drag Factors:

1. Full Flaps- 400 fpm approx.
2. Windmilling Prop- 400 fpm approx.
3. Gear Extended- 150 fpm approx.

# Single Engine Aerodynamics

A twin engine aircraft that has both propellers rotating the same direction (usually clockwise as viewed from inside the cockpit) is called a **conventional twin.** Since the same left-turning tendencies of a single engine airplane affect a multi-engine airplane, **counter-rotating** propellers have been developed to help combat those tendencies. The p-factor and torque from counter-rotating propellers cancel each other out which results in less rudder needed to oppose these tendencies.

## What happens when an engine fails?

When an engine fails, there are two things that will happen: **Yaw** and **Roll.**
An aircraft with a failed engine will yaw and roll towards the dead engine due to asymmetric lift, thrust, and drag.

1. Asymmetric thrust will cause a yawing moment around the C.G. towards the dead engine.

2. Accelerated slipstream (or induced flow) is extra lift created by air accelerated from an operating engine forced over the wing. There is a lack of this induced flow over the wing with the failed engine. This results in a rolling moment around the C.G. toward the inoperative engine.

To counteract the roll and yaw, you must apply rudder towards the operating engine!

**DEAD FOOT, DEAD ENGINE!**

## Zero Sideslip

Just using rudder to maintain direction will put the aircraft into a sideslip, which introduces the fuselage to the relative wind creating a large amount of drag. We need to minimize this drag as much as possible while still maintaining heading. The solution is to improve performance by using a zero sideslip condition.

When the aircraft is banked 2°- 5° toward the operating engine, the dihedral of the wing will create a horizontal component of lift. This will minimize the rudder deflection required to align the longitudinal axis of the airplane to the relative wind. With this bank, the appropriate amount of rudder deflection will be indicated on the inclinometer by the ball being halfway deflected toward the operating engine.

**RAISE THE DEAD!**

**Service Ceiling-** This is the maximum density altitude where the best rate of climb airspeed (Vx) will produce a 100 fpm climb with **both** engines at max continuous power.

**Absolute Ceiling-** This is the maximum density altitude that the airplane is capable of attaining or maintaining at max gross weight in the clean configuration and max continuous power. As altitude increases, Vx increases, while Vy decreases. Where these two speeds converge is absolute ceiling.

**Single Engine Service Ceiling-** This is the maximum density altitude at which the aircraft can maintain a 50 fpm climb with one engine operating at full power and one engine with a feathered propeller. This is critically important, especially when flying over mountainous terrain. If the aircraft is above the single engine service ceiling when an engine fails, it will slowly **drift down** to its single engine service ceiling. This should be determined during flight planning using the single engine service ceiling chart from the POH.

**Example:** Aircraft cruising altitude: 12,000’
MEA: 9,500’
Single engine service ceiling: 6,000’
If the aircraft has an engine failure at 12,000’, it will drift down to 6,000’. If you are IMC this could be very bad. **Always** plan for an engine to fail! Choose a different route with a lower MEA.

**Vyse-** This is best rate of climb single engine. Vyse is identified by the blue radial on the airspeed indicator. Always pitch for blue line when an engine fails. It will give you the best single engine performance, although it may not be a climb. In the BE-76 Duchess, Vyse is 85 KIAS.

**Vxse-** This is best angle of climb single engine. If you have obstacles to clear with an engine failed, use Vxse. Once the obstacles are cleared, pitch for Vyse. In the BE-76 Duchess, Vxse is also 85 KIAS.

**Vsse-** This is the minimum speed at which an intentional engine cut can be performed. It gives a safety margin from Vmc for safe engine cuts while training. MEI candidates need to know this. It is 71 KIAS in the Duchess.

## Action when an engine fails- **Memorize this!!**

1. **POWER UP-** right to left: mixtures full, props full, throttles full
2. **CLEAN UP-** flaps up, gear up, aux fuel pumps on
3. **IDENTIFY-** Dead foot, Dead engine
4. **VERIFY-** cautiously retard throttle to idle
5. **RECTIFY-** Floor to the door:
   - Fuel selectors- on
   - Cowl flaps- close
   - Carb heat- on
   - Mixtures- rich
   - Aux pumps- on
   - Magnetos- check L,R and Both

   Do this if you have time and altitude. If you don’t, immediately skip to secure.
6. **SECURE-** feather the prop
   Mixture to idle cut-off
   Use the checklist!

# CRITICAL ENGINE

A **critical engine** is the engine which, if lost, will most adversely affect the performance and handling characteristics of the aircraft. The effect of the critical engine is most significant when operating at low airspeeds with a high power setting, thus producing more p-factor and torque.

On conventional twins with the propellers rotating clockwise, the critical engine is the **left engine**.
On aircraft with counter-rotating propellers, such as the Beechcraft Duchess or Piper Seminole, there is no critical engine due to the turning tendencies cancelling each other out.

An engine can also be termed as a critical engine if important systems are operated off that engine. (i.e. landing gear, pressure system, etc.)

There are four factors used in determining a critical engine:

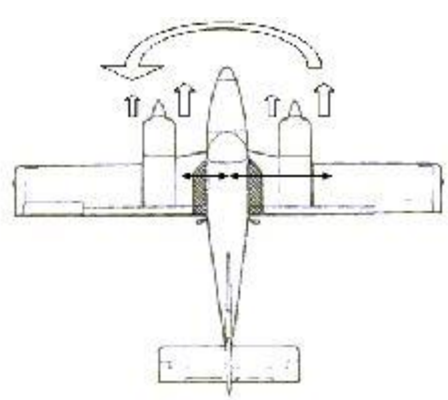
**P-** P-factor

**A-** Accelerated Slipstream

**S-** Spiraling Slipstream

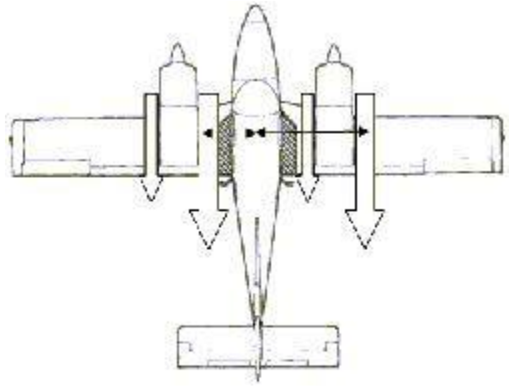
**T-** Torque

***P-factor***- The descending propeller blade is producing more thrust than the ascending blade.



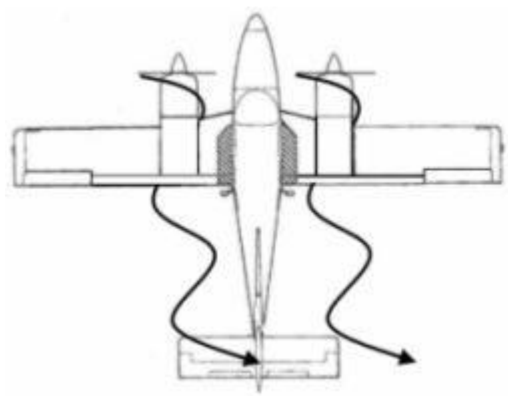
If the left engine fails, the p-factor being produced from the right engine is farther from the longitudinal axis of the aircraft, creating more of a yawing moment.

***Accelerated Slipstream-*** The air being forced over the wing by the operating engine creates extra lift.



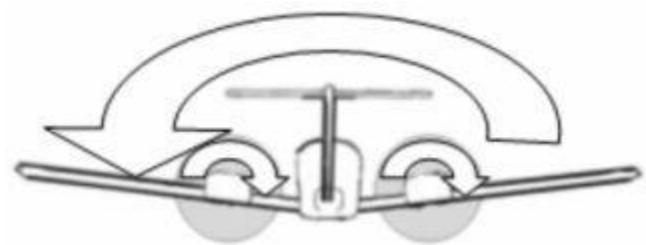
This is basically the equal and opposite reaction of p-factor. If the left engine fails, the effect of the p-factor creates more induced flow farther away from the longintudinal axis of the aircraft creating a rolling moment.

***Spiraling Slipstream-*** The effect of the propeller being pulled through the air while rotating creates a spiraling stream of air behind the propeller.



This spiraling air from the left propeller, due to its direction of spiral, hits the rudder creating more airflow to make the rudder more effective. If the left engine fails, the spiraling slipstream from the right engine spirals away from the rudder.

***Torque-*** This is the opposite reaction to the action of the turning propeller.



Torque tries to roll the airplane opposite of the propeller's direction of rotation. If the left engine fails, torque tries to roll the aircraft to the left, making it more difficult to **raise the dead** engine.

# Vmc- Minimum Controllable Airspeed

FAR 23.149- Vmc is the calibrated airspeed, at which, when the critical engine is suddenly made inoperative it is possible to:

1. Maintain control of the airplane with the engine still inoperative.
2. Maintain straight flight at the same speed with an angle of bank not more than 5 degrees.

As airspeed decreases the rudder becomes less effective, eventually an airspeed will be reached where full rudder deflection will be required to maintain directional control. This airspeed is Vmc. Any further reduction in airspeed will result in loss of directional control. Published Vmc is defined by the red radial on the airspeed indicator. In the BE-76 Duchess published Vmc is 65 KIAS.

**Vmc guarantees directional control only!!**

## How does the manufacturer determine Vmc?

**C-** Critical engine failed and windmilling

**O-** Operating engine at maximum takeoff power

**M-** Maximum gross weight

**B-** Bank of no more than 5 degrees

**A-** Aft center of gravity

**T-** Takeoff configuration (gear up, flaps up)

**S-** Standard temperature (15°C) and pressure (29.92" Hg)

***Critical engine failed and windmilling***- A windmilling propeller creates much more drag than a feathered propeller. If the airplane is equipped with an autofeather system then propeller is feathered.

***Operating engine at maximum takeoff power-*** With the engine at max power this will create more lift and produce more of a yawing tendency about the longitudinal axis, thus increasing Vmc.

***Maximum gross weight-*** While a heavier airplane is more stable, it also requires the wing to produce more lift. This is really more of a standardization requirement for certification.

***Bank of no more than 5°-*** This is also a standardization requirement.

***Aft center of gravity-*** Since an airplane rotates around the CG, an aft CG decreases the distance (arm) between the CG and rudder, which decreases the leverage or effectiveness of the rudder.

***Takeoff configuration-*** This includes flaps in normal takeoff position and landing gear retracted. While gear and flaps down creates drag, it also creates a keel effect which tends to stabilize the aircraft.

***Standard temperature and pressure-*** The published Vmc and red line on the airspeed indicator are based on standard day at sea level. As density altitude increases, the red line becomes less reliable because Vmc decreases with altitude – which brings Vmc closer to stall speed.

Vmc is not a static number. It changes with any combination of the above variables. The red line is the highest speed that Vmc will be, in fact, it will most likely be lower. The object is to keep Vmc as low as possible. For certification, Vmc cannot be greater than 1.2 times stall speed with flaps in takeoff position and gear retracted.

## Recognizing and recovering from Vmc

There are warning signs that Vmc is occurring or about to occur. These include:

**Loss of directional control-** The rudder pedal is depressed to its fullest travel and the airplane is still yawing or rolling toward the inoperative engine.

**Stall warning horn or buffeting of the controls-** A single engine stall is very dangerous and could result in a spin. Light twins are not known for good stall/spin recovery.

**A rapid decay of control effectiveness-** This could lead to the loss of control of the aircraft.

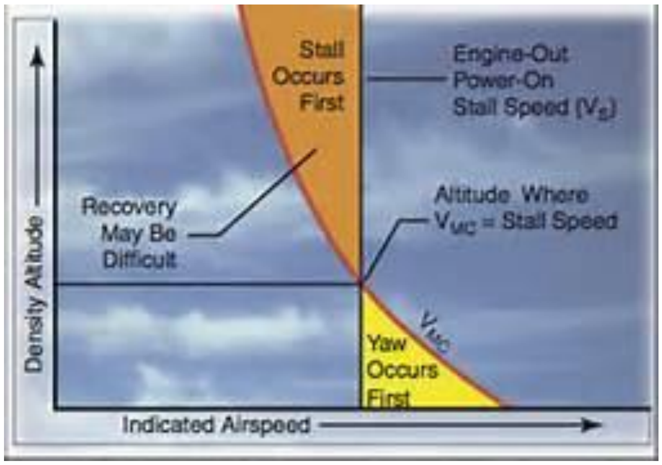
To recover from Vmc, you must simultaneously:

**Reduce power on the operating engine-** Reduce power on the operating engine reduces the asymmetric air flow.

**Pitch down-** Lowering the nose of the aircraft will get the air flowing again over the control surfaces and allow you to regain directional control.

## Vmc vs. Stall

Normally aspirated engines lose efficiency as density altitude increases. Since the operating engine is not producing as much thrust as at sea level, asymmetrical airflow will be reduced, which will lower Vmc. We must remember, though, that stall speed is an indicated airspeed that will remain constant as altitude increases or decreases. Eventually the two speeds will be at the same point.




If both Vmc and stall speed are reached at the same time, a spin is almost inevitable.

## Factors which effect Vmc

Vmc is defined using a very specific set of conditions. Published Vmc and actual Vmc can be two very different numbers. Vmc only addresses directional control and is not related to aircraft performance. While controllability is important, single engine performance is just as important. You must be able to balance both controllability and performance to keep a serious situation from getting out of control. In some cases, an element that provides an increase in controllability can actually hurt performance.

| **Factors:** | **Effect**: (Remember, lower Vmc is better.) |
|---|---|
| Increase power on good engine | Increases Vmc- More yaw and roll |
| Increase temperature | Lowers Vmc- less dense, less power, less yaw |
| Decrease pressure | Lowers Vmc- less dense, less power, less yaw |
| Increase altitude | Lowers Vmc- less dense, less power, less yaw |
| Reducing bank | Increases Vmc- less AOA on rudder=less effectiveness |
| Windmilling propeller | Increases Vmc- more drag=more yaw |
| Feathered propeller | Lowers Vmc- less drag=less yaw |
| Aft CG | Increases Vmc- less distance between rudder & CG |
| Heavier weight | Lowers Vmc- more lift needed in turn=helps prevent turn |
| Flaps down | Lowers Vmc- more drag-creates keel effect |
| Gear down | Lowers Vmc- more drag-creates keel effect |
| Critical engine fails | Increases Vmc- more yaw, more roll |
| In ground effect | Lowers Vmc- less drag= less yaw and roll |

The reverse of any above factors have a reverse on the effect.

## Single Engine Performance and Airspeeds

## V-Speeds (KIAS)

| | | |
|---|---|---|
| Vr | Rotation Speed | 71 |
| Vx | Best Angle of Climb | 71 |
| Vy | Best Rate of Climb | 85 |
| Vxse | Best Angle 1 Engine | 85 |
| Vyse | Best Rate 1 Engine | 85 |
| Vso | Stall w/ Flaps down | 60 |
| Vs1 | Stall w/ Flaps up | 70 |
| Vmc | Min Control 1 Engine | 65 |
| Va | Maneuvering (3000lbs.) | 116 |
| Va | Maneuvering (Max Gross) | 132 |
| Vno | Max Structural Cruise | 154 |
| Vne | Never Exceed | 194 |
| Vsse | 1 Engine Intentional | 71 |
| Vlr | Max Gear Retraction | 112 |
| Vle/Vlo | Max Gear Speeds | 140 |
| Vfe | Flap Extension (20°) | 120 |
| Vfe | Flap Extension (Full) | 110 |
| Best Glide | 3000lbs. | 82 |
| Best Glide | Max Gross | 95 |
| X-wind | Max Demonstrated | 25 |

## Zero Fuel Weight

Zero fuel weight is the maximum weight of passengers and baggage less the fuel weight that the airplane can withstand before structural damage occurs. Zero fuel weight for the Duchess is 3,500 lbs.

## Maximum Certificated Weights

| | |
|---|---|
| Maximum Ramp Weight | 3916 lbs. |
| Maximum Takeoff Weight | 3900 lbs. |
| Maximum Landing Weight | 3900 lbs. |
| Maximum Zero Fuel Weight | 3500 lbs. |
| Max Weight in Baggage Compartment | 200 lbs. |
| Maximum Useful Load | 1470 lbs. |

## Basic Single Engine Procedures

**#1 Cardinal Rule – Maintain control and airspeed at all times**
Apply max power to operating engine
Reduce drag to an absolute minimum
Secure failed engine and related sub-systems

## Takeoff Briefing

Always have a plan for takeoff. This the most critical time for a multi engine airplane. It's a good habit to have a standard takeoff briefing before each takeoff. An example of this is:

"I have a planned takeoff roll of ______ feet. If we lose an engine before rotation, I will pull both throttles to idle and apply maximum brakes to bring us to a stop on the runway. If we lose an engine after rotation with the gear down, I will pull throttles to idle and land straight ahead. If we lose an engine after rotation with the gear up, I will continue the takeoff, climb to a safe altitude, secure the engine and return for landing. If we are unable to climb, I will pull throttles to idle and land straight ahead."

# Performance Charts

**Know your performance!!** Your CFI will cover the performance charts with you, but it's good to have a basic understanding of several of them before you start your flight training. Refer to the BE-76 Duchess POH for these charts.

## Accelerate-Stop Distance

Accelerate-Stop distance is the distance required to accelerate to liftoff speed (71) and, assuming failure of an engine at the instant liftoff speed is attained, bringing throttles to idle and stopping the airplane.

## Accelerate-Go Distance

Accelerate-Go distance is the distance required to accelerate to liftoff speed (71) and, assuming failure of an engine at the instant liftoff speed is attained, continuing the takeoff and climbing to 50'. Know before you try to takeoff whether you can maintain control and climbout if you lose an engine with the gear still down!

## Takeoff Weight To Achieve A Positive Single Engine Rate Of Climb at Liftoff

This chart is for exactly what the title implies. Plug in your weight from the weight & balance to determine if you will be able to climb at liftoff, period. If you can't, then you are committed to pulling throttles to idle and stopping the airplane. Accelerate-Go would be impossible in this case.

**Remember**, These charts were printed in 1980 when the airplanes were new. Always assume that your airplane will not live up to the performance stated in the charts. Always plan for worst case scenario and always give yourself an out. Always fly under the assumption "what if".

# Beech Duchess Systems and Limitations

**Engines**

Two direct drive, horizontally opposed, normally aspirated, 4 cylinder engines by Avco Lycoming. The left engine is an O-360 (rotating clockwise). The right engine is an LO-360 (rotating counter-clockwise). Both engines are rated for 180 horsepower at 2700 RPM. Since the engines rotate in opposite directions, components are not interchangeable. The engines use a wet-sump pressure type oil system with a maximum of 8 qts. and a minimum of 5 qts.

**Propellers**

Two Hartzell, 76 inch diameter, constant speed, full feathering, 2-bladed propellers. Springs and dome air pressure, aided by counterweights move the blades to high pitch (feathered) position. Propeller RPM is controlled by the engine driven propeller governor which regulates oil pressure in the hub. The propeller controls in the cockpit allow the pilot to select the governor's RPM range. Springs and dome air pressure, aided by counterweights, move the blades to the high pitch, low RPM position. Engine oil under governor-boosted oil pressure moves the blades to the low pitch, high RPM position.

The blades have centrifugal lock pins that retract into the blade bases. When the propeller is rotating faster than 700-800 RPM, these pins will remain in the blade bases and allow the propeller to move into the feather position. Below 700-800 RPM, the pins will spring out preventing the blades from feathering. This is why the blades don't feather on engine shutdown on the ground.

**Unfeathering Accumulators**

Unfeathering accumulators store oil from the engine to use for forcing the propellers out of the feather position. The important thing to remember is that these are a one-shot deal. They build pressure by means of the engine oil pumps. If they are used and the blades don't come out of feather, they can't be used again until the engine has been restarted. You will have to use the starter to try to restart the engine in the air. Both of St. Charles Flying Service's aircraft are equipped with unfeathering accumulators.

**Fuel**

The Duchess is approved to use 100 (green) and 100LL (blue) aviation gasoline only. The fuel system uses an "ON-CROSSFEED-OFF" selector arrangement located on the lower center floor panel. Total fuel capacity is 51.5 gallons per wing tank with 50 gallons useable per side. Each tank has a visual measuring tab with markings for 30 (28.5 useable) and 40 (38.5 useable) and full at tank top.

There are two engine-driven and two electrically-driven auxiliary fuel pumps. The electric pumps are used for engine start, takeoff, landing, and fuel selector changes. Each tank feeds its respective engine.

Fuel cannot be transferred from tank to tank; however, either tank may feed both engines in crossfeed mode. The fuel crossfeed system is to be used during emergency conditions in level flight only.

A minimum of 9 gallons of fuel must be in each tank prior to flight. This is noted by the yellow arc on the fuel gauges.

| | |
|---|---|
| Total capacity | 103 gallons |
| Total useable | 100 gallons |

There are a total of 8 fuel sumps: 4 per side. 1 sump for each tank, 1 sump for each engine strainer, 2 for each crossfeed line.

**Pressure System**
Two engine-driven, dry pressure pumps supply air pressure to drive the attitude and directional gyro instruments, and autopilot (if installed). The pumps are interconnected to form a single system. Check valves will automatically close if either pump fails to ensure continued operation.

**Flaps**
Wing flaps are operated by an electric motor located under the right rear passenger seat and connected via torque tubes which operate worm gears to extend or retract the flaps. They are operated by a three position switch located to the right of the throttle quadrant with an UP, DOWN, and OFF position. The switch must be pulled out of the detent to raise or lower the flaps. There is an indicator gauge with UP, 10, 20, and DOWN (35). It takes 3 seconds to lower from UP to 10, 1 second from 10 to 20, and 1 second from 20 to DOWN (35).

**Landing Gear**
The Duchess is equipped with a retractable landing gear that is hydraulically actuated in a tricycle configuration. Hydraulic pressure is provided by an electrically-driven, reversible hydraulic pump. There are two circuit breakers: one for the pump and one for the control circuit. The gear is held in the up position by a hydraulic pressure of 1250-1550 psi. It remains in the down and locked position using an over-center brace and springs. The hydraulic pump is equipped with a time delay that will disengage it after 30 seconds of continuous operation.

The aircraft is equipped with a gear warning horn that will activate under the following conditions:

1. Gear is not in the down and locked position when throttles are reduced below a setting to sustain flight.
2. Gear is not in the down and locked position with flaps extended below 16°.
3. Gear handle is in the up position on the ground.

Gear retraction on the ground is prevented by a pressure safety switch located in the pitot system to deactivate the pump circuit when airspeed is below 59-63 KIAS. (Gear warning systems are no replacement for proper checklist usage and should not be relied upon to prevent an inadvertent gear up.) The gear system is equipped with a hydraulic bypass valve located beneath the floor panel in front of the pilot. By turning the valve counter-clockwise 90°, hydraulic pressure will release and allow the gear to free fall to the down and locked position. This can only be done with an airspeed below 100 KIAS and the emergency checklist should be used. In the event that hydraulic pressure is lost, the gear will free fall to the down and locked position.

**Stall Warning**
An electric sensing vane is installed on the leading edge of each wing. The left horn can only be triggered when flaps are 0-16°. The right horn can only be triggered when flaps are between 17-35°.

**Pitot-Static**
The pitot tube is located on the left wing. There are two static ports - one on each side of the aft fuselage. There is an alternate static located on the left lower side of the cabin. The pitot tube is also equipped with a pitot heat system.

**Brakes**
There are hydraulically actuated disc brakes on the main landing gear. The brake hydraulic system is separate from the landing gear hydraulic system. The brake reservoir is located on the left side of the nose compartment.

**Electrical System**

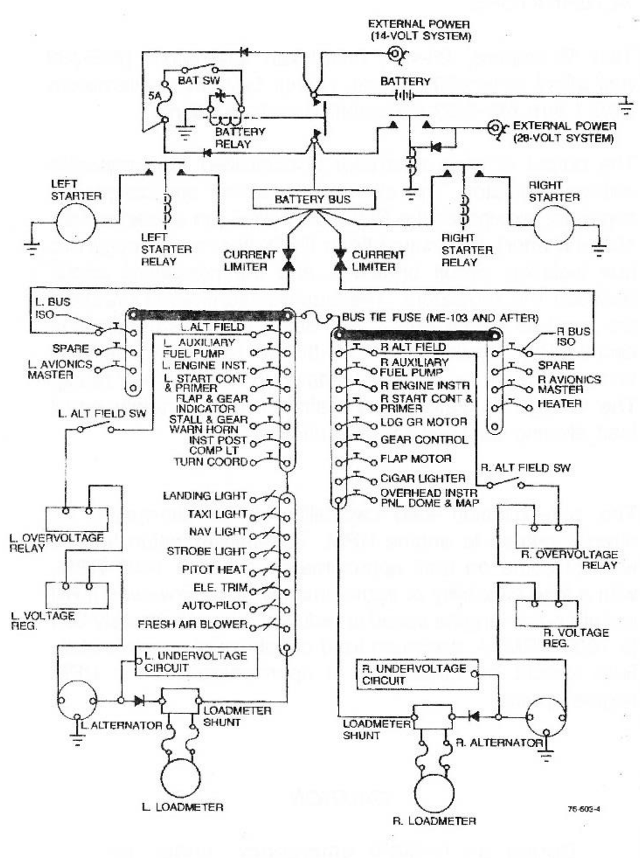
The Duchess is equipped with a 28 volt electrical system using push-pull type circuit breakers. The aircraft is equipped with two 12 volt, 25 amp lead acid batteries, connected in series to create 24 volts. Two 28 volt, 55 amp, belt driven alternators are installed on the aircraft. The output of each alternator is controlled by a separate voltage regulator. The alternator systems are completely separate, except for the bus tie fuse, the mutual tie to the battery bus through two bus isolation breakers. The aircraft uses a split bus system with each alternator powering its respective bus. The battery is used for engine start and emergency power.

The airplane is equipped with loadmeters instead of ammeters. Loadmeters show the percentage of the electrical load that is being carried by the respective alternator. It is important to make sure that each alternator isn't carrying more than 40% of the load at low RPM and not carrying more than 80% of the load at full power. If a loadmeter is registering a zero indication and undervoltage annunciator light is on, that is an indication that the respective alternator has failed. If one alternator fails, the remaining alternator should be able to provide adequate electrical power.

**Environmental Systems**

The Duchess is equipped with a 45,000 BTU Janitrol gas heater located on the right side in the nose compartment. This provides heated air for cabin warming and windshield defrosting. Fuel consumption for the heater is approximately 2/3 of a gallon per hour taken from the right fuel tank. This fuel must be taken into consideration during flight planning. The heater has an over-temp switch that automatically deactivates the heater upon reaching an internal temperature of 300°F. The over-temp switch cannot be reset in flight and must be reset after examination by a certified mechanic on the ground.

**Know your systems!!**




POWER DISTRIBUTION SCHEMATIC

# BE-76 Normal Procedures

## Normal Approach and Landing

Downwind:

1) Power to 18” MP, 2300 RPM- 120KIAS
2) Prelanding Check
   (GUMPFS)
   Gas – selectors, pumps, pressure
   Undercarriage – gear down, 3 green
   Mixtures – full rich
   Props – on final
   Flaps – 10°
   Seatbelts & switches – on

Abeam:

1) Throttles – 15” MP
2) Flaps – 10° (if not already)
3) Airspeed – 90 KIAS

Base:

1) Second GUMPFS check
2) Flaps – 20°
3) Airspeed – 85 KIAS (blueline on base)

Final:

1) Final GUMPFS check
2) Props – full forward
3) Flaps – 35° (with runway made)
4) Airspeed – 80 KIAS, 76 on short final

## Single Engine Approach and Landing

Downwind:

1) Power – 22”-24”, 2500 RPM – 120 KIAS
2) Prelanding check – GUMPFS

Abeam:

1) Throttle – 15” MP
2) Flaps – 10° (If not already)
3) Airspeed – 95 KIAS

Base:

1) Second GUMPFS check
2) Flaps – 20°
3) Airspeed – 90 KIAS

Final:

1) Final GUMPFS check
2) Props – full forward
3) Flaps – 35° (If needed)
4) Airspeed – 85 KIAS, 80 on short final

## Go Around Procedures (Normal)

1) Power up (mixture, props, throttles)
2) Flaps – retract
3) Pitch for Vy (85 KIAS)
4) Positive rate – Gear up

## Single Engine Go Around

1) Power up (mixture, prop, throttle)
2) Flaps – retract
3) Positive rate – Gear up
4) Pitch for Vyse (85 KIAS)

NOTE: In the BE-76, after full flaps are selected on a single engine approach, Go around is no longer an option. You are committed to land!

## Instrument Approach Procedures

**Normal:**

1) Landing checklist complete prior to FAF
2) When established – 18” MP, 2300 RPM, – 110 KIAS
3) FAF inbound – 10° flaps, 14”- 17” MP, gear down- 100 KIAS
4) 18” MP to level off at MDA

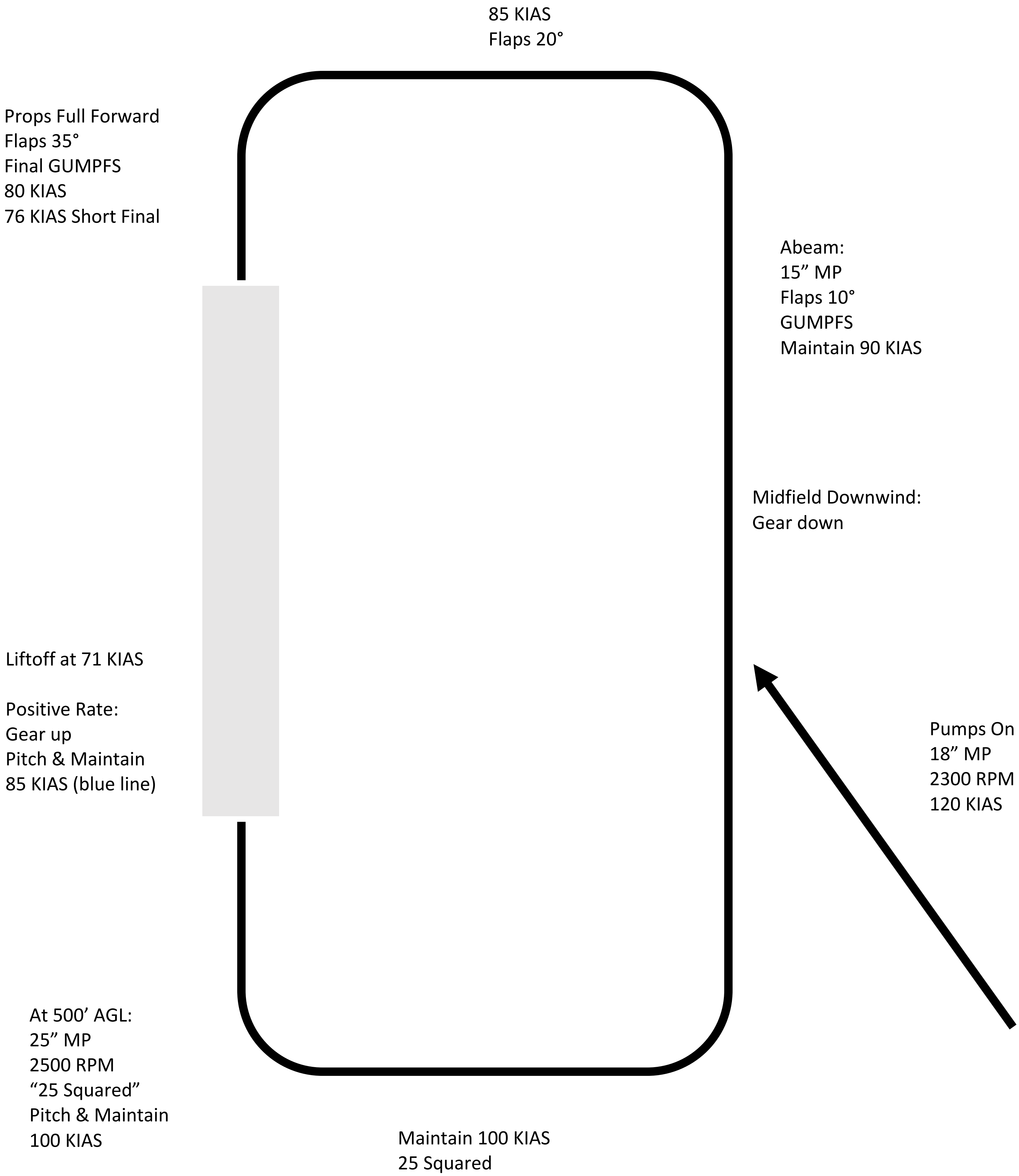
**Single Engine:**

1) Landing checklist complete prior to FAF
2) When established – 22”- 24” MP, 2500 RPM
3) FAF inbound – Flaps stay up!, 13”- 15” MP, gear down – 100KIAS
4) 24” MP to level off at MDA

NOTE: After breaking out and landing is assured, final GUMPFS check for props. Do not introduce flaps until landing is assured!!

NOTE: If circling to land, gear stays down unless you can’t hold altitude.

# BE-76 Normal Traffic Pattern



# BE-76 Maneuvers

All maneuvers will start with a pre-maneuver flow. The basic idea of this flow is configure the airplane for the maneuver, mainly to get slow enough to be able move the propeller controls to full forward. It would be to the applicant's benefit to practice this flow and become very proficient with it. Also, note that all maneuvers will start from slow cruise (20" MP, 2300 RPM). Furthermore, maneuvers can be classified as "clean" (gear up, flaps up) or "dirty" (gear down, flaps down). "Clean" maneuvers are Power-on (departure) stall, accelerated stall, Vmc demo, drag demo (MEI only), and steep turns. "Dirty" maneuvers are slow flight and power-off (approach) stall.

**Pre-maneuver Flow – "Clean Maneuvers"**

1. Clearing turns complete
2. Throttles – 15" MP
3. Aux pumps – On
4. Fuel selectors – On
5. Cowl flaps – Open
6. Carb heat – Off
7. Mixtures – Rich
8. When at 100 KIAS – Props forward

**Power-on (departure) stall**

1. Pre-maneuver flow complete
2. Airspeed – slow to 85 KIAS
3. Throttles – 20" MP
4. Pitch – 20° nose up
5. Recover at first indication
   a. Pitch – reduce
   b. Throttles – full forward
   c. Airspeed – 85 KIAS
6. Power – Cruise (20", 2300 RPM)

**Steep Turns**

1. Pre-maneuver flow complete
2. Throttles – 20" MP
3. Airspeed – 120 KIAS
4. Bank – 50°
5. Maintain altitude +/- 100'
6. Rollout – +/- 10° heading
7. Roll directly into opposite turn.
8. When complete – Power back to cruise

**Accelerated Stall**

1. Pre-maneuver flow complete
2. Airspeed – 85 KIAS
3. Bank – 45°
4. Add back pressure to induce stall indication
5. Recover at first indication, simultaneously:
   a. Bank – level wings
   b. Pitch – level
   c. Throttles – full forward
   d. Airspeed – at least 85 KIAS
6. Power – Cruise (20", 2300 RPM)

**Vmc Demonstration**

1. Pre-maneuver flow complete
2. Airspeed – 85 KIAS
3. Props – full forward
4. Throttle – one to full, one to idle
5. Pitch – to lose 1 knot/second
6. Recover at loss of directional control
   a. Throttle – idle
   b. Pitch – reduce
   c. Regain control & airspeed
   d. Throttle – full on good engine
   e. Airspeed – Maintain 85 KIAS
7. Warm up "dead" engine – 15"/2000 RPM

**Drag Demonstration (MEI Only)**

1. Pre-maneuver flow complete
2. Throttle – one to idle, one to full
3. Airspeed – 85 KIAS, note VSI
4. Failed engine – simulate feather
5. Airspeed – 85 KIAS, note VSI
6. Flaps – down
7. Airspeed – 85 KIAS, note VSI
8. Gear – down
9. Airspeed – 85 KIAS, note VSI
10. Recover – gear & flaps up incrementally
11. Warm up "dead" engine – 15"/2000 RPM

**Pre-maneuver Flow – "Dirty" Maneuvers**

1. Clearing turns complete
2. Throttles – 15" MP
3. Gear – down, below 140 KIAS
4. Aux pumps – on
5. Fuel selectors – on
6. Cowl flaps – open
7. Carb heat – off
8. Flaps – full down, below 120 KIAS
9. Mixtures – rich
10. When at 100 KIAS – props full forward

**Slow Flight**

1. Pre-maneuver flow complete
2. Airspeed – Maintain 71 KIAS
3. Throttles – As required to maintain altitude
4. Recovery
   a. Throttles – full
   b. Altitude – maintain
   c. Flaps – up
   d. Gear – up
5. Power – cruise (20", 2300 RPM)

**Power-off (Approach) Stall**

1. Pre-maneuver flow complete
2. Throttles – idle
3. Pitch – slowly raise
4. Recover at first indication
   a. Throttles – full
   b. Pitch – lower
   c. Flaps – up
   d. Pitch – for 85 KIAS
   e. Gear – at positive rate- up
   f. Level off
5. Power – cruise (20", 2300 RPM)

**Emergency Descent**

1. Throttles – idle
2. Props – full forward
3. Bank – 30°
4. Pitch – lower
5. Gear – down
6. Airspeed – 135 KIAS
7. Recovery
   a. Bank – level wings
   b. Pitch – slight climb
   c. Gear – below 112 KIAS- up
8. Power – cruise (20", 2300 RPM)

**Engine failure on Takeoff Roll**

1. Throttles – idle
2. Brakes – maximum braking
3. Maintain directional control

**Engine Failure at Low Altitude**

1. **Pitch** for 85 KIAS
2. **Power up** – mixtures, props, throttles full
3. **Clean up** – gear up, flaps up, pumps on
4. **Identify** – "Dead foot, Dead engine
5. **Verify** – cautiously retard to idle
6. **Secure** – feather prop.
7. **Airspeed** – Maintain 85 KIAS or greater
8. Return for landing

Some maneuvers will require a simulated engine failure. After you have run through the procedure, you will have to simulate the engine being feathered. This is called zero thrust.

**Zero Thrust**

1. Throttle on failed engine set to 10" MP
2. Prop lever on failed engine set to feather detent.

# Oral Exam Guide

## Vmc
A thorough knowledge of Vmc is probably the most important subject on the oral exam.

1. Be able to define Vmc.
2. How does the manufacturer determine Vmc speed?
3. What happens to Vmc if the aircraft is loaded aft of the CG limit?

## How is Vmc Determined?
**COMBATS**

Critical engine failed and windmilling
Operating engine at max t/o power
Max gross weight
Bank up to 5° into the good engine
Aft CG
Takeoff configuration
Standard day, 29.92" Hg, 15°C

Know the factors that affect Vmc

**Lowers Vmc (good)**
Add power to the critical engine
Reduce drag
Reduce power on the good engine
Forward CG
Gear down
Lower pressure
Higher altitude
Higher temperature

**Increases Vmc (bad)**
Reducing bank
Higher pressure
Lower temperature
Lower altitude

How will these affect your performance?

## Critical Engine
Be able to define critical engine.
How is it determined?
Why do some airplanes have a critical engine and some don't?
Does the Duchess have a critical engine?

## Performance Charts
Know your performance!!

1. Takeoff distance
2. Accelerate-stop distance
3. Accelerate-go distance
4. Takeoff weight to achieve single engine climb
5. Climb performance: 2 engine, 1 engine
6. Cruise chart: TAS, fuel flow, range
7. Single engine service ceiling
8. Landing distance: flaps up, flaps down

## Weight and Balance
Complete your weight & balance!
Be able to use the charts and graphs in the POH.
Explain zero fuel weight.

## Aircraft Systems
Know your systems!
Fuel system
Landing gear
Electrical system
Constant speed, full feathering props
Heater system
Pressure system

## Airspeeds
Red line
Blue line
Vy, Vx, Vyse, Vxse, Vmc, Va, Vlo, Vle, Vso, Vs1, Vsse, Vno, Vne