# PA-44-180 Seminole
# 2000+ Manufacture Year

# Multi-Engine Study Guide

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The Thrust Flight Study Guide is for reference only and is intended only to supplement, not replace, manufacturer and FAA publications such as the pilots operating handbook. All pilots must operate the aircraft in accordance with the Pilot's Operating Handbook and abide by Federal Aviation Regulations.

# Section 1: Engine-out Aerodynamics

## Turning Tendencies

The turning tendencies that affect a single engine aircraft (p-factor, torque, spiraling slipstream, gyroscopic precession) will also affect a multi-engine aircraft. Because a multi-engine aircraft has two engines many of these turning tendencies increase.

A twin engine aircraft where both engines are rotating the same direction is called a conventional twin. To combat p-factor and torque, aircraft with counter-rotating propellers have been developed (the PA44 Seminole has counter-rotating propellers). The p-factor and torque from counter-rotating propellers cancel each other out which results in less rudder needed to oppose their turning tendencies.

## 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 the aircraft is operating at low airspeed with a high power setting (thus more p-factor and torque).

On a conventional twin, with clockwise rotating propellers, the critical engine is the left engine. On a counter-rotating propeller aircraft such as the Seminole, there is no critical engine. This is because the turning tendencies of each engine are symmetric about the longitudinal axis of the airplane.

## How Do We Determine Our Critical Engine?

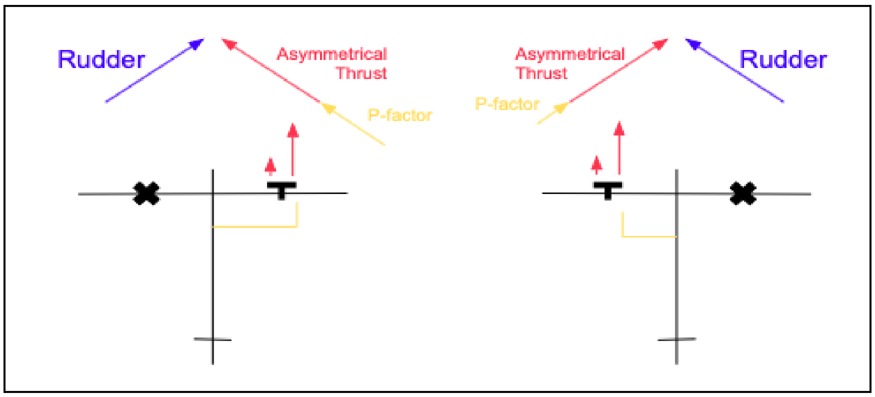
There are four factors which determine if an engine is critical.

1. P-factor
2. Accelerated slip stream
3. Spiralling slip stream
4. Torque

We can compare each factor in two different scenarios: left engine inoperative v.s right engine inoperative.

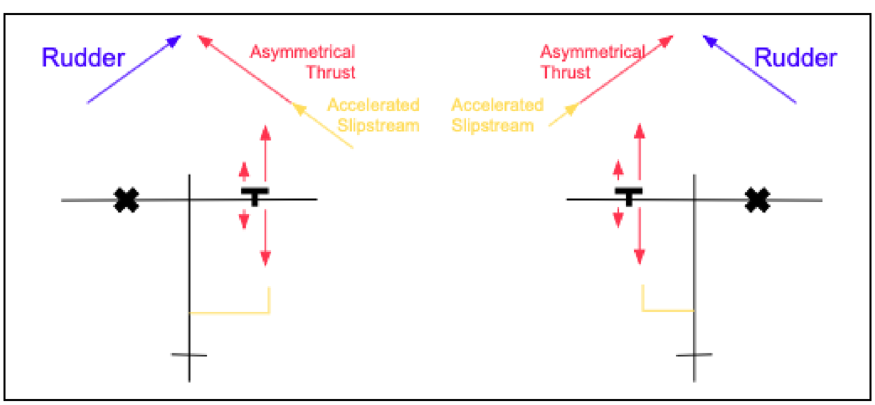
## P-Factor (YAW)

Given an airplane's positive angle of attack, its descending propeller blade(s) will have a greater angle of attack than its ascending blade(s). This will generate more thrust on the right side of the propeller. In turn, the center of thrust will be shifted to the right of the propeller. When we compare the moment/arm in both scenarios, the distance from the center of thrust when the left engine is inoperative, is longer than if the right engine is inoperative. A greater moment/arm, results in more force acting on the aircraft. In short, with the left engine inoperative, the right engine will generate more of a yawing force.



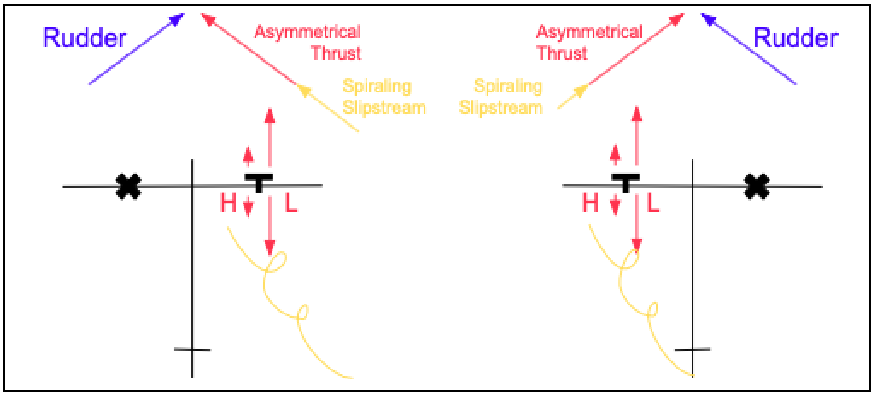

## Accelerated Slipstream (ROLL)

In light twin aircraft, engines are mounted on the wings. The propellers push air backwards and over the wings which generates extra lift. Resulting from the principle of P-Factor, the descending blade of the propeller is also pushing more air backwards. Greater airflow generated from the right side of the propeller, passes over the wings and produces greater lift with a bias to the right side. When measuring the moment/arm from the center of lift on each wing to the longitudinal axis of the plane, it is apparent that the right wing has greater leverage to generate a rolling action.



## Spiraling Slipstream (YAW)

Per the *accelerated slipstream principle*, air is pushed back at a faster speed on the right side of a propeller. Per the *Bernoulli Principle*, faster moving air has a relatively lower pressure compared to slower moving air. Given that air will flow from high to low pressure, the slip streams of a conventional multi engine aircraft will drift rearwards and towards the right. With a left engine inoperative, the air spiraling from the right engine will trail off without interaction with the plane. In the opposite scenario, the air spiraling from the left engine passes over the vertical stabilizer. This provides more airflow to the rudder, providing more authority to counteract other yawing tendencies.

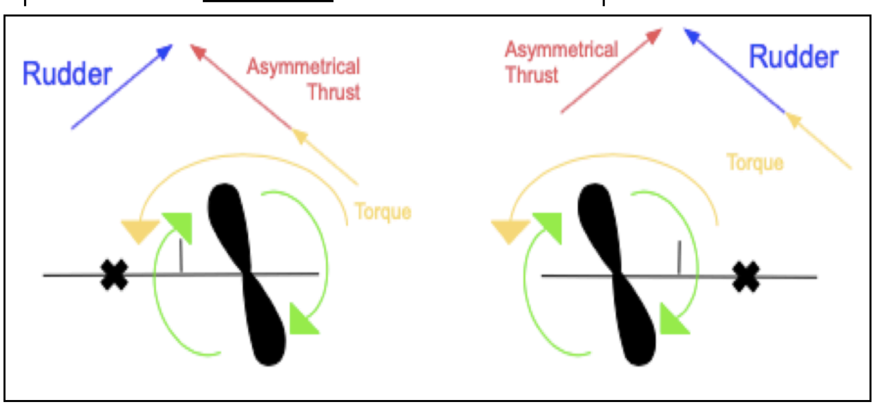



## Torque (ROLL)

*Newton's Third Law*: for every action, there is an equal and opposite reaction. Clockwise (right) rotating propellers result in a counterclockwise torque (left).

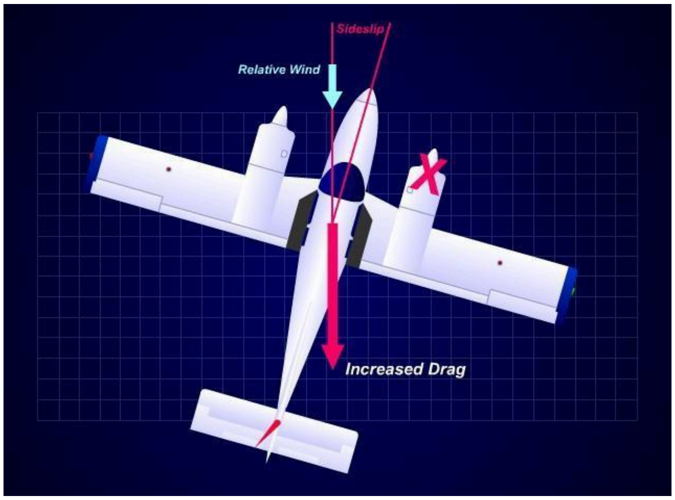
When a right engine is inoperative, the left engine's asymmetrical thrust acts <u>rightward</u>, while its torque acts <u>leftwards</u>. These forces counteract each other.

When a left engine is inoperative, the right engine's asymmetrical thrust acts <u>leftward</u>, while its torque also acts <u>leftwards</u>. These forces compile on each other.



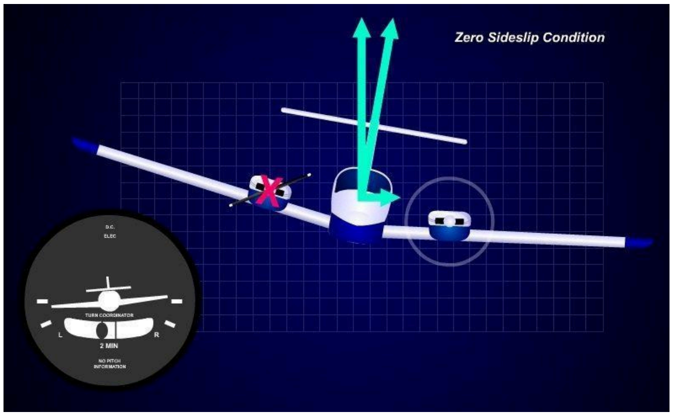

To counteract these P.A.S.T factors rudder pressure must be applied to the side of the operational engine. Hence the practice of "dead foot = dead engine".

## Zero Sideslip Conditions




The solution to maintaining aircraft heading and reducing drag is to improve performance using the *Zero Sideslip* technique. When the aircraft is banked into the operating engine (2-5 degrees of bank), the dihedral of the wing will create a horizontal component of lift. The horizontal component of lift minimizes rudder deflection required to align the longitudinal axis of the aircraft to the relative wind. In addition to banking into the operating engine, the appropriate amount of rudder required is indicated by the inclinometer ball being "split" towards the operating engine's side. The zero sideslip condition must be flown for optimum aircraft performance.

## Climb Performance And Service Ceiling




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 the climb. When an engine is lost, maximize thrust (full power) and minimize drag (flaps and gear up, feather prop, etc) in order to achieve optimum single engine climb performance.

Drag Factors:

- Full Flaps ~ 400 fpm approx
- Windmilling Prop ~ 400 fpm approx
- Gear Extended ~150 fpm approx

Single-Engine Service Ceiling - the highest altitude at which the airplane can maintain a steady rate of climb of 50 fpm with one engine operating at full power and one engine's propeller feathered.

Single-Engine Absolute Ceiling - the altitude where climb is no longer possible with one engine operating at full power and one engine's propeller is feathered.

## $V_{MC}$ - Minimum Controllable Airspeed

Rudder is applied to counteract yaw and roll from an inoperative engine in a multi-engine aircraft. As airspeed decreases the rudder becomes less effective, eventually an airspeed will be reached where full rudder deflection is required to maintain directional control. At this point, any further airspeed reduction will result in a loss of directional control. This airspeed is Vmc, the airspeed at which it is still possible to maintain directional control with an engine inoperative. This is the point where the force created by the operating engine combined with the drag from the failed engine is more than the force created by the deflected rudder, resulting in a loss of directional control.

### §23.149 Minimum Control Speed

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.*

*The method used to simulate a critical engine failure must represent the most critical aircraft configuration and situation with respect to controllability.Vmc must not exceed 1.2 Vs1 at maximum takeoff weight.*

*Vmc must be determined with:*

1. *Most unfavorable weight (not necessarily gross weight).*
2. *Most unfavorable center of gravity position.*
3. *The airplane airborne and the ground effect negligible.*
4. *Maximum available takeoff power on Operative Engine.*
5. *The airplane trimmed for takeoff.*
6. *Flaps in the takeoff position.*
7. *Landing gear retracted.*
8. *All propeller controls in the recommended takeoff position.*
9. *Critical Engine Inoperative and Windmilling.*

# C.U.S.T.O.M.F.A.M

| EFFECT ON | PERFORMANCE | VMC |
|---|---|---|
| Critical Engine Inoperative And Windmilling | Decreases:<br>A windmilling propeller creates more drag than a feathered propeller. | Increases:<br>The drag caused by the windmilling propeller increases yawing the yawing force. |
| Up To 5 degrees Of Bank And Zero Sideslip | Increases:<br>Aligns the longitudinal axis with the relative wind. | Decreases:<br>Raising the dead engine reduces the rolling force from the operating side. |
| Standard Day At SLP | Increases:<br>Relatively more performance | Increases:<br>More performance more PAST |
| Trim Set For Takeoff | N/A | N/A |
| Out of Ground Effect | Decreases:<br>Increased induced drag. | Increases:<br>More power required, more PAST. |
| Max Power On Operating Engine | Increases:<br>Most available power from full throttle. | Increases:<br>More power, more PAST. |
| Flaps Set For Takeoff And Gear Up | Increases:<br>Flaps and gear would create drag. | Increases:<br>Flaps resist yawing force, gear resists roll and yaw effects ( Keel Effect). |
| AFT CG | Increases:<br>Less back pressure to maintain straight and level. | Increases:<br>Moment/arm from rudder shortens reducing force applied. |
| Most Unfavorable Weight (Lightest) | Increases:<br>Same power available, less weight. | Increases:<br>Less weight = easier for PAST factors to move. |

## Recognizing And Recovering From $V_{MC}$

There are four warning signs that Vmc is occurring or about to occur:

1. Loss of directional control - the rudder pedal is depressed to its fullest travel and the airplane is still turning towards the inoperative engine.
2. Stall warning horn - a single engine stall may be just as dangerous as running out of rudder authority and could even result in a spin.
3. Buffeting before the stall - same reason as the stall warning horn.
4. A rapid decay of control effectiveness - any loss of control effectiveness could result in a loss of control of the aircraft.

To recover from Vmc, these two actions must occur simultaneously:

1. Reduce power on the operating engine - this will reduce the asymmetrical thrust causing the Vmc in the first place (remember, reducing power all the way to idle may help stop the Vmc, but the loss of airspeed and power can lead to a stall).
2. Pitch down - lowering the nose of the airplane will increase the forward airspeed making the rudder more effective in regaining and maintaining directional control.

*When recovering from Vmc:*

1. *The rudder pedal force required to maintain control must not exceed 150 pounds.*
2. *It must not be necessary to reduce power of the operative engine(s).*
3. *The airplane must not assume any dangerous attitude.*
4. *It must be possible to prevent a heading change of more than 20 degrees.*

## Factors Affecting $V_{MC}$ And Single Engine Performance

Vmc is defined using a very specific set of conditions, thus published Vmc and actual Vmc can be two very different numbers. Remember, Vmc only addresses directional control and is not related to aircraft performance. While controllability is important, the degradation of performance in a single engine situation also has serious consequences. A variety of factors affect both controllability and performance with one engine inoperative, such as aircraft configuration, flight conditions, and pilot action. In some cases, an element which provides an increase in controllability (translating into a decrease in Vmc) may actually hinder performance. Refer to the chart on the next page to review how certain factors affect both Vmc and performance.

## Accelerate Stop And Accelerate Go Distances

Accelerate-stop distance - Total distance from full power, accelerate to VR, experience an engine failure, abort takeoff and bring your aircraft to a complete stop.

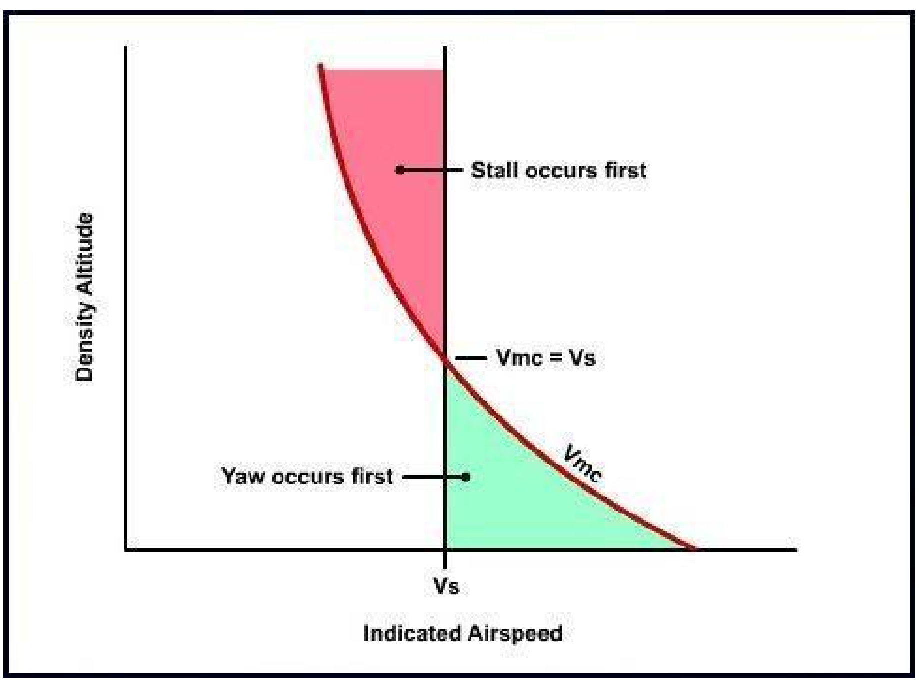
Accelerate-go distance - Total distance from full power, accelerate to VR, experience an engine failure,and continue the takeoff and climb to 50 feet.

## Density Altitude And Its Relationship To Stall Speed

As density altitude increases, Vmc speed will decrease because as density altitude increases engine power will decrease.

less engine power at higher density altitude
=
less asymmetric thrust
=
less yaw towards dead engine
=
lower Vmc

Stall speed is an indicated airspeed which will remain constant as altitude increases or decreases.



# Section 2: Aircraft Systems and Limitations

*This study guide is only to supplement the aircraft POH, not to replace it. Refer to aircraft POH for official operating limitations and systems information. It is the pilot's responsibility to be familiar with all information in the Pilot's Operating Handbook*

## V - Speeds (KIAS)

| | | |
|---|---|---|
| $V_R$ | Rotation Speed | 75 |
| $V_X$ | Best Angle of Climb | 82 |
| $V_{XSE}$ | Best Angle 1 Engine | 82 |
| $V_Y$ | Best Rate of Climb | 88 |
| $V_{YSE}$ | Best Rate 1 Engine | 88 |
| $V_{SSE}$ | Single Engine Intentional Safe Speed | 82 |
| $V_{SO}$ | Stall Speed Landing Configuration | 55 |
| $V_{S1}$ | Stall Speed Clean Configuration | 57 |
| $V_{MC}$ | Minimum Control Speed | 56 |
| $V_A$ | Maneuvering Speed (Max Gross) | 135 |
| $V_A$ | Maneuvering Speed (2700lbs) | 115 |
| $V_{NO}$ | Max Structural Cruising Speed | 169 |
| $V_{NE}$ | Never Exceed Speed | 202 |
| $V_{LR}$ | Max Gear Retraction Speed | 109 |
| $V_{LE}/V_{LO}$ | Max Gear Extending and Extended Speed | 140 |
| $V_{FE}$ | Flap Extension Speed | 111 |
| X-Wind | Max Demonstrated Crosswind | 17 |

## Maximum Certificated And Standard Aircraft Weights

| | |
|---|---|
| Maximum Ramp Weight | 3816lbs |
| Maximum Take-off Weight | 3800lbs |
| Maximum Landing Weight | 3800lbs |
| Maximum Weight in Baggage Compartment | 200lbs |

## Center Of Gravity

Forward Limits: 84 in aft of datum at 2800 lbs, then straight line variation to 89 in aft of datum at a weight of 3800 lbs.
Aft Limit: 93 in aft of datum at all weights

## Maneuvers

This is a normal category airplane. Aerobatic maneuvers, including spins, are prohibited. Avoid abrupt maneuvers.

## Load Factors (3800 lbs)

Positive maneuvering load factors:

| | |
|---|---|
| Flaps Up | 3.8G |
| Flaps Down | 2.0G |

## Kinds of Operation

| | |
|---|---|
| Minimum Flight Crew | 1 Pilot |

VFR day and night

IFR day and night

FAR part 91 operations when all pertinent limitations and performance considerations are complied with

Warning: Flight into known icing conditions prohibited.

## Engines

Two Lycoming Engines are installed; one IO-360-B1G6 (clockwise rotating) located on the left wing and one LIO-360-B1G6 (counterclockwise rotating) located on the right wing. The engines are four-cylinder, direct drive, horizontally opposed, fuel injected and each rated at 180 horsepower at 2700 rpm. The engines use a wet sump pressure type oil system with a maximum of 8 qts and a minimum of 2 qts.

Cowl flaps are controlled by levers inside the cockpit; they allow the amount of engine cooling air to be controlled to maintain a desired cylinder head temperature. Engine ignition is provided through a dual engine driven magneto system which is independent of the electric system (if electrical power is lost, engine will continue to run).

Each engine is equipped with a fuel pressure gauge, oil pressure, oil temperature, cylinder head temperature, manifold pressure, rpm, and exhaust gas temperature.

| | |
|---|---|
| Take-off and Maximum Continuous Power | Full Throttle, 2700 rpm |
| Maximum Oil Temp | 245 F |
| Maximum Cylinder Head Temp | 500 F |
| Minimum Oil Pressure (idle) | 25 psi |
| Maximum Oil Pressure | 115 psi |
| Minimum Fuel Pressure | 0.5 psi |
| Maximum Fuel Pressure | 8.0 psi |

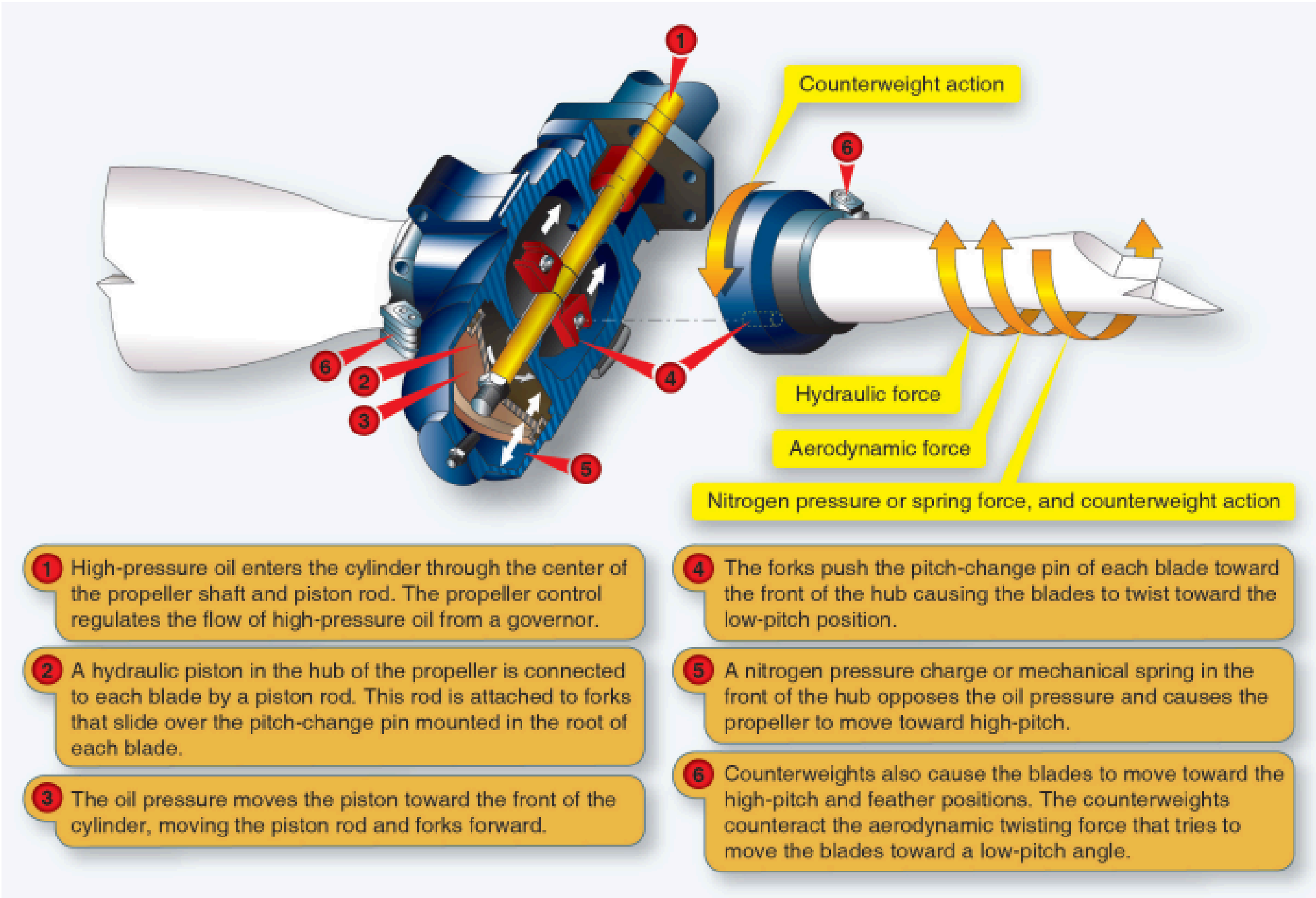
## Propellers

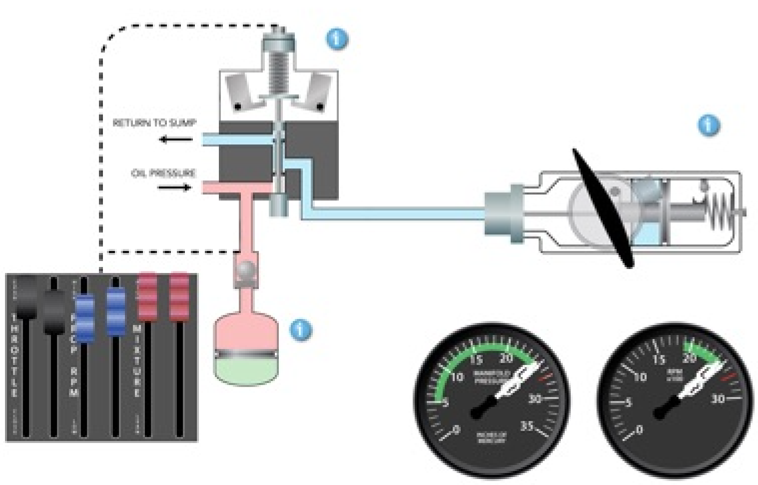
The airplane is equipped with two Hartzel, constant-speed, full feathering, two-blade scimitar propellers. Springs and nitrogen pressure, aided by counterweights, move the blades to the high angle of attack (feathered) position. Propeller rpm is controlled by the engine-driven propeller governor which regulates oil pressure in the hub. The propeller controls, on the control console, allow the pilot to select the governor's rpm range. Engine oil under governor-boosted pressure moves the blades to the high rpm position.

| Prop Lever Forward | Prop Lever Backwards |
|---|---|
| Oil Flows into the Hub | Oil Flows out of the Hub |
| Propeller Angle of Attack Decreases | Propeller Angle of Attack Increases |
| Propeller RPM Increases | Propeller RPM Decreases |

### Constant Speed

Is the ability to vary propeller pitch to maintain a constant engine rpm. When the propeller control is moved forward, positive oil pressure, regulated by a propeller governor, drives a piston, which rotates the blades to a low angle of attack high RPM (unfeathered) position. When the propeller control is moved aft, oil pressure is reduced by the propeller governor. After an rpm is selected, the prop governor will automatically adjust oil pressure inside the propeller hub. This results in a constant propeller rpm regardless of flight attitude or manifold pressure setting.




## Feathering

Is when the propeller blades are in alignment with relative wind. Feathering reduces the amount of drag produced by the propeller windmilling by reducing its exposed area to the relative wind. This is accomplished by moving the propeller control to the full aft (feather) position.

If oil pressure is lost when the engine is operating above 950 rpms (it will be in any phase of normal flight) then the propeller will automatically go into the feather position. A feathering lock, operated by centrifugal force, prevents feathering during engine shut down by making it impossible to feather any time the engine speed falls below 950 RPM. For this reason, when airborne, and the pilot wishes to feather a propeller to save an engine, he must be sure to move the propeller control into the FEATHER position before the engine speed drops below 950 RPM.

## Unfeathering Accumulator

Each propeller system is equipped with an unfeathering accumulator for use when conducting in-air engine shutdown training. The accumulators are fed oil under pressure while the engine is running, and when the propeller level is moved to the feathered position, the oil pressure is stored in the accumulator. When ready to move the propeller out of the feathered position for engine restart, moving the propeller lever to the high RPM setting will release the oil from the accumulator, and the propeller will usually windmill automatically. Starter assist is required if the propeller is not windmilling freely within 5-7 seconds after the propeller lever has been moved full forward. When propeller unfeathering occurs, it may be necessary to retard the prop control slightly so as to not overspeed the prop.

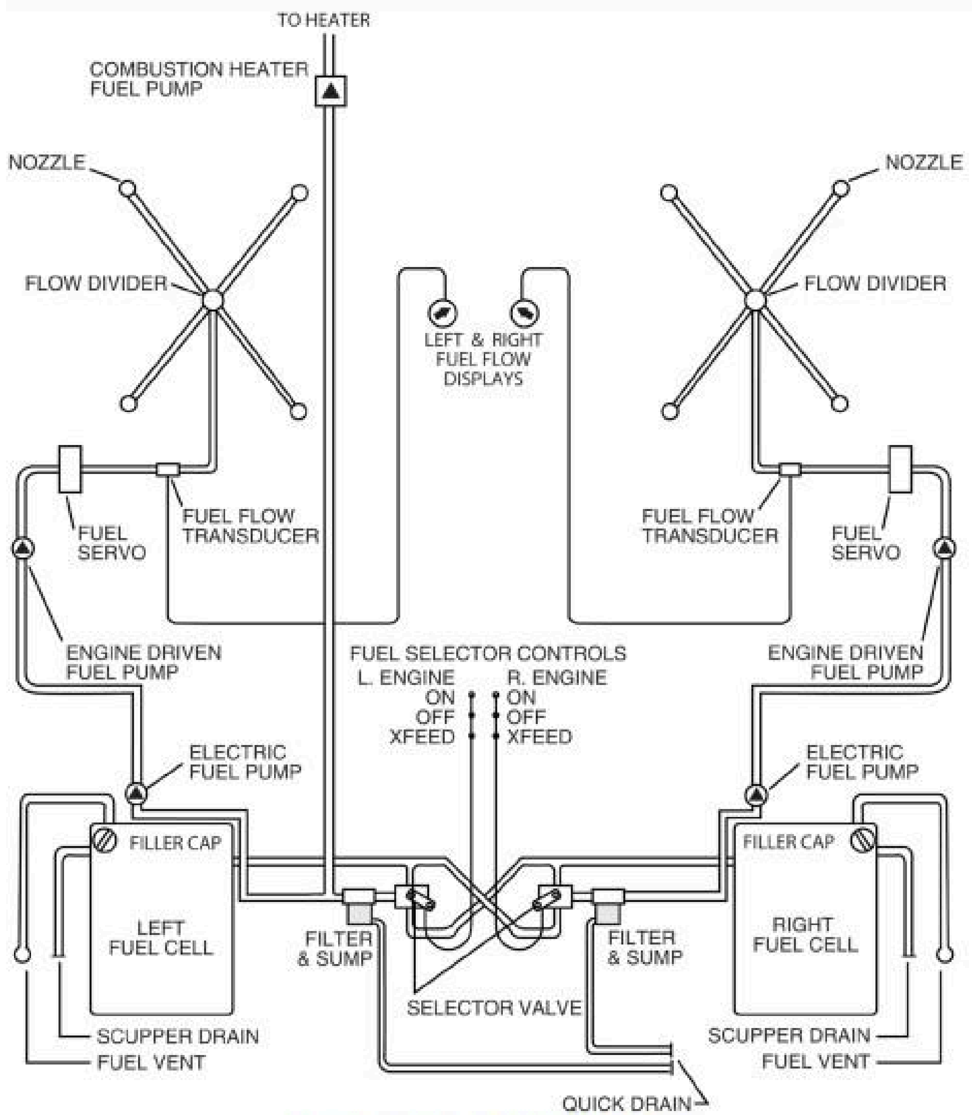
## Fuel

Grade 100 (green) or grade 100LL (blue). The fuel system is an "ON-OFF-CROSSFEED" arrangement and controlled by the fuel selectors located on the lower rear floor panel. Total capacity is 55 gallons per wing tank with 54 gallons is usable in each tank.

There are two engine-driven and two electrically driven auxiliary fuel pumps. The electric fuel pumps are used for engine start, takeoff, landing, and fuel selector changes. The combustion heater utilizes an independent fuel pump, making a total of five fuel pumps. The fuel selector remains in the on position during normal operations, with each tank feeding its respective engine.

Fuel cannot be transferred from tank to tank; however, either tank may feed both engines in crossfeed mode (normally used for emergency engine out if needed.) The cabin heater, located in the nose compartment uses approximately 1/2 gallon per hour from the left fuel system only.

| | |
|---|---|
| Total Capacity | 110 |
| Total Usable | 108 |




## Flight Controls

The control surfaces are bearing supported and operated through the conventional cable assembly using push-rods and bell cranks.

## Trim Controls

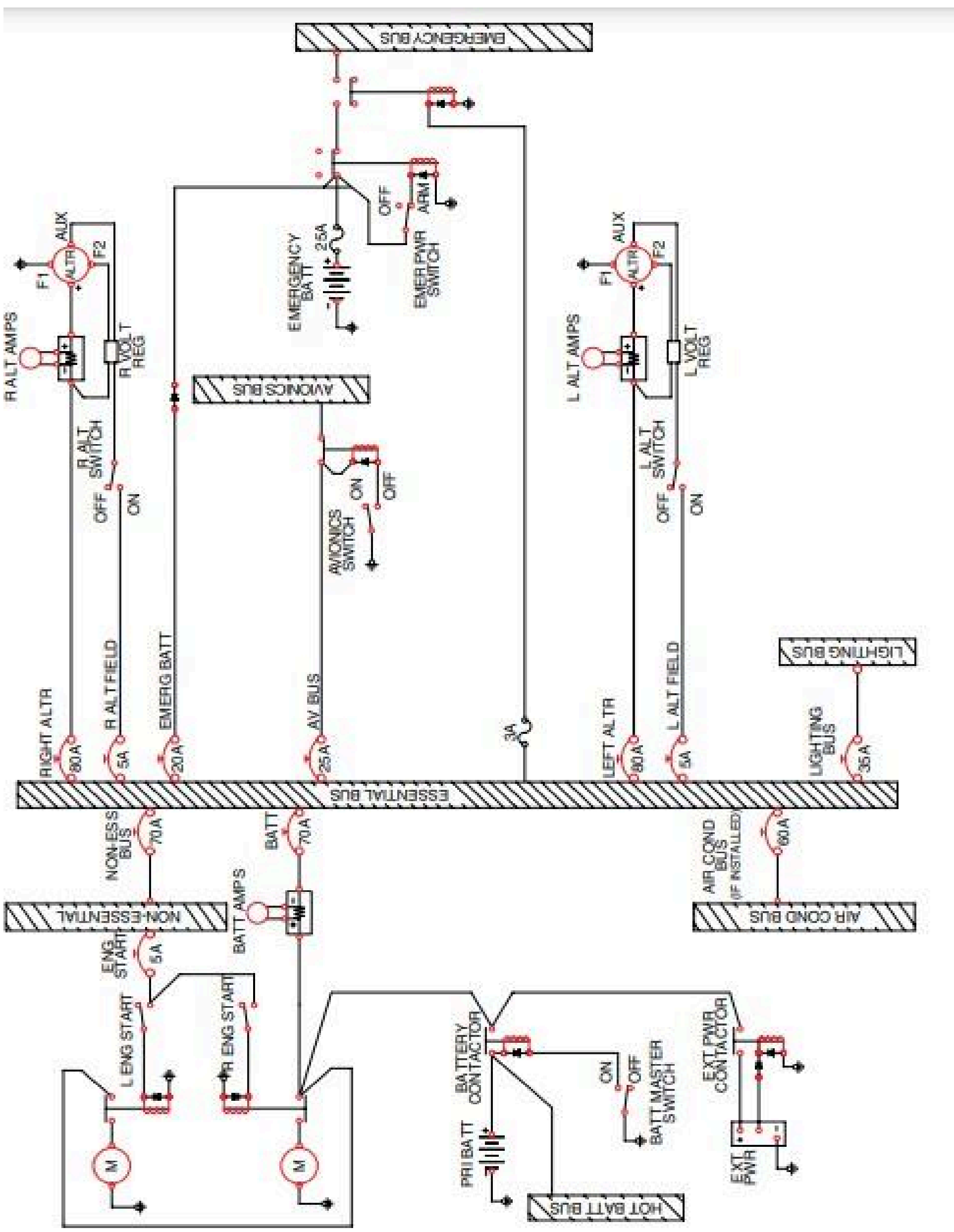
Aircraft trim is accomplished using either the manual or electric pitch trim system. An emergency disconnect button will disengage the trim motor when depressed allowing time to turn off the trim circuit breaker.

## Flaps

Wing flaps are operated by a three position "Johnson Bar." There is no position indicator other than the physical position of the lever. Each "click" of the bar equates to a flap position. When flaps are in the 25 to 40 degree position and the landing gear is up, the landing gear horn will sound.

## Electrical System

The electrical system is capable of supplying sufficient current for complete night IFR equipment. Electrical power is supplied by two 65 ampere alternators, one mounted on each engine. A 13.6 ampere hour, 24-volt battery provides current for starting, for use of electrical equipment when the engines are not running, and for a source of stored electrical power to back up the alternator output. The battery, which is located in the nose section is normally kept charged by the alternators. If it becomes necessary to charge the battery, it should be removed from the airplane. Two solid state voltage regulators maintain effective load sharing while regulating electrical system bus voltage to 28-volts. An overvoltage relay in each alternator circuit prevents damage to electrical and avionics equipment by taking an alternator off the line if its output exceeds 32-volts. If this should occur, the alternator light on the annunciator panel will illuminate.



The electrical system and equipment are protected by circuit breakers located on a circuit breaker panel on the lower right side of the instrument panel. The circuit breaker panel is provided with enough blank spaces to accommodate additional circuit breakers if extra electrical equipment is installed. In the event of equipment malfunctions or a sudden surge of current, a circuit breaker can trip automatically. The pilot can reset the breaker by pressing it in (preferably after a few minutes of cooling period). The circuit breakers can be pulled out manually.

The alternator provides full electrical power output even at low engine rpm. Dual ammeters and the ALT annunciator light provide a means of monitoring the electrical system operation. The two ammeters (load meters) indicate the output of the alternators. Should an ammeter indicate a load much higher than the known consumption of the electrical equipment in use, it should be suspected of a malfunction and turned off. In this event, the remaining alternator's ammeter should show a normal indication after approximately one minute. If both ammeters indicate a load much higher than the known consumption for more than approximately five minutes, an electrical defect other than the alternator system should be suspected because a discharged battery will reduce the alternator load as it approaches the charged conditions. A zero ammeter reading indicates an alternator is not producing current and should be accompanied by illumination of the ALT annunciator light. A single alternator is capable of supporting a continued flight in case of alternator or engine failure in most conditions, however, with deicing equipment and other high loads. Care must be exercised to prevent the loads from exceeding the 65 ampere rating and subsequent depletion of the battery. For abnormal and/or emergency operations and procedures, refer to Section 3 - Emergency Procedures.

## Landing Gear

The aircraft is equipped with hydraulically operated, fully retractable, tricycle landing gear. Hydraulic pressure for gear operation is furnished by an electrically powered, reversible hydraulic pump (refer to Figures 7-9 and 7-11). The pump is activated by a two-position gear selector switch located to the left of the control quadrant on the instrument panel (Figure 7-7). The gear selector switch, which has a wheel-shaped knob, must be pulled out before it is moved to the UP or DOWN position. When hydraulic pressure is exerted in one direction, the gear is retracted; when it is exerted in the other direction, the gear is extended. Gear extension or retraction normally takes six to seven seconds.

CAUTION If the landing gear is in transit, and the hydraulic pump is running, it is NOT advisable to move the gear selector switch to the opposite position before the gear has reached its full travel limit, because a sudden reversal may damage the electric pump.

The landing gear is designed to extend even in the event of hydraulic failure. Since the gear is held in the retracted position by hydraulic pressure, should the hydraulic system fail for any reason, gravity will allow the gear to extend. When the landing gear is retracted, the main wheels retract inboard into the wings and the nose wheel retracts aft into the nose section. Springs assist in gear extension and in locking the gear in the down position. After the gear are down and the down lock hooks engage, springs maintain force on each hook to keep it locked until it is released by hydraulic pressure.

To extend and lock the gears in the event of hydraulic failure, it is necessary only to relieve the hydraulic pressure. An emergency gear extension knob, located directly beneath the gear selector switch is provided for this purpose. Pulling this knob releases the hydraulic pressure holding the gear in the up position and allows the gear to fall free. Before pulling the emergency gear extension knob, consult the gear extension emergency checklist. If this does not resolve the issue, be sure to place the landing gear selector switch in the DOWN position to prevent the pump from trying to raise the gear, and the airspeed is at or below 100 KIAS. If the emergency gear knob has been pulled out to lower the gear by gravity, due to a gear system malfunction, leave the control in its extended position until the airplane has been put on jacks to check the proper function of the landing gear hydraulic and electrical systems. See the Service Manual for proper landing gear system check out procedures.

If the airplane is being used for training purposes or a pilot check out mission, and the emergency gear extension knob has been pulled out, it may be pushed in again when desired if there has not been any apparent malfunction of the landing gear system. When the gear is fully extended or fully retracted and the gear selector is in the corresponding position, an electrical limit switch on each gear stops the flow of current to the motor of the hydraulic pump. The three green lights directly above the landing gear selector switch illuminate to indicate that each of the three landing gears is down and locked. A convex mirror on the left engine nacelle both serves as a taxiing aid and allows the pilot to visually confirm the condition of the nose gear. If the gear is in neither the full up nor the full down position, a red warning light on the instrument panel illuminates. Should the throttle be placed in a low setting - as for a landing approach - while the gear is retracted, a warning horn sounds to alert the pilot that the gear is retracted. The gear warning horn emits a 90 cycles per minute beeping sound.

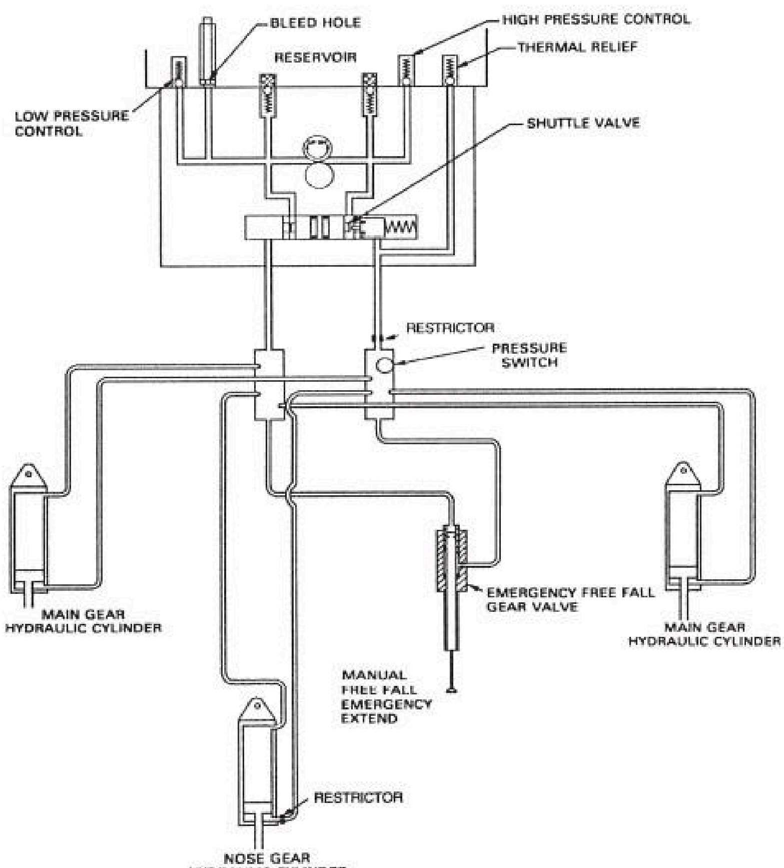
A micro switch incorporated in the throttle quadrant activates the gear warning horn under the following conditions: (a) The gear is not locked down and the manifold pressure has fallen below 14 inches on either one or both engines. (b) The gear selector switch is in the UP position when the airplane is on the ground. (c) The gear selector switch is in the UP position and wing flaps are extended to the second or third notch position. To prevent inadvertent gear retraction should the gear selector be placed in the UP position when the airplane is on the ground, a squat switch located on the left main gear will prevent the hydraulic pump from actuating if the master switch is turned on. On takeoff, when the landing gear oleo strut drops to its full extension, the safety switch closes to complete the circuit which allows the hydraulic pump to be activated to raise the landing gear when the gear selector is moved to the UP position.

**Squat Switch**

**On the Ground**

**Airborne – Strut extends**

During the preflight check, be sure the landing gear selector is in the DOWN position and that the three green gear indicator lights are illuminated. On takeoff, the gear should be retracted before an airspeed of 109 KIAS is exceeded. The landing gear may be lowered at any speed up to 140 KIAS. The hydraulic reservoir for landing gear operation is an integral part of the gear hydraulic pump. Access to the combination pump and reservoir is through a panel in the baggage compartment.

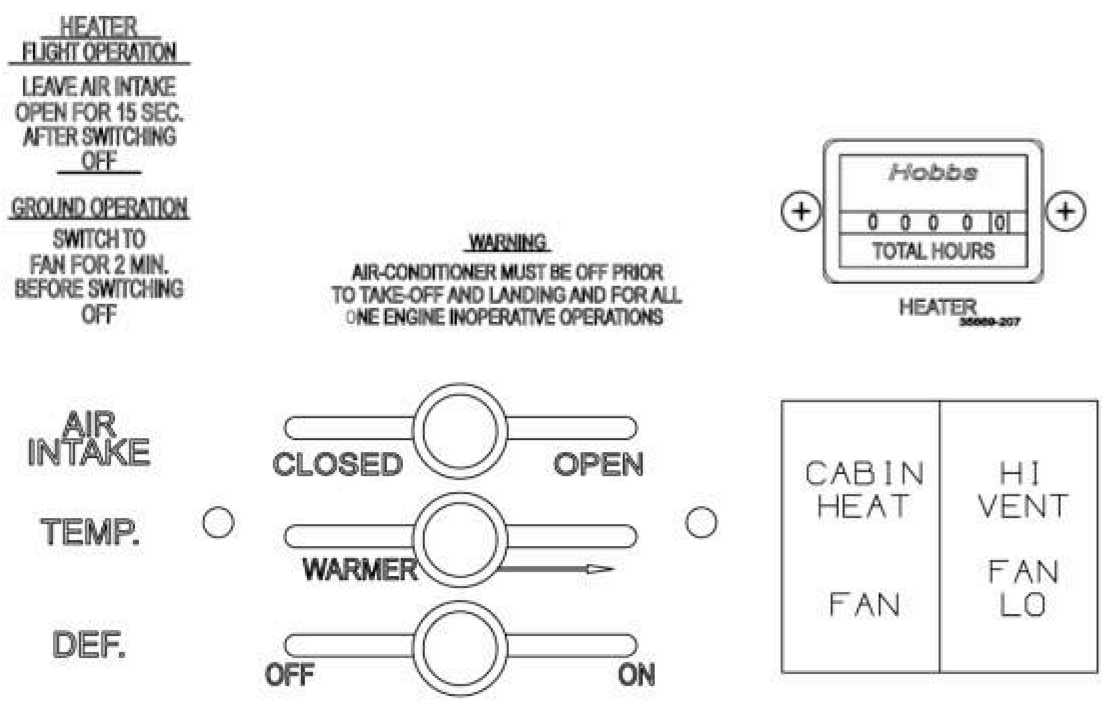


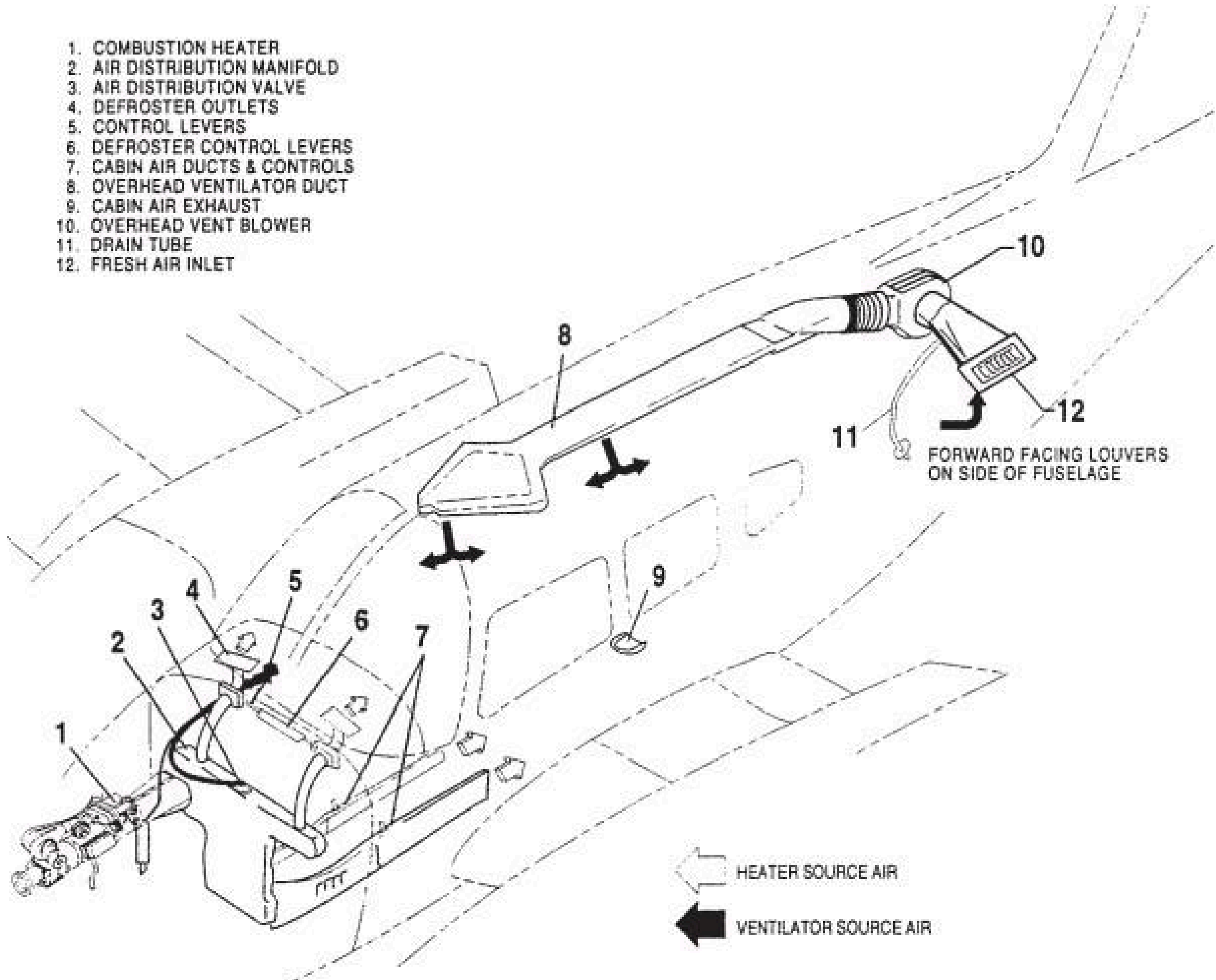
## Environmental

The PA-44 Piper Seminole is equipped with a Janitrol combustion heater located on the right side in the nose compartment. This provides heated air for cabin warming and windshield defrosting. Fuel consumption of the heater is approximately 1/2 gal per hour from the left fuel tank and should be considered during flight planning. If the fuel selector is moved to the OFF position, the Heater will cease operating.

Operation of the combustion heater is controlled by a three-position switch located on the instrument panel (Figure 7-31) and labeled FAN, OFF and HEATER. Airflow and temperature are regulated by the three levers on the instrument panel. The upper lever regulates air intake and the center lever regulates cabin temperature. Cabin comfort can be maintained as desired through various combinations of lever positions. Passengers have secondary control over heat output by individually adjustable outlets at each seat location. The third lever on the instrument panel controls the windshield defrosters. For cabin heat, the air intake lever on the instrument panel must be partially or fully open and the three-position switch set to the HEATER position. This simultaneously starts fuel flow and ignites the heater; and, during ground operation, it also activates the ventilation blower which is an integral part of the combustion heater. With instant starting and no need for priming, heat should be felt within a few seconds. When cabin air reaches the temperature selected on the cabin temperature lever, ignition of the heater cycles automatically to maintain the selected temperature.

Two safety switches activated by the intake valve and located aft of the heater unit prevent both fan and heater operation when the air intake lever is in the closed position. A micro switch, which actuates when the landing gear is retracted, turns off the ventilation blower so that in flight the cabin air is circulated by ram air pressure only.




1. COMBUSTION HEATER
2. AIR DISTRIBUTION MANIFOLD
3. AIR DISTRIBUTION VALVE
4. DEFROSTER OUTLETS
5. CONTROL LEVERS
6. DEFROSTER CONTROL LEVERS
7. CABIN AIR DUCTS & CONTROLS
8. OVERHEAD VENTILATOR DUCT
9. CABIN AIR EXHAUST
10. OVERHEAD VENT BLOWER
11. DRAIN TUBE
12. FRESH AIR INLET
FORWARD FACING LOUVERS ON SIDE OF FUSELAGE
HEATER SOURCE AIR
VENTILATOR SOURCE AIR

## Brakes

The brake system is designed to meet all normal braking needs. Two single-disc, double puck brake assemblies, one on each main gear, are actuated by toe brake pedals mounted on both the pilot's and copilot's rudder pedals. A brake system hydraulic reservoir. independent of the landing gear hydraulic reservoir. is located in the rear top of the nose compartment. Brake fluid should be maintained at the level marked on the reservoir. For further information see "Brake Service" in Section 8 of this Handbook. The parking brake is engaged by depressing the toe brake pedals and pulling out the parking brake knob located on the lower instrument panel adjacent to the throttle quadrant. The parking brake is released by depressing the toe brake pedals and pushing in the parking brake knob.

# Section 3: Emergency Procedure Flows

*These are emergency* ***memory/review items only****, they do not encompass all the emergency procedures listed in the POH. In any emergency or abnormal condition the POH should be consulted.*

## In-Flight Engine Failure

| | | |
|---|---|---|
| 1 | Airspeed | 88 (Blue Line) |
| 2 | Mixtures | Full FWD |
| 3 | Props | Full FWD |
| 4 | Throttles | Full FWD |
| 5 | Flaps | UP |
| 6 | Gear | UP |
| 7 | Identify | Dead Foot |
| 8 | Verify/ Throttle | CLOSE (Slowly) |
| 9 | Troubleshoot *"Fix or Feather"* | If Alt Permits |

After going through the *in-flight engine failure flow,* a decision will be made to try to fix the dead engine or to immediately feather. (i.e. "fix or feather.") If an engine is lost below 2000 ft AGL feather the prop on the dead engine. If an engine is lost above 2000 ft AGL and there is sufficient time/ground clearance, "fix" and troubleshoot the dead engine. The zero sideslip condition should be established. ("raise the dead.") After going through the engine failure memory items always remember to consult the appropriate emergency checklist and declare an emergency.

## Takeoff Emergency Brief

Should be completed before each takeoff

| When Failure Occurs | Procedure |
|---|---|
| On The Runway Before Rotation | Bring Both Throttles to Idle, and Stop |
| After Rotation with the Gear Down | Both Throttles to Idle, and Land on Remaining Runway |
| After Rotation with the Gear UP, Below 2000 AGL | Perform Engine Out Flow, Feather Inop Prop, Return to Land |
| After Rotation with the Gear Up, Above 2000 AGL | Perform Engine Out Flow, Troubleshoot |

NOTE: The most important aspect of engine failure is the necessity to maintain lateral and directional control. If airspeed is at 56 knots, reduce power on operative engine as required to maintain control

NOTE: Per the POH, the Vmc demo and all intentional one engine operations should not be performed at an altitude of less than 4000 feet AGL.