Cessna 402C

Limitations/Systems

Review Guide

Introduction

The system's review guide has been put together to help you better understand the Cessna 402C Aircraft. The information was derived from the Aircraft Flight Manual, Maintenance Manual as well as years of operational experience.

In the event of a discrepancy between this guide and the aforementioned source documents, the Cessna 402 Pilots Operating Handbook will take precedence.

Speeds and Definitions

		C-402C KIAS	C-402C-VG KIAS	Company Rec. Speeds
Vso	Stall Speed (gear and flaps extended)	71 (69 KCAS)	71 (67 KCAS)	
Vs1	Stall Speed (gear and flaps retracted)	80	79	
Vmc	Minimum Control Airspeed (critical engine inoperative)	80	69	
Vsse	Safe Single Engine Speed (minimum speed to intentionally fail an engine)	95	100@ 7210 lbs. 96 @ 6900 lbs. 95 @ 6850 lbs.	
Vx	Best Angle of Climb Speed (two engines)	84	84	
Vy	Best Rate of Climb (two engines)	109	112	
Vxse	Best Angle of Climb (single engine	95	95	
Vyse	Best Rate of Climb (single engine)	104	106	
Va	Maneuvering Speed (gross weight)	150	153	
Vle	Maximum Landing Gear Extend Speed	180	180	160
Vlo	Maximum Landing Gear Operating Speed	180	180	160
Vfe	Flap Extend Speed -15 -45	180 149	180 149	160 140
Vno	Maximum Structural Cruise Speed	205	205	
Vne	Never Exceed Speed	235	235	
	Maximum Landing Light Extension Speed	140	140	
	Maximum Demonstrated Crosswind Component	15	15	
	Best Two Engine Glide Speed	117	121	

LIMITATIONS

Aircraft Weight (Maximum)

	C-402C	C-402C-VG
Maximum Ramp Weight	6885 lbs.	7250 lbs.
Maximum Takeoff Weight	6850 lbs.	7210 lbs
Maximum Landing Weight	6850 lbs.	6850 lbs.
Maximum Zero Fuel Weight	6515 lbs.	6515 lbs. at 151.0 in and 6750 lbs. aft of 151.9 in

Baggage Weights (Maximum)

Avionics Bay	250 lbs. (less installed equip.)
Nose Compartment	350 lbs. (less installed equip.)
Aft Cabin "A" (shelf)	400 lbs. (200 lbs. each side)
Aft Cabin "B" (aft shelf)	100 lbs. (50 lbs. each side)
Wing Lockers	200 lbs. or 120 lbs. short wing locker

Maximum cargo load aft of the front spar is 2000 lbs.
Maximum cargo load in any 22.5 length of the cabin floor 500 lbs.
Maximum allowable combined weight from station 238.1 to the aft bulkhead is 600 lbs.

ENGINE

Maximum Takeoff/Single Engine Power:

- 39" MP and 2700 RPM (325 hp from s.l. to 12,000 ft)

Maximum normal power (a.k.a. Maximum Continuous):

- 39" MP and 2600 RPM (310 hp from s.l. to 16,000 ft)

STARTER

- If cranking longer than 30 seconds is required, allow starter motor to cool for 5 minutes before cranking again.
- Minimum Volts for starting…………………………………..…21 volts

IGNITION

- Maximum mag drop 150 RPM with 50 RPM difference between the two during engine runup.

OIL SYSTEM

Oil

- Oil Capacity…………………….....12 Quarts (13 with the filter)
- Operating range……………..…Not less than 9 quarts. Fill to 10 quarts for normal flights of less than 3 hours.

Pressure

- Minimum oil pressure……………………………..……10 psi
- Normal oil pressure…………………………….……30 to 60 psi
- Maximum oil pressure…………………………..…….100 psi
- Engine start-10 psi minimum in 30 seconds in normal weather, or 60 seconds in cold weather.

Temperature

- Normal operating……………………………….75 F to 240 F
- Maximum operating…………………………………….240 F

Cylinder head temperature

- Normal operating………………………………200 F to 460 F
- Minimum for taxi…………….……………………….……100 F
- Minimum for engine runup…..………………………….150 F
- Minimum for takeoff……………….…………………….200F

VACUUM SYSTEM

- Minimum……………………………………….…4.75" Hg.
- Maximum…………………………………………5.25" Hg.

FUEL

- Minimum for takeoff……………………...20 gallons per side
- Maximum fuel imbalance……………………………..120 lbs
- Maximum side slip duration…………...………….30 seconds
- Total fuel capacity………………………………213.4 Gallons
- Total usable fuel…………………………..…..…..206 Gallons

ELECTRIC WINDSHIELD HEAT

- Do not leave the electric windshield anti-ice switch on for more than 20 seconds on the ground or with the pilots windshield covered with ice.

AUTOPILOT (Refer to FOM for Minimum Altitude for Autopilot use)

1. King KFC-200
   - 220 KIAS
   - 30 Flaps
   - 90 intercept
2. Cessna 400B/400IFCS Autopilots
   - 225 KIAS
   - 15 Flaps
   - 90 intercept for a localizer and 135 intercept for VOR radial
3. S-TEC 55, 55X and 60 Autopilots
   - 220 KIAS
   - 15 Flaps

HEATER OPERATION (Company operating limitation)

- Minimum volts for heater operation…………………….………..…28 volts
- Ground operation
  1. Cabin air control knobs……………...at least one must be fully open
  2. Ram air/Recirculation knob.....................…......Ram air (Pulled out)
  3. Heater fan……………………………….…………………….High.
- Flight operation
  1. Cabin air control knobs ……………...at least one must be fully open

TIRES

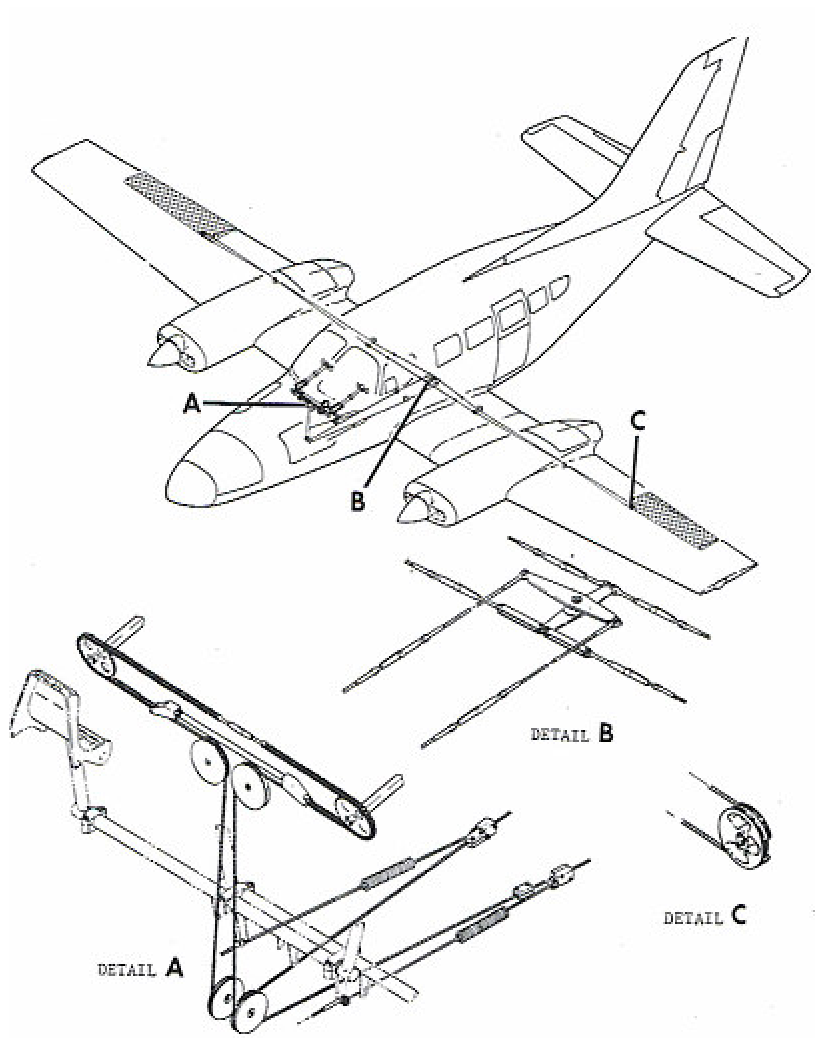
Tire pressure should be maintained at 70 PSI for the main wheel tires and 35 PSI for the nosewheel tire.

Flight Control System

The flight controls consist of the ailerons, elevators and rudder and the respective trim systems. All of these surfaces are constructed of aluminum and are statically mass balanced.

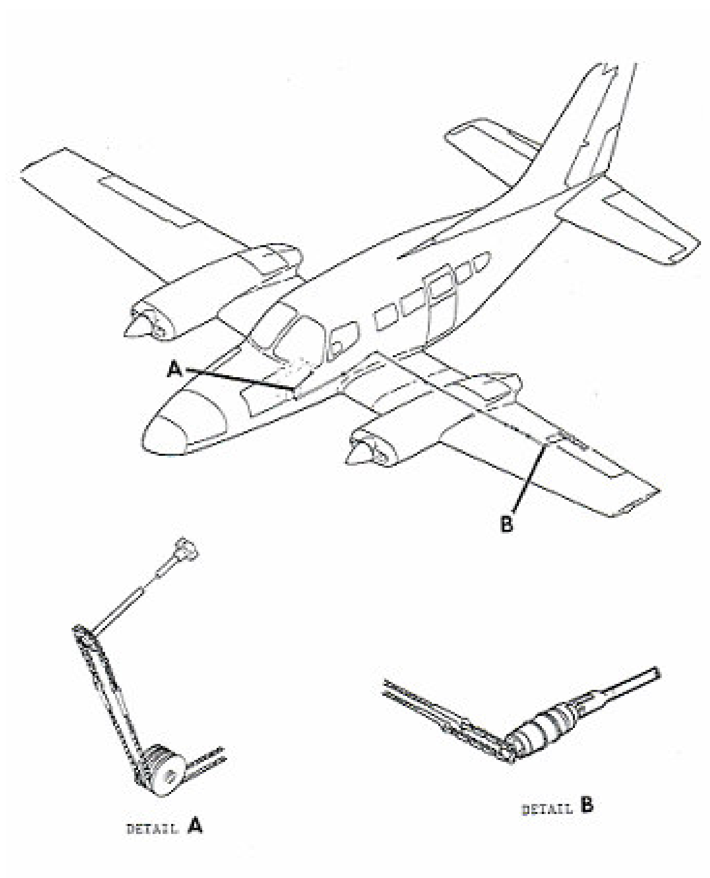
AILERON SYSTEM

Each aileron is attached to the rear main wing spar at two points. The aileron is actuated by a bellcrank which is attached to a wheel in the wing. The wheel is actuated by cables attached to the pilot's control wheel. When rudder is actuated, a spring assembly, interconnected to the aileron system, causes the ailerons to assist the turn.



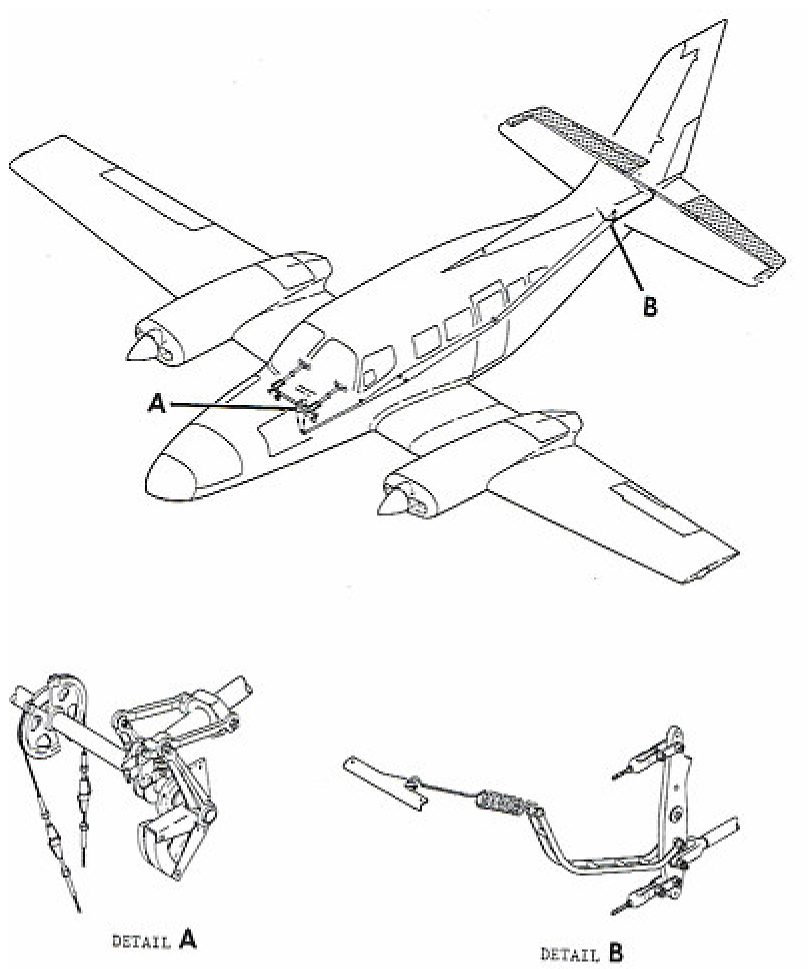
AILERON TRIM SYSYTEM

Aileron trim is achieved by a trim tab attached to the left aileron with a full length piano-type hinge. The trim tab is actuated by a push-pull rod which is attached to a jack screw type actuator in the wing. The actuator is driven by cables attached to the trim control knob on the cockpit control pedestal. The aileron trim tab also acts as a servo tab so that aerodynamic forces on the tab will move the ailerons to the selected position, which reduces the forces required to activate the ailerons in flight.



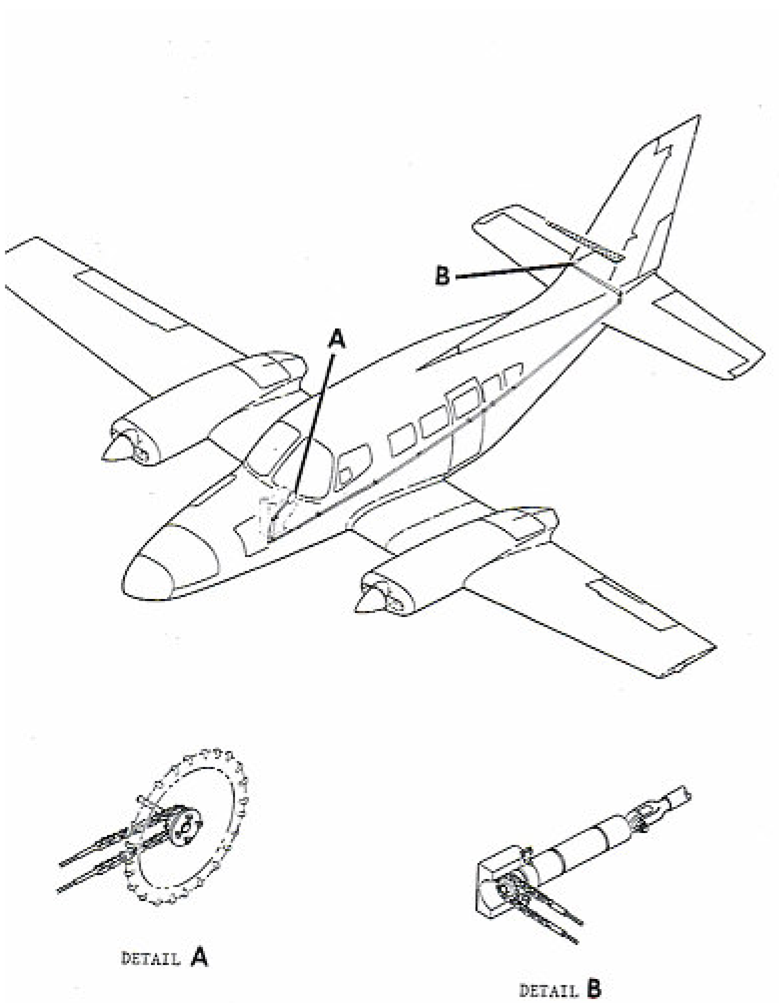
ELEVATOR SYSTEM

The two elevator control surfaces are connected by a torque tube. The resulting elevator assembly is attached to the rear spar of the horizontal stabilizer at six points. The elevator assembly is actuated by a push-pull rod which is attached to a bellcrank in the empennage. The bellcrank is actuated by cables attached to the pilot's control wheel.



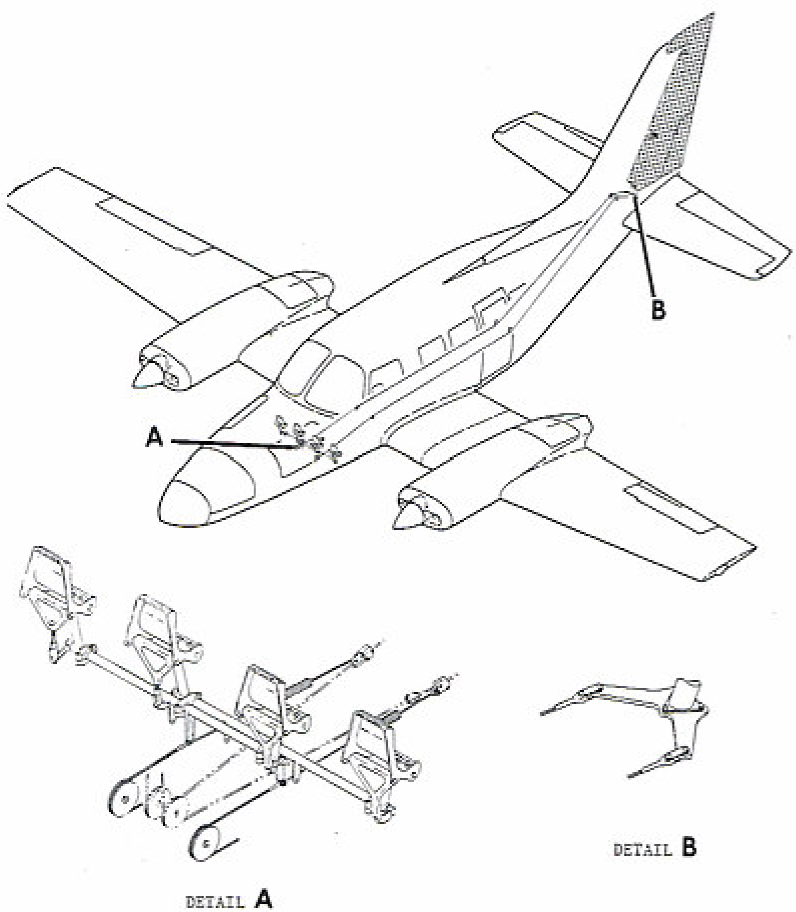
ELEVATOR TRIM SYSTEM

Elevator trim is achieved by an elevator trim tab attached to the right elevator with a full length piano-type hinge. The trim tab is actuated by a push-pull rod which is attached to a jack screw type actuator in the horizontal stabilizer. The actuator is driven by cables attached to the trim control wheel on the cockpit control pedestal.



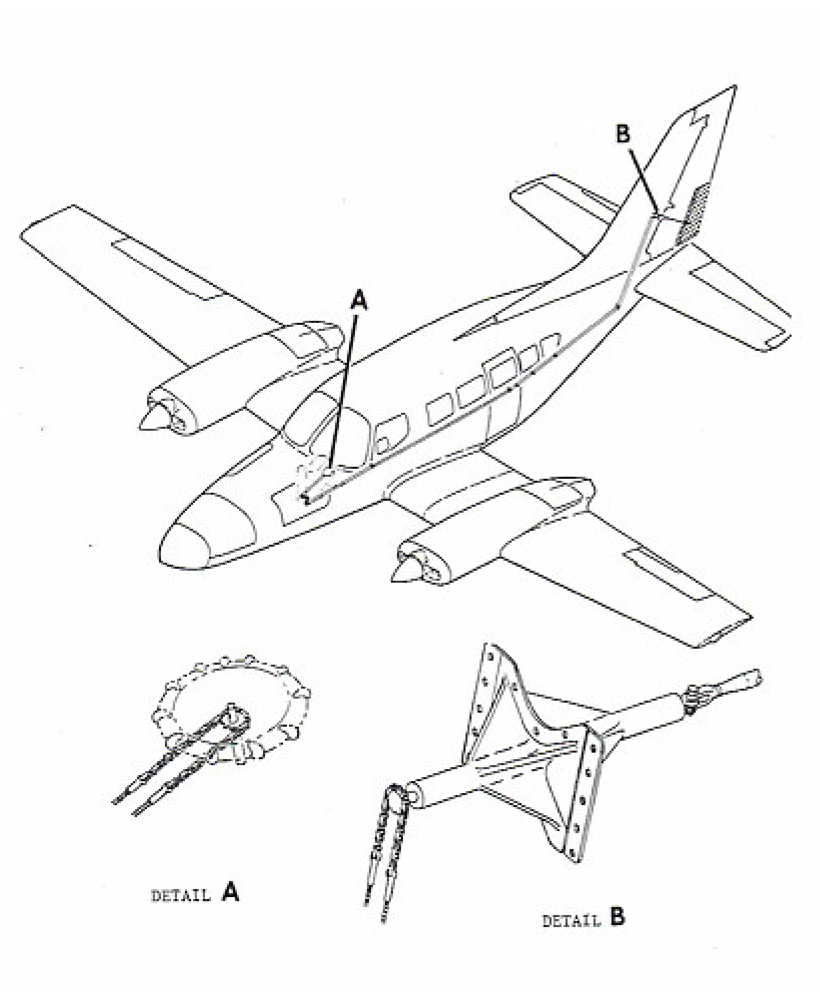
RUDDER SYSTEM

The rudder is attached to the vertical stabilizer rear main spar at three points. The rudder is actuated by a bell crank attached to the bottom of the rudder. The bellcrank is actuated by cables attached to the cockpit rudder pedals. When the rudder is actuated, a cable and spring assembly that is connected to the aileron system causes the ailerons to automatically assist the turn.



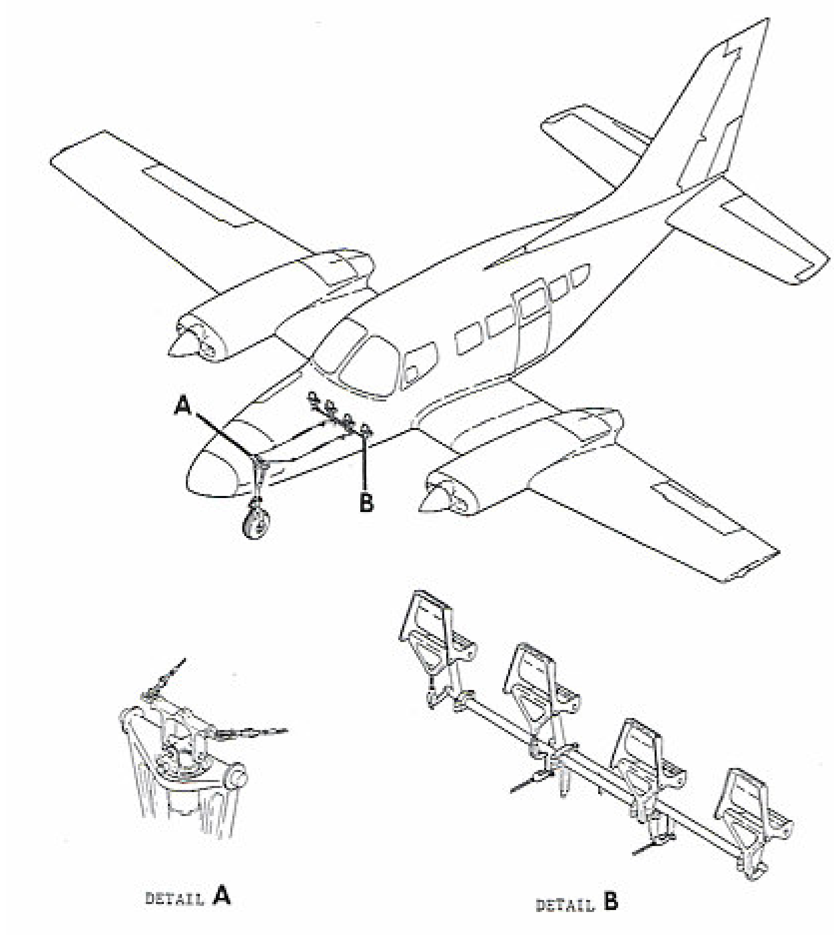
RUDDER TRIM SYSTEM

Rudder trim is achieved by a trim tab attached to the lower half of the rudder with a full length piano-type hinge. The trim tab is actuated by a push-pull rod which is attached to a jack screw type actuator in the vertical stabilizer. The actuator is driven by cables attached to the rudder trim wheel on the cockpit control pedestal. The rudder trim tab also acts as a servo tab so that aerodynamic forces on the tab will move the rudder to the selected position, which reduces the forces required to activate the rudder in flight.



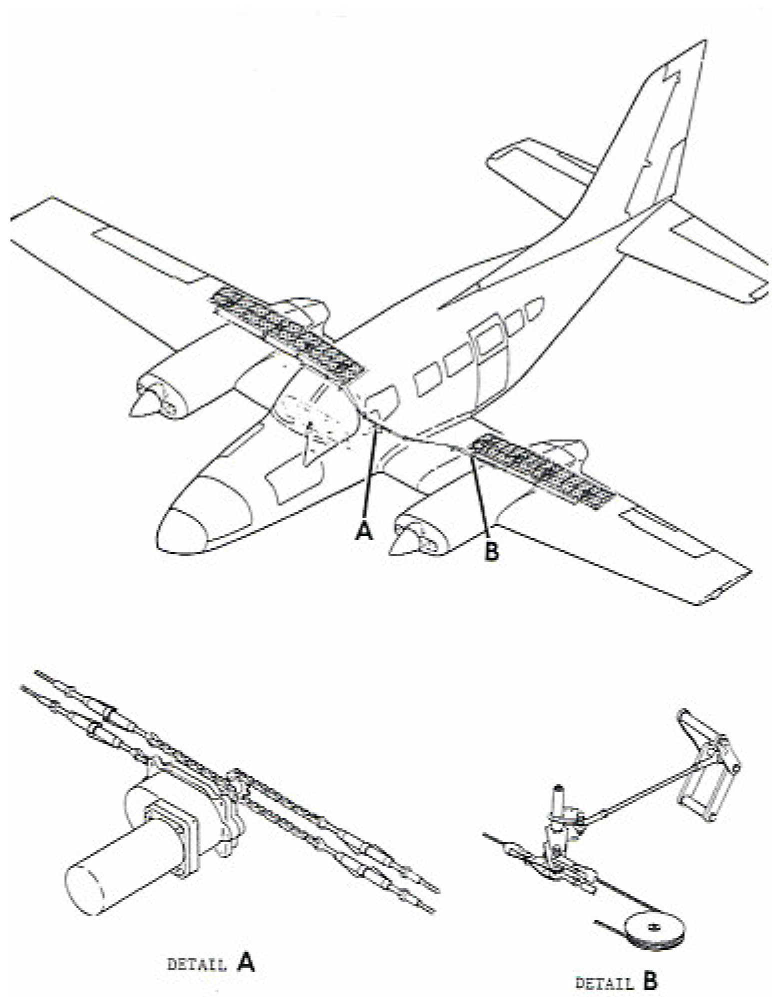
NOSEWHEEL STEERING SYSTEM

The nosewheel steering system consists of the rudder pedals, nose gear, bungee spring assembly and cables. During ground operation, the nose gear automatically engages the nosewheel steering system, allowing normal directional control.



WING FLAPS SYSTEM

The wing flaps are of the split flap design. Each wing flap (two per side) is attached to the rear wing main spar lower surface and is actuated by two push-pull rods attached to bellcranks in the wing. The bellcranks in each wing are ganged together with push-pull rods. Each inboard push-pull rod is attached to a cable which is actuated by an electric motor with reduction gear in the fuselage center section.
The electric flap motor is controlled by the wing flap position switch in the cockpit. This switch incorporates a preselect feature which allows the pilot to select the amount of flap extension desired. When the 0°, 15°, 30° or 45° position is selected, the flap motor is electrically actuated and drives the flaps toward the selected position. As the flaps move, an intermediate cable feeds position information back to the preselect assembly. When the actual flap position equals the selected position, a microswitch deenergizes the flap motor.



Pneumatic

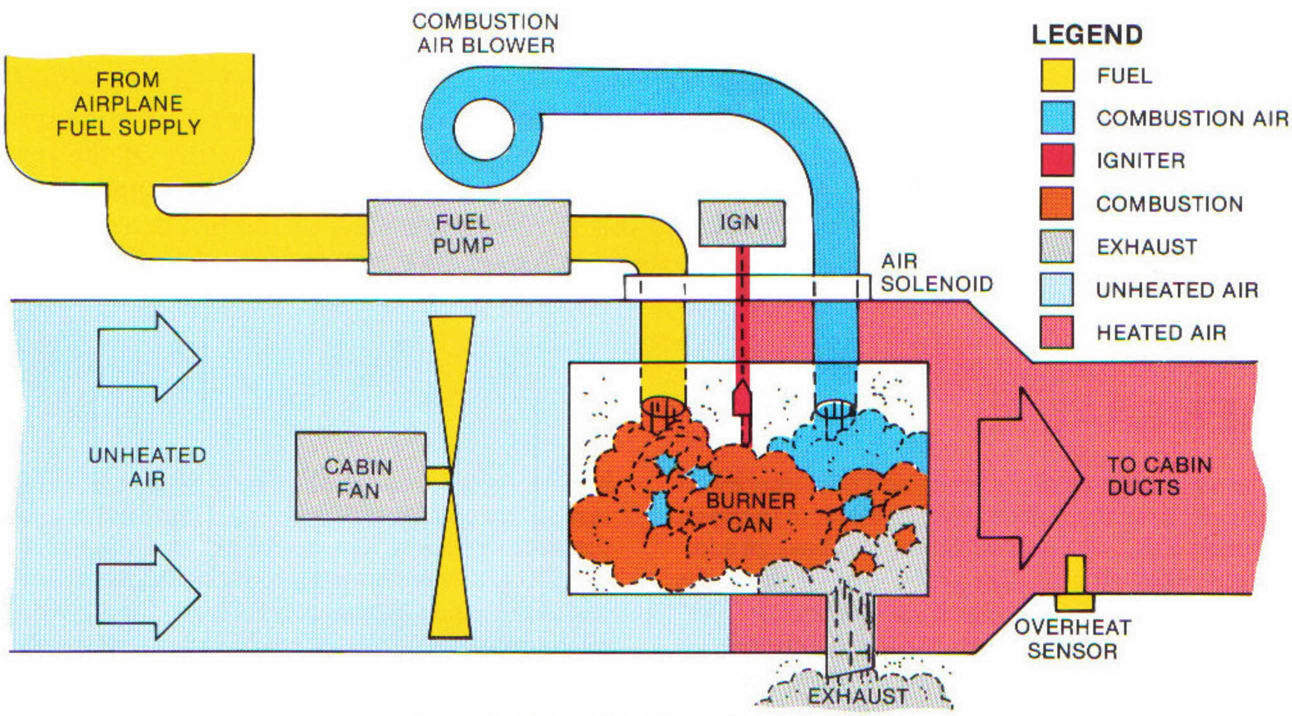
Pneumatic air on the Cessna 402 is used for the vacuum-driven gyro instruments (all attitude Indicators and the Cessna heading indicator) and the surface deice boot system. There is a dry vacuum pump which requires no lubrication located on the left of the aft accessory case on each engine. Each pump provides a vacuum in the common manifold, exhausting air overboard or to the deice boot system. Should either of the pumps fail a check valve is provided in each end of the manifold to isolate the inoperative pump from the system. A single pump will power the pneumatic instruments and the de-ice boots.

A suction gauge is located on the pilot's instrument panel that monitors the vacuum pressure. There are two small red buttons located on the lower portion of the suction gauge which should extend if insufficient vacuum occurs from either pump. The system should isolate the failed vacuum source, allowing normal operation of the remaining vacuum pump.

It is important to perform the vacuum system check during engine start/shutdown procedures to verify that the check valves will isolate a failed vacuum pump.

Cabin Heater System

The cabin heating system provides for cabin heating, ventilation, and defrosting. The system consists of an air inlet in the nose, a cabin fan, a gasoline combustion–type heater and heat outlets.



The cabin heater is located in the right forward baggage compartment. The heater gets its fuel from the right cross-feed line and uses approximately 3-5 GPH. Fuel pressure is supplied by a pump mounted on the heater assembly. Air for the burner can is supplied by the combustion air blower. When the air and fuel are mixed and the igniter is actuated, combustion takes place. This action heats the burner can and the heat is exchanged from the burner can to the air flowing around it.

The air temperature is controlled by the cabin heat control knob. Clockwise rotation increases the desired temperature. This knob controls a thermostat located just down line of the heater. The thermostat turns the heater on and off as necessary to regulate the temperature. If the temperature in the duct reaches 220 degrees F the thermostat will shut the heater off until the duct drops to a normal operating temperature.

An amber HEATER OVHT annunciator will illuminate if the heater exceeds 325 degrees F. If this happens the heater overheat switch has been activated and it has shut the heater off. The heater can not be turned back on until the overheat switch has been reset. The switch is accessible from inside the nose wheel well. Prior to resetting the overheat switch, the heater should be checked to determine why it overheated.

Powerplant

ENGINES

TCM (Teledyne Continental Motors) TSIO-520-VB.

- TS= Turbo Supercharged. “Supercharged” means it’s able to achieve manifold pressures above ambient. “Turbo” means the supercharging is accomplished through the use of an exhaust driven turbine, as opposed to mechanically driven.
- I= Fuel injected
- O= horizontally opposed cylinders.
- 520= 520 Cubic inches of displacement.
- V= Heavy duty crankcase.
- B= Increased diameter (heavy duty) crankshaft.

ACCESORY SECTION

The accessory section at the aft of the engine is driven by the crankshaft and provides gear reduction to drive the following accessories:

- Oil pump
- Fuel pump
- Vacuum pump
- Hydraulic pump
- Magnetos (2)

In addition to these accessories, a direct drive alternator is located on the front right side of the engine.

INDUCTION AIR SOURCES

There is an airbox just behind the engine. The airbox is shaped like a donut, as is the filter inside of it. In the center of the donut is the alternate engine air valve. This is actuated through a manual control knob located beneath the pilots yoke. Pulling the Alternate Engine Air Control Knob will admit warm, unfiltered nacelle air to the induction system.

OIL

The engines have a wet sump type, pressure lubricating system. Oil temperature is controlled by a thermally operated valve that routes oil through the oil cooler or around it. If the cooler becomes blocked or the bypass valve gets stuck in the closed position, it would cause an increase in oil temperature and a decrease in oil pressure.

Oil provides cooling and lubrication for the engine. It also is used to control the propeller, actuate the turbocharger waste gate, and lubricate the turbine.

IGNITION

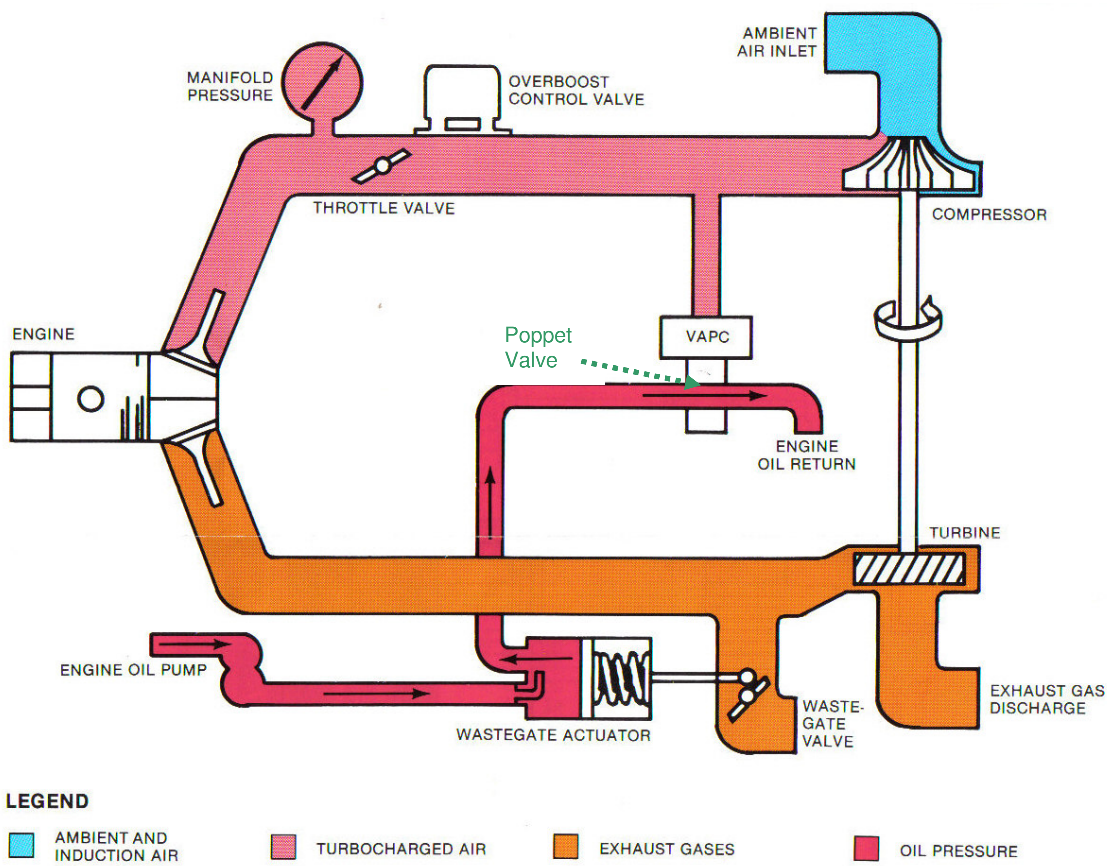
Each engine has a dual high-tension ignition system. The ignition system includes two engine-driven magnetos, high-tension cables and two spark plugs for each cylinder.

A direct-drive starter motor is used to crank the engine. These engines feature the "shower of sparks" ignition which is engaged during engine starting. The left magneto features a retard breaker consisting of a second set of contact points. When the aircraft starter switch is operated, the left and right primary magneto breaker points are grounded and the retard breaker points are activated. The starter switch also energizes the battery-powered starter vibrator which supplies pulsating voltage to the retard breakers. As the engine turns during cranking the retard breaker points open, and create a "shower of sparks" at the left magneto spark plugs. The high intensity ignition occurs later than would normal ignition (0° TDC vs. 24° TDC) and promotes smoother engine start.

Turbocharger

The turbo charger system on the Cessna 402 is a boot strap system in that it works by its own exhaust gases. The system works as follows:

- Ambient air enters through the inlet under the nacelle or the alternate air intake
- The compressor compresses the induction air
- The pressurized induction air then passes into the cylinders through the induction manifold
- The air and fuel are burned and then expelled through the exhaust manifold to the turbo
- The exhaust gases drive the turbine which, in turn, drives the compressor
- The wastegate allows excessive exhaust gas to be expelled overboard in order to control turbine (and therefore, compressor) speed



WASTEGATE

The wastegate is a valve that regulates the amount of exhaust gases flowing to the turbine. It's spring loaded to the open position and hydraulically modulated toward the closed position by oil pressure supplied from the engine oil pump. The engine oil pressure for the wastegate is controlled by a variable absolute pressure controller (VAPC).

VARIABLE ABSOLUTE PRESSURE CONTROLLER (VAPC)

The device that controls the wastegate, and therefore controls turbocharger boost, is the Variable Absolute Pressure Controller (VAPC). The VAPC's job is to sense the post-compressor pressure (known as "Upper Deck Pressure"), and set the boost amount to hold a pre-determined throttle position (and therefore, a set Manifold Pressure).

As the aircraft climbs, the VAPC will sense a drop in Upper Deck Pressure and an increase in boost will be required in order to hold it at the preset level (throttle position set for a Manifold Pressure of 29.5", for example). The VAPC controls oil pressure via a poppet valve in order to manipulate the *wastegate actuator.* As the aircraft climbs, the drop in Upper Deck Pressure will cause a set of bellows in the VAPC to move. The bellows move in a fashion which moves the poppet valve towards the closed position. As less oil is able to flow by the poppet valve, more oil pressure is exerted on the wastegate actuator, which is upstream. This pressure will cause the wastegate actuator to move the wastegate towards the closed position, causing *more* exhaust gas to flow past the turbine. More exhaust gas flowing past the turbine = faster turbine speed = faster compressor speed = more boost. More boost allows us to hold our 29.5" during the climb.

During a descent, as less boost is needed, the VAPC will allow more oil to flow past the poppet valve, allowing the wastegate actuator to spring back towards the "more open" position, resulting in less boost.

OVERBOOSTING

Momentary overboost of the engine by 2 to 3 inches of MP can occur during rapid throttle advancement, especially with cold oil. This can be prevented by slower throttle movement and by paying attention as the throttles are advanced, being prepared to manually control the MP if necessary. If the momentary overboost does not correct itself or if it exceeds 4 inches MP the controller system should be checked. To prevent extreme over boosting of the engine there is a absolute pressure relief valve (pop-off valve) set to open at approximately 41" MP. This valve is a spring loaded pressure relief valve that automatically closes once the MP is reduced to a safe level.

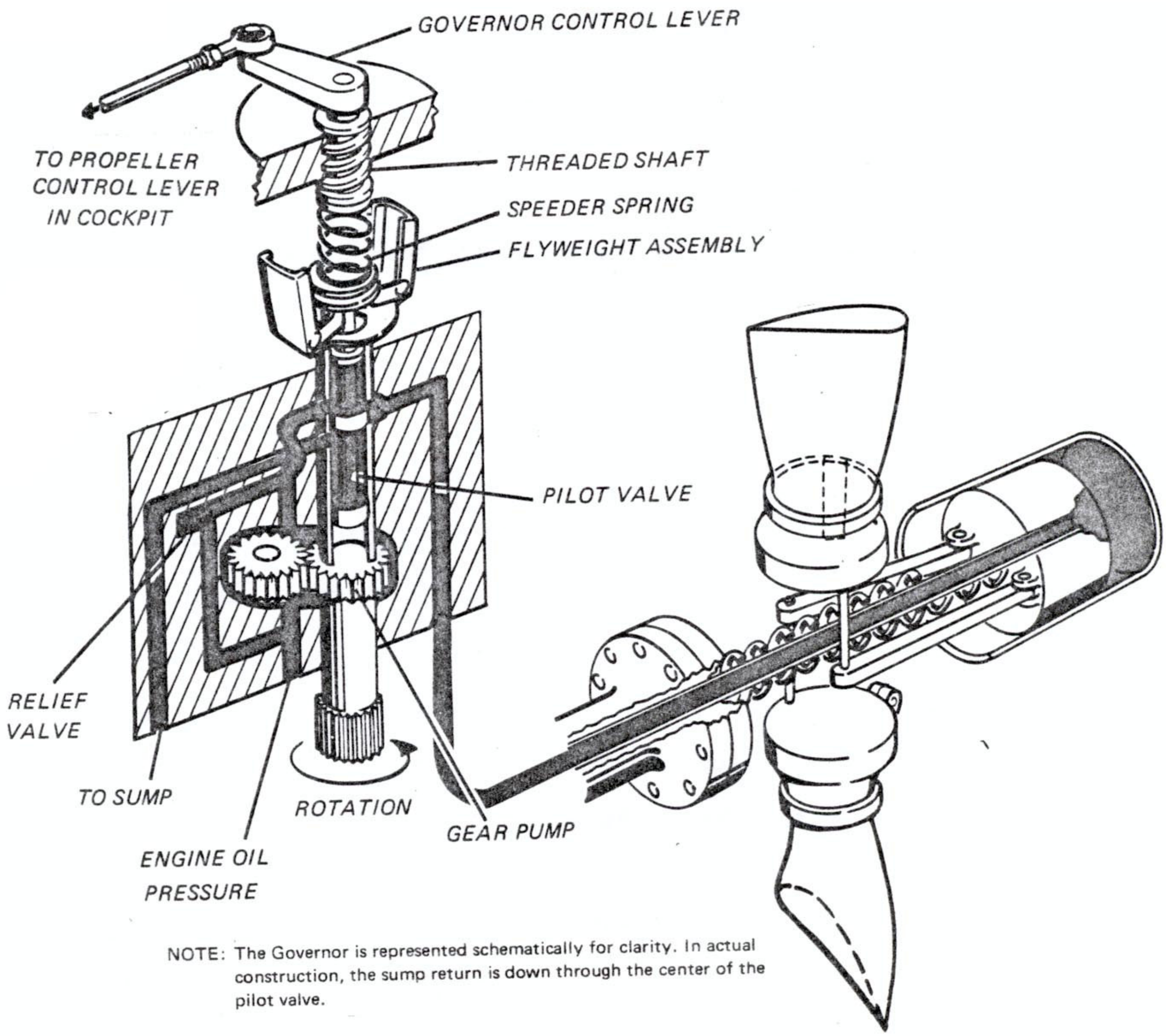
SHUTDOWN PROCEDURES

After extended periods of ground operations above 1600 RPM or when the CHT is within the upper half of the green arc, power should be reduced to between 600 - 800 RPM for a period of not less than 2 - 3 min. prior to shutdown. This allows the Turbo to spool down reducing the temperature and preventing the possibility of premature accumulation of carbon on the turbine shaft seals.

Propellers

The Cessna 402 has 2 McCauley 3 bladed 6'4.5 diameter constant speed, full feathering, non reversible, hydraulically actuated, governor regulated propellers.

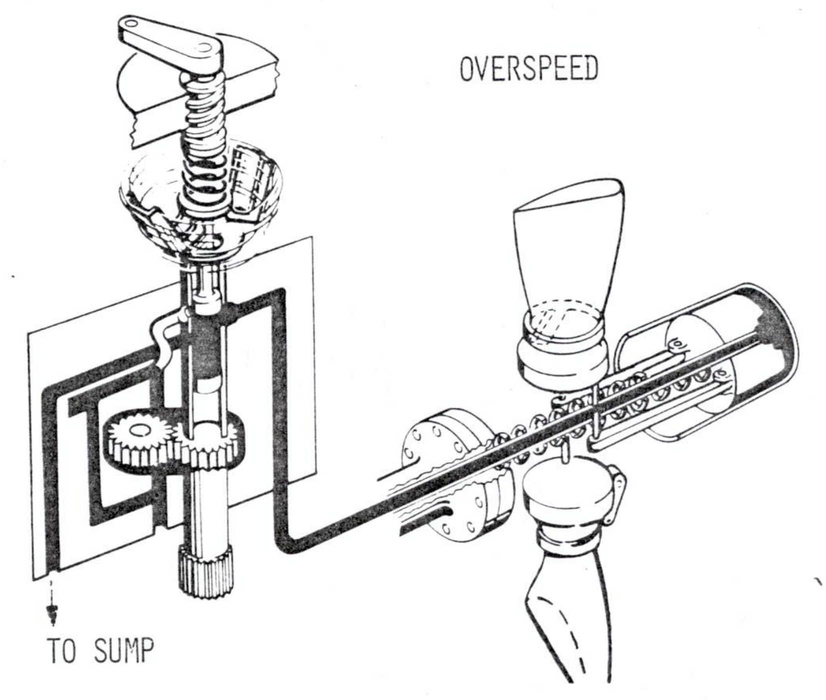
Operation of the propeller within the blade angle range is determined by the governor. The governor operates on the principle of balancing two opposing forces-a speeder spring force and a flyweight force. Both of these forces are variables. The force of the speeder spring is determined by the position of the propeller control lever. The force of the flyweights is determined by engine RPM. Any unbalance between these forces determines the position of the pilot valve in the governor that either directs boosted engine oil pressure to the propeller control piston to reduce blade angle, or allows oil to drain from the propeller control piston chamber to the engine sump, forced by the propeller piston ring. The propeller spring and centrifugal flyweights then increase the blade toward feather.



NOTE: The Governor is represented schematically for clarity. In actual construction, the sump return is down through the center of the pilot valve.

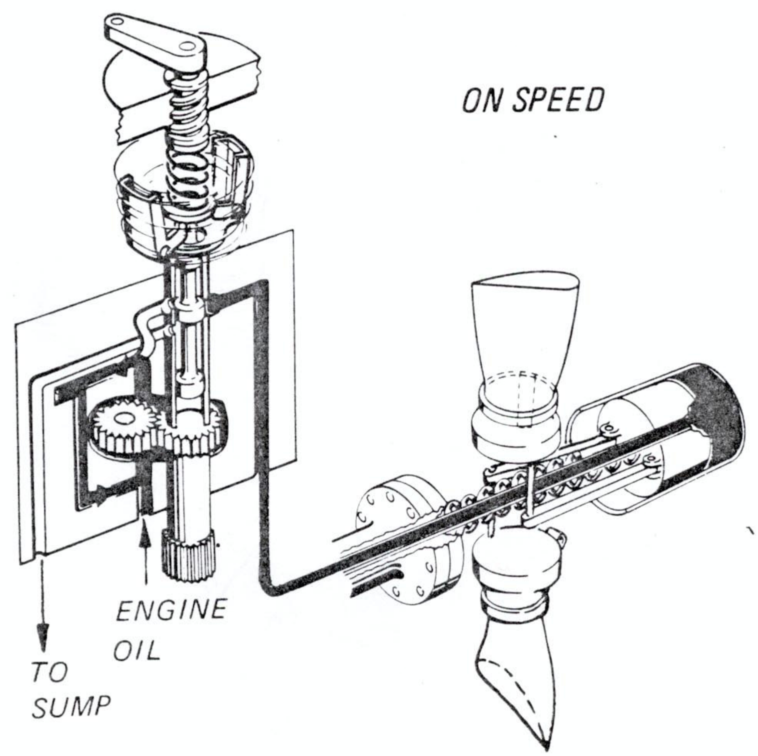
OVERSPEED CONDITION

Airspeed increases. Since the pitch of the propeller blades is too low to absorb engine power, the engine RPM begins to increase. However, the instant this happens, the flyweights move out and raise the pilot valves. This, in turn, causes oil to flow from the propellers, increasing the pitch of the blades. Engine speed then slows down to maintain the original RPM setting.



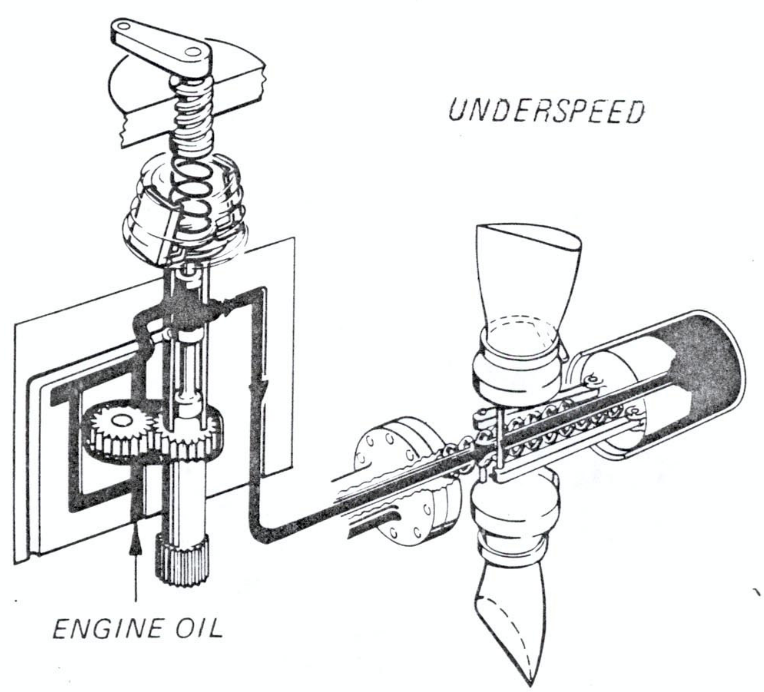
ON SPEED CONDITION

This exists when the RPM is constant. Movement of the cockpit controls have set the speeder springs at the desired RPM. The flyweights have positioned the pilot valves to direct oil from or to the propellers. This, in turn, has positioned the propeller blades at a pitch that absorbs the engine power at the RPM selected. When the movement of RPM balance occurs, the force of the flyweights equals the speeder spring load. This positions the pilot valves in the constant RPM position with no oil flowing to or from the propellers.



UNDERSPEED CONDITION

Airspeed is reduced and, since the pitch of the propeller blades is too high, the engines start to slow down. But the instant this happens, the flyweights will droop causing the pilot valves to move down. Simultaneously, oil flows to the propellers, reducing the pitch of the blades. This automatically increases the speed of the engines to maintain the original RPM setting.

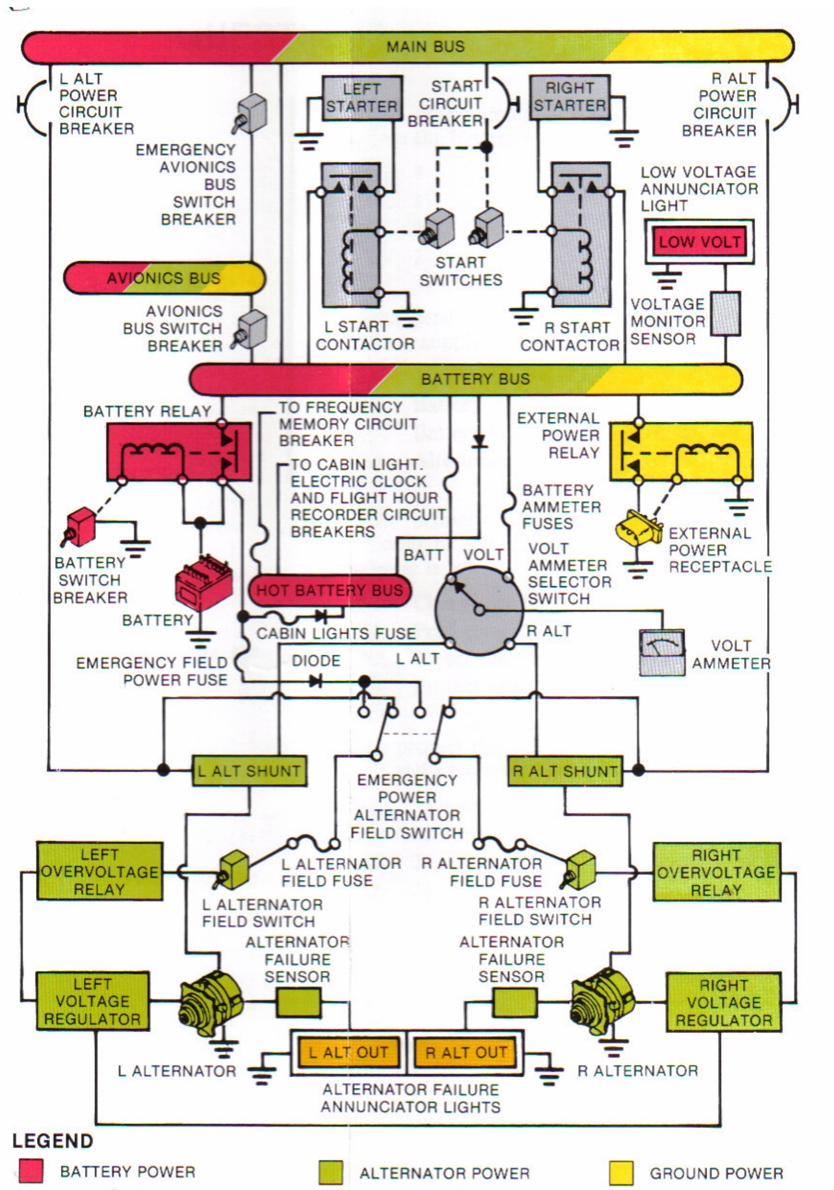


To prevent the propellers from going into feather during the shutdown there are a set of feathering lock pins built into the propeller hub assembly. In order to insure that the propeller will go into feather, the prop lever must be pulled into the feather detent before the engine RPM drops below approx. 800.

It is important to cycle the propeller during the run-up to make sure that the propeller will go into feather. Cycling the propeller also circulates warm oil into the prop hub to allow proper propeller operation. When cycling the propeller check feathering to 1200 RPM and do not let the engine go below 1000 RPM because this could cause damage to the prop hub.

Electrical

The electrical system is a 28 volt, negative ground, direct current system powered by an alternator on each engine.



The system has four busses to distribute the electricity to the systems. They consist of the <u>hot battery</u> bus which distributes power anytime the battery or external power is hooked up. The <u>battery bus</u> which is used to route the power to the systems and starter from either the battery or external power unit. The <u>avionics bus</u> is used to distribute power to the avionics. This bus powered and protected through the *Avionics Bus Switch Breaker*. If the main switch fails there is an emergency avionic bus switch breaker located on the top aft side of the side console next to the emergency alternator field switch. The main bus is used to distribute the power to the majority of the systems. A sensor will illuminate a LOW VOLT light if normal system voltage falls below 25 volts.

BATTERY

A single 24 volt, 35 ampere-hour, air cooled, lead acid battery is installed. Depending on the airplane, it could be located in the left wing root or in the nose compartment. The battery is directly connected to the hot battery bus which supplies power for essential loads such as emergency alternator field switch, clock, courtesy light, flight hour recorder, passenger reading lights, and nose and wing locker baggage compartment lights. Power to the battery bus from the battery is routed via the battery relay, which is controlled by the two-position (ON-OFF) *Battery Master Switch Breaker* on the pilot's left side console. The battery relay requires approximately 7 volts to close.

ALTERNATORS

There is a 28 volt 100 amp, negative ground, direct engine driven alternator located on the front right side of each engine. The two alternators operate as left and right independent systems. There is an individual voltage regulator for each alternator to maintain a constant alternator voltage during variations in engine speed and electrical load requirements. A paralleling circuit connects the two systems in order to facilitate load sharing between the two alternators. The alternators are self exciting once they are in operation. Initial normal field excitation is provided from battery or external power through the main bus. The red guarded emergency alternator field switch may be used to route excitation current directly from the battery. Placing the switch in the on position provides excitation from the battery, even when the battery relay is not closed.

OVERVOLTAGE PROTECTION

Over voltage protection prevents an alternator from applying more voltage then the maximum bus voltage by removing the field current if the alternator exceeds approximately 32 volts.

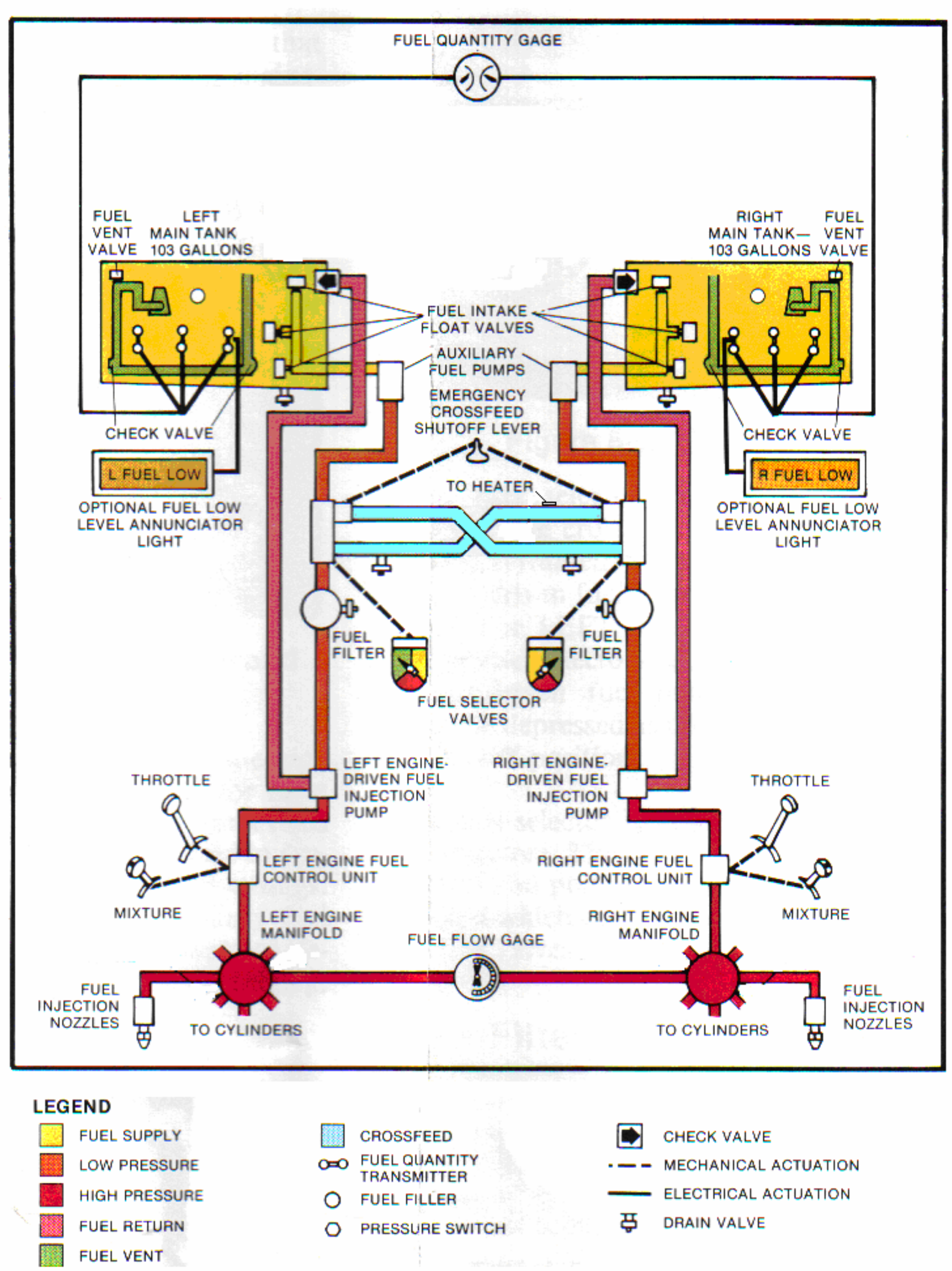
All electrical systems in the airplane are protected by push-to-reset circuit breakers or switch breakers. If a circuit breaker pops out or a switch breaker returns to the off position you must wait for approximately 3 minutes before resetting. If the circuit opens a second time this would indicate a short in the system and the circuit breaker or switch breaker should not be reset again.

GROUND POWER

There is an external power connecter located in the left wing aft nacelle fairing. When the ground power unit is connected to the airplane, a relay in the external power circuit will close only if the polarity of the voltage being supplied to the external power receptacle is correct. For starting, the external power source voltage must be set to 24-28 volts. Follow the checklist in section 4 of the POH/AFM to ensure proper engine start procedures with external power. Incorrect starting procedure could damage the electrical system.

Fuel System

The fuel system consist of two fuel tanks that are integral sealed (wet wing) tanks, 2 fuel selector valves, 4 fuel pumps and an emergency crossfeed shutoff valve.
The main tanks are located outboard of the nacelles. Each tank includes 3 float valves, 3 fuel quantity probes, 2 sump drains and a NACA vent (which maintains positive tank pressure).



ENGINE-DRIVEN FUEL PUMPS

Each engine is equipped with a mechanically driven fuel pump mounted on the engine's accessory case. This pump provides a volume in excess of engine requirements. Excess fuel is returned back to the fuel tank though a return line. The volume of fuel delivered to the engine is determined by the Fuel Control Unit (FCU).

FUEL CONTROL UNIT

The fuel control unit is a fuel/air control assembly that functions to control induction airflow and fuel flow. The FCU receives input from the throttle and mixture control levers in order to determine the proper fuel/air ratios.

AUXILIARY FUEL PUMP SWITCH

The aircraft have been modified by Service Bulletin MEB88-3. There is now a 3 -position auxiliary fuel pump switch labeled "LOW-HIGH" (unmarked center off). Low provides 5.5 psi for vapor clearing and purging. "Low" is used during taxi, takeoff and landing. "High" is used in the event of an engine driven pump failure and will provide sufficient fuel for partial-power engine operations (approximately 80%). The auxiliary fuel pump will also be activated on "High" for pre-start priming when the engine primer switch is selected to either left or right.

AUXILIARY FUEL PUMPS

The electric auxiliary fuel pump is located outside of the main tank. In the event of an engine driven fuel pump failure the auxiliary pump will send fuel to the engine at a constant pressure, so the pilot must regulate the flow manually with the mixture to keep the engine running smoothly. The auxiliary fuel pump operates at a constant RPM whether set on high or low. A shuttle valve inside the fuel pump changes the size of the orifice restricting the flow for low and opening for high.

FUEL SELECTORS

The fuel selector valves are mechanical valves located on the floor between the pilots seat. Each valve has three settings, LEFT MAIN, RIGHT MAIN, and OFF. The valve will rotate between the main tanks, but a button needs to be depressed in order to turn the selector off. With the fuel selector on its respective main tank it provides fuel for normal operation. The fuel selector can be selected to run its respective engine off the other side's tank in order to balance asymmetric fuel situations or in case of an emergency.

Located in-between the fuel selector valves is the emergency x-feed shut off lever. This lever is used to shut off the pressurized x-feed fuel lines and the fuel supply to the heater in case of nacelle, wing or center section fire or a wheels-up landing.

FUEL DRAINS

There are a total of eight fuel quick-drain valves in the system. There are 2 valves located at the low point of each main tank. There is one located under each nacelle for the fuel filter sump, and one located between each nacelle and fuselage under the wing for the crossfeed line drain.

FUEL GAUGES

The fuel quantity gauge is a dual scaled gauge that is calibrated in pounds (white outer scale) and gallons (blue inner scale). The gauge displays accurately the weight of the fuel in the tank in pounds**.** The volume markings are predicated on the use of 100 octane avgas. If you use 100LL reduce the indicated gallonage by 4 % (Pounds unchanged).

Some of our airplanes are equipped with the optional LOW FUEL annunciator lights, they will illuminate with approximately 60 lbs of fuel remaining in the tank.

FUEL FLOW INDICATOR

The fuel flow indicator system consists of a dual-needle indicator actuated by fuel pressure at the fuel manifold assembly. Since fuel pressure at this point is proportional to fuel consumption of the engine, the gauge is marked as a flow meter. The gauge indicates the fuel consumption of each engine in pounds per hour and is predicated on the use of 100/130 grade aviation fuel. The fuel flow markings must be increased by 2% when 100LL grade aviation fuel is used.

Landing Gear

This aircraft is equipped with retractable tricycle landing gear that consists of two inboard-retracting main gear and an aft-retracting nose gear. The gear actuators attach directly to the strut and have internal locks to hold the gear in the extended position. The gear is held up by mechanical up-locks and the gear doors are mechanically linked to their respective landing gear. There is a squat switch located on the left main gear in order to prevent gear retraction on the ground.

There are two engine driven hydraulic pumps that provide continuous fluid flow when the engines are operating. Flow is bypassed to the reservoir with minimal pressure buildup until the landing gear operation is selected. The Hydraulic pumps will produce a flow rate of 2.5 GPM at takeoff rpm. If either pump's output drops below 1.25 GPM the associated HYD FLOW annunciator light will illuminate. The HYD FLOW lights must be extinguished by 1700 RPM.

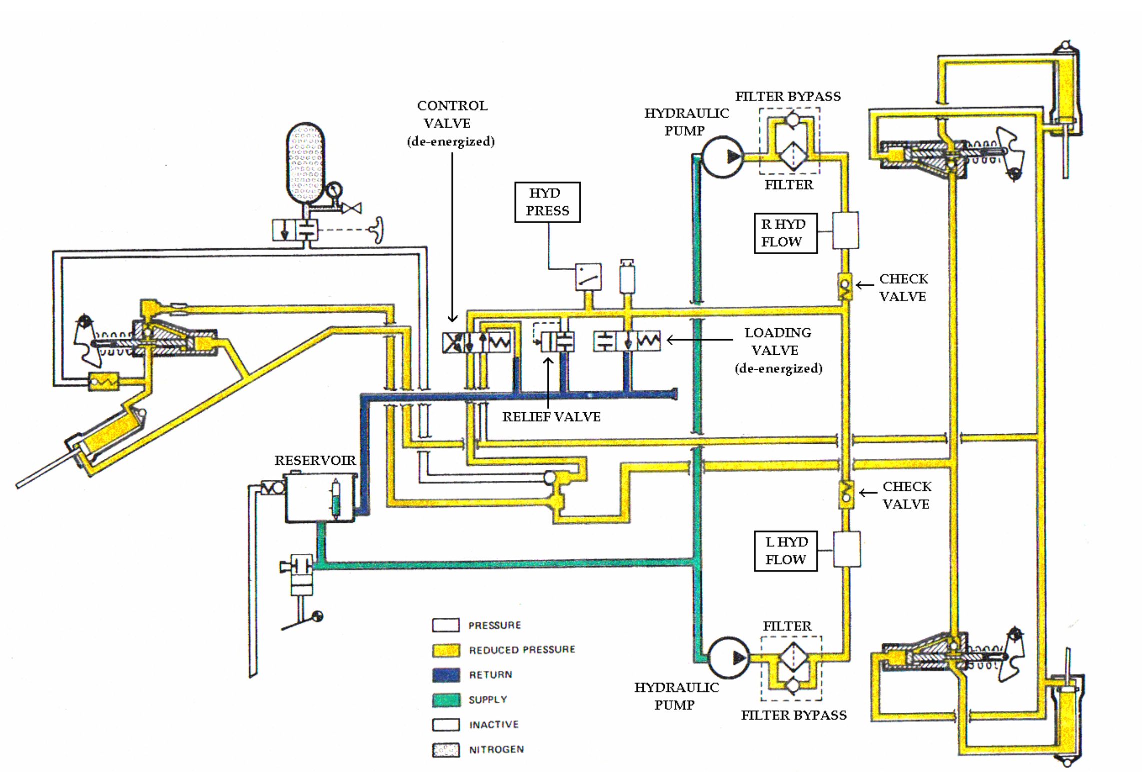
The landing gear is an *electrically-controlled, hydraulically-actuated system*. Placing the Gear selector switch in the up position electrically energizes the **loading valve** to the closed position and the **control valve** to the up (retract) position. Pressure builds up in the system, illuminating the HYD PRESS annunciator light (at approximately 175 psi). Pressure is directed to release the integral downlocks in the gear actuators. The gears retract and are mechanically locked up. The loading valve is then deenergized, returning the valve to the open position. This depressurizes the system by routing the hydraulic fluid back to the reservoir, allowing it to circulate freely.

Placing the selector switch to the down position energizes the loading valve to the closed position and the control valve remains de-energized to the "extend" position. The hydraulic system pressurizes and the HYD PRESS light illuminates. Pressure releases the uplocks through sequencing valves and extension begins. When the gear reaches the extend position, the downlocks in the actuators engage. The loading valve is deenergized to the open position and the hydraulic system depressurizes.

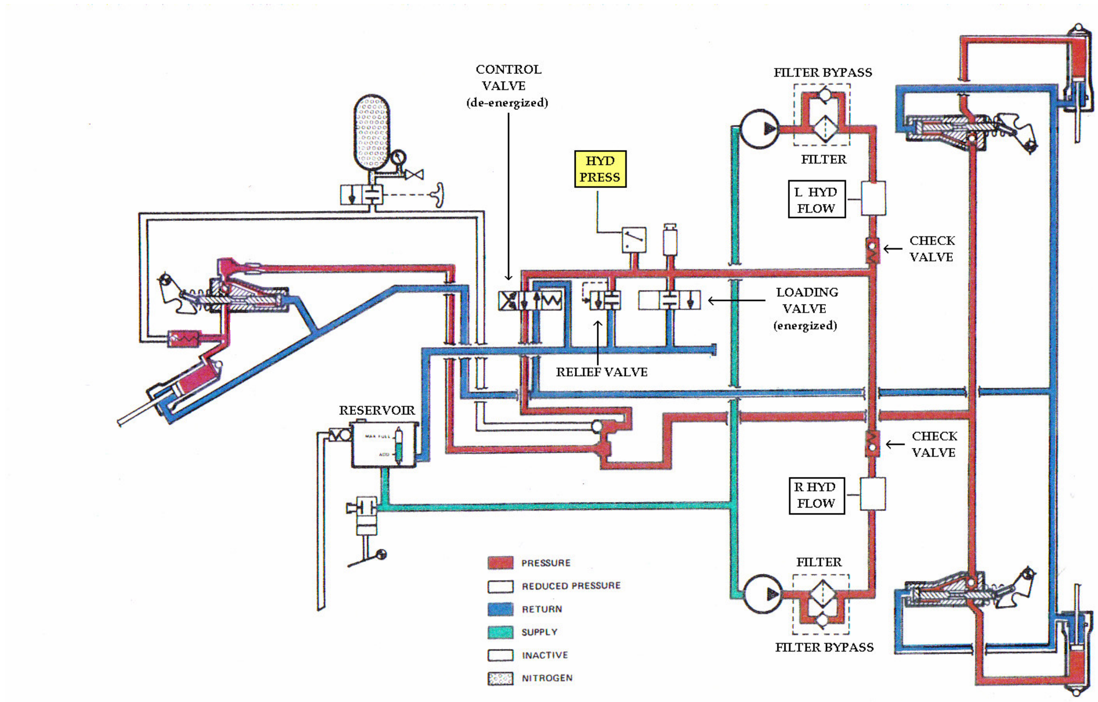
The loading valve is spring loaded to the open position and the control valve is spring loaded to the down (extend) position. They will remain in these positions until energized.

Each downlock and uplock has a microswitch installed to record when the gear is locked up or down. The red GEAR UNLOCKED light is illuminated when the gear is in transit or if any gear is not locked up or down.

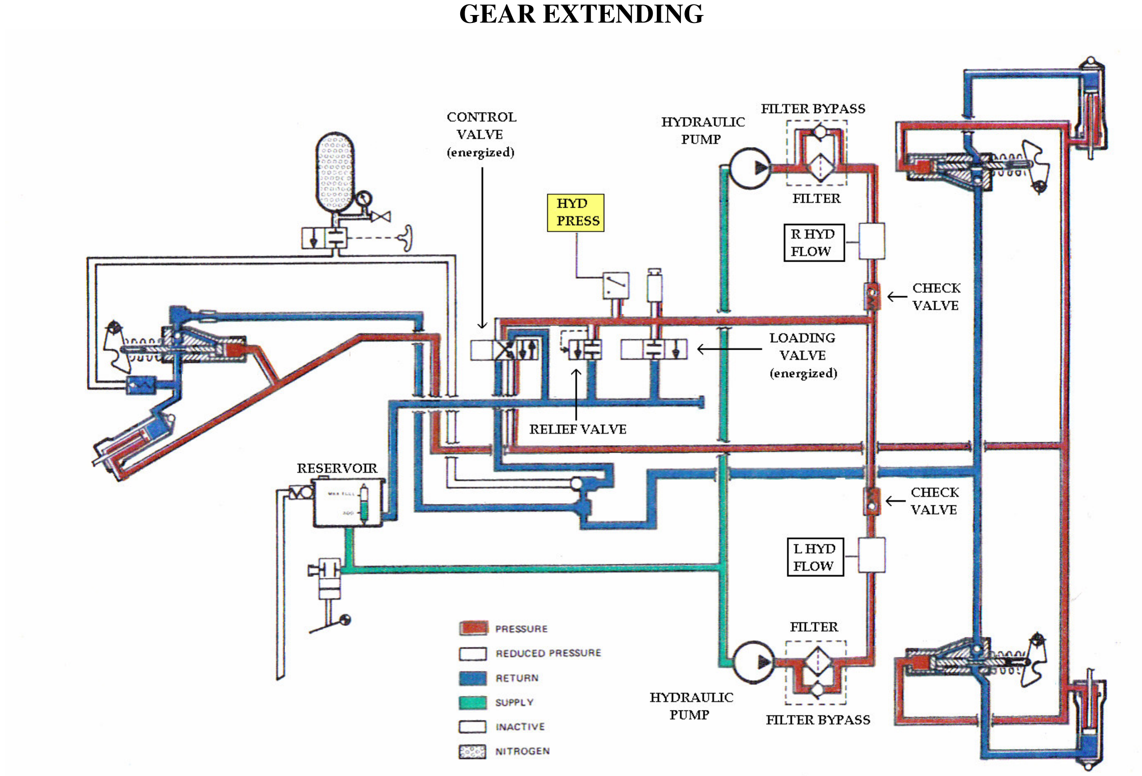
Emergency gear extension is accomplished by a 2000 psi nitrogen blow down bottle. If the gear will not extend hydraulically consult your checklist to trouble shoot. Pulling the EMER GEAR CONTROL handle releases pressurized nitrogen which repositions a shuttle valve and pressurizes the gear extension system.



Hydraulic System Unloaded



GEAR EXTENDING



GEAR RETRACTING

ICE PROTECTION

Our deice airplanes are equipped with Pitot heat, stall vane heat, static port heat, heated propeller boots, surface deice boots and a heated pilot's windshield. All items must be operational in order to meet the FAA requirements for flight into known icing conditions.

SURFACE DEICE SYSTEM

The surface deice boots are located on the leading edges of the wings and tail surfaces and are designed to remove ice after accumulation. The system is electrically controlled and pneumatically operated. The boots expand and contract, using pressure and vacuum from the engine-driven vacuum pumps. The vacuum system provides suction to the boots to keep them flush against the aircraft surfaces while not being used. When a deicing cycle is initiated, vacuum is removed and pressure is applied to inflate the boots. Inflation causes a change in leading-edge contour, breaks up any ice accumulation, and allows the ice to be removed by air flowing over the wing.

The deicing system is manually controlled by activating the surface deice switch in the cockpit whenever a cycle is desired. Placing the switch to SURFACE DE-ICE inflates the empennage boots for approximately 6 seconds, then the wing boots for the next 6 seconds. One complete inflation and deflation cycle will last approximately 45 seconds. A SURF DE ICE annunciator light will illuminate when the tail section boots reach proper operating pressure, this only indicates pressure and not if the boots inflated property. Placing the switch to RESET causes the system cycle to reset to the uninflated boot state. It is recommended to activate the system once the aircraft has accumulated between 1/4" and 1/2" of ice.

PROPELLER ANTI-ICE SYSTEM

The propeller deice system consists of electrically heated boots on the propeller blades. Each boot houses an outboard and inboard heating element, which receive electrical power through a sequencing timer. The sequencing timer directs current to the propeller boots in cycles between boot elements and between propellers in the following sequence:

- **Heating period # 1 – outboard heating elements – right engine blades**
- **Heating period # 2 – inboard heating elements – right engine blades**
- **Heating period # 3 – outboard heating elements – left engine blades**
- **Heating period # 4 – inboard heating elements - left engine blades**

Each heating period last 20 seconds, for a total system cycle time of 80 seconds. There is a propeller deice ammeter that indicates if the blades are being heated uniformly. Uneven deicing of the blades can result in propeller imbalance. This would be indicated by excessive vibration and could lead to engine failure. The checklist for this problem is located in the supplement section of the POH since the propeller deice system is considered optional equipment. The propeller anti-ice system should be activated, per the Before Takeoff Flow, if flight through visible moisture in temperatures ≤ 40°F (4.4°C) is expected.

ELECTRIC WINDSHIELD

The electric windshield anti-ice system consists of an electrically heated element in the pilot's windshield, an inverter, an annunciator light, a heat sensor and a switch breaker.

There is an inverter, located in the right wing stub, which is utilized to convert DC voltage to AC voltage to operate the electric heated windshield. A heat sensor will remove AC voltage from the windshield when the windshield reaches the cut off temperature. The green WINDSHIELD annunciator light illuminates during each heating cycle. It is important not to leave the electric windshield heat on for more than 20 seconds on the ground or with the pilot's windshield covered with ice. This could overheat the windshield causing distortion and crazing of a very <u>expensive</u> windshield. The heat sensor controls current to the windshield, but continuous airflow is a vital component of temperature control. The electric windshield should be turned on at the *first sign* of windshield ice. If a thick layer of ice is allowed to cover the windshield, the applied heat may only de-ice the portion of the layer closest to the windshield itself causing eventual overheat & distortion due to the lack of airflow.

Revision #1 (11-23-05)