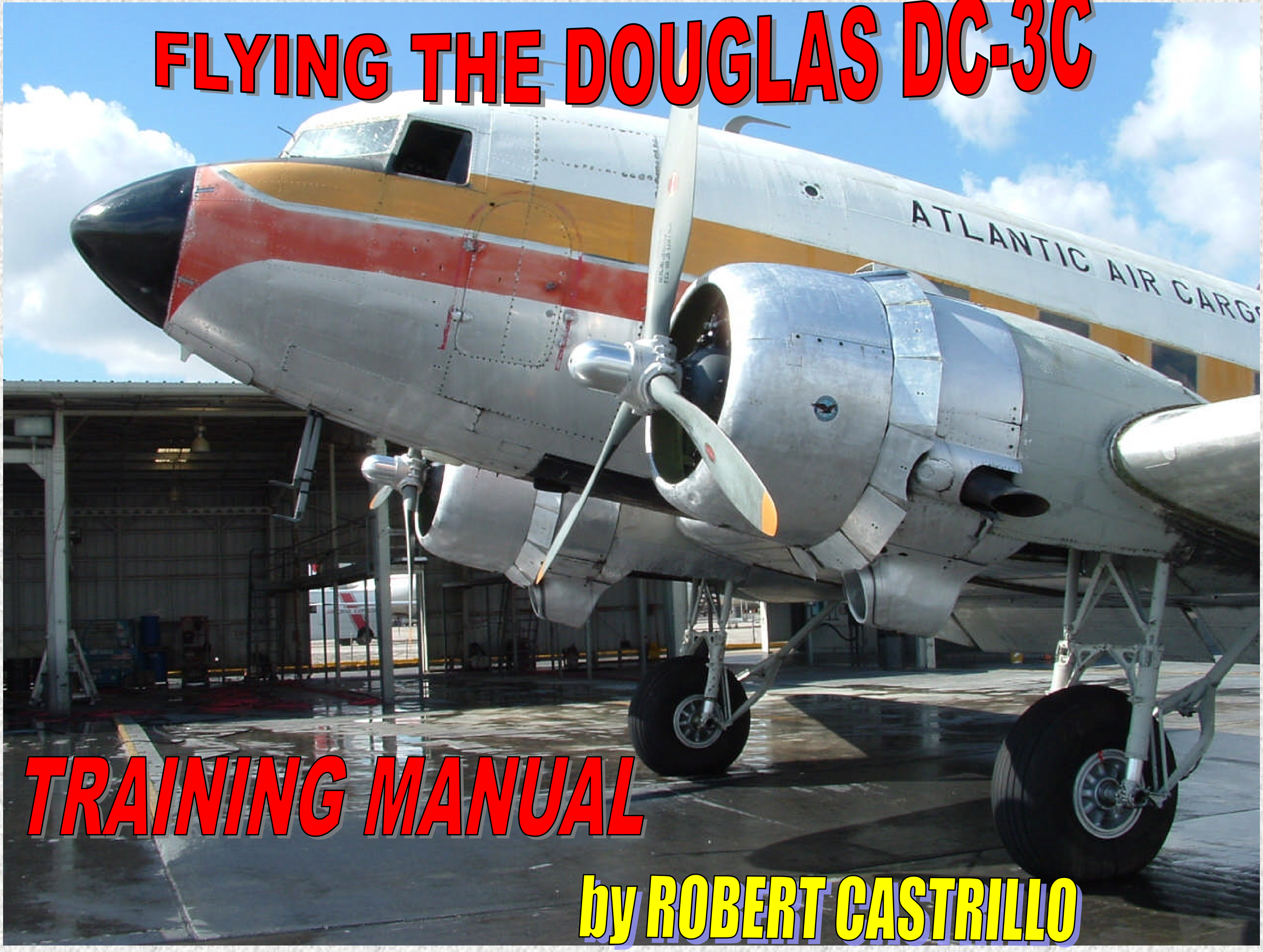
FLYING THE DOUGLAS DC-3C



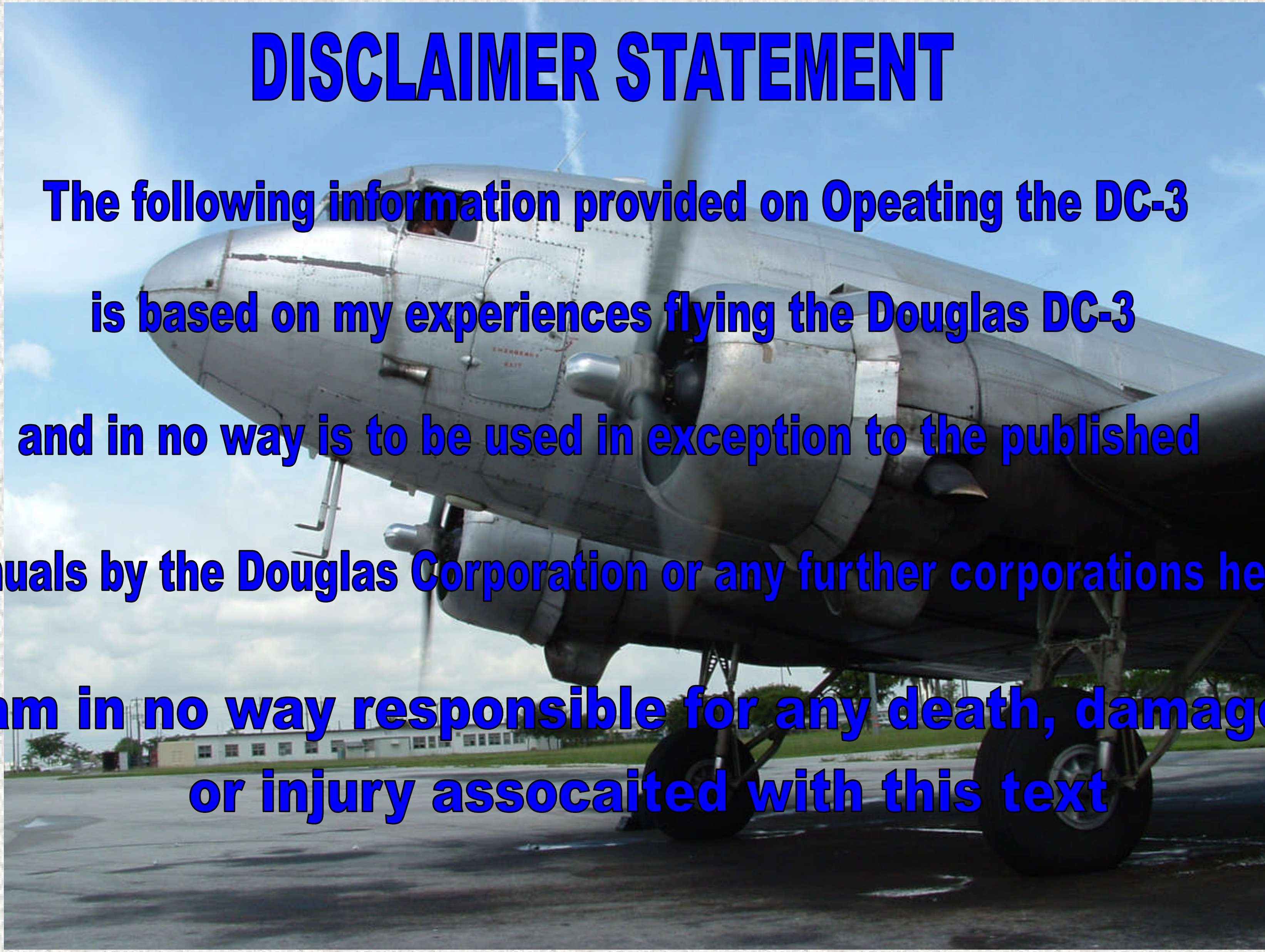
TRAINING MANUAL

by ROBERT CASTRILLO

OPERATING THE DC-3

Douglas DC-3C

By Robert Castrillo



DISCLAIMER STATEMENT

The following information provided on Opeating the DC-3

is based on my experiences flying the Douglas DC-3

and in no way is to be used in exception to the published

manuals by the Douglas Corporation or any further corporations herein

I am in no way responsible for any death, damages, or injury assocaited with this text


GROUND SCHOOL

Reference Data

FLIGHT CHARACTERISTICS

GENERAL

Stability

With normal and full loads the aircraft is stable

Under normal loading conditions a tendency toward nose heaviness is noticed

Do not subject the aircraft to high acceleration loading during steep turns

Trim

Trim Tabs – Conventional trim tabs are installed on the rudder, both elevators and the right aileron. Response is normal

Flaps Down – The aircraft has a tendency to be nose heavy

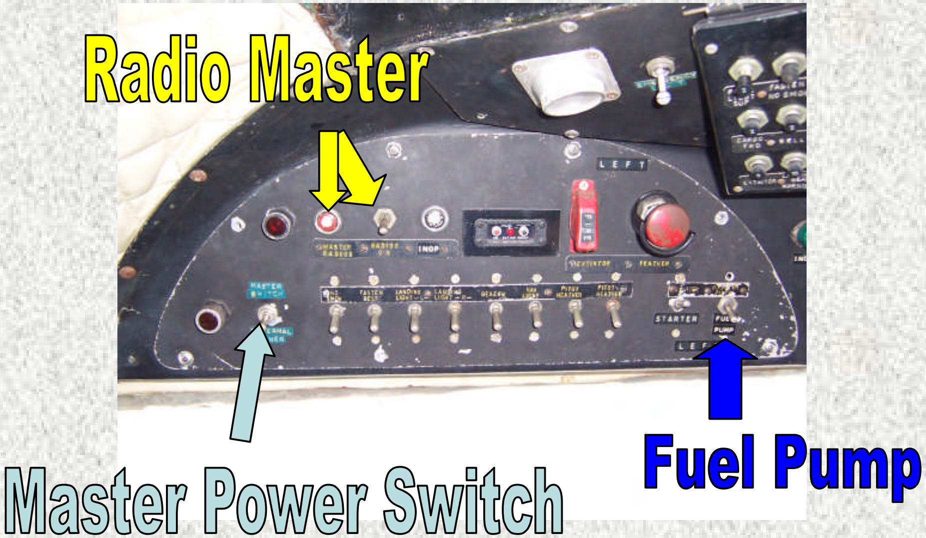
Landing Gear Down – Slightly nose heavy

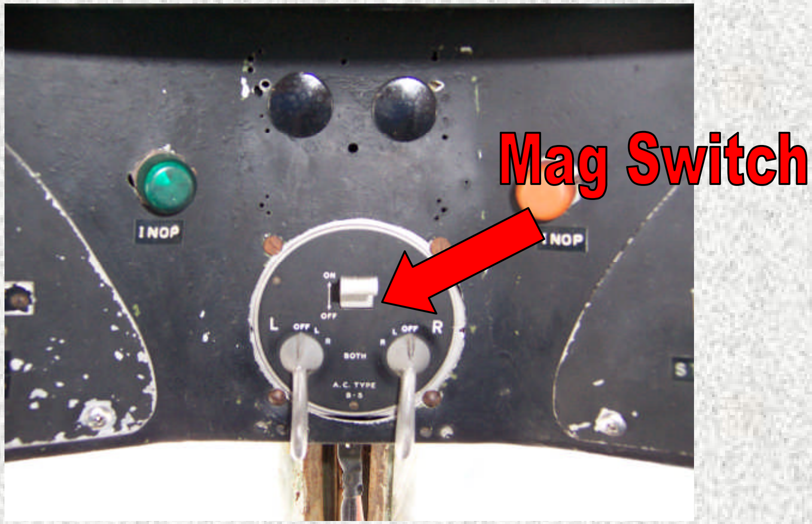
Cowl Flaps Open – Slightly nose heavy

Single Engine Operation – Nose heavy, Requires 2 ½ - 3 degrees rudder trim

Possible rudder force reversal and/or sudden lock may be experienced in this aircraft if rudder application is not coordinated with lateral control. Avoid yawed flight.

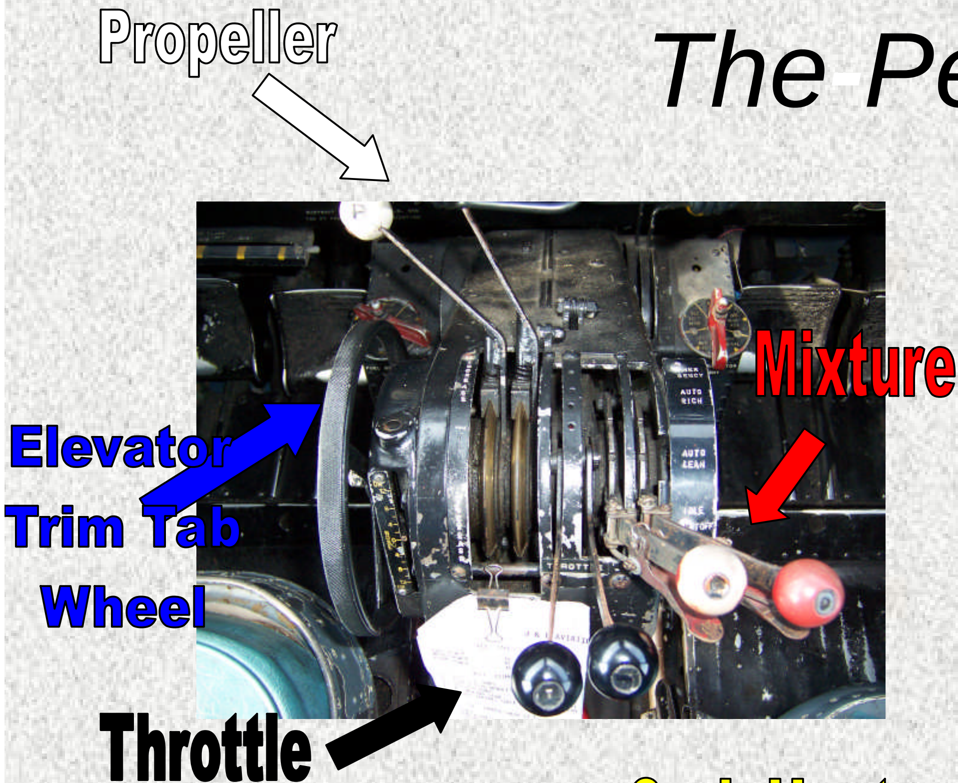
The Left Overhead Panel

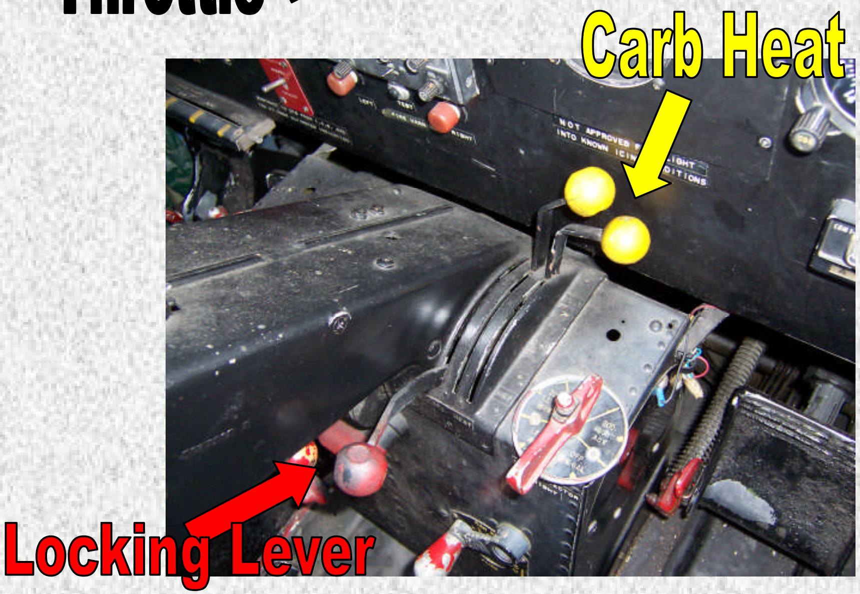




- We'll start with the Basic Procedures in a minute. First let's get familiar with the overhead panel and Magneto switches. To get it all started we first must engage the Master Power switch (***Turquoise arrow***) to the "ON" position. On the far right of the panel you have the "Start" switch and the "Fuel Pump" switch (***Blue arrow***).
- On the Left Overhead Panel we also have the Radio/Avionics Master switch and Button (*Yellow arrow*). Note: No two DC-3's are alike, so panel placement may change on various aircraft.
- On this particular DC-3 you must first flip the Radio Switch to the "ON" position and then depress the Red Radio Master button.
- You have the regular assortment of Exterior aircraft lighting switches
- The Magneto switch has the center "ON and OFF" switch and then individual Magneto selectors for each engine. The Magneto switch positions are Left, Right, Both and Off (***Red Arrow***).

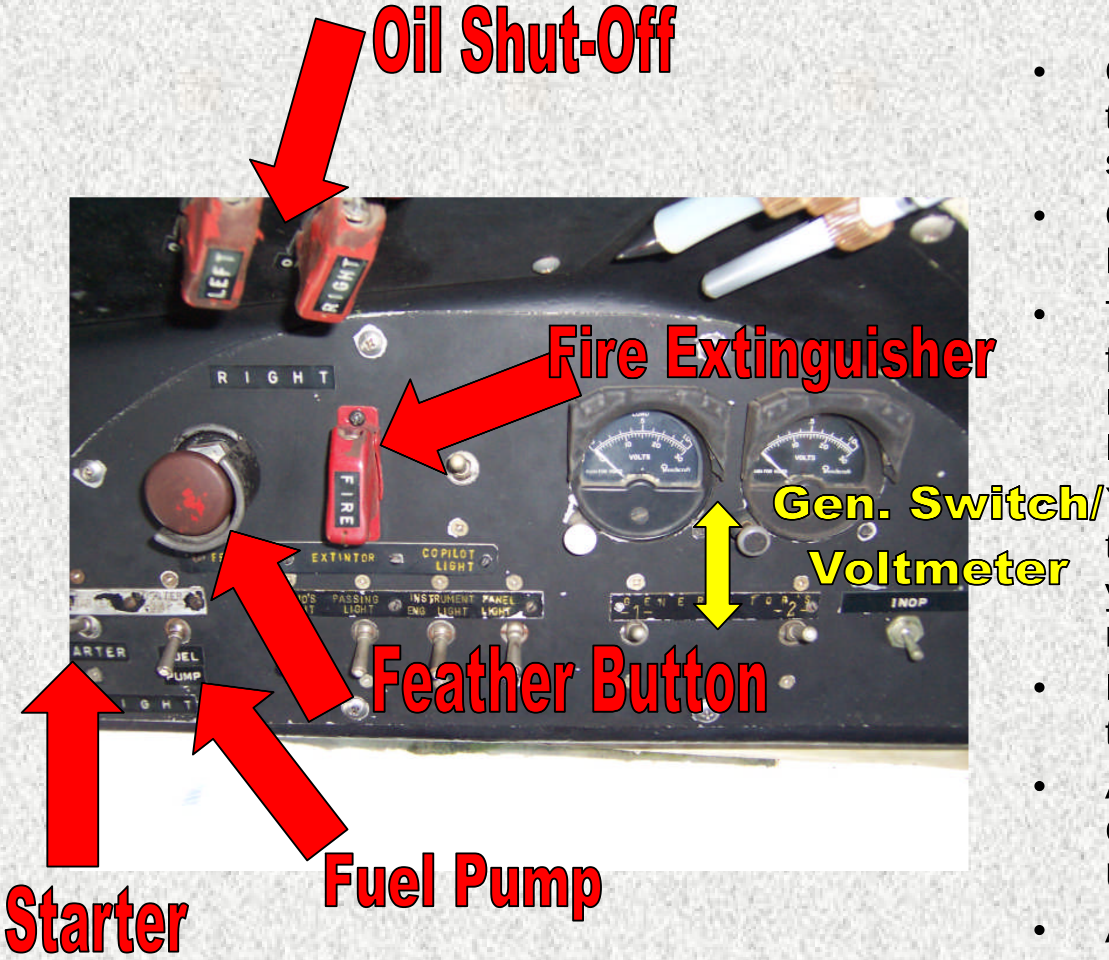
The Pedestal





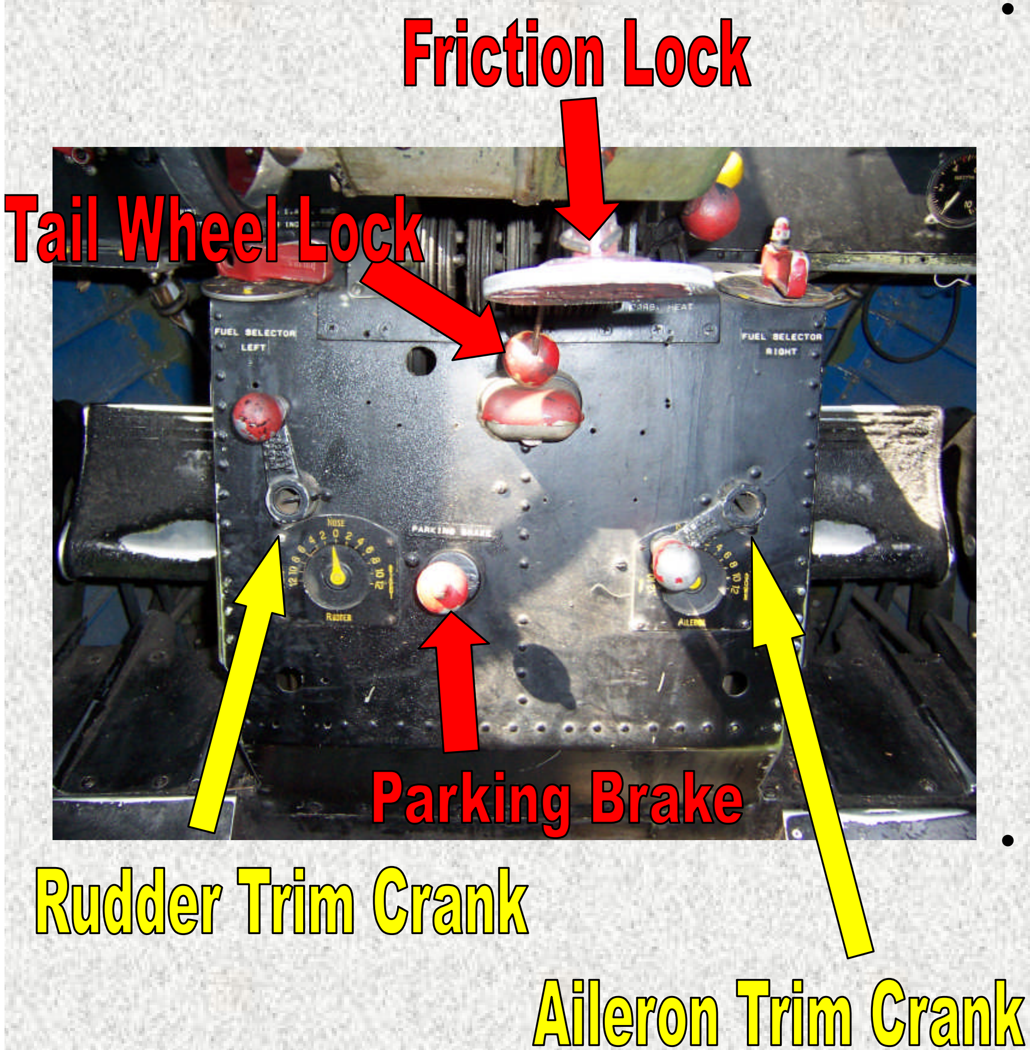
- On the far left you have the elevator Trim Tab Wheel
- The "*White*" knob controls are your Propeller Control Levers. Full forward is Low Pitch and all the way back is High Pitch
- The center two "**Black**" knob controls are your Throttle Levers.
- The "***Red***" knobbed controls are your Mixture Control Levers. It has four positions: 1) Idle Cut-Off, 2) Auto Lean, 3) Auto Rich, and 4) Emergency. Note: Auto Rich and Auto Lean are sometimes called, respectively, "Takeoff and Climb" and "Cruise."
- The "***Yellow***" knobbed control is your Carburetor Air Control Levers. The "***Red***" knob is the Carburetor Air Lock Lever. As pictured the Carburetor Heat is Cold and Locked. In order to engage Carburetor Heat you must first push forward the Lock lever and pull the "*Yellow*" controls rearward.
- On each side of the Pedestal you have a separate Fuel Tank Selector. The one on the Left is for the Left engine and the one on the Right is for the Right Engine. The Fuel Tank Selector displays five positions: Left Main, Right Main, Left Aux, Right Aux, and Off.

Right Overhead Panel



- On the left side of the panel you have the Right engine Starter and Fuel Pump switches.
- On the top of the panel you have the Left and Right engine Oil Shut-Off valve.
- The "***Red***" circular shaped button is your feather button and the "***Red***" rectangular Flip switch label "Fire" is your Fire Extinguisher switch.
- You have the Interior Aircraft Lights just to the right of your fuel pump switch and your Generator switches to your far right.
- Note: Leave the Generator switches in the "ON" position.
- Above the Generator switches are the Generator Voltmeter gauges (See Run-UP)
- And of course it's always nice to have the handy pen or two to copy down your clearances.

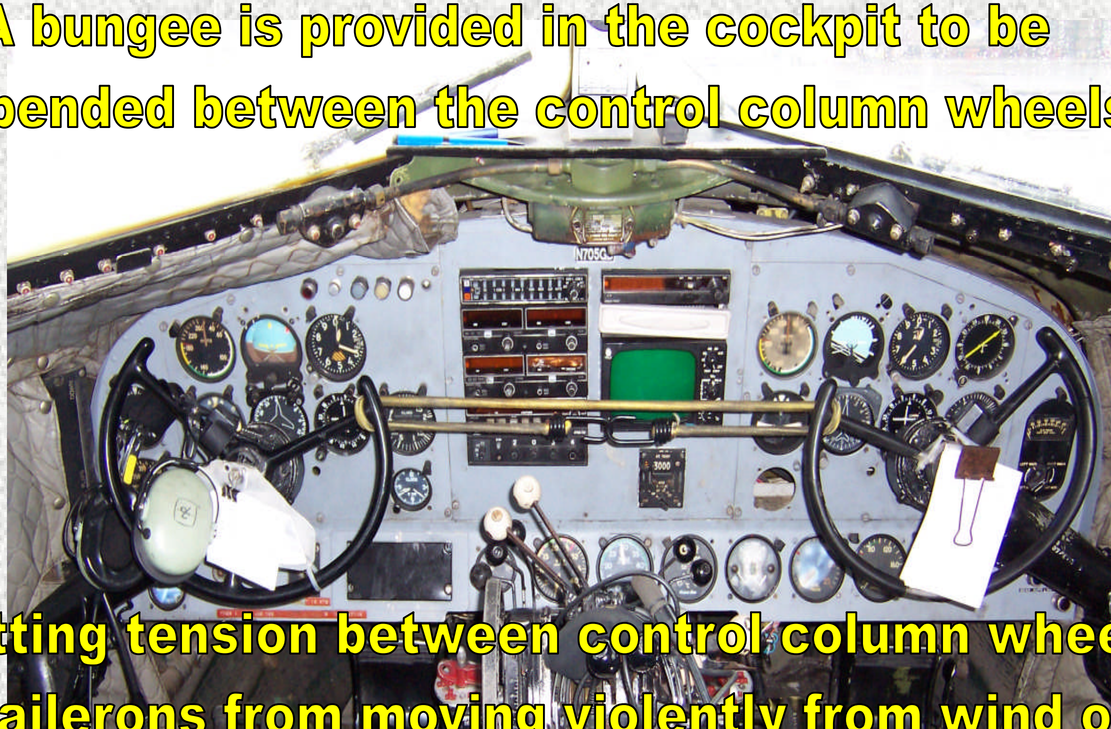
Below the Pedestal



- The Large "***Red***" circular lever is the Throttle Lever Friction Lock.
- The round "***Red***" centered knob is your Tail Wheel Lock Lever.
- On the DC-3 you have four Trim Tabs (1-Aileron, 2-Elevator, 1-Rudder) and three Trim Tab controls. The elevator Trim Tab Wheel as discussed earlier and two on the lower portion of your pedestal. On the far left you have the Rudder Trim Crank and on the Right you have the Aileron Trim Crank. On the Rudder Trim Crank, To trim the aircraft's nose: You crank Left to go Left and Crank Right to position the aircrafts nose to the right. On the Aileron Trim Crank: You crank to the left for the Right Wing to go up and crank right for the right wing to go down. Note: Just remember to Crank the Aileron's toward the angle of bank. If the aircraft has a tendency to want to turn to the left, then crank the aileron trim crank to the left. If the aircraft wants to bank to the right then crank it to the right.
- The "***Red***" knob just to the right of the Rudder Trim Tab Indicator is your Parking Brake Control Knob. To set the Parking Brake push the brake pedals all the way down and pull out the parking brake knob. While holding the knob out, release the brake pedals. Reverse Order to release.

Control Columns

A bungee is provided in the cockpit to be suspended between the control column wheels

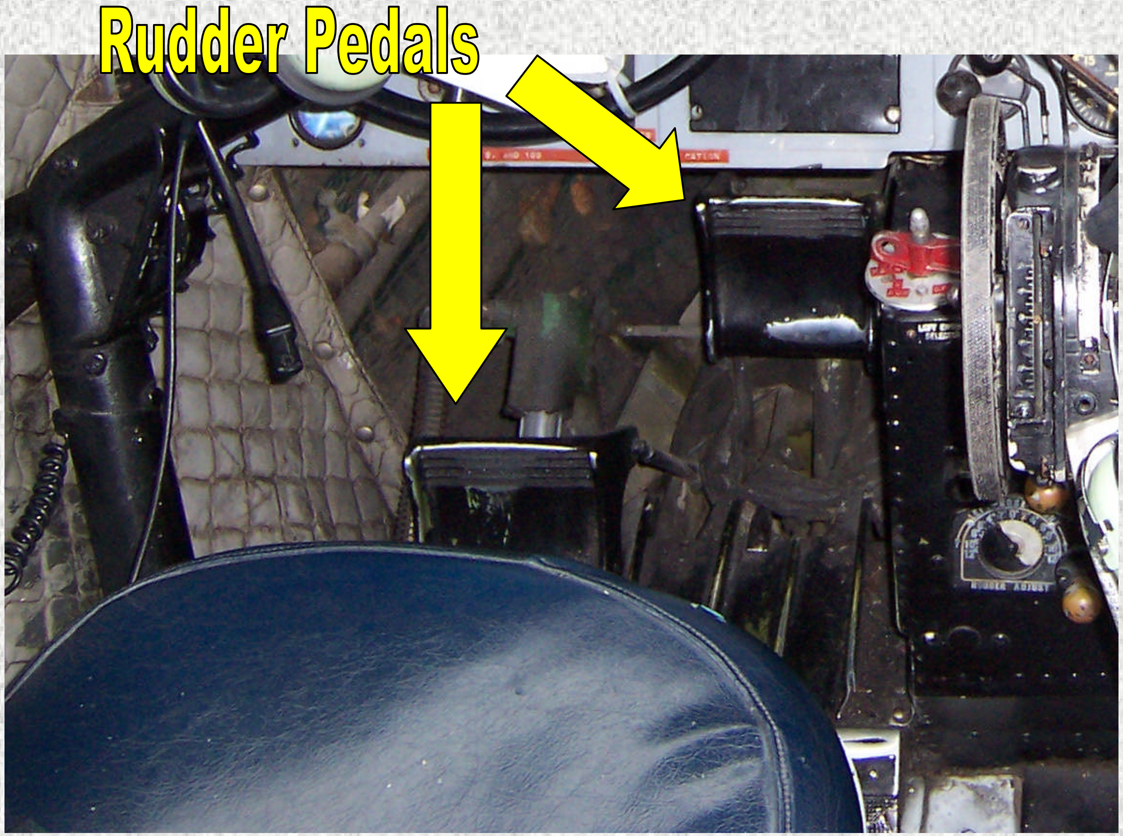


Putting tension between control column wheels prevents the ailerons from moving violently from wind or prop blasts

Dual control columns mounted forward of the pilot's seat provide mechanical control of the elevators and ailerons. Fore and aft movement of the column provides elevator control while a wheel for each pilot provides aileron control.

Rudder Controls

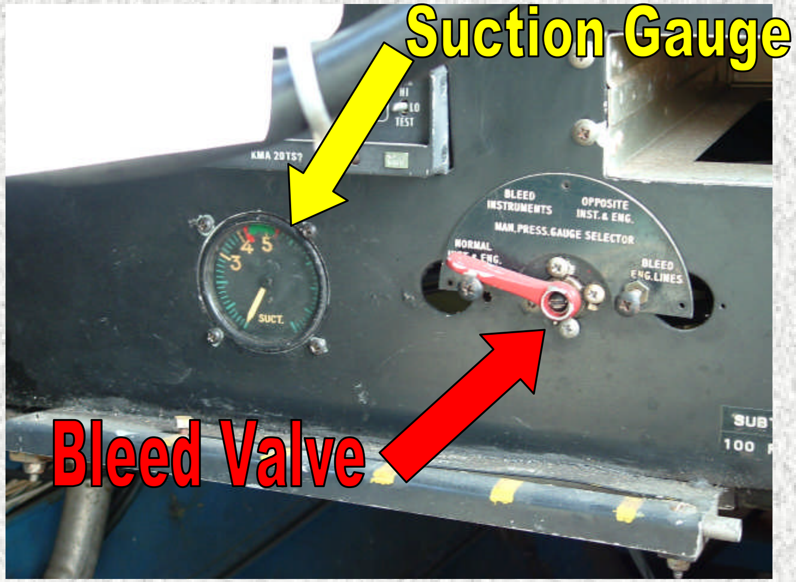
The Rudder is mechanically controlled by a duplicate set of hinged rudder pedals. Toe brakes are incorporated in the rudder pedals. The pedals can be adjusted fore and aft by adjustment devices located on the outboard side of each pedal. The primary control surfaces stop is located in the tail of the aircraft.



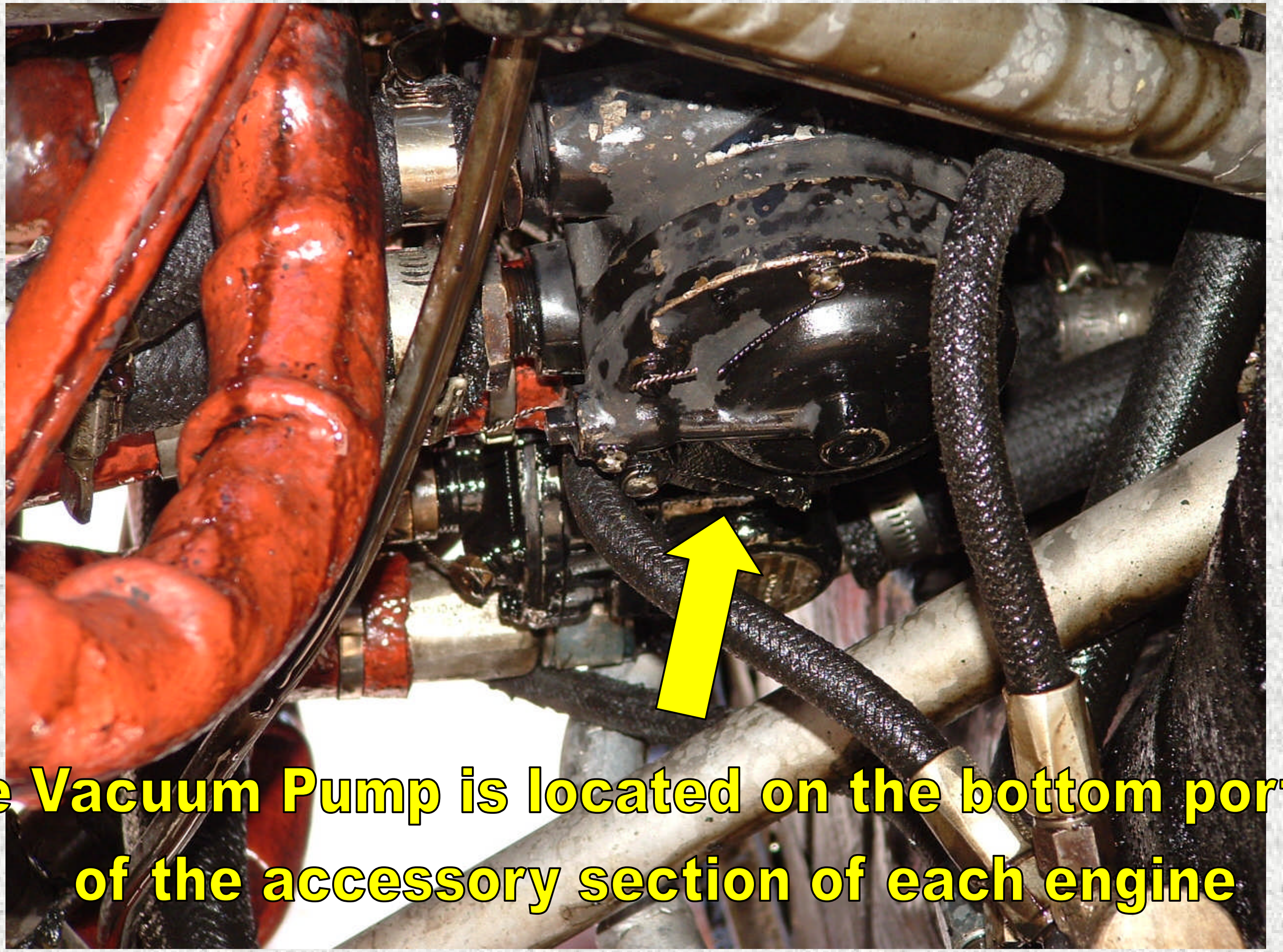
Vacuum System

A vacuum pump is mounted on each engine to furnish a vacuum source for the vacuum operated instruments. Normally the left engine vacuum pump furnishes suction for the left pilot's seat and vice- versa for the right pilot's seat.

A bleed valve for each turn and bank instrument is incorporated to adjust the suction for these instruments.

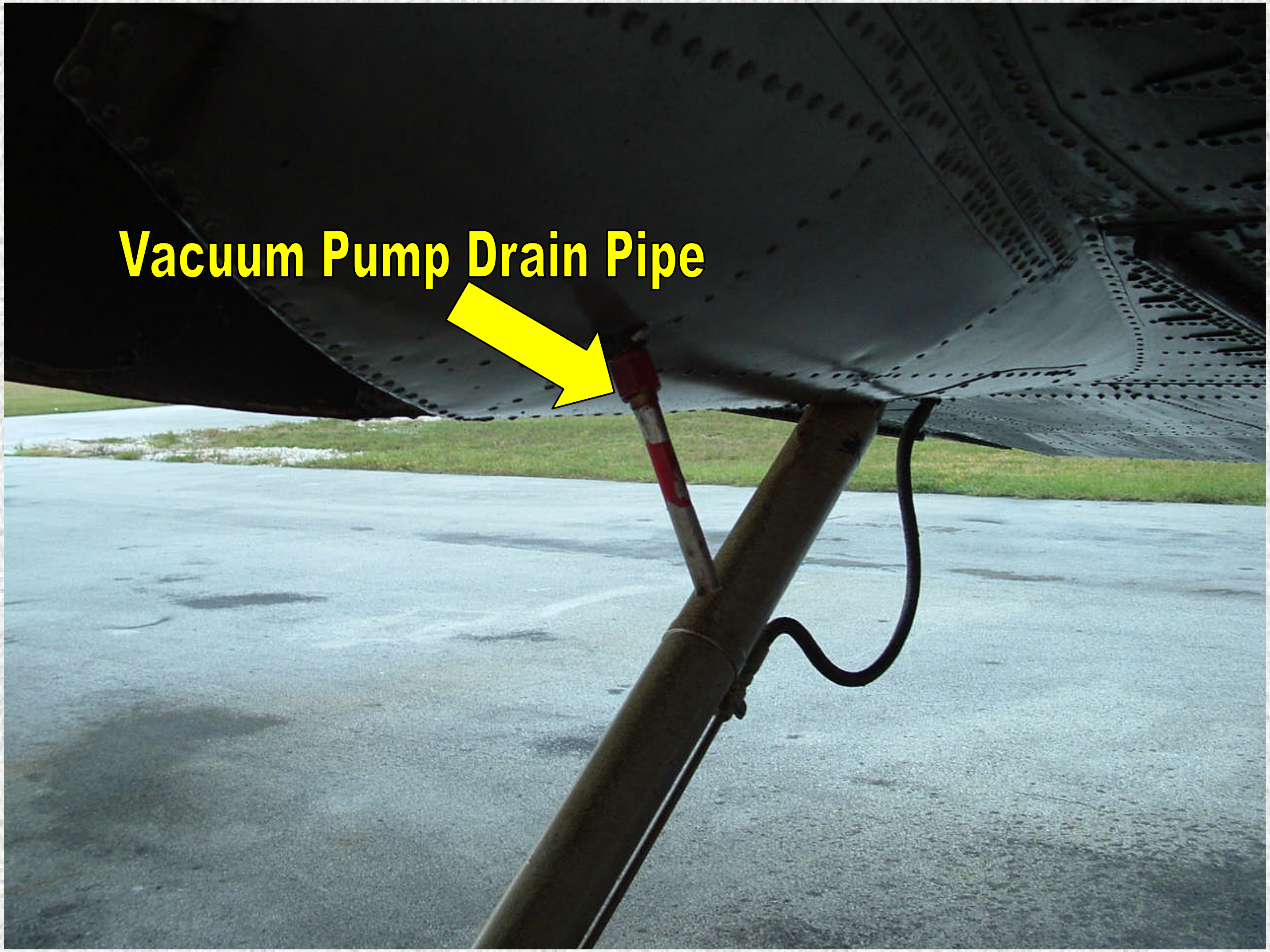


Vacuum Pump



The Vacuum Pump is located on the bottom portion of the accessory section of each engine

Vacuum System

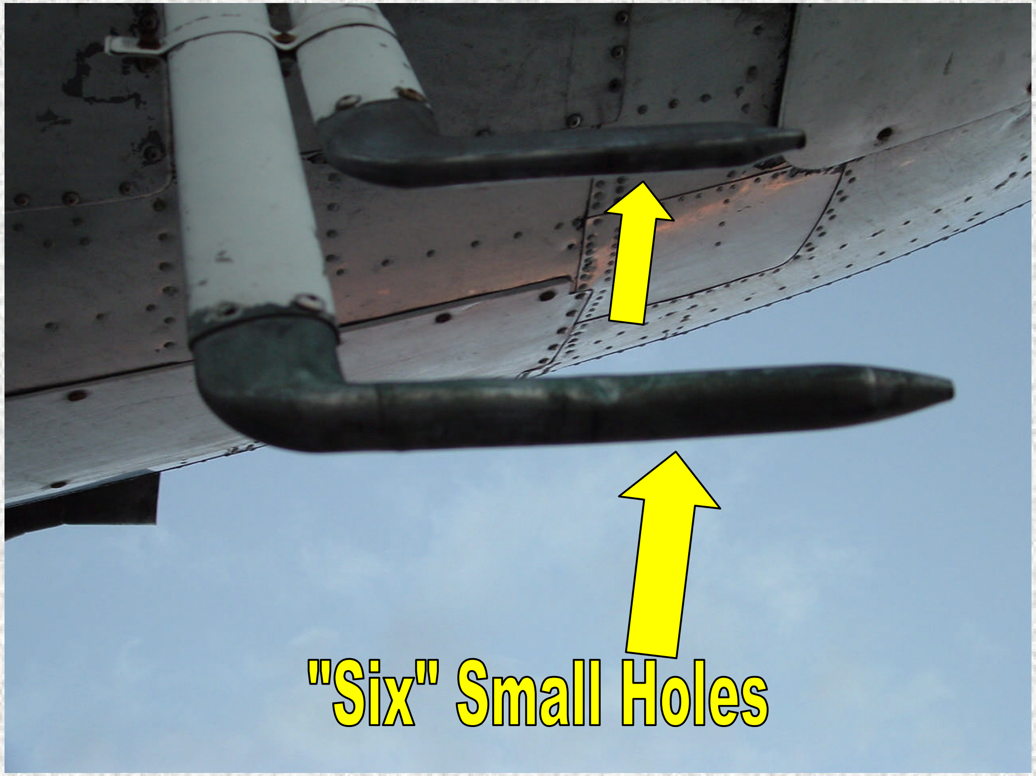


PITOT-STATIC-SYSTEM

The Pitot Static System instruments and equipment consist of two air speed indicators, two altimeters, and two rate of climb instruments. Two pitot static masts are mounted on the forward lower section of the fuselage, just forward of the battery wells. The mast heads are de-iced electrically to prevent blockage of either the pressure of static openings. In case of blockage of the static opening on either mast, the pilot is able to select an alternate static source which is taken from the right auxiliary fuel tank bay.

Pitot Static Masts

PITOT-STATIC-SYSTEM



Each pitot mast utilizes six small holes drilled into the outer shell of he mast. This pressure is then routed through tubing to a manifold, which is in turn connected to the air speed, altimeter, and rate of climb instruments. The air speed indicator must utilize ram pressure in conjunction with static pressure; consequently, each pitot mast has an open end directed into the air stream, which is then routed to the air speed indicator only.

PITOT STATIC SYSTEM

In case of blockage of the static opening on either masts, the pilot is able to select an alternate static source which is taken from the right auxiliary fuel tank bay.

Subtract 10 kts from I.A.S.

and 100 ft. from Current Altimeter Indication

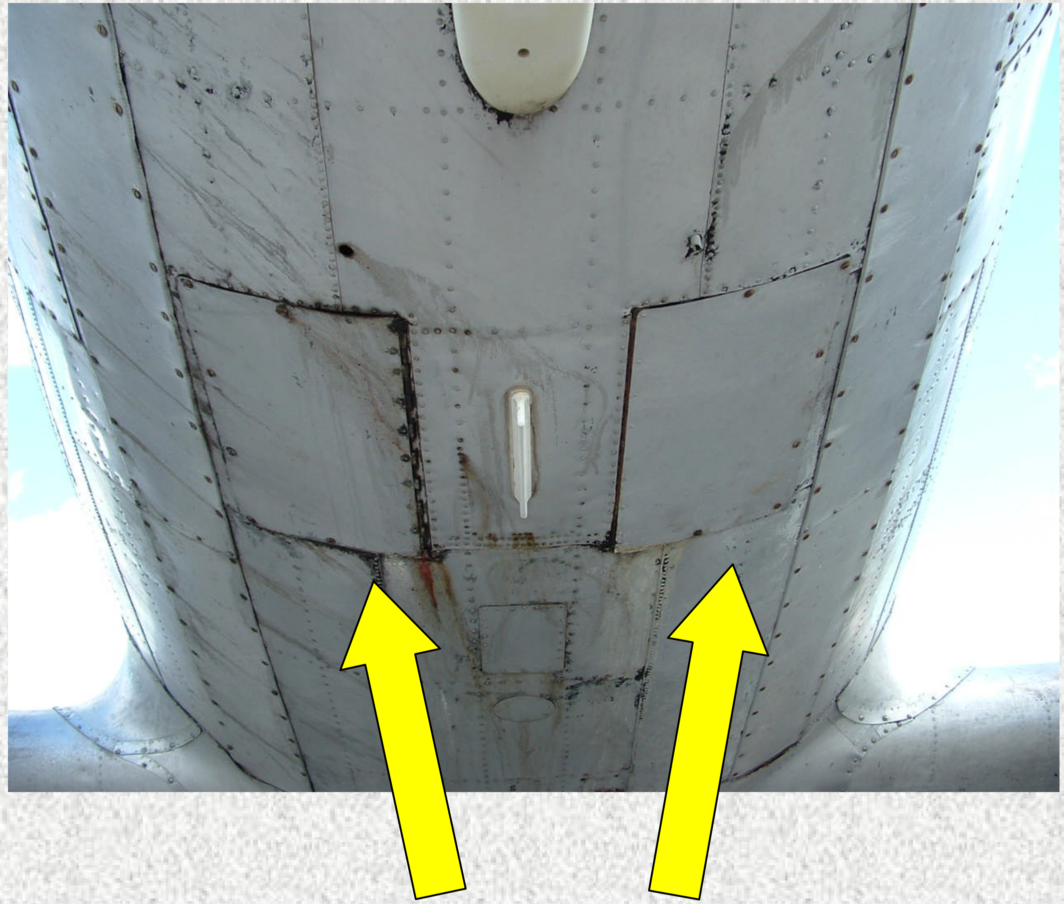
Engage switch in the down positon for alternate static source

Electrical System

- **General:** Electrical installations in the DC-3 type of aircraft are single-wire, ground return systems, except where instrument deflections may occur. The DC system is a 24 volt, single-bus system with two engine-driven generators in parallel and two 12-volt batteries in series. Panels above the cockpit windshield contain switches controlling heater, pitot heaters, lights, propeller feathering pumps, engine starters, primers, and radio equipment. Two ammeters are also mounted in the right hand control panel.
- Note: Spare fuses and light bulbs are stowed in a box behind the F/O head. The spare landing light bulb is stowed in a box right side of companionway overhead the jump seat position.

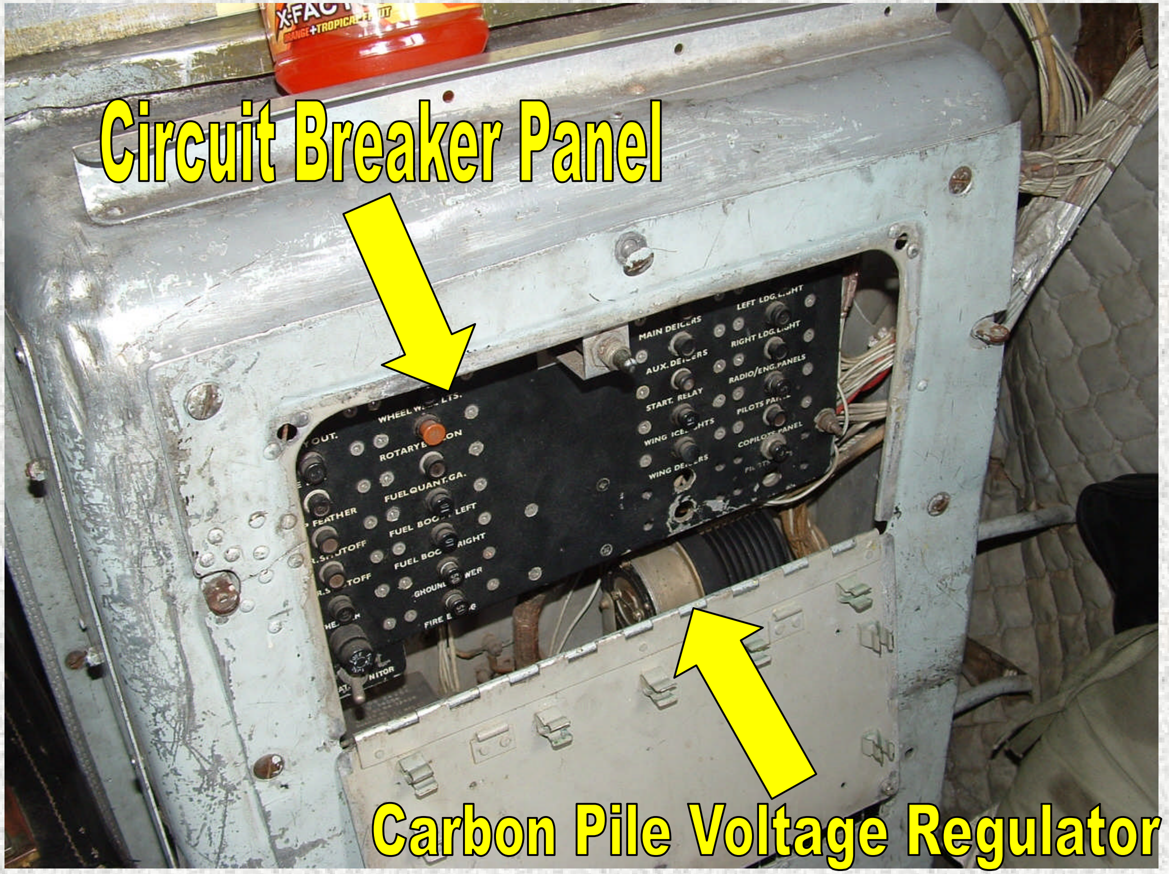
Electrical System

Two 12 volt/88 ampere-hour capacity storage batteries are located in the bottom of the fuselage a short distance forward of the leading edge of the wing and just aft of the pitot tubes. Each battery is mounted on a platform which may be lowered until the battery is clear of the airplane. Special terminals on the batteries plug into receptacles in the fuselage so that when the batteries are raised into position they are automatically connected into the system. Under normal conditions the batteries are just an additional load on the generators, the size of the load depending on the state of charge of the batteries. The generators, when charging, feed all electrical loads.



Battery Location
in the lower fuselage

Main Electrical Junction Box



The main electrical junction box is installed on the forward side of the port side bulkhead of the aircraft. It houses various electrical components such as Circuit Breaker Panel and Voltage Regulator.

Generator Field Flashing

Caution:

DO NOT FLASH THE GENERATOR IF VOLTAGE IS INDICATED

On the lower portion of the circuit breaker panel are two Generator field flashing switches. In the event voltage output is not indicated you can flash the respective generators by depressing the two red buttons momentarily. You can also flash the generator by attaching a wire from a power source to the “A” tab of the respective voltage regulator (voltage regulator removed) momentarily. *You should see a spark!* Refer to the Maintenance manual for this procedure.

Electrical System

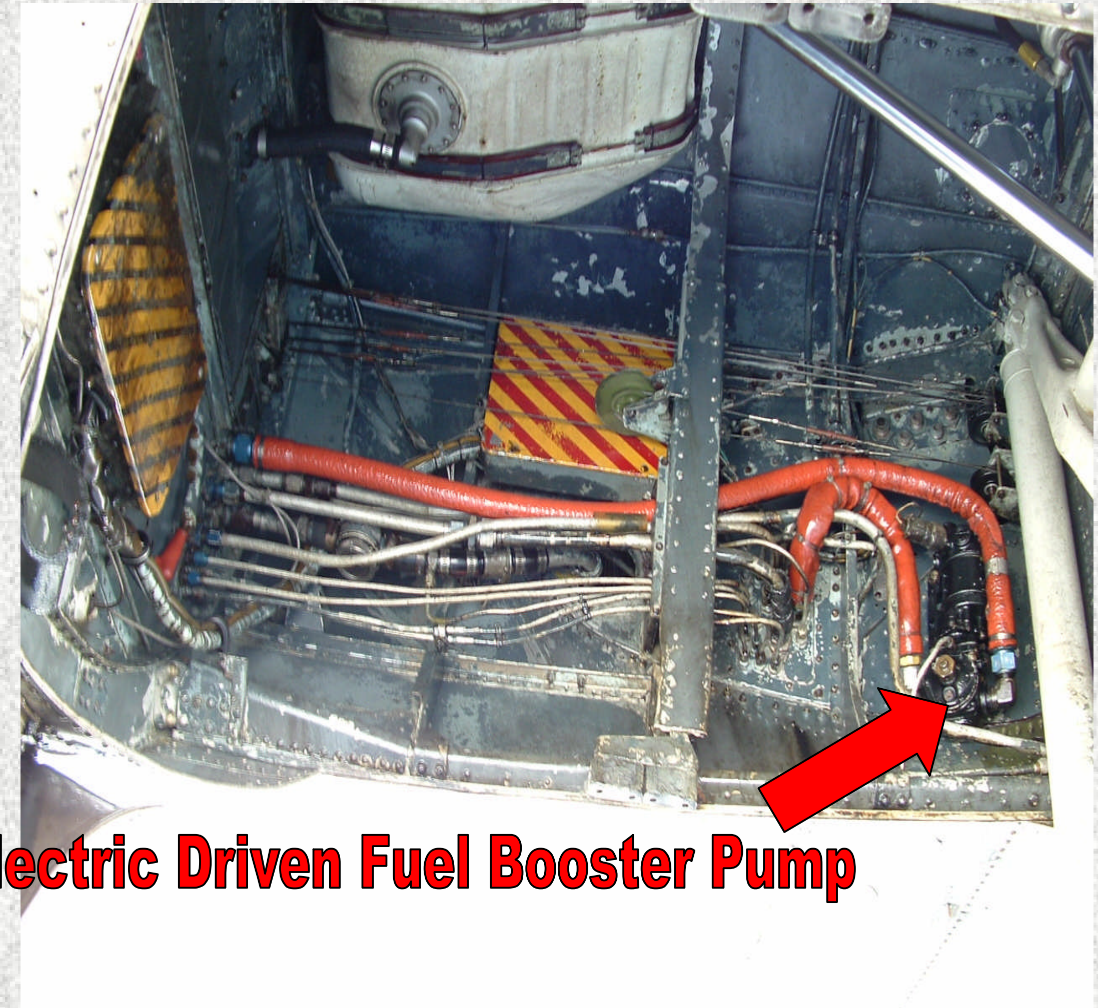
<u>Voltage Regulator</u> – Two generator voltage regulators are installed in the main companionway just aft of the forward of the "Hamburger Door" and are held in place by quick-release clamps which permit them to be removed easily. Each regulator is adjusted according to the procedure outlined in the DC-3 Maintenance Manual.

Voltage Regulator
(Solid State)

ELECTRICAL SYSTEM

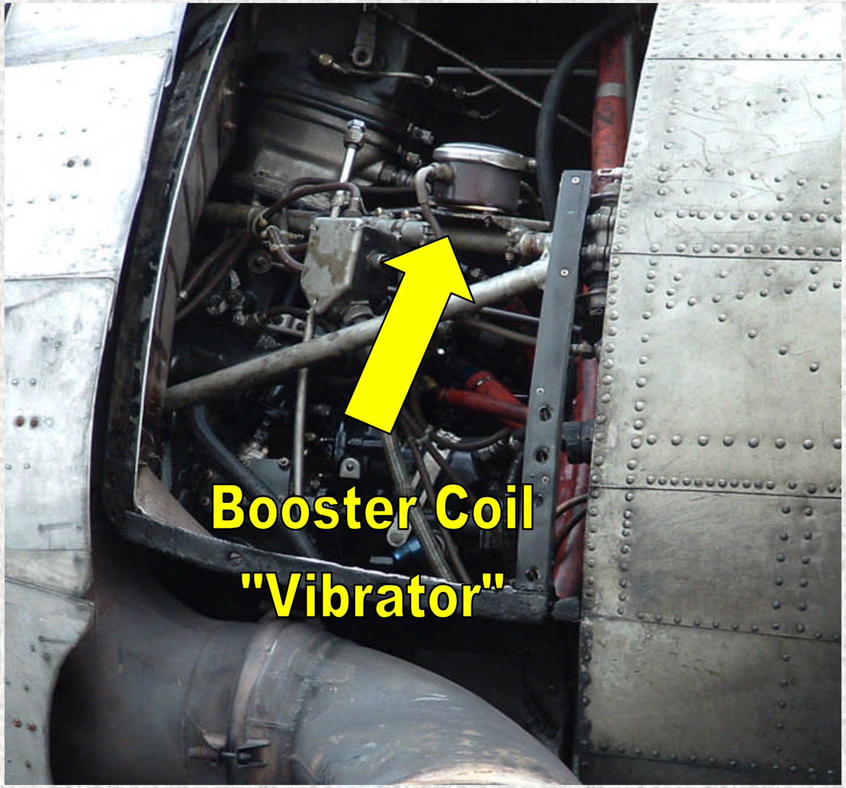
Each **Fuel booster Pump** circuit consists of an electrically driven pump. The switch and circuit protector are located in the same locations as stated above.

Junction boxes are installed in several locations in order to provide central connecting points for power sources and systems. The main junction box is located on the bulkhead just aft of the forward baggage loading door.



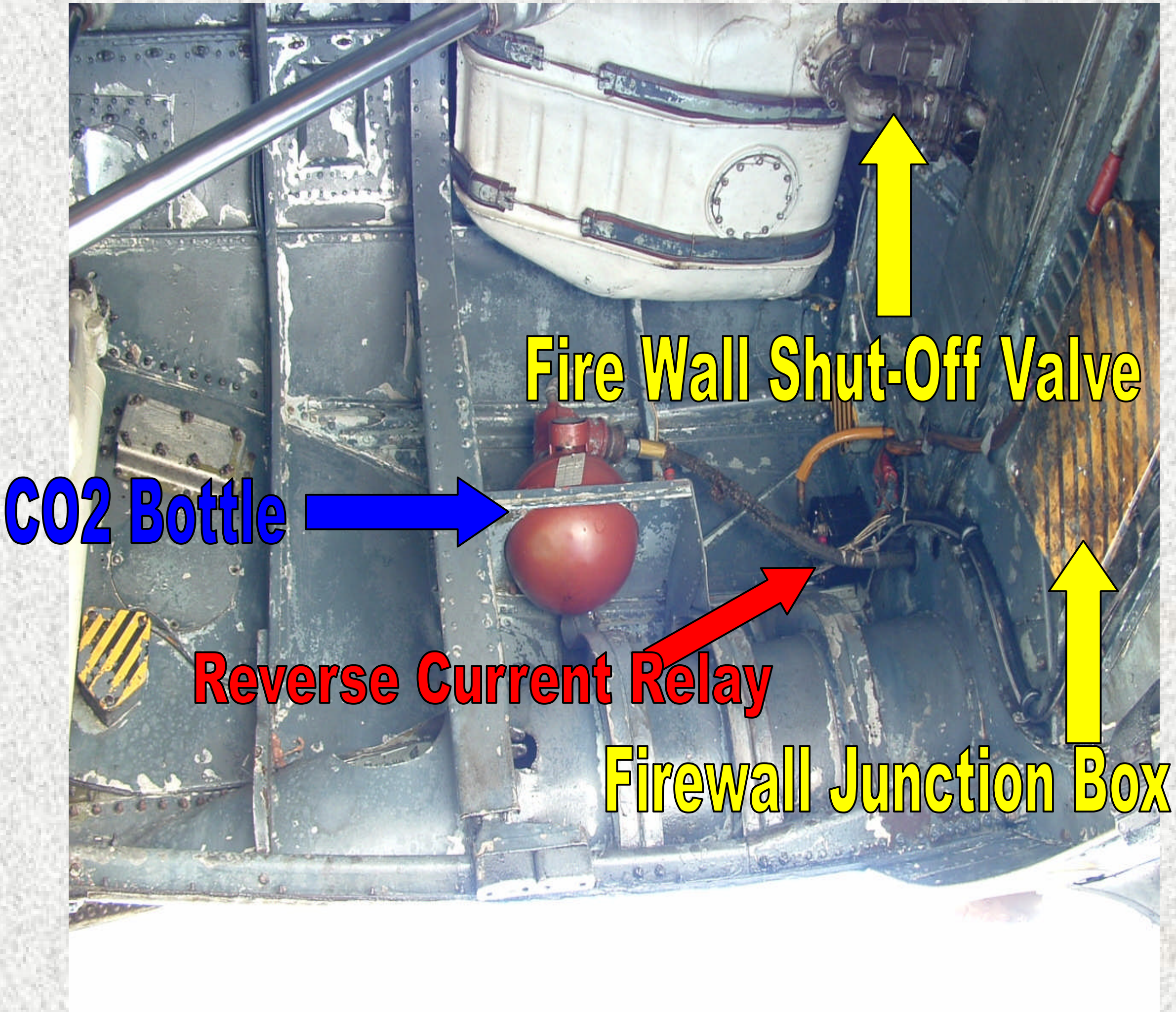
ELECTRICAL SYSTEM

On most aircraft the Booster Coil is located on the engine mount



A **booster coil** is used on each engine to assist in starting. The Spring-loaded control switch is located on the overhead panel. On some aircraft, the “Start” switch and “Booster” switch are incorporated into the same switch. A circuit protector is located in the main junction box.

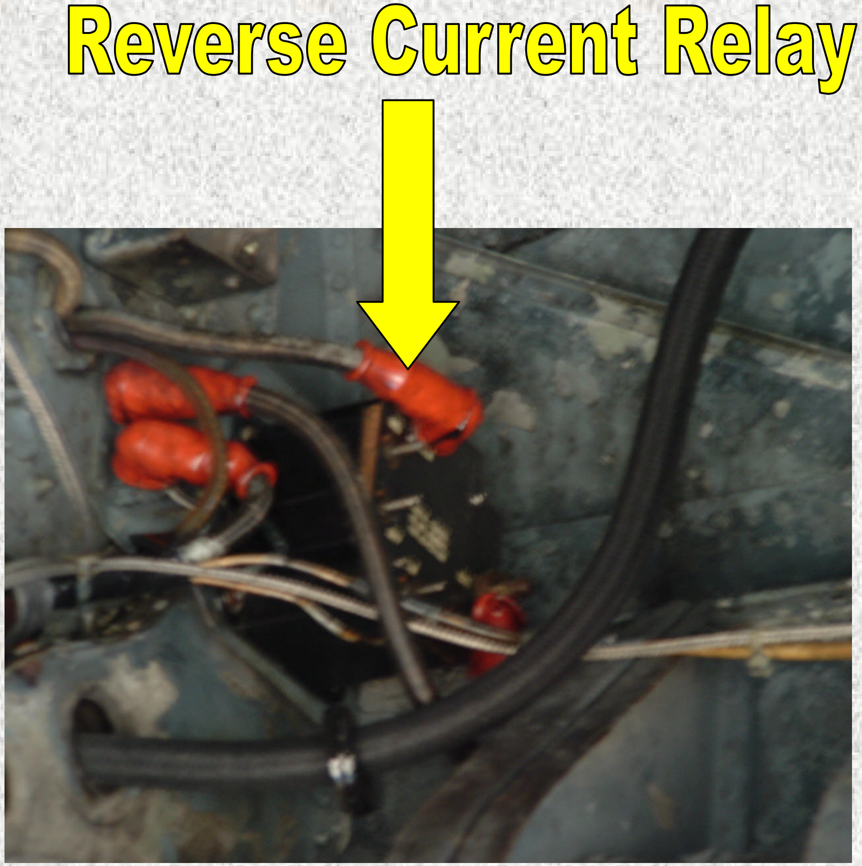
ELECTRICAL SYSTEM



<u>Starter:</u> A direct cranking electrically driven starter is mounted on each engine. Operating the starter switch energizes the starter relay located in the firewall junction box, which furnishes current to the starter motor. Each engine nacelle is provided with one **<u>CO2 extinguisher</u>**. Upon being discharged, the compressed liquid in the cylinder rushes in one burst to the outlets in the perforated rings in the affected engine. One ring completely encircles the accessory section of the engine (zone2); and one is a half ring behind the fire wall in the wheel well (zone3).

Electrical System

Each generator is connected to the bus through a reverse current relay and a circuit breaker switch. The reverse current relay automatically connects the generator to the bus when the generator speed is sufficient to produce a voltage slightly higher than that of the batteries. It also prevents discharging the batteries through the generators when the generators are running at low speeds or stopped. A voltage regulator cuts resistance in and out of the generator field to automatically maintain a constant voltage. A balancing circuit is installed to assist the voltage regulators in uniformly distributing the load to the operating generators. This balancing circuit is controlled by either reverse current relay manual switch.



Electrical System

Inverters – One 115V, 400 Cycle Inverter is providedto supply alternatingcurrent (AC) for radio equipmentonly.

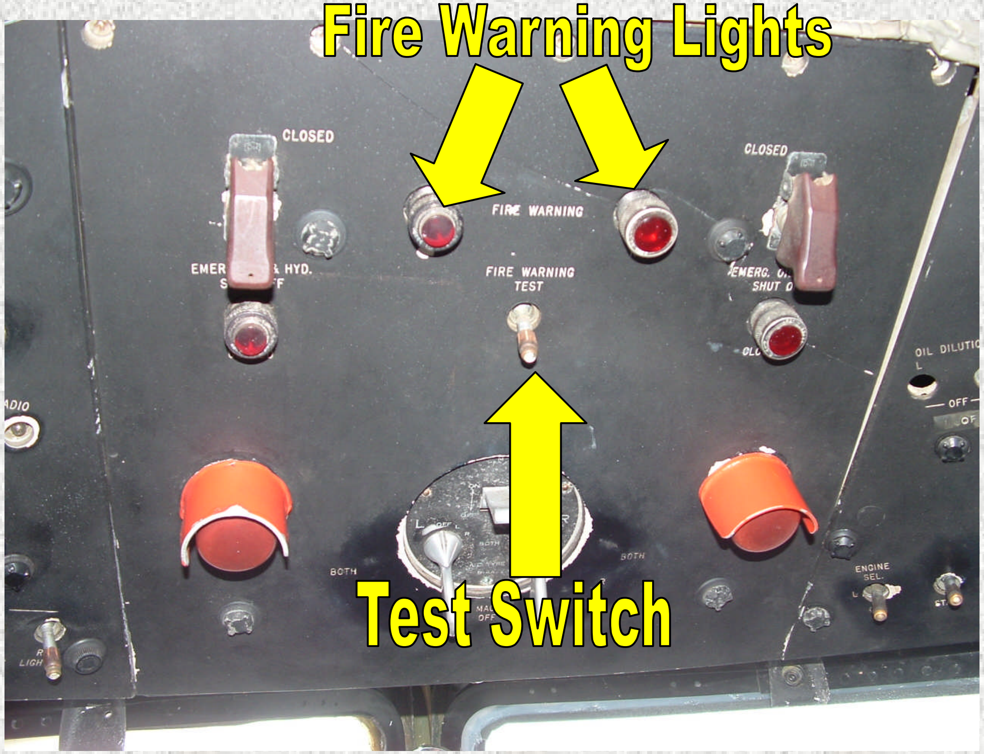
Most modern day DC-3's have removed the Inverters from the Electrical System

Engine Fire Extinguisher System

The heart of the engine fire extinguishing system is the Lux CO2 cylinder and remote control valve assembly which provide flame-smothering carbon dioxide, the pressure required to distribute the liquefied gas to the engines, and a means of remote control

To operate the engine fire extinguisher system, set selector valve in control panel assembly for the engine which is on fire then pull upward on the adjacent control handle.

Fire Warning System



The slave relay is a simple on-off relay to operate the fire warning lights

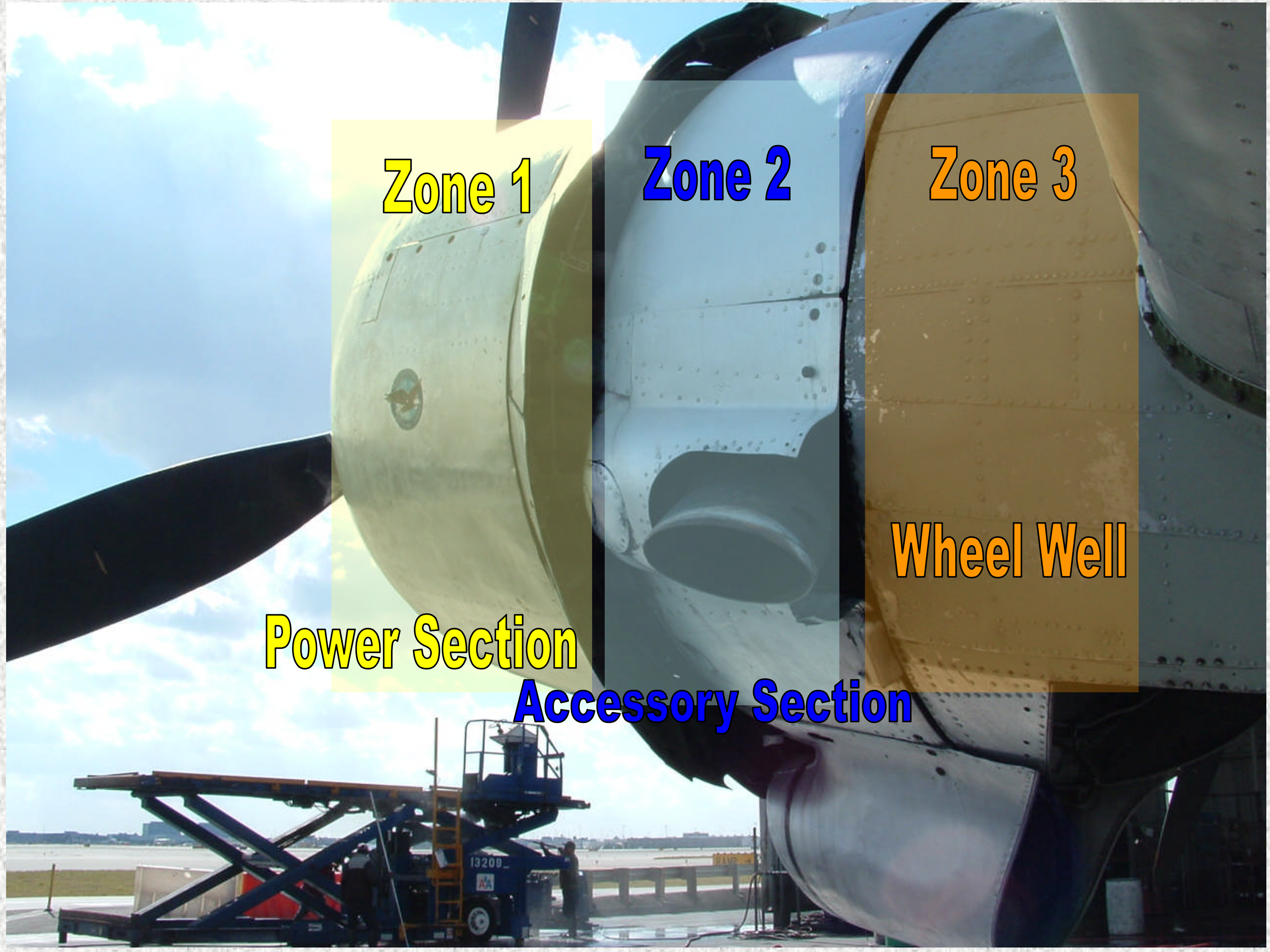
Depressing the test switch supplies 28 volts to heat a thermocouple in the thermal test unit

The Fire Warning System is used to warn the pilot of fire conditions or overheating on either engine. Warning is given by light (one for each engine) located on the main or overhead instrument panel. In a proper installation , no safe operating temperature can cause an alarm since the electrical characteristics of the detectors are not affected by ambient temperature, nor by gradual rises due to engine warm-up or power runs.

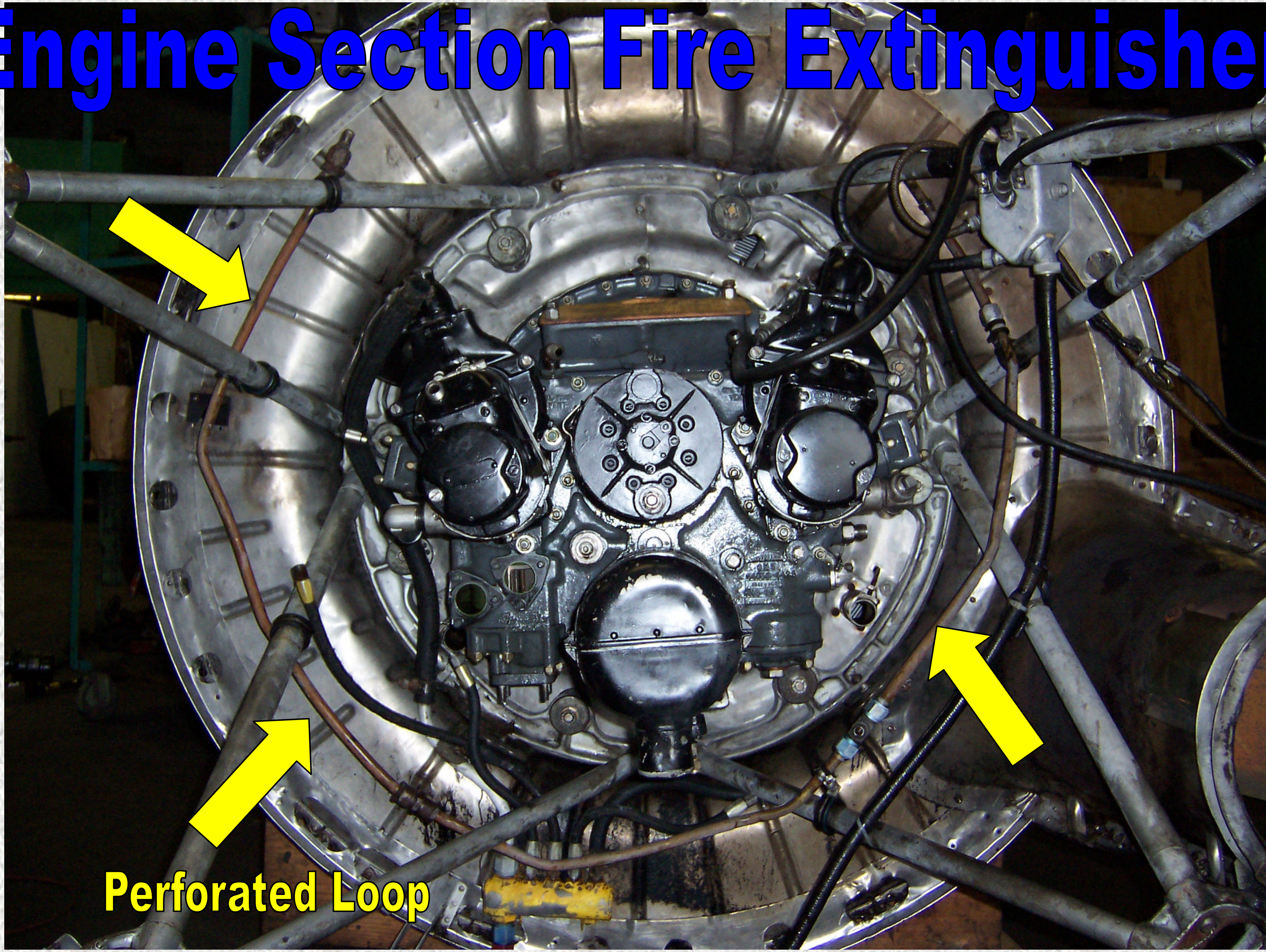
Detector Thermocouples – These are located back of the "dish pan" in the accessory section, and on the forward side of the fire wall. The sensing unit of the system consists essentially of two wires of dissimilar metals. When the temperature of the unit rises at a abnormal rate, a very small amount of electricity is generated by the dissimilar metals and is delivered to the "sensitive relay."

Sensitive Relay – This relay is mounted in the "Edison Box". It is sensitive to the very small amounts of current generated by the thermocouples, but it is not rugged enough to operate the warning circuit. The sensitive relay operates a 28 volt "slave relay."

ENGINE FIRE ZONE AREAS



Engine Section Fire Extinguisher



ENGINE FIRE EXTINGUISHER SYSTEM

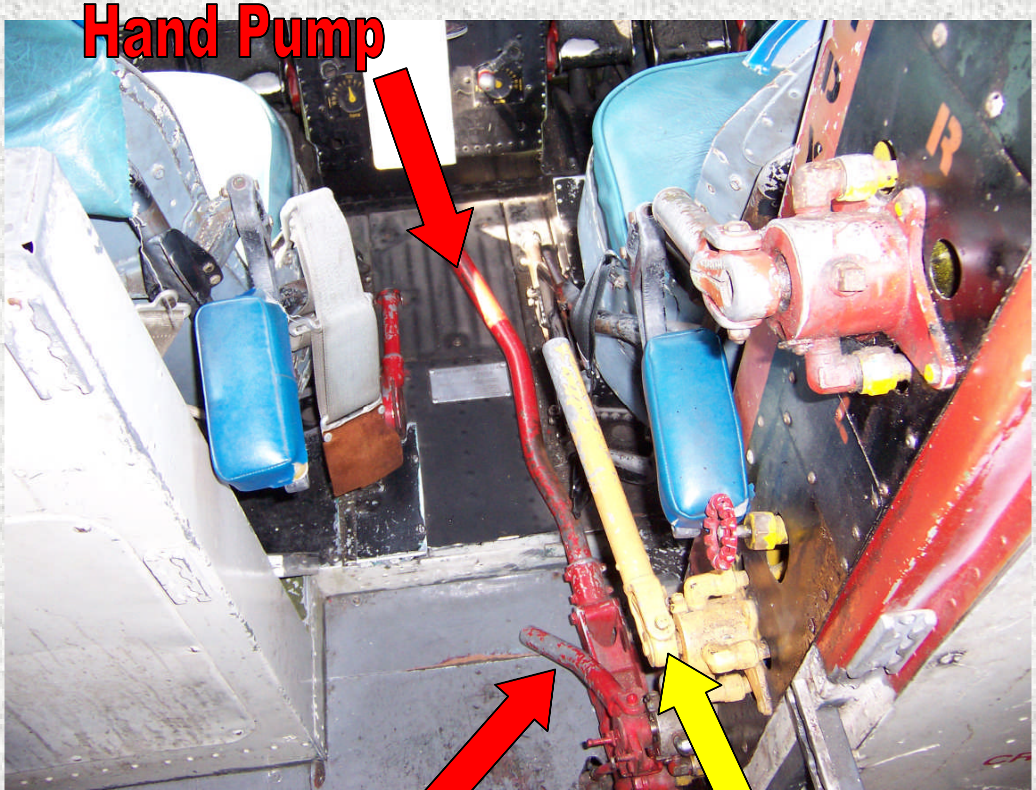
The DC-3 is equipped to fight engine fire instantaneously while in flight or on the ground. The entire system consists of a CO2 cylinder and remote control valve assembly, which provides the flame-smothering carbon dioxide and the pressure required to distribute the liquefied gas to the perforated loops which encircle the engine, and terminate at the carburetor air intake throat. The CO2 cylinder is a light-weight steel cylinder with a remote control valve threaded into its neck. They cylinder has a capacity of 7.25 lbs of carbon dioxide in a compressed liquid form. The assembly is installed vertically on the floor behind the Co-pilot's seat and the cylinder is clamped to the wall by a bracket designed to withstand violent maneuvers and landing shock.

Attached to the remote control valve is an outlet for a safety vent line. The safety vent line terminates on the forward right hand side of the aircraft. Installed in the overboard end of the safety line is a small red celluloid disk. If the bottle should be discharged prematurely by thermal expansion, the disk will be blown clear of the vent line; however, this particular disk will not be blown out due to manual operation or discharge.

A quick check to determine if a bottle has been discharged manually is to look at the small window in the side of the bottle actuating mechanism. If the bottle has been discharged manually, an "X" appears in the window.

The CO2 cylinder is for combating fires in Fire Zone 2. There is no provisions for combating fires in Zones 1 or 3. However, some DC-3's have a half ring behind the fire wall in the wheel well (Zone 3).

Hydraulic System



- **Description:** A pressure accumulator-type hydraulic system is installed. The hydraulic system is used to operate the landing gear (lower ***short red handle***), wing flaps (upper *yellow handle*), cowl flaps, windshield wipers, and wheel brakes. The system has a capacity of 28 quarts of type MIL5606 hydraulic fluid. Fluid is furnished by a reservoir with a capacity of 13 quarts. The engine-driven hydraulic pumps pressurizes hydraulic fluid to a predetermined valve, controlled by the system regulator and relief valve. The fluid is stored under pressure in the system pressure accumulator from which it is discharged into the system when the demand arises. Shut off valves control the fluid flow to the actuators. These valves may be positioned to an off or neutral position which isolates the system pressure from the actuating cylinders.

- An emergency hand pump ***(long red handle)*** to the left of the co-pilots seat) is incorporated with a fluid supply being taken to the 3 quart reserve below the level of the stand pipe in the system reservoir.

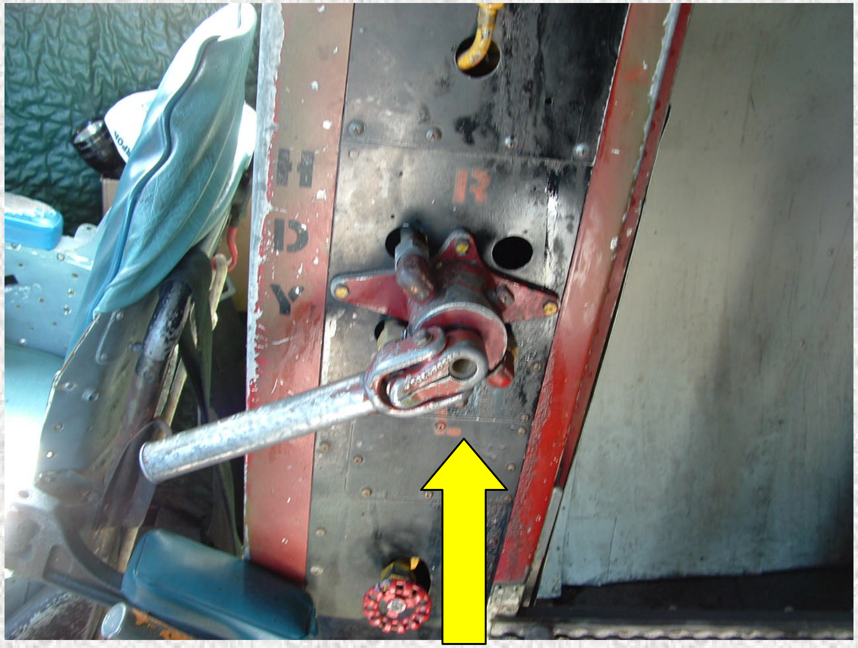
Hydraulic System

General: The hydraulic system on the Douglas DC-3 is of the pressure accumulator type and serves to operate the landing gear, brakes, wing flaps, cowl flaps, and windshield wipers. Six gallons of fluid is the total capacity of the system. Two engine-driven hydraulic pumps are installed, one on the accessory drive section of each engine, to furnish pressure for the hydraulic system. In the pressure discharge line of each pump is installed a check valve to prevent reverse flow in the event of a malfunctioning pump. During normal operation the right engine-driven pump supplies fluid pressure to the hydraulic system. When the right engine pump is furnishing pressure for the hydraulic system, the left pump by-passes, and vice-versa. Provision for selecting either pump to supply hydraulic pressure to the system is by means of a selector valve located on the hydraulic panel.

Hydraulic System

Pressure in the system is controlled by means of a pressure regulator which is set to maintain a system operating pressure of ***600-875*** pounds per square inch. If the regulator fails, a system relief valve is installed to relieve the system of pressures over ***1000*** psi. This valve by-passes the excess fluid to the reservoir. The valve closes when the system pressure decreases to ***950*** psi. If for some reason, the relief valve does not function, the pump drive shaft will shear when the pressure reaches ***1500*** psi.

Hydraulic Pump Selector Valve

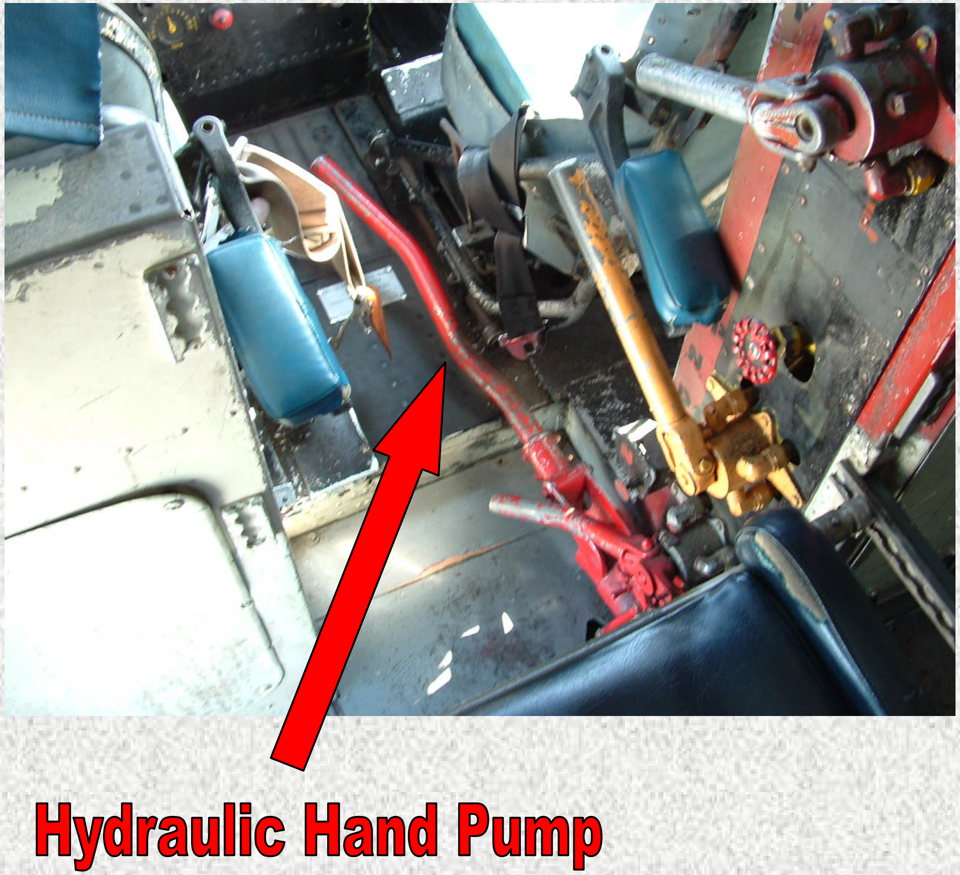


Selector Valve

The hydraulic pump selector valve, located on the hydraulic control panel, controls the flow of fluid from the hydraulic pumps into the system. The valve is connected to both hydraulic pump pressure lines. When the valve control handle is in the normal alternate position, the system is supplied with pressure from the right engine-driven pump, and when the handle is in the aft position, the pressure is supplied by the left engine-driven pump. The valve controls only the direction of the fluid flow and does not shut off the flow at either handle position. However, if one engine fails, the shifting of the handle to the alternate position will supply the system with pressure from the alternate pump.

The control handle operates in a notched quadrant, and it is necessary to lift the handle slightly before moving it from one position to another. It is advisable to make all movements of the handle quickly to reduce the amount of interflow in the system.

Hydraulic Hand Pump



The hydraulic hand pump is a double-throw piston type pump incorporated in the system for use when the engine pump fail to supply sufficient pressure, or when the hydraulic fluid (except reserve supply) has been lost. Ball check valves are provided to prevent reverse flow of fluid between strokes of the pump. The hand pump also serves to supply pressure for operation of hydraulic units when airplane is on the ground and the engines inoperative.

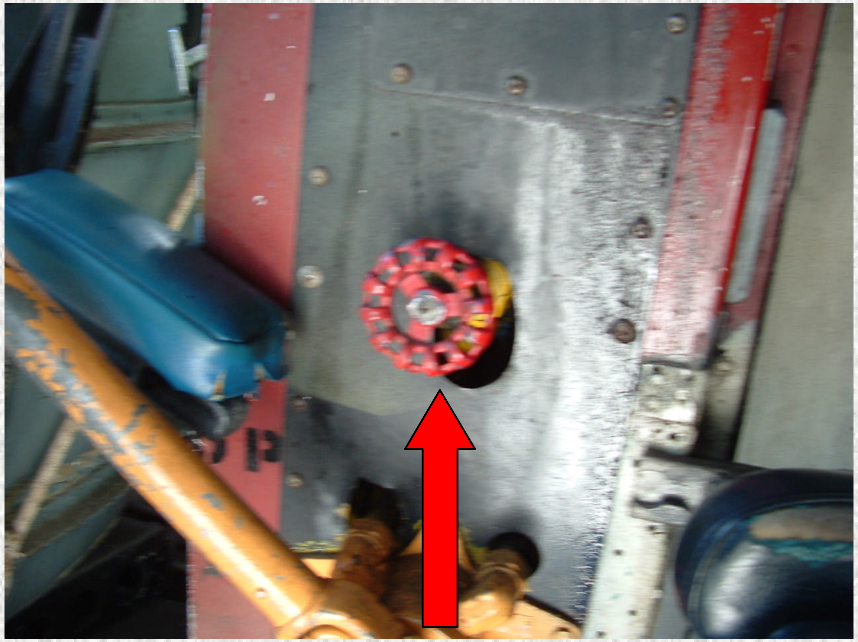
Auxiliary Hydraulic Pump

Just like the hydraulic hand pump, the Auxiliary (Electric) Hydraulic pump supplies pressure in the event the engine driven pump fails to supply enough pressure, hydraulic fluid loss, and when the aircraft is on the ground and the engines inoperative. The Auxiliary Hydraulic Pump switch is located on the overhead panel.

Auxiliary Hydraulic Pump Switch

Located on the Right Overhead Panel

Pressure Accumulator Shut-Off Valve (Star Valve)



Star Valve

The pressure accumulator shut-off valve is located at the bottom of the pressure regulator, with the control handle located on the hydraulic panel. It provides a by-pass around the check valve in the pressure manifold when it is desired to increase pressure in the accumulator by means of the hand pump. It is closed for all normal operation.

When fluid is lost, caution should be exercised when pumping up the accumulator with the Star Valve open, as the reserve of fluid may not be sufficient to provide the system pressure necessary for operation of the hydraulic units.

The Star Valve's main purpose is to allow maintenance personnel to build up pressure in the accumulator when the airplane is on the ground.

Pressure Accumulator

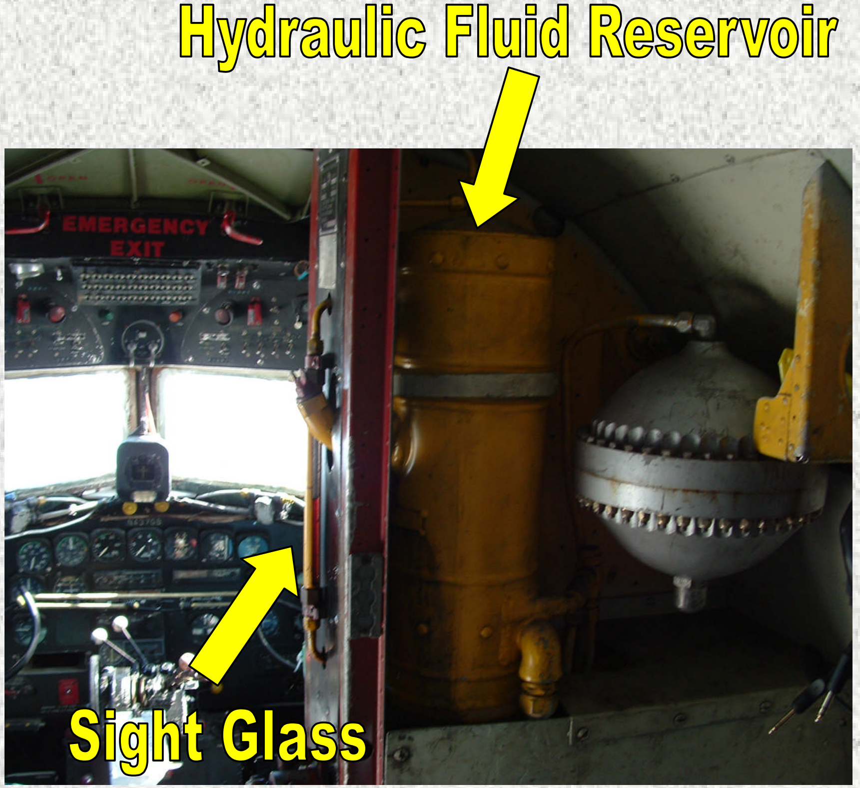
The pressure accumulator is a spherical metal container separated into two internal sections or compartments by a diaphragm. With the hydraulic system pressure at zero psi, one side of the accumulator is charged with air pressure to ***250*** psi. This compartment of air under pressure acts as a cushion to absorb shocks in the system when opening or closing a hydraulic component control valve. It also serves as an extra source of power when sudden demands are made on the system.

Pressure Regulator

The hydraulic pressure regulator is installed on the out-board side of the hydraulic control panel and functions to maintain the system operating pressure between ***600*** and ***875*** psi. When system pressure increases to ***875*** psi or more, the regulator unseats a ball check valve and allows fluid to flow into a return line to the reservoir. A check valve at the bottom of the regulator prevents any reverse flow from the pressure accumulator and the maximum operation pressure of ***875*** psi is maintained.

Hydraulic Fluid Reservoir

The hydraulic system fluid reservoir is a cylindrical container installed to the right of the hydraulic control panel with a filler neck that extends into the companionway. The reservoir incorporates a strainer assembly to filter the hydraulic fluid, and a baffle to separate the strained fluid from the fluid returned to the reservoir. A quantity sight gauge is located below the filler neck and indicates the fluid level in the reservoir. The outlet to the engine-driven pumps is a standpipe located above the bottom of the reservoir so that a 3 quart emergency supply of fluid remains for use of the hand pump. The outlet for the hand pump is at the bottom of the reservoir. Approximately 7 US quarts of fluid is available to the engine-driven pumps, and 3 quarts remaining at the bottom of the reservoir, are available for the use of the hand pump. The reservoir can be filled in flight from the reserve supply of fluid carried on board the airplane.



<u>Note:</u> Sight glass does not show all the fluid, just that above the standpipe. In order to test fluid level, it is necessary to spill all pressure in the system and then check sight glass for hydraulic fluid level.

Hydraulic System Operation

Fluid flows from the reservoir by gravity flow to each of the engine-driven pumps. With the engines operating, the fluid is returned under pressure to the hydraulic panel as registered on the individual pressure gauges. From the gauge manifold, the fluid passes through the filter to the pressure regulator, controlling the system pressure at 950psi, +/- 50psi. Whenever the system pressure is built up to the setting of the pressure regulator, the regulator directs the flow to the reservoir; therefore, the pumps continue to pump fluid through the reservoir until a demand is again placed on the system.

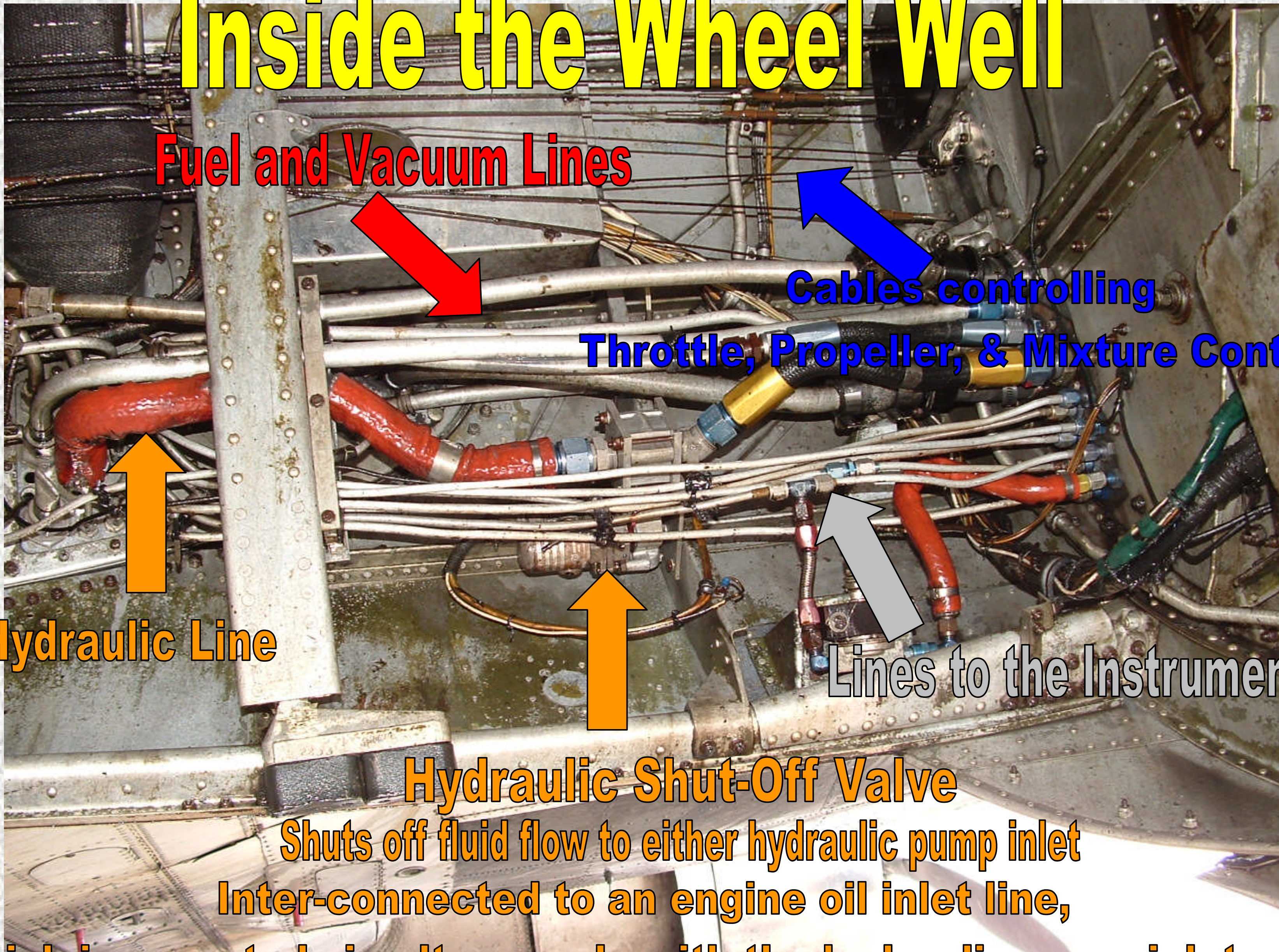
Should the pressure regulator malfunction over pressurizing the system, the system relief valve would open at 1100psi, +/- 50psi, and direct the flow back to the reservoir, protecting the system from excessive pressure buildup. The relief valve also protects the pressure system from excessive pressures, due to thermal expansion.

Hydraulic System Operation

From the pressure regulator, the fluid flows to the accumulator and on into the pressure manifold. A check valve isolates the accumulator from the pressure manifold, thus allowing flow only from the accumulator into the pressure manifold. The emergency hydraulic hand pump output is directed into the pressure manifold; therefore, the hand pump outlet is isolated from the pressure accumulator by the check valve. To “build up” pressure in the accumulator, it is necessary to open the Star Valve. This valve is normally closed to provide for fluid flow from the hand pump directly to the desirable system rather than to the accumulator. The actual pressure in the pressure manifold is recorded on the main hydraulic system pressure gauge.

The star valve is for maintenance purposes to charge the accumulator.

Inside the Wheel Well



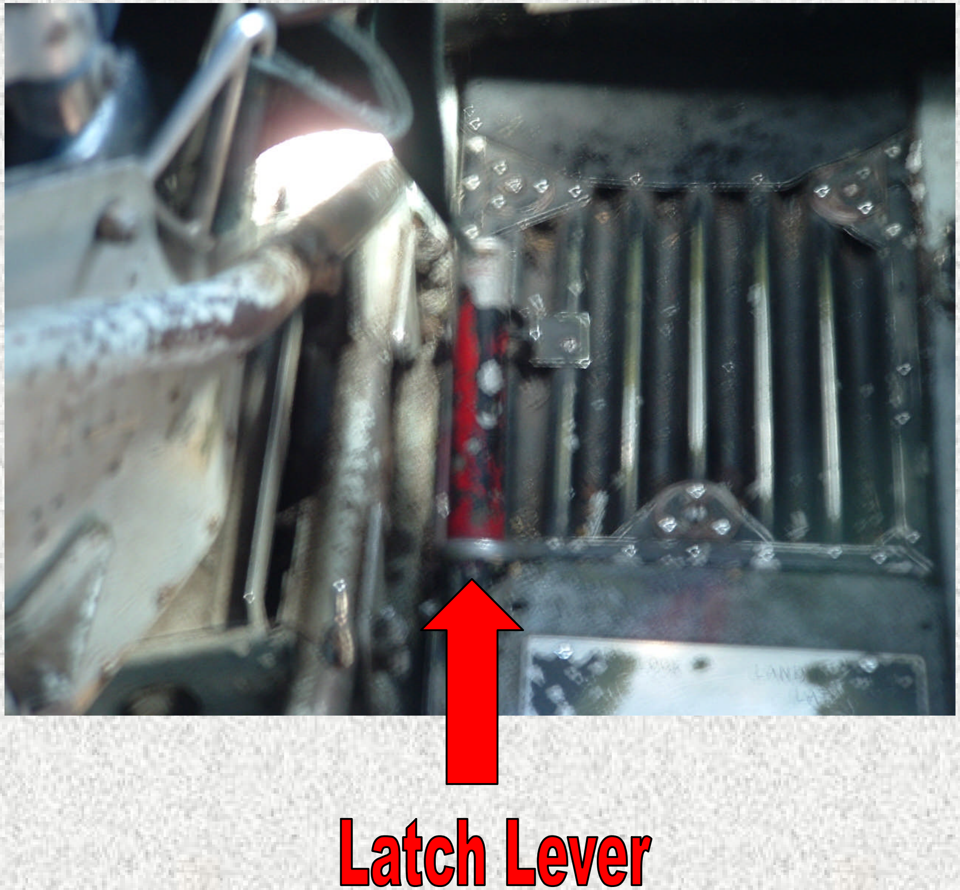
Shuts off fluid flow to either hydraulic pump inlet

Inter-connected to an engine oil inlet line,

which is operated simultaneously with the hydraulic pump inlet valve

"Fire Wall Shut-off" valves are normally open

Landing Gear Operation

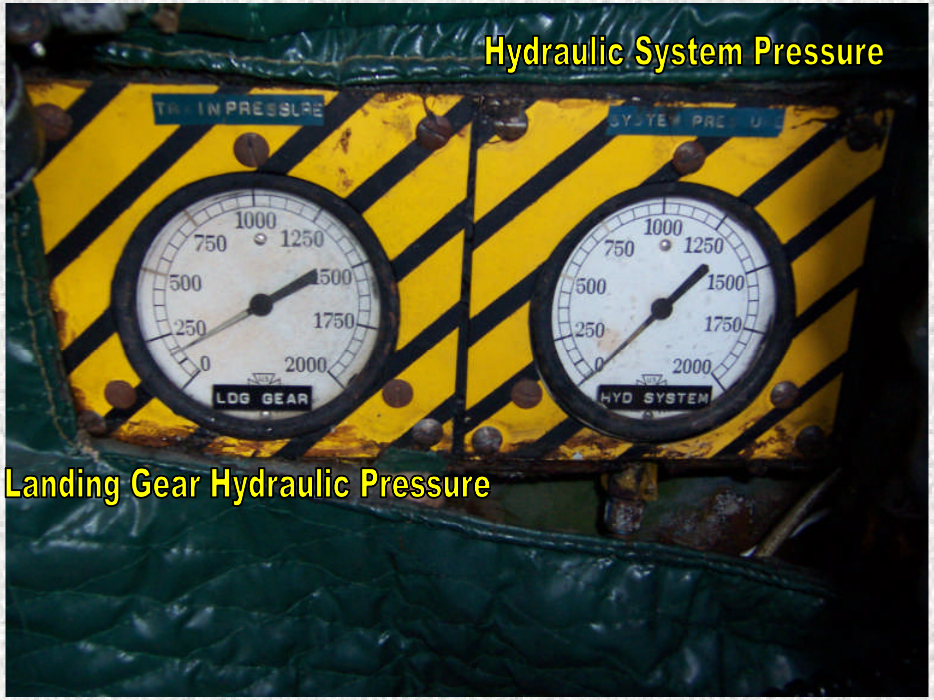


Your landing gear control is a valve, the red handle of which is on the left side of the copilot's seat. Move the handle to the full UP position to raise the gear, to the DOWN position to lower the gear. After lowering or retracting the gear, return handle to neutral to trap fluid in hydraulic lines.

A safety latch, operated by a lever on the floor, locks the gear in place when the gear is extended. This lever is at the right of the pilot's seat. When pressure indicates that your gear is in full DOWN position, return valve handle to neutral and lock gear by pushing the lever forward parallel to the floor and securing it in the handle catch. Disengage safety latch by moving latch lever to vertical position.

The latch lever has a spring-latch position at an angle of 50 degrees to the floor. The latch automatically assumes this position when the gear is raised and the valve handle in neutral. The latch lever remains in the 50 degrees position until you have lowered the gear and are ready to lock it by moving the latch to DOWN.

Landing Gear Operation



Pressure Drop When Gear Is Down

If landing gear pressure falls below ***500*** psi, place gear handle in the DOWN position until pressure is equal to the hydraulic system pressure.

Pressure Rises

When gear is retracted and the handle is in neutral, landing gear pressure should be zero. If pressure creeps up, place latch in vertical position and move handle to full UP position, then return to neutral.

Warning Lights

There are green and red warning lights at the right-hand corner of the instrument panel. The green light burns only when the gear is down and latched and the valve handle is in neutral. Under any other condition the red light burns.

AIRSPEED LIMITATIONS

- **All airspeeds are calibrated air speeds:**

Vno Normal Operation	**159 knots**
Vmc Minimum Control Speed	**77 knots**
Vne Never Exceed	**190 knots**
Vfe Max, Flaps Ext. ¼	**135 knots**
Max, Flaps Ext. ½	**99 knots**
Max, Flaps Ext. ¾	**97 knots**
Max, Flaps Full Down	**97 knots**
Vle Maximum for Gear Extension	**148 knots**
Vlo Landing Gear Operation	**148 knots**
V1 Critical Engine Failure Speed	**84 knots**
V2 The take-off Safety Speed	**84 knots**
Turbulence Penetration Speed	**105/115 knots**
Maximum for Un-feathering	**138 knots**

AIRSPEED (KNOTS)

WHITE ARC	**64-135**
GREEN ARC	**69-159**
YELLOW ARC	**159-190**
RED RADIAL	**190**

ENGINE INSTRUMENT MARKINGS

- TACHOMETER (RPM)

Green Arc	1200-1900/2050-2550
Yellow Arc	1900-2050/2550-2700
Red Radial	2700

- MANIFOLD PRESSURE (Inches HG)

Green Arc	14-45
Yellow Arc	45-48
Red Radial	48

Maximum Continuous HP Setting is 42"MP/2550 RPM (1050 HP)

ENGINE INSTRUMENT MARKINGS

Red Radial Line (RR) – Maximum and Minimum Limits
Yellow Arc (YA) – Take-Off and Precautionary Ranges
Green Arc (GA) – Normal Operation Ranges
Red Arc (RA) – Prohibited Operation Ranges

OIL PRESSURE (PSI)		OIL TEMP (DEGREES C.)	
RR	120	RR (Min)	40
YA	90-120	YA	95-104
GA	70-95	GA	40-85
RR Min (Idling)	15	RR	104

CYLINDER HEAD TEMP (DEGREES C.)		CARB AIR TEMP (DEGREES C.)	
RR	85	YA	-10 -+15
YA	217-245	GA	+15-+40
GA	85-217	RR	+40

HYDRAULIC PRESSURE		FUEL PRESSURE (PSI)	
GA	750-950 PSI	RR	10
RR	1150 PSI	GA	14-16
		RR	16

Maximum Permissible Cylinder Head Temperature...245 Deg. C.
Maximum Permissible Oil Inlet Temperature...104 Deg. C.

FUEL SYSTEM

Fuel quantity is measured by a 28 volt liquidometer system

Fuel Tanks: The C-47/DC-3 airplane has four center section tanks, two on each side of the fuselage. Main tanks are forward; each has a capacity of 202 U.S. gallons. Auxiliary tanks are aft of the main tanks; each has a capacity of 200 U.S. gallons. Each tank is independent of the others.

Left Main	202 Gals
Right Main	202 Gals
Left Aux	200 Gals
Right Aux	200 Gals
TOTAL	804 Gals

Turn Fuel Quantity Indicator "Clockwise"

Turning the Indicator knob counter-clockwise may cause damage

FUEL SYSTEM

The fuel system consists of four fuel tanks within the center wing section, two tank selector valves, two electric auxiliary pumps, two fuel strainers, an engine-driven pump mounted on each engine, and a primer for each engine. Each engine may draw fuel from any of the tanks. Normally, the right engine draws fuel from the right tanks and the left engine from the left tanks. Fuel quantity is measured by a liquidometer unit mounted in each tank and electrically connected to the fuel quantity gauge mounted on the instrument panel.

FUEL SYSTEM

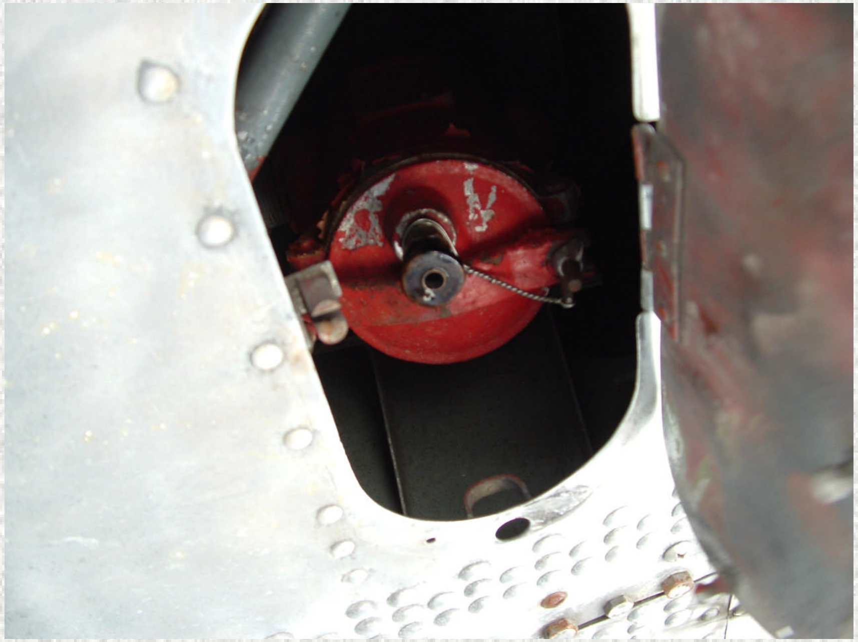
The engine-driven fuel pump mounted on the accessory section of the engine, supplies fuel to the carburetor under a pressure of ***15 ½*** to ***17 ½*** psi. A pressure gauge, indicating fuel pressure to each engine carburetor is mounted on the instrument panel. Two warning lights, which are lighted when fuel pressure drops to a dangerous level, are also located on the instrument panel and are considered part of the electrical system. Integral relief and by-pass valves are provided in the pump for relieving excess fuel pressure and for by-passing excess fuel. A vapor return line connecting each carburetor to its respective main tank, normally returns <u>5 gallons per hour</u> to the tank. It is possible for a mal-functioning carburetor or vapor return line to return as much as <u>20 gallons per hour</u> to the main tank. Over-flow of the main tank is prevented, when operating from the auxiliary, through connection of an overflow line between the main tank and auxiliary.

FUEL SYSTEM

The electrically-driven auxiliary pumps (***Red Arrow***) are used to supply fuel to the carburetors during starting, or in case of a malfunctioning engine-driven pump. The control switches are located on the overhead electrical panel near the starter switches. A red light, located on the instrument panel for each pump, is lighted when these pumps are turned on.

It is recommended that the auxiliary fuel boost pump be turned on for takeoffs, climbs, changing tanks, single-engine operations, and landings.

FUEL SYSTEM



A fuel strainer for each engine is located towards the leading edge of the wing below the fuselage, and is provided with a manual drain cock to drain off any accumulation of water.

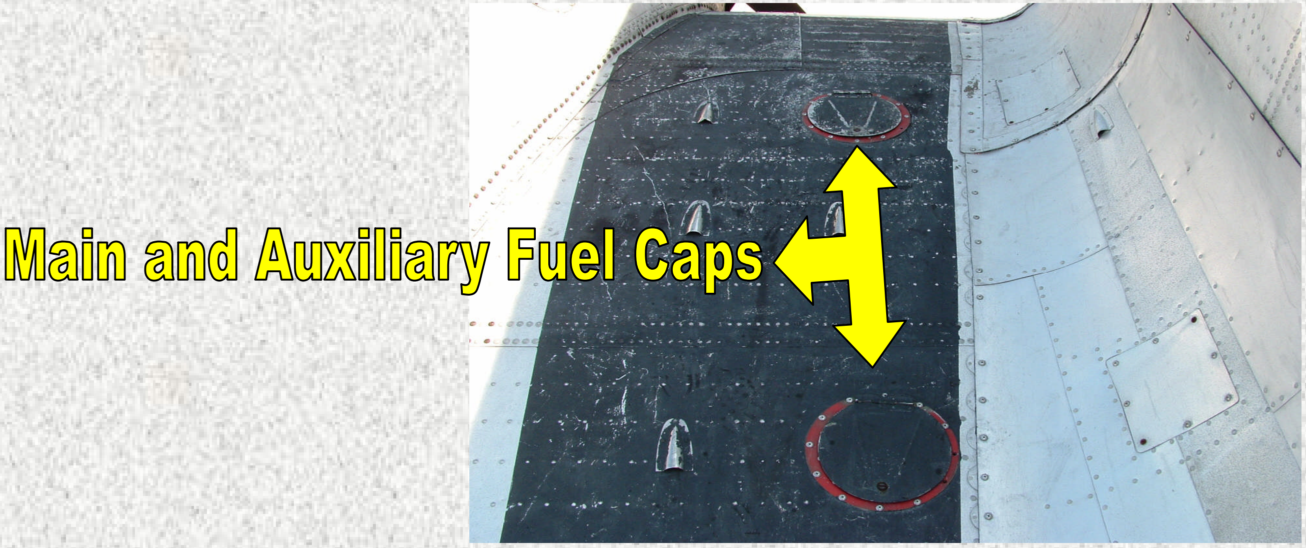
FUEL SYSTEM

It is recommended that fuel be used from the auxiliary tanks first and from the front tanks last. They should be filled in the reverse order, keeping the main tanks with the most gasoline and the auxiliary tanks with the least.

Note: Both fuel selector valves are identical, so if the left main tank is selected for the left engine and the right main tank for the right engine, the selector handles will not be symmetrical.

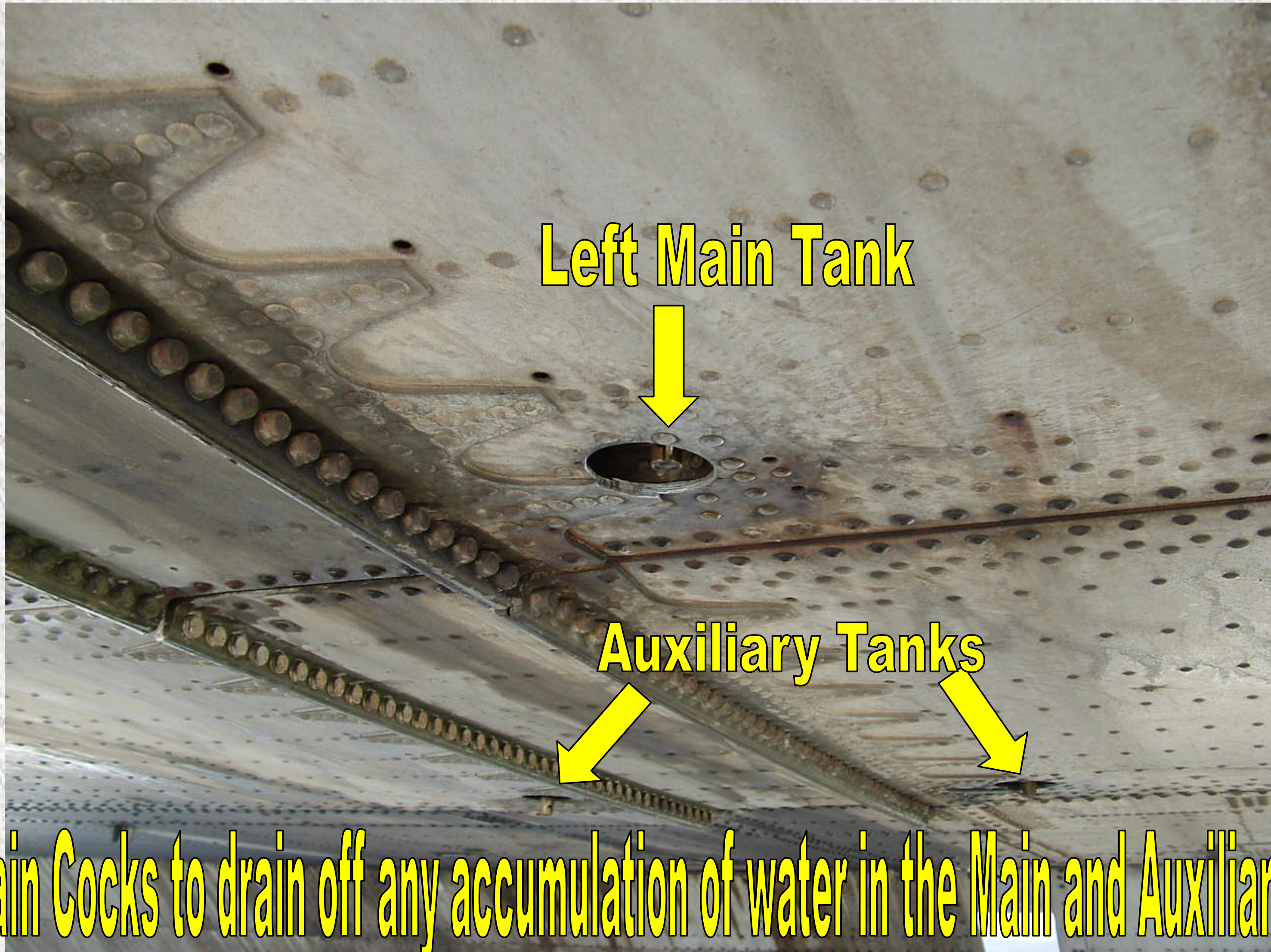
Note: All filler caps should be manually checked to see that they are properly installed and secured.

FUEL SYSTEM



Each wing has two fuel caps. The Fuel cap toward the Leading Edge of the wing is for the Main Tank, and the Fuel cap toward the Trailing edge is for the Auxiliary Tank. Ensure that the fuel cap is secure and the little arrow is pointed toward the front of the aircraft. Secure the outside cap with a flat-head screwdriver.

FUEL SYSTEM



Manual Drain Cocks to drain off any accumulation of water in the Main and Auxiliary Tanks

FUEL SYSTEM

The tanks are of a welded aluminum construction

Oil System

Type Pump (Pressure) Type	One Positive Displacement Gear
Type Pump (Scavenger) Type	Three Positive Displacement Gear
Oil Specification	Ashless
Normal Tank Capacity	29 Gallons
Minimum Requirement for Feather	1.5 Gallons

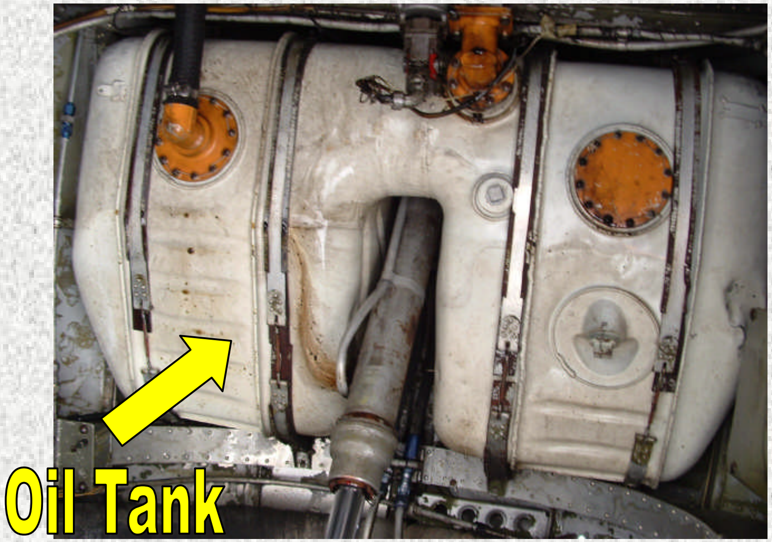
There are two oil tanks, each with a capacity of 32 gallons; one is in each nacelle. ** 29 Gallons usable, leaving 3 gallons for expansion. Note: 25 gallons – normal operation

Oil pressure and temperature gauges and oil pressure warning lights are on the instrument panel in front of the copilot.

Keep oil pressures between 80 and 90 psi in normal flight operation. If pressure falls below 50 psi, the red warning light above the pressure gauge illuminates.

Oil Firewall Shutoff valves are located on the overhead panel and are used in the event of an emergency (See Emergency Procedures).

To visually inspect oil levels, there are two locations on top of each engine nacelle. You can visually inspect by checking the dip stick or by insuring that the oil level is at or slightly above the circle opening in the engine oil fill location.



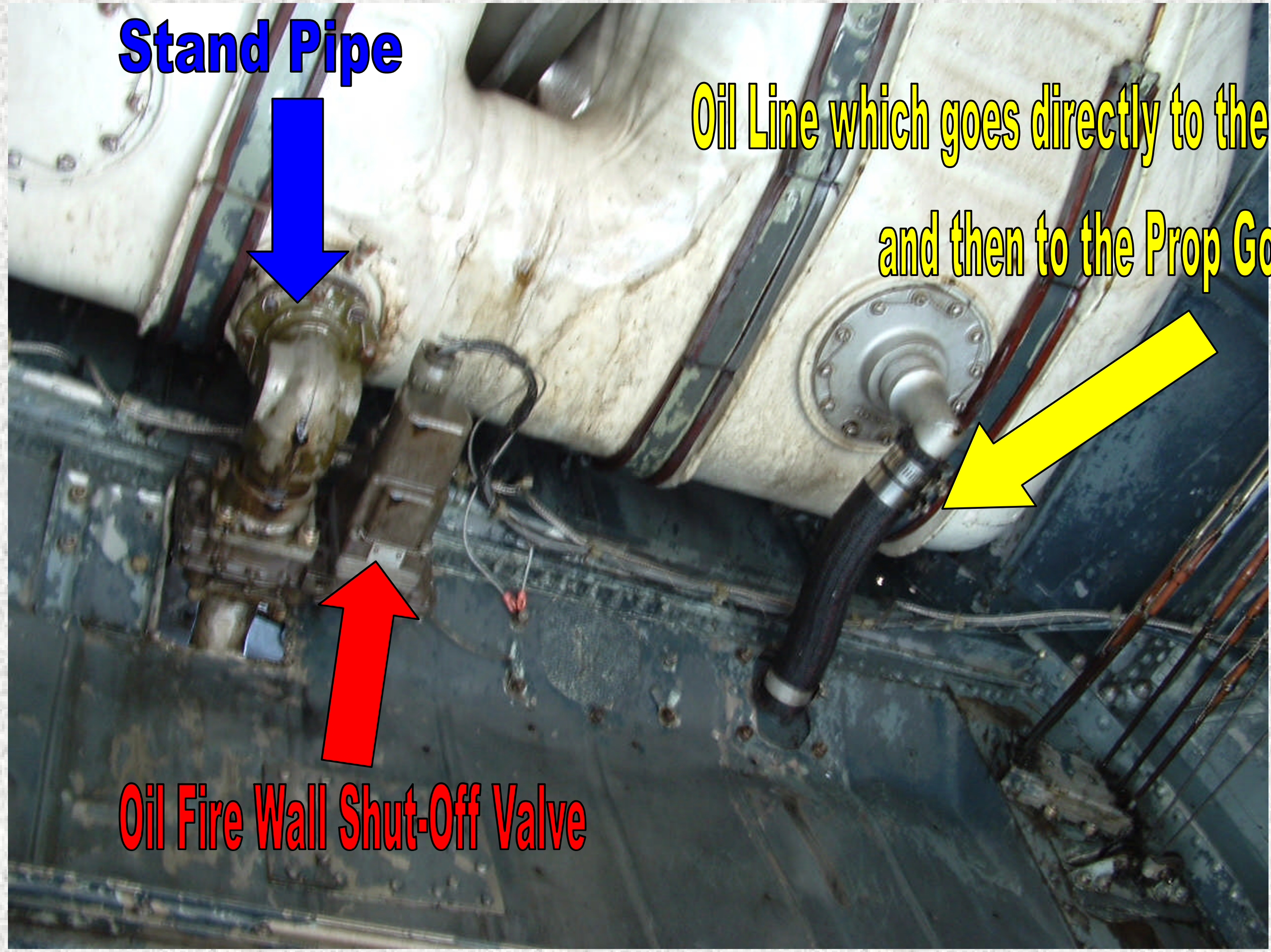
Oil System

An independent external oil system is provided for each engine. It consists of an oil tank, a thermostatic oil temperature control unit, an oil radiator, and necessary oil piping.

The oil tanks are of the standpipe type, having a capacity of ***32*** US gallons and are located in the top of each engine nacelle behind the firewall. The filler neck is so located that no more than ***29*** US gallons can be put in the tank, thus leaving a ***3*** gallon space for foaming. Oil is drawn from the bottom of the tank through a fitting which extends several inches above the bottom of the tank on the inside, leaving a sump containing approximately three gallons of reserve oil for the propeller feathering pump.

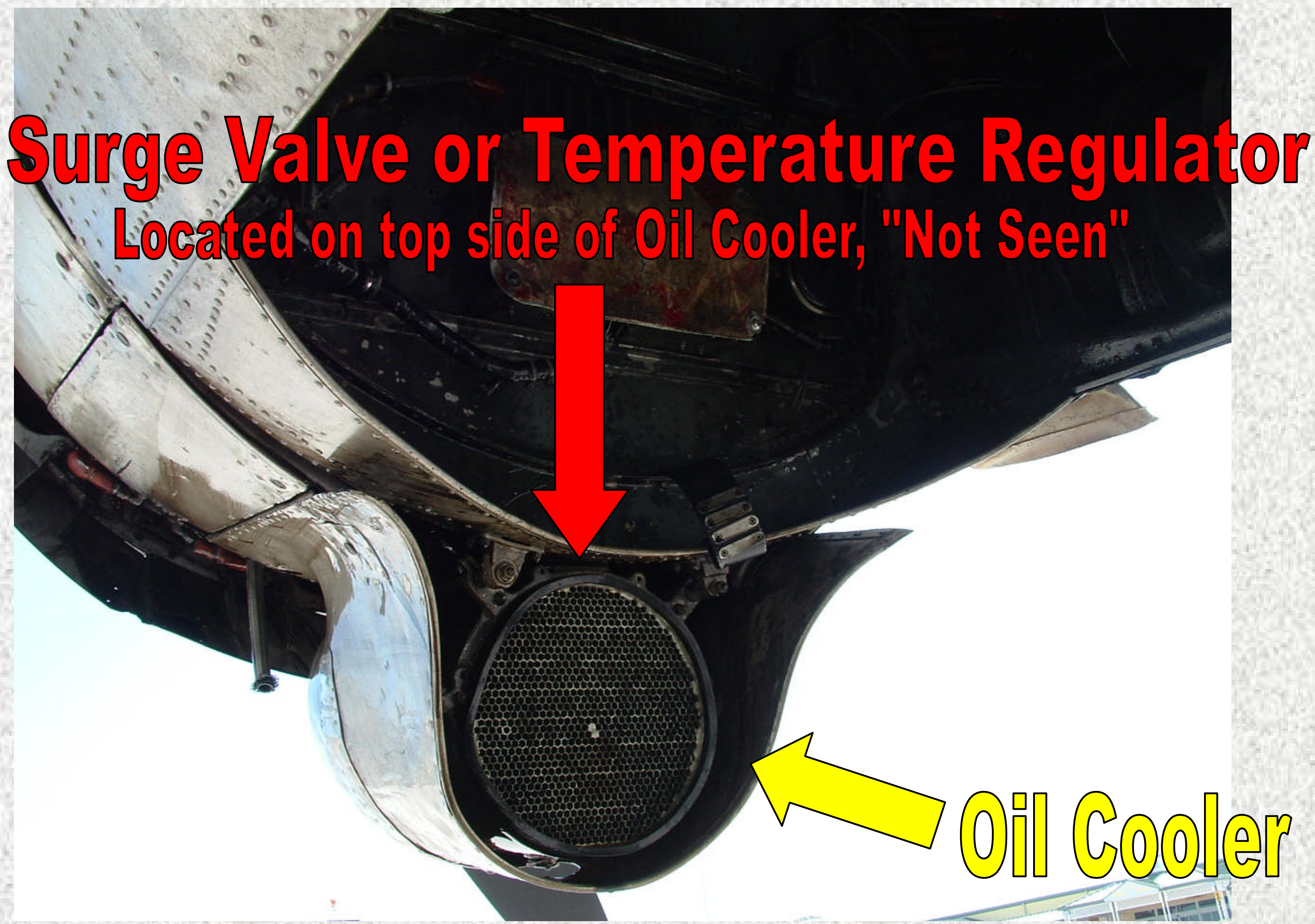
The oil radiator is a tubular radiator in which oil is circulated around the side of the tubes through which the cooling air flows.

OIL SYSTEM



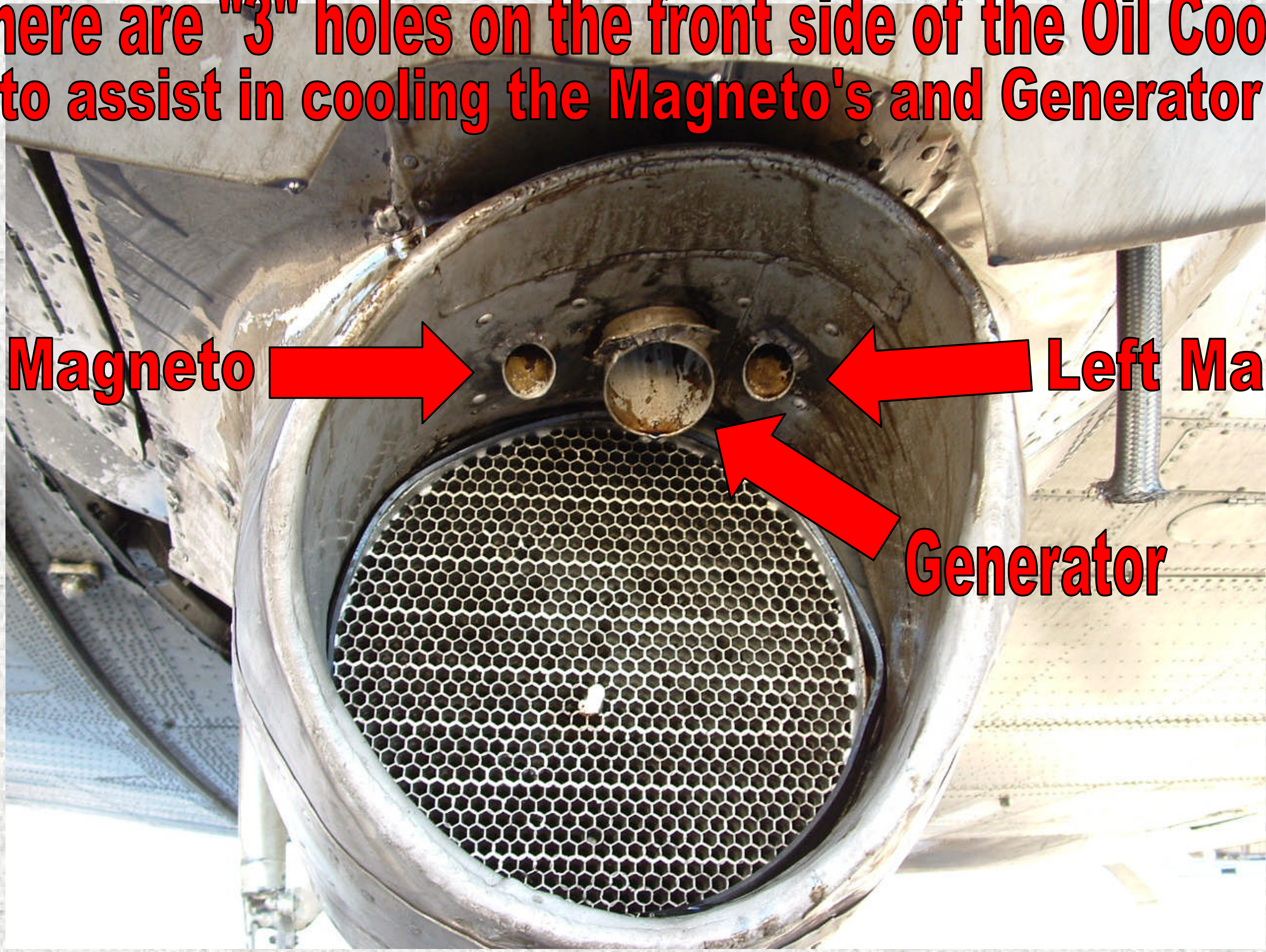
Stand Pipe
Oil Line which goes directly to the Feathering Pump
and then to the Prop Governor
Oil Fire Wall Shut-Off Valve

OIL SYSTEM


Surge Valve or Temperature Regulator
Located on top side of Oil Cooler, "Not Seen"
Oil Cooler

OIL SYSTEM

There are "3" holes on the front side of the Oil Cooler
to assist in cooling the Magneto's and Generator



Front Side of Oil Cooler

Oil System

The radiator is provided with a relief valve between the inlet and outlet connections. If the radiator becomes clogged or if the oil becomes congealed, the relief valve allows the oil to pass directly to the return line of the tank. In this case, the oil is not cooled before it goes to the tank and high temperature will result.

In operation, oil passes from the oil tank to the engine-driven pump. Returning oil passes through a thermostatic temperature control unit. When the oil is cold, the return oil from the engine scavenging pumps is passed by the temperature control unit to the tank. As the temperature of the oil rises, the control unit starts directing some of the oil through the oil radiator and back to the tank. When the temperature of the oil reaches ***70*** to ***75*** degrees C., all of the return oil is directed through the radiator and to the tank.

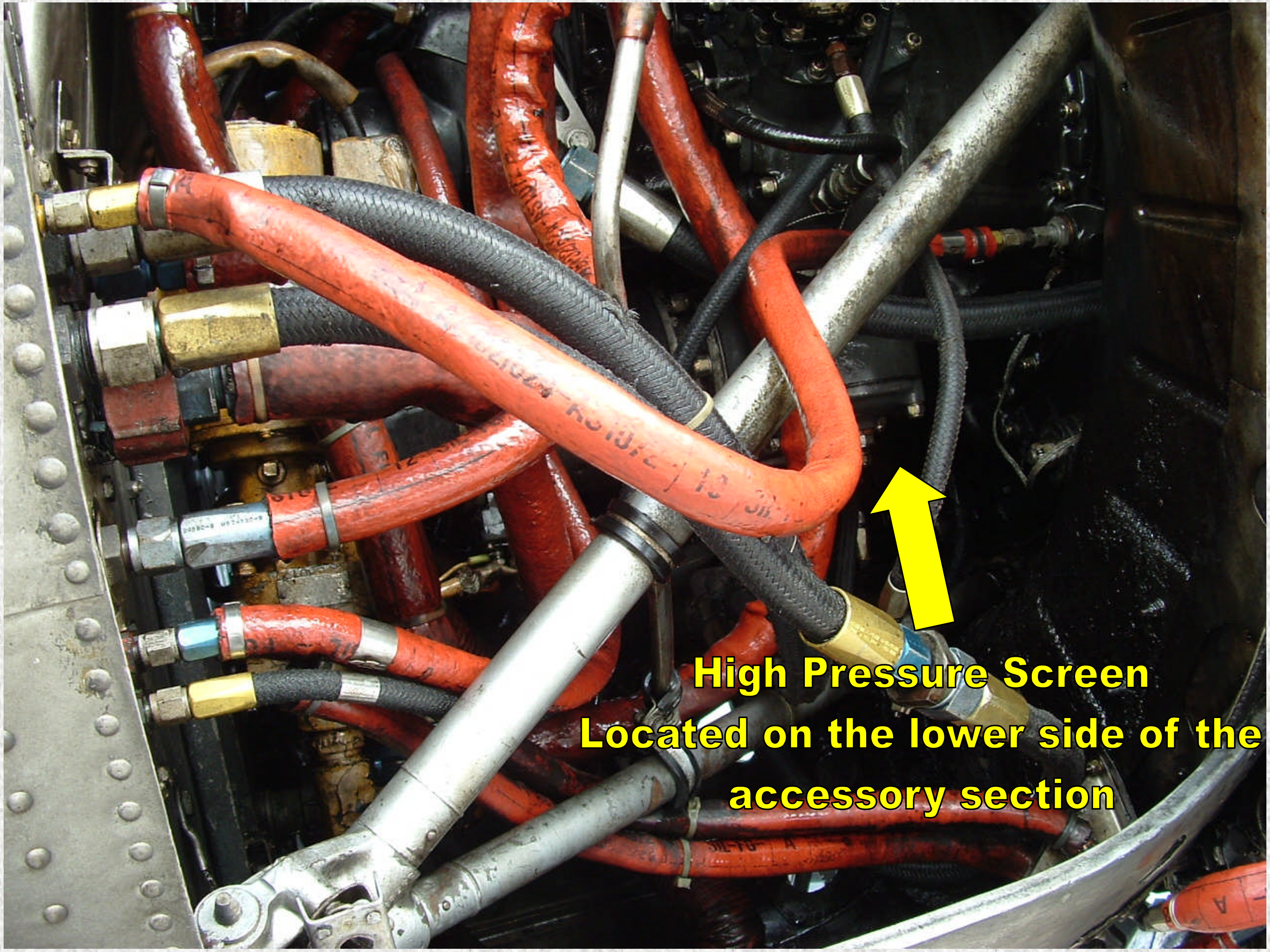
Note: On a hot day, if the oil temperature is running high, reduction of RPM will reduce engine heat and also allow the oil to remain in the cooler longer.

Oil System

Oil Pump - A three section gear type oil pump assembly is installed at the bottom left hand side of the rear case. The pump casing houses one pressure pump and two scavenger pumps.

High Pressure Screen – Located immediately down stream of the high pressure pump, this strainer serves to prevent foreign material from entering the engine. The screen consists of a series of screens I disk form, separated by spacers around a perforated tube. In case of screen blockage due to foreign material, the screen incorporates a by-pass valve which will allow a continuous flow of oil to the engine.

OIL SYSTEM


High Pressure Screen
Located on the lower side of the
accessory section

Oil System

<u>Pressure Relief Valve</u> – This valve is incorporated into the drilled passage down stream of the pressure screen, and is of a piston type and controlled by tension of a back-up spring. This pressure relief valve is set to control the upper limits of the oil pressure as it enters the engine, and is adjusted to maintain a desired pressure through all ranges of engine operation.

<u>Oil Temperature Indicator</u> – A resistance type temperature sensing element is located on the right side of the accessory section. The sensing element or bulb functions on the principle of varying resistance. At the temperature increases, the resistance increases proportionately; the result being a variable indication on the temperature gauge in the cockpit. This temperature is taken at a point just prior to entering the engine. In placing the element in this position relative to oil inlet, it can be used as a accurate check on engine operation through the entire power range. 28 volt DC from ship's power is required to operate the system.

Oil System

Oil Pressure Indication – Installed in the pressure pump outlet; a fitting is attached. This fitting secures an air-quip line which is routed to the aircraft nose section through a low pressure transmitter. The function of the transmitter is to cause an electric circuit to operate the low pressure warning light. The light will be illuminated whenever oil pressure at the outlet of the pump falls below 40 psi. A bourdon tube instrument will give a direct reading of engine oil pressure at all times. Oil pressure gauge lines contain hydraulic fluid to prevent an erratic reading due to viscosity change during cold weather operation.

Fire Wall Shut-Off Valve – The open closed valve is located, one in each wheel well. The valve is electrically controlled from the cockpit, by an electrical switch. The primary function of the shut-off valve is to stop the flow of oil to the engine during an emergency shut down of the engine.

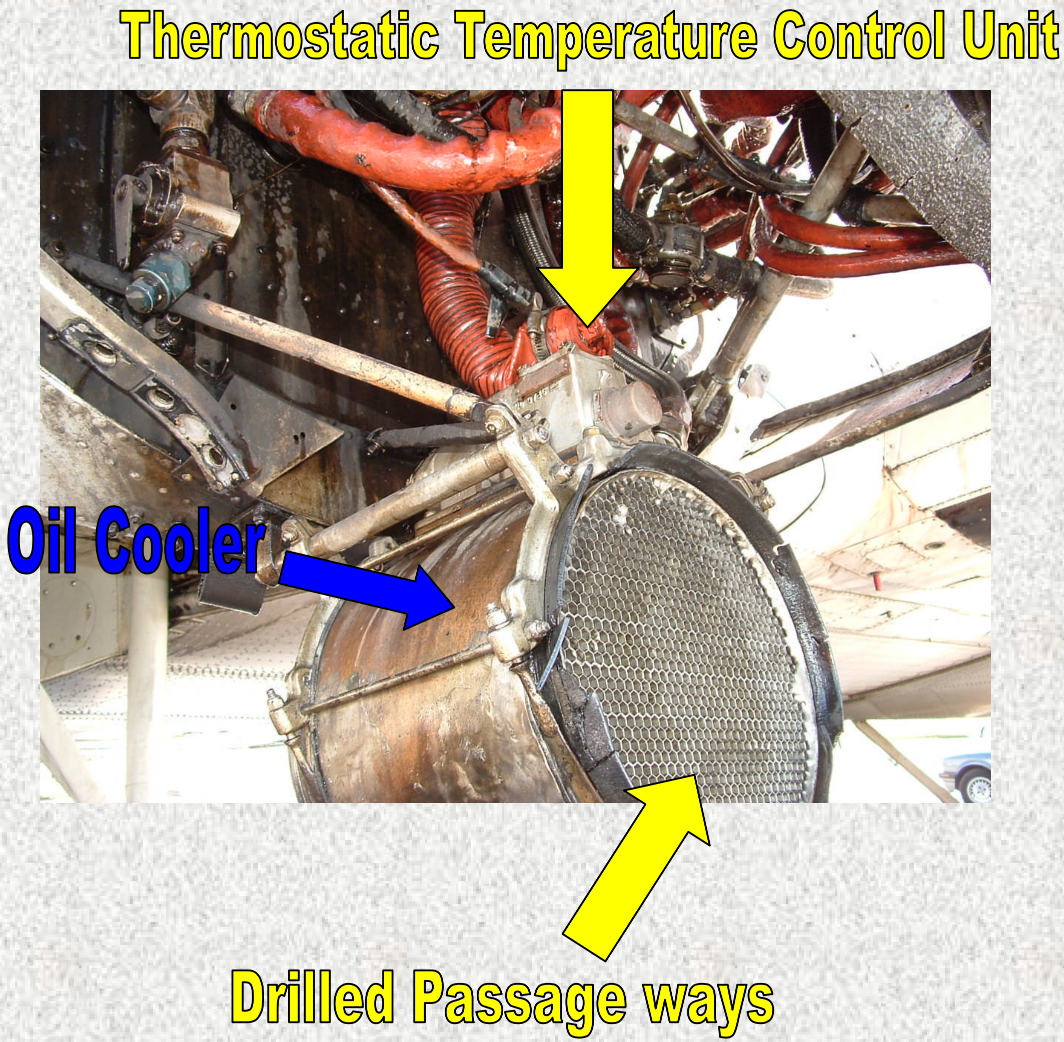
The supply of oil for operation of the feathering pump is completely independent of the fire wall shut-off valve; consequently , a complete feathering operation can be made with the fire wall shut-off valve closed.

Linked mechanically to the engine oil shut-off valve in the inlet lines to the engine-driven hydraulic pumps is a hydraulic shut-off valve. In actual operation whenever the fire wall shut-off valve controls are positioned to the closed position, both engine oil and hydraulic oil is stopped prior to the fire wall.

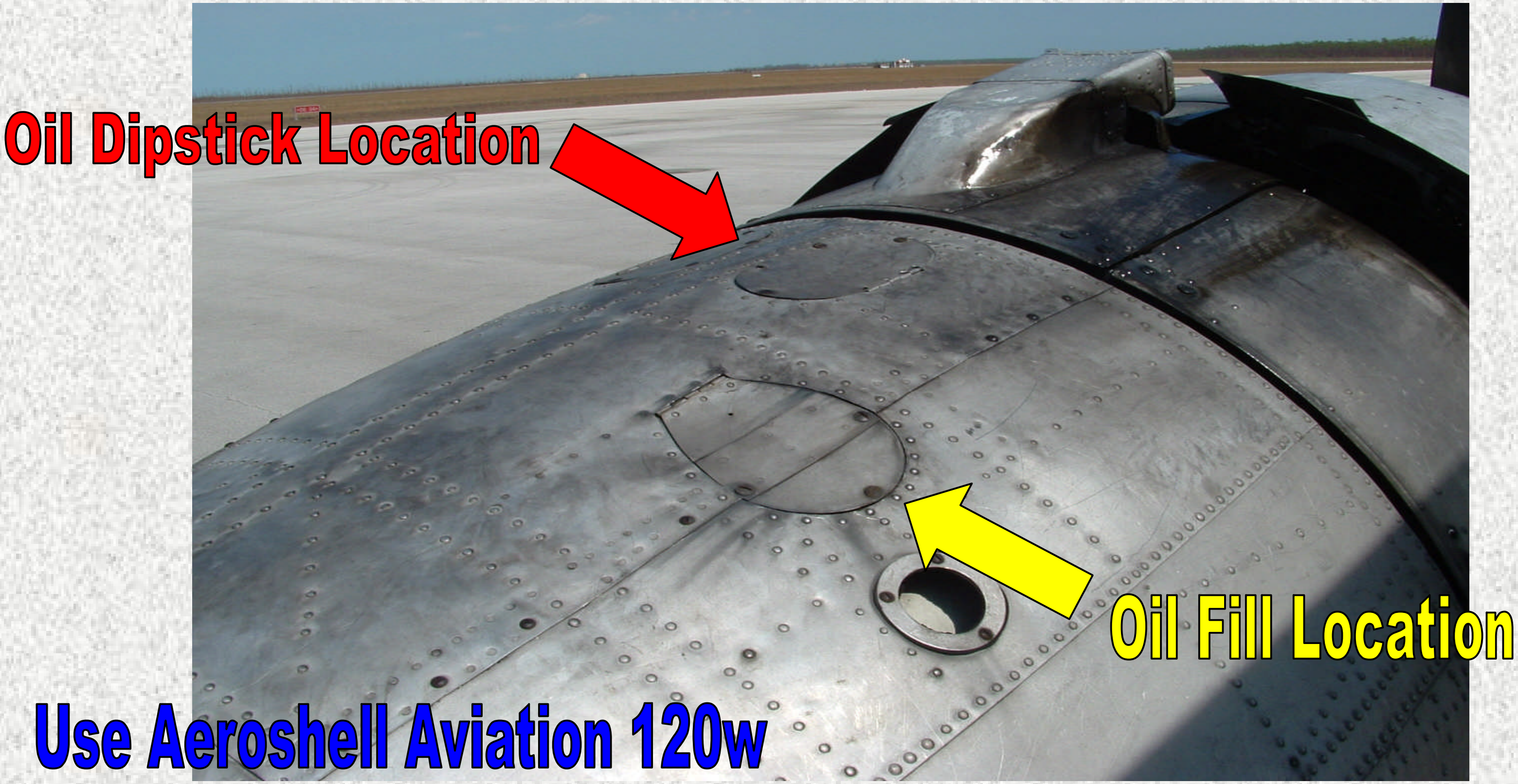
OIL SYSTEM

The oil system is primarily a dry sump system as the oil is contained in an internal tank. Oil is supplied through a stand pipe to a single high pressure pump which provided continuous circulation of oil through a pressure screen, temp. sensing element, through drilled passage ways to lubricate and cool the engine. Oil is also supplied for the operation of the propeller governor.

Return oil is forced back to the tank by scavenger pumps located in the nose case and rear case of the engine. Before reaching the tank, the oil must pass through or around a free flow cooler when it is cooled and then returned to the supply tank.



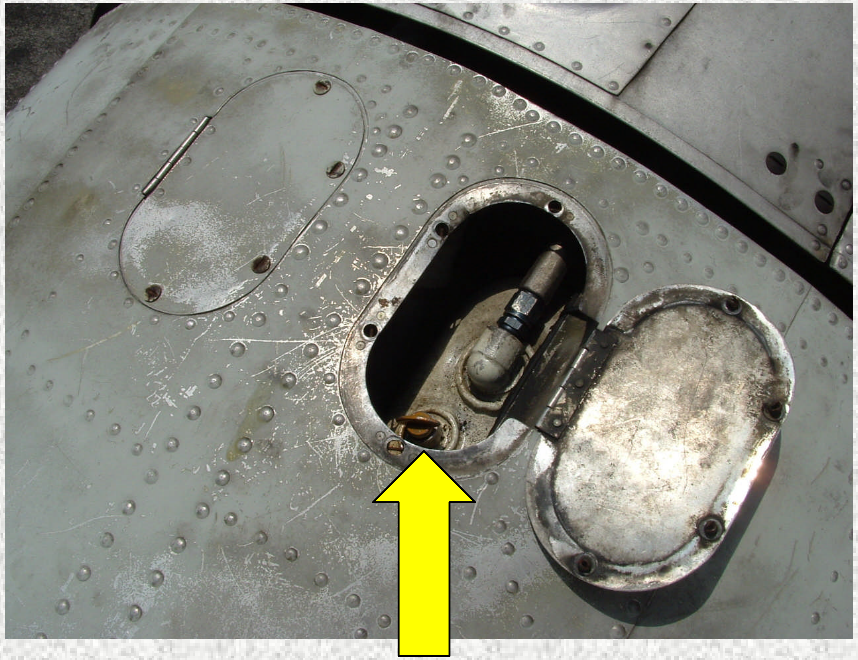
OIL SYSTEM



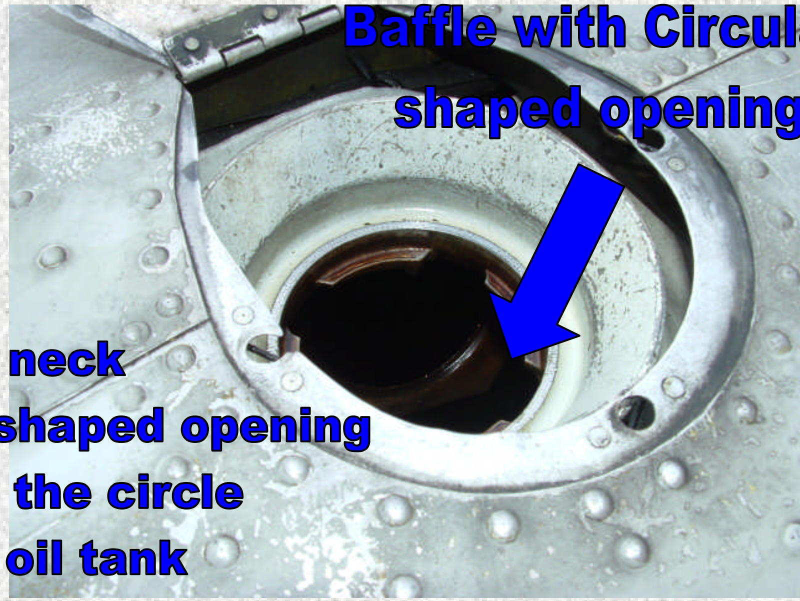
Oil fill is located on the inboard side of each engine. See *Yellow Arrow*. Open outside cover with a flat-head screwdriver, then unlatch cap by turning counter-clockwise. Tighten the opposite. Ensure that the half-moon side of the cap (handle) is facing toward the rear of the aircraft in a 45 degree angle.

The oil dipstick is located on the inboard side of the port side and outboard on the starboard side of the engine. See ***Red Arrow***

OIL-SYSTEM



The Oil Dipstick is of conventional design. It has hash marks indicating gallons. The top two hash marks read 25 and 29 gallons.

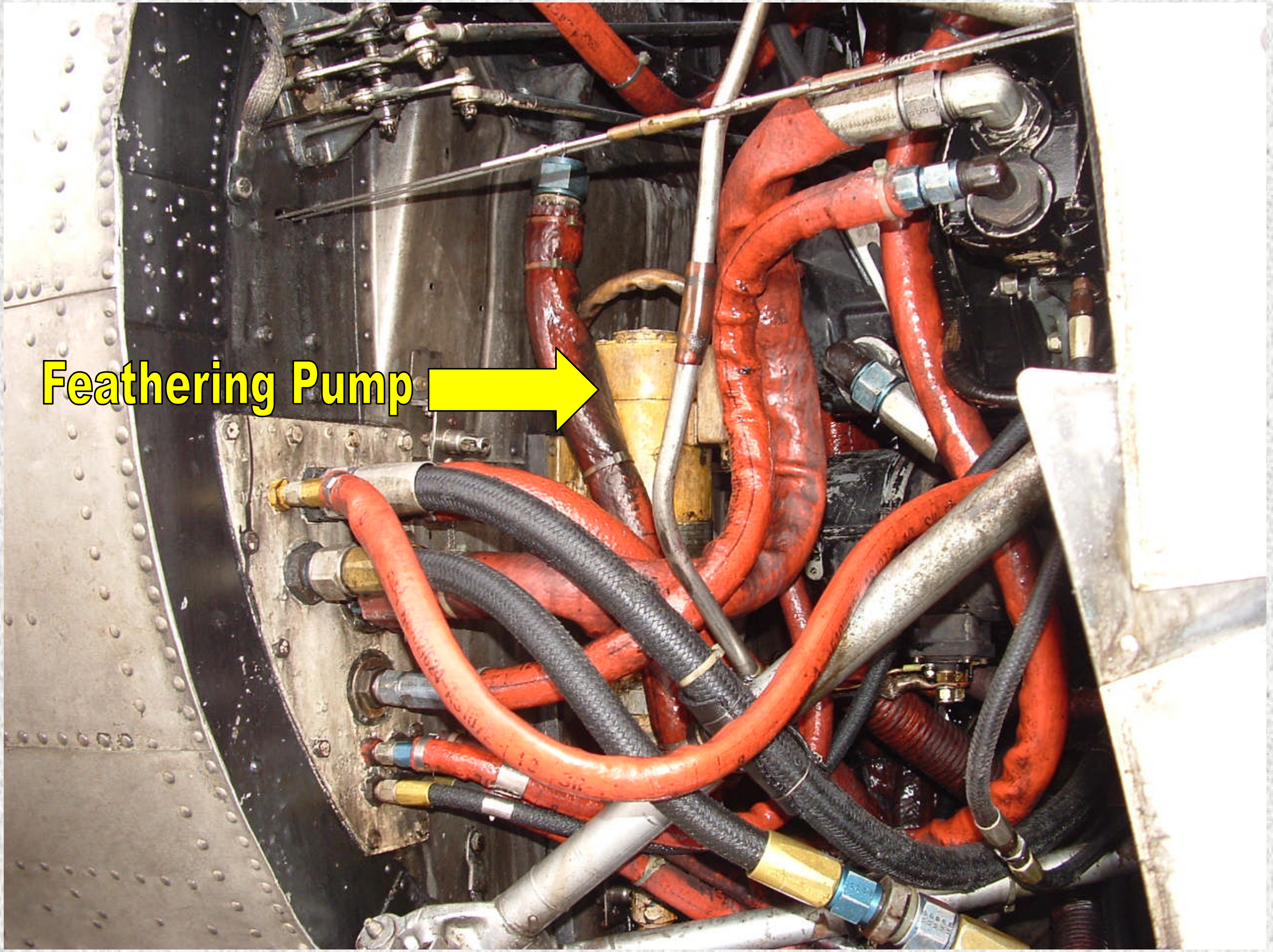


As you look inside the oil filler neck
you will observe a baffle with a circular shaped opening
When the oil reaches the bottom of the circle
there should be 25 gallons in the oil tank

Propeller Feathering System

The propeller feathering system incorporates an auxiliary pump, electrically operates to supply the necessary pressure. This pump receives its oil supply from the reserve supply in the engine oil tank. The switch for starting the pump is located on the overhead electrical panel and is referred to as the feathering button. ***(Yellow Arrows)***

Propeller Feathering System



Propeller Feathering System

<u>Feathering Pump and Oil Delivery Lines</u> – The feathering pump is a positive displacement gear type pump, driven by a 3 HP DC electric motor. The motor is directly connected to the ship's power through the solenoid relay. The pump intake is connected to the bottom of the engine oil tank where a minimum of 2.8 gallons of oil is reserved for feathering. The pump is capable of delivering oil to the propeller at a pressure of 1200 psi.

The oil line between the feathering pump and propeller governor is made of fireproof material where it passes through the engine hot zone. There are no shut-off valves in this system; therefore, the feathering system is not affected by the operation of the fire wall shut-off.

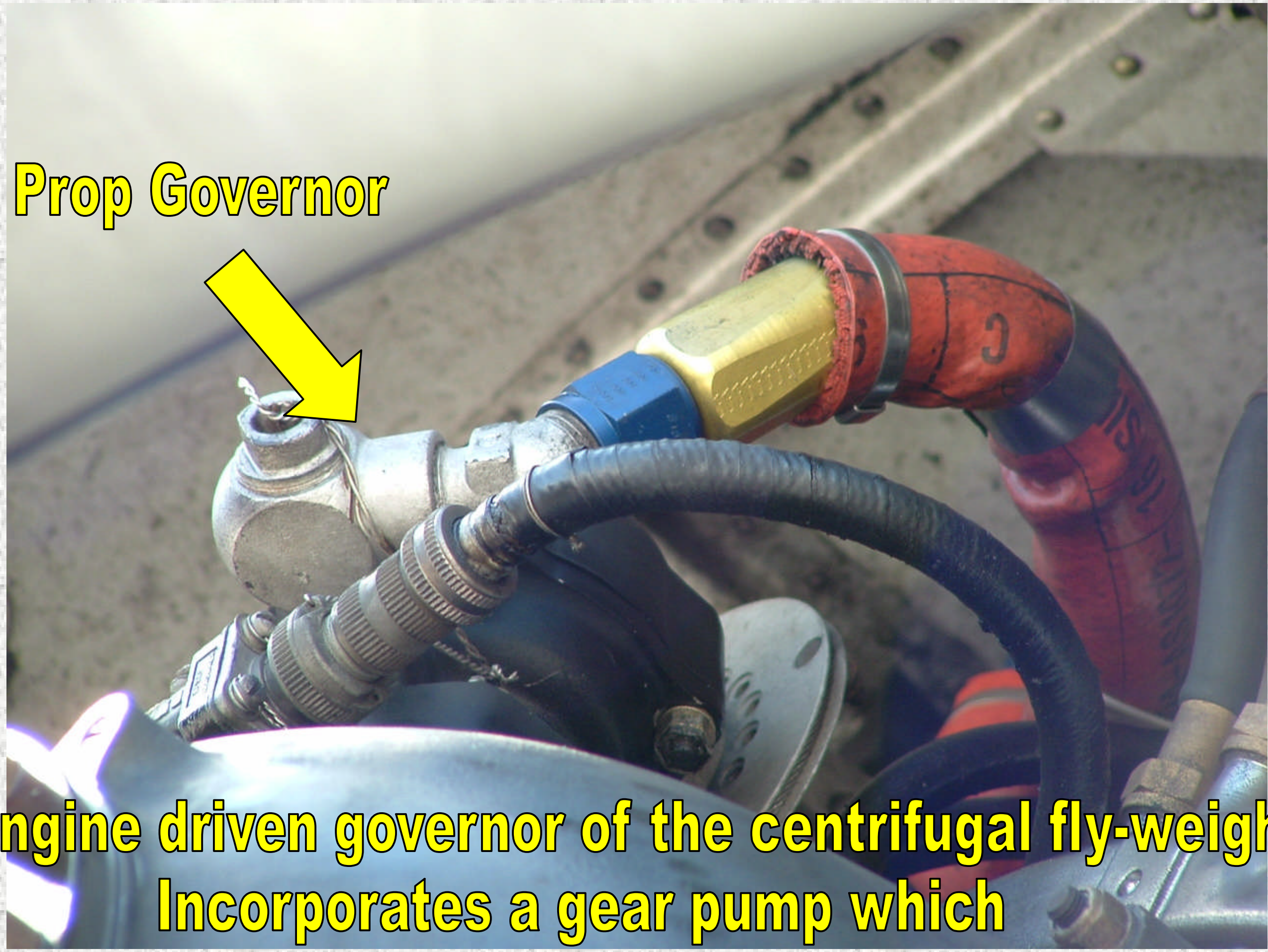
Propeller Feathering System

In operation, depressing the button starts the pump operating which forces oil to the propeller through a check valve in the base of the constant speed control. When oil pressure from the feathering pump actuates this check valve, it automatically cuts out the constant speed control and the governor booster pump. The oil is then directed against the rear of the piston forcing it outward and increasing the pitch of the propeller blades until the adjustable mechanical stop is reached (full feathered position). A pressure of approximately ***300*** psi is required for the feathering operation which takes about nine seconds. After the propeller blades reach the adjustable mechanical stop, the pump continues to build up pressure against the piston. When the pressure has reached approximately ***400*** psi, it actuates a pressure operated switch, which de-energizes a holding coil on the feathering pump switch, allowing it to open, and shut off the pump.

Propeller Feathering System

When the propeller blades are in the full feathered position, and the feathering button is depressed, oil is directed against the aft side of the piston until pressure reaches approximately ***600*** psi; at which point a distributor valve directs the oil to the forward side of the piston. The piston moves aft, decreasing the pitch until the speed of the airplane causes the propeller to windmill. During this operation, the feathering pump switch must be kept manually depressed, as the holding coil is de-energized by action of the pressure operated switch. Displaced oil during feathering and unfeathering operation passes into the engine oil and is scavenged to the oil tank.

Propeller Feathering System



It's an engine driven governor of the centrifugal fly-weight type

Incorporates a gear pump which

Boosts the engine oil to the pressure required for propeller operation

Propeller RPM Control

The propeller constant speed control unit is an engine-driven governor of the centrifugal fly-weight type. The governor incorporates a gear pump which boosts the engine oil to the pressure required for propeller operation, a pilot valve actuated by the fly-weights that controls the flow of oil through the governor, and a relief valve system which regulates the operating pressures in the governor. The governor is designed to let the pilot change the spring load through the rack and pinion gear. If the pilot loads the spring, the flyweights will have to be driven faster by the engine to make them fly outward against the greater spring load. A high RPM setting is obtained in this manner.

If the pilot relaxes the load in the spring, the flyweights fly outward with ease so they will have to be rotated more slowly to match the load of the speeder spring. This condition results in low ROMs.

Since the spring setting determines how fast the flyweights will have to be turned to position the pilot valve, the spring is called the speeder spring. This spring also maintains the cruise RPM should the cable to control the propeller governor break.

Propeller Feathering System

The electrical circuit of the propeller feathering system functions as follows:

Depressing the feathering button energizes a holding coil, which, when the circuit is closed, holds the switch in the “ON” position against a spring, tending to return it to “OFF”. When the holding coil is energized, the circuit is closed through a relay located in the firewall junction box furnishing energy for the feathering pump motor. It is not necessary to hold the feathering button in during feathering; it will return automatically to “OFF” when feathering is completed.

The pressure cut-out switch is mounted on the propeller constant speed control and is wired in series with the feathering button holding coil. The switch consists of a piston linked with a set of contacts held closed by a heavy spring; the piston is exposed to the feathering pump oil pressure. When the pump pressure reaches ***400*** psi, the piston opens the contact points breaking the circuit, and de-energize the holding coil which in turn releases the feathering button and stops the pump. From the above it can be seen why it is necessary to keep the feathering button manually depressed during unfeathering operations.

Propeller Feathering

Practical Aspects of Propeller Operation – The pitch range of the blades is from 18 to 88 degrees, however, the constant speed range of the propeller is about 23 degrees. Above the 23 degrees of constant speed travel, the blades will move very rapidly toward high pitch to expedite the feathering procedure.

Normally the blades will stay in the feathered position when driven there; however if the torque loading on the blades is low, it may tend to come out of the feathered position. Should this take place, it would windmill. This situation could become serious.

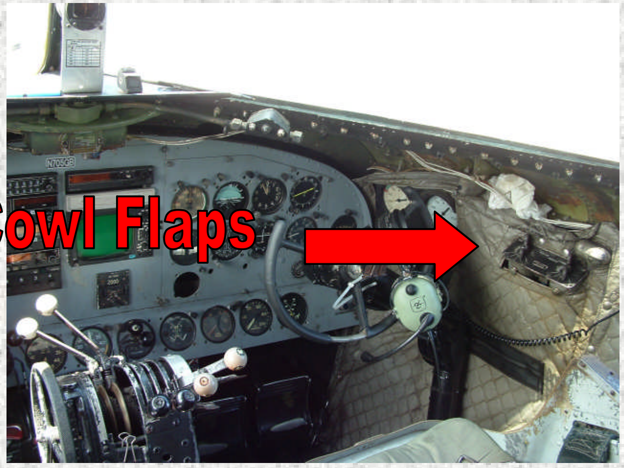
On the dead engine cleanup procedure, the propeller control is placed in a low RPM position. Looking back on the propeller theory, this is significant since the governor would be able to maintain a low engine RPM should this condition exist.

Propeller Feathering

<u>Practical Aspects of Propeller Operation, Cont'd</u> – A number of conditions exist during feathering procedure that may be confusing. A defective solenoid, for example, in the feathering button would make it necessary to hold the feathering button in, if it were desired that propeller be feathered. Another example is that if the feathering button failed to pop out during a feathering procedure, this would simulate an intentional un-feathering procedure; consequently, the propeller blades would move to feather and the distributor valve would then shift, causing the propeller to move toward low pitch.

In some cases it may be desirable to quickly feather the engine. Taking advantage of the existing pitch angle of the blades by activating the feathering system before a power reduction is made would complete the feathering procedure in a shorter length of time.

Cowl Flaps



Cowl Flap Control Valve (Adel Precision Products Corp.)

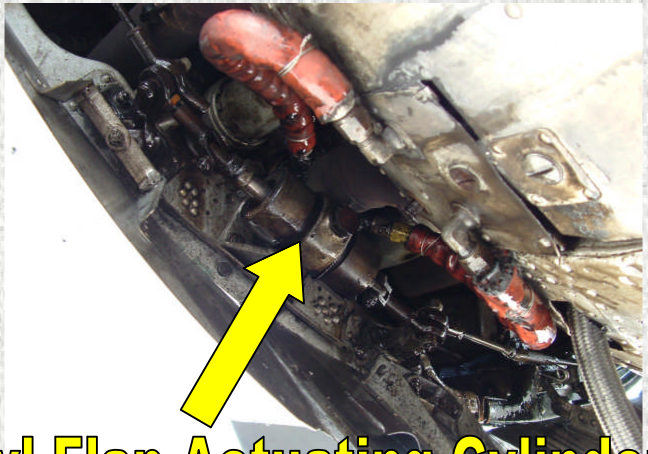
The C-47/DC-3 has cowl flaps around each engine directly behind the engine cowling. They control engine temperature by regulating airflow through the cowling.

Cowl flap controls are on the right side of the copilot's seat (***Red Arrow***). They are marked: CLOSED, OFF, TRAIL, OFF, OPEN. Operate by moving them clockwise and counter-clockwise. After opening or closing, return to OFF position.

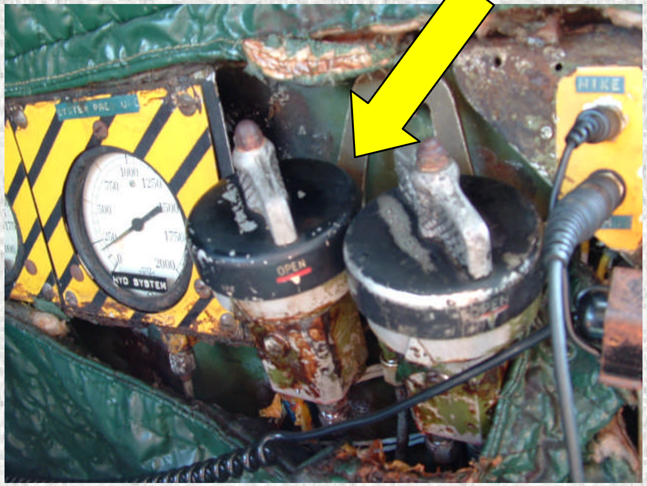
Cowl Flaps

COWL FLAPS

Cowl Flap Control Valve (Douglas)



Cowl Flap Actuating Cylinder



Cowl flaps are mounted on the aft side of the cowl ring to provide controlled cooling of the engine power section. Controls for their operation are mounted in the pilot's compartment. In the "OPEN" position, fluid under pressure is directed through the open line to the proper side of the cowl actuating cylinder; the returning fluid is directed through he cowl flaps "Close" line, through the valve, to the reservoir. When the control handle is moved to "CLOSE", the fluid flow is reversed. To lock the cowl flaps in a desired position, the control handle is moved to "OFF", trapping the pressure in the line and holding the actuating cylinder in place. When the control handle is moved to the "TRAIL" position, the actuating cylinder is allowed to move in either direction depending on the balance of the air loads on the cowl flaps.

Note: The cowl flap control valve has an integral pressure relief valve and by-passes fluid to the return line if the cowl flap system pressure increases to ***1150*** psi due to thermal expansion or excessive air loads on the flaps.

POWER PLANT

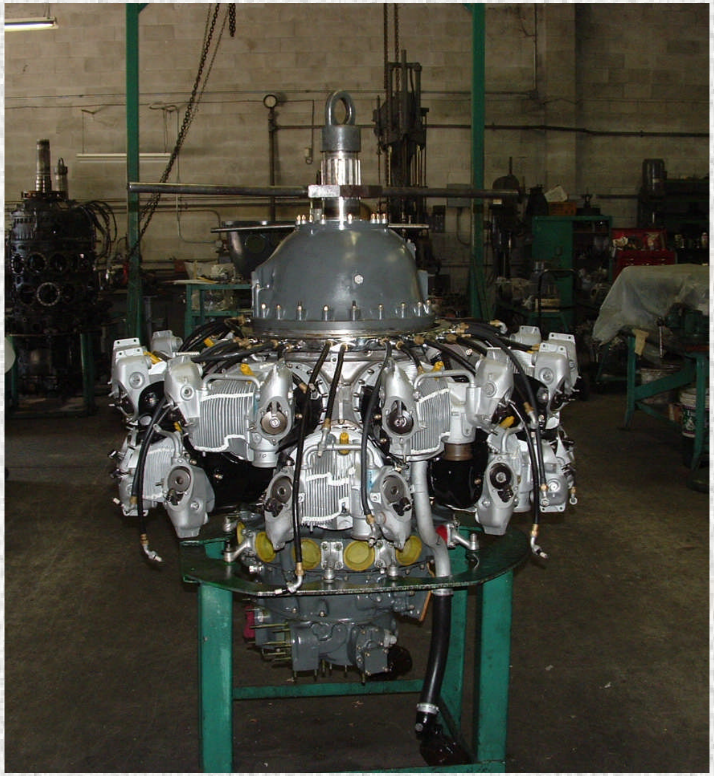
PRATT & WHITNEY R1830-90D

Type	Air-Cooled, Twin Row Radial
Engine Make	Pratt & Whitney Twin Wasp
Cylinders	14
Blower Ratio	7:15 to 1
Compression Ratio	6.7 to 1
Bore	5.5 inches
Stroke	5.5 inches
Displacement	1830 cubic inches
Overall Diameter	48.19 inches
Average Dry Weight	1492 lbs
Crankshaft Rotation	Clockwise
Reduction Ratio	16.9

Single speed impeller drive, Spline-coupled reduction gearing, .5625:1 reduction gear ratio, AN type ignition harness, injection carburetor, Bendix magnetos, (Similar to -90C except no clutches)

R1830-90D Description

The DC-3 is powered by two Pratt & Whitney R1830-90D engines capable of delivering 1200 horsepower @ 48"MP/2700 RPM. Each engine incorporates an integral single speed, single stage supercharger, a pressure injection type carburetor, and a direct cranking starter. The cylinders are of twin row, flange mounted type located around the periphery of the main power case. The cylinders are numbered clockwise, the odd numbered cylinders in the rear row, and the even numbered in the front row. Ignition is supplied by two flange mounted magnetos installed in each engine accessory section, which distribute current to the spark plugs through high tension ignition harness. The accessory section houses the drive for magneto, generator, starter, fuel pump, internal oil pump, hydraulic pumps, and vacuum pump.



POWER PLANT

Starters: Each engine is equipped with a direct drive electric starter which is operated by a starter switch on the electrical panel in the pilot's compartment. The solenoid switch for each starter is located in the engine nacelle.

Generators: The two generators are mounted, one on each engine, and are controlled by carbon pile voltage regulators and reverse current relays.

Booster Coil: A booster coil is provided for retarded ignition starting and is controlled by a separate switch on the electrical control panel. The booster switch is used in conjunction with the starter (and primer switches).

POWER PLANT

Magnetos: The Scintilla magnetos are mounted on the accessory section of the rear case. Magnetos should not be checked at any time that the engine is operating at over 30" manifold pressure nor should they be checked in auto-lean. Always check in auto-rich.

Carburetors: The engines are equipped with Bendix-Stromberg pressure injected carburetors. This carburetor employs a small auxiliary venturi in the center of the large venturi for fuel metering but the fuel is injected in the engine side of the conventional butterfly throttle valve so that the refrigeration caused by the fuel does not tend to form ice on the butterfly valve. A diaphragm arrangement controls the fuel metering and provides fully automatic mixture regulation compensating for variations of both pressure and temperature.

POWER PLANT

FUEL SYSTEM OVERVIEW – The 1830-92 and 1830-90D fuel system controls the flow of fuel to maintain a satisfactory fuel air ratio over the entire operating range. This is done by the use of a pressure type, down draft carburetor. The purpose of the carburetor is to mete fuel I proportion to mass air flow into the engine. The mass air flow is determined by the throttle valve opening. After being metered by the carburetor, the fuel is then discharged into a single stage, single speed, supercharger, where it is taken up by the impeller, mixed with air, vaporized, and then delivered to the cylinder through the intake valves. The major components of the fuel system are the carburetor, supercharger, M.A.P. gauges, fuel pump, and fuel pressure gauges.

POWER PLANT

<u>FUEL PUMP</u> – An engine driven fuel pump is mounted on the lower left hand side of each accessory section and is coupled to the engine drive gear. This pump is vane type with inlet and outlet ports and an adjustable pressure relief valve which maintains constant fuel pressure at varying engine speeds. At 2500 RPM, the pump output is approximately 400 gallons per hour.

The pressure relief valve is a spring-loaded diaphragm that opens when the pump is operated at high speed and allows excess fuel to flow back to inlet of the pump. At low speed, the relief valve closes and allows fuel to pass to the outlet port. A drain line is connected to the diaphragm vent boss to allow for draining of any small amount of fuel that might leak around the diaphragm.

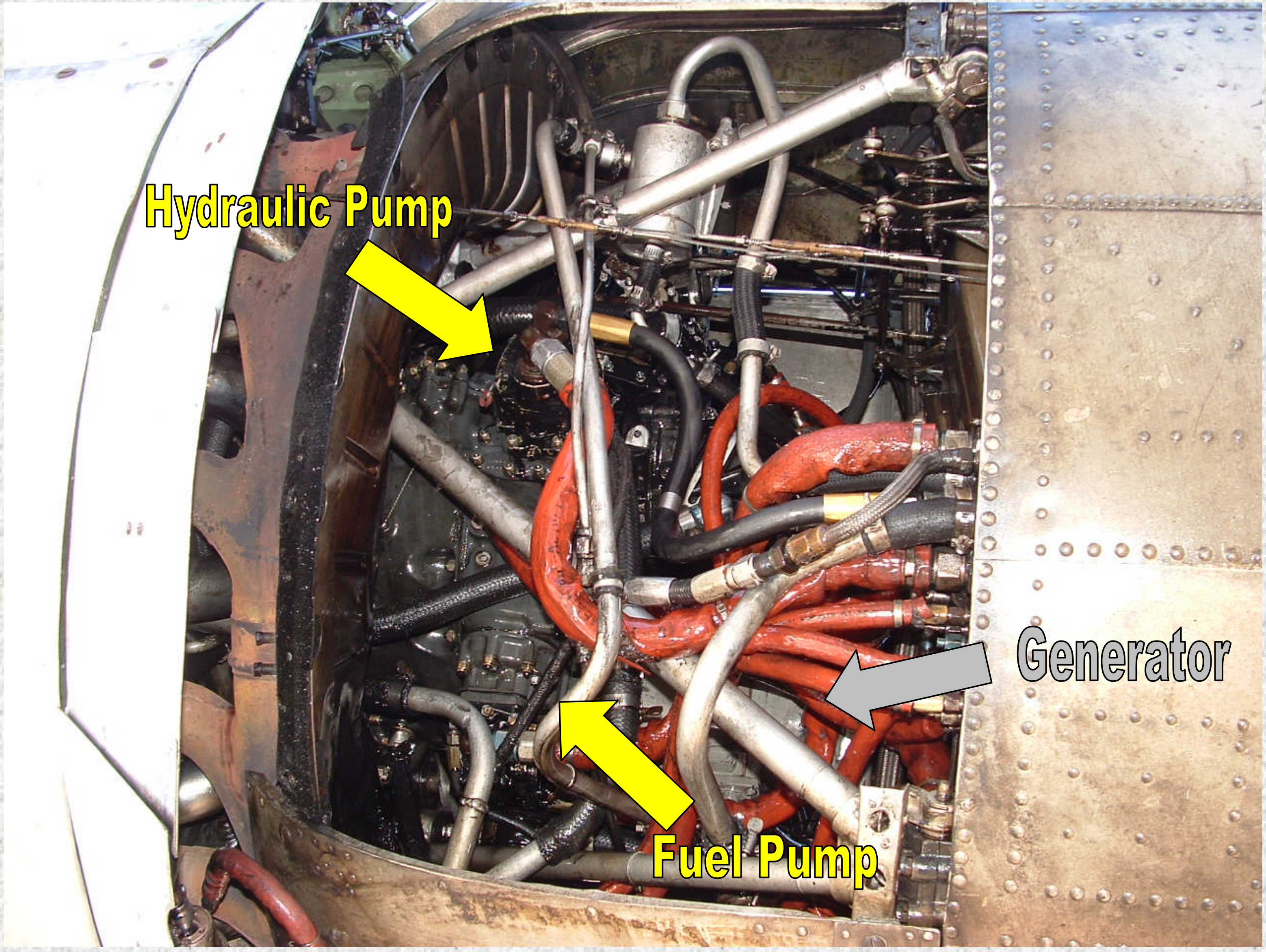
<u>Fuel Pressure Indication</u> – The pressure tapping is taken immediately down stream of the fuel pump at the carburetor and through line routing is directed to a pressure sensitive switch, located in the nose section of the aircraft. This will cause a light to be illuminated when fuel pressure drops below 12 psi. A pressure tapping is also routed to a sensitive instrument, giving a direct pressure reading on the gauge.

POWER PLANT

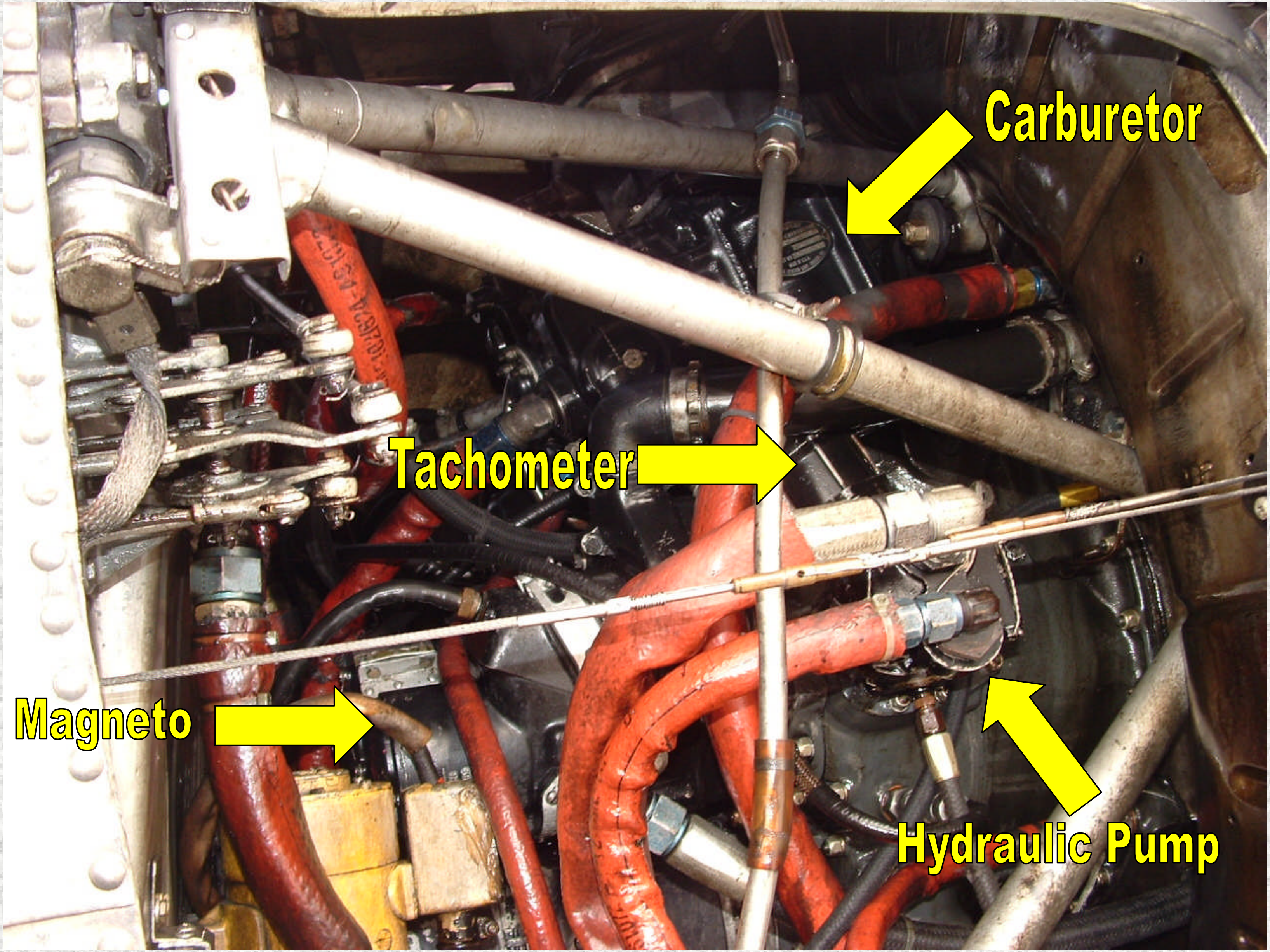
Manifold Pressure – The MAP or MP is measured at the blower or supercharger rim and is an absolute pressure. This tapping is located on the upper right side of the blower case and, through routing of lines, eventually is attached to an absolute pressure gauge in the cockpit. The MP is controlled primarily by the position of the throttle, but cannot be read as direct power output, but merely as a convenient index for measuring one of several factors affecting power.

Supercharger – This unit is a centrifugal air compressor which turns approximately 7.15:1, and is housed in the blower section between the power section and the accessory section. After leaving the impeller, the air mixture passes through the diffuser which ensures a smooth flow to the collector where the pressure is measured and directed to the intake pipes and cylinders.

POWER PLANT

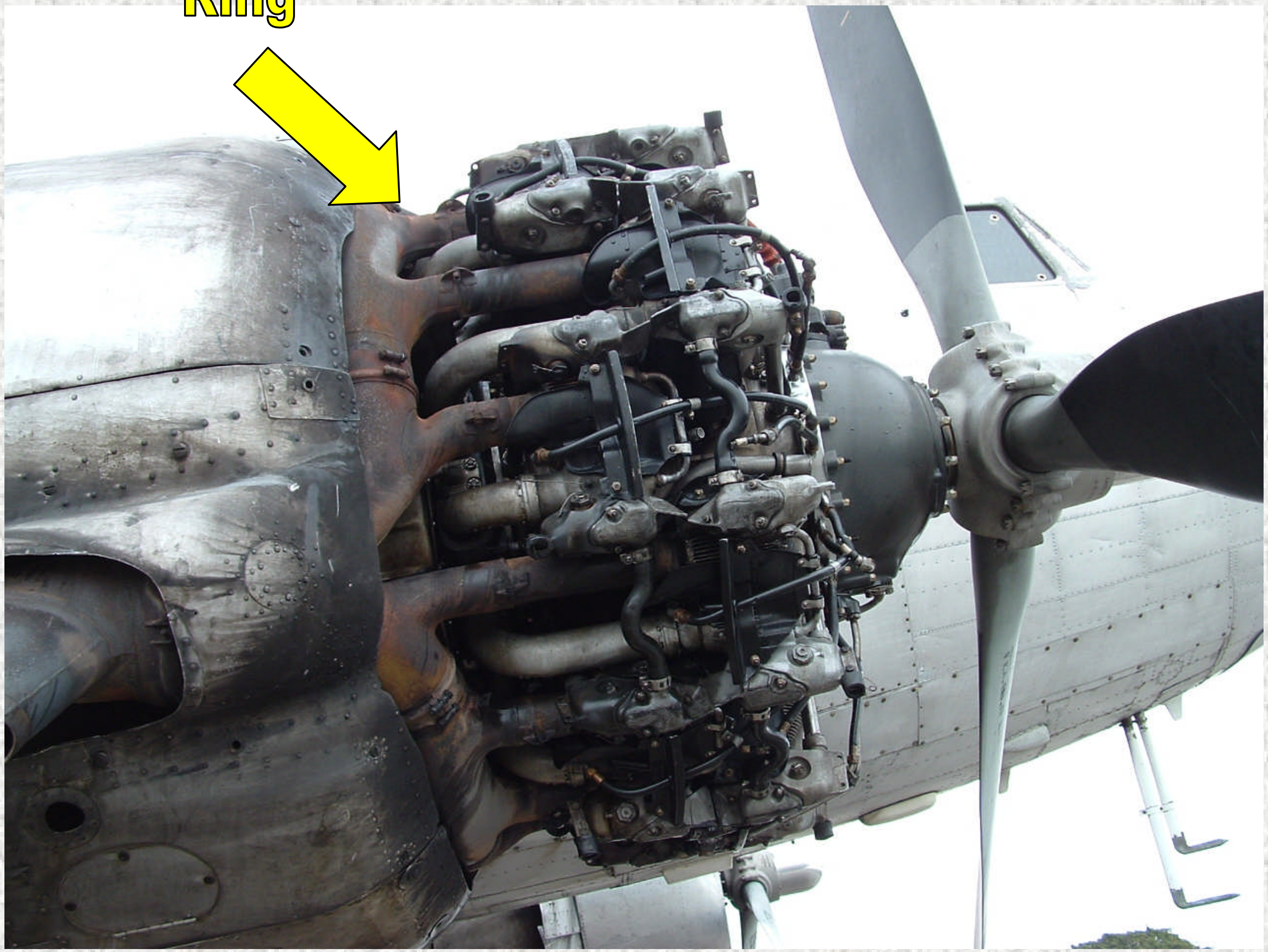


POWER PLANT



Exhaust

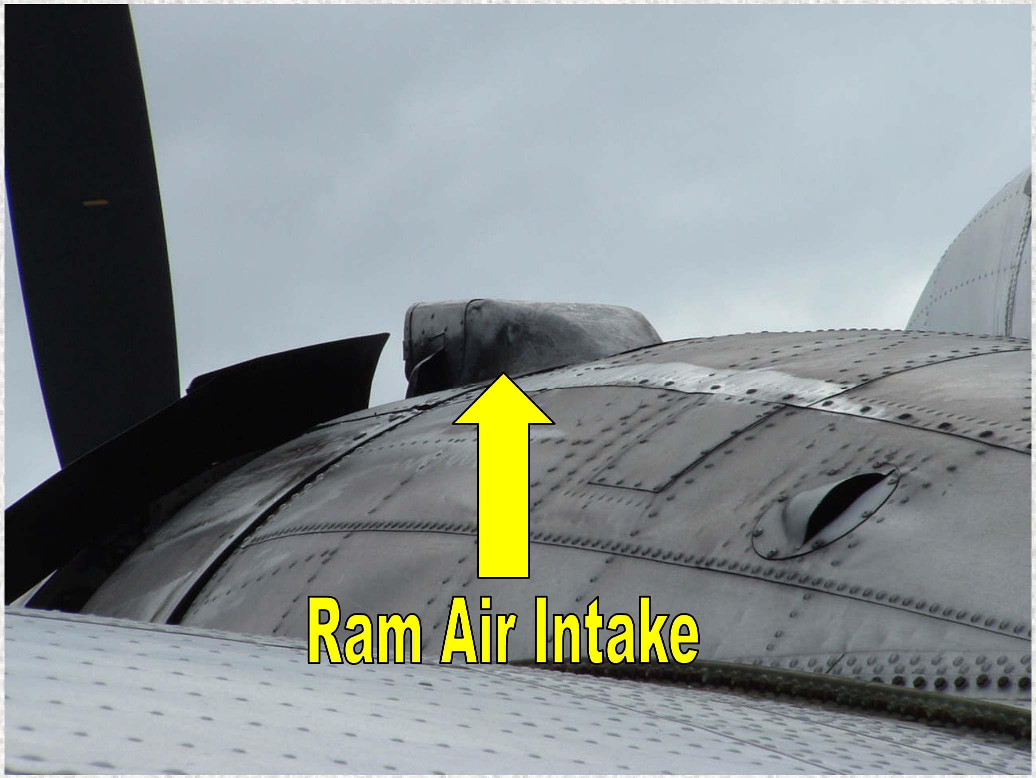
Collector Ring



The exhaust collector ring is a welded corrosion-resistant steel assembly made in seven sections, each section collecting exhaust from 2 cylinders

Carburetor Hot Air System

Provision is made for supplying hot air to the carburetor to eliminate or prevent the formation of ice in the carburetor air passage. This is accomplished by installing a butterfly valve in the ram air intake, which in operation, closes ram air and opens the air duct so that the air entering the carburetor is warmed from a point behind the exhaust manifold. This butterfly valve is operated by a control located on the right side of the pedestal. Moving the control aft, closes the ram air and opens the door for warm air. Moving the control forward reverses the process.



The Application of Carb Heat may be necessary when flying through clouds associated with moisture

Propeller

Needle Blades (Pictured)

Type	Hamilton Standard Hydro-Matic, Quick Feathering, Constant Speed Control
Model Number	23E50/6353A
Diameter	11 Feet 6-3/8 Inches
	11 Feet 3-3/8 Inches

Blade Angle Setting

(6353A-Needle Blades)

Low Pitch 18 degrees-High Pitch 88 degrees

(6477A-0- Paddle Blades)

Low Pitch 16 degrees-High Pitch 88 degrees

Measured at the 42 inch station

Propeller

The three bladed propeller has a approximate diameter of 11 feet 7 inches. It is securely mounted to the end of the engine propeller shaft. The gear ratio to the propeller from the engine is 16 to 9.

Blade movement is accomplished by mounting the blades in bearings; thus allowing them to turn in the propeller hub. Gears mounted on the hub end of the blades engage the gears of a cam. The cam is forced to turn by connecting it to a piston which is acted upon by governor-controlled oil pressure and engine oil pressure.

The hub and spider assembly, made of high grade steel, locates the blades in position and engages with the engine propeller shaft splines to transfer the propeller load to the engine.

The blades are made from aluminum alloy forgings, and are heat-treated for high strength. The blades are individually balanced and when assembled into the hub, the whole assembly is balanced as a unit.

Propeller Dome Assembly

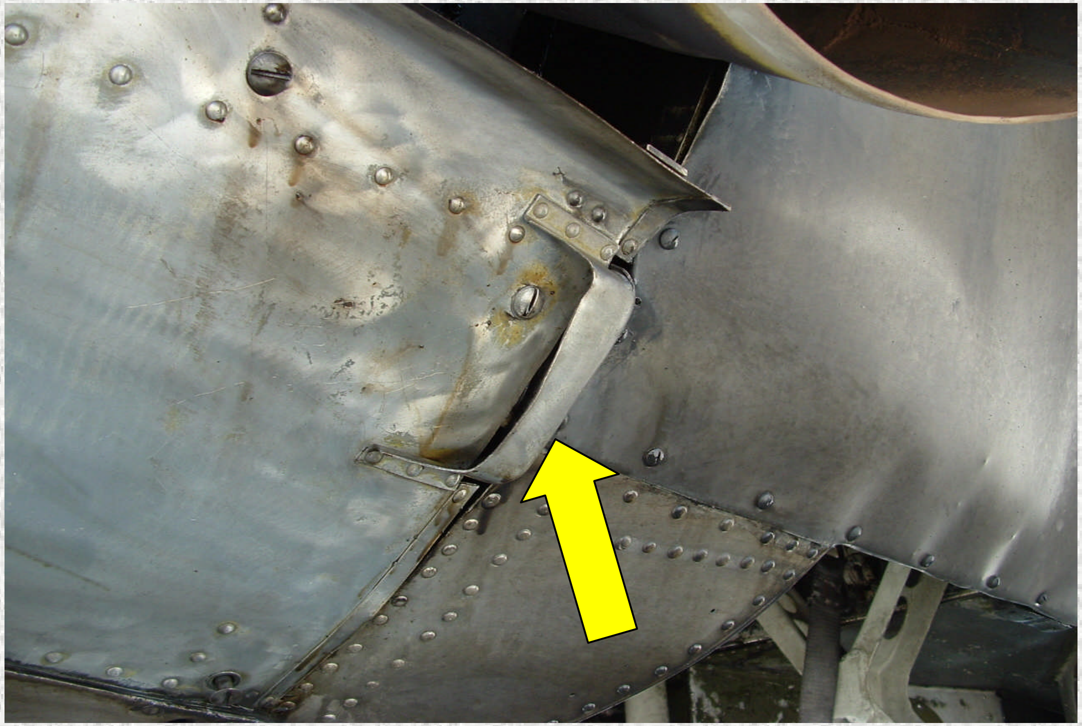
The dome assembly houses the cam and gear arrangement and the hydraulic piston which, when mounted on the hub assembly, is capable of twisting the propeller blades. Stops are located within the dome to control the low and high pitch blade angles.

Provisions are provided within the piston assembly to allow oil to bleed form the high pressure side of the piston to the low pressure side of the piston to prevent congealing of the oil.

Correct Pitch Angles

To check the blade angles, use the index line on the shank of the blades and the graduation on the barrel blade bore, or by a protractor at the reference station

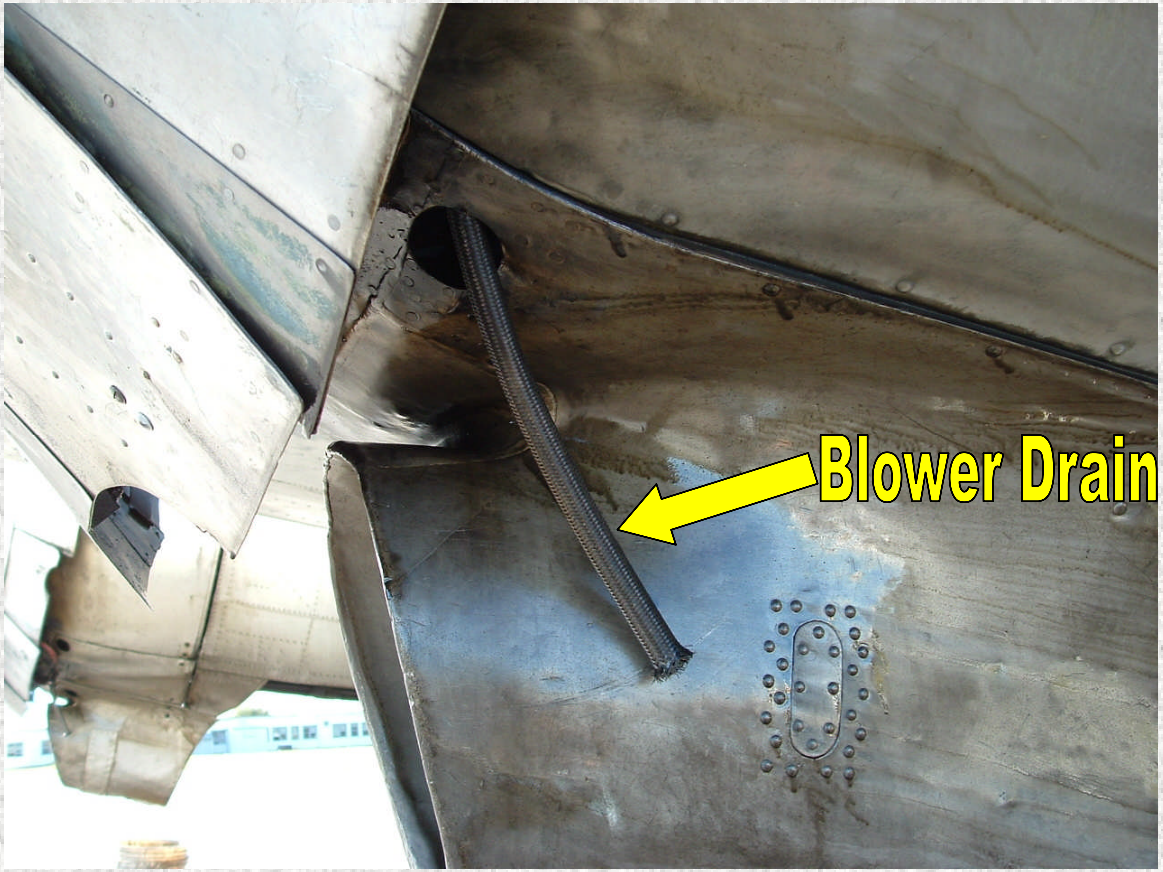
Engine Mount Cooling



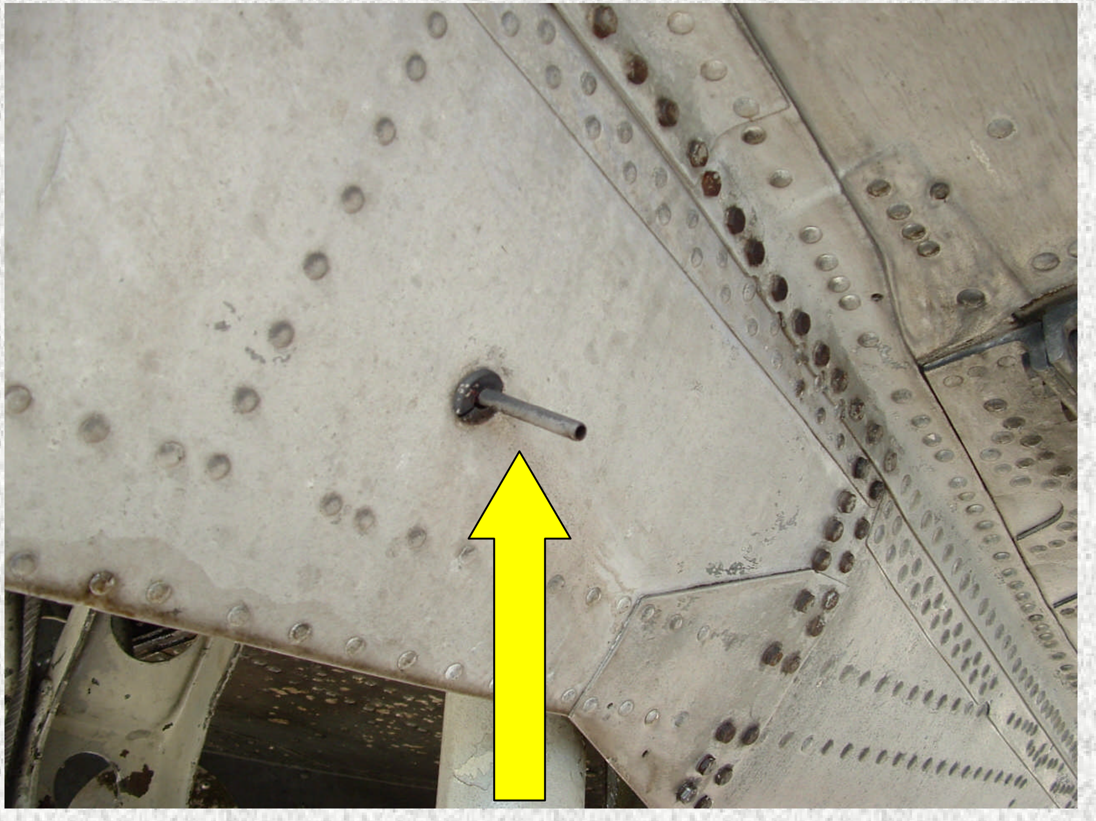
Just below the exhaust stack on the outside of the engine cowling is an aluminum scoop which aids in the cooling of the engine mounts.

Blower Drain Valve

The blower drain valve is located on the bottom of the intermediate rear crank case of the engine. It is connected with a line leading away from the blower case to a point outside the cowling, near the lower forward edge of the firewall. The function of the blower drain valve is to prevent an accumulation of fuel in the lower part of the blower case, which might otherwise run into the lower cylinders and cause damage to the engine when it is started.

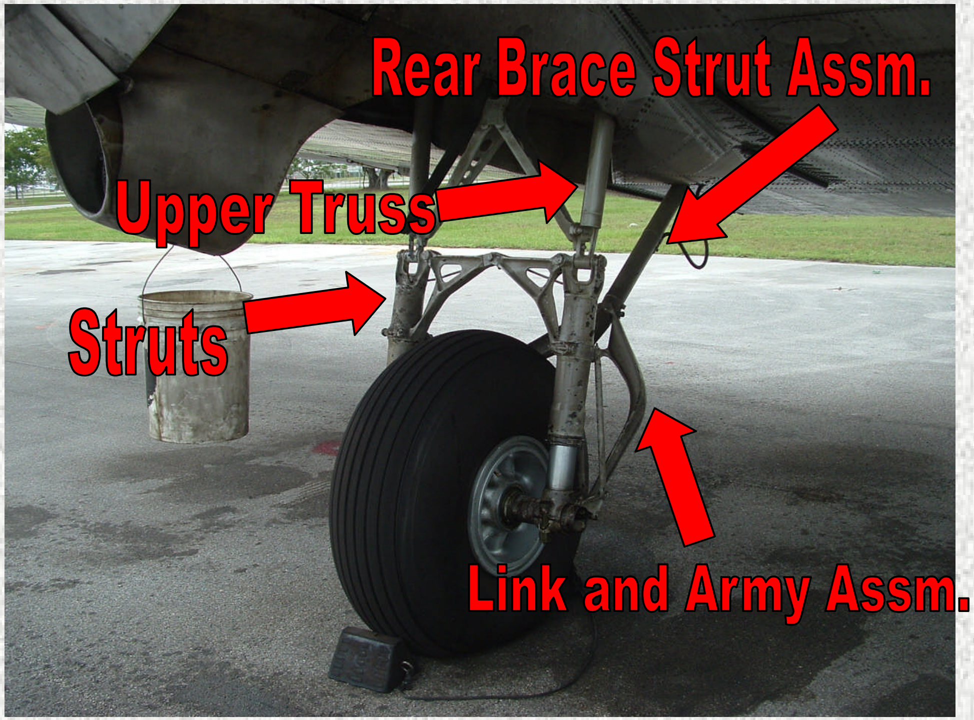


Booster Pump Vent Line



A vent line is installed on each booster pump at the junction of the motor drive and the splined shaft of the fuel pump. This line runs through the skin of the ship and vents into the atmosphere to take care of any leakage of gasoline that might otherwise seep into the motor housing.

Landing Gear

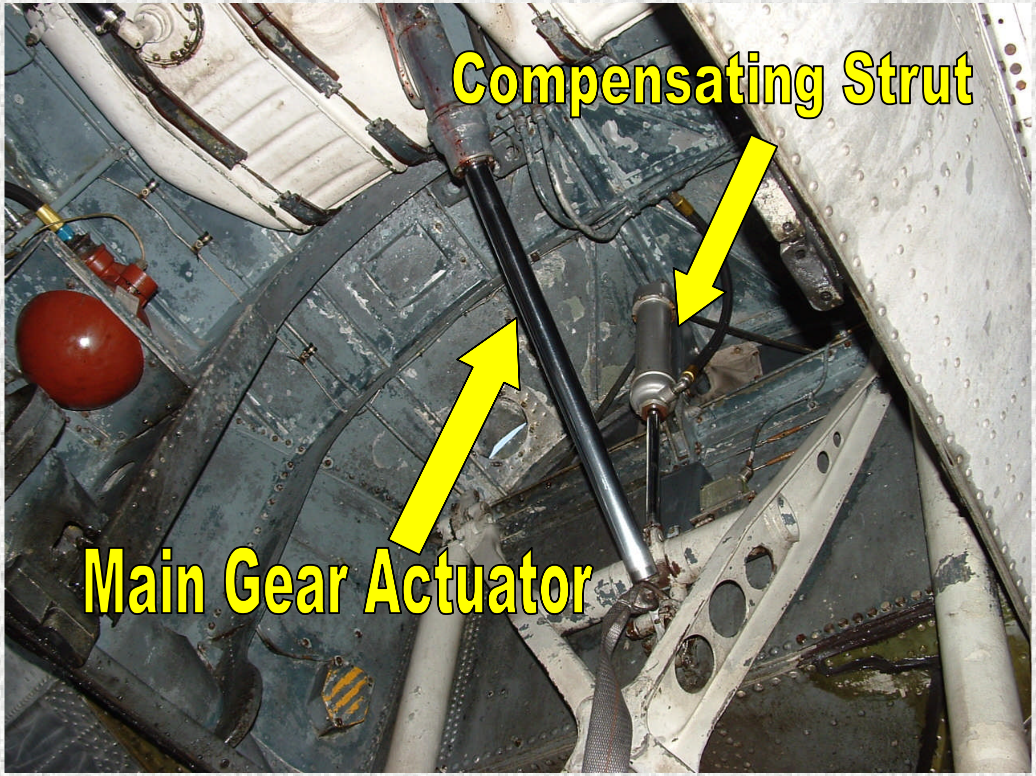


<u>Description</u> – The landing gear consists of three units – two retractable main gears with single wheels and dual brakes, and a tail wheel gear which is not retractable, but is full swiveling. Extension and retraction of the gear is accomplished by hydraulic actuating struts which are controlled by the landing gear control lever on the hydraulic panel.

A mechanically-controlled locking device is incorporated by holding the gear in the down position. Another additional locking procedure may also be employed, which consists of locking the gear to a positive down position by installing a mechanical lock.

Landing Gear

To retract the main gear, an actuator is employed. The cylinder end of the actuator is attached to the forward nacelle structure- the piston rod end to the upper truss. Retraction is accomplished by pulling the upper truss forward and upward. Since the upper truss is connected to the shock absorbers and wheels, the gear will be pulled up into the wheel well. To assist the action of the retract mechanism, a hydraulic compensator is utilized assisting upward travel of the gear, snubbing downward travel. All aircraft have the hydraulic compensator installed.

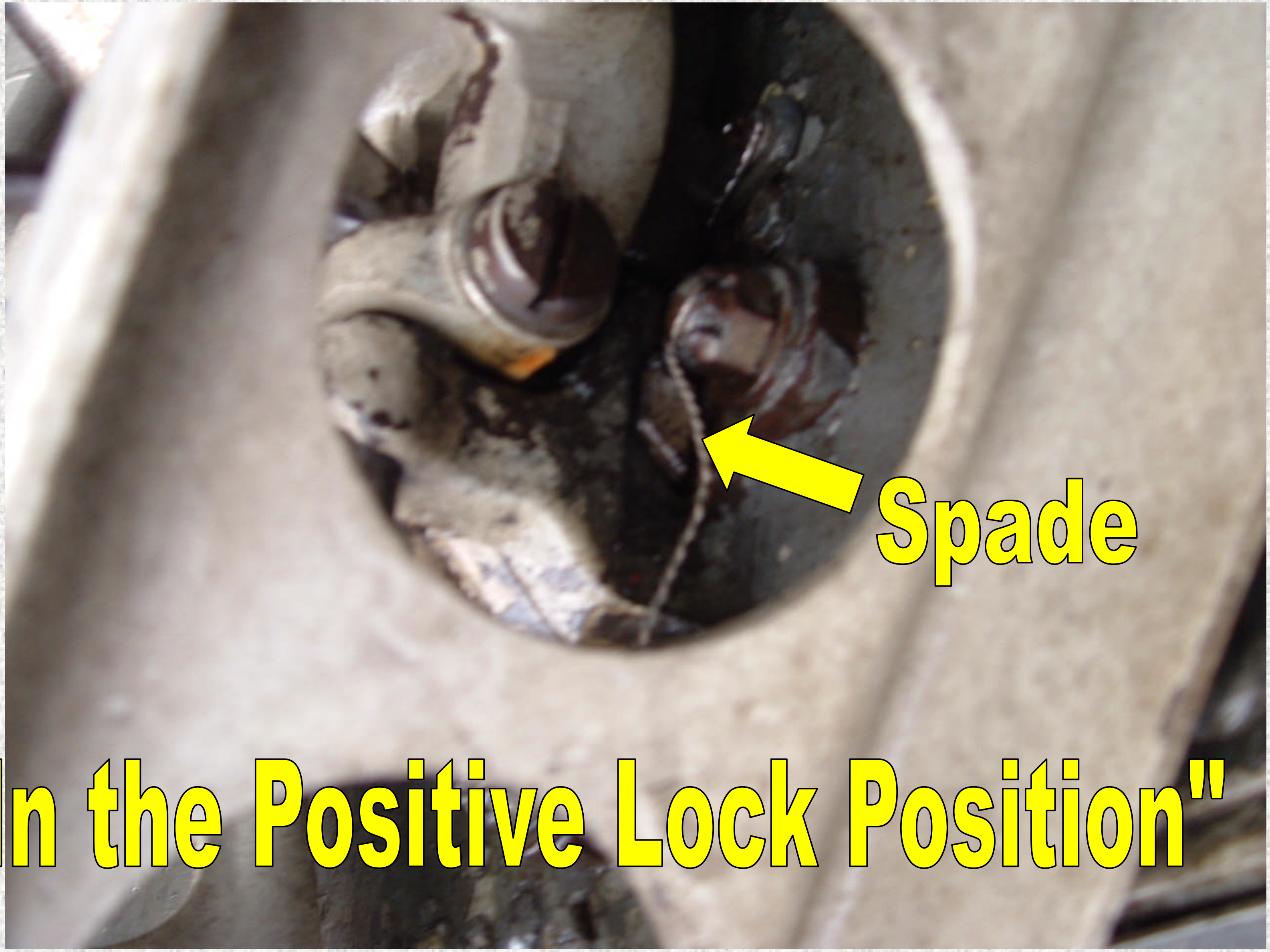


Landing Gear

A spring-loaded mechanical safety latch, installed in each nacelle on the forward side of the front spar automatically latches when the landing gear is fully extended, by engaging a slot in the lower end of the actuating cylinder piston rod. The latches for both gears are controlled simultaneously by cables connected to a single control handle located on the floor between the pilot’s seat.

The control handle has “3” positions –latch raised, which lifts the lock commonly called the spade for gear retraction – spring lock, which receives and latches the landing gear actuating rod hook when the gear is extended – and positive lock, which may be locked by mechanical linkage rather than spring pressure, after the gear is spring locked down. This is accomplished by positioning the latch handle against the floor, maintaining it there by means of a lock.

Landing Gear



Landing Gear Struts

The main landing gear struts should be carried with approximately ***4" +/- ¼*** clearance measured from the top edge of the axle to the bottom edge of the packing nut and the tail strut approximately ***1 ¼ +/- ¼"*** from the packing gland nut to the red line on the piston tube. There is an equalizing line connecting the two struts on each main gear to evenly distribute the pressure on both sides of the gear.

Landing Gear Offset

The landing Gear Offset is incorporated within the Landing-Gear Upper Truss and Shock Absorber Strut to assist the Landing Gear from buckling under extreme loads and impact

LANDING GEAR SAFETY PINS

Landing gear safety pins are provided to prevent inadvertent retraction of the main gear when the aircraft is on the ground. When not in use, they are stowed on board the aircraft.

Landing Gear Latch-Warning Switch

The Latch-Warning Switch is mounted on each upper truss of the two landing gear assemblies, so that when the gear is completely extended the switch arm may be operated by a lug on the latch assembly. When the latch is down, the lug causes the switch to close the circuit for the green light. However, if the latch is raised, the switch automatically opens the green light circuit and closes the circuit for the red light and horn.

C-47 and DC-3 Landing Gears

The gear components on a DC-3 look slightly different from those of a C-47; however, their operation is identical

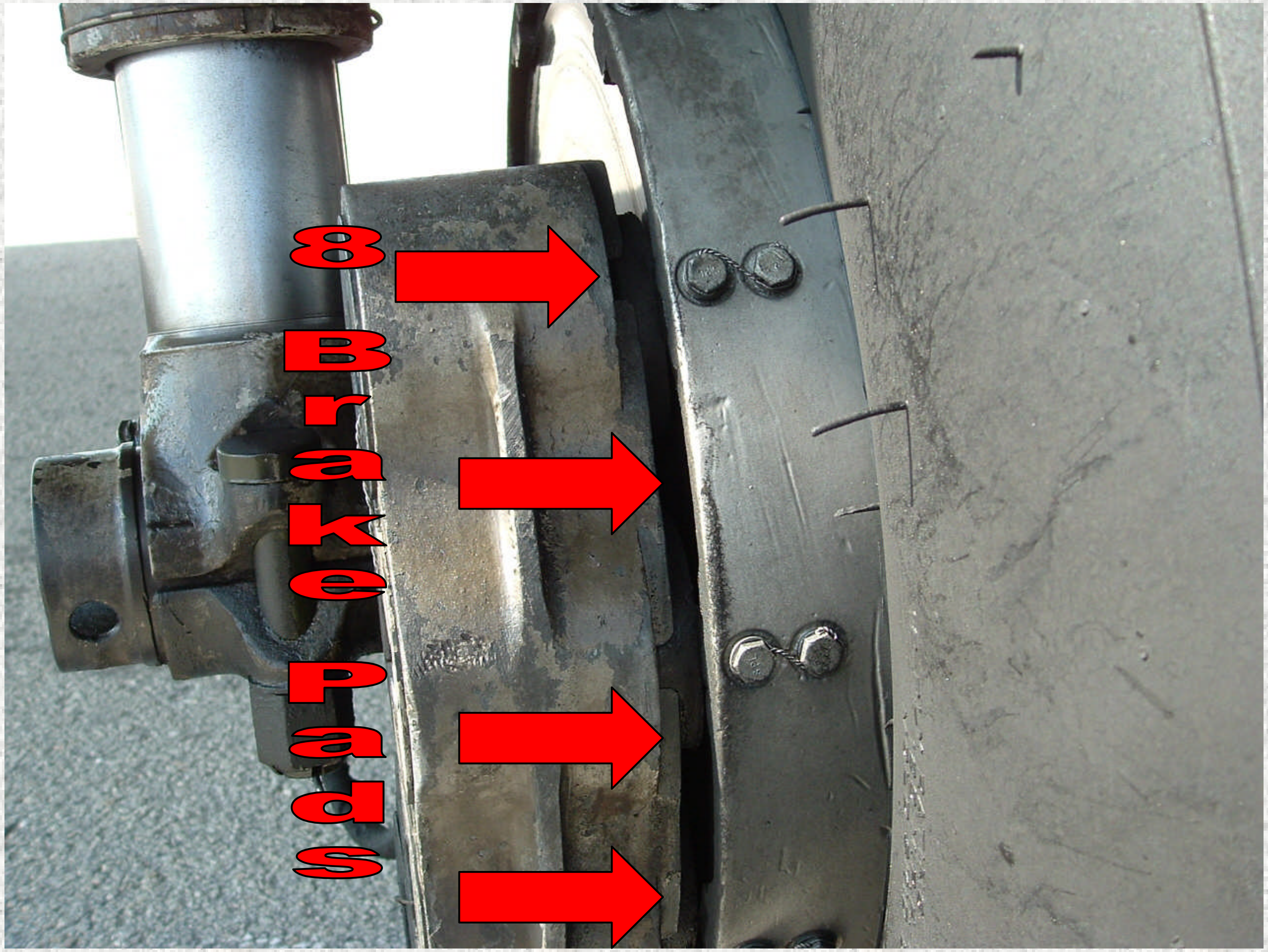
Main Wheels And Brakes

- Wheels

  Goodyear 17 X 16 Main wheel Assembly No. 9540547 and Brake Assembly No. 9540385 manufactured by the Goodyear Tire and Rubber Co. Ltd. The Goodyear brake is a single disc, four cylinder unit with automatic adjustment of lining wear.
- Tires

  Aero Classic 17.00 X 16 12 Ply Rib design (***55*** psi)

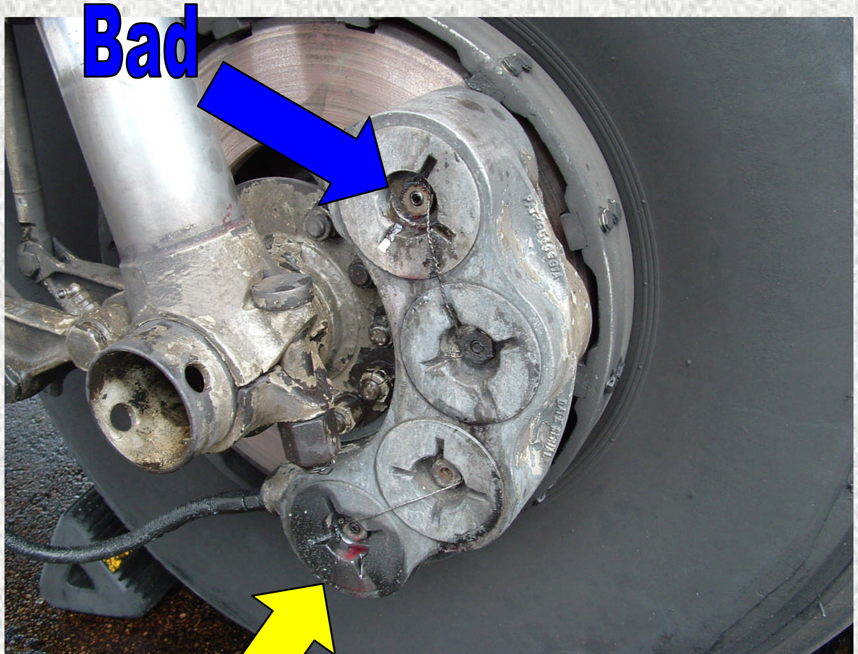
Goodyear Brakes

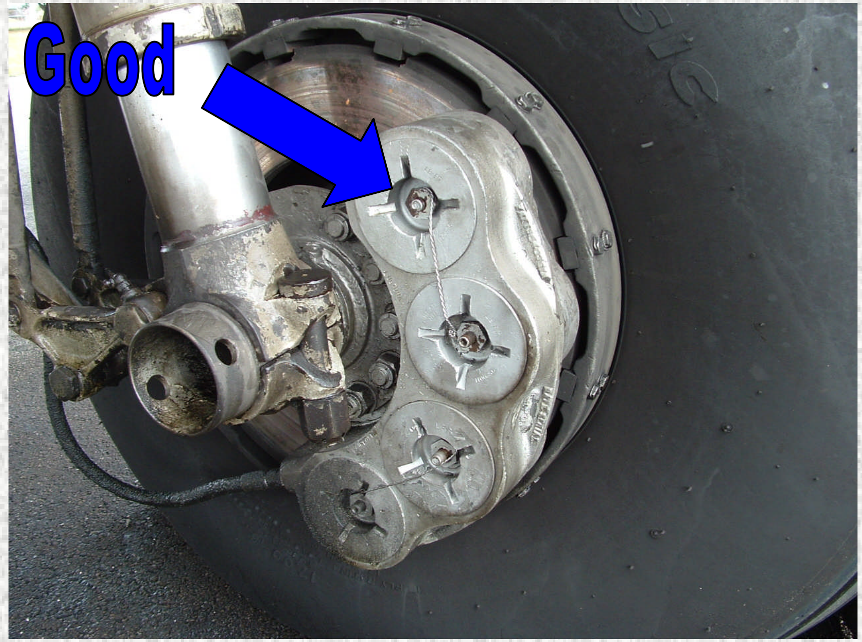


4 on the outside and 4 on the inside

Goodyear Brakes

Visual Inspection



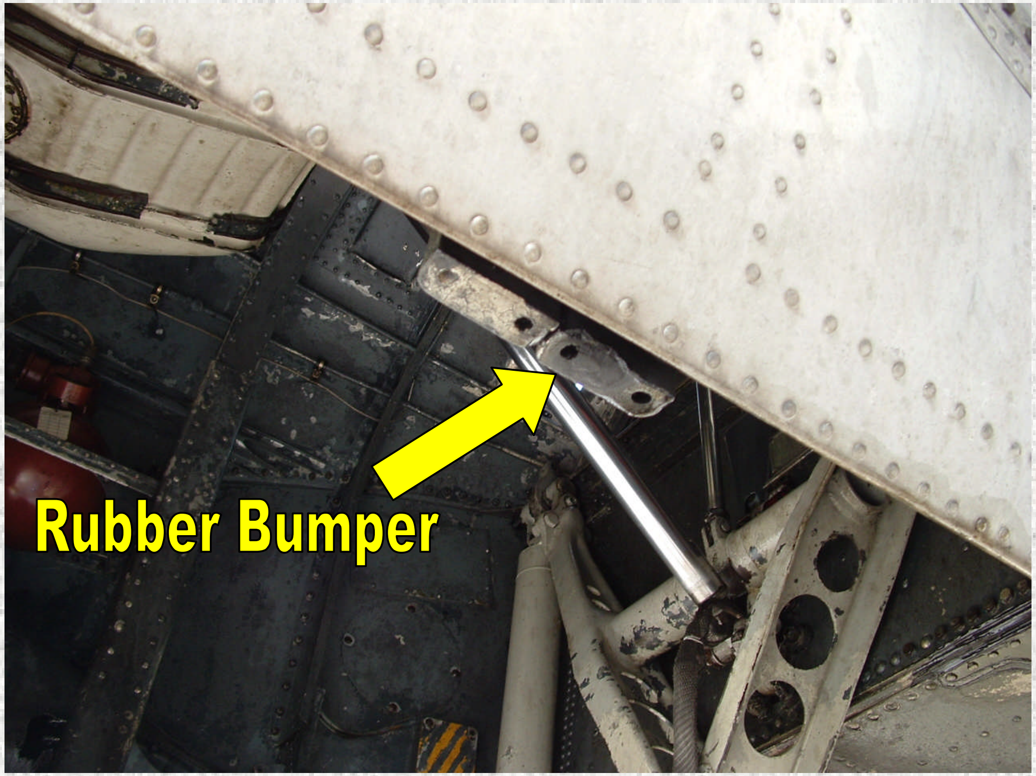


Note the Hydraulic Fluid leakeage

This is an indication of worn Brake pads

Landing Gear Bumper

When the gear is fully retracted, the projecting ends of the axles are held against rubber bumpers built into the sides of the nacelles.



Flight Wheel Brake

A flight wheel brake is attached to the rear face of the fire wall in each nacelle and consists of a length of heavy flexible belting fastened at each end to the fire wall and faced with small steel plates. When the landing gear is retracted into the nacelle wheel well, the brake automatically contacts the tire tread and causes sufficient braking action to stop the rotation of the wheel caused by the slip stream.

Wing Flaps

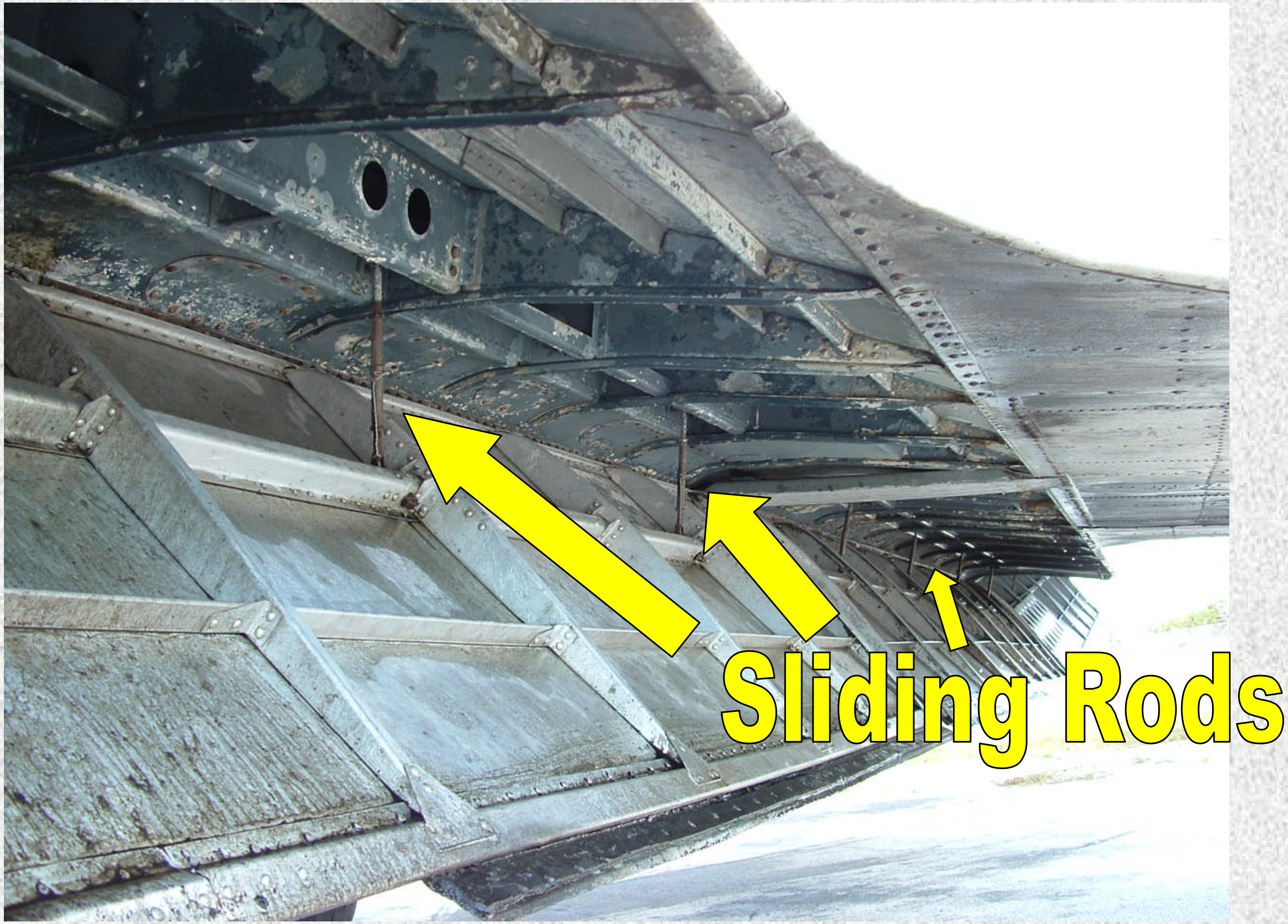
The Metal wing flaps are composed of four sections which extend from the inboard end of the left aileron, under the fuselage to the inboard end of the right aileron. The flaps are of the split trailing edge type.

The flaps are hydraulically raised and lowered by the flap control valve, located on the hydraulic panel.

The flaps are hinged to the underside of the wing and center section, and are raised and lowered by a series of sliding rods, attached to the hydraulic actuating cylinder.

To raise or lower the flaps, first clear the slot that holds it in neutral by swinging the lever (Yellow handle) toward the aisle. Move the lever down to lower the flaps, up to raise them, and return to neutral when flaps are in position. There is a flap position indicator below or to the left of the instrument panel.

Wing Flaps



WING FLAPS EXTENDED

Wing Flaps

A wing flap relief valve prevents the lowering of the flaps beyond the quarter position at an airspeed of more than 112 mph. This valve operates to limit the pressure in the forward end of the actuating cylinder to 375 psi. Therefore, when the air load on the flaps is sufficient to produce a back pressure of more than 375 psi, the relief valve shuts off pressure from the hydraulic system and opens the forward end of the actuating cylinder to the return line.

In operation, moving the control handle to the “DOWN” position, actuates the control valve which directs fluid to the forward end of the actuating cylinder. As the piston extends, pulling the push-pull rods forward, the flaps are lowered. The fluid in the aft end of the cylinder flows through the control valve, and back to the hydraulic reservoir. Moving the control to the “UP” position reverses the process.

There is a restriction in the “UP” lines which prevents the flaps from being raised too quickly.

When the airplane is parked, the flap control handle should be left in the “UP” position to prevent damage to the system due to thermal expansion.

Trim Tabs

Aileron Trim Tab
(Right Side Only)

Rudder Trim Tab

Elevator Trim Tab
(One on each Side)

The Left and Right Elevators are Interchangable

Tail Wheel

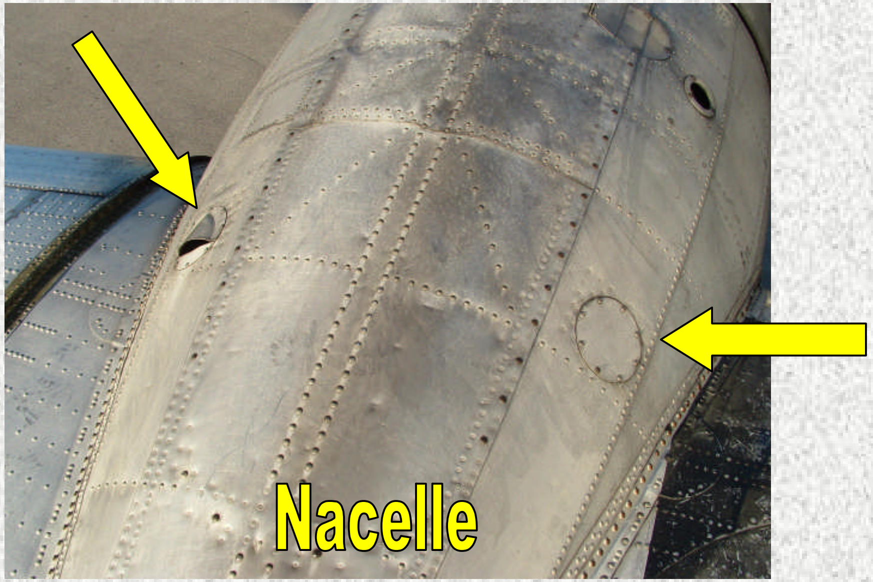
The Tail Wheel gear is a full-swiveling, non-retracting assembly. The gear consists of a magnesium wheel on which is mounted a 9.00 x 6 tire **(*60* psi).** The wheel is attached to a fork assembly which anchors to a post attached to the fuselage. The tail wheel assembly may be prevented from swiveling by engaging the tail wheel lock.

An air-oil shock absorber is installed between the structure and the fork to cushion the action of the tail wheel.

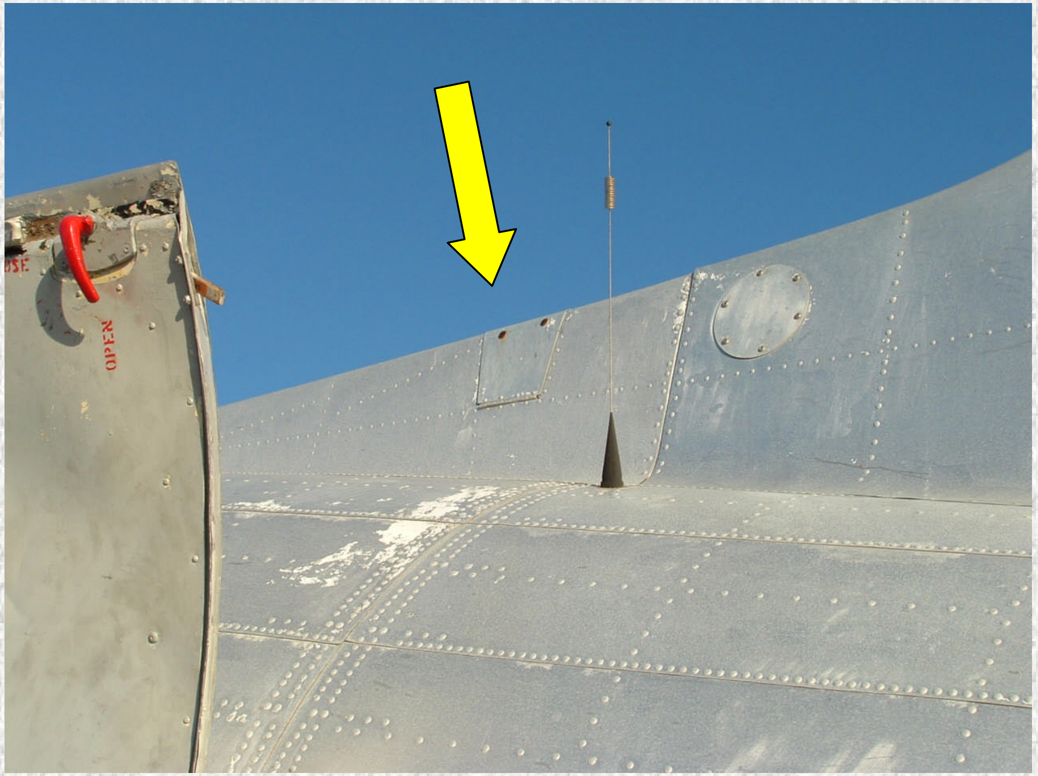
The mechanically operated tail wheel lock lever located on the control pedestal below the throttle levers has LOCK and UNLOCK positions. The LOCK position locks the tail wheel in the trailing position for take-offs and landings. The UNLOCK position allows free swiveling of the tail wheel for taxiing. Forcing the tail wheel to turn while in the locked position shears an aluminum shear pin on the tail wheel post, rendering the LOCK position inoperative. The lock mechanism will bind if side pressure is placed on the tail wheel when attempting to unlock the tail wheel lock.

Aircraft Hoisting

Inside the nacelle are two fittings to which cables are fastened. The fittings are bolted to the top of each main landing gear strut which in turn is secured to the front spar of the center wing section. The arrows show where the Cable Nacelle Sling hook to the Strut.

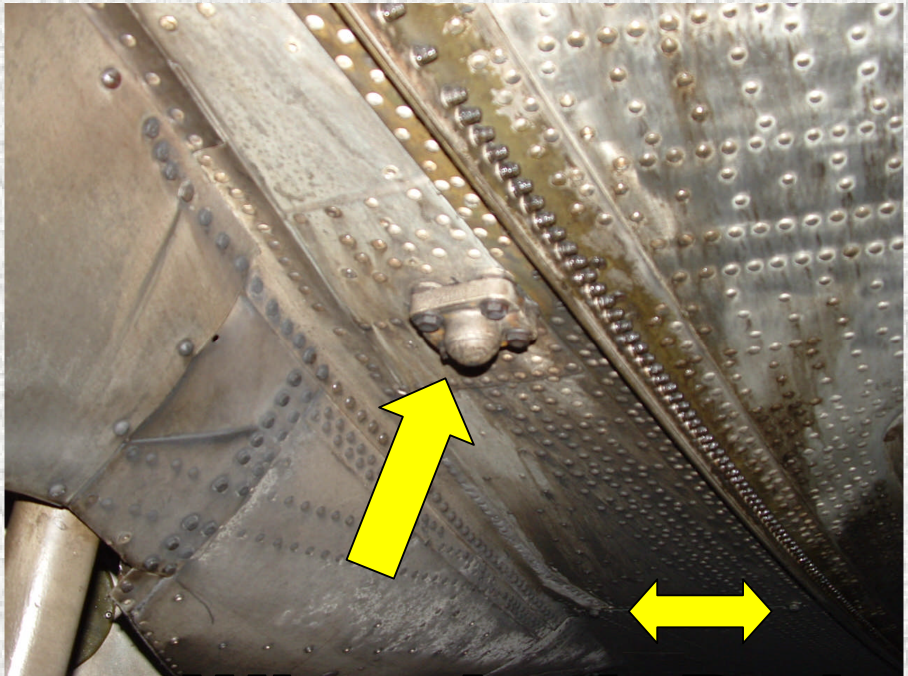


Aircraft Hoisting



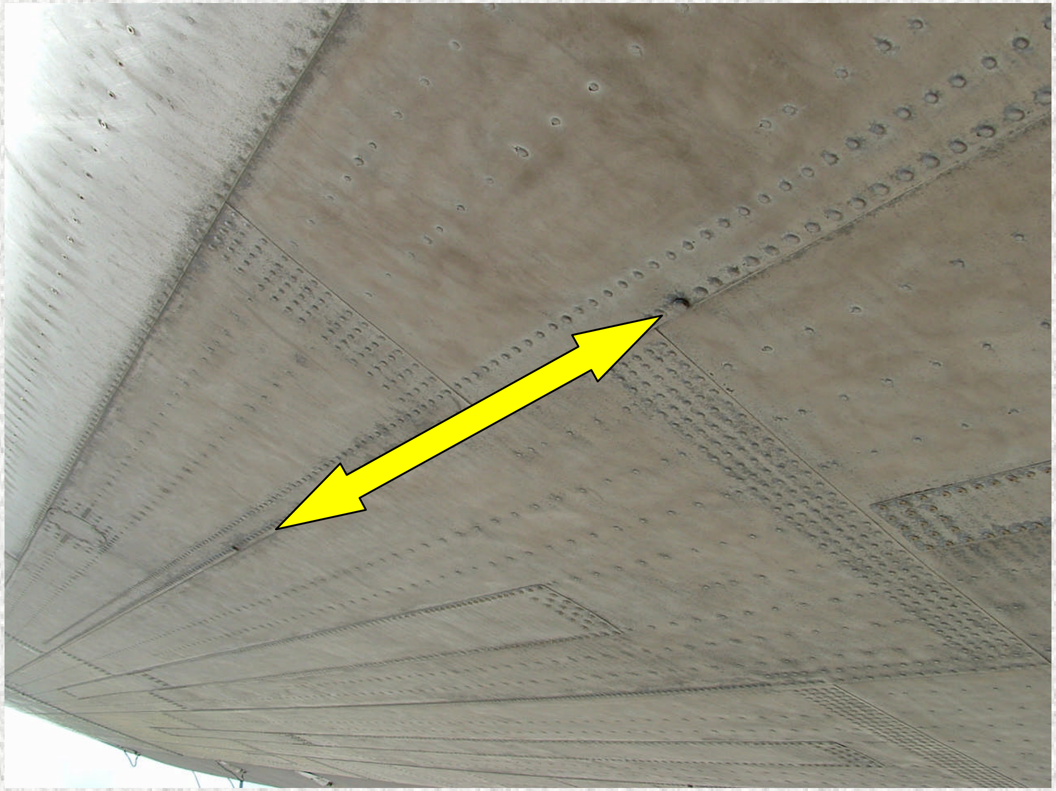
To raise the tail of the aircraft, the tail hoist is hooked to a permanently installed cable which is bolted to the fuselage structure located in the fairing forward of the vertical stabilizer.

Lifting the Aircraft



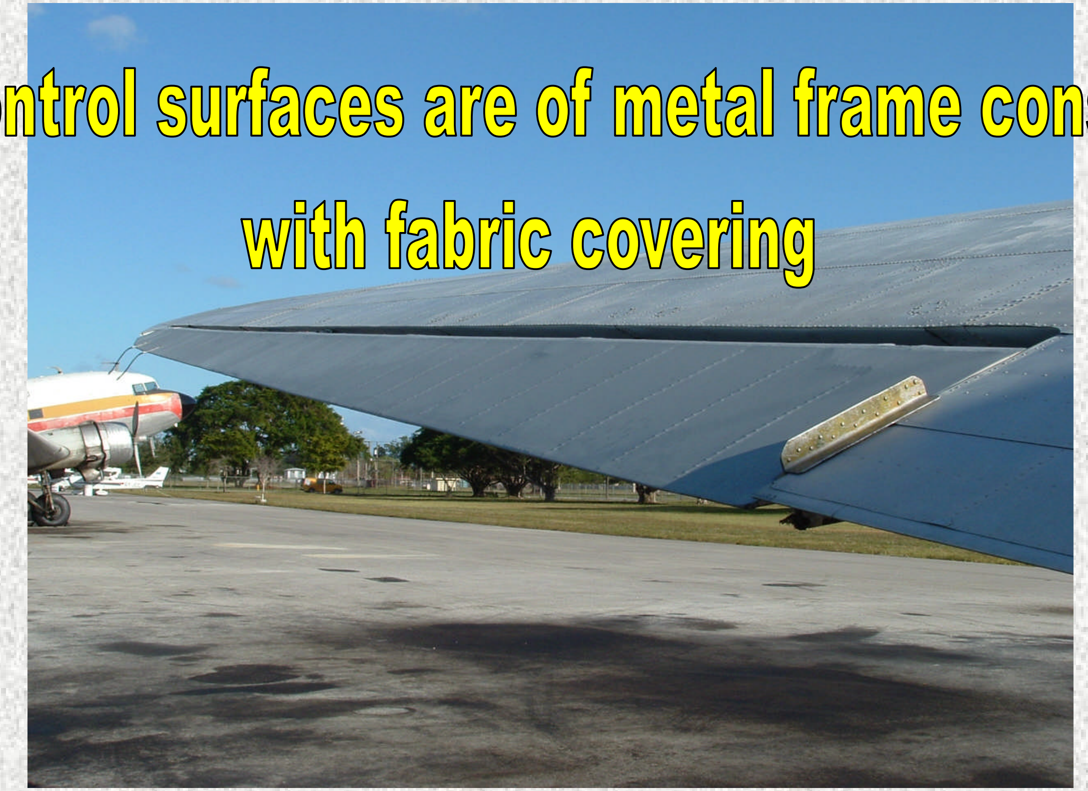
Wing Jack Pad and
Two Auxiliary Lifting Points

WING SLING



Attachment points for the Wing Sling. They are positioned on both the upper and lower portions of the wings.

Flight Controls



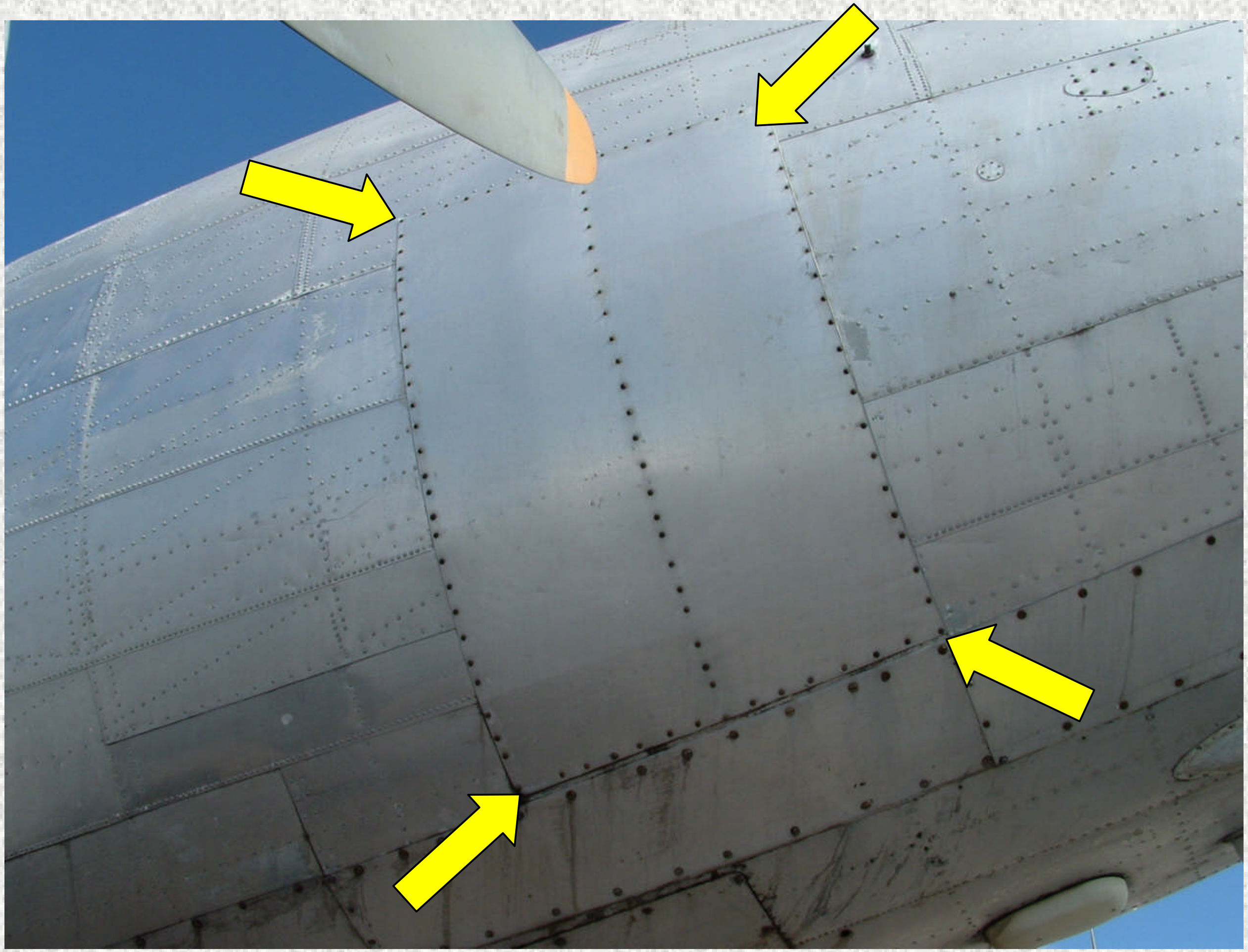
Primary control surfaces are of metal frame construction, with fabric covering

The flight controls consist of independent elevator, aileron, and rudder systems. The flight controls are cable-operated from controls in the cockpit. The elevator, rudder, and aileron systems incorporate trim tabs.

Landing Light

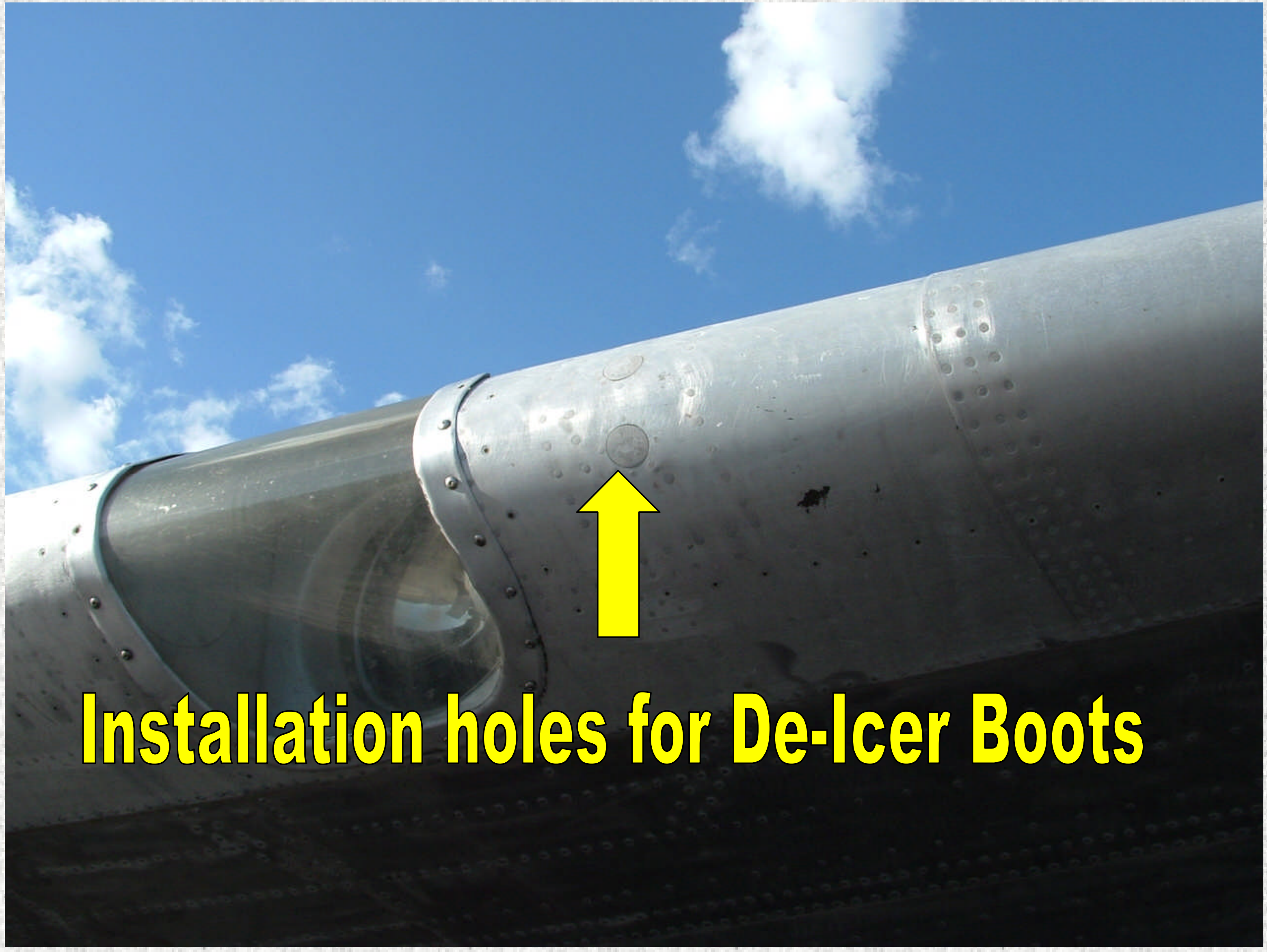
Landing Light assemblies are located on each leading edge of the wing. Lamp assemblies are adjusted to project a beam on the ground approximately 430’ for the left and 380’ for the right, in front of the nose on the centerline of the pilots seat, with the plane in the 3 point ground position.

Stainless Steel Panels

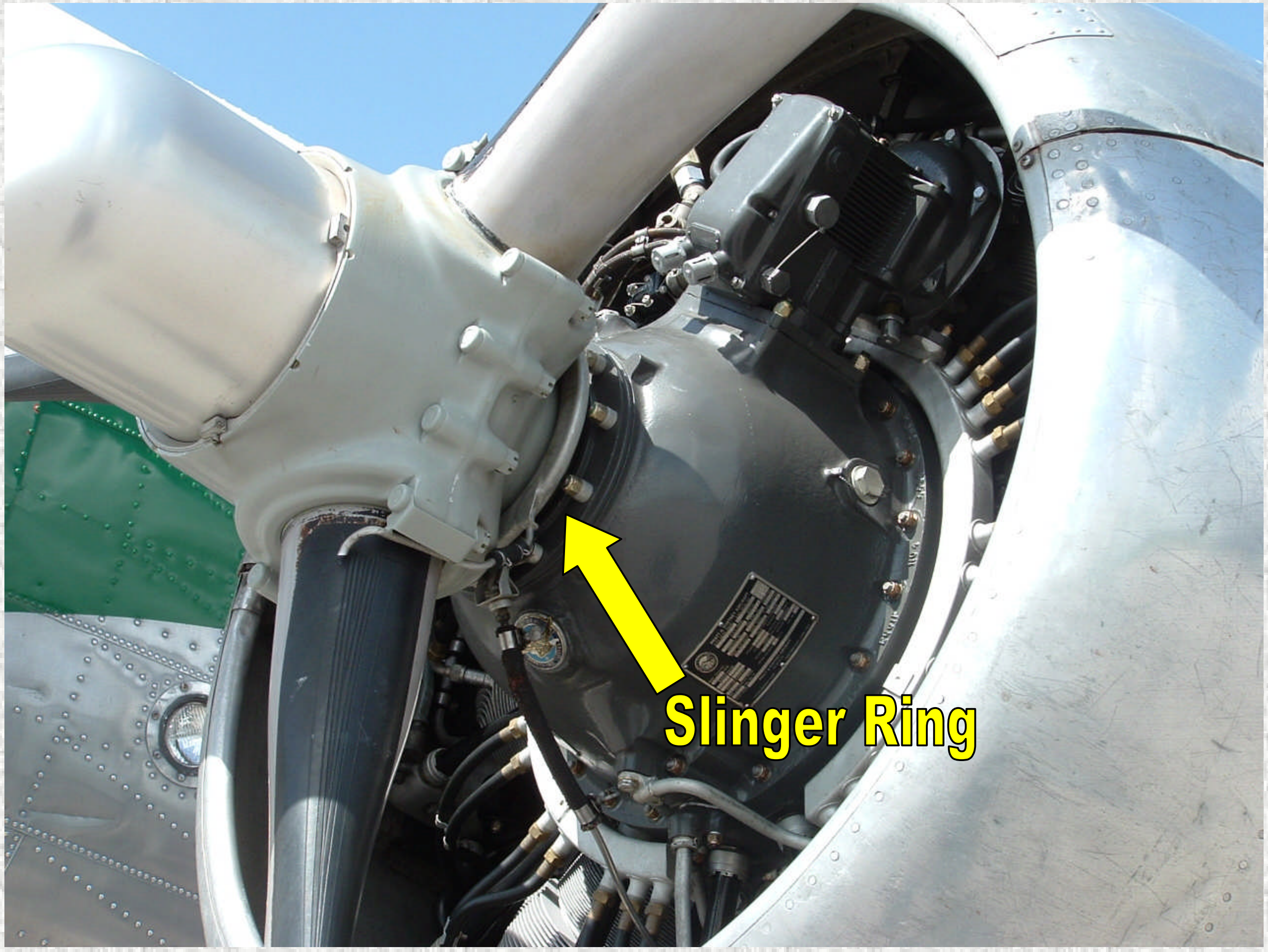


Stainless Steel panels where installed on the right forward side of the fuselage adjacent the right propeller due to the dissipating ice thrown from the propellers during flight while operating the propeller de-icers. On many aircraft you can visually see small dents on these panels due to dissipating ice.

Ice Elimination System



PROPELLER ANTI-ICER



Propellers are de-iced by means of a de-icing liquid (isopropyl alcohol). It operates as follows:

Alcohol is drawn from the supply tank located in the wing fillet. The alcohol pump forces the liquid to a slinger ring mounted behind the propeller hub. This ring is provided outlets for each propeller blade. Centrifugal force causes the liquid to be forced through the outlets of the ring and on to the leading edges of the propeller blades, thus eliminating ice that has formed or preventing its formation in case none is present.

DC-3 or C-47?

Is this a DC-3 or C-47? Note the separation of the aluminum panels and the four rows of rivets. On the C-47 the Tail Section can be removed. The Original DC-3, not C-47's converted are not equipped as such.

DC-3 or C-47?

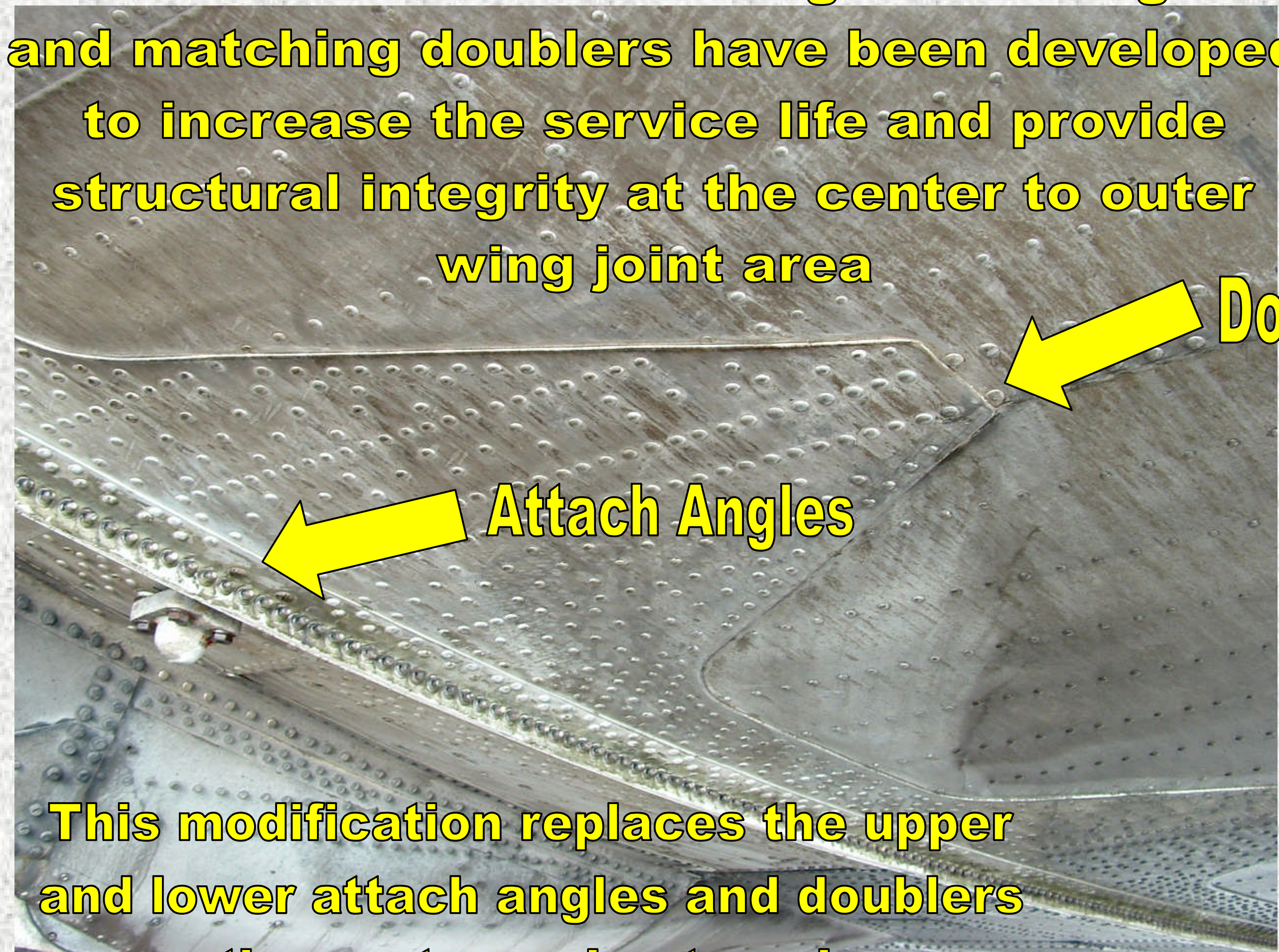
DC-3 or C-47?

The tail section on the Right is that of a C-47B -- note the absence of the split, like that of a DC-3

The previous example is from a C-47A

AD 63-23-01/SB 262

New center and outer wing attach angles and matching doublers have been developed to increase the service life and provide structural integrity at the center to outer wing joint area

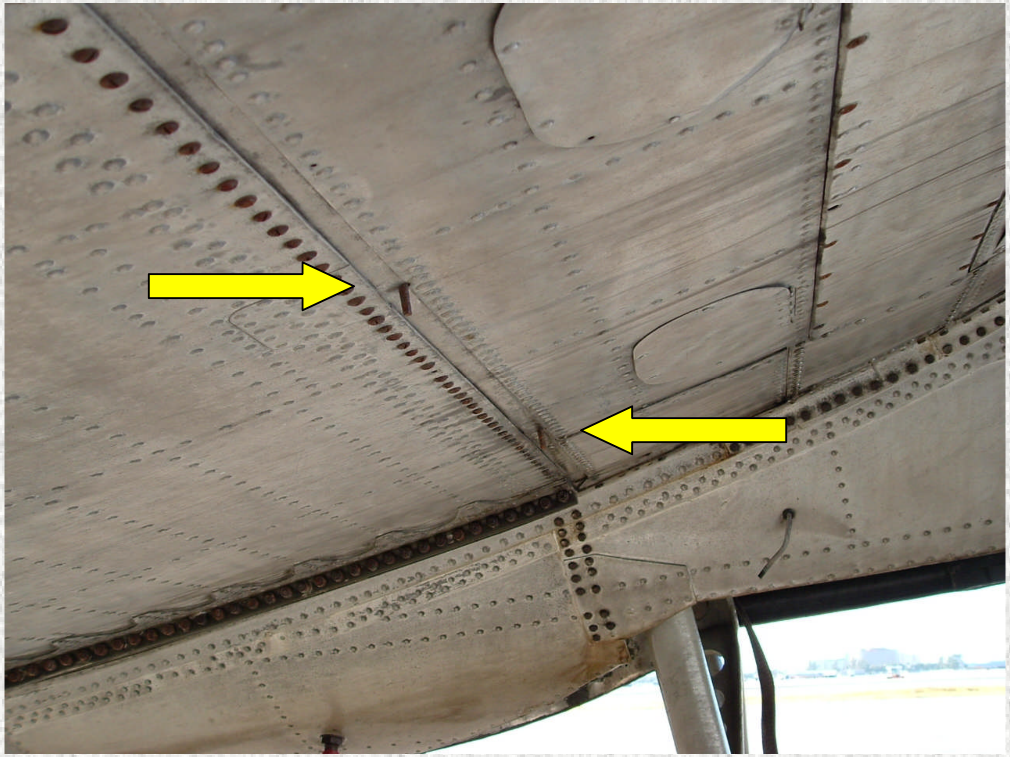


This modification replaces the upper and lower attach angles and doublers on the center and outer wings at wing station 142.000

STATIC DISCHARGERS

Twelve static dischargers, to dissipate static, are installed; two on the trailing edge of each aileron, one on the trailing edge of each wing tip, two on the trailing edge of each elevator, and two on the trailing edge of the rudder

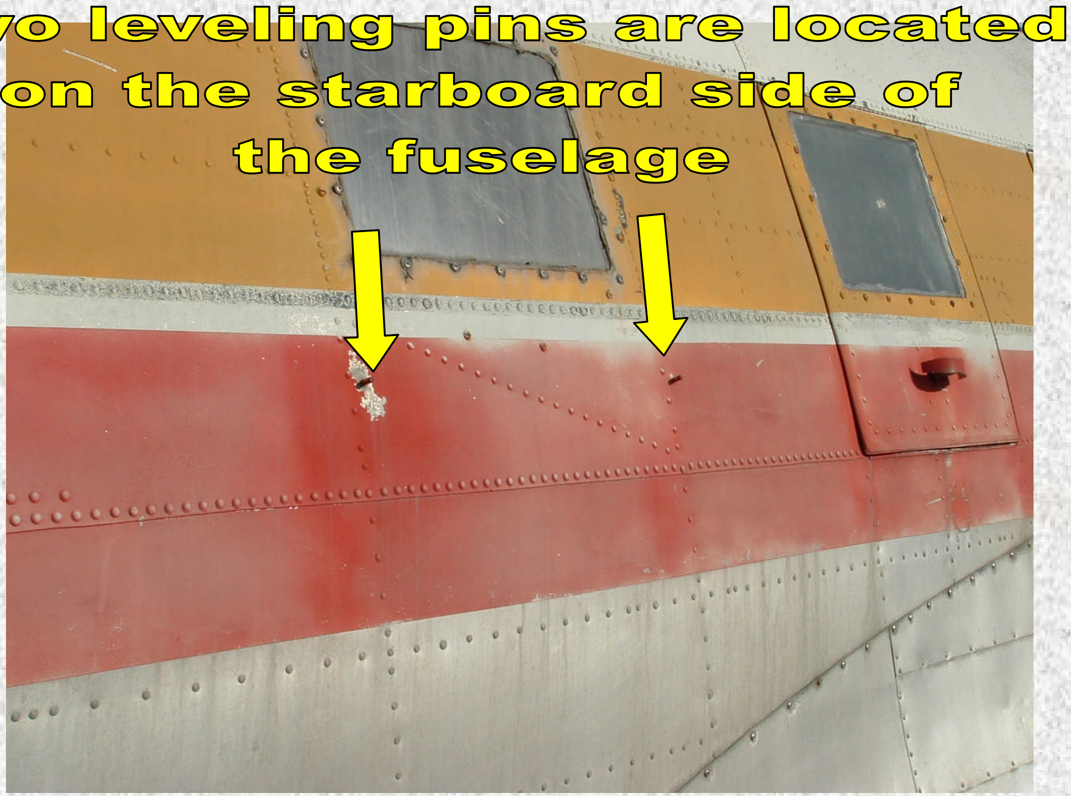
Leveling the Aircraft



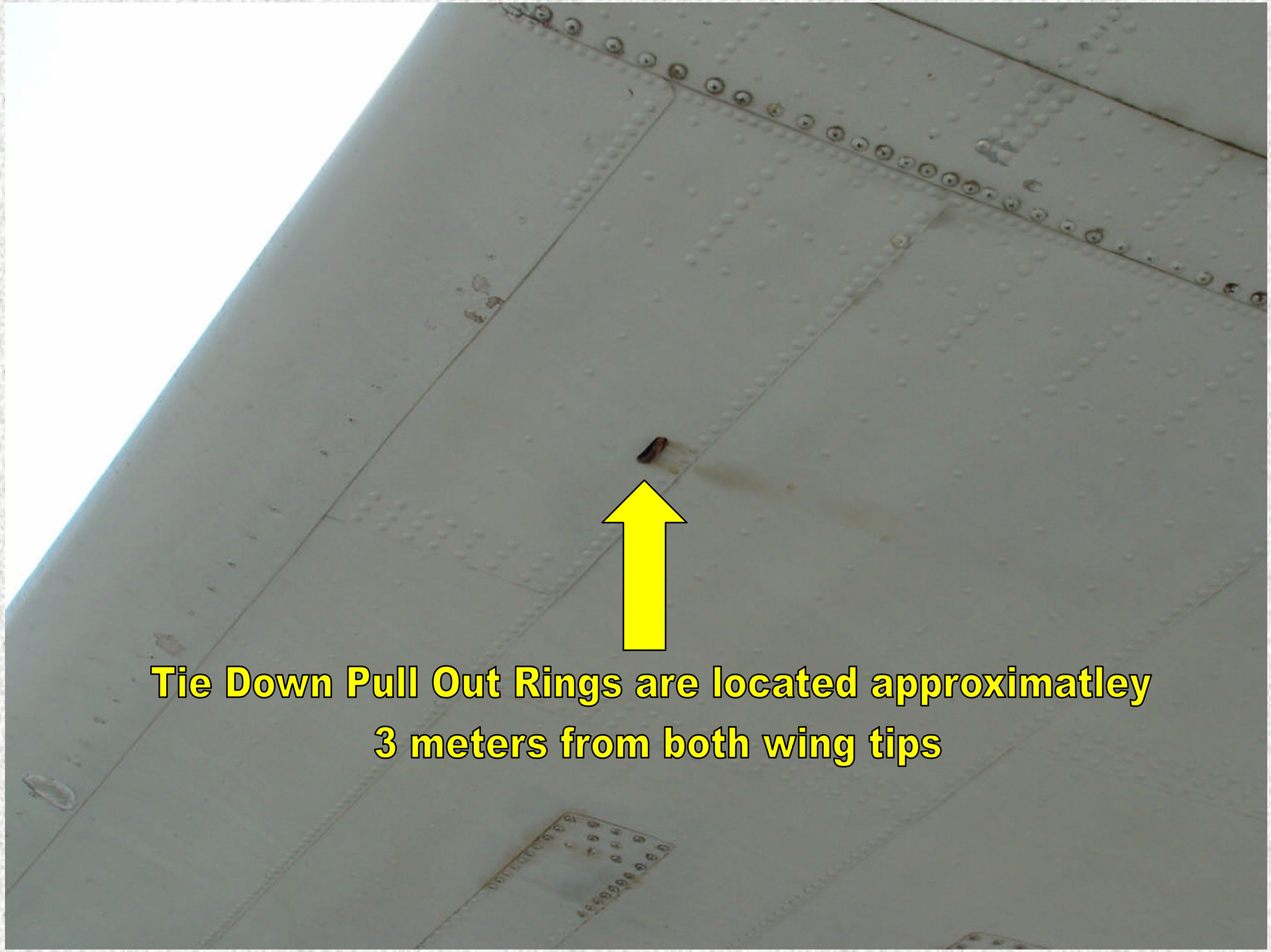
The two leveling pins located on the bottom of the center wing section toward the forward edge, on the port side are for leveling the aircraft from wing tip to wing tip.

Leveling the Aircraft

Two set of leveling pins are provided as reference markers so that the airplane can be leveled on both longitudinal and lateral axes. Leveling is required before weighing the airplane to determine its basic weight and the location of the Center of Gravity.

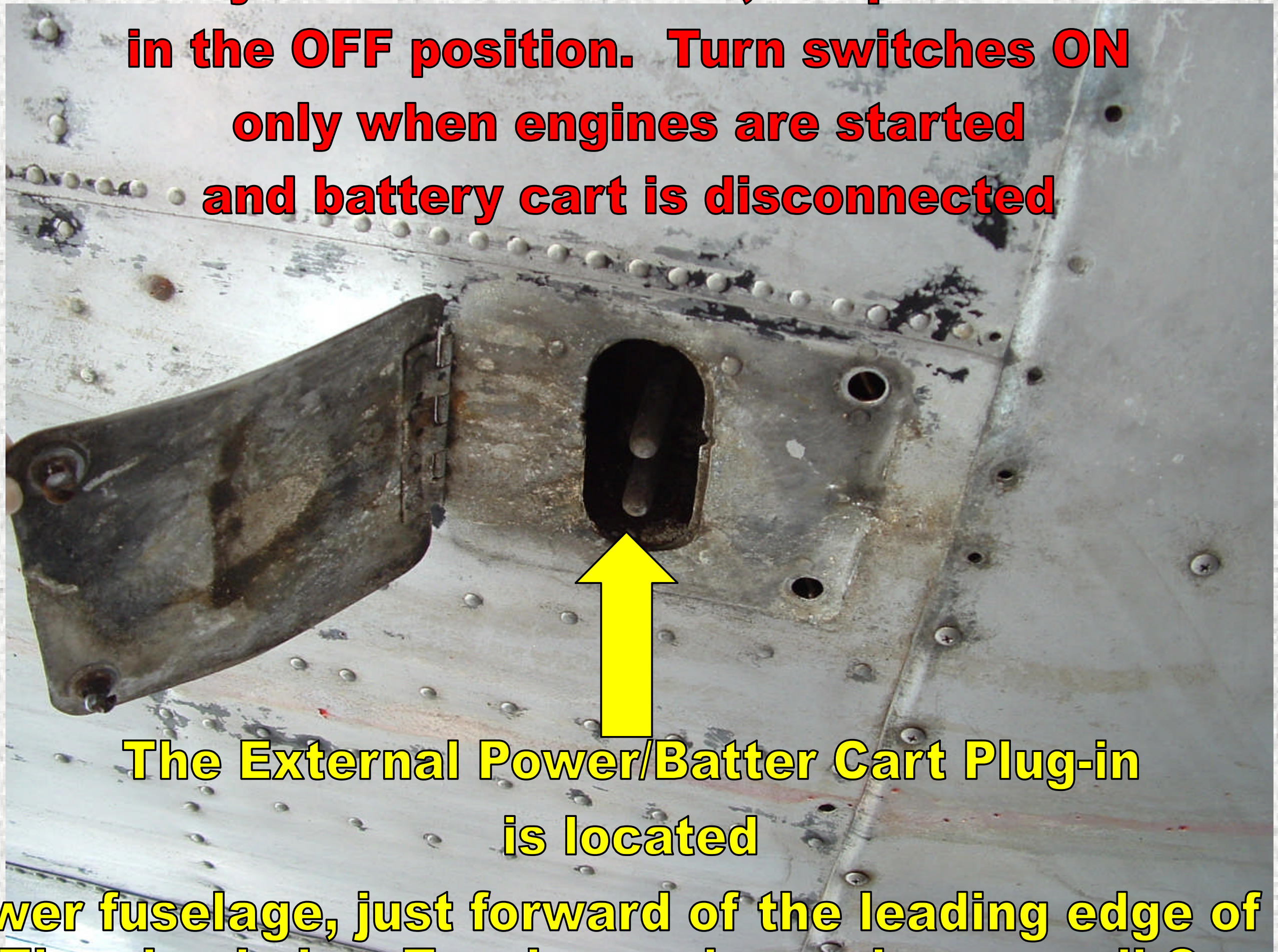


Tie-Downs


Tie Down Pull Out Rings are located approximatley
3 meters from both wing tips

External Power Hookup

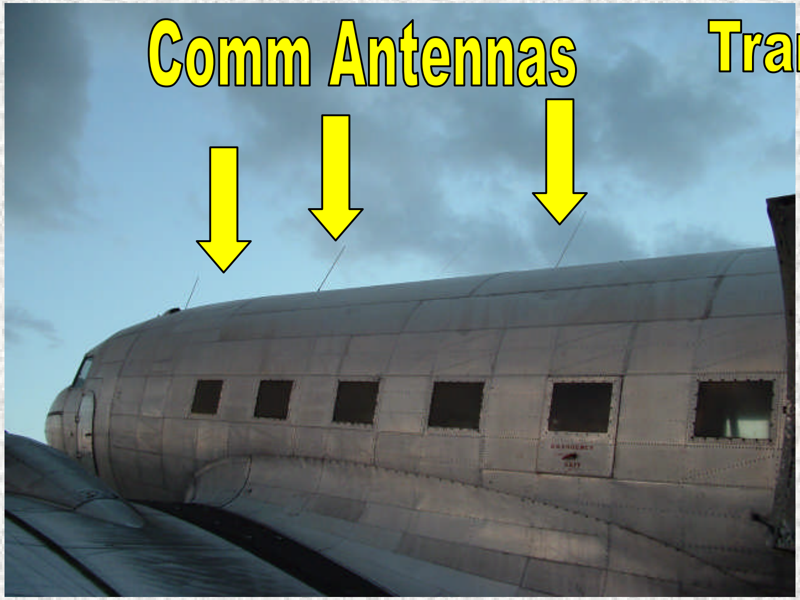
When a Battery Cart is connected, keep the master switch in the OFF position. Turn switches ON only when engines are started and battery cart is disconnected

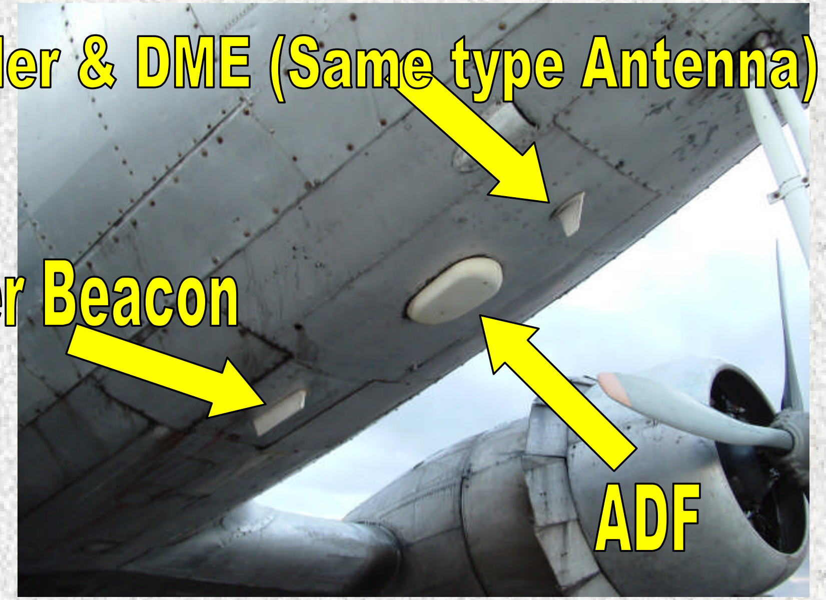


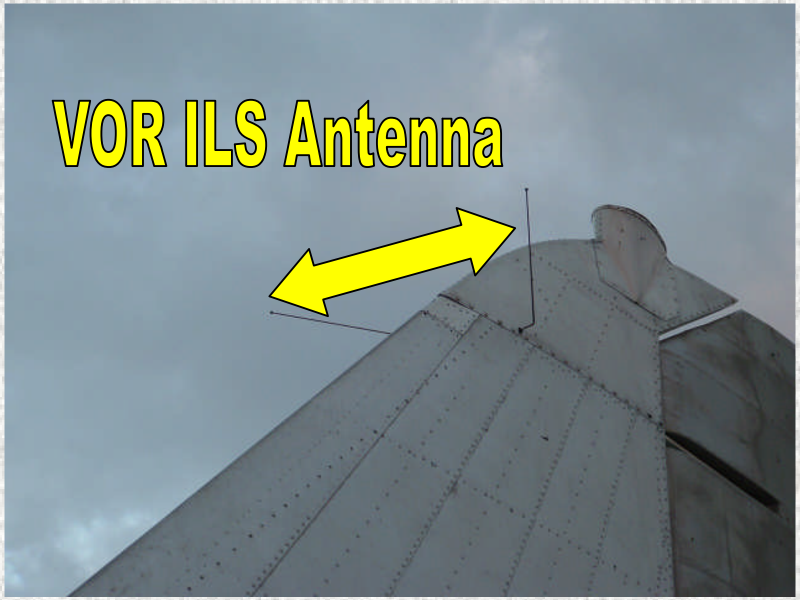
The External Power/Batter Cart Plug-in is located on the lower fuselage, just forward of the leading edge of the wing

The plug-in has Two large pins and one small One to ensure proper hookup

ANTENNAS


Comm Antennas


Transponder & DME (Same type Antenna)
Marker Beacon
ADF


VOR ILS Antenna


ELT

POWER CHARTS AND SETTINGS

Changing Power Conditions During Flight

- **Increasing Power**

  Mixture Controls

  Propeller Controls

  Throttle Controls

  Mixture Controls – (readjust if necessary)

- **Decreasing Power**

  Throttle Controls

  Propeller Controls

  Throttle Controls – (readjust if necessary)

  Mixture Controls

CLIMB POWER

800 BHP 2300 RPM AUTO RICH
F/F 77 GPH/ENG
STANDARD DAY CONDITIONS

ALT.	S.L.	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
STD. TEMP 0 Degree C.	15	13	11	9	7	5	3	1	-1	-2	-5
MAP "HG	36	35.8	35.6	35.4	35.2	35.0	34.8	34.6	34.4	34.2	34.0

ALTERNATE CLIMB POWER

700 BHP 2070 RPM AUTO RICH

F/F 58 GPH/ENG

STANDARD DAY CONDITIONS

ALT.	S.L.	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
STD. TEMP. 0 Degree C. +	15	13	11	9	7	5	3	1	-1	-2	-5
MAP “HG	33.2	33.0	32.8	32.6	32.4	32.2	32.0	31.8	31.6	31.4	31.2

DC-3 CRUISE CONTROL
MAXIMUM ENDURANCE

ALT.	GRS. WT.	IAS	BHP/ENG	RPM	M.P.	GAL.HR.
S.L.	18,000	73	161	1700	16.0	32.8
S.L.	20,000	75	187	1700	17.0	37.2
S.L.	22,000	77	215	1700	18.4	41.6
S.L.	24,000	80	244	1700	19.6	46.0
S.L.	26,000	83	276	1700	20.9	50.8

DC-3 CRUISE CONTROL
MAXIMUM ENDURANCE

ALT.	GRS. WT.	IAS	BHP/ENG	RPM	M.P.	GAL./HR
6000	18,000	73	187	1700	15.0	36.0
6000	20,000	75	218	1700	16.7	40.8
6000	22,000	77	250	1700	18.4	46.0
6000	24,000	80	285	1700	19.7	50.2
6000	26,000	83	320	1700	21.2	54.6

DC-3 CRUISE CONTROL
MAXIMUM RANGE

ALT.	GRS. WT.	IAS	TAS	BHP	RPM	M.P.	GAL/HR	MI/GAL
S.L.	18,000	94	94	220	1700	18.8	33.0	3.27
S.L.	20,000	99	99	260	1700	20.5	39.0	2.92
S.L.	22,000	105	105	300	1700	22.0	45.0	2.67
S.L.	24,000	109	109	340	1700	23.7	51.0	2.45
S.L.	26,000	113	113	365	1700	25.3	57.7	2.25

DC-3 CRUISE CONTROL
MAXIMUM RANGE

ALT.	GRS. WT.	IAS	TAS	BHP	RPM	M.P.	GAL./HR	MI./GAL.
10,000	18,000	94	109	265	1700	17.4	39.8	3.17
10,000	20,000	99	116	310	1700	19.5	46.5	2.86
10,000	22,000	105	122	350	1700	21.2	52.5	2.67
10,000	24,000	109	127	395	1700	22.8	59.2	2.47
10,000	26,000	113	131	445	1700	24.8	66.2	2.26

OPERATING INSTRUCTIONS

DOUGLAS DC-3 AIRCRAFT WITH PRATT & WHITNEY R-1830-90D

NORMAL CRUISE-AUTO LEAN

525 BHP

RPM		MP	FUEL FLOW	IAS
1850	-9	27.0	76	132
1850	-5	27.5	76	136
1850	-1	28.0	76	139
1850	3	28.5	76	142
1850	7	29.0	76	145
1850	11	29.5	76	147
1850	15	30.0	76	150

Numbers indicate STD Degrees Celcius

OPERATING INSTRUCTIONS

DOUGLAS DC-3 WITH PRATT & WHITNEY R1830-90D

NORMAL CRUISE –AUTO LEAN

550 BHP

RPM		MP	FUEL FLOW	IAS
2050	-9	26.0	82	142
1850	-7	28.5	79	144
1850	-1	29.0	79	148
1850	3	29.5	79	150
1850	7	30.0	79	152
1850	11	30.5	79	155
1850	15	31.0	79	157

Numbers indicate STD Degrees Celcius

OPERATING INSTRUCTIONS

DOUGLAS DC-3 WITH PRATT & WHITNEY R1830-90D

NORMAL CRUISE-AUTO LEAN

575 BHP

RPM		MP	FUEL FLOW	IAS
2050	-9	27.0	86	146
2050	-3	27.5	86	150
2050	1	28.0	86	153
2050	7	28.5	86	156
2050	11	29.0	86	159
2050	15	29.5	86	161

Numbers indicate STD Degrees Celcius

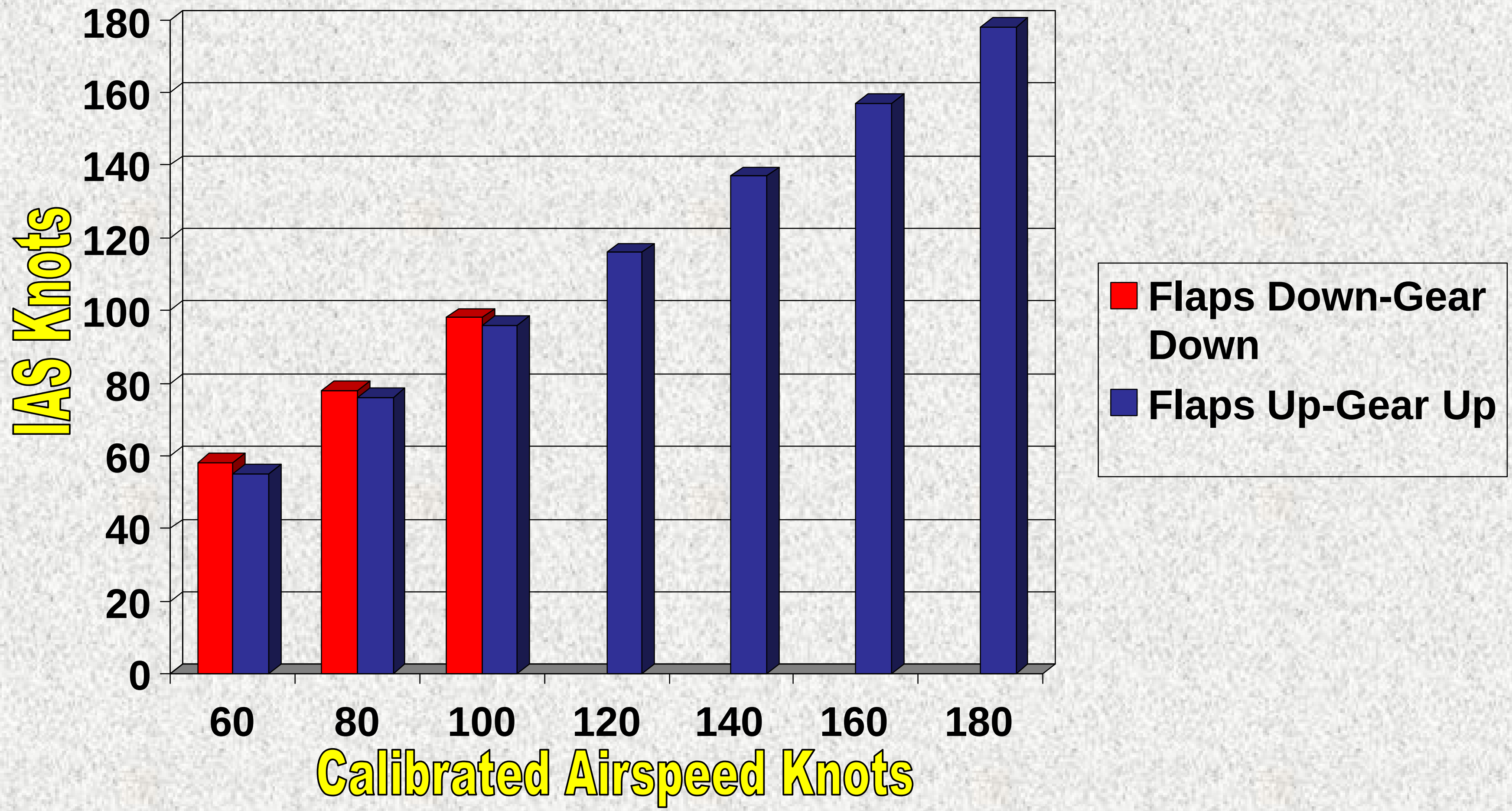
OPERATING INSTRUCTIONS

DOUGLAS DC-3 WITH PRATT & WHITNEY R1830-90D
NORMAL CRUISE – AUTO LEAN
600 BHP

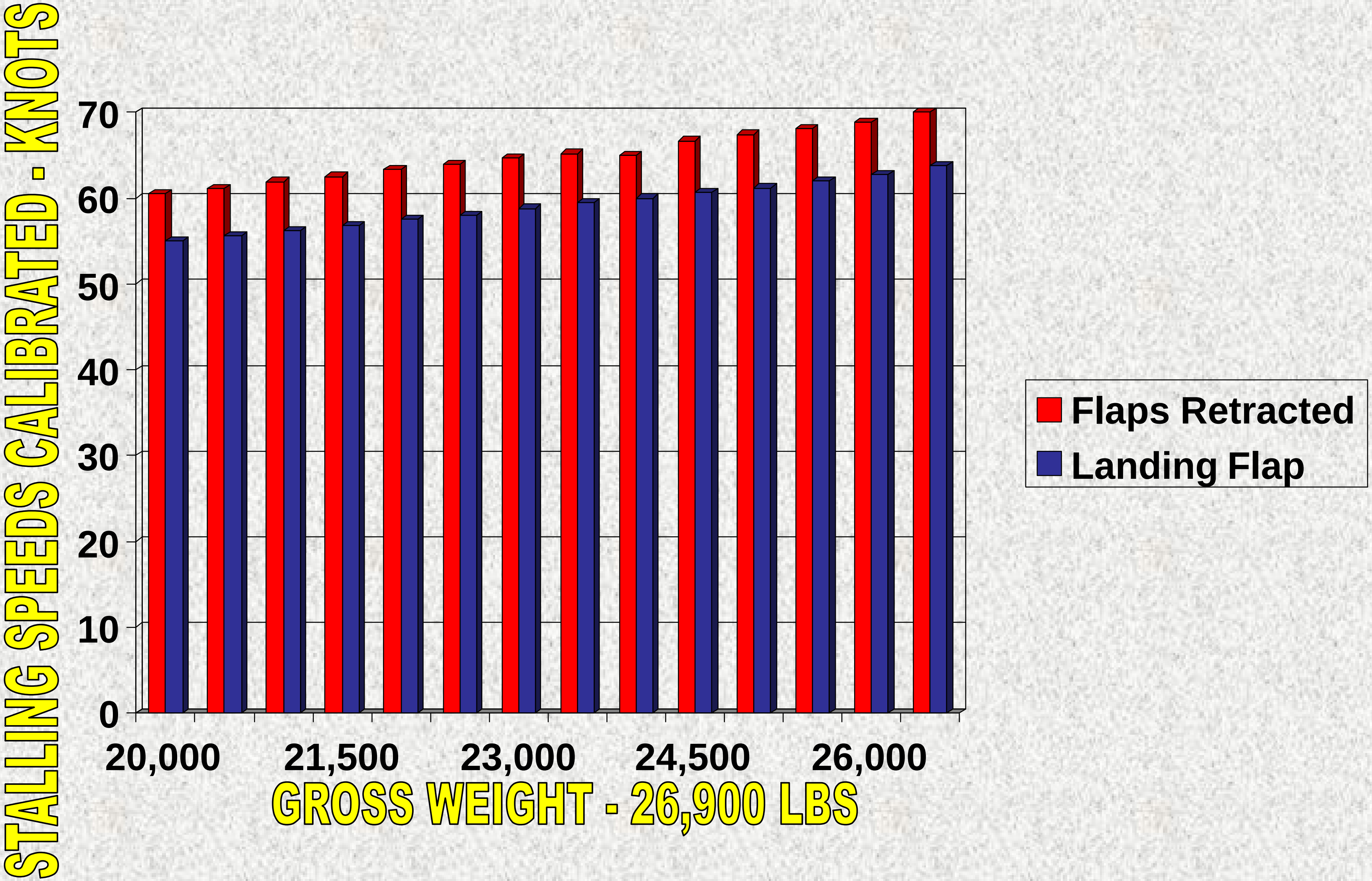
RPM	MP	FUEL FLOW	IAS
2050 -9	28.0	90	150
2050 -3	28.5	90	153
2050 3	29.0	90	157
2050 7	29.5	90	160
2050 11	30.0	90	162
2050 15	30.5	90	165

Numbers indicate STD Degrees Celcius

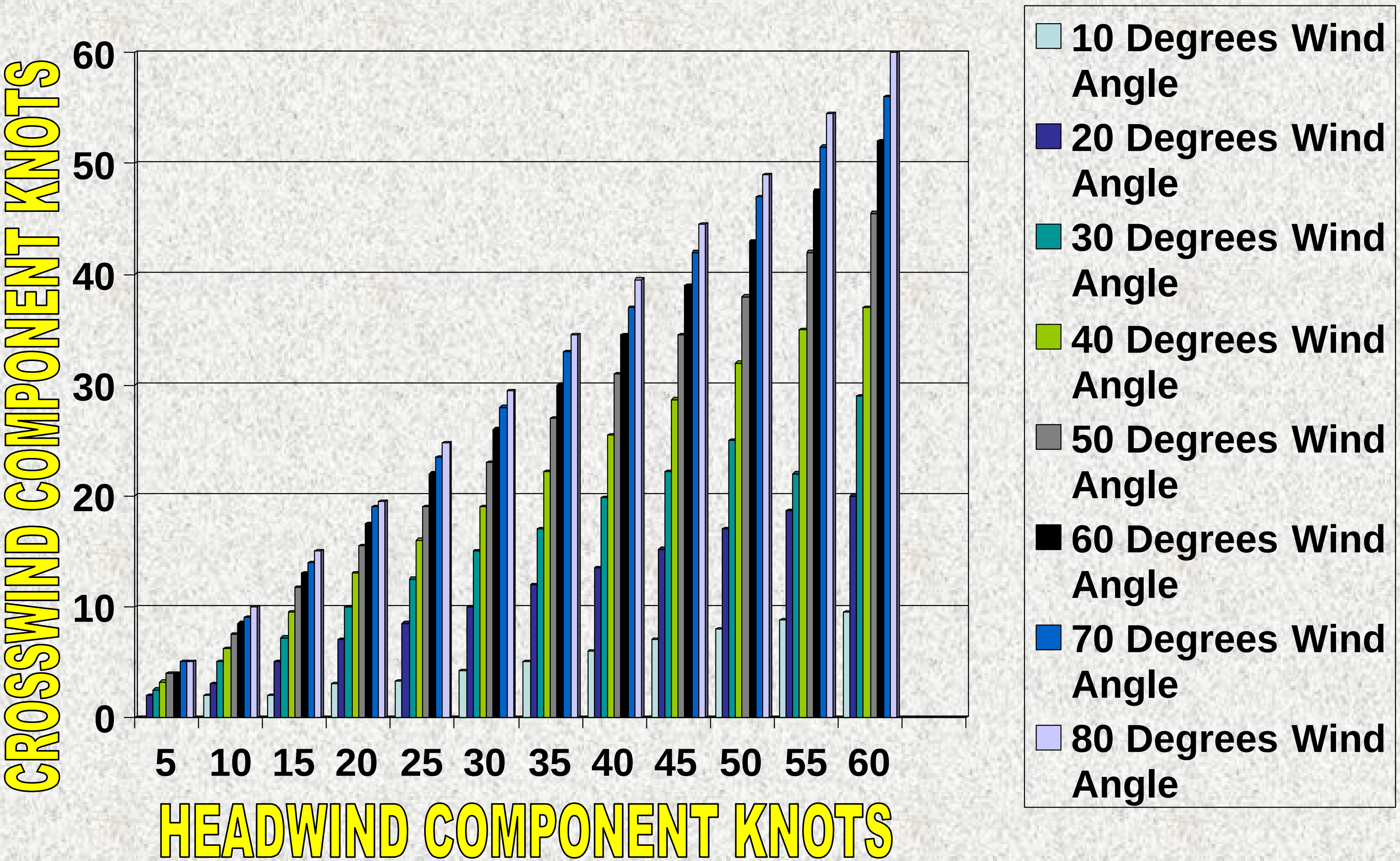
AIRSPEED CALIBRATION



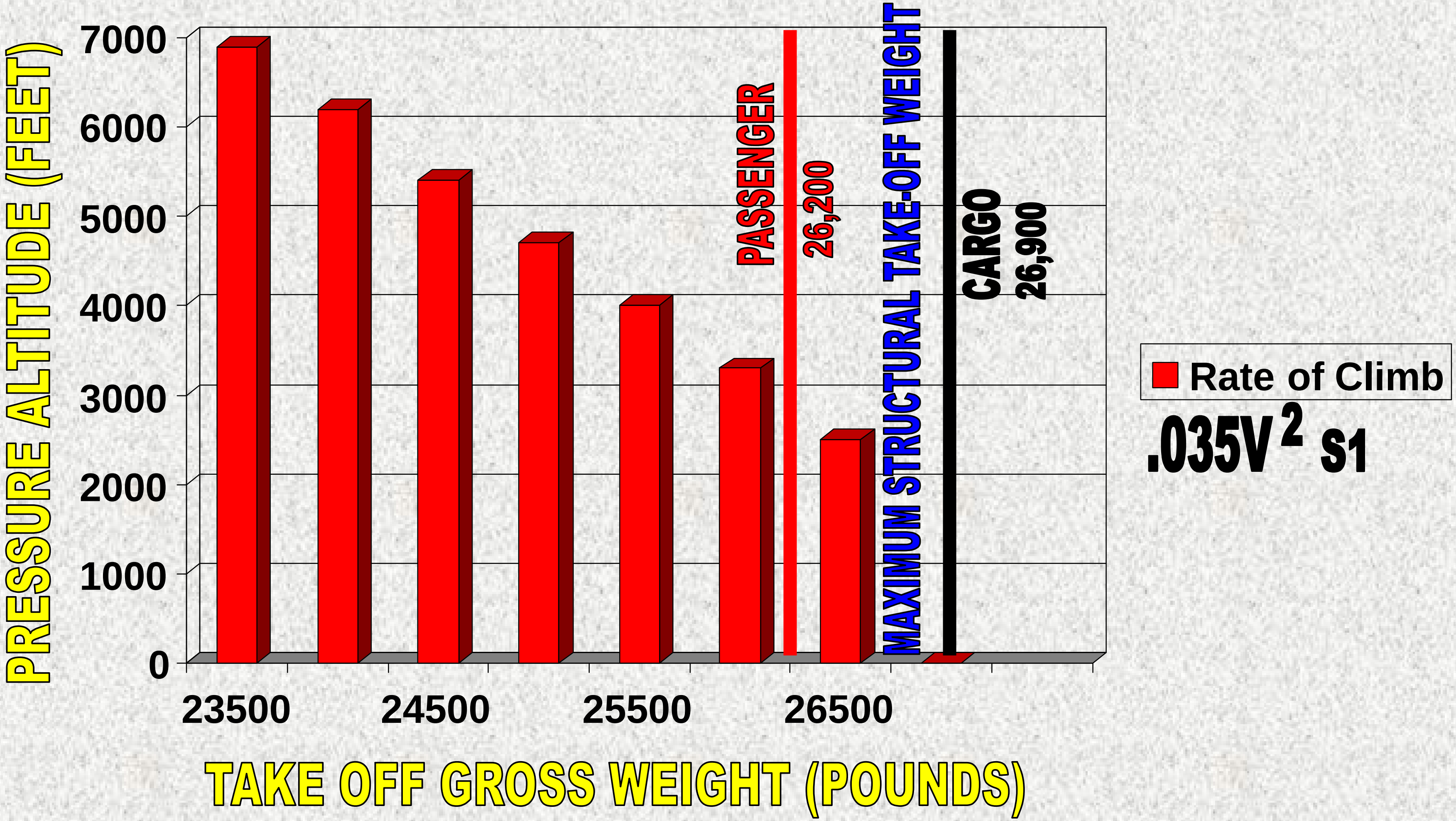
STALLING SPEEDS



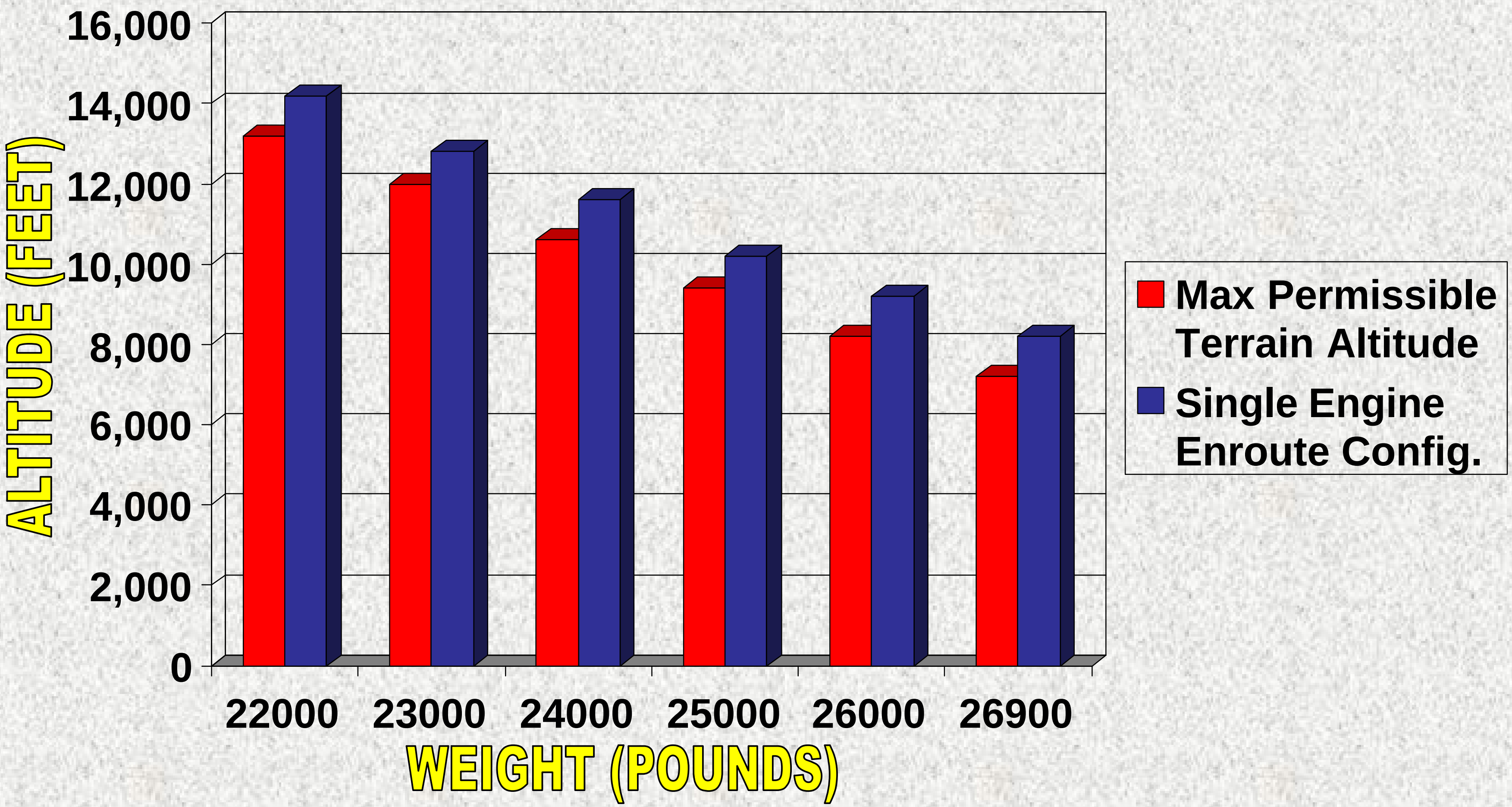
CROSSWIND COMPONENT



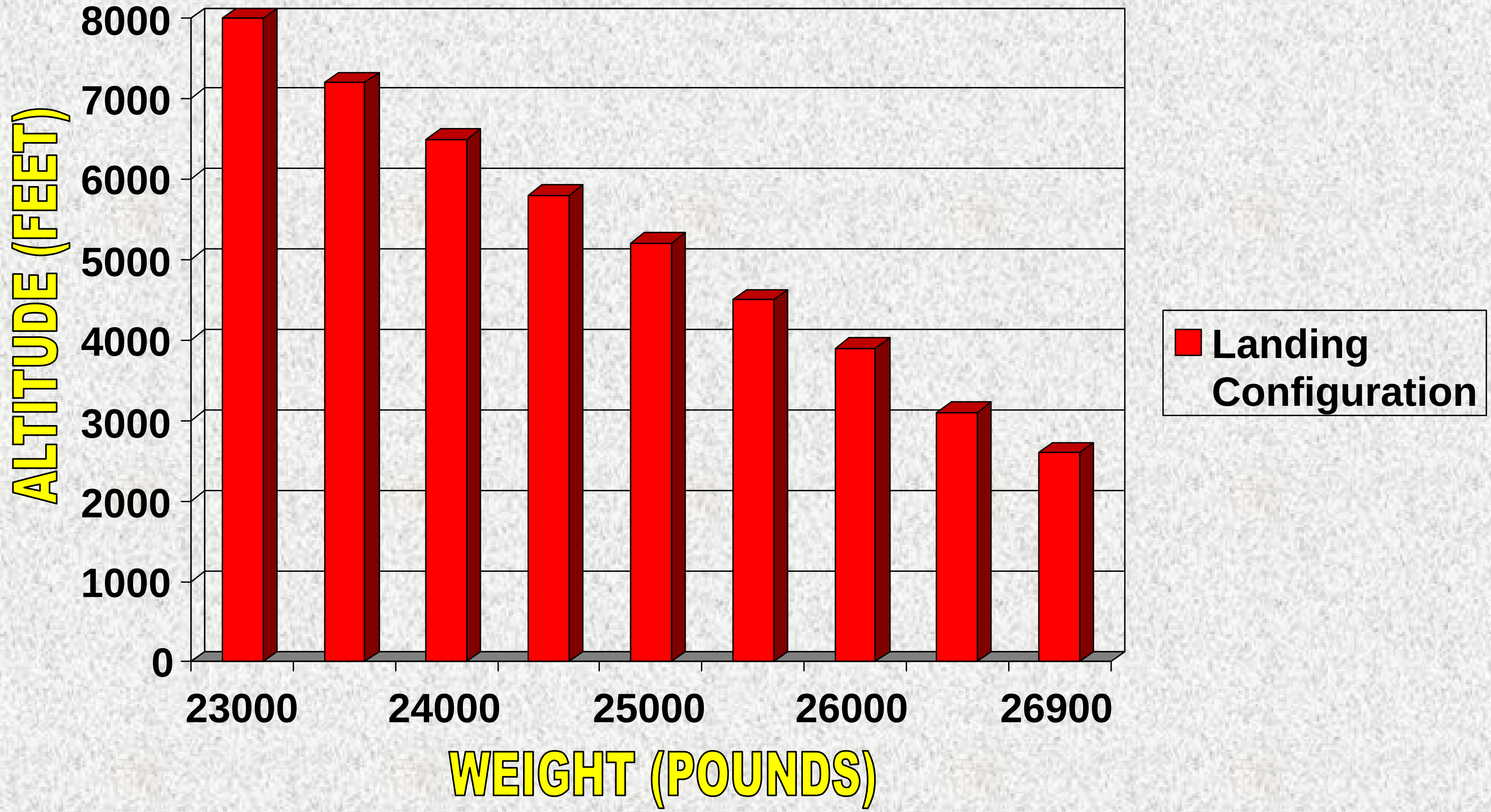
MAXIMUM PERMISSIBLE TAKEOFF WEIGHT



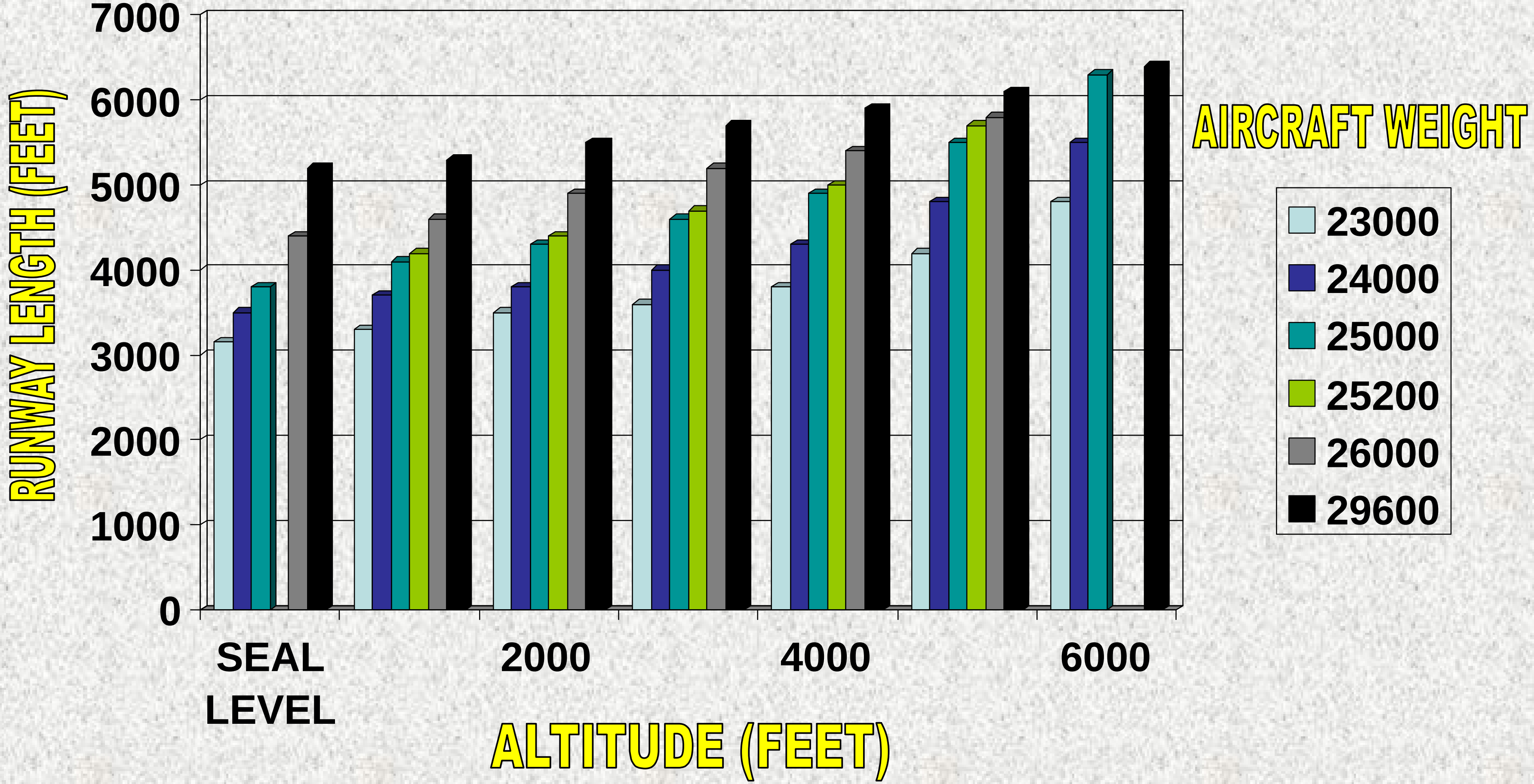
MAXIMUM PERMISSIBLE ENROUTE WEIGHT

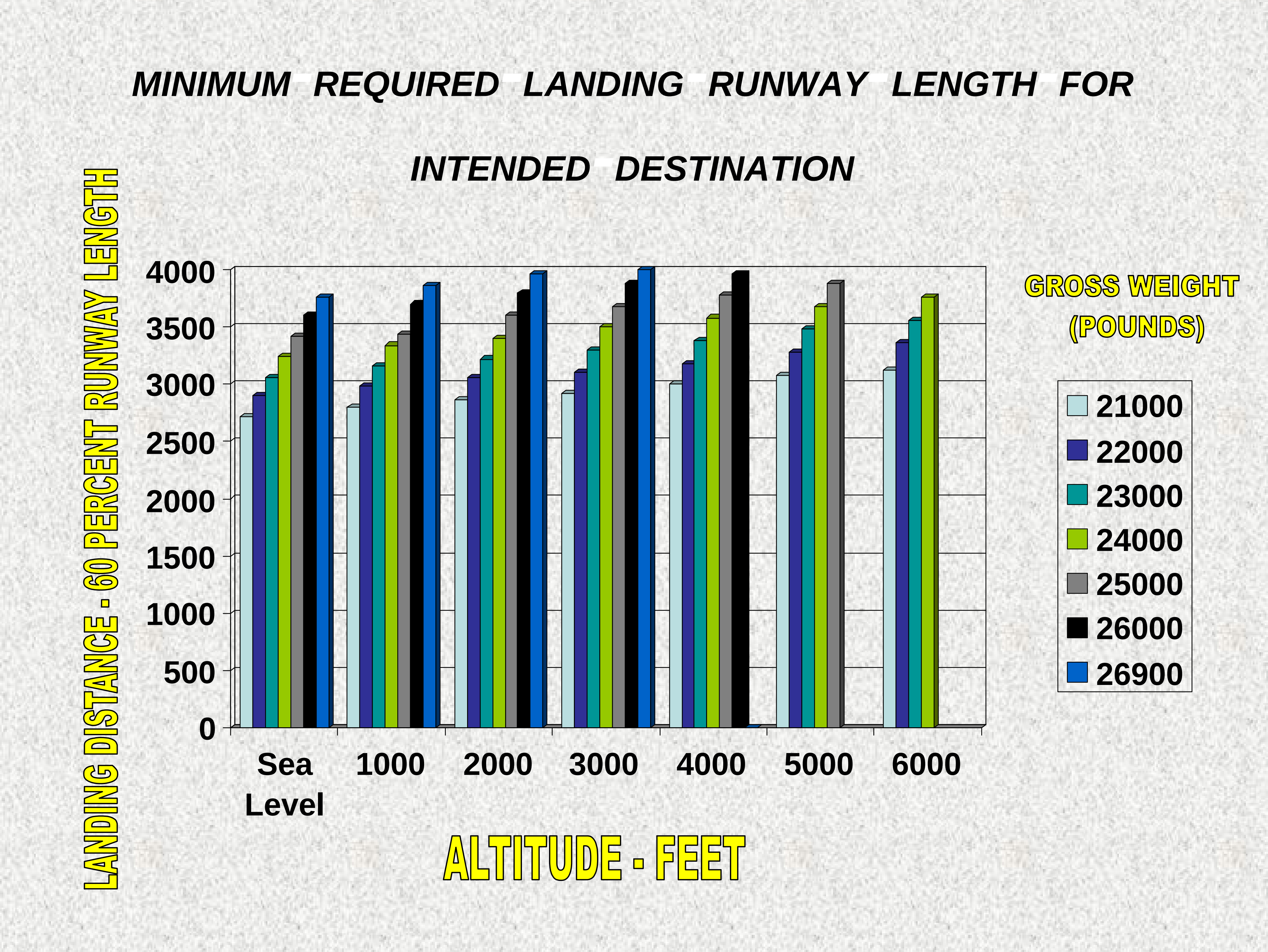


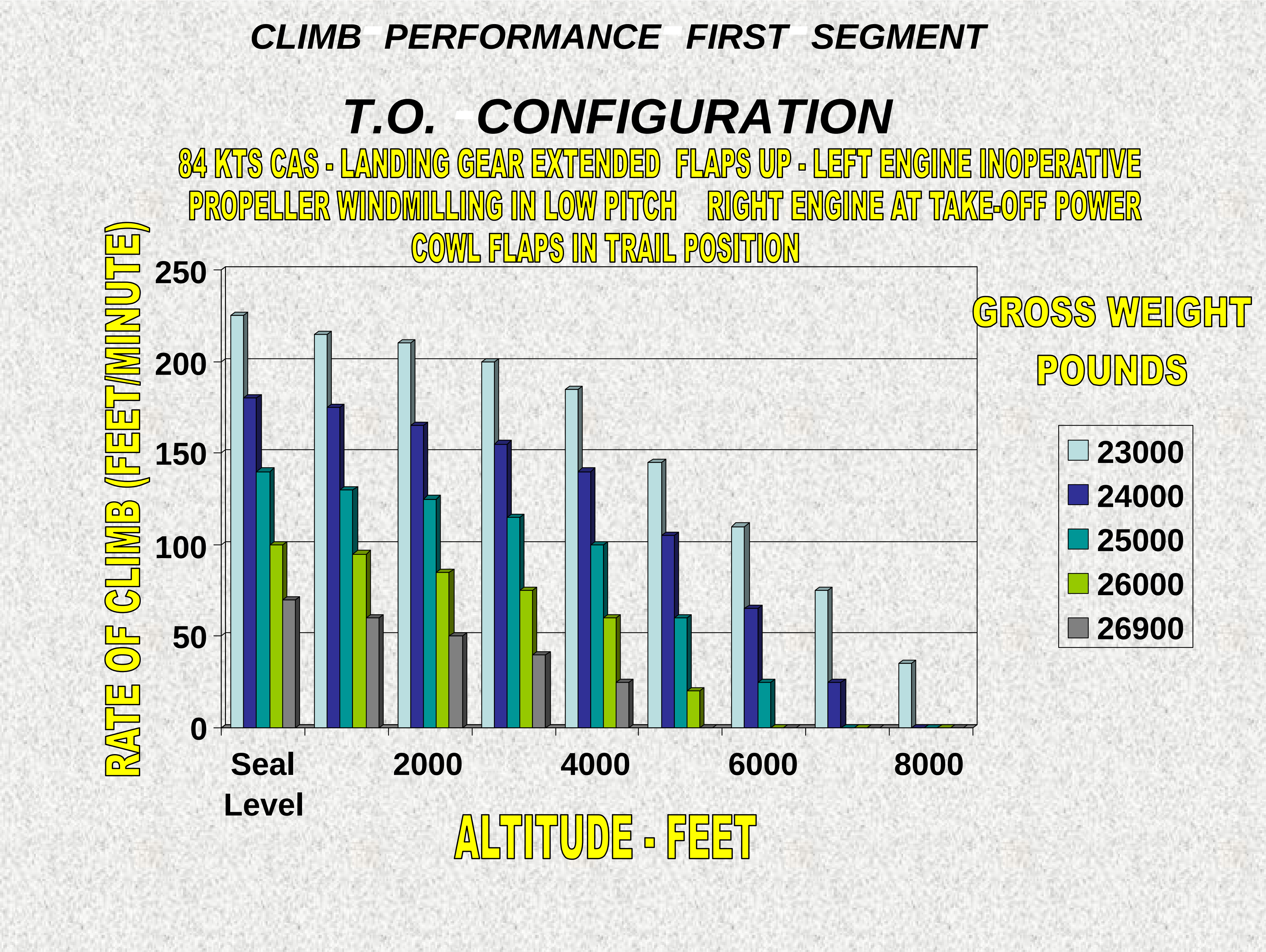
MAXIMUM PERMISSIBLE LANDING WEIGHT



MINIMUM TAKE-OFF RUNWAY LENGTH

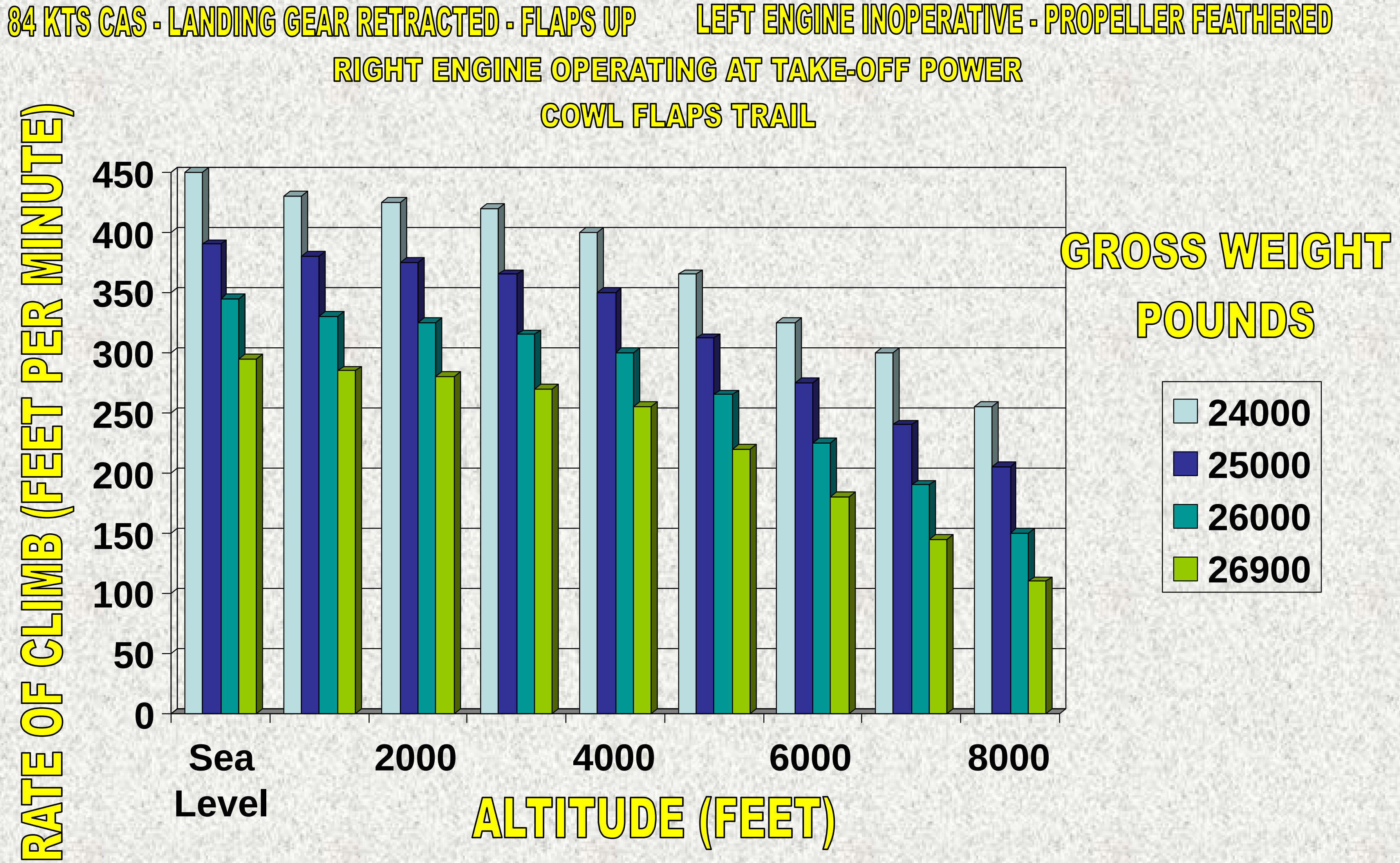



MINIMUM REQUIRED LANDING RUNWAY LENGTH FOR
INTENDED DESTINATION
LANDING DISTANCE - 60 PERCENT RUNWAY LENGTH
4000
3500
3000
2500
2000
1500
1000
500
0
Sea Level
1000
2000
3000
4000
5000
6000
ALTITUDE - FEET
GROSS WEIGHT (POUNDS)
21000
22000
23000
24000
25000
26000
26900


CLIMB PERFORMANCE FIRST SEGMENT
T.O. CONFIGURATION
84 KTS CAS - LANDING GEAR EXTENDED FLAPS UP - LEFT ENGINE INOPERATIVE
PROPELLER WINDMILLING IN LOW PITCH RIGHT ENGINE AT TAKE-OFF POWER
COWL FLAPS IN TRAIL POSITION
RATE OF CLIMB (FEET/MINUTE)
250
200
150
100
50
0
Seal Level
2000
4000
6000
8000
ALTITUDE - FEET
GROSS WEIGHT POUNDS
23000
24000
25000
26000
26900

CLIMB PERFORMANCE THIRD SEGMENT

T.O. CONFIGURATION



WEIGHT & BALANCE

Take-Off

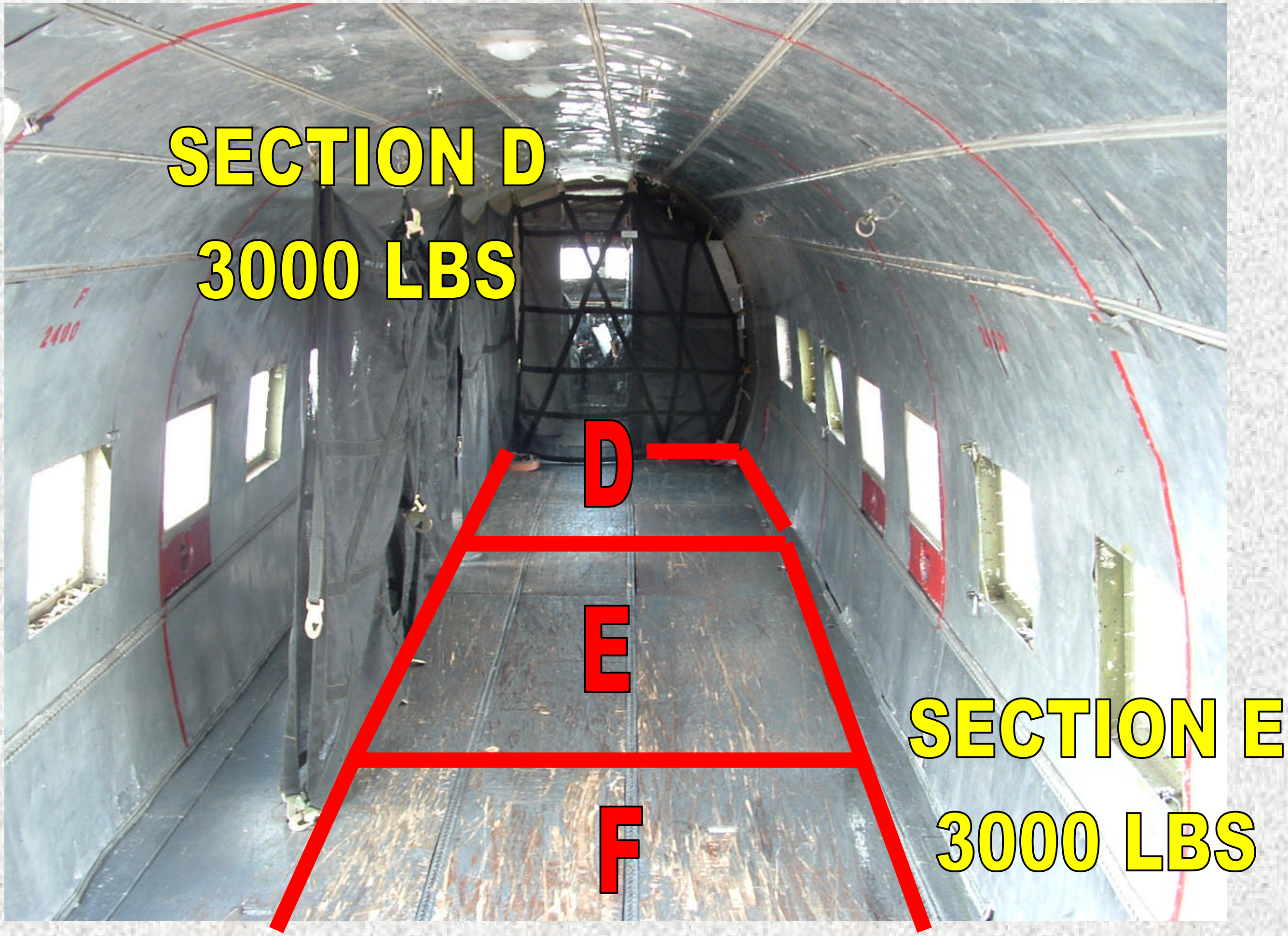
DISTANCE IN FEET

GROSS WEIGHT →

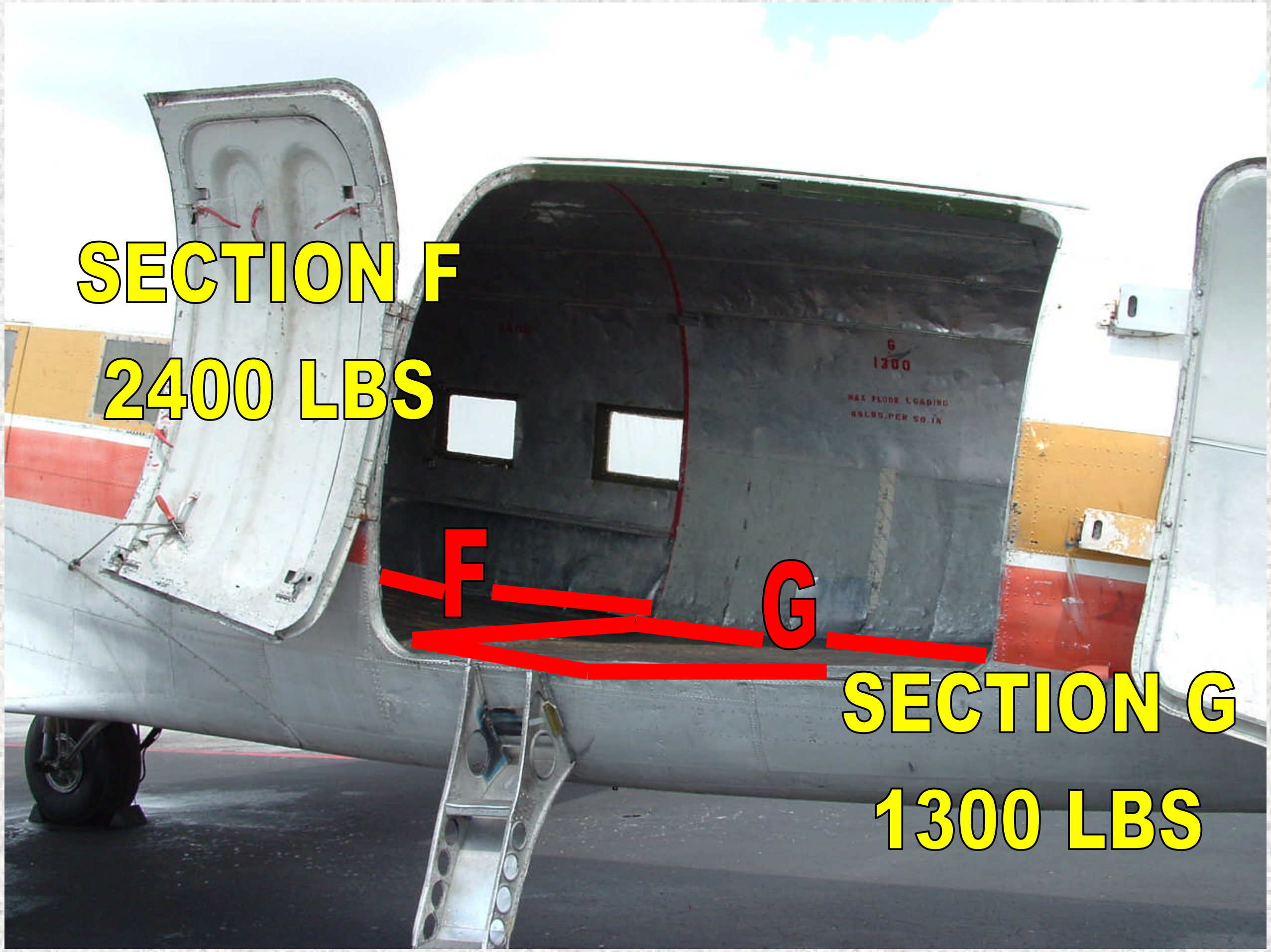
ALTITUDE IN FEET

	22000	23000	24000	25000	26000	26900
SL	3675	3765	3835	3915	3980	4055
1000	3830	3005	3090	4090	4115	4230
2000	3985	4070	4165	4265	4315	4410
3000	4145	4245	4340	4460	4530	4610
4000	4330	4410	4540	4645	4745	4856
5000	4635	4686	4775	4880	5006	5076
6000	4775	4905	5035	5155	5280	5360
7000	5055	5190	5325	5455	5645	5700
8000	5110	5525	5655	5700	5915	6055

WEIGHT & BALANCE



WEIGHT & BALANCE



WEIGHT & BALANCE

Operating	Index	Weight					
A	26.4	1	7	6	2	2	
B	750						
C	1000						
D	3000						
E	3000						
F	2400						
G	1300						
H	350						
TOTAL CABIN LOAD							
ZERO FUEL WT.							
FRONT TANK							
REAR TANK							
TAKEOFF GROSS WT.							
EST. FUEL BURN OFF							
EST. LANDING WT.							
MAX ZERO FUEL WT.							
MAX LANDING WT.							
MAX TAKEOFF WT.							
WEIGHT & BALANCE CORRECTION							

DC-3/C-47

EMERGENCY PROCEDURES

Emergency Procedures

- **Engine Failure**

  Minimum control speed for the DC-3 is 77 knots CAS. This is the minimum speed at which the airplane is controllable in flight with one engine inoperative, its propeller wind-milling, the other engine at take- off power.

  V-1 (Critical Engine Failure Speed) and V2 (Take-off safety speed) are the same on the DC-3 (84 knots CAS).

  The first indication of engine failure will probably be a yaw towards the failed engine. Other indications are a drop in manifold pressure, RPM, and cylinder head temperature.

Engine Failure Before Reaching V1 Speed

- The Captainwill guard the throttles on the take-off roll until reaching V-1 speed. If for any reasonthe crew needs to reject the take-off, the following procedureswill be performed:

1. DiscontinueTake -Off
2. Close Throttles
3. Apply Brakes

Engine Failure or Fire In Flight

Immediate Action Items:

1.	Gear and Flaps	Up
2.	Power	As Required
3.	Propeller	Feather
4.	Mixture	Idle Cut Off
5.	Fuel Tank Selector for Failed Engine	Off
6.	Firewall Shut Off for Failed Engine	Close

If Fire Exists:

CO_2 Selector	Set & Discharge

Secondary Action Items:

1.	Cowl Flaps	As Required
2.	Fuel Boost Pump	Off
3.	Vacuum Pressure	Check
4.	Prop Alcohol	Off
5.	Generator	Off
6.	Ignition	Off
7.	Electrical Load	Check

Engine Over-speeding On Take-Off

- **Immediate Action Items**

1. Immediately reduce power to 25” Hg on affected engine
2. Retard the affected propeller control. If this action has no effect, proceed with the following steps:
3. Hold RPM below 2700 by alternately operating and releasing the feather button until sufficient altitude is attained to return to the airport.
4. Feather propeller.

EngineOver -speedingWhile Un-feathering

1. Check airspeed at or below 138 knots
2. Prop control full forward, then slowly aft, then forward again, watching for proper RPM response.
3. If the above does not result in governor control, feather the affected propeller.

Runaway Propeller

Causes – Complete or partial failure of the propeller governor can result in propeller over speeding due to failure of the propeller to increase pitch with increasing airspeed or engine power. If propeller controls are set for "full increase RPM" on the landing approach and a "pull-up" is made, rapid advance of the throttles to take-off power produces over speeding, and in some cases, causes a runaway propeller. This can be materially remedied by leaving propeller control in climbing or cruising RPM position on the approach and advancing power in a step up procedure.

At first evidence of a runaway propeller:

- Reduce the forward speed of the airplane to the minimum single engine operating speed (110 mph) or slower if practicable, by retarding the throttles and propeller control, and pulling up in a climbing attitude.
- Place the mixture control for the over speeding engine in idle-cutoff, turn off fuel, cut ignition, and when the engine speed has been reduced to 2700 RPM, feather the propeller.
- If the propeller cannot be feathered continue flight at an airspeed which is low enough to hold engine speed to not more than 2700 RPM and, if possible, below 2550 RPM.

Runaway Propeller

With the mixture control in idle-cutoff, and the propeller in full low pitch, the RPM will be below 2550 up to 150-160 mph, and below 2700 RPM up to 170 mph.

In the event a runaway propeller cannot be feathered, it is possible at 3000 ft pressure, and 120 mph, to use 19 ½ " MP without exceeding 2700 RPM. In this manner the flight may be continued with uncontrolled propeller developing somewhat more power than that necessary to overcome the drag of the windmilling propeller.

Propeller Un-feathering

1.	Airspeed	138 knots or less
2.	Throttle	Closed
3.	Prop Control	Full Aft (Low RPM)
4.	Mixture	Idle Cut Off
5.	Tank Selector	As Desired
6.	Firewall Shut Off	Open
7.	Cowl Flaps	As Desired
8.	Generator	On
9.	Ignition	Both
10.	Feather Button	Hold to 800 RPM
11.	Oil Pressure	Check (For rise above 50 psi)
12.	Fuel Pressure	Check for normal
13.	Mixture Control	Auto Rich
14.	Warm Up @ 17” & 1700 RPM(MP/RPM)	Set
15.	Cowl Flaps	As Required

Engine Induction System Fire (Starting)

1.	Mixture Control (Keep Engine Turning With Starter)	Idle Cut-Off
2.	Throttle	Open
3.	Firewall Shut-Off Valve	Close
4.	Fuel Tank Selector	Off
5.	Boost Pump	Off
6.	Ignition Switch	Off

- Stop other engine if operating
- If Ground Crew does not extinguish fire immediately, Discharge Fire Extinguisher
- Evacuate Aircraft
- Do Not Restart engine after fire extinguisher has been discharged

Electrical Fire

Immediate Action Items (Source Known)

1. Affected Component - Off/Pull Circuit Breaker
2. Portable CO2 Bottle - Stand By (F/O)

Immediate Action Items (Source Unknown)

1. Prop Alcohol Tank Valve – Off
2. Battery and Generator Switches – Off
3. Portable Oxygen Bottles – Use If Necessary
4. Portable CO2 Bottle – Discharge (If Circumstances Dictate)

Secondary Action Items (Source Unknown)

1. Circuit Breaker/Switches – Pull/Off
2. Battery/Generators – On
3. Restore Power to Essential Components – Attempts to Isolate Fault
4. If efforts unsuccessful and fire persists, land as soon as possible.

Caution: Provide adequate ventilation when using CO2. Do not use water on electrical fires or on any type fire in the vicinity of electrical equipment.

Fuselage Fire

<u>Immediate Action Items</u>

1. Prop. Alcohol Tank Valve – Off
2. Notify Other Crewmembers
3. Combat Fire

Smoke Evacuation

<u>Immediate Action Items</u>

1. Emergency descent, if considered necessary for maximum smoke removal flight deck or cabin
2. All cockpit windows – Closed
3. Cabin to Cockpit door – Open
4. Forward Cargo door – Open
5. Co-pilot’s storm window – Open (Break if necessary)

Landing Gear Fire

1. Immediate Action Items:

   Turn airplane into wind while calling for assistance. Maintain a minimum of 2000 RPM on engine ahead of fire. Shut down engine not ahead of fire.

2. Secondary Action Items:

   Flaps full down –

   Shut down engine ahead of the fire when ground fire extinguisher equipment has been placed in position to fight fire.

3. Precautionary Items:

   Test on other types of aircraft have shown that insufficient air flow is produced at maximum RPM to blow out a landing gear fire; however similar to other types of aircraft, fires can be controlled by use of the above procedures so that the flames will be blown back and will not impinge upon the nacelle or wing.

   It is extremely dangerous for exposed personnel to approach closer than 25 feet to a burning tire prior to its exploding.

A burning tire may be expected to explode in tow to five minutes.

Fuel Pressure Failure

Fuel pressure failure may be the result of fuel exhaustion in the selected tank, failure of the engine driven fuel pump, failure of a fuel supply line or failure of the fuel pressure gauge line. The proper action to be taken in the event of loss of fuel pressure is determined by whether or not the engine continues to operate.

Fuel Pressure Failure Accompanied by Loss of Power:

1. Fuel Boost pump on.
2. Insure tank selector is positioned to a tank containing fuel.
3. If failure caused by fuel tank depletion, retard throttle until power restored to prevent over-speed.
4. If adequate fuel in selected tank, power loss due to engine driven fuel pump failure. Continue engine operation utilizing fuel boost pump. Land as soon as practicable.

Caution: Fuel pressure failure accompanied by normal engine operation is an almost certain indication of fuel line or fuel gauge pressure line rupture. In view of the attendant possibility of fire, immediate engine shutdown, by use of the mixture control, is recommended.

Generator Failure

In the event of a generatorfailure, shut-off affectedgenerator and reduce electrical load as much as possible. Continue to watch enginefor any othermalfunction or fire.

Hydraulic System Failure

Hydraulic system malfunctionsor failures may vary from minor leaks to complete system pressurefailure. The effects on hydraulic componentfunctions will, of course, vary with the severity of the malfunction. With completesys tem failure no hydraulicallyoperated componentswill functionwith the exceptionof the landing gear which can be free fallen.

Landing Gear Emergency Extension

The only occasion necessitating a landing without fluid pressure would be in the case of failure in the lines from the auxiliary hydraulic manual pump to the retracting struts. In this case the latches will hold the gear in place, and a safe landing can be made with a fully-loaded airplane.

1. Hydraulic Pressure Accumulator – Shut-Off Valve (Star Valve Off (Closed)).
2. Landing Gear Lever – Down
3. Manual Hydraulic Pump – Operated Until Gear is Down
4. Landing Gear Lever – Neutral
5. Landing Gear Latch Lever – Locked
6. Warning Lights and Horn – Check
7. In case of hydraulic line failure the gear may be snapped down to engage latches by diving the airplane and pulling up sharply. This should be done at low airspeed. (However, fluid capacity is usually sufficient in the pressure accumulator to lower the gear since in most cases a leak in landing gear hydraulic lines will be small.)

Wing Flap Emergency Operation

If partial system failure occurs, obtain desired flap setting by using manual hydraulic pump and selector handle. Return handle to neutral when desired flap position is obtained. If this procedure is ineffective a no-flap landing will be necessary.

Caution: If flaps do not extend, or they return to a less setting, make no further attempt to lower because of probable leak I flap down line. If flaps cannot be extended, use no flap landing procedure.

Note: All available hydraulic fluid may be used by the above procedure, necessitating “Free Fall” of the gear and leaving no fluid for brake operation.

Emergency Braking

Emergency Braking with fluid available for the emergency hand pump:

1.	Star Valve	Closed
2.	Landing Gear Handle	Neutral
3.	Flap Handle	Neutral
4.	Depress Brake Pedals	
5.	Use Emergency Hand Pump to desired pressure.	

Note: Do not operate brakes by alternately applying and releasing the brake pedals. Each time the pedals are released, all pressure built up is lost requiring several additional strokes of emergency hand pump to restore pressure.

Before landing, depress brake pedals and operate hand pump until a slight pressure is felt against the pedals. This will indicate that brakes will be operable after landing.

Do not taxi after landing, unless necessary to clear runway, while depending on the emergency hand pump.

Cowl Flap Emergency Operation

Ifa lossof hydraulicpressure occurs,cowl flapsmay be operatedby themanual emergencyhand pumpand the cowlflaps selector. Turnselector toOFF whenPosition isobtained.

Landing Gear Latch Failure

The airplanemay be landedsafely without down-latchesengaged providedlanding gear is full down, hydraulic system pressureis normal(750 -950 psi) and landinggear controlhandle is in the "Neutral" position. Use brakes with caution. Do not allow landing gear pressureto exceed1500 PSI.

Gear-Up Emergency Landing

1. Approach – Normal
2. Fire Extinguisher Door - Open prior to ground contact
3. Wing Flaps – Down
4. Throttles – Closed
5. Boost Pumps – Off
6. Ignition – Off
7. Be prepared to discharge fire extinguisher if fire occurs.

Emergency Descent

1. Presented below are two methods of emergency descent:

   a. High airspeed – minimum drag (gear up and flaps up) NOTE: Vne 190 knots.

   b. Low airspeed – maximum drag (gear and flaps down)

   The method used will, of course, depend on the circumstances. However, it is recommended that the high airspeed-minimum drag method of descent be used whenever possible for the following reasons:

   a. No deceleration period is required prior to starting descent.

   b. In case of engine fie, landing gear and wing flap extension should be delayed as long as possible before landing. This will help prevent extensive fire damage to gear and flaps. If fire is in zone 1 (which has no CO_2 protection), the higher airspeed will result in higher engine cooling airflow for blowing out the fire and for cooling engine surfaces.

2. Use of the low airspeed-maximum drag method of descent is recommended only when circumstances suggest it as a safer course of action than the high airspeed-minimum drag descent.

   For example:

   a. In case of engine failure or propeller over-speed and propeller cannot be feathered.

   b. When airplane structural damage has been sustained.

   c. When descent is made in turbulent air.

High Airspeed–Minimum Drag Descent

1.	Throttles	Close
2.	Landing gear and wing flaps	Up
3.	Propellers	Full Low RPM
4.	Descent at Maximum Speed of Vne	190 knots

NOTE: When making high speed descentwith featheredpropeller carefully monitorpropeller to guard againstits un-feathering. If propellerstarts to un-feather,immediately depress feather button.

Low Airspeed–Maximum Drag Descent

1.	Throttles	Close
2.	Propellers	Full High RPM
3.	Gear	Down
4.	Airspeed	Reduce for Flap Extension
5.	Flaps	Down

6. Descent at maximum speed of 97 knots, with gear down and flaps fully extended.

Note: Rate of descent will be approximately 1500 FPM.

Landing With One Engine Inoperative

1. Notify tower to insure that conflicting traffic does not cause a "Go Around."
2. Make normal approach and normal power-off landing except cross boundary at 84 knots or above IAS. Do not exceed ¼ flap extension until landing assured.

NOTES: The approach should be made very carefully to insure that a "Go Around" will not be necessary. Single engine Climb is critical with gear and flaps down and with a initial airspeed of less than 84 knots IAS.

The minimum control speed, that speed at which the airplane is directionally controllable in flight with one engine inoperative, propeller wind-milling with the good engine at take off power, is 77 knots IAS.

Rejected Landings

Sufficient climb performance has been demonstrated to permit a rejected landing go around on two engines if the airspeed is not below 77 knots (Vmc) and on one engine if the airspeed is not below 84 knots (V2). In the case of a two engine go around, METO power should be applied (MAX power if considered necessary), flaps retracted. Single engine rejected landings require the immediate application of MAX power, immediate flap retraction (flap extension should not exceed ¼ on single engine landing approach until landing assured), and, when a positive rate of climb has established at 84 knots, the landing gear retracted. When flaps and gear have been retracted, accelerate to 95 knots (single engine) and 110 knots (two engine) climb speed.

Many times a rejected landing shows good judgment.

Landing With Ice On Wings

1. Ice on the wing of an airplane, especially along the attachment of the de-icer boots on the upper surface, materially increases the stalling speed. The stall will be sudden with no warning.
2. If a landing must be made with any quantity of ice on the wings, the speed should be held at 100 knots IAS, or above, until the wheels are on the ground.

Landing With Tire Flat

Main Wheel Tire Flat

1. In choosing point of touch-down, anticipate swerve toward flat tire side.
2. Make normal landing with flat tire wing up slightly.
3. Ground the locked tail wheel and use brake on good tire side

Tail Wheel Tire Flat

1. Make normal landing, hold tail off ground as long as possible, then gently lower while elevators are still effective.

STALLS

Characteristics

General buffeting warns of an impending stall

When stalled, recovery is normal

Maintaining the aircraft at a stall results in severe tail buffeting

The aircraft will stall with power on at speeds considerably below those given in the Airspeed Limitations Slide and Stalling Speed Chart, and has a definite tendency to fall off on one wing or snap roll

Recovery – Normal procedure is used for corrective measures. Accomplish the recovery smoothly

SPINS

If an inadvertent spin occurs, recovery is normal

ENGINE FAILURES

Immediate Action:
Booster Pumps "ON"
Mixture "Auto Rich"
Fuel Selector - Left Main/Right Main
Verify Faulty Engine
Reduce Power on Bad Engine
Feather if necessary

The types of engine failures and conditions of failure vary considerably. It's not necessary to apply power in all cases, identify the engine which is malfunctioning and then take the necessary action.

When engine malfunctioning is experienced, check engine instruments closely as they generally give a good indication of the cause and severity of the trouble. The fuel flow indicator is generally a good indicator when loss of power is experienced except with complete ignition failure where RPM, MP, and fuel pressure will remain normal.

Remember on engine failures, rudder pressure will be required to hold straight flight on the side on which the good engine is operating.

ENGINE FAILURES

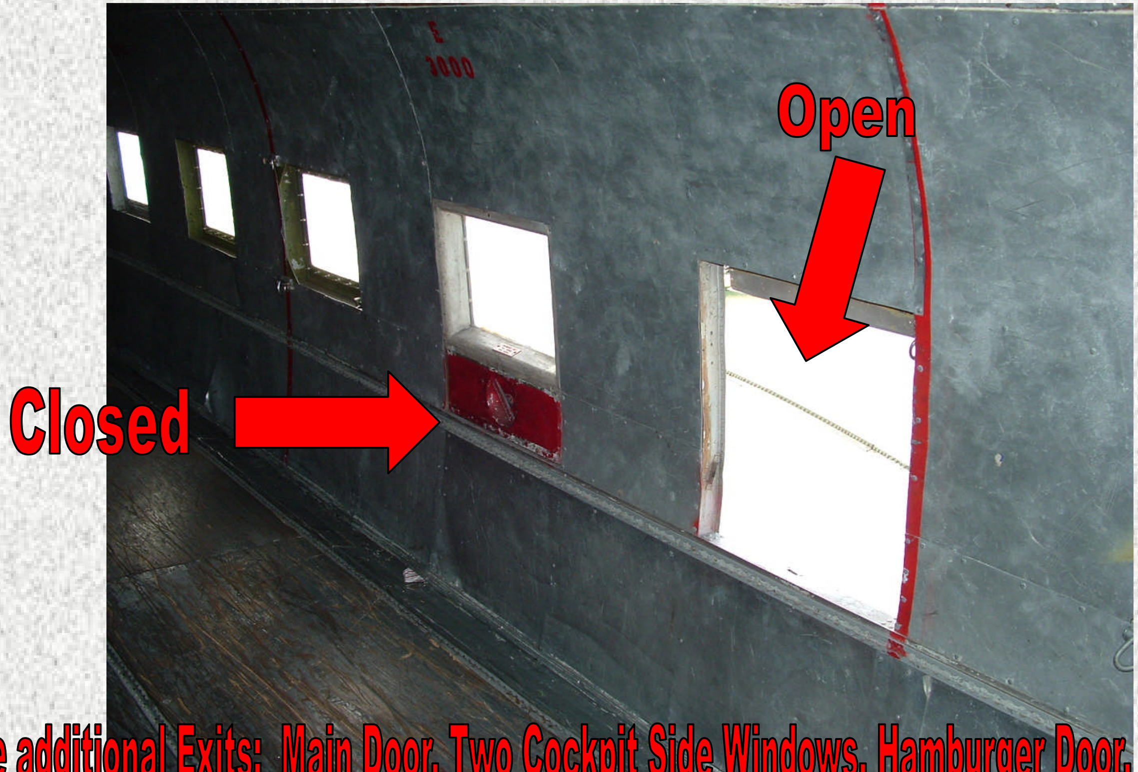
Throttling an engine and/or reducing engine speed may reduce vibration or cutting out and possibly restore normal engine operation. In case of loss of fuel or oil pressure due to line failure or in case of an extremely rough engine, it will be necessary to shut down that engine by going through the feathering procedure, thus protecting against further damage to the engine, airplane, and against fire.

In all cases of engine failure in the air certain general procedures should be done immediately, APPLY POWER IF NEEDED– GEAR AND FLAPS AS REQUIRED –FEATHER BAD ENGINE.

In the event that you are experiencing increased fuel consumption on either the left or right engine, check the fuel lines immediately to ensure that you do not have a faulty fuel line or carburetor

Emergency Exits

Three auxiliary emergency exits are provided to assist in the evacuation from the airplane during emergency conditions on the ground. They are located on each side of the main cabin and are distinguished from the ordinary window by the release handle below the window (Red). To operate the auxiliary exit door, rotate the release handle in a clockwise direction and push the door outward. It hinges from the top.



Five additional Exits: Main Door, Two Cockpit Side Windows, Hamburger Door, and Overhead Cockpit Door

Paratrooper Door

The Paratroop Door can be
opened while in Flight

It may be necessary to open the door
while in flight
and throw out cargo
to reduce aircraft weight
ONLY IN THE EVENT OF AN
EMERGENCY

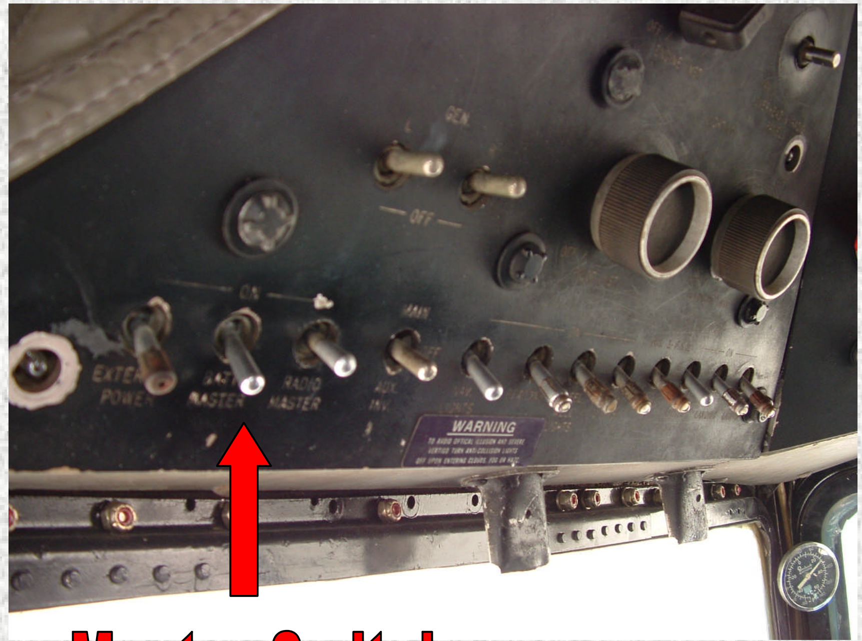
In the event of an emergency,
unlatch the Two Red Handles and pull the
Paratroop Door inside the aircraft

FLYING THE DC-3

Starting Engines

- ***PINS, LOCKS, AND CHALKS ON BOARD!!!!***
- <u>AIRCRAFT ENGINE OPERATION PROCEDURES</u>
- <u>STARTING ENGINES</u>
- **Generally most DC-3 Operation Procedures require the use of the "Primer." Since we conduct operations in a warmer climate we do not use Primer.**
- Master Switch "***ON***" RED ARROW
- Mixture "***Auto Lean***", could be set to Auto Rich as well
- ***Crack*** the Throttles
- Ensure ignition switch is "***ON***"
- "***Right Engine Select***"

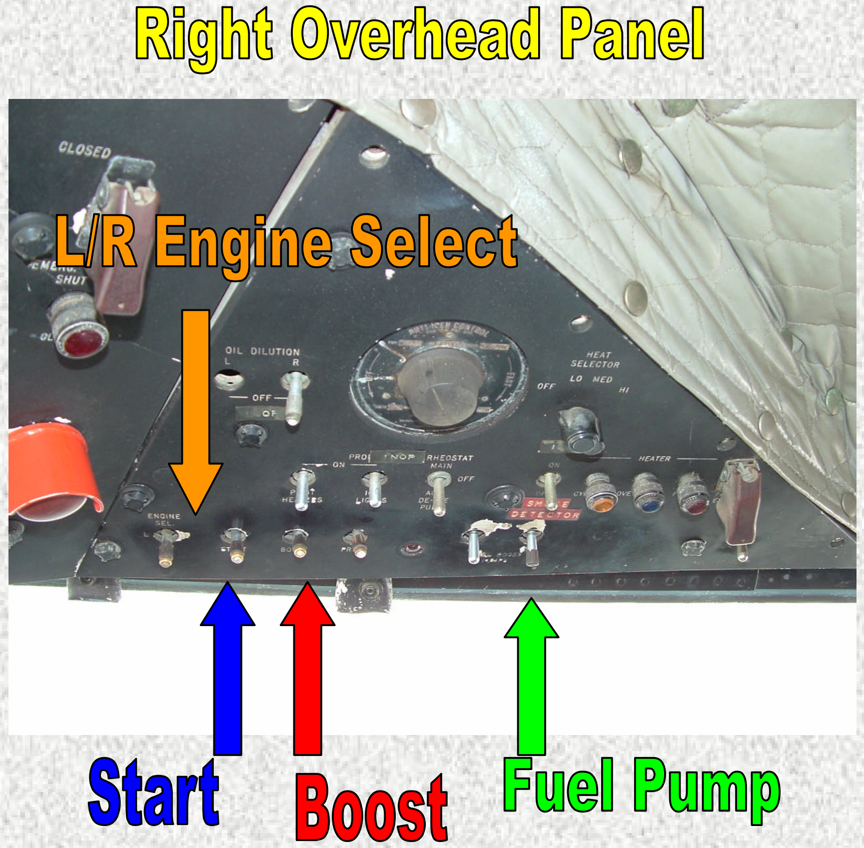
Left Overhead Panel



Master Switch

Starting Engine (Cont)

- Depress "***Start***" (4 to 6 Blades) **BLUE ARROW**
- Ignition "***Both***"
- Immediately Depress "***Boost***" –**RED ARROW-** (Note: On some aircraft the start switch incorporates both 'Start' and 'Boost')
- Right Fuel Pump ***"ON"*** ***GREEN*** **ARROW**
- Hold "***Start and Boost***" until Engine Fires
- *** The engine should start discharging fuel from the drain barrel (*draining from underneath the cowling*) just before starting ***
- *** If you have to much fuel discharging (*draining from underneath the cowling*), Bring the Mixture to Idle Cut Off ***Watch the MP, a high indication at start-up indicates excessive Rich fuel mixture
- Fuel Pump "***OFF***"
- Mixture "***Idle Cutoff***" until RPM recovers
- Mixture "***Auto Lean***"
- Engine Select "***Neutral***"



Starting Engines (Cont)

- Now that Starting sequence is with the Engines Cold, Everything is pretty much the same except for as stated below……Engine Hot (ex. Heading back to Miami)
- Depress “***Start***”
- Ignition “***Both”***
- Immediately Depress “***Boost***”
- Right Fuel Pump “***ON”***, *** Hold for a brief second or two, then turn off, Wait once again for a few seconds and repeat until engine fires.
- Hold “***Start and Boost***” until Engine Fires
- Mixture “***Idle Cutoff***” until RPM recovers
- Mixture “***Auto Lean***”
- Engine Select ***Neutral (if equipped)***
- Now start the left engine the same way for both, Good Luck!

Right Overhead Panel

Starting Engines (Cont)

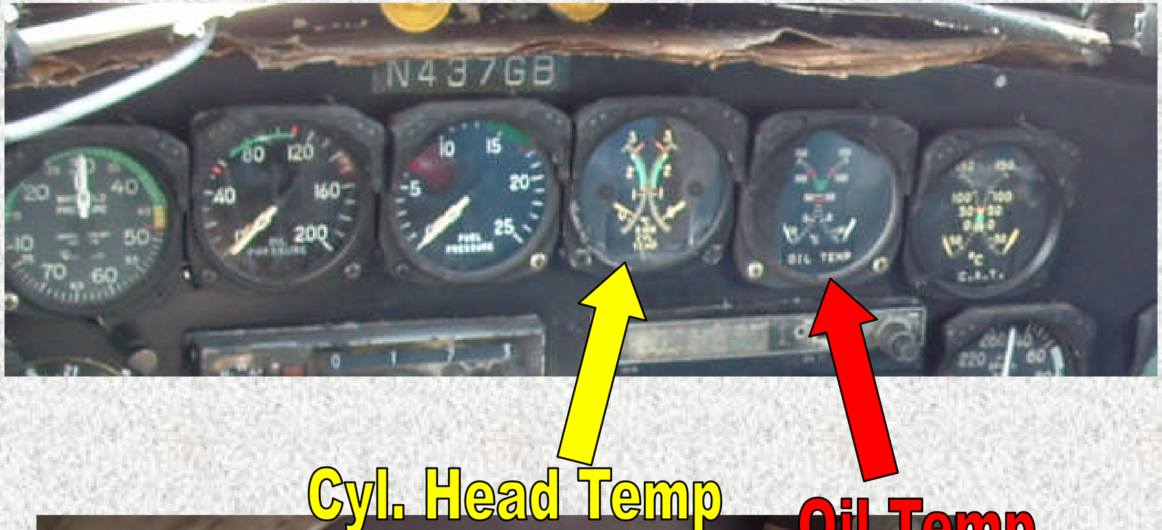
- ***This is how it works……..***
- While holding the ***start switch*** with your (right hand) Thumb (after 4 to 6 blades) switch the ***Mags to Both*** with your Left hand….then with your Index finger hold ***Boost*** down (maintaining the pressure with your Thumb)…..With your Middle Finger flip the ***Booster Pump On*** (refer to cold/warm start)…..Once the engine fires flip the ***boost pump off*****…..at the same time move the mixture control from ***Auto Lean to Idle Cut Off*** until engine recovers(runs smoothly)….

With a Warm Engine,
Momentarily Depress Fuel Booster Pump,
Then Engage the Starter, Mags to Both, and Depress Boost.
Engine may start Immediately without any further Fuel Booster Pump application.

Engine Start Notes

- **If the engine starts but runs erratically, immediately depress the Boost Pump on until engine recovers---this usually happens when you hold the mixture control in Idle Cut Off for too long**
- **If the engine backfires and causes any excess fuel to catch fire, open the throttle wide and keep the engine turning over with the starter**
- After hydraulic pressure builds, set the Flap and Gear handle to the Neutral position.(**850-900 psi**)

After Engine Start



- Turn on Avionics Power BLUE ARROW
- Wait until the engines warm up prior to Taxi (at or slightly below **1000 RPM**) **Warm-up should be continued until oil temperature has reached 40 degrees centigrade, oil pressure is normal (70-95 lbs.), and head temperatures above 100 degrees centigrade**
- If landing gear pressure falls below **500 psi**, place gear handle in the Down position until pressure is equal to the hydraulic system pressure and return to neutral

After Engine Start (Cont)

Once the Right Engine has started, observe Landing Gear Hydraulic Pressure to note a rise in pressure. Once the Landing Gear Pressure has reached it's Operating/Max Pressure, Momentarily Depress the Brakes (Note a drop in pressure), repeat procedure, and then return the Gear and Flap handles to the Neutral position.

Oil pressure should register within 30 seconds after starting the engines. Do not allow the engines to run over 1000 RPM until oil pressure is up to 30 pounds per square inch and oil temperature is at or above 40 degrees C.

Cowl Flaps should be Full Open for all ground running. Attempting to warm-up engines with the cowl flaps closed may cause burning of the ignition leads and spark plug elbows

Before Taxi

- BEFORE TAXI
  - HYDRAULIC PRESSURE…750-950 PSI
  - AVIONICS …ON
  - ALTIMETER…SET
  - FLIGHT CONTROLS…FREE AND CORRECT
  - CLEARANCE…AS FILED

Ready to Taxi

- ***Okay now were ready to Taxi,***
- Set the Mixture to "**Auto Rich**"
- Advance the throttles slightly (The aircraft will Roll at idle speed- Empty/ **1000 RPM**)(It may take an initial **1200 RPM** to get rolling then idle back to 1000 RPM for taxiing))
- After rolling for a few feet, **Unlock** the Tail wheel
- Avoid Pivot Turns
- Don't under-estimate your 95'- wing span
- Anticipate your turns
- Taxi as needed **make sure to use differential power as needed**
- ****NOTE**** When taxiing in a straight line for distances of 200 feet or more, LOCK the tail wheel, ensure you unlock it approximately a few hundred feet before turning.

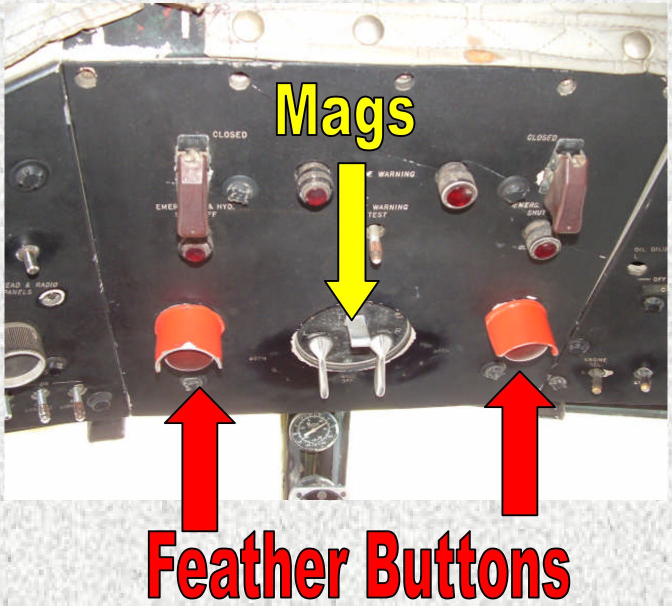
Before Take-Off

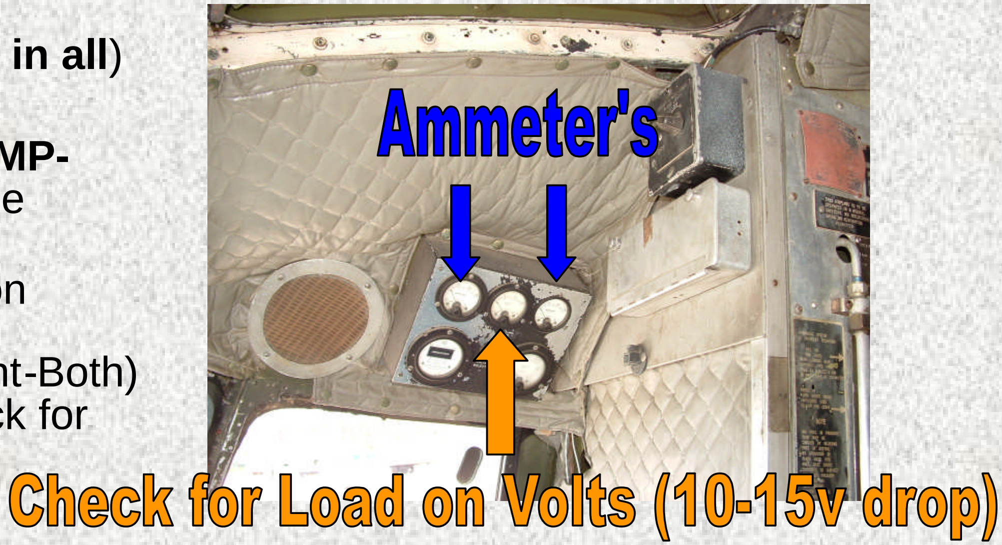
BEFORE TAKE OFF

- **PROPS……FORWARD**
- **MIXTURE…..AUTO RICH**
- **FUEL TANKS…LEFT MAIN/RIGHT MAIN**
- **FLIGHT INSTRUMENTS…SET ON LEFT/RIGHT**
- **RADIOS SET**
- **TRIM TABS…ONE, TWO , THREE SET**
- **FLAPS…UP INDICATION**
- **CARB HEAT…COLD AND LOCKED**
- **STANDING BY FOR FINAL ITEMS**

Run-Up

- ***Now, you've positioned the airplane into the wind ready for run-up***
  - **Lock** the Tail Wheel
  - Hold Brakes
  - Advance Throttle to **1700** RPM
  - Cycle Props through full range of motion (Minimum governing speed is **1200 RPM**) ****Twice****
- ** This forces warm oil into the propeller dome**
  - Push in the feather button, Prop should feather (Don't go below **1500 RPM**)**No more than a **200 RPM** drop**Both Engines** **make sure to pull the feather button back out after depressing it**-Note load on generator
  - Cycle Props again (**Three times in all**)
  - Throttle back to Idle
  - Advance Throttle to approx**. 30"MP-Field Barometric Pressure** (One engine at a time)
  - **Check ignition** by turning ignition switch to left and right magnetos individually (Both-Left-Both-Right-Both) 50-75 RPM drop **Visually Check for signs of vibration**
  - Throttles back to Idle





Final Items

- **FINAL ITEMS**
- **Cowl Flaps "Trail"**
- **Transponder in "Alt"**
- **Boost Pumps "On" – (Once In Position)**
- Position the aircraft on the runway, **Lock** the Tail Wheel…..and away we go.

Red Line may be exceeded by 2 PSI when both engine and booster pumps are operating

TAKE-OFF

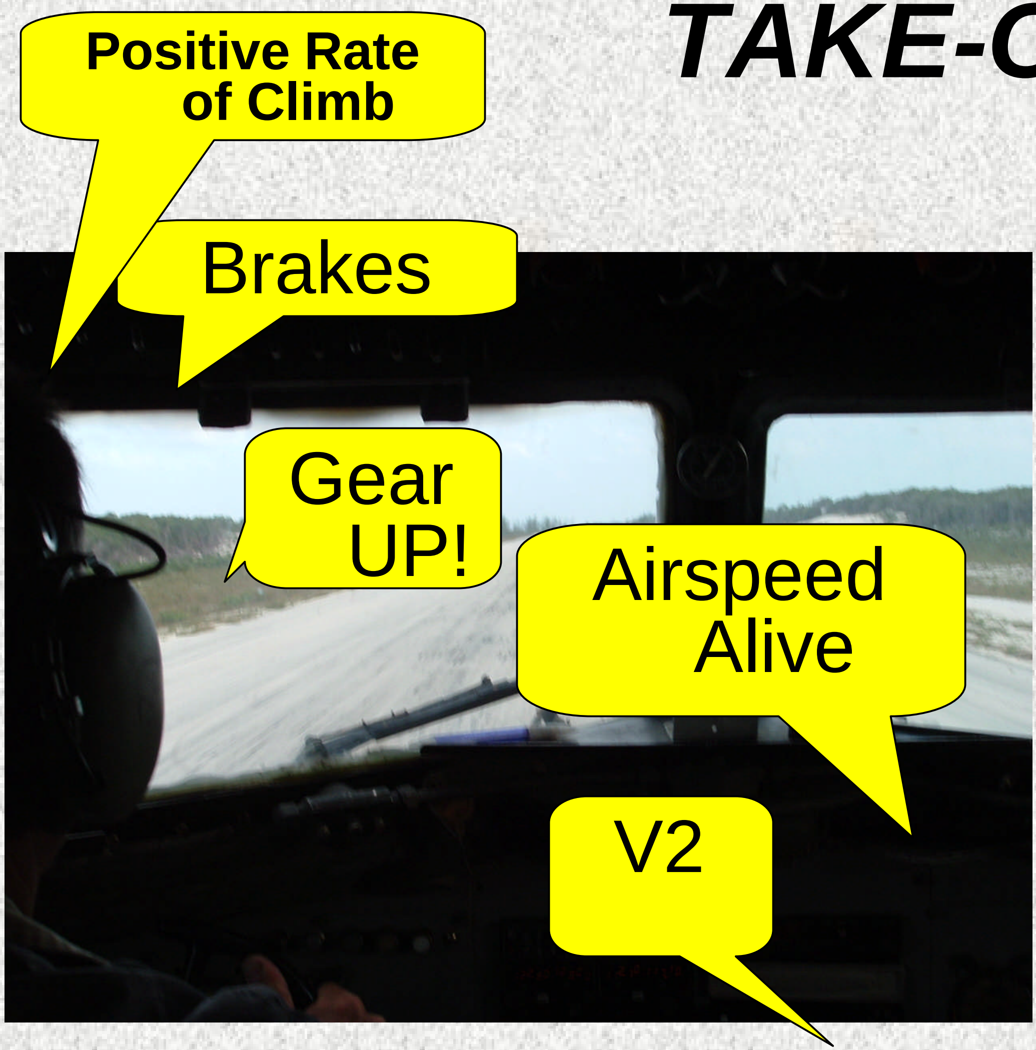
- **Slowly** advance the throttles to take off power (should take approximately **five** seconds) FO guards the throttles by positioning his hands at the base of the Throttle controls and calls out 30”, 35”,40” (Manifold Pressure), to the desired Take-Off Power Setting and taps the Captain on the back of the hand to adjust Power Setting if necessary.
- Scan temperature gauges to make sure they’re in the **GREEN**
- ** If your taking off with reduced power, ensure to pull the Props back to appropriate RPM (**ex. *40” MP and 2550 RPM***)
- Use Rudder and differential power to maintain runway centerline**forcing the tail off the ground increases drag**In strong crosswind conditions, lead with the engine towards the wind, approximately 4” to 5” MP**

Warning: Do Not Release Throttles on Take-Off

45" MP Standard Take-Off

V2 @ 84 kts

TAKE-OFF



- First Officer calls out "Airspeed Alive." 40kts**slowly add elevator trim (Nose Up) when aircraft is empty to reduce elevator pressure and reduce stress on the tires.
- Around ***50 to 60 kts (loaded)*** the Tail wheel will rise on its own
- First Officer calls out ***V2*** @ ***84 kts***
- Adjust <u>Nose Up</u> Trim ** Apply some back pressure on the yoke if needed **
- Once the aircraft is airborne
- **CPT/FO verifies and calls out "Positive Rate of Climb"**
- ***Trim for a target speed of 95 kts/loaded – 105 kts/empty, until 200' AGL, Then 105 kts***
- Apply Brakes
- Call ***<u>Gear UP</u>*!**
- The Captain takes over the throttles while the FO raises the Gear

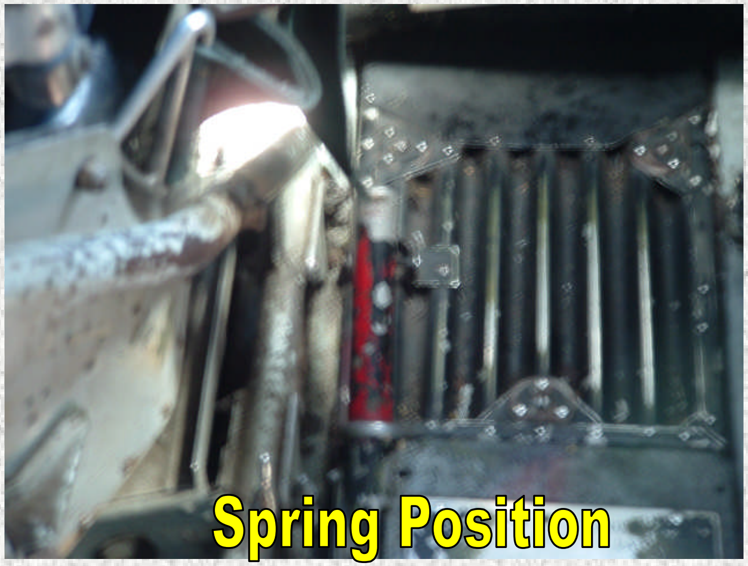
Immediately Retract the Landing Gear

Vx/Vxse - 85 Kts **Vyse - 95 Kts**

Vy - 105 Kts

GEAR RETRACTION

- **<u>GEAR RETRACTION</u>**
- Release latch from floor and pull to vertical position
- Raise Gear handle to UP position **Watch for the Hyd. Pressure to decrease to (0)**
- When gear has retracted, return gear handle to neutral position **visually plant your face to the side window or stick your head out to visually verify that the gear is up**
- The Release latch should return to a 50 degree angle



CLIMB

Empty/Long Runway/No Obstacles

- **<u>CLIMB</u>**
- Aim for **105 kts to 700' AGL**
- METO @ approx. 200-300' AGL **(40"-41"MP @ 2550 RPM)**
- CLIMB power @ approx. 700' AGL **(35"MP @ 2300 RPM) 115 kts**
- Fuel Pumps **OFF** @ 700' AGL
- Visually Check Engines

CLIMB

When Fully Loaded/Short Runway/Obstacles Present

- <u>**CLIMB**</u>
- Aim for **95 kts to 200' AGL**, **105 kts to 700' AGL, and then 115 kts** (Target Climb Speed – IAS)
- METO @ approx. 200-300' AGL **(40-41"MP @ 2550 RPM)**
- CLIMB power @ approx. 700' AGL **(35"MP @ 2300 RPM) 115 kts**
- Fuel Pumps **OFF** @ 700' AGL
- Visually Check Engines

Take Off/Climb Check

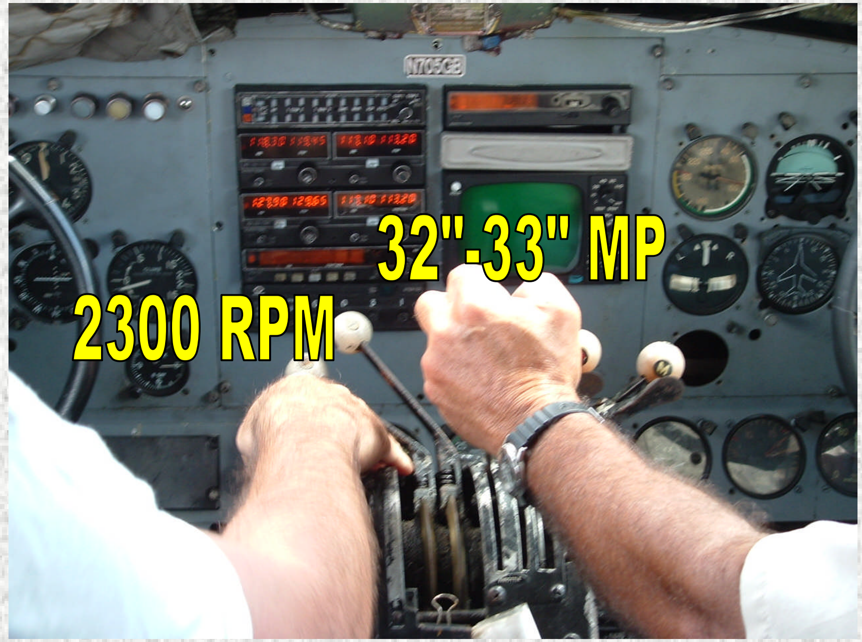
Press& Temps	Checked
GearHandle	Neutral
BoosterPumps	Off
VisualEngine Check	Clean

ALTERNATE CLIMB POWER

- **<u>ALTERNATE CLIMB POWER</u>**
- **32–33” MP @ 2300 RPM** (Allow manifold pressure to drop to 32”/33” with altitude)

Use initial climb power until 2000’ AGL before reducing to alternate climb power settings

- **Crews are encouraged to use alternate climb power settings in the interest of economy and engine longevity**



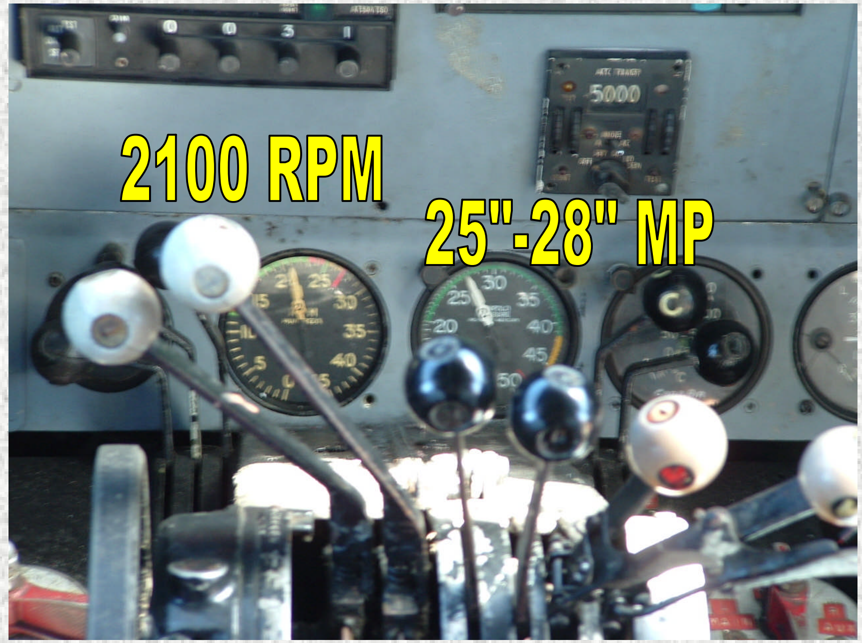
Watch your CHT, If temperatures are at 200 degrees or above, reduce rate of climb to 120 KIAS.

DURING CLIMB

- Remember that your Manifold Pressure will decrease 1” for every thousand feet
- Gear pressure should be zero while the gear is retracted and the handle is in neutral. If pressure rises, place latch in vertical position and move gear handle to full UP position, then return to neutral
- Keep oil pressures between 75 and 90 psi (***85 psi desired***) and 50 – 70 degrees C in normal flight operation.

CRUISE

- ***Okay you've finally reached your destination altitude…….***
- Turn the **Cowl Flaps CLOSE and OFF** **Approximately 100' before assigned altitude**
- Trim the aircraft for level flight attitude
- Reduce MP to desired setting **(25" to 28")** after accelerating through 125 knots, Reduce Props to desired setting(**2100 RPM**)**Watch those instruments**(**2200 RPM** to cool engine until oil pressure sustains)
- Mixtures to **AUTO LEAN**(Wait approx. 2 to 5 min.'s to cool engines and allow carburetor to stabilize)
- Now it's time to eat your sandwich and talk about how nice of a day it is to fish



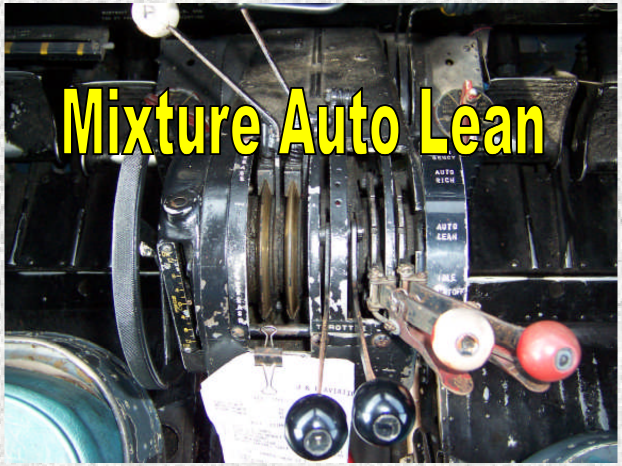
Auto Lean

CRUISE CHECK

- **COWLFLAPS ….CLOSE..AND ..OFF**
- **POWERSET TOCRUISE**
- **PROPSSET**
- **ALLOWENGINES TOCOOL (2 to5 min)THEN AUTOLEAN**

CRUISE CHECK

Close and Off



IN-RANGE CHECK

ALTIMETER SET CROSS	CHECKED
FUEL TANK SELECTOR	L & R MAIN
CARBURETOR HEAT	COLD & LOCKED

DESCENT

- ***Alright, you've been cleared to descend………….***
  - Trim aircraft to a Nose Down attitude (**140-135 knots**)
  - Reduce Power (**24-25" MP**)

  - **IN RANGE CHECK (When you start your descent)**
  - **FUEL TANKS..LEFT MAIN/RIGHT MAIN**
  - **CARB HEAT…COLD AND LOCKED**
  - **ALTIMETERS SET**

Slowly reduce power from Cruise Settings to the desired descent power setting (25"-24"MP)

Reduce One Inch of manifold pressure

every two minutes until you reach the desired descent power setting.

BEFORE LANDING CHECKLIST

- **LANDING GEAR SET….DOWN AND LATCHED, GEAR HANDLE NEUTRAL, PRESSURE UP, GREEN LIGHT: CHECK WHEELS VISUALLY**
- **MIXTURES…AUTO RICH**
- **BOOSTER PUMPS …ON (Approx. 500’ AGL)**
- **FLAPS AS NEEDED**
- **PROPELLERS…SET**

GEAR EXTENSION

LandingGear Down (Actuatethe Landing Gear LeverDown, Wait…until Pressure Rises, Place Gear Handlein the Neutral position, and then Latch LandingG ear Latch

- Visually Check that landing gear is down and locked
- Look for the “**Green Light**” (Landing Gear Light)

GEAR EXTENSION

Visually verify that the Gear....

Is Down and Locked!

LANDING

- Downwind leg is going to be around **120-110 knots-1500'AGL**
- Around the Approach Leg reach for a target speed of **100 knots-900' AGL at base and 600' on final**
- **¼ Flap @ or below 135 kts(120)**
- **½ Flap (*Two*) @ or below 99 knots**
- **¾ Flap (*Three*) @ or below 97 knots**
- ***Full Flap* @ or below 97 knots**
- Trim appropriately for best approach angle
- Boost Pumps on @ **500' AGL** (Loaded w/ Cargo)
- Adjust Manifold Pressure as necessary (Try to stay square if permissible(MP = RPM))
- Around Touch down your going to be around **90 to 80** kts, Just keep forward pressure and trim as necessary
- Touch down with the Main Wheels (Wheel Landing)

2100 RPM 21"-18" MP Desired

Try to keep Manifold Pressure and RPM "SQUARE"

Example: 2100 RPM/21" MP

LANDING

- Maintain **Forward Pressure** (Just Enough) to keep aircraft from becoming airborne again
- If you bounce apply Forward Pressure and Land again
- Be ready with your Feet, STAY AHEAD OF THE AIRPLANE, **Apply Rudder Pressure** as necessary to maintain runway centerline
- Power to Idle
- Flaps Up
- Props Forward
- Trim Tabs to Neutral
- @ **60 knots**, slowly apply Back Pressure on the Yoke to drop the Tail (Hold Back Pressure)
- **Unlock** Tail wheel before exiting runway
- Minimize using brakes – Apply when exiting runway

Touch Down

60 kts Lower Tail "Gently"

LANDING NOTES

- *** As you add Flaps, You must Trim your Nose “UP” as neededto maintaina descentflight attitude ***
- REMEMBER, YOU HAVE NOT FINISHED FLYING YOUR AIRPLANE UNTIL YOU HAVE COME TO A FULL STOP-

CROSSWIND LANDINGS

- CROSSWIND LANDINGS- Hold aircraft straight and level and drop one wing into the wind just enough to counteract drift, Crab into the wind sufficiently to keep the track aligned with the center line of the runway. Use flaps at your own discretion. As aircraft begins round out (flare) level the wings and straighten the airplane to avoid side loading the landing gear. Once on the ground hold the aircraft solidly on the wheels using rudder and a little power as necessary to maintain center line. That's what the books say's, I think it's better to keep the aileron input, and add more with slower airspeeds. From my experience if you level the wings, the wing towards the wind will rise and bring the landing gear off the ground)
- All landings should be performed with full flaps.

The critical crosswind component for this airplane

has not been determined. However,

the maximum crosswind component considered satisfactory is 13 kts.

CLEAR OF RUNWAY

- ***Finallyw e haveexited the runway (clear) and initiatedthe contactto ground……***
  - Cowl Flaps **Open and Close**
  - Transponder set to **STBY**
  - Set Trim Tabs to **Neutral** setting **(Elevator)**
  - Boost Pumps **Off** if used
  - Landing Light Off if used
  - Bungee the Yoke

AFTER LANDING CHECKLIST

- **PROPS FORWARD**
- **FLAPS UP**
- **COWL FLAPS - OPEN AND OFF**
- **TRIM TABS - NEUTRAL**
- **TRANSPONDER - STBY**

SHUT DOWN

- ***Okay we're on the ground nice and safe, Ready to shut down…..***
  - Straighten out the aircraft
  - **Lock** the Tail Wheel** you may want to tap left and right brakes to ensure that the tail wheel is centered (aircraft centerline)
  - Mixtures **to Idle Cut Off**
  - Avionics/Beacon/Lights **Off**
  - Mags "**OFF**" ** make sure to wait until all blades stop spinning**
  - Master Power **OFF**

PARKING & SECURING CHECK

TAIL WHEEL	LOCKED
PARKING BRAKE	SET
MIXTURE CONTROL	IDLE CUT-OFF
IGNITION SWITCH	OFF
RADIOS/INV/BATT	OFF
BEACON/LIGHT	OFF
GEAR & FLAPS	SPLIT
LANDING GEAR PINS	IN PLACE
CONTROL LOCKS	IN PLACE
DOORS	LOCKED

SECURING AIRCRAFT

- ***Okay make your way back to the Cargo Door…………***
- Upon opening Door secure with bungee cord
- Immediately Chalk Tail Wheel
- Secure Landing Gear with (PINS) ** call up to the Captain "SPLIT" / This ensures the aircraft is secure and the Captain can then exit the aircraft (cockpit)
- SPLIT – refers to raising the flap handle to the UP position and the Landing Gear handle to the DOWN position
- Install Control Lock on the Rudder

- ***If the aircraft is at it's final destination………….***
- Install all Control Locks (aileron and elevator)
- Hook up buckets under engines
- Chalk the main wheels

I Recommend to Close Cowl Flaps after Engine Shut Down

In the SPLIT position hydraulic pressure is automatically relieved when thermal expansion of the hydraulic fluid occurs

POWER SETTINGS

Take off:

- **45-48" @ 2700 RPM - Loaded - V2 84kts**
  35-41" @ 2550 RPM - Empty

METO:

- **40-41" @ 2550 RPM - approx. 200’- 300' - 105kts to 700’ / Then 115 kts to Cruise**

Climb:

- **35" @ 2300 RPM - approx. 700' AGL - 115kts**

Cruise Climb:

- **32-33" @ 2300 RPM - 115 kts**

Cruise:

- **25-28" @ 2100 RPM - depending on weight, loaded vs. empty, somewhere around 120-130kts IAS**

POWER SETTINGS (CONT)

- **Descent:**
- **24-25" @ 2100 RPM** ***note*** we do not descend based on fpm, we descend at **135-140** knots. Do not exceed 140kts unless situation dictates.
- Note: RPM under **2100 RPM** leads to more vibration which isn't good for the rear section of your lovely R1830. Just wanted to throw that in there, because I see a lot of RPM settings around 1850-1900 RPM.

  Pull power back to **23-21"** as needed around base and final. Do not pull the power back under square (RPM vs. MP) until landing in assured on short final. You want to limit reverse-loading as much as possible. Kind of hard at the airports we fly into.

  You want to keep the MP up to prevent shock cooling the cylinders.

  Maintain around **1500'** on downwind, drop gear under **130kts.**
- Since we fly into busy international airports such as Miami Intl, approach control likes you to keep the speed up, anywhere from 120-100 kts. Use flaps as necessary to touch down, I think I usually touch down around **80 to 85 knots**.

ADDITIONAL NOTES

- We use a lot of trim. Once you reach **V2, trim nose up** until you lift off the runway. I hardly ever lift on the yoke, only occasionally, and then just a little bit. Same thing for landing, trim, trim , trim on final. On touchdown, immediately flaps up, and props forward, in case of emergency go around."
- **** sometimes we wait a few minutes before reducing the mixture to "auto lean" to cool the engines down.******
- ****if the oil pressure is low, you can leave the props at **2200 RPM** for additional cooling of the oil until oil pressure rises****
- NOW DESCENTS!!!!
- If flying VFR, we start descending around **35 to 40 nm** out from our destination.

- descend at **135-140kts.**......Not to fpm......your descent rate while change based on aircraft weight.
- If your almost right over the airport, as in some cases while flying IFR,
- Level off, decelerate to **130kts**, drop landing gear, and continue descent at **125kts(IAS).** Your rate of descent will increase. If you have to reduce power to **23-24"** MP, then do so.
- **** Watch your airspeed, MP, and RPM. Rate of descent doesn't split cylinders and break gears in your rear section. Reverse loading and shock cooling (180-200 degrees C is desired) will ****
- NOTE: THE ABOVE INFORMATION IS BASED OFF OF YEARS OF EXPERIENCE FLYING THE DC-3. OPERATING THE AIRCRAFT TO IMPROVE ON EFFICIENCY/RELIABILITY AND TO CUT DOWN ON OPERATING COSTS.

ADDITIONAL NOTES

Go-Around From Landing Configuration – Whether two engine or single engine, as soon as it is evident that a go-around is required, pull up straight ahead by adding MAX power. Raise the flaps to ¼ while rotating the nose to maintain 84 kts; thereby preventing loss of altitude. Raise the gear and the rest of the flaps as soon as the positive rate of climb is established.

No-Flap Landing – Should hydraulic failure necessitate a no-flap landing, maintain 105 knots while maneuvering. When established on final approach taper airspeed from 105 kts to cross runway threshold at 1.3 vs1 (87 kts at 25,346 pounds to 78 kts at 20,000 pounds).

ADDITIONAL NOTES

Crosswind Take-Offs - When making a cross-wind take-off, advance the up-wind throttle 3 to 5 inches in Manifold Pressure to assist in holding the aircraft in a straight line. When positive rudder control is obtained and the aircraft is on it wheels in flying position, or if the aircraft has become airborne, equalize power of the engines.

Use of Wing Flaps – All take-offs under normal conditions will be made with flaps fully retracted. Tests have proven that the aircraft can be lifted off the ground in a shorter distance by using between one-quarter and one-half flaps, but the climb over the obstruction when taking off from a hard-surfaced runway is equally good when using no flaps. Since single engine performance is definitely reduced when operating with flaps partially extended, it is not advisable to use them except when taking off from a muddy or soft field.

When a propeller does not maintain an engine speed of 2700, plus or minus 50 RPM, it should be reported to the Maintenance Department. It is important that take-off RPM, and the proper RPM and Manifold Pressure combinations shall be used for intermediate power to avoid excessive internal cylinder pressure.

ADDITIONAL NOTES: LANDINGS

Enter the Pattern at 1500' AGL (115 kts), **Gear Down** approximately 5-6 miles out from the runway threshold on a ***straight-in approach***. Adjust speed and rate of descent necessary to maintain the proper glide path to the runway. **¼ flap** 5-6 miles out. ***If you are entering downwind***. Gear Down approximately at a 45 degree angle from the opposite runway threshold on the downwind leg. Once the gear is down and locked slowly descend to approximately 1000' AGL. **¼ flap** crossing the point of intended landing.

ADDITIONAL NOTES: LANDINGS

Turn base at a 45 degree angle from the runway threshold at or around 900’ AGL (105kts) and turn final around 600’-500’ AGL. Once under a hundred knots and it has been determined that the runway is made. Add additional flaps as necessary. **Full flaps** over the fence or airport boundary


PERFECT APPROACH ANGLE
Maintain "ONE" dot below Glide Slope
or
3 Red and 1 White on the PAPI/ VASI

CREW COORDINATION

Starting Engines – Once the CPT and FO are in the Cockpit and the aircraft is secure, the CPT will very that the Pins, Locks, and Chalks are onboard and stowed. The FO will sound off verbally or with a Thumbs Up to verify. The FO will verify that the right side engine is clear-Clear! The CPT will turn on the Master Power Switch, Mixture Controls Auto Lean, Throttles Cracked, Right Engine Select. The CPT will then engage the Starter, after approximately 4-6 blades, Magnetos to Both, Boost Engaged, Booster Pump On, all simultaneously. After the engine starts, release the Start and Boost Switches and Turn off the Booster Pump. Verify that the engine has started before disengaging the Start/Boost Switches. If you have a high Manifold Pressure Setting it may be necessary to bring the Mixture Control to idle cut-off or between the previous in order for the Idle and RPM/MP to stabilize. Excessive smoke is a good indication that the Engine is Rich and should be temporarily leaned. The FO should be visually inspecting the engine during start-up and notify the CPT once the fuel starts pouring out of the drain pipe. Once Engine becomes Stabilized, then Engine select Neutral. Immediately check Oil Pressure. Set Power to 1000 RPM or less (Maximum Idle Speed until oil temperatures reach 40 degrees C or above). The FO reads off the Starting Engine Check-Engine Start Complete!

The same procedure is used to start the left engine. The CPT manipulates the controls and verifies that the Left Side is Clear-Clear Left! The FO watches the Hydraulic Pressure and when the pressure builds to 750 psi, sets the Gear and Flap handle to Neutral. The FO reads off the Starting Engine Check-Engine Start Complete! On a Hot Start, the same procedures are used as in a Cold Start. The CPT will engage the Starter, Immediately Magnetos to Both, Boost Engaged, and Booster Pump ON, The CPT will hold the Booster Pump on for approximately 2 seconds then disengage. Wait two seconds and engage again. He will repeat this procedure until engine fires.

CREW COORDINATION

After the Engine Start Checklist has been completed. The FO will turn on the Avionics by engaging the Avionics Power switch and turning on the proper radios. He will then return to his After Engine Start Checklist to verify completion-After Engine Start Complete! The FO will monitor the local ATIS Frequency and copy down any clearances if necessary and set the proper transponder code/Frequencies. The CPT will then go over a Pre-Takeoff Brief with the FO and cover any special instructions or Arrival/Departure procedures in use. Once the engines are properly warmed up (100 CHT/40 C Oil Temp) and the FO has received the taxi clearance, the CPT will call the Before Taxi/Taxi Check- The FO sounds off with Taxi Check Complete! The CPT will position the Mixture Controls in Auto Rich and slowly add power to Approximately 1000-1200 RPM. As the aircraft starts to roll he will tap left and right brakes while simultaneously holding the Tail Wheel Lock with his Right hand and add slight pressure until Tail Wheel Lock unlocks. The CPT should conduct a brake test and should receive an appropriate response after the FO does the same-Brakes! While Taxiing the CPT or FO whoever is taxiing should avoid pivot turns and use differential power and brakes to conduct turns and maintain centerline on the taxiway. While conducting a turn. You should input opposite Rudder and possibly Tap the Brakes just before Reaching Centerline of the Taxiway. If you keep the Rudder Input until established centerline, you will overshoot and have to use more rudder, brakes, and differential power to correct your path. For Taxiing distances over 200' you should lock the Tail wheel by reaching under the pedestal and gently release the Tail Wheel lock, allowing it to move forward. If power properly set. The aircraft will Taxi in a straight line while holding equal rudder pressure. You should only have to use small corrections with the rudder to remain straight on the Taxiway. Remember to lead into the wind with the corresponding engine.

CREW COORDINATION

Run-Up: Position the aircraft away from other aircraft or pedestrians. The R1830's produce a lot of thrust and can throw small objects at great force that can cause serious injury to bystanders or other aircraft in the area. Once the aircraft is positioned into the Wind the CPT locks the tail wheel and applies brakes. The CPT will increase the RPM by applying forward pressure on the throttles to 1700 RPM. The CPT then will move the Propeller controls to the Aft position and return to the full forward position (full range of motion). Minimum governing speed is 1200 RPM. The CPT will cycle the props once again. Maintaining 1700 the CPT reaches and engages the Right Feather button by pushing in and holding until RPM drops 200 RPM. While the CPT is engaging the Feather button, the FO monitors the Voltmeter and notes the load on the Generator. The CPT then pulls the Feather button back out and does the same with the Left engine. RPM should return to 1700 RPM. The CPT will once again cycle the Props (full range of motion). After RPM restores, the CPT will pull the throttles back to idle speed (1000 RPM). Starting with the Right engine the CPT will advance the throttles to Field Barometric pressure (approx. 29"-30" MP and 2300 RPM) and conduct a Mag check. Starting with the Right engine, the CPT will cycle the Magneto Switch – Both-Left-Both-Right-Both. The CPT inspects the Tachometer looking for any RPM drop while the FO will visually inspects the Right engine and looks for any vibrations that occur will changing magnetos and report it to the CPT. The CPT will then retard the Right throttle and do the same with the left engine. This time the CPT visually inspects the Left Engine while the FO watches the Tachometer for any RPM drop. The FO should maintain the controls during run-up to prevent any unnecessary forces on the elevator/rudder. The CPT brings the throttles back to idle, releases the brakes and unlocks the Tail wheel while the FO calls Ground Control for further Taxi Clearances.

CREW COORDINATION

Once into position taxing to the runway the CPT will call for **Before Take-Off Check**. The FO reads the checklist as the CPT physically verifies the checks. **(FO) *Props*…(CPT) *Forward*** - Pushes forward on the propeller controls,

(FO) *Mixture*…(CPT) *Auto Rich* -Physically checks that Mixture controls are in the Auto Rich position and locked,

(FO) *Fuel Tanks*…(CPT) *Left Main* -Insures that the Fuel Tank is set to the Left Main/ **(FO) *Right Main*** -Ensures that the Fuel Tank Selector is set to the Right Main,

(FO) *Flight Instruments*…(CPT) *Set on the Left* -DG Set, Altimeter Set, and VORs on selected radial**/(FO) *Set on the Right*** -DG Set, Altimeter Set, and VORs on selected Radial,

(FO) *Radios*…(FO) *I have the radios*!,

(*FO) Trim Tabs*…(CPT) *One, Two, Three, Set*!-Verifies that the elevator, rudder and aileron Trim tabs are set,

(FO) *Flaps*…(CPT) *Up Indication, Neutral, Check* -Actuates the Flaps UP, verifies the indication of Flaps Up and returns the Flap handle to the Neutral position,

(FO) *Carburetor Heat*…(FO) *Cold and Locked*!-Push's the Carb Heat controls forward and back on the locking lever,

(FO) *Standing By for Final Items and Captains Brief*. The CPT then instructs on Take-Off power settings. **(CPT) *Standard Take-Off 45"*** or as specified. Once in position for Take-Off the FO initiates the call to the tower. Upon clearance for Take-Off the CPT calls for Final Items. The FO turns the Cowl Flaps to TRAIL and sets the Transponder to ALT. The CPT taxis the aircraft onto the runway, runway heading and locks the Tail wheel. The FO engages the Left and Right Booster Pumps. The Elevator Trim should be set to 2-4 Degrees Nose Down on Take-Off while loaded and 2-3 Degrees Nose Up while Empty.

CREW COORDINATION

TAKEOFF – The CPT will advance the power to 45" MP and 2700 RPM (Standard when loaded) or 35"-42" MP (When empty) @ 2550 RPM. Should take approximately 5 seconds to advance from idle to full throttle. If the runway is short the CPT may decide to hold the brakes and advance the throttles to 30" MP and scan the gauges before releasing the brakes and further power advancement. The FO will place his left hand at the base of the throttles and guard them until either the CPT states "Set Power" or the CPT reaches the appropriate Takeoff power setting. The FO then taps the Captain on the back of the hand and adjusts the MP if necessary. Once the FO has the power to the correct setting, he will state "Power Set." While the CPT is the manipulator of the controls the FO scans the gauges to ensure they are in the Green and sounds off with "Gauges in the Green." Once around 40 knots the Airspeed will come alive and the FO will sound off with "Airspeed Alive." Around 50-60 knots the tail will rise on its own. The CPT will then adjust the trim slightly Nose Up (2 pulls) to reduce stress on the Main Landing Gear and tires. The CPT maintains Directional Control by applying the appropriate rudder pressure and throttle placement. At 84 knots the FO will sound off with "V2." The CPT will then increase nose up trim (2 pulls) or pull back on the elevator slightly (or a combination of both). Once the aircraft leaves the runway the CPT will pitch for 95 knots (IAS) loaded – 105 knots empty. As the CPT applies brakes he will then call out "Brakes, Positive Rate of Climb, Gear Up." The CPT will then tap on the FO's hand and take over control of the throttles while the FO raises the gear. Once the FO pulls the landing gear latch and raises the landing gear handle, he calls out "Coming Up." The FO then takes over the throttles and adjusts the Power Setting at 200'-300' above ground level. Notes: On Crosswind Takeoffs the CPT may lead with 3"-5" more MP on the leading engine toward the wind to aid in maintaining directional control. If the CPT or FO senses any abnormal conditions it may be necessary to discontinue takeoff.

CREW COORDINATION

CLIMB – At 200'-300' above ground level the FO adjusts the throttle and propeller controls to the METO power setting, 40" MP and 2550 RPM. The CPT maintains directional control and rate of climb at 105 knots (IAS). Upon reaching 700' above ground level the CPT calls for Takeoff Climb Check. The FO adjusts the throttles and prop controls to Climb Power setting, 35" MP and 2300 RPM. The FO turns the Boost Pumps OFF (Watch the Fuel Pressure to make sure it sustains) and returns the Gear handle to the neutral position (verify Gear Hydraulic Pressure on Zero). The CPT and FO visually check their respective engines and sounds off with "Good on the Left/Right or Clean." The CPT then pitches for a climb speed of 115 knots to cruising altitude. The FO then reverts back to his checklist and responds with "Takeoff climb check complete." At approximately 2000' the CPT/FO will reduce power to 32"-33" MP. Remember to watch your manifold pressure. You will loose approximately one inch of manifold pressure per thousand feet. It is the crews responsibility to watch the engine gauges and report any unusual indications immediately. The SIC sounds off with "One to Go" approximately 1000' before cruising altitude. 100' before cruising altitude the FO turns the cowl flaps to close and off on both engines. The CPT calls for **"Cruise Check."** The FO/CPT will bring the throttle and propeller controls to cruise power setting; 25"-28" manifold pressure and 2100 RPM. The power setting is based on weight and winds aloft. Usually while flying empty 25-26 inches of manifold pressure is desired. Leave the mixture controls in Auto Rich for approximately 2-5 minutes before bringing them to the Auto Lean Ident position. The CPT or FO can control the mixture control. The FO then calls out "Cruise Check Complete." If it is necessary to use the auxiliary tanks, the crew should wait approximately five minutes before switching tanks. To switch tanks, the CPT/FO turns on the Boost Pump for the appropriate engine and firmly changes the fuel selector for that engine. The CPT/FO then disengages the Boost Pump and verifies fuel pressure stabilization. Same procedure is done for the opposite engine.

CREW COORDINATION

DESCENT – Once you receive the instruction from ATC to descend, the CPT calls for the IN-Range Check. The SIC reads off the checklist and responds with “In-Range Check complete.” The PIC trims the aircraft for a nose down attitude to start the descent. The SIC reduces the Manifold Pressure to 25”. All descents will be conducted anywhere from 135-140 knots IAS, not by feet per minute. If a more desirable descent rate is needed you may need to bring the Manifold Pressure to 24” or increase speed to 145 knots. The DC-3 averages around 10nm per 1000’ of altitude (descent rate). In some cases the aircraft will not give a sufficient descent rate as required by ATC. If this happens, it may be necessary to level off, slow to 130 knots or less and drop the gear. With the gear down, do not exceed 125 knots during your descent. The SIC/FO should monitor the destination airports ATIS frequency prior to being handed off to Approach control. Within 6nm from your destination the CPT will call for **Before Landing Check**. The Crew will descend below 130 knots before dropping the gear. The CPT calls for Gear Down. The FO will lower the gear by placing the gear handle in the down position and watch the Gear Hydraulic pressure rise and sustain at or around 750 psi +. The FO will then return the Gear handle to the neutral position and lock the locking lever. Both the CPT and FO will look at their respective gears and verify that the gear is down and locked. The FO looks for a Green light and sounds of with “Down and Locked, Green Light.” The CPT will sound off with “Down on my side” and verify that the gear handle is neutral, latch is locked, pressure up, and Green light indicated. The propeller controls will be left at 2100 RPM for Landing. While establishing final the FO will place the Mixture controls in the Auto Rich Ident position and sound off with “Before landing check complete.” The CPT manipulates the throttles while landing and calls for the appropriate flap settings. The FO will assist the CPT if needed and stands by with the Flaps. The FO actuates the flap handle by placing it in the down position and returning it to the neutral setting after the desired setting has been reached.

CREW COORDINATION

LANDINGS – A normal approach and landing flare is made. As the main wheels touch the ground, add forward pressure on the elevator. The aircraft at times has a tendency to bounce, if this occurs it is the pilots responsibility to time the flare and add just enough forward pressure for the mains to come back into contact with the ground. A technique in which I use is to milk the yoke, “add smooth pitch up and down on the elevator during the flare.” By using this technique the Main wheels come into contact with the runway smoothly without bouncing or excessive load on the gears and tires. In a crosswind situation the PIC/SIC can adjust the windward engine approximately 2”-5” manifold pressure to counteract the crab. Upon touchdown/contact with the runway. The PIC maintains directional control with the rudders (and ailerons if needed/crosswind) and the SIC immediately pulls the throttle controls to Idle, Flaps UP, and Propeller controls forward. The SIC call out “60 knots” and the PIC gently adds elevator UP pressure until the Tail Wheel comes into contact with the runway. The tail wheel should come into contact with the ground at the same time the control yoke reaches full aft travel. Apply brakes only if necessary. This is the preferred method unless runway length dictates otherwise. The PIC exits the runway and calls for After Landing Check. The SIC returns the flap handle to the neutral position, Cowl Flaps to Open and Off, and adjusts the Trim to the Neutral position, Transponder to Standby, and secures the yoke with the bungee. The SIC sounds off with “After Landing Check Complete.” The SIC requests clearance to taxi while the PIC controls the aircraft. Upon reaching the final destination. The PIC ensures that the aircraft is straight and locks the tail wheel. The SIC turns off the Avionics. The PIC brings the Throttle to Idle, and Mixture Controls to Idle Cut-Off. The SIC turns off all electrical equipment and continues with the After Landing Check. The PIC verifies that all electrical equipment is off and Magnetos are turned OFF. The SIC exits the aircraft and Immediately secures the door with the bungee. The SIC then chalks the Tail wheel, Rudder, and Install the Landing Gear Safety Pins. The PIC remains in the cockpit maintaining control of the aircraft until the PIC sounds off with “SPLIT.” The PIC then raises the Flap handle (Flaps UP position) and Lowers the Gear Handle (Gear Down position). The PIC can then exit the aircraft. The SIC secures the aircraft with all control locks and Chalks the main wheels.

SIMPLE POWER SETTING CHART

- **POWER SETTINGS**
- **Take off:**
- **45-48" @ 2700 RPM - Loaded - V2 84kts**
  35-41" @ 2550 RPM – Empty 105kts to 700' AGL

- **METO:**
- **40-41" @ 2550 RPM - approx. 200'/300' – 105kts to 700' AGL then 115kts**

Climb:
- **35" @ 2300 RPM - approx. 700' AGL - 115kts**

Cruise Climb:
- **32-33" @ 2300 RPM - 115 kts**

Cruise:
- **25-28" @ 2100 RPM - depending on weight, loaded vs. empty, somewhere around 120-130kts IAS**

Descent:
- **24-25" @ 2100 RPM 135-140** knots. Pull power back to **23"-21"** as needed around base and final. Do not pull the power back under square (RPM vs. MP) until landing in assured on short final.

Maintain around **1500'** on downwind, drop gear under **130kts.**
  - **¼ Flap @ or below 135 kts**
  - **½ Flap (*Two*) @ or below 99 kts**
  - **¾ Flap (*Three*) @ or below 97 kts**
  - ***Full Flap* @ or below 97 kts**
  - Touch down around **80 to 85 knots**.

DC-3 CHECKLIST

BEFORE STARTING CHECK	
PRE-FLIGHT	COMPLETED
BATTERY SWITCH	ON
HYDRAULIC FLUID	CHECKED
HYDRO PRESS (500 PSI MIN)	CHECKED
PARKING BRAKE	SET
COWL FLAPS	OPEN & OFF
GEAR & FLAP HANDLES	NEUTRAL
STAR VALVE	CLOSED
CONTROL LOCKS & GEAR PINS	REMOVED
FUEL & OIL CAPS	SECURED
FLIGHT KIT & TRIP PAPERS	ONBOARD
IGNITION SWS	MASTER ON, MAGS OFF
SEAT, RUDDERS	ADJUSTED
SHOULDER HARNESS	ADJUSTED
TRIM TABS 1, 2, 3	SET
ENGINE CO2 SYSTEM	SAFETIED
FUEL TANK SELC. 1 & QUAINT. L&R MAINS	ON
MIXTURE CONTROLS	IDLE CUT OFF
THROTLLES	CRACKED
PROPELLER CONTROLS	FORWARD
CARBURETOR HEAT	COLD AND LOCKED
EMERGENCY ESCAPE HATCH	LOCKED
SEAT BELTS & NO SMOKING SIGN	ON
PILOT HEATER	OFF
GENERATORS	ON
STATIC SOURCE	NORMAL
INSTRUMENT WARNING LIGHTS	CHECKED
FIRE WARNING SYTEM	CHECKED
CABIN & COCKPIT LIGHTS	ARMED
NAVIGATION LIGHTS	AS REQUIRED
DOORS LOCKED	LOCKED
CLEAR TO START	CLEAR
F/A REPORT	RECEIVED

DC-3 CHECKLIST

STARTING ENGINE

START RIGHT ENGINE FIRST	**CLEAR**
SELECTOR SWITCH	**RIGHT**
ENERGIZER SWITCH	**ENGAGED**
IGNITION	**ON**
MIXTURE	**AUTO LEAN**
BOOSTER PUMP	**ON, PRESS CK**

AFTER STARTING CHECK OIL PRESS & OIL PRESS AND OIL TEMP AND FUEL PRESS

BOOSTER PUMP	**OFF**
SAME WITH LEFT ENGINE	

AFTER STARTING CHECK

BATTERY	**SHIP**
TEMPS & PRESSURES	**NORMAL**
BOOSTER PUMPS	**OFF**
HYDRO PRESS (500 PSI MIN)	**CHECKED**
RADIOS & INVERTERS	**ON**
VACUUM	**CHECKED**
FLIGHT INSTRUMENTS	**SET & UNGAGED**
ROTATING BEACON	**ON**
ALTIMETERS & CLOCKS	**SET**

NOTE:

BEFORE STARTING CHECK SHOULD BE PERFORMED COMPLETELY ON FIRST FLIGHT.

DC-3 CHECKLIST

TAXI CHECK	
FLAPS	CYCLE FULL DOWN & UP
TURN & BANK INDICATOR	CHECKED
BRAKES	CHECKED
CONTROLS	FREE
RUN-UP	
TAIL WHEEL	LOCKED
PARKING BRAKE	SET
TEMPS & PRESS	MIN FOR RUN-UP
MIXTURE CONTROLS	AUTO RICH
FUEL TANK SELECTOR	LEFT & RIGHT MAIN
RPM	1700 RPM
PROPELLERS	EXERCISE
FEATHERING	CHECKED
GENERATORS	CHECKED
CARB HEAT	CHECKED
POWER & IGNITION	CHECKED

DC-3 CHECKLIST

BEFORE TAKE-OFF

PROPELLERS	FULL FORWARD
MIXTURE CONTROLS	AUTO RICH
FUEL TANK SELECT	L & R MAIN
FLIGHT INSTRUMENTS	SET & UNGAGED
RADIOS	TUNED & IDENT
TRIM TABS	SET T/O
FLAPS	UP INDICATION
CARB HEAT	COLD & LOCKED
BOOSTER PUMP	BOTH ON***
PILOT HEAT	AS REQUIRED
COWL FLAPS	TRAILED***
CAPT BRIEFING	STATED
SMOKE DET.	AS REQUIRED
TAIL WHEEL	LOCKED***

FINAL ITEMS

TAKE-OFF

FULL POWER	45	2700 RPM
METO POWER	40-42	2550 AT 300’
CLIMB POWER	35	2300

CLIMB CHECK

PRESS & TEMPS	CHECKED
GEAR & FLAP HANDLES	NEUTRAL
BOOSTER PUMPS	OFF
NO SMOKING SIGN	OFF
VISUAL ENGINES CHECK	CLEAN

*** *FINAL ITEMS ON THE RUNWAY OR WHILE POSITIONING* ***

DC-3 CHECKLIST

CRUISE CHECK LIST	
POWER	25-28, 2100 RPM
TEMP & PRESS	IN THE GREEN
MIXTURE CONTROLS	AUTO LEAN
COWL FLAPS	CLOSED & OFF
IN-RANGE CHEK LIST	
ALTIMETER SET CROSS	CHECKED
FUEL TANK SELC.	L & R MAIN
CARBURETOR HEAT	AS REQUIRED
BEFORE LANDING CHECK	
LANDING GEAR	DOWN
PRESS, LIGHT & LATCH	CHECKED
BRAKES	CHECKED & OFF
MIXTURE CONTROLS	AUTO RICH
COWL FLAPS	CLOSED
TAIL WHEEL	LOCKED
BOOSTER PUMP	ON
FLAPS	AS REQUIRED
PROPELLERS	2100 RPM

DC-3 CHECKLIST

AFTER LANDING CHECK	
PROPELLERS	FULL FORWARD
FLAPS	UP & NEUTRAL
COWL FLAPS	OPEN & OFF
TRIM TABS	NEUTRAL
PITOT HEAT	OFF
PARKING & SECURING	
TAIL WHEEL	LOCKED
PARKING BRAKE	SET
MIXTURE CONTROL	IDLE CUT OFF
IGNITION SWITCH	OFF
RADIOS & BATTERY	OFF
ROTATING BEACON & LIGHT	OFF
GEAR AND FLAPS	SPLIT
LANDING GEAR PINS	IN PLACE
CONTROL LOCKS	IN PLACE
EMERGENCY LIGHT	OFF
DOORS	LOCKED

AMENDMENTS

Landings - I believe it's best to use over correction of Elevator Trim on short final and use application of downward force on the yoke. When you flare the aircraft, you will already have sufficient trim to make a nice, smooth touchdown, and concentrate on the landing instead of trimming the aircraft.

With a well coordinated descent, proper airspeed and distance from the airport, the gear can be lowered at Mid field. Proper planning is essential, slowly decrease manifold pressure during your descent. Power should be set around 23-22"MP when established on long final/downwind leg.