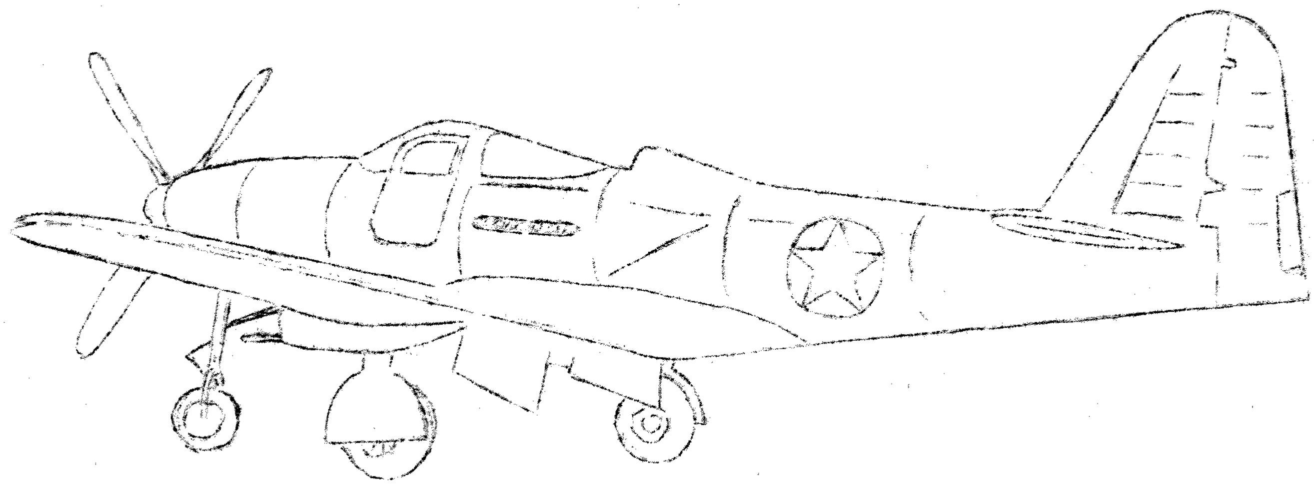
P-63



Pre-Flight Curriculum for P-63

I. GENERAL DESCRIPTION

The P-63 fighter airplane is a single place, low-wing, all metal land monoplane, powered with an Allison V-1710-93 liquid cooled engine mounted within the fuselage aft of the pilot.

The engine is connected to the 2.23:1 reduction gear box in the nose of the airplane by an extension drive shaft. Take-off rating of this engine is 1325 Horse Power at 3000 RPM and 54" Hg. manifold pressure at sea level. The propeller is a four bladed Aeroproducts hydraulic propeller of the selective, automatic, constant speed, governor controlled type. Wing flaps and the tricycle landing gear are electrically controlled and operated.

II. DIMENSIONS

Span	38'4"
Length	32'10 3/8"
Height	11'4"
Gross Weight	8410 pounds
Tread	14'3"
Fuel Capacities	Main Tanks-136 U.S. gallons Aux. Tanks- 64 gal. Belly and 75 gal. wing
Coolant Capacity	13.5
Oil Capacity	With 136 gal. fuel 9.6 gal. With 211 gal. fuel 13.7 gal.
Oil Capacity Nose Gear Box	2 U.S. gallons

III. LANDING GEAR

The airplane is equipped with a fully retractable landing gear of the tricycle type composed of two main wheels and one nose-wheel. The nose-wheel draws up and aft into the forward fuselage. The retracting mechanism is operated by an electric motor through a system of torque tubes, worm and sector gears, screws, universal joints, gear boxes, and splined connections. The operation of the landing gear motor is governed by a toggle type switch on the instrument panel. In the event of power failure or for purposes of repair or adjustment, extension or retraction of the landing gear may be accomplished by use of an emergency manual ratchet handcrank to the right of the pilot's seat. The main landing gear installation consists of wheels, tires, brakes, air-oil struts, retracting mechanism, and electric motor, a control switch, limit switches, two red warning signals on the instrument panel, wheel fairings, and provision for electric or manual extension and retraction of the landing gear. Maximum gear down speed is 180 IAS. NOTE: When operating landing gear electrically burning smell is normal in cockpit, as motor is under pilot's seat.

NORMAL LANDING GEAR DOWN PROCEDURE

1. Slow ship to 170 IAS desired.
2. Gear switch to down.
3. Return gear switch to neutral.

LANDING GEAR DOWN CHECKS

1. Red warning lights burn while gear is in transit. Then out when gear is down.
2. High amperage reading while gear is in transit. Then back to normal when gear is down.
3. Landing gear switch to neutral. Rachet on gear handle to down position and crank down.

FLAPS - The P-63 has full contour wing flaps of the sealed balance type, extend from the inboard ends of the ailerons to the wing splice at the center section.

The toggle switch for raising or lowering wing flaps is located on the forward end of the trim tab control box at the pilot's left. The switch is marked UP and DOWN and there is a neutral OFF position in the middle.

Flap position is indicated by a red and white marking on the forward outboard edge of the left hand flap.

(1) Flap up: no color shows
(2) Flap in Intermediate position: white
(3) Flaps Full Down: red
(4) Maximum flap down speed is 150 IAS.

NORMAL FLAPS DOWN PROCEDURE

1. Desired IAS 140.
2. Flap switch down.
3. Flap switch returned to off.

IV. PROPELLER

P-63's are equipped with the four (4) bladed Aeroproducts Propeller which functions and is controlled in a manner similar to the standard hydromatic constant speed propeller.

The P-63 has the propeller control linked to your throttle control. With this system any time you make a change in throttle setting you automatically change your propeller setting.

It is no longer possible to make a magneto check by noting the drop-off on the ground. Magneto checks on the ground must be performed the same as the pilot performs magneto checks in the air - that is, by switching from both mags to right and left mag and noting the smoothness of the engine operation and apparent loss in the "feel" or power. If bad plugs are suspected from a check of this sort, it may be well to disconnect the propeller push-rod at the quadrant, push the propeller linkage to the full RPM position, and make a "drop-off" mag check at 30" as has been done before.

"Purging" of the propeller (if it does not seem to govern properly) may be accomplished by changing manifold pressure from 20 inches to 37 inches several times in succession.

Pilots who fly airplanes equipped with the synchronized engine control will note that the desired schedule gives them a lower RPM for equivalent manifold pressure than they have formerly used in the cruising range. This change is to obtain a more economical use of fuel and consequently greater range at cruising power.

MANIFOLD PRESSURE	DESIRED RPM	LIMITED RPM
20	1725	1725
25	1750	1750-1800
30	2000	2000-2050
35	2350	2350-2400
40	2700	2700-2750
45	3000	2950-3040
50	3000	3000-3040

THE PRIMARY PRECAUTION TO BE OBSERVED IS THAT THE RPM IS NOT ALLOWED TO DROP BELOW THE MINIMUM LIMIT FOR ANY OF THE MANIFOLD PRESSURE SHOWN. THIS IS NECESSARY TO AVOID POSSIBLE DETONATION IN HOT WEATHER WITH LOW GRADE FUELS.

I. PRE-FLIGHT CHECK SHEET FOR P-63
LOOK YOURSELF. DON'T TAKE ANYONE'S WORD FOR IT!

1. Look the ship over for low shock struts and tires, also tire slippage.
2. Check for signs of oil or hydraulic leaks.
3. Take hold of auxiliary gas tanks and see if they are secure. Take caps off and check fuel. Check that pressure tubes on Auxiliary Tanks are open.
4. Verify that switch is off then check propeller for nicks or cracks.
5. Check ship for loose inspection plates.
6. Check main wing tanks visually for amount of fuel.
7. See that airspeed tube cover is off under left wing. (not visible from cockpit)
8. Inspect flight control surfaces (flaps, ailerons, rudder and elevators for holds or damage and for free movement.
9. Climb in right side of ship (hand hold is on that side.)
10. Check form 1A.

11. Put chute on, fasten safety belt and shoulder straps.
12. Check that switch OFF and have propeller pulled through 2 or 3 times.
13. Check gear switch (should be OFF) before turning battery ON.

II. START YOUR LEFT TO RIGHT COCKPIT CHECK.

1. Rudder trim - 4 degrees right.
2. Elevator trim - 2 degrees up.
3. Flaps UP.
4. Mixture Idle-Cut-Off.
5. Open throttle to unlock controls then crack 1".
6. Fuel Selector on "Left and Right Main".
7. Battery ON.
8. Gun Switches OFF.
9. Gun Sights OFF.
10. Filter OFF, Cold Rammed Air (Switch on panel).
11. Pitot heat OFF.
12. Oil Shutters OPEN.
13. Coolant Shutters OPEN.
14. Fuel Pumps NORMAL (Emergency for high altitude only).
15. Carburetor heat COLD.

III. STARTING ENGINE (Refer to Sec. II Page 1).

IV. BEFORE TAKE-OFF

1. Mixture AUTO RICH, Carburetor heat FULL COLD carburetor Filter Off (Except where indicated by dusty conditions).
2. Coolant and oil shutters AUTOMATIC.
3. Warm up at engine speed that is free of vibration (under 1400 RPM).
4. Check magnetos at ~~30"~~. 26-28"
5. Check operation of propeller at 30" with less than 2200 RPM.
6. Check generator.
7. Check flap operation (NO flaps for Take-Off).
8. Check all instruments for proper functioning, especially coolant temperatures. Watch for Overheating.
9. Close and latch cabin doors and windows.
10. Open throttle occasionally while taxiing to 1500 RPM to keep plugs from fouling.

V. USE OF POWER WHEN USING 100 OCTANE FUEL

	Manifold Pressure	RPM	Mixture Control
Take-Off	54" Max.	Synchronized	AUTO RICH
Climb	40" Max.	Control	AUTO RICH
Cruise	31.5" Max.	On Throttle	AUTO RICH

NOTE: AUTO LEAN IS USED FOR CRUISE IF MAXIMUM RANGE IS NEEDED.

VI. LANDING PREPARATIONS

1. Gas selector on RIGHT and LEFT.
2. Fuel booster pump on NORMAL.
3. Mixture Control AUTO RICH.
4. Oil and coolant shutters AUTOMATIC.
5. Flaps down below 150 IAS (or as ship is placarded)
6. Gear down below 180 IAS (or as ship is placarded).
7. Return gear and flap switches to OFF.

VII. EMERGENCY PROCEDURES

A. EMERGENCY GEAR DOWN PROCEDURE

1. Slow down to 130 IAS (minimum).
2. Landing gear switch in neutral position.
3. Ratchet to the down position and crank down.

B. FLAPS

There is no emergency flap operation available to the pilot.

NOTE: (flaps on P-63 make very little change in landing characteristics.)

C. ENGINE FAILURE ON TAKE-OFF

1. Get nose down STRAIGHT AHEAD.
2. Drop belly tank and wing tanks.
3. Mixture in IDLE CUT-OFF.
4. Gear UP.
5. Ignition OFF.
6. FULL FLAPS.
7. Gas OFF, battery OFF, generator OFF.
8. Right door "EMERGENCY" released.

D. FUMES AND FIREFLIGHT

1. In case fumes begin entering the cabin, the cabin heater should immediately be switched to cold air. This is to prevent coolant fumes from entering the cabin through the hot air duct in case of a burst radiator or coolant line. Do not open door or windows unless immediate exit is contemplated.

   In case of fire, turn off fuel selector valve and ignition switch. Place mixture in IDLE CUT-OFF position close throttle. Attempt to extinguish flames by diving the airplane. If the fire is put out a dead stick landing may be made at the pilot's discretion. Turning on the fuel would probably restart the fire. Do not land if the plane is burning. Jumping or landing is up to the individual pilot.

E. RELEASE OF AUXILIARY TANKS.

1. Hold ship level when dropping tanks if possible.

2. Have IAS below 210 when releasing wing tanks.

F. RELEASE OF BELLY TANK

1. <u>Drop belly tank before a forced landing</u>. When it is necessary to drop the belly tank in flight pull the release handle located on the floor under the pilot's left knee.

G. RELEASE OF WING TANKS:

1. Put wing tank switch in "TRAIN". (top switch on left inst. panel)
2. Press button on top stick ONCE to RELEASE left tank.
3. Press button SECOND time to RELEASE right tank.

EMERGENCY RELEASE OF WING TANKS:

1. Put "SALVO" switch in UP position (second switch on left inst.panel)
   Putting switch UP, releases both wing tanks simultaneously.

H. EMERGENCY EXIT

Pilot should have as much altitude as possible and reduce airspeed below cruising speed. Then proceed as follows:

1. Trim nose heavy and switch OFF.
2. Put aircraft in shallow right turn.
3. Free shoulder harness and belt.
4. Release right top door pin.
5. Pull right door emergency release.
6. Push right door out.
7. Go out right side head low.

VIII. FUEL SYSTEM

1. The P-63 fuel system is an improvement over the P-39, one advantage being that instead of six fuel cells in each wing panel inter-connected by tubes, there is one large self sealing cell of 68 gallon capacity in each wing.

2. The P-63A fuel system has two booster pumps, one in each tank to cut down possibility of vapor locks. These pumps have a high and low speed, controlled by a toggle switch on the instrument panel. Desired is 8-13 pounds in NORMAL and 18-25 pounds in EMERGENCY.

3. The booster pumps should never be operated in the EMERGENCY position without sufficient fuel in the tankto cover the bottom of the pumps; otherwise the metal portion of the pumps inner seal will overheat, and cause failure of the flexible seal.

All take-offs and landings and normal flights will be with the fuel booster pumps switch in NORMAL.

4. There are two fuel lever warning lights, one for each fuel cell, located on the lower center instrument panel. These operate when the fuel level in the tank drops to 12 gals. or less.

5. There are three check valves in the fuel system. One is located in each main wheel well, just aft of the main wheel landing gear spindle, and one under the left center section fillet for the auxiliary tank.

6. The venting system consists of two lines which are pressure scarfed, at 15°. Incorporated in the vent system is a check valve, which is attached to the top outboard end of the fuel cells. This valve is so designed that if fuel were to start syphoning, air pressure should automatically eliminate the condition.

7. Fuel is pumped by the booster pumps from the wing fuel cells, valve, to the fuel strainer. The engine driven pumps and the carburetor. A minimum fuel pressure of 8 pounds should be obtained on the fuel pressure gauge when the booster fuel pump switch is in the NORMAL position on the ground at 28 volts. When the booster pump switch is in the EMERGENCY position, a minimum of 18 pounds should be indicated on the fuel pressure gauge. The readings, of course, are checked with the engine inoperative, to eliminate the engine driven fuel pump from consideration.

8. When operating on auxiliary tanks pressure is supplied by the engine driven pump only. The electric booster pumps do not operate on the Auxiliary tanks. ~~The auxiliary~~ tanks are pressurized by a ~~small tube projecting into the wind at the top of the tank.~~

9. The seven positions on selector valve are: "OFF", "CENTER AUXILIARY", "LEFT AUXILIARY", "LEFT MAIN", "LEFT AND RIGHT MAIN", "RIGHT MAIN", and "RIGHT AUXILIARY". Pilots when operating under ferrying conditions of normal operations, should be instructed to fly on one tank approximately 15 minutes, and then switch to the opposite tank for 15 minutes. The purpose of this is to keep fuel as evenly distributed as possible. The "LEFT AND RIGHT MAIN" position setting on the selector valve was designed for TAKE-OFF, LANDINGS AND COMBAT FLYING.

On your ground run up it is recommended to draw fuel from each tank separately as a check for air in fuel lines.

Some field reports have been based on the assumption that when the selector valve is in the "LEFT AND RIGHT MAIN" position, fuel is being drawn out of both fuel cells evenly. This is erroneous, for the reason that fuel pump output varies, since the fuel lines from one fuel cell have a greater distance to travel, resulting in a difference in friction loss. This condition makes it impossible to draw an equal amount of fuel from both cells, if the booster pump in the right fuel cell

HP - 1325 or 54"

was developing a pressure of 17 pound and the fuel pump in the left cell 15 pounds then the right cell would be pumped out before the fuel in the left cell could be used.

EXPLANATION: With the fuel in the right fuel cell at 17 pounds fuel pressure comes in contact with the selector valve at 17 pounds. This pressure reverses itself and goes through the left fuel line until it reaches the left check valve, which automatically closes, due to lower fuel pressure output. Fuel is unable to leave the left fuel cell because the booster pump in this cell is delivering only 15 pounds pressure against the check valve.

As soon as fuel is exhausted within the right fuel cell, pressure in this line drops and the fuel in the left wing tank is then in use. see note below

IX. CARBURETOR AIR FILTER AND HEATER

Hot or cold, filtered or unfiltered air can be provided for the carburetor. Air temperature is regulated by a push-pull control on the bulk-head at the right of the pilot's seat. Pull the control handle out for hot air: push the control handle in for cool air. The filter is controlled by a toggle switch in the right center section of the left hand instrument panel. The switch is marked RAMMED AND FILTERED. THE FILTER MUST BE ON BEFORE CARBURETOR HEAT IS AVAILABLE.

old.

CAUTION: Carburetor Ice. The automatic manifold regulator will allow no indication of carburetor ice. If ice forms in the intake system it will tend to reduce the manifold pressure, and the manifold pressure regulator will open the throttle wider to maintain manifold pressure. The pilot has little, if any warning, of the condition. Carburetor icing usually occurs with the carburetor air temperature below 10°C in high humidity air. It is evidenced by roughness or loss of manifold pressure. Apply carburetor heat as required to clear and prevent icing of the carburetor.

do not operate on both position whenever one main tank is empty. In both position both internal fuel pumps are in operation. The pump in the empty tank would soon burn out.

X. SUPERCHARGER

The Supercharger has two stages. First stage is engine driven and the second stage, hydraulically driven; variable speed and automatically controlled.

The auxiliary supercharger is mounted aft of the engine accessory housing and below the ram air scoop to the carburetor. Engine and auxiliary supercharger are connected by means of a drive shaft incorporating a fluid coupling. The carburetor attaches directly to the inlet elbow flange of the auxiliary supercharger and an air duct (cross-over tube) conducts the output of this supercharger to the inlet of the engine supercharger. The engine driven supercharger thus becomes the second stage in the two-stage supercharging of this engine.

The fuel passes through the carburetor where it is metered then through a transfer tube to the injector nozzle which sprays the fuel into the engine supercharger. The mixture of air and fuel is picked up by the engine-stage supercharger guide vanes and drawn against the impeller into the intake manifold.

The auxiliary supercharger has an impeller of larger diameter than the engine supercharger. The auxiliary supercharger drive includes a shaft with Spicer universal joints driven from the engine starter pad, with a hydraulic coupling between this drive shaft and the impeller. The auxiliary supercharger unit contains its own oil system for both supply and scavenging, using engine oil from the engine scavenger system. A pressure relief valve and Cuno oil strainer are further provided.

At sea level the hydraulic drive of the auxiliary supercharger is allowed a 55% slippage which gradually decreases until at approximately 22,000 feet the auxiliary supercharger reaches its maximum output. This unit is a true fluid drive.

This slippage is controlled by increasing or decreasing the oil level in the fluid coupling. This control unit is of the same type as the manifold pressure regulator. It differs from the latter only in that atmospheric pressure instead of scroll pressure is introduced into the bellows and is also controlled by the throttle.

The operation of the piston actuates a control-tube and the position of the control tube determines the oil level that will be maintained in the fluid coupling.

The engine accessory ratios on the P-63 are the same as on the P-39 with the exception of the engine-stage supercharger which is 8.1 to crank-shaft speed on the P-63. The ratio of the auxiliary stage supercharger as installed on the P-63 is 6.85 to crankshaft speed.

Pressurizing of Magneto and Wiring Harness - The purpose of pressurizing the magneto and wiring harness is to eliminate the possibility of ignition flash-over at high altitude. A flexible line leading from the auxiliary supercharger to the magneto, supplies this pressure to the latter at high altitude. From the magneto, this pressure is carried by means of two flexible lines to the distributors and wiring harness. At low altitudes, when the supercharger is not supplying as much pressure as the scoop, these units automatically receive their pressure from a line leading from the carburetor intake scoop.

XI. OIL SYSTEM AND OIL DILUTION

The oil cooler in the P-63 is a single unit, located immediately below the engine in the center section between the longitudinal beams.

The oil supply tank (hopper tank) has the same location as in the P-39 but its capacity is 13.7 gallons. A swivel outlet line in the base of the tank assures continuous oil flow except during inverted flight. A small draincock is installed at the base of the tank.

A one-inch tube welded to the supply line just aft of the oil "Y" drain supplies oil to the auxiliary-stage supercharger through an elbow at the bottom of that unit.

After circulating through the engine the oil is discharged through an outlet elbow on the bottom face of the engine oil pump adapter. Here it joins with oil which has been scavenged from the auxiliary-stage supercharger and flows to the oil cooler.

Mounted on top of the oil cooler, at the oil inlet, there is a thermostatic control valve of the rotating type, which, like the viscosity valve in the P-39, eliminates the possibility of heavy cold oil building up a pressure in the cooler and causing damage.

The operating temperature of the oil in the cooler is maintained by means of air ducts, leading one each from the leading edge of the center section on each side into the front of the oil cooler. This air is controlled by means of a shutter door at the rear of the cooler radiator.

In place of manual control as in the P-39, this shutter is electrically operated by a shutter actuator motor assembly installed outboard in the center section, right side. This motor is controlled by a thermo switch. The thermo bulb for the unit is tapped into the oil return line between the engine and the cooler. The electric actuator may also be controlled by a switch on the instrument panel. This switch has four positions: Auto, Open, Closed, Off.

An inlet oil temperature gauge is mounted on the instrument panel. The thermo bulb for this unit is in the base of the oil hopper tank.

The oil tank is vented into the engine on the right. A vent tube also ties into this vent line at a T fitting to vent the auxiliary stage supercharger. A second vent line from the oil tank extends down the left inclined deck and vents into engine on the left.

<u>OIL SYSTEM</u>

Two engine oil breather lines are provided: One from the front of the engine, and one from the rear: Both extending out at the rear of the left upper engine cowl into the slip stream.

ENGINE OIL CAPACITY WITHOUT AUXILIARY TANK	9.6 gallons
ENGINE OIL CAPACITY WITH AUXILIARY TANK	13.7 gallons
ENGINE OIL TEMPERATURE RANGE	60° - ~~80°~~ 95 ~~85°~~ 110 C Maximum
ENGINE OIL PRESSURE RANGE	55-85 pounds
REDUCTION GEAR OIL PRESSURE	70-190 pounds 50

XII. OIL DILUTION

The oil dilution system consists of a solenoid operated oil dilution valve controlled by a momentary type toggle switch on the forward right hand side of the auxiliary switch box to the pilot's left in the cabin. Dilution of oil is obtained by the controlled addition of the engine fuel to the oil tank outlet line. A warm-up compartment is installed in the main engine oil tank for the dilution system. Oil dilution thins the oil and allows the engine to turn over quite freely even after standing in sub-zero temperatures. It provides proper lubrication immediately after starting, and does away with the usual long warm-up period.

Normal oil dilution should be done with the engine at 1000 to 1200 RPM, dilution is done for 2 minutes only with the oil temperature at 40° to 50°C to prevent evaporation of the gas and unnecessary fire hazards. For ground temperatures below 10F hold dilution switch ON 2 minutes, stop engine, release oil dilution switch, and 2 quarts of gas will have flown into the oil system at the rate of 1 quart per minute. For temperatures of -0°F or less dilute for a second 1 minute period - 15 minutes after first dilution.

XIII. OPERATION

Opening of the oil dilution valve injects a quantity of engine fuel into the oil lines, thus diluting the oil. Diluted oil is gradually circulated to the engine oil tank where it is deposited in a hopper compartment (compartment contains approximately 1.5 gallons) inside the oil tank. Oil circulating from the engine is kept from the main supply which is outside the hopper. As oil in the hopper is used up, oil from the main supply flows in at the bottom of the hopper and keeps the main supply of oil and hopper oil at a constant level. The upper end of the hopper is open and connected with the expansion space in the main tank. Continuous heat in the engine crankcase eventually vaporizes fuel in the oil and exhausts the vapor through the engine breather line. Distillation is complete in 30 minutes of engine operation-most of the dilution is eliminated within 10 minutes.

XIV. COOLING SYSTEM

The P-63 coolant system utilizes two radiators in place of one as in the P-39. These radiators are located in the center section, below the engine and outboard of the longitudinal beams.

Cooling is accomplished by air currents passing through air ducts directly to the radiators. These air ducts are located on the leading edge of the wing butt (center section) leading directly to the forward end of the radiators. An additional duct (exhaust) is located aft of each radiator.

Temperature is controlled by shutters placed at the aft end of the exhaust ducts of the radiators; these shutters are electrically operated instead of manually as in the P-39.

The coolant shutter actuator motor assembly is installed outboard in the center section left, and operates by a thermo switch connected into the coolant tube underneath the engine. This unit is connected to control the right and left shutters automatically with the temperature changes. It is also connected to a switch on the instrument panel, which allows the pilot to control the shutters from the cabin. This switch has four positions: AUTO, OPEN, CLOSED, OFF.

The control assembly operates the shutters by a shaft, assembly connecting to the right and left shutters by rod assemblies. Fully open position is 44°.

The thermo-bulb for the coolant shutter actuator is located in the coolant outlet line which runs from the left bank of the engine to the left coolant radiator.

The temperature bulb for the coolant temperature gauge is of the same type and location as in the P-39, ~~but a coolant temperature warning light has been added in the P-63. This light, mounted on the main instrument panel, indicates high engine temperature.~~ A well is provided in the left cylinder bank coolant outlet line to accomodate the temperature bulb for this unit.

Coolant Capacity	13.5 gallons
Engine Capacity	6.7 gallons
Minimum operating temp.	85°C
Maximum operating temp.	125°C
Desired operating temp.	105-120°C

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The coolant expansion tank is located between the right and left banks of the engine, just aft of the turn-over beam. This tank has capacity of $1\frac{1}{2}$ gallons as compared with three gallons in the P-39 tank. It is held in place by two straps which are riveted to the tank support brackets. The support for the tank is mounted between the banks of the cylinders and attached to the engine hold-down bolts by four U-bolts.

There are two lines running from this tank. One located at the aft section of the tank which carries the overflow aft along the top of the left bank to the rear of the engine and down to the coolant pump. The purpose of this line is to expell from the tank any coolant which might collect due to expansion. The outer line originates at the top center of the tank, running aft along the left engine cowl former and through the outside skin. This line is used as a vent line to expel the air pressure which is built up by expansion of the coolant and is controlled by a pressure relief valve, set to open at 23 pounds, pressure absolute, at the forward section of each bank of the engine and is then routed to the filler neck tube.

The coolant system is filled at the left side of the airplane through a flush type filler cap mounted on the outside of the turnover beam.

The coolant enters a line which passes through the turnover beam and connects to the left bank coolant outlet line. It should be noted that at no time during filling operations does the coolant enter the expansion tank.

XV. BRAKES

Each main wheel has a complete and separate multiple disc hydraulic brake system and a parking brake device which can be used to lock both main wheels against motion. The brakes can be used individually for ground steering.

The hydraulic brakes used are interchangeable so that the brake can be used on either the right or the left main wheel. The brakes are composed of ten stationary steel discs and nine rotating bronze faced discs assembly. The steel discs are held in place by steel inserts in the brake housing, while the grooves on the rotating bronze discs slip into tongues in the brake drum and move with the wheel. When the brake is applied, these discs are pressed together against the brake adjusting flange by hydraulic pressure transmitter through the lines from the master brake cylinder to the brake housing, entering behind a neoprene ring seal behind the brake discs.

Parking Brake

The parking brake works in conjunction with both of the regular service brakes. It is applied by depressing the service brakes and then pulling out the parking brake handle. To release the parking brake, depress the service brakes, thereby releasing the tension and permitting the return of the parking brake to the "OFF" position.

THE ELECTRICAL SYSTEM OF THE P-63.

The most important electrical circuit on the P-63 is the battery and generator system.

The 24-volt storage battery in the P-63 is used as an electrical power supply in conjunction with a 28-volt generating system. The battery consists of 12 wet cells, connected in series, for generating electricity by the reversal of a chemical reaction previously produced in it by an electric current. The cells are enclosed in a hard rubber inner case which, in turn, is housed in a rubber lined aluminum box. ~~The battery is mounted forward of the fume tight bulk head in front of the left rudder pedal well. Access is gained by the removal of the left side gun cowling.~~ plug in, left trail edge

The efficiency of the current voltage in relation to the generator current required to produce it is dependent upon the internal resistance of the battery. The internal resistance increases as the battery becomes more discharged and decreases as the battery becomes more charged. A fully charged battery presents little resistance to a circuit, and a very low rate of current from the generator will maintain it fully charged. A battery in a low or discharged condition would require a heavy current from the generator to maintain its condition and a much heavier charge to improve its condition towards a full charge.

It is futile and foolish to fly an airplane with a low battery and expect to have the battery become recharged in flight. Do not attempt to recharge a battery through the use of another, and at all times when an outside source of power is used the main battery switch in the airplane must be turned OFF or the battery be removed from the airplane. When an outside source powered by a generator is used, the battery in the airplane may be allowed to remain connected to the line and subjected to a charging current.

A rubber line aluminum cover plate, held fast by the battery installation bolts, completely seals the battery case except for vent connections. Acid is prevented from spilling inside the case by nonspill caps on each cell of the battery. These caps are installed so that in turning the battery upside down, as in inverted flying, enclosed conically shaped lead weights will drop and cover the cap vent hole, thereby retaining the acid within the battery cell.

The P-63 uses a 28 volt, 100 ampere hour generator. The generator output is connected to a buss bar in the generator control box, which is at the extreme rear end of the airplane's electrical load line. Thus, the generator is at one end, the battery is at the other end, and the electrically operated apparatus is connected to the load line between the two. Should a piece of electrical equipment be turned on, it will operate from one of five buss bars in the load line which are energized jointly by the battery and the generator.

The electrical load line of the P-63 may be compared to a water- pipe line having a mechanically driven pump on end and a chemically operated device at the other end, the faucets in the water-line corresponding to the buss bars in the electrical load line. If enough faucets are opened to draw a greater capacity than the combined capacity of the two pumps, both pumps will become overworked and be ruined from overload in trying to maintain pressure in the line. Similarly this happens electrically in the airplane when the battery and generator become overloaded.

Either the battery or the generator can become overloaded easily. The combined safe power output from both is needed for the use of heavy current drawing apparatus. Should one be weakened or out of service the other is forced to attempt to carry the load.

A generator large enough to supply all accessories simultaneously is not desired, because the four heaviest current carrying circuits on the P-63 (namely, the starter, landing gear, wing flap and landing light circuits) operate only a few minutes over a possible interval of several hours, each of these circuits being several times as heavy as any other circuit on the airplane.

Unless the pilot uses extraordinary skill in the use of the electrical devices a burned out generator will result each time a flight is made with a low battery installed. The battery may be overloaded in almost the same way, if the generator is not used in flight, either because of burnout or failure to turn on the generator control switch.

LONG RANGE OPERATION

The following is extracted from a Bell Aircraft report dated October 17, 1944, entitled "Flight Characteristics of the P-63 Airplane with 75 gallon Auxiliary Wing Tanks Installed".

The take-off speed, tanks installed, should be increased by about 5 to 6 miles per hour; and the take-off distance necessary to clear a 50' obstacle will be increased by approximately 1000 feet. The take-off characteristics are normal.

In order for both tanks to be quickly released in case of an emergency landing during take-off, it is recommended that the "Salvo" switch on the L.H. instrument panel be tripped. This will release the tanks simultaneously.

The wing tank installations have no noticeable affect on the stability of the airplane either directionally, laterally, or longitudinally. The airplane will handle normally for all maneuvers necessary for normal ferry flight. At speeds above 250 m.p.h. a slight aileron buffeting may be noticeable.

In normal maneuvering, as in landing, a speed increment of about 6 m.p.h. above normal should be maintained, this increment should be increased to about 10 m.p.h. for turns.

The airplane will fly, take-off, and land with only one fully loaded wing tank installed. It will be quite wing heavy, but this is correctable by use of ailerons; a stick force of from 10 to 15 pounds being necessary.

The following data is based on flight at 10,000 feet. With the production synchronized throttle, 2000 R.P.M. should be maintained for the entire flight. This gives a manifold pressure of about 29 to 30 inches of hg. In still air, the indicated air speed will vary from about 207 m.p.h. with full fuel load to about 214 m.p.h. as fuel is exhausted. This gives an average true air speed of approximately 230 m.p.h.

With the same power setting, wing tanks dropped, an increase of approximately 25 m.p.h. indicated is obtainable.

Allowing 25 gallons of fuel for warm-up, take-off, climb and reserve, a range of approximately 1200 miles will be obtained when the wing tanks are retained for the entire flight. A slightly greater range is attainable if the tanks are dropped when their fuel supply is exhausted. A greater range is also obtainable by flying at higher altitudes.