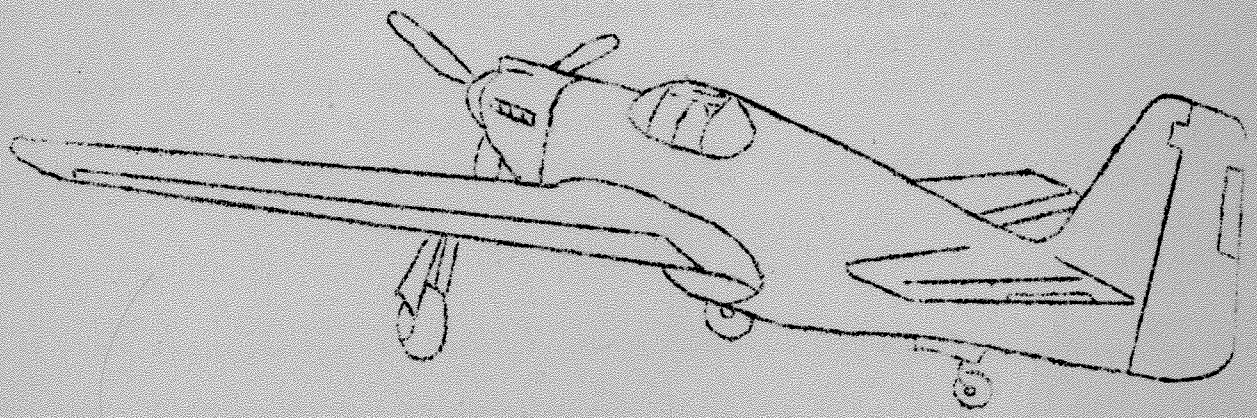
P-51



40" water max per sq. in.

P-51 CURRICULUM

GENERAL DESCRIPTION

The North American P-51D Fighter airplane is a single place, low wing monoplane powered by a 12 cylinder V-1650-7 liquid cooled, Packard built Rolls Royce engine. The engine is equipped with a two-speed, two stage supercharger and an automatic manifold pressure regulator. The P-51D has a four bladed Hamilton Standard Hydromatic propeller.

The Packard engine delivers approximately 1490 horsepower at sea level. It has a critical altitude of approximately 14,000 feet in low blower and a critical altitude of approximately 27,000 feet in high blower. The maximum altitude is approximately 40,000 feet. The supercharger ratios are 5.8 to 1 in low blower and 7.35 to 1 in high blower.

Specifications

Specifications for the P-51D are:

Wing Span - 37 feet
Overall length - 32 feet 3 inches.
Height (tail down) - 12 feet 2 inches
Tread - 11 feet 10 inches
Prop diameter - 11 feet 10 inches
Pitch setting - 23° to 65°
Wing area - 233.19 square feet

Wings

The wing is a full cantilever, two spar, laminar flow wing. It is filler finished and hand polished. The efficiency of the wing is adversely affected by nicks, dents, and scratches on the surface.

Tests have been conducted at the factory and it has been found, that with a strip of wire, 1/16" in diamter, taped along the leading edge of the wing, the airplane would not leave the ground. Frost will affect the wing in the same manner; therefore, never attempt a take-off with frost on the wing.

The airplane is redlined at 505 IAS, with a maximum diving RPM of 3240. Extreme caution should be used not to attempt steep dives at low altitudes as the airplane accelerates very rapidly.

The airplane is susceptible to high speed stalls, but not any more so than any other high speed plane. A buffeting of the tail section occurs about 5 to 10 MPH above the stall. All that is necessary to recover from a high speed stall is to release the back pressure on the stick, and then the recovery is almost instantaneous.

Recovery from a normal stall is the same. The buffeting, however, occurs at about 3 to 5 miles per hour above the stall. It is plain to see from the above that buzzing and dives from a low altitude are very definitely NON-HABIT FORMING. AVOID THEM.

Armament

The airplane is armed with six .50 caliber machine guns and may be equipped with wing racks to carry bombs, depth charges, chemical tanks, or fuel tanks. It carries 2080 rounds of ammunition.

It is protected from gunfire by a 1 1/2" thick armor glass windshield center section; the coolant header tank is armored, and so is the back of the pilot.

Fuel System

In the fuel system the fuel cells are self-sealing and so are the fuel lines. The auxiliary drop tanks are not self-sealing. The main tanks have a capacity of 92 gallons in each or a total of 184 gallons. In addition, the models from the B-5 and subsequent models, have a fuselage tank with a capacity of 85 gallons. On all models of the P-51, it is possible to install two droppable combat tanks with a capacity of 75 gallons each or two droppable ferry tanks with a capacity of 150 gallons each. The main fuel tanks and the fuselage tank is equipped with a submerged type electrical fuel booster pump. The droppable tanks do not have a booster pump. However, a constant and controlled pressure of 5 lbs./sq. in. is maintained within the tanks (combat tanks only) by pressure obtained from the vacuum pump. This is, of course, in addition to the pressure obtained from the main engine fuel pump.

Oil System Capacity

The P-51D series has an oil capacity of 2[illegible] gallons.

Scavenge oil flows from the engine to an oil cooler located in the large scoop beneath the fuselage. A thermostatically controlled air duct exit flap regulates the flow of air through the oil cooler. After the oil has been cooled, it then returns to the hopper type oil tank, located on the forward face of the firewall, and thence to the engine for another circuit of the system. Grade 1100 oil is used in the P-51D.

Cooling System

The cooling systems on the P-51D are composed of two separate and distinct systems. One system with a capacity of 16.5 gallons is used to cool the engine and the other, known as the after coolant system, with a capacity of 5 gallons, is used to cool the supercharged fuel-air mixture after it leaves the supercharger. These two systems are not interconnected in any way. They each have a separate pump, tank, radiator, and lines. The two coolant radiators are mounted side by side in the large scoop beneath the fuselage. An air duct exit shutter, thermostatically controlled by the temperature of the main cooling system, regulates the flow of air through the radiators.

Hydraulic system

The hydraulic system on the P-51D operates the landing gear and wing flaps. The flaps are operated by moving the control lever to the desired flap setting. They are automatically held in that position until another setting is selected. THERE IS NO NEUTRAL POSITION FOR EITHER THE FLAP SELECTOR OR THE LANDING GEAR SELECTOR. No emergency hydraulic hand pump is provided. The hydraulic system capacity is 3.75 gallons, or 15 quarts. Use only AN-O-366 grade hydraulic fluid for the system.

Weights

Weight of the P-51D

Empty weight - 7000 pounds (including radio)
Basic weight - 7500 pounds (including radio, emergency equipment and gun installations)
Gross weight - 11,000 pounds (including fuel, oil, pilot, radio, emergency equipment and gun installations)

R E S T R I C T E D

Pre-Flight Check List

A. Before Starting Engine

1. Examine the airplane Flight Report, Form No. 1A.
2. Check the quantities of fuel and oil in the tanks and enter on Form No. 1A.
3. Self-sealing fuel tanks: Visually inspect the structure surrounding the cells and all fitting attached to the cells which are visible through quick opening access doors for leaks.
4. See that cooling system is filled to the proper level and solution is of adequate protective strength. All filler caps must be in place.
5. Inspect landing gears and fairings for damage and obvious defects.
6. Check for proper shock strut extension and tire inflation.
7. See that wheel chocks are in proper position.
8. Make sure ignition switches are OFF and then inspect propeller blades for nicks, scratches, looseness, etc.
9. Remove the airspeed tube protection cover and check tube openings for freedom from obstructions. Test heating unit with aid of an outside observer.
10. Inspect wings, ailerons, fuselage, stabilizers, elevators and rudder against damage or obvious defects.
11. Check cowling and all inspection doors and covers for security.
12. Check oxygen equipment for condition, completeness, sufficient pressure and proper functioning.
13. Windshield and cockpit canopy must be clean. Sliding canopy must function properly.
14. Verify canopy emergency release is properly safetied.
15. Set clock to operations office time.
16. Set altimeter to station altitude.
17. Set Rate of Climb Indicator to zero, tap instrument to insure that hand is properly set.
18. Check ALL INSTRUMENTS for proper operation and pointer position. Inspect all instruments against loose or broken cover glasses. Clean with soft cloth.
19. Rotate the fuel cock control handle one complete revolution and note whether binding occurs at any point.
20. NOTE: Always set fuel cocks by "Click and Feel".
21. Check the lighting of all instrument, landing, passing, and running lamps. Replace any defective lamps found. Check all circuit breakers.

22. Check controls for freedom of movement. Check all loose equipment in the fuselage which could interfere with the controls.
23. Check operation of brake and parking brake controls (must be sufficient slack in parking brake control cables to allow full application of brakes without locking parking brake.)
24. Make visual inspection of all installed radio equipment for general condition. Make operating check of all units. Inspect fixed antenna system for condition and see that wires are taut. Clean dirt and carbon from insulators.
25. Check for presence, completeness and serviceability of "Radio Data and Aids to Airways Flying", "Radio Facility Charts", and "Pilot's Check List."
26. Check for presence of hand starter crank.
27. Check fairing door emergency pull knob; SHOULD BE IN.

B. <u>During Engine Warm-Up</u>

1. Before starting the engine pull propeller through several revolutions by hand to clear the combustion chambers.
2. Warm-up test periods should be as brief as possible to prevent excessive wear on moving parts. Do not run engines at high speeds with control surfaces locked.
3. Check engine instruments for functioning and proper readings - consistent with the stage of engine warm-up.
4. Check propeller operation during engine warm-up for full range and free operation of controls.
5. Test functioning of engine on each fuel tank, obtaining the required fuel pressure on each tank. Check that gage registers amount of fuel in tanks.
6. Check engine primer for leakage in the OFF position.
7. DO NOT EXCEED 40" M. P. ON GROUND RUNUP UNLESS THE TAIL IS LASHED DOWN AND WHEEL CHOCKS ARE IN PLACE.

SYSTEMS

The systems of the P-51D model airplane are composed of the hydraulic, oil, coolant, electrical, and fuel.

A. Hydraulic

There are two separate hydraulic systems. One is the main power system for the operation of the landing gear and wing flaps. The other system is the foot pedal operated brake system. The only connection between the two systems is that they receive their supply of fluid from the same reservoir in which a 3 cubic inch capacity cup is so arranged that, in the event all the hydraulic fluid for the main power system might be lost, the brakes may still be operated. At any time the pilot notices a complete loss of hydraulic pressure, no acrobatics are to be performed. Doing so would cause complete loss of brake supply fluid.

In the main power system a pump is permanently geared to the engine and maintains a pressure of 800 - 1100 lbs/sq. in. As long as the engine is running, the engine unloader valve loads the hydraulic system when hydraulic pressure drops to 800 - 850 lbs. It unloads the system when hydraulic pressure reaches 1050 - 1100 lbs. In the event of hydraulic pump failure, no provision is made on the P-51D for emergency operation of the wing flaps, inasmuch as there is no hand pump.

Incorporated into the hydraulic system on all P-51 model airplanes is an emergency landing gear pull knob, or fairing door emergency knob. The purpose of this knob when pulled out, is to release or by-pass hydraulic pressure from the fairing door cylinders and lines directly back to the reservoir. After the knob has been pulled out and has served its purpose, pushing it back IN will once again restore normal operation of the hydraulic system.

Therefore, if emergency landing gear procedure has been followed, push the knob back, and attempt normal operation of the flaps. If flaps will not extend, there is NO emergency procedure available.

NORMAL LANDING GEAR PROCEDURE

1. Retard throttle until landing gear warning light comes ON. This should be approximately 17-22" M. P. This will check proper operation of landing gear warning light.

2. Slow ship to 170 IAS or below and place landing gear handle in the down position. When the landing gear handle is moved to the down position, the landing gear up locks are unlocked and this also releases the fairing door locks and allows hydraulic pressure to actuate the fairing door and landing gear cylinder.

3. When the gear is down and locked, retarding the throttle again to the previously noted position (17 - 22" M. P.) will give the pilot his only gear check. The landing gear warning light should be OUT. The landing gear warning light will not be "ON" while the gear is in transit UNLESS the throttle is retarded below 20" M. P.

NOTE: The landing gear warning light does not indicate the position of the tail wheel. If there is any doubt as to whether or not the tail wheel is down, dive the airplane a short distance and pull out with enough acceleration to down the tail wheel.

REMEMBER * THE ONLY CHECK AVAILABLE FOR THE MAIN GEAR IS THE WARNING LIGHT. USE IT!

EMERGENCY GEAR PROCEDURE

1. If normal extension fails, recheck landing gear warning light by retarding throttle until landing gear warning light comes on.
2. At an I. A. S. of 170, put gear handle in down position and yaw plane. Recheck landing gear warning light by retarding throttle below 20" M. P.
3. If the landing gear warning light is still "ON", indicating gear not down and locked pull fairing door emergency release knob and yaw the plane again to lock gear.
4. Then again retard throttle to check warning light.

NOTE: The warning light does NOT indicate the position of the tail wheel. If there is any doubt as to whether or not the tail wheel is down, dive the airplane a short distance and pull out with enough acceleration to down the tail wheel.

REMEMBER - THE ONLY CHECK AVAILABLE FOR THE MAIN GEAR IS THE WARNING LIGHT. USE IT!

B. Engine Oil Systems

The airplane is equipped with a self-thawing oil radiator mounted forward of the coolant radiator in the bottom of

the fuselage, aft of the cockpit. The flow of air through the radiator is electrically operated and thermostatically controlled, through an air exit duct shutter. An override control for the operation of the shutter is provided on the left side of the cockpit. The oil switch has four positions: "AUTOMATIC" (up), "OFF" (straight out), MANUAL "OPEN" (held forward), MANUAL "CLOSE" (held back). The oil switch is spring loaded so that to manually open or close the oil shutter, the switch must be held in either the "OPEN" or "CLOSE" position until the operation is completed. (approximately 20 seconds.)

In addition to this method of temperature control of the oil in the system, the oil radiator is equipped with a thermostatic valve mounted on the side of the radiator. This valve is built integral with a surge valve which permits the oil at excessive pressure (resulting from the cold oil) to by-pass the radiator completely and return to the tank. The oil tank, located on the forward side of the fire wall, is of the hopper type. The tank is so designed as to allow the airplane to assume any attitude when the tank is full, and to feed oil adequately to the engine in a vertical climb or dive when the tank is only one fourth full. However, because of the loss of oil pressure and the failure of the scavenger pump to operate in the inverted position, inverted flying must be limited to 10 seconds. A restrictor elbow at the engine end of the oil pressure gage line dampens out fluctuations of pressure at the gage, and retards the loss of oil from the engine in case of an oil pressure gage line failure. The Army Air Forces standard oil dilution system is installed on the airplane; its proper use will tend to eliminate starting difficulties. The full capacity of the oil system is 2[illegible] U. S. gallons: specifications No. AN-VV-O-446A, grade 1100.

Desired Temperature 70° - 80°C Maximum Temperature - 90°C

Desired Pressure - 70-80 lbs/sq. in. Maximum Pressure - 90 lbs/sq.in.

Minimum Temperature - 40°C. Minimum Pressure - 60 lbs/sq.in.

C. Cooling Systems

The P-51D, powered by a Packard built Rolls Royce V-1650-7 engine, has two separate and distinct coolant systems. One is the MAIN engine coolant system and the other is the AFTER coolant system which is used to cool the supercharged fuel-air mixture.

1. Engine Cooling System - The engine cooling system is a high-pressure (30 pounds per square inch), liquid cooling system,

employing a closed circuit with continuous flow from a centrifugal pump. This pressure system is similar to the conventional liquid-cooling system in that it uses a radiator, header tank, and a centrifugal pump. The units are dissimilar only in the respect that they are constructed to withstand pressures up to 50 pounds per square inch. The coolant medium is 70 per cent water and 30 per cent ethylene glycol, specification No. AN-E-2. The ethylene glycol and water ratio is reversed when the temperature is below ~~16~~ -12 degrees Centigrade.

In addition to the ethylene glycol and water medium, an inhibitor MUST be added. This inhibitor is known by its chemical symbol of NANBT. Operation without the inhibitor is prohibited as damage to the coolant radiator as well as to the engine due to corrosion will result. Twenty (20) hours of operation without the inhibitor is sufficient to almost completely clog the coolant radiators and overheat the engine, which will, in turn, damage the engine. The coolant liquid is pumped into the bottom of the coolant jacket on the lower exhaust side of each cylinder block, passes to the cylinder heads through brass rubber-sealed transfer tubes, and out through manifolds attached to the intake side of each cylinder head via two large ports at each end of the cylinder head and a small one at the center. These manifolds discharge into the header tank. From the header tank the coolant liquid flows to the radiator, where it is cooled by air flowing through the radiator and then continuing to the pump for another circuit of the system.

The coolant temperature is thermostatically and automatically regulated by an electrically operated air exit door located in the aft end of the main scoop beneath the airplane. An override switch is located on the left side of the cockpit. The coolant switch has four positions: "AUTOMATIC" (up), "OFF" (straight out), MANUAL "OPEN" (held forward), MANUAL "CLOSE" (held back). The coolant switch is spring loaded so that to manually open or close the coolant shutter, the switch must be held in either the "OPEN" or "CLOSE" position until the operation is completed (approximately 20 seconds). The capacity of the system is 16.5 U. S. gallons.

Coolant Temperature

Desired: 100° - 110°C
Maximum: 121°C
Minimum: 60°

2. After Cooling System

An after-cooling system is provided for cooling the supercharged fuel-air mixture. The system consists essentially of an expansion tank, heat exchanger, and coolant pump. The coolant liquid flows from the expansion tank to the coolant pump, where it is pumped to the radiator and then back through the system to the supercharger case. The coolant passes through a jacket between the impellers, cooling the charged air as it passes into the second stage impeller chamber. The coolant then passes into the heat exchanger and cools the charged air as it passes from the second stage impeller chamber into the intake manifolds. The coolant then returns to the expansion tank to complete the cycle. The capacity of the system is 5 U. S. gallons. There is no after coolant temperature gauge; therefore, the coolant level must be checked after each flight, but not before the coolant has been allowed to cool. The after coolant system is regulated simultaneously with the main engine coolant.

D. Electrical System

The electrical system is basically of the 24-volt direct-current, single-wire type which employs the metallic structure of the airplane as a common ground return. The system is energized primarily from a storage battery located just behind the pilot's seat. The battery charge is maintained by an engine driven generator mounted on the left side of the engine. External battery receptacle is mounted on right side of fuselage at trailing edge of flaps.

The P-51D is equipped with an electric, direct drive starter. Due to the fact that it is a small starter and has a large engine to turn, extreme caution should be used not to overheat it. This starter should not be used for more than four 20 second attemps to start, with 15 second intervals; then if the engine is not running, allow the starter to cool for at least five minutes.

The oil and coolant shutters are electrically operated on the P-51D. There is an individual switch for both the oil and coolant shutters. Small electric motors which are thermostatically controlled, actuate the oil and coolant shutters.

If the thermostats or the "AUTOMATIC" circuits became inoperative, the pilot could switch the toggle position from "AUTOMATIC" to either manual "OPEN" or "CLOSE", and attempt to control oil and coolant temperatures. First, however, it is necessary to check the circuit breaker. If the circuit breaker has popped out, push it back in. If it will not stay in, hold it in long enough ONLY to operate the shutters. WARNING; Do not hold it in over 30 seconds, as it may start an electrical fire.

The above is only an alternate procedure. In the event of failure of the two electric motors, there is NO emergency procedure.

The electrical system also operates cockpit lights, emergency fuel pumps, remote compass, pitot heater, gun heaters, gun sight, radio and carburetor, air temperature gauge, coolant temperature indicator, bomb release, warning lights, position lights, circuit breakers, Aldis lamp, oil dilution system, and IFF destructor controls.

The generator switch should be left on at all times when engine is running. The maximum charging rate of the generator is 100 amperes. Take-off should not be attempted if generator is charging over 50 amperes.

E. Fuel System

The engine is supplied with fuel from two main self-sealing tanks in the wings, a self-sealing fuselage tank which is located behind the pilot's seat and also from two droppable combat or auxiliary ferrying tanks, if they are carried. These tanks when carried, are attached to the bomb racks. Each main tank and the fuselage tank is provided with Thompson submerged type fuel booster pumps. These pumps are operated by a master booster pump switch located on the lower center instrument panel, which is wired in a circuit with micro switches incorporated in the fuel selector valve.

The main tanks, fuselage tank, and all lines from the tanks to the engine are the self-sealing type. Fuel is supplied from the main system in the following manner: Each tank has a line extending from the booster pump to a check valve, which permits fuel to flow to the engine but does not allow it to return. The two systems are joined at the check valve by a T fitting, and a line extends from the T fittings to a fuel shut-off valve. From the fuel shut-off valve, a line extends through a fuel strainer to an engine-driven fuel pump mounted directly on the engine. The auxiliary tanks consist of droppable ferrying tanks or combat tanks, one mounted to each bomb rack. When combat or ferrying tanks are used, the fuel from them passes through the fuel system selector valve and on the main fuel lines. The tanks are not interconnected, and it is necessary to switch from one tank to the other to maintain balance. The carburetor is of the fuel injection type with a separate idle cut-off device, and is equipped with a vapor return line that extends to the left fuel tank. The vapor vent line may become a fuel return line if the needle valve in the vapor eliminator sticks in the open position.

1. Main Fuel Tanks - Each main tank has a total fuel capacity of 92 U. S. gallons (75 Imperial) and has a magnetic type fuel gage mounted on it. A vent line extending from each tank into the fuselage has its outlet at the wing fillet. A fuel vent relief valve near the end of the vent line will open to allow venting of the fuel system if the end of the line becomes clogged.

2. Fuselage Tank - Fuselage tank capacity is 85 gallons. The sight gage is visible to the pilot over his left shoulder. One Thompson submerged type fuel booster pump is installed in the tank and the switch on the instrument panel works in conjunction with the fuel selector valve.

3. Booster Pump - One Thompson electric fuel booster pump is installed in each main tank and the fuselage tank. The booster pump master switch located on the lower center instrument panel is wired in a circuit with micro switches incorporated in the fuel selector valve. With the master switch in either the NORMAL or EMERGENCY position. In the NORMAL position, the boost pump will deliver 9-10 pounds pressure. In the EMERGENCY position, the boost pump will deliver 12-13 pounds. The circuit is completed when the handle is within 20° of either side of the "CLICK" position, of a tank that has a booster pump. Turning the selector valve from one position to another automatically shuts off the booster pump on the tank formerly used and starts the pump on the tank selected. The combat tanks are selected by the same selector valve, but have no booster pump; a constant pressure of 5 PSI is maintained within the combat tanks by the vacuum pump outlet. The booster pumps, Model TFD-13000, are the submerged type, mounted inside each of the fuel tanks with the outlet on the outside of the tanks. The pumps are of the variable pressure type and function to boost fuel to the engine-driven fuel pump in the event of engine pump failure, and serve as an aid to fuel system priming as connected with engine starting. The boost pump switch has three positions, OFF, NORMAL, and EMERGENCY. The normal position is used for starting the engine and during flight, while the emergency position is used for take-off. The electrical circuit is arranged so that the booster pumps are off when the fuel selector valve control handle indicates any selective position other than Main Fuel Tanks or Fuselage Tank.

Operation of P-51 Airplane with 85 gallon Fuselage Tank

1. The P-51D fuel system consists of a right and left wing tank each of 92-gallon capacity, fuselage tank of 85 gallon

capacity, and two droppable combat tanks of 75 gallons capacity which may be replaced by two droppable long range ferrying tanks of 150 gallon capacity. Fuel lines from all five of these tanks lead to a selector valve and thence to the fuel shut-off valve. The selector valve, as its name implies, closes or opens the fuel line to the selector tank. The selector valve has five positions, each position connecting to one of the five tanks as indicated by the placard at the valve. When the selector valve is turned to either the left main, right main, or fuselage tank position, a micro switch automatically turns on booster pump in the tank selected if the booster pump switch is on. Only one of the three booster pumps operates at one time, depending on which tank is being used. The carburetor is vented to the left wing tank.

a. Use the fuselage tank in starting, during warm-up, for take-off, and in climbing to a safe altitude.

NOTE: It is essential that the fuselage tank be burned down to twenty-five (25) gallons as soon as possible as with the fuselage tank service, the Center of Gravity is in the aft end of the airplane.

b. When a safe altitude has been reached, switch to left main tank and use fuel for a period of ten minutes.

c. Switch back to the fuselage tank and use all but twenty-five (25) gallons of fuel. This moves the Center of Gravity forward where it belongs.

d. Use fuel from drop tanks alternately until they are empty.

e. Switch to main tanks alternating from left to right tank to avoid wing heaviness until the wing tanks are empty.

f. It is very desirable to retain a reserve fuel of twenty-five (25) gallons in the fuselage tank for loading.

2. Warning: Do not lower the flaps over 20° when the droppable ferrying tanks are installed, as serious structural damage to the airplane would result. Neither the tank nor the flaps are designed to withstand the hydraulic pressure that would be placed upon them if an attempt were made to lower the flaps fully.

3. Fuel Pressure - Desired: ~~12-16~~ 16-18 pounds/sq. in. Maximum: 19 pounds/sq. in. Minimum: 12 pounds/sq. in. Idling - 9 pounds/sq. in. Desired operating fuel pressures are ~~12 - 16~~ 16-18 pounds.

a. Boost pumps - Emergency 12 pounds. Normal 9 pounds.

R E S T R I C T E D

Familiarization with Cockpit Procedure and Emergency Operations

1. Preliminary Check
   a. Obtain flight clearance.
   b. Check outside of airplane carefully. Remove pitot cover.
   c. Check service of ship and status of it on Form 1A carefully.
   d. Make sure chocks are in place.

2. Enter Cockpit
   a. Adjust seat and rudders for height and length.
   b. Check ignition switch "OFF".
   c. Set parking brakes.
   d. Check bomb and gun safety switches are "OFF".
   e. See that landing gear control handle is in the "DOWN" position. On the P-51D, there is NO ARENS control to prevent accidental raising of gear on the ground.
   f. Unlock controls and check for freedom of movement. Control lock is located at the base and just forward of the stick. Pull the plunger on the left side of the lock to unlock controls.
   g. Fasten safety belt and shoulder straps.
   h. Set altimeter to correct barometric pressure.
   i. Oil and coolant shutters to full "OPEN" position as soon as battery cart is plugged in.
   j. Set trim tabs.
      Rudder 5° Right
      Elevator 2° to 3° Nose "UP" (with 25 gallons or less in fuselage tank)
      Elevator 1° to 3° Nose "DOWN" (fuselage tank full).
      Aileron 0° for Take-off.
   k. Release hydraulic pressure with wing flaps and flap handle to "UP".
   l. Close canopy (bubble) as follows:
      (1) Push in on axle of crank on right side of cockpit to engage clutch.
      (2) Disengage pin on crank handle from the holes on the face of the clutch housing by pulling crank knob inboard gently.
      (3) Turn crank counter clockwise, holding knob inboard to close canopy.

WARNING: If red indicators show through openings on each side of the forward end of the enclosure, the emergency release is unlocked and unsafe for flight.

3. Starting and Warm-Up
   a. Ignition switch "OFF"
   b. Have propeller pulled through if it has been idle more than 2 hours.

c. Generator and battery switch "ON", unless battery cart is being used, then battery switch "OFF".
d. Throttle 1 inch open.
e. Mixture control in "IDLE CUT-OFF".
f. Propeller control "INCREASED RPM".
g. Supercharger switch in "AUTOMATIC".
h. Carburetor air control in RAM AIR.
i. Turn ignition switch to "BOTH".
j. Fuel shutoff valve "ON" and fuel selector valve to fuselage tank (if full), or Left Main if fuselage tank not serviced.
k. Fuel booster pump on "NORMAL" and check for 8-12 pounds of fuel pressure.
l. Prime engine 3 to 4 shots when cold. 1 to 2 when warm.
m. See that prop is clear.
n. Lift guard on starter switch on pilot's switch panel and press switch to "START". Caution in use of starter not to overheat.
o. As engine starts, move mixture control to "AUTO RICH". If engine does not fire, after several turns, continue priming. WARNING: When engine is not firing, mixture control should be in "IDLE CUT OFF".
p. Warm engine at approximately 1300 RPM. Check for constant oil pressure. If no oil pressure or low pressure after 30 seconds, shut off engine.
q. Check all instruments for proper readings.
r. Check hydraulic system operation by lowering and raising flaps. Loading 800-850 pounds and unloading at 1050-1100 pounds.
s. Check communication equipment for proper operation.
t. Uncage all gyro instruments.
u. Check both "LEFT" and "RIGHT MAIN" and "FUSELAGE" fuel systems by rotating fuel selector with booster pump switch in "EMERGENCY". Check for 14-19 lbs/sq. in. If drop tanks are installed, check fuel flow by rotating fuel selector control.

4. Taxiing Instructions
a. Check wing flaps "UP".
b. Have wheel chocks pulled.
c. Steer a zigzag course.
d. Taxi with stick slightly aft of neutral. This will lock the tail wheel. Inthe locked position, the tail wheel may be turned 6 degrees to the right or left by use of the rudder pedals. For sharp turns, push stick forward of the neutral position to allow the tail wheel full swiveling action. Use brakes as little as possible.

e. Always taxi with the WING FLAPS UP and the oil and coolant shutters in the open position.

5. Before Take-Off (Run-up)

a. At 2000 RPM, check the following:

Suction	3.75 - 4.25 inches H. G.
Hydraulic pressure	800 - 1100 lbs/sq. in.
Ammeter not to exceed 50 amps.	

b. Check instruments for the following limitations:

	Desired	Maximum
Oil Pressure	70-80 lbs/sq in.	90 lbs/sq. in.
Oil Temperature	70 - 80°C	90°C
Coolant Temperature	100 - 110°C	121°C
Fuel Pressure	12-16 lbs/sq. in.	19 lbs/sq. in.

c. Check mags at 2300 RPM
Maximum drop 100 RPM
d. At 2300 check propeller - 300 RPM maximum drop, and return to full "INCREASED RPM".
e. Oil and coolant shutters "AUTOMATIC".
f. Wing flaps 20° if desired.
g. Mixture "AUTO RICH".
h. Propeller in full "INCREASE RPM".
i. Fuel booster pump on "EMERGENCY"; check for 14-19 lbs./sq. in.
j. Generator switch "ON".

6. Use of Power

	Manifold Pressure	RPM	Mixture Control
Take-Off	40"	3000	AUTO RICH
Climb	35"	2600	AUTO RICH
Cruise	26" - 28"	2300-2400	AUTO RICH

7. Before Landing
a. Mixture "AUTO RICH".
b. Oil and coolant shutters "AUTOMATIC".
c. Fuel selector to fullest tank. NOTE: Never land on droppable wing tanks.

d. Booster pump switch to "NORMAL" position.
e. RPM increased to 2600
f. Normal Gear Procedure
   (1) Retard throttle to check landing gear warning light (17"-22" M. P.)
   (2) I. A. S. 170 or below. Put landing gear handle in "DOWN" position.
   (3) Allow time for gear to extend.
   (4) Retard throttle to check warning light. If light does NOT come "ON" at previously noted position of throttle, gear is DOWN and LOCKED.
g. Lower flaps as desired. Full flap speed 165 or below.

8. After Landing
a. Raise flaps.
b. Booster pump "OFF".
c. Oil and coolant shutters "OPEN".
d. Run engine to 1500 RPM; set mixture control to IDLE CUT OFF and move throttle open fully.
e. Turn ignition switch "OFF" after propeller stops turning.
f. Fuel shut-off valve "OFF".
g. Turn all switches "OFF".
h. Lock controls.

9. Emergency Wing Flap Operation
a. There is NO emergency wing flap operation provided on the P-51D as the hand pump has been eliminated. On all earlier models of the P-51, emergency operation is as follows:
   (1) Put flap selector to desired position and operate the hand pump until it seizes. Flaps will be in desired position and will stay there until another selection is made.

10. Emergency Landing Gear Extension Procedure
a. If normal extension fails, recheck landing gear warning gear warning light by retarding throttle until landing gear warning light comes on.
b. At an I. A. S. of 170, put gear handle in down position and yaw plane. Recheck landing gear warning light by retarding throttle below 20" M. P.
c. If the landing gear warning light is still "ON", indicating gear not down and locked, pull fairing door emergency release knob and yaw the plane again to lock gear.
d. Then again retard throttle to check warning light.

NOTE: The warning light does NOT indicate the position of the tail wheel. If there is any doubt as to whether or not the tail wheel is down, dive the airplane a short distance and pull out with enough acceleration to down the tail wheel.

REMEMBER - THE ONLY CHECK AVAILABLE FOR THE MAIN GEAR IS THE WARNING LIGHT. USE IT!

11. Alternate Procedure for Operating Oil and Coolant Shutters
   a. If "AUTOMATIC" operation of oil and coolant shutters fail due to thermostat or "AUTOMATIC" circuit
   b. check circuit breaker. If it has popped out, push it back in. If it won't stay in hold it in and
   c. hold switch in manual "OPEN" (or "CLOSE") long enough to open (or close) shutters (approximately 15-20 seconds).

   WARNING: Do not hold circuit breaker in too long as it may start an electrical fire.

The above is an ALTERNATE procedure ONLY. If the electric motors are burned out, there is NO EMERGENCY PROCEDURE.

12. When the drop tanks are installed, the gear may not retract or extend properly due to aerodynamic forces causing a suction between the drop tanks and the fairings on the landing gear; to break this suction it is necessary to yaw the airplane from side to side.

13. Flying Characteristics

A. GENERAL - The airplane is stable at all normal loadings, but the directional trim changes at low speeds as speed and horsepower output is varied. The trim tab controls are sensitive and must be used carefully. The effect of flap and landing gear operation on the trim of the airplane in flight is as follows:

Landing gear retracted	- airplane becomes tail heavy.
Landing gear extended	- airplane becomes nose heavy.
Flaps lowered	- airplane becomes nose heavy.
Flaps raised	- airplane becomes tail heavy.

A sustained sideslip cannot be performed in this airplane; recovery should be effected above 200 feet.

B. Flight Characteristics for Airplanes with Fuselage Tank Installation

IMPORTANT

The pilot should become accustomed to the handling qualities of the airplane with full fuselage tanks before engaging in any maneuvers. One or two hours of flying should acquaint the pilot with the airplane characteristics.

1. FUSELAGE TANK FULL - The stability of the airplane improves rapidly as fuel is expended from the fuselage tank. The stick forces will reverse when entering a tight turn of attempting a pull-out with the fuselage tank full. Considerable forward pressure on the stick is necessary to prevent the airplane from tightening up in a turn or pull out to a marked degree. The tendency is more severe in left turns than in turns to the right. In this condition, it is practically impossible to trim the aircraft for hands-off level flight.

2. FUSELAGE TANK HALF FULL - When this condition is reached, the stability is much improved. A slight tendency to tighten up is noticeable in left turns only, and it is impossible to trim for hands-off level flight. The airplane stability improves rapdily and the flying characteristics are normal as more fuel short of the half-full position is used.

14. Maneuvers Prohibited

A. Only normal flying attitudes are permitted when the airplane is carrying external fuel tanks. I. A. S. is limited to 250 when drop tanks are installed.

B. Intentional "power-on" spins and snap rolls are prohibited.

1. It is impossible to do a good snap roll with the airplane and most attempts usually end up in a power spin.
2. In the event a power spin is entered inadvertently, the throttle should be closed immediately and normal recovery methods used. The controls must be held in the recovery position until full recovery is completed. Recovery from a two to five-turn power spin may require up to six turns with a loss in altitude of as much as 9,000 feet.

15. Stalls

The stall in this airplane is comparatively mild in that it does not whip at the stall but rolls rather slowly, and has very little tendency to drop into a spin. If the stick and rudder are released at the stall, the nose drops sharply and the airplane recovers from the stall almost instantly. When the stalling speed is reached, a wing will drop. If the backward movement on the stick continues when the wing drops, the airplane will fall into a steep spiral. In a straight "power-off" stall, some warning is given about 3 to 4 mph above the stall, by slight elevator buffet. A high-speed stall is preceded by sharp buffeting at the elevators and wing root, but recovery is almost immediate when pressure on the stick is released. Recovery from any stall in this airplane is entirely normal; that is, by the release of back pressure on the stick and the application of rudder opposite the dropping wing. The speed at which a stall occurs can vary widely, depending on the gross weight and external loads of the airplane.

16. Spins

A. Differences - there are marked differences between a sustained left and right spin in the airplane.

(1) The left spin oscillates from 80 degrees below the horizon back to the horizon during the first turn, dampens out 50 per cent during the second turn, and then becomes stable, smooth, and quiet with the nose approximately 30 to 40 degrees below the horizon.

(2) The right spin starts exactly the same as the left spin, but the oscillations continue without increasing or decreasing in magnitude.

B. Recovery - Recovery procedure is the same in both a left and right spin. Upon application of opposite rudder, the nose drops slightly and the spin speeds up rapidly for 1 1/4 turns, after which the spin stops. Rudder force is light at first, becomes very heavy for a period of about one second at the first half turn after starting recovery, then drops to zero as the spin stops. Recovery is effected in the normal manner; that is, by applying full opposite rudder followed by movement of the stick to neutral. NOTE: Slight rudder buffet occurs during the spin. If recovery from the dive is attempted too soon, after the spin is stopped, a rather heavy elevator and rudder buffet will occur.

Precautions

A. Use of Brakes

The brakes system is separate from the main hydraulic system. Their only connection is that they receive their supply of fluid from the same reservoir. Use brakes as little as possible. They generate heat rapidly and abusive use will cause possible locking or complete failure.

Never put parking brake on when brakes are hot. Check placard for method of application of parking brake. Release parking brakes as soon as chocks have been put in place.

B. Engine Failure

1. The chances of the engine failing during take-off can be greatly reduced and prepared for by observing the following practices:

a. Run up engine carefully and check thoroughly before take-off.

b. Retract the landing gear as soon as the airplane is definitely airborne.

c. Raise the flaps as soon as the airplane reaches a safe altitude.

2. If the engine fails immediately after the take-off, act quickly as follows:

a. Depress the nose at once so that the airspeed does not drop below stalling speed.

b. If external fuel tanks or bombs are installed, release them immediately.

c. Release the sliding canopy by pulling the emergency release handle on top of the longeron just to the right of the instrument panel.

IMPORTANT: When releasing the canopy, bend forward and lower head slightly so as to avoid a heady injury from the loose enclosure.

d. Make sure landing gear has started to come up. There is no time to take further action, and even if it is only unlocked and on the way up, the gear will collapse on landing. Do not try to lower gear. There is less chance of personal injury if the airplane is landed with the gear up.

e. Lower the flaps fully, if possible.

f. Move mixture control to "IDLE CUT OFF" and turn OFF ignition switch.

g. Turn fuel shut-off valve "OFF".
h. Turn battery-disconnect switch "OFF".
i. Land straight ahead, only changing direction sufficiently to miss obstructions.
j. After landing, get out of the airplane as quickly as possible and remain outside.

C. Engine Failure During Flight

1. If the engine fails during flight, the airplane may be abandoned, ditched, or brought in for a dead-stick landing, as the case requires. For a landingwith the engine dead, follow these instructions:

a. Depress the nose at once so that airspeed does not drop below stalling speed.
b. If external fuel tanks or bombs are installed, release handle on right longeron.

WARNING: Bend forward and lower head slightly when pulling release handle so as to avoid injury from the loosened canopy. If the canopy does not fly off, move it back with hand-crank.

c. Do not lower the landing gear. There is less chance of personal injury if the airplane is landed with the gear up.
d. Lower the flaps fully, if possible.
e. Move mixture control to "IDLE CUT OFF" and turn ignition switch "OFF".
f. Turn "OFF" fuel shut-off valve and battery disconnect switch.
g. Land into the wind, only changing direction sufficiently to miss obstructions.
h. After landing, get out of the airplane as quickly as possible and remain outside.

D. Emergency Exit During Flight

1. In the event that an emergency exit must be made during flight, the following procedures are recommended:
a. Release sliding canopy and unfasten safety belt and shoulder harness. Roll airplane over on its back and drop out.
b. Release sliding canopy and unfasten safety belt and shoulder harness. Climb out of cockpit, lower self onto wing, and roll off.

IMPORTANT: When pulling emergency release handle, bend forward and lower head to avoid heady injury when canopy releases.

E. Emergency Drop Tank Release

On early P-51D's, the bomb salvo handle on the left side of the cockpit salvoes the tanks simultaneously. To drop tanks in an emergency on these models, the pilot merely pushed the bomb release handle to the "SALVO" position.

On late P-51D's, two salvo handles, cable operated, provide a selective mechanical release of bombs or fuel tanks. To drop tanks on these models, pull both handles to drop tanks.

F. Cold Weather Operations

1. Oil Dilution

Oil dilution is one of the most important factors in cold weather operations. Oil dilution on the P-51D is critical. A limit of two minutes maximum must be adhered to. Dilution of more than two minutes can cause bearing failure upon re-starting and running of the engine the following morning. Over dilution may even cause overflowing of oil in flight. This happens when too much fuel is present in the engine oil system, which in turn causes the oil to foam and fill the foaming chamber in the oil tank. When this happens, the oil will start overflowing the oil breather and can only be stopped by stopping the engine. Since this is not only impractical, but non-habit forming in flight, care should be taken not to over dilute. Proper oil dilution procedure is as follows:

a. With the engine oil temperature below 50°C, preferably 40°C, idle the engine at 1000 - 1200 RPM.

b. Hold the oil dilution switch "ON" for a maximum of two minutes, not allowing oil temperature to exceed 50°C, and not allowing oil pressure to drop below 15 lbs/sq. in. If oil pressure drops below 15 lbs/sq. in., stop dilution immediately.

c. After approximately 1 1/2 minutes of dilution, run engine up to 1600 RPM and change propeller pitch at least once.

d. Then pull mixture control to "IDLE CUT OFF" and release dilution switch after propeller stops turning. Write up dilution in Form 1A. DO NOT REDILUTE. If two minute dilution is not sufficient, the oil must be drained and pre-heated.

COLD WEATHER STARTS

Starting can be carried out as under normal conditions with a few additional instructions.

1. Turn engine over at least 12 blades by hand.
2. Always use an external battery source.
3. Considerable priming will be necessary.
4. Warm engine up at 900 RPM until oil temperature is above 15°C.
5. To vaporize the fuel out of the oil system, the engine should be run for at least 10 minutes, AFTER the oil has reached a temperature of 55°C.

After take-off, under moisture freezing or icing conditions, the gear and flaps should be operated through several cycles to guard against the mechanism freezing in flight. If, after operating the gear several times, the gear indicates possible freezing in the UP position, continue to the destination with the gear in the down position.

During flight under these conditions, increase RPM at least 200 every 30 minutes to test operation of the propeller and governor and also to prevent congealing of oil in the propeller dome.

AIR INDUCTION SYSTEM

The carburetor air induction system provides a selection of two kinds of carburetor air, cold ram air and cold filtered unrammed air. Normal operation is with cold ram air. However, under moisture freezing conditions, operation should be with unrammed filtered air. With the cockpit control in this position, the ram air door is closed off and the filter air door is opened. A hairpin type icing screen is located in the rear duct section. This screen will ice over under icing conditions and then suction created in the induction system will open emergency doors, located just aft of the icing screen, and allow engine compartment warm air to enter the carburetor. Under moisture freezing conditions or at any time that temperature and conditions indicate the possibility of carburetor ice, flight should be with the carburetor air control in the UNRAMMED FILTERED AIR POSITION.

General Description of P-51D Airplane Engines

The P-51D airplane is powered by a Packard built Rolls Royce (V-1650-7) engine. It is a twelve (12) cylinder "vee" type, valve in head, pressure liquid cooled engine, with a built-in reduction gear and a two stage, two speed supercharger.

The induction system consists of a centrifugal, two stage, two speed, gear driven supercharger controlled by an automatic manifold pressure regulator and fuel is supplied by a Bendix Stromberg double-throated, injection type, updraft carburetor. The two piece cylinder blocks have two inlets and two exhaust valves for each cylinder, while the valves are actuated by an overhead camshaft on each bank. The force-feed lubrication system is of the dry sump type having three pressure stages. Ignition is provided by two high tension magnetos, each supolying one of the two spark plugs in each cylinder.

V-1650-7 Engines

12 cylinders
60 degrees
5.4 bore
6.0:1 compression ratio
Low Blower 5.8 to 1
High blower 7.35 to 1
Impeller - 12 inches - 1st stage
- 10 inches - 2nd stage
Prop Reduction - 0.478 to 1

I. Following is a chart of the performance figures of the V-1650-7 engine:

RPM	MP	CRITICAL ALTITUDE With Ram	CRITICAL ALTITUDE No Ram	BLOWER Ratio	FUEL FLOW U. S. gal./hr.	BHP
2700	46.0"hg.		Sea Level	L. S.	109	1050
2700	46.0		11,300 ft.	L. S.	106	1180
2700	46.0		23,400 ft.	H. S.	161	1065
3000	61.0		Sea Level	L. S.	178	1490
3000	61.0	13,500	8,500 ft.	L. S.	170	1590
3000	61.0	13,500	21,400 ft.	H. S.		1370

A. Supercharger

The supercharger on the P-51D series is a two stage, two speed gear driven unit utilizing a 24 volt solenoid to operate the gear ratio changeover and is located on the aft end of the engine. Low and high blower ratios are obtained by three planetary clutches which are in operation in low and high ratio.

In low blower the planetary system is locked, obtaining a ratio of 5.8 to 1.

In high blower, hydraulic pressure, activated by a solenoid at the critical altitude unlocks and sets the planetary gears in operation, obtaining a ratio of 7.351 to 1.

Rated Horsepower at Take-off - 1490 HP at 3000 RPM in low blower at 61 inches.

Horsepower at 13,000 feet - 1590 HP at 3000 RPM in low blower at 61 inches.

Horsepower at 27,000 feet - 1370 HP at 3000 RPM in high blower at 61 inches.

Impeller Size - 1st stage impeller 12 inches.
- 2nd stage impeller 10.1 inches.

The fuel mixture enters the supercharger at the first stage impeller vanes and is forced by the first stage diffuser ring around the outer edge of the diffuser assembly into the volute case and through the after cooler into the induction manifolds.

The after cooler is placed on this supercharger to reduce the temperature of the mixture created by the two stage supercharger. To obtain the necessary horsepower the fuel mixture must be cooled to normal temperatures 82°C (180°F), because at 61" M. P., the air entering the induction manifold upon leaving the second stage impeller will have increased to 204°C (400°F) before entering the after cooler.

The coolant which is a mixture of 30% glycol and 70% water above -16°C and 70% glycol and 30% water below -16°C, leaves the coolant radiator which is located in the aft end of the fuselage by means of a hose, and is conveyed to the bottom of the supercharger volute case. There it circulates through the inner passages of the case and comes out at the top and is transferred to the after cooler. The coolant now circulates through the cartridge and to the after coolant pump where it is pumped back to the coolant radiator. The capacity of the system is approximately five gallons.

B. Automatic Manifold Pressure Regulator

The manifold pressure is automatically controlled by a regulating unit which is attached to the top side of the supercharger. The object of the pressure regulator is to limit the manifold pressure to the maximum of 67 inches when the throttle is fully open, and to maintain the pressure at any predetermined figure within the limits of the regulator for any given position of the throttle on the cockpit quadrant.

When the throttle lever of the cockpit quadrant is advanced as far as permitted by the safety wire stop, the regulator will

limit the engine to 61 inches; by advancing the throttle lever beyond this point and thus breaking the thin safety wire, it can be moved to the wide open position limited by a metal stop and at this setting will give 67 inches.

The effective range of the manifold pressure regulator is from 40 inches to 67 inches. Below 40 inches, it is partially in effect but not sufficiently to automatically regulate.

C. Carburetor

The engine is equipped with a Bendix Stromberg double barrel injection type carburetor (PD-18A1). Fuel is delivered to the carburetor by the engine pump at about 16 pounds per square inch pressure. It is then metered and forced to the spray nozzle which is located just in front of the first stage impeller. Fuel is prevented from leaking into the engine by a spring controlled discharge nozzle which is closed when the nozzle pressure is less than 4 pounds pressure.

D. Oil System

The oil circuit starts at the hopper tank located on the forward side of the firewall and from the bottom outlet of this reservoir the oil flows through a filter to the main engine pressure pump which then delivers the oil to the oil pressure regulator where it is divided into three systems of different pressures, the main, moderate, and low pressures. The oil after it has circulated through the engine and performed its various functions, drains to the lower crankcase sumps where it is removed by two scavenge pumps and returned to the hopper tank via a cooler.

1. Main pressure stage - 60 to 90 pounds pressure

This includes one circuit to the crankshaft and connecting rod bearings and another circuit to the constant speed governor and Hollow Prop Shaft. Oil is supplied to the crankshaft main bearings at 60 to 90 pounds pressure regulated by the main pressure relief valve in the regulator and then to the connecting rod bearings through the drilled passages in the crankshaft.

2. Prop Pitch Operating Oil Circuit

The prop pitch operating oil circuit is supplied at the main pump pressure side of the relief valve and to the constant speed governor, where then it is boosted to high pressure to operate the prop mechanism.

3. Moderate Pressure - 28 to 32 pounds pressure

Moderate pressure oil is supplied to the spring loaded clutch control valve to operate the change between low and high blower, and also to lubricate the supercharger tailshaft bearing and gears.

4. Low Pressure - 4 to 8 pounds pressure

A. Two systems

(1) One system is used to lubricate the propeller reduction gears by spray nozzles.

(2) The other system is used to lubricate the camshaft and rocker arm mechanism.

E. Ignition - High Tension Magnetos

Ignition is supplied by two Northeast magnetos, which are of the rotating magnet type, one mounted on each side driven at $1\frac{1}{2}$ crankshaft speed. The northeast magneto has been designed to operate efficiently at high altitudes. By sealing the distributor assembly in a chamber, it is possible to maintain sea level pressure within the distributor housing at altitudes up to 50,000 feet. The right hand magneto fires the spark plugs directly over the intake valves and the left hand or "B" bank magneto fires the spark plugs located next to the exhaust valves.

The design of these magnetos incorporates the use of a variable spark advance, which words automatically with the throttle movement. The advance and retard arm on the magneto is connected through linkage in such a manner that the ignition timing is advanced or retarded as the carburetor throttle is opened or closed.

Full advanced ignition is maintained over the cruising range for smooth running on lean mixtures and maximum fuel economy. A partial retard becomes effective at full throttle or high speeds and manifold pressure to avoid detonation.

F. Cooling System

The liquid cooling system uses a percentage of glycol and water. 70% water, 30% glycol above $-16^{\circ}C$; 30% water - 70% glycol below $-16^{\circ}C$. Cooling capacity of system is 16.5 U. S. gallons. Maximum operating temperature at sea level $121^{\circ}C$. Minimum for take-off $60^{\circ}C$.

The high pressure cooling system employs a closed circuit with continuous flow from centrifugal pump. The system is so constructed to withstand pressures up to 50 pounds per square inch. Coolant flows from the coolant radiator to pump. From there it is pumped to the bottom of each cylinder block. There it passes to the cylinder head through 14 brass transfer tubes and out of the cylinder head to the header tank. From the header tank, the coolant is returned back to the radiator.

P-51 Questions

1. What type engine is in the P-51D?
2. What horsepower does it develop at sea level?
3. What type propeller is mounted on the P-51D?
4. Where does the Hamilton Constant Speed get its source of oil?
5. What is the effect of frost on the wing?
6. Why is the acceleration in dives so great in this airplane?
7. What armament is installed in the P-51?
8. What are the empty, basic, and gross weights of the P-51D?
9. What is the first item to be checked on a pre-flight check list?
10. What is the procedure for testing the pitot heating unit?
11. How should the quantity of fuel be checked?
12. How should you check the fuel selector?
13. Why may you still have brakes if your system pressure is lost?
14. What should the hydraulic pressure gauge normally read when in flight?
15. What method other than the automatic control do you have to operate the oil and coolant scoops?
16. What type oil tank is installed?
17. Give the desired oil temperature for the P-51D.
18. Give the desired oil pressure for the P-51D.
19. Is the engine cooling system of the high or low pressure type?
20. Below a -16° reading, what is the cooling system mixture?
21. Explain the purpose of the after cooling system.
22. Give the desired coolant temperature.
23. Where is the storage battery located?
24. What is the purpose of the booster pumps mounted in each main fuel tank?
25. Do the booster pumps operate when the fuel selector is on the drop tank position?
26. What is the capacity of the two main wing tanks?
27. What is the emergency exit procedure?
28. What caution should be exercised when operating the brakes?
29. What is the emergency landing procedure on take-off?
30. Explain in detail, the oil dilution procedure for the Packard Rolls Royce engine.
31. What is the manual procedure for jettisoning droppable fuel tanks?
32. How does the automatic manifold pressure regulator operate?
33. When should the high blower be used on the P-51D?

NOTICE NOTICE NOTICE

PILOTS FLYING P-51 K MODEL AIRPLANES

When parking the P-51K after the engine has been shut off and the flaps put in the down position, pull the emergency fairing door release out and then push down on the handle. Doing this serves a dual purpose:

I. Pulling the fairing door emergency release, by-passes the hydraulic pressure from the fairing door lines back to the reservoir. This will prevent damage to the hydraulic system due to thermol expansion.

II. By pushing down on the fairing door emergency release handle after pulling it out, positions a mechanical stop against the landing gear down locks. This prevents anyone accidently retracting the gear when the plane is parked. It acts very much the same as the "Arens" control on earlier models. However, the Arens control would prevent the gear from being retracted as long as the weight of the plane was on the struts. The control on the P-51K will work ONLY when the plane is parked and the fairing doors are extended.