PILOT'S MANUAL

FOR

Curtiss P-40 Warhawk

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SECTION I

DESCRIPTION

1. Airplane.

a. General. - The P-40D and P-40E Fighter Airplanes are manufactured by the Curtiss-Wright Corporation at Buffalo, New York under contracts W535 ac-12414 and -15802. They are low wing, land monoplanes, each powered by one model V-1710-39 engine. The engine drives a three-bladed electrically-operated propeller. Hydraulically-operated landing gear, tail wheel, wing flaps, and brakes are provided. The approximate over-all dimensions are as follows:

Length	31 ft 8-3/4 in.
Height, taxying position	10 ft 8 in.
Span	37 ft 3-1/2 in.

b. Access to Airplane. - Access to the airplane is gained through the canopy over the pilot's cockpit. The canopy may be opened by pressing a flush type release button located at the extreme top rear frame of the windshield proper. If no button is provided, the canopy is held shut by a friction grip, and it may be opened by placing one hand on each side of the canopy and giving it a sudden backward push.

c. Fuel, Oil, and Coolant.

(1) Fuel: Specification No. AN-VV-F-781, Amend. 5
Grade: 100 Octane

(2) Oil: Specification No. AN-VV-O-446
Viscosity: Summer - 1120
Winter - 1100

(3) Coolant: Ethylene glycol

d. Pilot Protection. - Front and rear armor protection sufficient to withstand enemy fire by direct right angle hit is provided for the pilot. Enemy fire originating within the areas graphically illustrated in figure 1 will not reach the pilot.

e. Mooring Provisions. - Tie-down rings are located in the undersurface of each wing near the wing tip. They are held in a retracted position in the wing by springs, and can be pulled down through slots by small tabs which protrude through the bottom surface of the wing. A towing ring on the inboard end of each landing wheel axle can also be used for tie-down purposes.

f. Fuel System. - See figure 4.

g. Oil System. - See figure 5. Oil dilution is provided.

h. Cooling System. - See figure 6.

i. Hydraulic System. - See figure 7.

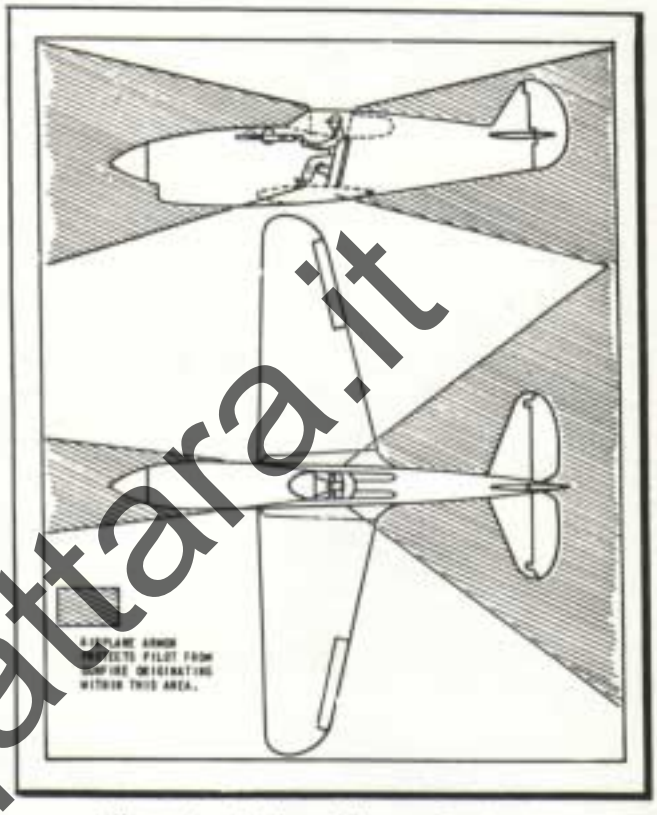


Figure 1 - Angles of Armor Protection

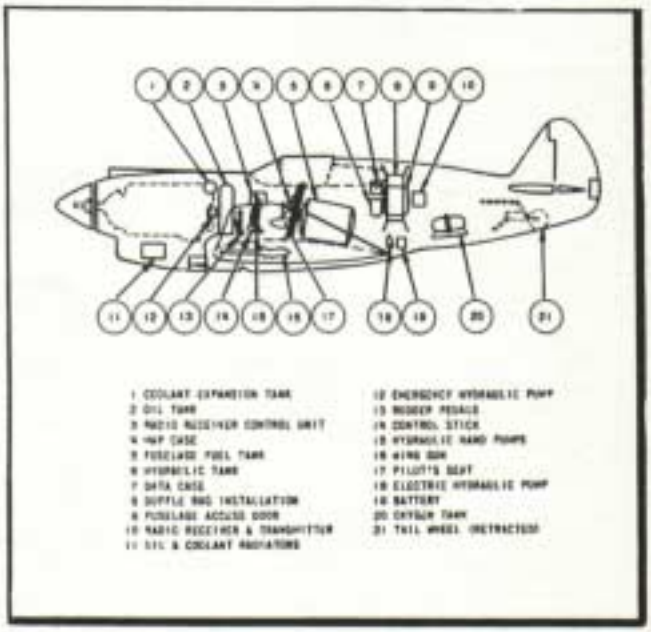


Figure 2 - Fuselage Contents Arrangement Diagram

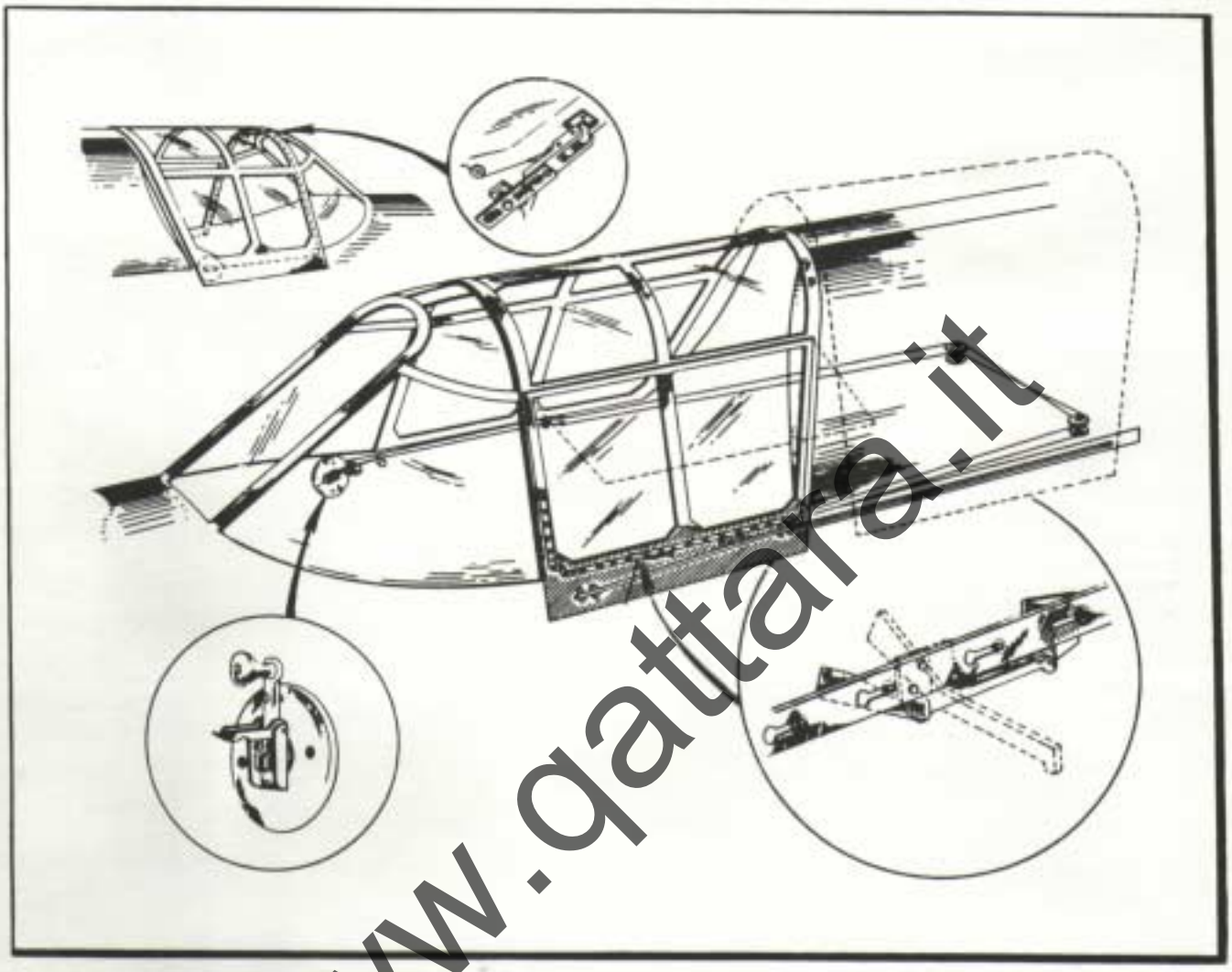


Figure 3 - Cockpit Canopy Release Diagram

2. Power Plant.

The V-1710-39 engine is a 12-cylinder vertical "V" type aircraft engine, glycol cooled, is equipped with integral reduction gears through which the propeller is driven, and is provided with a Bendix-Stromberg model PD-12K-2 carburetor.

3. Propeller.

The Curtiss constant speed electrically-operated propeller may be controlled automatically or manually. When controlled automatically, a predetermined engine speed is held constant by means of a governor set by the propeller control on the throttle quadrant. When controlled manually, the blade angle is varied by operation of the switch (figure 10) which is independent of the governor.

4. Operational Equipment.

a. Airplane Controls.

(1) Cockpit Seat. - The cockpit seat may be adjusted for height by lifting the lock release handle on the right side of the seat, and then raising or lowering the seat as desired. To lock the seat in position, release the locking handle and "juggle" the seat slightly in a vertical direction until its spring-loaded locking device definitely snaps into position.

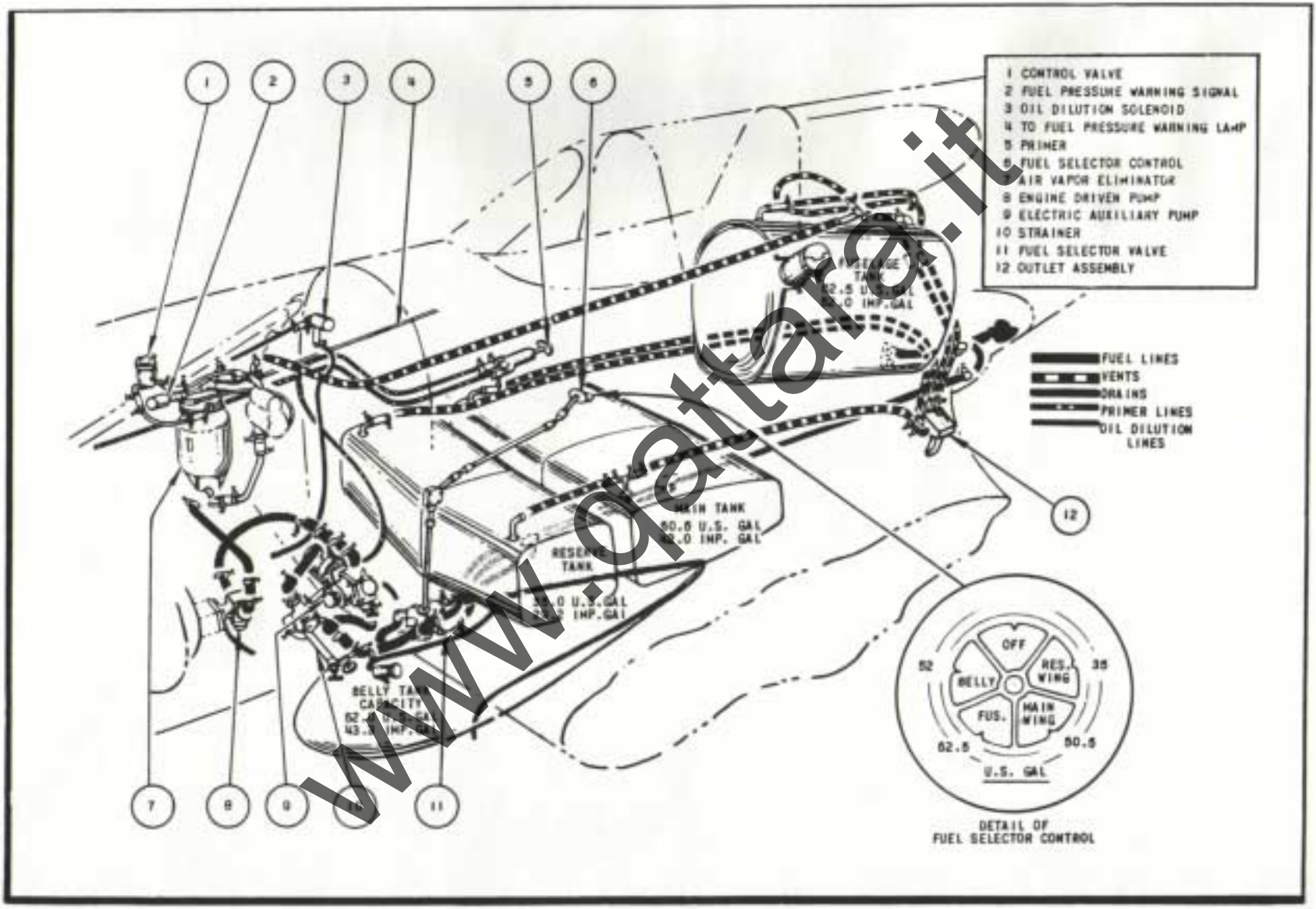


Figure 4 - Fuel System Diagram

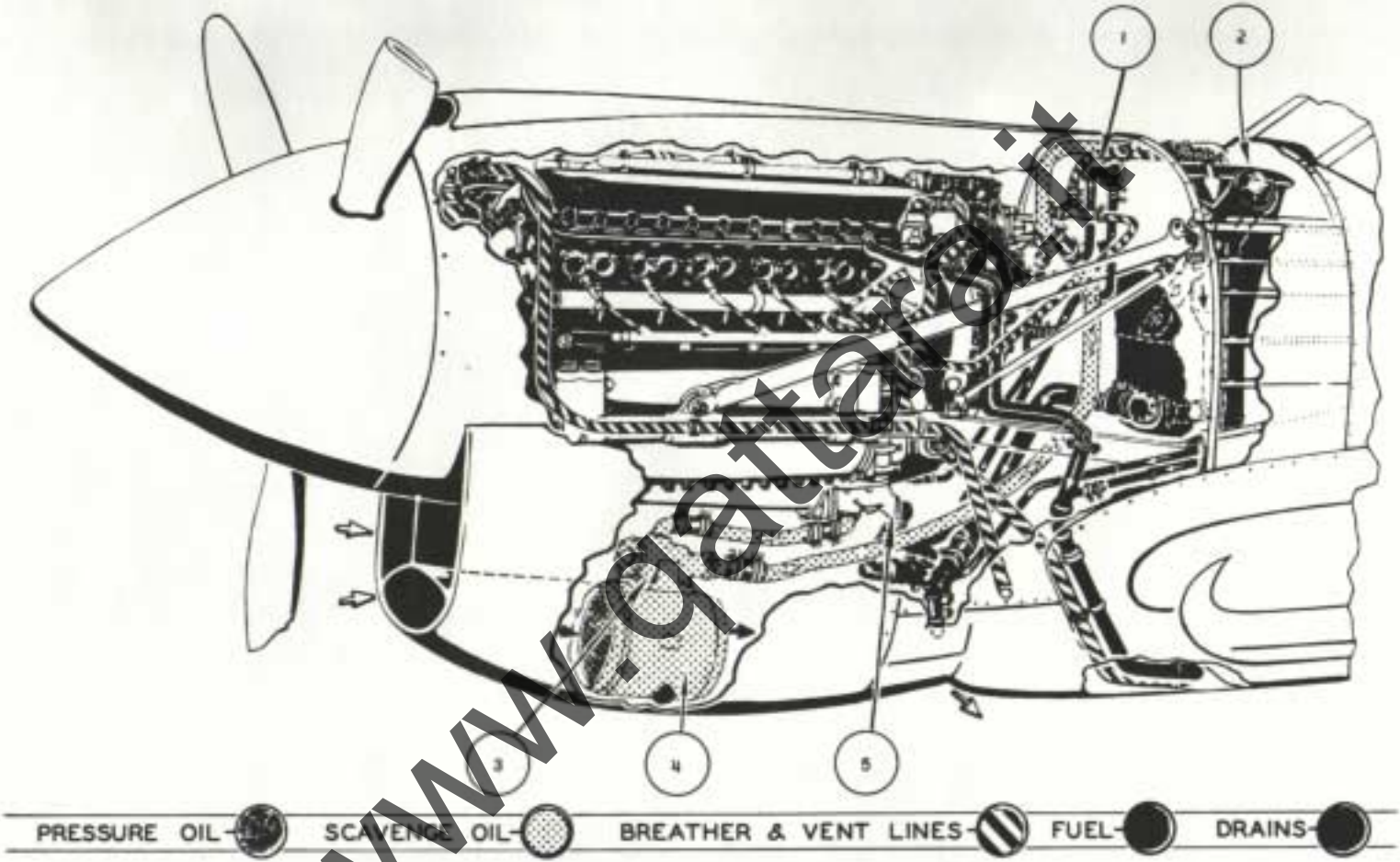


Figure 5 - Oil System Diagram

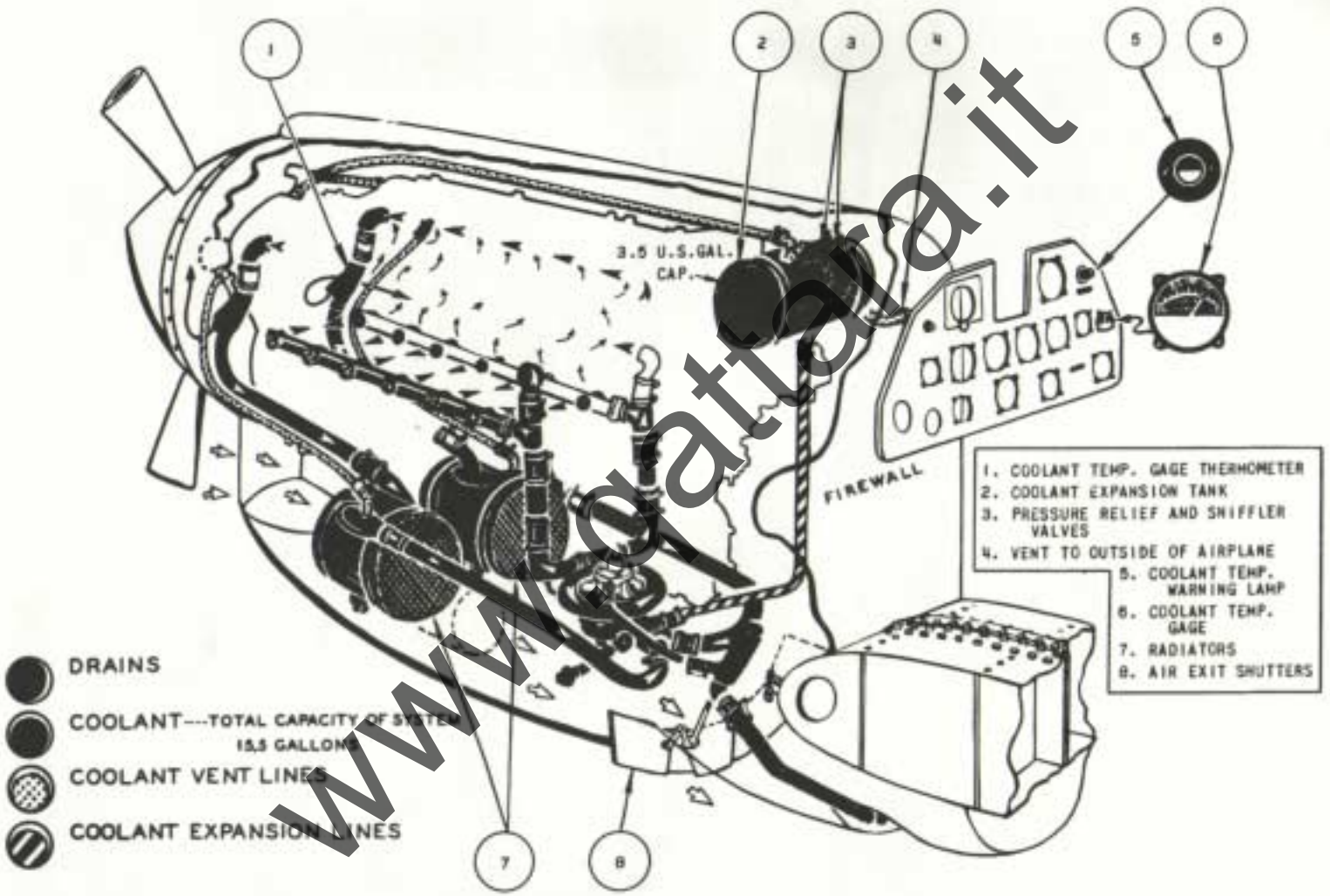


Figure 6 - Cooling System Diagram

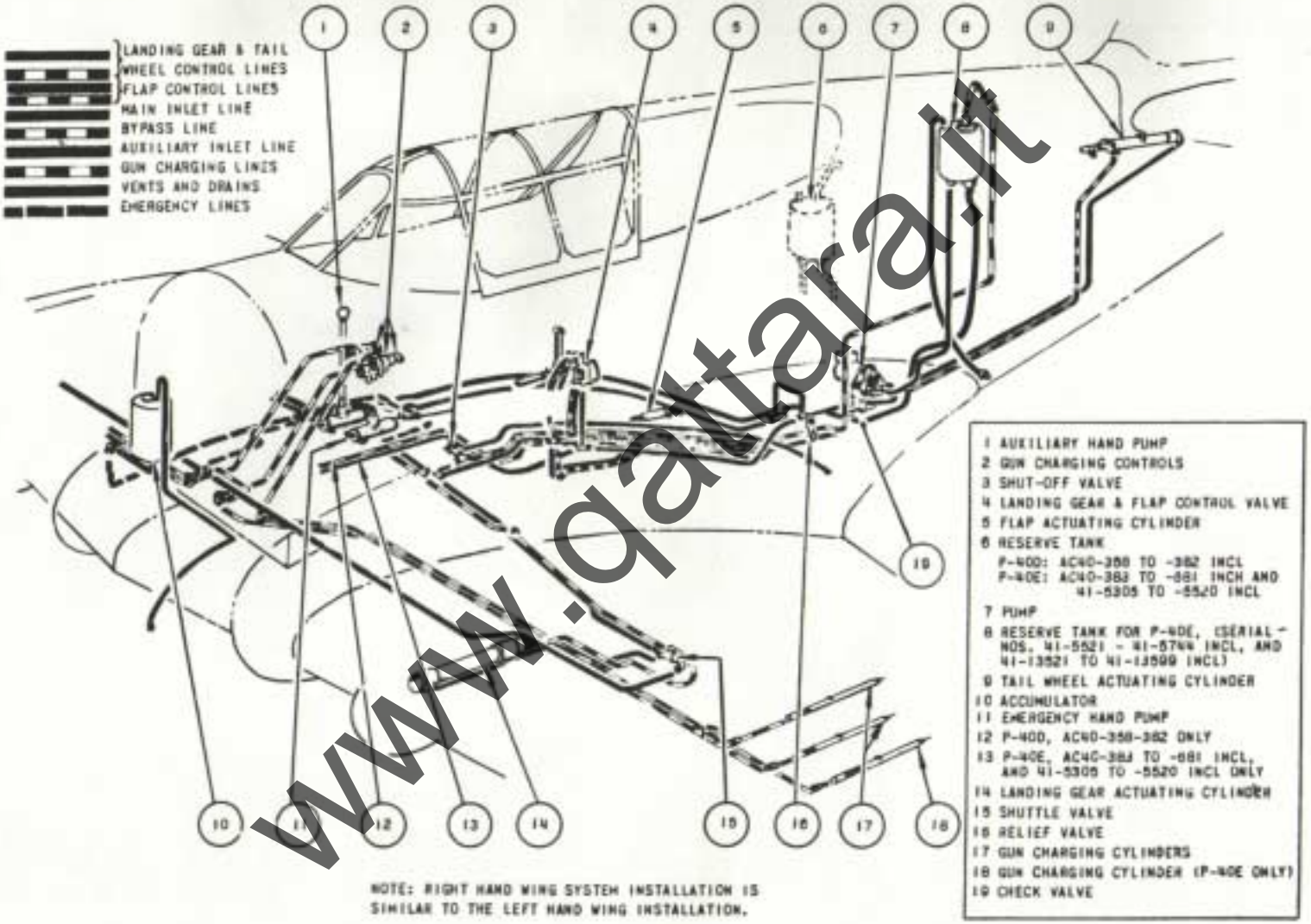


Figure 7 - Hydraulic System Diagram

(2) Aileron and Elevator. - Conventional control stick, equipped with a thumb-operated hydraulic system "OFF-ON" button on the top of the grip, and a squeeze type machine gun trigger lever on the front side of the grip.

(3) Rudder Control. - Conventional pedals and toe-operated brakes. Each rudder pedal may be adjusted to desirable length by first pushing inboard on the spring-loaded adjustment lock which permits the pedal to float free on its hinge. After moving pedal to desired location, release lock and juggle pedal slightly to allow locking pin to snap into position. ALWAYS ADJUST BOTH PEDALS TO THE SAME LENGTH.

(4) Elevator Trim Tab Control. - The trim tab is actuated by a round control knob (figure 8) on the left side of the cockpit. The knob has calibration marks around its outer circumference. Rotating the knob clockwise (forward) puts the airplane nose down.

(5) Rudder Trim Tab Control. - The rudder tab is actuated by a round control knob (figure 8) on the left side of the cockpit. Rotating it to the left (counter-clockwise) turns the nose of the airplane to the left.

(6) Aileron Trim Tab Control. - The aileron trim tab is electrically controlled. When the switch (figure 10) is raised, the left wing raises, and when the switch is pushed down, the left wing lowers. The switch returns to a neutral "OFF" position when released, allowing trim tab to remain as adjusted.

(7) Landing Gear and Tail Wheel. - Hydraulically actuated with provisions for automatic power or hand operation.

(a) Gear Down. - The landing gear may be lowered (WHEN THE IAS IS 175 MPH OR LESS) by pulling the safety latch bolt on the landing gear lever (figure 8) forward, and lowering the handle to its "DOWN" position. Press the hydraulic control switch button on top of the control stick until a few seconds after the indicator (figure 10) shows the gear to be down and locked in place. As a final check, operate the hand pump (figure 9) and if a high pressure is required to move it, the gear is down. If the landing gear warning horn fails to sound when the throttle lever (figure 8) is closed, the landing gear locks are definitely in place. RETURN THE CONTROL LEVER (FIGURE 8) TO "NEUTRAL". The safety latch bolt prevents the accidental raising of the handle beyond the neutral position.

NOTE: The gun charging valve handles must be in the "OUT" position when operating the landing gear.

(b) Gear Up. - The gear may be raised at any speed. Pull the safety latch bolt on the landing gear control lever (figure 8) forward, and raise the handle to its "UP" position. Press the hydraulic switch button on the top of the control stick until the indicator (figure 10) on the instrument panel shows the gear completely up. RETURN CONTROL HANDLE (FIGURE 8) TO "NEUTRAL" AFTER GEAR IS RETRACTED.

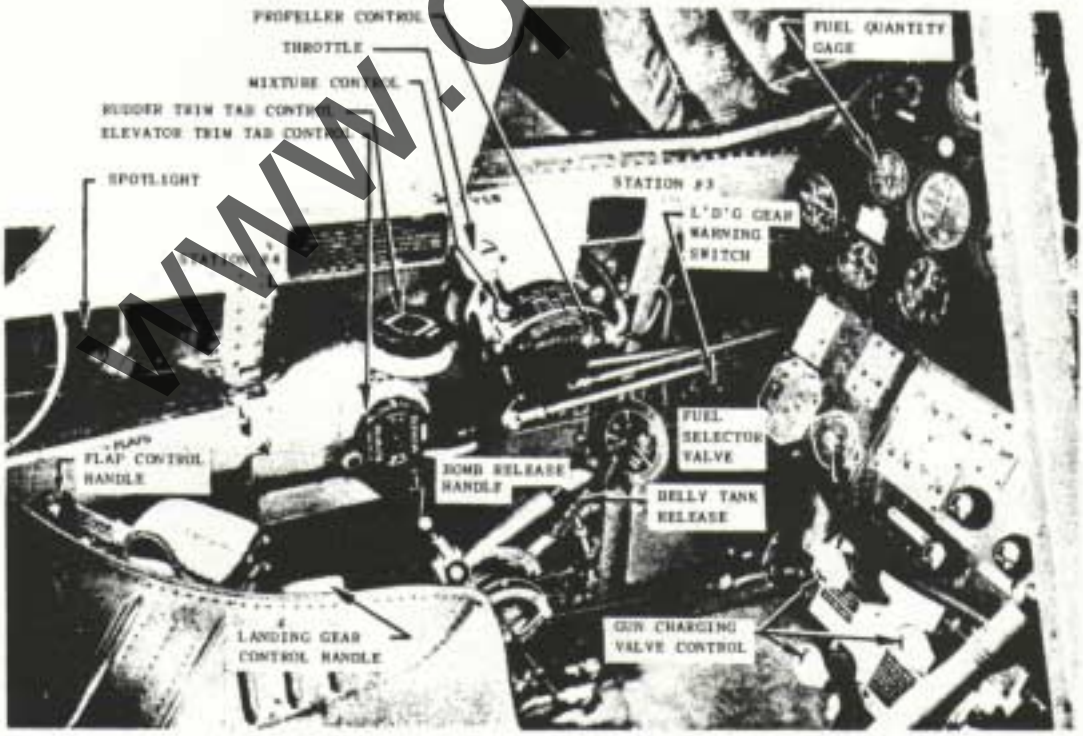


Figure 8 - Cockpit - Left Side

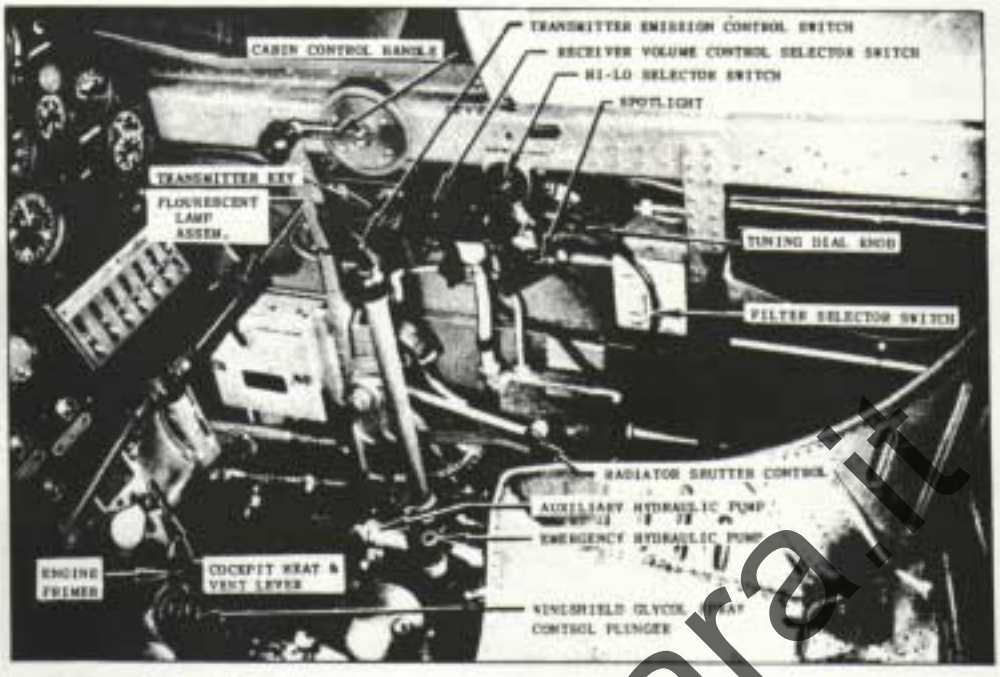
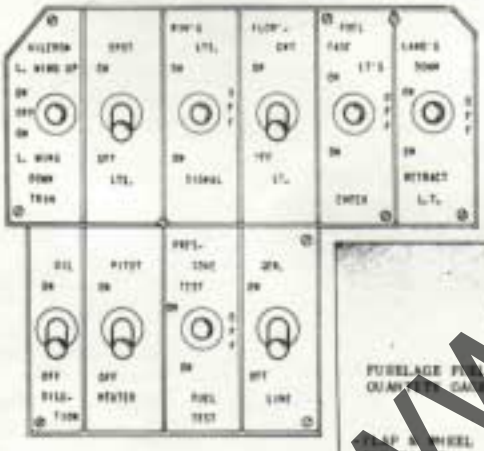


Figure 9 - Cockpit - Right Side



Detail "A"

Figure 10 - Cockpit - Front

(c) Emergency Operation. - If the hydraulic switch button on the top of the control stick fails to operate the landing gear, manually operate the auxiliary hand pump. (See figure 9.) If this fails to operate the gear, manually operate the emergency hand pump. (See figure 9.) When the emergency system is used to lower the landing gear, a "tail high" landing must be made, because the emergency system does not operate the tail wheel.

(8) Wing Flaps Operation. - Hydraulically actuated with provisions for automatic power or emergency hand operation.

(a) Flaps Down. - Move flap control lever (figure 8) to "DOWN" position. Press button on top of control stick until a second or two after indicator shows flaps are down. If a high pressure is required to move the auxiliary hand pump, the wing flaps are fully extended. RETURN FLAP CONTROL HANDLE TO "NEUTRAL" AFTER EXTENSION.

CAUTION: DO NOT LOWER FLAPS WHEN AIR SPEED IS ABOVE 140 MPH.

(b) Flaps Up. - Move flap control lever to "UP" position. Press button on top of control stick until a few seconds after indicator on instrument panel shows flaps are retracted. RETURN FLAP CONTROL LEVER TO "NEUTRAL" AFTER RETRACTION.

NOTE: The flaps may be placed in any intermediate position by releasing the button on the control stick when the flap position indicator shows the desired deflection.

(9) Landing Gear Warning Horn. - The horn may be tested by first turning the ignition switch (figure 10) to "BAT" and then turning the landing gear warning horn switch "ON." Sounding of the horn indicates that the horn and its circuits are in good working order. Turn switches "OFF."

(10) Warning Horn Disconnect Switch. - Pull out the cam on the throttle rod to disconnect the switch temporarily. Automatic engagement of the switch results the next time the throttle is opened to its stop, placing the warning horn back in operation.

(11) Heating and Ventilation Control. - Pull the control (figure 9) for heat and push for cold. The control may be set for any intermediate position. Closing the radiator shutters increases the temperature of the air coming into the cockpit.

(12) Fuel Tank Gages. - Gages are direct visual reading gages. It is not necessary to operate any switch to place them in operation.

(13) Fuel Selector Valve. - Conventional. (See figure 8.)

CAUTION: Do not turn pointer through "BELLY" when the belly tank is not installed.

(14) Radiator Shutter Control. - Move the control (figure 9) up to close and down to open the shutters. Set as the coolant and outside temperatures require. This control is equipped with an index finger release lock which must be operated before the shutter control can be moved. The coolant temperature warning lamp (figure 10) can be tested by operating the small test switch. (See figure 10.)

CAUTION: Do not extend radiator shutters at IAS in excess of 175 mph.

(15) Parking Brake. - The parking brake lever (figure 10) will lock the wheels if pulled when the toe brakes are depressed. The parking brake will release automatically by pressing on the toe brakes.

(16) Lights.

(a) Cockpit Lights.

1. The ignition switch (figure 10) must be turned to "BAT" before any lights will function by operation of their individual switches. Turn on cockpit lights by placing switch (figure 10) in the "ON" position. Adjustment of the knurled ring on the end of the flexible fluorescent lamp will control its light.

2. A cockpit spotlight (figure 9) is located on each side of the cockpit, and both are controlled by a switch (figure 10) on the central control panel.

3. The brilliancy of the compass light and the gun sight may be regulated by turning the two rheostat controls. (See figure 10.)

(b) Landing Light. - After the switch (figure 10) has been turned on, the light will not glow until after the landing light mechanism has extended the lamp to its operating position. Do not operate the landing light at speeds in excess of 175 mph. The switch has three positions, up and down for "ON" and neutral for "OFF." When the switch is placed in the upper "ON" position, the landing light swings down and out of the left wing. The light automatically illuminates after passing the center line of the pivot. When the switch is placed in the lower "ON" position, the landing light retracts up into the wing and is automatically turned off. The entire circuit is open when the toggle is in the neutral "OFF" position.

CAUTION: Do not test operate the light for more than 5 seconds. Do not operate the light for more than 3 minutes.

(17) Windshield Defroster Control. - The glycol spray pump must be operated by hand to force the liquid onto the windshield.

(18) Coolant and Fuel Pressure Test Switch. - The switch (figure 10) is a double-throw momentary contact toggle switch with two "ON" positions and a neutral "OFF" position. The coolant test "ON" position is the upper "ON" position, and the fuel pressure test "ON" position is the lower.

(19) Pilot's Shoulder Strap Adjustment. - The locking pin handle may be placed in the locked or unlocked position by pressing the button on its top and moving it fore or aft. When the handle is in the aft position, the locking pin is in the released position and the only restraining force on the shoulder straps is the bungee spring. The straps may be locked by having the bungee in its retracted position and inserting the locking pin by placing the handle in the forward position.

(20) Cockpit Enclosure.

(a) General. - Fore and aft movement of the enclosure is controlled by a crank (figure 9) located on the right side of the cockpit. The canopy can be locked in the closed position from the outside by inserting a padlock through the locking lug on the lower left side of the canopy frame.

(b) Emergency Exit on Ground. - In case of a turn-over on the ground, the kick-out panel on the left side of the canopy may be opened by pulling handle (figure 3) inward and aft which disengages the panel frame from the canopy frame and allows the panel to swing open. The canopy can also be opened from the outside by pulling the release handle outward and forward.

(c) Emergency Exit During Flight. - Pull down on release tab located on the upper forward beam of the canopy.

WARNING Before every flight be sure that the canopy release mechanism is lockwired shut. If lock wires are not installed, the canopy may be ripped off by slipstream, causing serious damage to the airplane.

(21) Parking Harness. - The control surfaces are locked by rigging the parking harness around the control stick. The short cables on the harness fasten into the eyes on the rudder pedal frames and the long cables fasten into the eyes on the pilot's seat frame. The parking harness is stowed in the fuselage baggage compartment.

b. Power Plant Controls.

(1) Throttle Control. - Conventional.

(2) Mixture Control. - On the left side of pilot on throttle quadrant and has four positions: "IDLE CUT-OFF," "AUTO LEAN," "AUTO-RICH," and "FULL RICH."

(a) To increase engine power during flight, set the mixture control in "AUTO-RICH," adjust propeller to desired rpm, adjust the throttle to obtain the desired manifold pressure and then readjust the mixture control if necessary.

(b) To decrease engine power, adjust the throttle to obtain desired manifold pressure and adjust the propeller control to obtain desired rpm. Readjust mixture control if necessary.

(3) Oil Dilution. - When a cold-weather start is expected, the oil should be diluted before the engine is stopped. Operate the engine at about 800 rpm and hold the oil dilution switch (figure 10) "ON" for about 4 minutes.

(4) Propeller Control. - Whenever the airplane is being operated, the safety switch (figure 10) should be "ON." When the switch opens due to overload, it may be reset by placing it in the "OFF" position and then returning it to the "ON" position. Propeller pitch may be changed independently of the rest of the propeller control system by holding the three-way toggle switch (figure 10) in either the "INC. RPM" or "DEC. RPM" position until the desired rpm is obtained. The automatic constant speed control may be used by placing the switch in the "AUTO" position and setting the propeller governor control lever (figure 8) to the required rpm.

NOTE: The markings on the propeller control are approximate. The desired rpm should be obtained accurately by reading the tachometer.

(5) Primer Control. - The primer (figure 9) must be turned counterclockwise to the "ON" position and pumped to prime the engine.

(6) Carburetor Heat Control. - This control (figure 10) operates a hinged vane in the carburetor air intake duct elbow and permits either warm air from the engine compartment or cold air from outside to enter the carburetor.

NOTE: The engine should be operated on "FULL COLD" at all times unless engine behavior leads the pilot to believe that carburetor icing conditions are being experienced and in that case, the control should be moved to "FULL HOT." If this does not clear up the trouble, the control should again be returned to the "FULL COLD" position.

SECTION II

PILOT OPERATING INSTRUCTIONS

1. Before Entering the Pilot's Compartment.
Check weight and balance.

2. On Entering the Pilot's Compartment.

a. Special Check for Night-flying.

(1) Turn ignition switch (figure 10) to "BAT."

(2) Turn cockpit fluorescent lamp (figure 10) and the two cockpit spotlights (figure 10) "ON."

(3) Test operate fuel gage lights. (See figure 10.)

(4) Test operate running lights. (See figure 10.)

(5) Test operate landing lights. (See figure 10.)

(6) Test operate the compass light brilliancy. (See figure 10.)

(7) Test operate gun sight lights. (See figure 10.)

b. Check for All Flights.

(1) Ignition switch (figure 10) "OFF."

(2) Gun selector switches (figure 10) "OFF."

(3) Landing gear control handle (figure 8) in neutral.

(4) Flap control handle (figure 8) in neutral.

(5) Parking brake (figure 10) on.

(6) See that controls are FREE.

(7) Turn ignition switch to "BAT."

CAUTION: When turning to the "BAT" position for preflight check be absolutely sure that the switch is not placed in either magneto position ("L" or "R") as the respective engine magnetos will then be "hot" with possible danger to the ground crew.

(8) Fuel selector (figure 8) on "RES." Do not turn selector valve to "BELLY" if the belly tank is not installed.

(9) Generator line switch (figure 10) "ON."

(10) Propeller circuit breaker switch (figure 10) "ON."

(11) Propeller selector switch (figure 10) in "AUTO."

(12) Throttle (figure 8) wide open.

(13) Mixture control on "IDLE CUT-OFF."

(14) Carburetor air heater control (figure 10) in full "COLD" position.

(15) Radiator shutter control (figure 9) as required.

3. Starting Engine.

a. Cold Engine. - With ignition switch (figure 10) "OFF," pull propeller through about three revolutions.

b. Turn ignition switch to "BAT."

c. Prime the engine two to four strokes.

d. ENERGIZE starter.

e. With mixture control (figure 8) in "IDLE CUT-OFF" position and the throttle wide open, operate the electric fuel pump switch (figure 10) to obtain 16 pounds per square inch.

f. Turn ignition switch to "BOTH," and engage the starter.

g. When engine begins to fire, immediately retard throttle and set mixture control to "AUTO-RICH."

CAUTION: If engine does not fire, return mixuture control lever to "IDLE CUT-OFF" immediately.

h. Set throttle to maintain an engine speed between 800 and 1000 rpm until the oil pressure begins to come up.

WARNING Do not operate the electrical booster pump with the mixutre control out of "IDLE CUT-OFF," when the engine is NOT FIRING. Prime to keep the engine from stalling. Pumping the throttle does NOT prime the engine.

4. Engine Warm-up.

a. Idle the engine between 500 and 800 rpm for 30 seconds after normal idling oil pressure (15 pounds per square inch) is indicated on the gage, and then continue the warm-up between 800 and 1000 rpm.

b. Set radiator shutters as desired.

c. Set carburetor heat control (figure 10) "COLD."

CAUTION: Do not attempt take-off with the carburetor heat control "ON."

5. Emergency Take-off.

If the engine was properly diluted when previously stopped, no trouble should be experienced in maintaining oil pressure within the limits set forth in the SPECIFIC ENGINE FLIGHT CHART in section III. However, the engine may be flown as soon as it will "take" the throttle, the oil dilution system being operated sufficiently to overcome oil pressure above or below the limits. There is very little danger of over-dilution, so operate the system as the oil pressure gage (figure 10) indicates. Refer to paragraph 8. of this section for routine take-off procedure.

6. Engine and Accessories Ground Test.

a. After warm-up has been completed, advance throttle to obtain 2300 rpm.

b. Test ignition on each magneto.

WARNING This test should never exceed 15 seconds on either magneto. Drop should not exceed 80 rpm on either magneto.

c. Set propeller governor control (figure 8) at 2800 rpm and then set propeller selector switch (figure 10) to "AUTO."

d. Check fuel and oil pressures. Refer to Specific Engine Flight Chart.

e. Check oil and coolant temperatures. Refer to Specific Engine Flight Chart.

7. Taxying Instructions.

The view ahead is poor when taxying; it is, therefore, necessary to keep swinging the airplane from side to side for visibility directly ahead.

CAUTION: Avoid taxying through mud holes and tall grass as the propeller can easily be damaged by small stones, mud clots, or hidden pieces of foreign material. DO NOT TAXY WITH FLAPS EXTENDED.

8. Take-off.

a. Preflight Check.

(1) Set rudder trim tab control (figure 8) to neutral.

(2) Set elevator trim tab control (figure 8) to neutral.

(3) Set left aileron trim tab flush with the trailing edge of the aileron by operating switch. (See figure 10.)

(4) Mixture control (figure 8) "AUTO-RICH."

(5) Propeller pitch at 2800 rpm.

(6) Fuel selector valve (figure 8) to "RES," and check fuel pressure. (See figure 10.)

(7) Set flaps as required, but never over one-half way down.

CAUTION: When using flap control handle be sure that the landing gear control is not moved by mistake.

(8) Radiator shutter control (figure 9) wide "OPEN."

(9) See that controls are free.

(10) Refer to section III for all flight operating data.

b. Take-off Procedure.

(1) Raise landing gear and tail wheel as soon as practicable after leaving the ground.

(2) In flight the flaps will go up automatically as soon as the flap control (figure 8) is set in its "UP" position.

CAUTION: Anticipate the sudden resultant loss of lift caused by the raising of the flaps.

9. Engine Failure During Take-off.

a. Nose down immediately.

b. Belly tank (if installed). Pull release lever immediately.

c. Mixture control to "IDLE CUT-OFF."

d. Ignition switch "OFF."

e. Put nose of airplane well down and maintain a gliding speed of approximately 110 mph STRAIGHT AHEAD. DO NOT TRY TO TURN BACK INTO THE FIELD.

CAUTION: LAND AIRPLANE ON ITS BELLY; DO NOT attempt to lower the landing gear.

10. Climb.

If flaps are used for take-off, do not raise them below 500 feet altitude.

11. Flight Operation.

Use the FLIGHT OPERATION INSTRUCTION CHARTS in section III during flight.

12. General Flying Characteristics.

a. Stability. - With normal and full military loads, the airplane is stable.

b. Trim.

Landing gear DOWN	- Nose heavy until retrimmed
Flaps DOWN	- No appreciable change
During dive	- Strong yaw to right
During climb	- Strong yaw to left

c. Order of Fuel Tank Use.

Belly tank (if installed)
Fuselage tank
Main tank
Reserve tank

d. Belly Tank.

(1) If the airplane is equipped with a belly tank, the fuel selector valve (figure 8) should be set at "BELLY" as soon as practicable after take-off.

(2) If the belly tank is dropped during flight, a slight tail heaviness will be observed.

13. Engine Failure During Flight.

a. Drop nose of ship immediately.

b. Ignition switch "OFF."

c. If airplane is equipped with belly tank, pull release lever immediately.

d. Fuel selector valve "OFF."

e. Lower flaps manually with the auxiliary hand pump.

f. If a suitable landing field is available, the landing gear may be lowered. If not, keep landing gear UP and land airplane on its belly.

14. Stalls.

a. Stalling speeds. (Power on.)

Flaps and landing gear DOWN	- 75 mph IAS
Flaps and landing gear UP	- 85 mph IAS

b. Stalls develop very rapidly with a consequent rapid dropping of the nose and a rapid "Whipping" or rolling movement (usually to the left). The airplane has no tendency to go into a spin from a stall.

15. Spins.

Intentional spinning is prohibited; however, if a spin develops, throttle back and apply opposite rudder and at normal load and cg positions, will be effective within two turns. The spin itself is extremely violent.

16. Acrobatics.

Cage gyro horizon indicator before doing acrobatics. All normal acrobatics may be done with the exception of those listed in paragraph 22. of this section.

WARNING Care must be taken to see that ample height is left for recovery from any maneuver, as acceleration during the dive is rapid, and at high speeds the initial pull-out is inclined to be heavy. The elevator trim tab is very sensitive and should not be employed to assist in a pull-out unless absolutely necessary.

17. Diving.

a. Speed Limitation. - Do not exceed a diving speed of 480 mph IAS or 3120 rpm.

b. Stability. - Elevator and rudder loads are heavy at high diving speeds. Strong yaw to the right and right wing heaviness require use of trim tabs to counteract turning and rolling forces.

CAUTION: Pull out should start at 8000 feet for dives at maximum diving speeds.

c. Power Off Dives. - To decrease the possibility of the engine malfunctioning and missing considerably, upon opening the throttle after pull-out from POWER OFF DIVES, the following precaution will be rigidly observed:

"DO NOT CLOSE THE THROTTLE TO ALLOW A MANIFOLD PRESSURE OF LESS THAN 20 INCHES HG DURING DIVE."

18. Emergency Exit.

a. In Flight. - Pull release handle at top forward frame of the cockpit and the entire canopy will open.

b. Turn-over on Ground. - Remove parachute harness, pull the emergency release handle and push open the "kick-out" panel on the left side of the canopy. This panel may be opened from the outside by operating the handle indicated on the lower rear left cabin frame.

19. Approach, Landing and Cross-wind Landing.

a. Approach.

(1) Gun selector switches (figure 10) "OFF."

(2) Mixture control (figure 8) to "AUTO-RICH."

(3) Propeller control (figure 8) to 2230 rpm and slowly close throttle to about 18 inches Hg manifold pressure.

(4) Turn fuel selector valve (figure 8) to a full main tank.

(5) Close radiator shutter as necessary.

(6) Lower the landing gear when the IAS is below 175 mph.

(7) Flaps must not be lowered with air speed above 140 mph IAS.

b. Emergency Operation of Landing Gear. - If the hydraulic switch button on top of the control stick grip and the auxiliary hand pump fail to put the gear down, pump it down with the emergency hydraulic pump. (See figure 9.)

c. Emergency Operation of Flaps. - If the hydraulic switch button on the control stick grip fails to extend the flaps, pump them down with the auxiliary hydraulic hand pump. (See figure 9.)

d. Cross-wind Landing. - Avoid cross-wind landings whenever practicable.

e. Landing. - At conclusion of landing run:

(1) Close throttle.

(2) Open radiator shutters.

(3) Raise the wing flaps.

f. Emergency Take-off if Landing Is Not Completed.

(1) Open throttle and after propeller rpm has stabilized, increase rpm to 2800.

(2) Do not retract flaps until above a 500-foot altitude.

20. Stopping of Engine.

a. Apply toe brakes and set parking brake lever. (See figure 10.)

b. Hold flight control stick back and run engine up to about 18 inches Hg for 30 seconds.

c. When cold-weather starting is anticipated, dilute the oil system for about 4 minutes at 800 rpm before stopping the engine.

d. Move mixture control to "IDLE CUT-OFF," holding oil dilution switch (figure 10) "ON" until engine stops.

e. When propeller stops rotating, turn ignition switch "OFF."

21. Before Leaving the Pilot's Compartment.

a. Fuel selector valve (figure 8) "OFF."

b. All cockpit light switches, pitot heater switch, fuel gage light switches, etc., "OFF."

c. Ignition switch "OFF."

d. Cage gyro horizon indicator.

e. If oxygen has been used during flight, close valve to prevent leakage.

f. Lock flight controls.

g. Make out Form 1.

22. Maneuvers Prohibited.

Outside loop
Inverted flight
Inverted spin
Snap roll at speed in excess of 140 mph IAS
Slow roll at speed in excess of 285 mph IAS
Spin of more than three turns
Spin with baggage, auxiliary fuel, or any other overload
Aerobatics are prohibited when belly tank is installed.

SECTION III

FLIGHT OPERATION DATA

1. Determining Gross Weight.

Refer to the "WEIGHT AND BALANCE CHART" in this section and check the listed basic and alternate tabulated items against those loaded in the airplane. If the airplane is loaded in accordance with the "Basic Load Items" whose weights are entered in the "Pounds" column, and the "Alternate Items" whose weights are entered under four loading conditions in the "Alternate Loading (Pounds)" column, the gross weight will be found listed at the bottom of the chart. If any items tabulated in the "Pounds" column are omitted in the loading of the airplane, deduct the weight of the missing items from the "Gross Weight," and the resulting figure will be the correct gross weight as the airplane is actually loaded.

2. Flight Planning.

a. General.

(1) A series of charts on the following pages is provided to aid in selecting the proper power and altitude to be used for obtaining optimum range of the airplane. A chart is provided for each airplane configuration with its probable range of gross weight.

(2) If the flight plan calls for a continuous flight where the desired cruising power and air speed are reasonably constant after take-off and climb and the external load items are the same throughout the flight, the fuel required and flight time may be computed as a "single section flight." If this is not the case, the flight should be broken up into sections, and each leg of the flight planned separately since dropping of external bombs or tanks causes considerable changes in range and air speed for given power. (Within the limits of the airplane, the fuel required and flying time for a given mission depend largely upon the speed desired. With all other factors remaining equal in an airplane, speed is obtained at a sacrifice of range, and range is obtained at a sacrifice of speed.)

b. Use of Charts.

(1) Although instructions for their use are shown on the "FLIGHT OPERATION INSTRUCTION CHARTS," the following expanded information on proper use of the charts may be helpful.

(2) Select the "FLIGHT OPERATION INSTRUCTION CHART" for the model airplane, gross weight and external loading to be used at take-off. The amount of gasoline available for flight planning purposes depends upon the reserve required and the amount required for starting and warm-up. The fuel required for warm-up is set forth on the chart. Reserve should be based on the type of mission, terrain over which the flight is to be made, and weather conditions. The fuel required for climb and time to climb to various altitudes is shown on the "TAKE-OFF, CLIMB, AND LANDING CHART." Fuel remaining after subtracting reserve, warm-up, and climb fuel from total amount available is the amount to be used for flight planning.

(3) Select a figure in the fuel column in the upper section of the chart equal to, or the next entry less than, the amount of fuel available for flight planning. Move horizontally to the right or left and select a figure equal to, or the next entry greater than, the distance (with no wind) to be flown. Operating values contained in the lower section of the column number in which this figure appears, represent the higher cruising speeds possible at the range desired. It will be noted that the ranges listed in column I under "Maximum Continuous Power" are correct only at the altitude shown by the note on the chart for this column. The ranges shown in column II and other columns to the right of column II can be obtained at any of the altitudes listed in the "Density Altitude" column. All of the power settings listed in a column will give approximately the same number of miles per gallon if each is used at the altitude shown on the same horizontal line with it. Note that the time required for the flight may be shortened by selection of the higher altitudes. In long range cruising it is important that altitude air speed and rpm be held constant. The manifold pressure should be changed as required to hold the above values reasonably constant.

(4) In order to obtain the flight duration, pilot's indicated air speed must be converted to true air speed and this true speed divided into the air miles to be flown. True air speed may be obtained first by correcting pilot's indicated air speed for position error to obtain an approximate calibrated indicated air speed; then apply the pertinent altitude correction factor to this calibrated indicated air speed. (The air-speed indicator on the P-40 series reads about 2 miles per hour slow at 150 miles per hour and about 10 miles per hour slow at 300 miles per hour.) The following table shows the approximate true air speed corresponding to pilot's indicated air speed on the P-40 series airplanes.

PILOT'S I. A. S.	APPROXIMATE TIME AIR SPEED			
	5,000	10,000	15,000	20,000
150	165	180	190	210
200	220	240	260	280
250	270	300	320	350
300	330	360	390	425
350	390	420	450	480

(5) The flight plan may be readily changed at any time en route, and the chart will show the balance of range available at various cruising powers by following the INSTRUCTIONS FOR USING CHART printed on each chart.

IMPORTANT: The above instructions and following charts do not take into account the effect of wind. Adjustments to range values and flight duration to allow for wind may be made by any method familiar to the pilot such as by the use of a flight calculator or a navigator's triangle of velocities.

CAUTION: Ranges listed in column I under "Maximum Continuous Power" are correct only at the altitude given in footnote 1, and the engine and airplane operating data listed under OPERATING DATA will give constant miles per gallon if operation is consistent with values set opposite the listed altitudes.

(6) The flight plan may be readily changed at any time en route, and the chart will show the balance of range at various cruising powers by following the "INSTRUCTIONS FOR USING CHART" printed on each page.

If the original flight plan calls for a mission requiring changes in power, speed, gross load, or external load, in accordance with "GR. WT." or "EXTERNAL ITEMS" increments shown in the series of "FLIGHT OPERATION INSTRUCTION CHARTS" provided, the total flight should be broken down into a series of individual short flights, each computed as outlined in paragraph 2.a. in its entirety, and then added together to make up the total flight and its requirements.

SPEC. AN-A-8 Rev. 15, 1945 Form 40C-310

AIRPLANE MODELS

P-40D,E

TAKE-OFF, CLIMB & LANDING CHART

ENGINE MODELS

V-1710-39(F-3R)

TAKE-OFF DISTANCE (IN FEET)

GROSS WEIGHT IN LBS.	HEAD WIND MPH	HEAD WIND KNOTS	HARD SURFACE RUNWAY: AT SEA LEVEL GROUND RUN	AT SEA LEVEL TO CLEAR 50' OBJ.	AT 3,000 FT. GROUND RUN	AT 3,000 FT. TO CLEAR 50' OBJ.	AT 6,000 FT. GROUND RUN	AT 6,000 FT. TO CLEAR 50' OBJ.	SOD-TURF RUNWAY: AT SEA LEVEL GROUND RUN	AT SEA LEVEL TO CLEAR 50' OBJ.	AT 3,000 FT. GROUND RUN	AT 3,000 FT. TO CLEAR 50' OBJ.	AT 6,000 FT. GROUND RUN	AT 6,000 FT. TO CLEAR 50' OBJ.	SOFT SURFACE RUNWAY: AT SEA LEVEL GROUND RUN	AT SEA LEVEL TO CLEAR 50' OBJ.	AT 3,000 FT. GROUND RUN	AT 3,000 FT. TO CLEAR 50' OBJ.	AT 6,000 FT. GROUND RUN	AT 6,000 FT. TO CLEAR 50' OBJ.
6700	0	0	1600	2700	1250	2300	2150	4150	1650	2750	2000	3350	2500	4200	1750	2850	2200	3500	2750	4350
	20	17	1000	1900	1250	2350	1600	3000	1050	1350	1300	2400	1650	3050	1100	2000	1400	2500	1800	3250
	40	35	550	1200	700	1550	950	2000	550	1200	750	1600	950	2000	600	1250	800	1650	1050	2100
6100	0	0	1300	2200	1600	2800	2000	3300	1350	2250	1650	2850	2200	3800	1450	2350	1750	2350	2200	3500
	20	17	800	1550	1000	1850	1300	2400	850	1000	1050	1300	1300	2400	900	1650	1100	1050	1450	2550
	40	35	400	950	550	1150	750	1550	450	1000	550	1150	750	1550	450	1000	600	1200	800	1600
7500	0	0	1050	1800	1300	2150	1600	2650	1100	1850	1350	2250	1850	2700	1150	1900	1400	2250	1750	2800
	20	17	650	1200	800	1500	1000	1850	650	1200	800	1500	1050	1300	700	1250	900	1600	1100	1050
	40	35	300	750	400	950	550	1200	300	750	450	1000	550	1200	350	800	450	1000	600	1250

NOTE: INCREASE DISTANCE % FOR EACH 10°C ABOVE 0°C (% FOR EACH 20°F ABOVE 32°F)

ENGINE LIMITS FOR TAKE-OFF 3000 RPM & 45.5 IN. HG

CLIMB DATA

COMBAT MISSIONS USE 3000 RPM & 44.6 * IN. HG

FERRY MISSIONS USE 2300 RPM & 28 IN. HG

GROSS WEIGHT IN LBS.	TYPE OF CLIMB	S. L. TO: BEST I.A.S. MPH	BEST I.A.S. KNOTS	FT./MIN.	TIME FROM S. L.	FT. ALT.: BEST I.A.S. MPH	BEST I.A.S. KNOTS	FT./MIN.	TIME FROM S. L.	FUEL FROM S.L. U. S.	FUEL FROM S.L. IMP.	FT. ALT.: BEST I.A.S. MPH	BEST I.A.S. KNOTS	FT./MIN.	TIME FROM S. L.	FUEL FROM S.L. U. S.	FUEL FROM S.L. IMP.	FT. ALT.: BEST I.A.S. MPH	BEST I.A.S. KNOTS	FT./MIN.	TIME FROM S. L.	FUEL FROM S.L. U.S.	FUEL FROM S.L. IMP.	FT. ALT.: BEST I.A.S. MPH	BEST I.A.S. KNOTS	FT./MIN.	TIME FROM S. L.	FUEL FROM S.L. U.S.	FUEL FROM S.L. IMP.	BLOWER CHANGE
6700	COMBAT	145	126	1850	1.6	150	130	1800	5.5	30	25	140	122	1400	9.5	38	32	135	117	650	15.3	46	38	130	113	250	26.1	60		
	FERRY	135	117	700	4.4	140	122	700	19.5	33	28	140	122	650	21.9	42	35	130	113	400	31.2	51	43							
6100	COMBAT	145	126	2050	1.4	150	130	2000	4.8	29	24	140	122	1250	8.3	35	29	135	117	800	13.2	43	36	130	113	400	21.6	53		
	FERRY	135	117	800	3.7	140	122	800	12.2	30	25	140	122	800	18.4	38	32	130	113	500	26.0	45	37							
7500	COMBAT	145	126	2300	1.3	150	130	2250	4.4	28	24	140	122	1400	7.2	34	28	135	117	950	11.4	40	33	130	113	550	18.1	48		
	FERRY	135	117	950	3.2	140	122	950	16.8	28	23	140	122	950	16.2	35	29	130	113	650	22.0	51	39							

NOTE: INCREASED ELAPSED CLIMBING TIME % FOR EACH 10°C ABOVE 0°C FREE AIR TEMPERATURE (% FOR EACH 20°F ABOVE 32°F) FUEL INCLUDES WARM-UP AND TAKE-OFF ALLOWANCE

LANDING DISTANCE (IN FEET)

GROSS WEIGHT IN LBS.	BEST I. A. S. APPROACH MPH	BEST I. A. S. APPROACH KNOTS	HARD DRY SURFACE: AT SEA LEVEL TO CLEAR 50' OBJ.	AT SEA LEVEL GROUND ROLL	AT 3,000 FT. TO CLEAR 50' OBJ.	AT 3,000 FT. GROUND ROLL	AT 6,000 FT. TO CLEAR 50' OBJ.	AT 6,000 FT. GROUND ROLL	FIRM DRY SOD: AT SEA LEVEL TO CLEAR 50' OBJ.	AT SEA LEVEL GROUND ROLL	AT 3,000 FT. TO CLEAR 50' OBJ.	AT 3,000 FT. GROUND ROLL	AT 6,000 FT. TO CLEAR 50' OBJ.	AT 6,000 FT. GROUND ROLL	WET OR SLIPPERY: AT SEA LEVEL TO CLEAR 50' OBJ.	AT SEA LEVEL GROUND ROLL	AT 3,000 FT. TO CLEAR 50' OBJ.	AT 3,000 FT. GROUND ROLL	AT 6,000 FT. TO CLEAR 50' OBJ.	AT 6,000 FT. GROUND ROLL
6400	90	78	1750	1100	1850	1200	2000	1300	1850	1200	1950	1300	2100	1400	3100	2450	3350	2700	3650	2950
7500	84	73	1550	950	1700	1050	1800	1150	1650	1050	1800	1150	1900	1250	2800	2200	3000	2350	3250	2600

NOTE: FOR GROUND TEMPERATURES ABOVE 35°C (95°F) INCREASE APPROACH I.A.S. 10% AND ALLOW 20% INCREASE IN GROUND ROLL.

REMARKS * For five minutes only - then use 2600 RPM & 38.5 IN. HG

I.A.S.: Indicated Air Speed
M.P.H.: Miles Per Hour
S.L.: Sea Level
U.S.: U. S. Gallons
IMP.: Imperial Gallons
NOTE: All Distances are Average
RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

SPEC. AN-A-4 Jan. 15, 1943 FORM ASC-510

AIRPLANE MODELS

P-40, E

ONE 52 OR 75 GAL. BELLY TANK OR ONE 500 LB. BOMB

TAKE-OFF, CLIMB & LANDING CHART

ENGINE MODELS

V-1710-39 (F-3R)

TAKE-OFF DISTANCE (IN FEET)

GROSS WEIGHT (IN LBS.)	HEAD WIND		HARD SURFACE RUNWAY						SOD-TURF RUNWAY						SOFT SURFACE RUNWAY					
			AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.		AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.		AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.	
	M.P.H.	KNOTS	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.	GROUND RUN	TO CLEAR 50' OBJ.
9100	0	0	2100	3600	2600	4400	3250	5600	2150	3650	2650	4450	3350	5600	2350	3850	2300	4700	3700	5950
	20	17	1350	2500	1700	3150	2150	4050	1400	2550	1750	3200	2250	4150	1500	2650	1900	3350	2450	4350
	40	35	750	1650	950	2100	1250	2750	750	1650	1000	2150	1300	2800	800	1700	1050	2200	1450	2950
8400	0	0	1700	2950	2050	3450	2550	4300	1700	2950	2100	3500	2650	4500	1850	3000	2250	3650	2850	4600
	20	17	1050	2000	1300	2400	1650	3100	1100	2050	1350	2450	1800	3250	1150	2100	1450	2550	1300	3350
	40	35	550	1250	700	1550	950	2050	550	1250	750	1600	1000	2100	800	1300	800	1650	1050	2150
	0	0																		
	20	17																		
	40	35																		

NOTE: INCREASE DISTANCE % FOR EACH 10°C ABOVE 0°C (% FOR EACH 20°F ABOVE 32°F)

ENGINE LIMITS FOR TAKE-OFF 3000 RPM & 45.5 IN. HG

CLIMB DATA

COMBAT MISSIONS USE 3000 RPM & 44 * IN. HG

FERRY MISSIONS USE 2300 RPM & 28 IN. HG

GROSS WEIGHT IN LBS.	TYPE OF CLIMB	S. L. TO 3,000 FT. ALT.				10,000 FT. ALT.						15,000 FT. ALT.						20,000 FT. ALT.						25,000 FT. ALT.						BLOWER CHANGE
		BEST I.A.S.		FT/MIN	TIME FROM S. L.	BEST I.A.S.		FT/MIN	TIME FROM S. L.	FUEL FROM S.L.		BEST I.A.S.		FT/MIN	TIME FROM S. L.	FUEL FROM S.L.		BEST I.A.S.		FT/MIN	TIME FROM S. L.	FUEL FROM S.L.		BEST I.A.S.		FT/MIN	TIME FROM S. L.	FUEL FROM S.L.		
		M.P.H.	KNOTS			M.P.H.	KNOTS			U. S.	IMP.	M.P.H.	KNOTS			U. S.	IMP.	M.P.H.	KNOTS			U. S.	IMP.	M.P.H.	KNOTS			U. S.	IMP.	
9100	COMBAT	140	122	1650	3.0	145	126	1250	6.4	32	27	140	122	900	10.8	40	33	130	114	500	18.0	51	43	130	114	100	34.9	80	67	
	FERRY	130	114	600	5.2	135	117	550	17.6	36	30	135	117	500	27.0	46	38	130	114	250	40.3	61	51							
8400	COMBAT	140	122	1900	2.6	145	126	1450	5.9	30	25	140	122	1100	9.2	37	31	130	114	650	14.9	46	38	130	114	250	25.9	62	52	
	FERRY	130	114	700	4.2	135	117	700	14.1	32	27	135	117	650	21.5	40	33	130	114	400	31.2	51	43							
	COMBAT																													
	FERRY																													

NOTE: INCREASED ELAPSED CLIMBING TIME % FOR EACH 10°C ABOVE 0°C FREE AIR TEMPERATURE (% FOR EACH 20°F ABOVE 32°F) FUEL INCLUDES WARM-UP AND TAKE-OFF ALLOWANCE

LANDING DISTANCE (IN FEET)

GROSS WEIGHT IN LBS.	BEST I. A. S. APPROACH		HARD DRY SURFACE						FIRM DRY SOD						WET OR SLIPPERY					
			AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.		AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.		AT SEA LEVEL		AT 3,000 FT.		AT 6,000 FT.	
	M.P.H.	KNOTS	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL	TO CLEAR 50' OBJ.	GROUND ROLL
8400	95	83	1600	1050	1750	1150	1850	1250	1700	1150	1850	1250	1950	1350	2850	2300	3100	2500	3350	2750
7500	90	88	1450	950	1550	1000	1700	1100	1550	1050	1650	1100	1800	1200	2550	2050	2800	2250	3000	2400

NOTE: FOR GROUND TEMPERATURES ABOVE 35°C (95°F) INCREASE APPROACH I.A.S. 10% AND ALLOW 20% INCREASE IN GROUND ROLL.

REMARKS * For five minutes only - then use 2600 RPM & 38.5 IN. HG

I.A.S.: Indicated Air Speed
M.P.H.: Miles Per Hour
S.L.: Sea Level
U.S.: U. S. Gallons
IMP.: Imperial Gallons
NOTE: All Distances are Average

RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

SPEC. AN-01-B DEC. 15, 1942 — FORM ASC-511

MODEL (S) P-40 D&E

FLIGHT OPERATION INSTRUCTION CHART

SHEET 1 OF 1 SHEETS

GR. WT. 8700 TO 7300 POUNDS

EXTERNAL LOAD ITEMS
NONE

CONDITION	R.P.M.	M.P. (IN. HG.)	BLOWER POSITION	MIXTURE POSITION	DURATION IN MIN.	U.S. G.P.H.	IMP. G.P.H.
TAKE-OFF	3000	45.5	–	A R	5	140	117
MILITARY POWER	3000	44.6	–	A R	5	132	110

ENGINE NO. V-1710-39 (F-3R)

INSTRUCTIONS FOR USING CHART: Select figure in fuel column equal to or less than total amount of fuel in airplane. Move horizontally to the right or left and select a figure equal to or greater than the air miles to be flown. Vertically below and opposite desired cruising altitude read optimum cruising conditions. **NOTES:** (A) Avoid continuous cruising in Column I except in emergency. (B) Columns (II, III, IV & V) toward the right progressively give increase in range at sacrifice in speed. (C) Manifold Pressure (M.P.), Gallons Per Hour (G.P.H.), are approximate maximum values for reference. (D) For quick reference, take-off and military power data are listed in the upper left corner of chart.

ALTERNATE CRUISING CONDITIONS

(NO WIND) (NO RESERVE FUEL ALLOWANCE)

I (MAX. CONT. POWER) RANGE IN AIR MILES				FUEL U.S. GALS. ①	II RANGE IN AIR MILES		III RANGE IN AIR MILES		IV RANGE IN AIR MILES		FUEL IMP. GALS. ①	V (MAX. RANGE) RANGE IN AIR MILES	
STATUTE		NAUTICAL			STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL		STATUTE	NAUTICAL
AT S.L.	AT 9,000	AT S.L.	AT 9,000										
					20 U.S. (25 Imp.) Gallons not available in flight.								
325		285		148 120	425	370	565	490	630	550	123 100	700	610
300		260		110	390	340	520	450	560	500	92	645	560
270		235		100	355	310	470	405	525	455	83	585	510
245		210		90	320	275	425	370	475	410	75	525	455
215		190		80	285	245	380	330	420	365	67	470	405
190		165		70	250	215	330	285	370	320	58	410	355
165		140		60	210	185	285	245	315	275	50	350	305
135		120		50	175	155	235	205	265	230	42	300	255
110		95		40	140	125	190	165	210	185	33	235	205
80		70		30	105	90	140	125	150	135	25	175	150
55		45		20	70	60	95	80	105	90	17	115	100
25		25		10	35	30	45	40	50	45	8	55	50

OPERATING DATA					① DENSITY ALT. IN FEET	OPERATING DATA						OPERATING DATA						OPERATING DATA						① DENSITY ALT. IN FEET	OPERATING DATA					
R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.		R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.		R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.
					30000																			30000					
					25000																			25000					
					20000																			20000					
2600	238	207	F.T.	98	15000	2450	225	196	31	85	71	2100	216	187	28	60	50	2100	203	176	27	51	42	15000	1900	184	161	26	42	35
2600	255	222	38.5	112	12000	2300	226	203	32	83	69	2100	216	187	28	58	48	2050	209	181	28	50	42	12000	1800	188	164	26	41	34
2600	261	227	38.5	116	9000	2250	226	207	34	80	67	2250	216	187	28	55	46	2000	208	180	28	48	40	9000	1800	183	159	26	38	32
2600	263	229	38.5	113	6000	2150	216	209	34	78	65	2250	217	188	28	53	44	1950	206	179	28	45	38	6000	1800	181	157	26	36	30
2600	266	231	38.5	109	3000	2150	216	211	34	75	63	2250	217	188	28	50	42	1950	204	177	28	43	36	3000	1800	177	154	26	33	28
2600	276	240	38.5	105	S.L.	2150	216	212	34	72	60	2250	217	188	28	48	40	1950	201	176	28	40	33	S.L.	1800	173	150	26	31	26

① INDICATED ALTITUDE CORRECTED FOR FREE AIR TEMPERATURE.

② ALLOW 28 U.S. GALS. 23 IMP. GALS. FOR WARM UP.

TAKE-OFF AND CLIMB TO 5000 FEET ALTITUDE

RETURN FUEL FLOWS TO TANK

USE FUEL FROM TANKS IN THE FOLLOWING ORDER

REFER TO "SPECIFIC ENGINE FLIGHT CHART" FOR ADDITIONAL ENGINE OPERATION DATA.

BOLD NUMBERS: Use Auto-Rich
LIGHT NUMBERS: Use Auto-Lean
WITH TWO SPEED BLOWER: Use high blower above heavy line only

I.A.S.: Indicated Air Speed
M.P.: Manifold Pressure (In. Hg)
U.S.G.P.H.: U. S. Gallons Per Hour
IMP. G.P.H.: Imperial Gallons Per Hour
F.T.: Full Throttle
S.L.: Sea Level

RED FIGURES ARE PRELIMINARY: SUBJECT TO REVISION AFTER FLIGHT CHECK

SPEC. AN-01-B DEC. 18, 1942 — Table AOC-511

MODEL (S) P-40D,E

FLIGHT OPERATION INSTRUCTION CHART

SHEET 1 OF 2 SHEETS

GR. WT. 9100 TO 8300 POUNDS

EXTERNAL LOAD ITEMS

ONE 52 OR 75 GAL. BELLY TANK OR ONE 500 LB. BOMB

CONDITION	R.P.M.	M.P. (IN. HG.)	BLOWER POSITION	MIXTURE POSITION	DURATION (M. MIN.)	U.S. G.P.H.	IMP. G.P.H.
TAKE-OFF	3000	45.5	-	A.R.	5	140	117
MILITARY POWER	3000	44.6	-	A.R.	5	132	110

ENGINE (S) V-1710-39 (F-3R)

INSTRUCTIONS FOR USING CHART: Select figure in fuel column equal to or less than total amount of fuel in airplane. Move horizontally to the right or left and select a figure equal to or greater than the air miles to be flown. Vertically below and opposite desired cruising altitude read optimum cruising conditions. **NOTES:** (A) Avoid continuous cruising in Column I except in emergency. (B) Columns (II, III, IV & V) toward the right progressively give increase in range at sacrifice in speed. (C) Manifold Pressure (M.P.), Gallons Per Hour (G.P.H.), are approximate maximum values for reference. For quick reference, take-off and military power data are listed in the upper left corner of chart.

ALTERNATE CRUISING CONDITIONS

(NO WIND) (NO RESERVE FUEL ALLOWANCE)

I (MAX. CONT. POWER) RANGE IN AIR MILES STATUTE AT S.L.	I STATUTE AT 9000	I NAUTICAL AT S.L.	I NAUTICAL AT 9000	FUEL U.S. GALS. ①	II RANGE IN AIR MILES STATUTE	II NAUTICAL	III RANGE IN AIR MILES STATUTE	III NAUTICAL	IV RANGE IN AIR MILES STATUTE	IV NAUTICAL	FUEL IMP. GALS. ①	V (MAX. RANGE) RANGE IN AIR MILES STATUTE	V NAUTICAL
				200		30 U.S. (25 Imp.) Gallons not available in flight.					167		
420		365		170	555	485	755	655	835	725	142	895	780
395		345		160	525	455	710	620	785	680	133	845	730
370		325		150	490	425	665	580	735	640	125	790	685
345		300		140	460	400	625	540	685	595	117	740	640
320		280		130	425	370	580	500	635	555	108	685	595
300		260		120	390	340	535	465	590	510	100	635	550
275		235		110	360	310	490	420	540	470	92	580	505
250		215		100	325	285	445	385	490	425	83	525	455
225		195		90	295	255	400	345	440	385	75	475	410
200		170		80	260	225	355	310	390	340	67	420	365
175		150		70	230	200	310	270	345	300	58	370	320
150		130		60	195	170	265	230	295	255	50	315	275
125		110		50	165	140	225	195	245	215	42	265	230

OPERATING DATA R.P.M.	I.A.S. (M.P.H.)	I.A.S. (KNOTS)	M.P. (IN. Hg)	U.S. G.P.H.	IMP. G.P.H.	① DENSITY ALT. (IN FEET)	OPERATING DATA R.P.M.	I.A.S. (M.P.H.)	I.A.S. (KNOTS)	M.P. (IN. Hg)	U.S. G.P.H.	IMP. G.P.H.	OPERATING DATA R.P.M.	I.A.S. (M.P.H.)	I.A.S. (KNOTS)	M.P. (IN. Hg)	U.S. G.P.H.	IMP. G.P.H.	OPERATING DATA R.P.M.	I.A.S. (M.P.H.)	I.A.S. (KNOTS)	M.P. (IN. Hg)	U.S. G.P.H.	IMP. G.P.H.	① DENSITY ALT. (IN FEET)	OPERATING DATA R.P.M.	I.A.S. (M.P.H.)	I.A.S. (KNOTS)	M.P. (IN. Hg)	U.S. G.P.H.	IMP. G.P.H.
						30000																		30000					
						25000																		25000					
						20000																		20000					
2600	220	191	F.T.	94	82	15000	2450	211	183	31	85	72	2300	198	172	28	50	42	2100	185	161	27	50	42	15000	1950	172	140	26	44	37
2600	224	203	38.5	112	98	12000	2300	215	187	32	83	69	2300	200	174	28	57	48	2000	101	166	28	40	42	12000	1850	178	155	27	43	36
2600	242	210	39.5	116	97	9000	2150	220	191	33	81	67	2300	197	171	28	53	44	1950	189	164	28	47	39	9000	1800	175	152	27	40	33
2600	243	211	39.5	112	93	6000	2150	220	192	34	78	65	2300	198	172	28	51	42	1950	188	163	28	44	37	6000	1800	174	150	27	38	32
2600	240	209	39.5	109	91	3000	2150	220	191	34	75	62	2300	199	173	28	50	41	1900	187	162	28	42	35	3000	1800	171	148	26	36	30
2520	246	214	39.5	106	88	S.L.	2150	224	194	34	72	60	2300	202	175	28	47	39	1900	192	167	28	40	33	S.L.	1800	168	146	26	34	28

① INDICATED ALTITUDE CORRECTED FOR FREE AIR TEMPERATURE.

② ALLOW 30 U. S. GALS. 25 IMP. GALS. FOR WARM UP.
TAKE-OFF AND CLIMB TO 5000 FEET ALTITUDE
RETURN FUEL FLOWS TO TANK
USE FUEL FROM TANKS IN THE FOLLOWING ORDER

REFER TO "SPECIFIC ENGINE FLIGHT CHART" FOR ADDITIONAL ENGINE OPERATION DATA.

BOLD NUMBERS: Use Auto-Rich
LIGHT NUMBERS: Use Auto-Lean
WITH TWO SPEED BLOWER: Use high blower above heavy line only

I.A.S.: Indicated Air Speed
M.P.: Manifold Pressure (In. Hg)
U.S.G.P.H.: U. S. Gallons Per Hour
IMP.G.P.H.: Imperial Gallons Per Hour
F.T.: Full Throttle
S.L.: Sea Level

RED FIGURES ARE PRELIMINARY. SUBJECT TO REVISION AFTER FLIGHT CHECK

SPEC. AN-01-B DEC. 15, 1942 — FORM ASC-511

MODEL (S) P-40 B E

FLIGHT OPERATION INSTRUCTION CHART

SHEET 2 OF 2 SHEETS

GR. WT. 8300 TO 7300 POUNDS

EXTERNAL LOAD ITEMS

ONE 52 or 75 Gal. BELLY TANK or ONE 500 lb Bomb

CONDITION	R.P.M.	M.P. (IN. HG.)	BLOWER POSITION	MIXTURE POSITION	DURATION IN MIN.	U.S. G.P.H.	IMP. G.P.H.
TAKE-OFF	3000	45.5	–	A R	5	140	117
MILITARY POWER	3000	44.6	–	A R	5	132	110

ENGINE (S): V-1710-39 (F-3R)

INSTRUCTIONS FOR USING CHART: Select figure in fuel column equal to or less than total amount of fuel in airplane. Move horizontally to the right or left and select a figure equal to or greater than the air miles to be flown. Vertically below and opposite desired cruising altitude read optimum cruising conditions. **NOTES:** (A) Avoid continuous cruising in Column I except in emergency. (B) Columns (II, III, IV & V) toward the right progressively give increase in range at sacrifice in speed. (C) Manifold Pressure (M.P.), Gallons Per Hour (G.P.H.), are approximate maximum values for reference. (D) For quick reference, take-off and military power data are listed in the upper left corner of chart.

(NO WIND) **ALTERNATE CRUISING CONDITIONS** (NO RESERVE FUEL ALLOWANCE)

I (MAX. CONT. POWER) RANGE IN AIR MILES STATUTE AT S.L.	I STATUTE AT 9,000	I NAUTICAL AT S.L.	I NAUTICAL AT 9,000	FUEL U.S. GALS. ②	II RANGE IN AIR MILES STATUTE	II NAUTICAL	III RANGE IN AIR MILES STATUTE	III NAUTICAL	IV RANGE IN AIR MILES STATUTE	IV NAUTICAL	FUEL IMP. GALS. ②	V (MAX. RANGE) RANGE IN AIR MILES STATUTE	V NAUTICAL
				166		26 U.S. (22 Imp.) Gallons not available in flight.					139		
	350		305	140	460	400	625	540	700	605	117	705	680
	325		285	130	425	370	580	500	650	565	108	730	835
	300		260	120	390	340	535	465	600	520	100	675	585
	275		240	110	360	310	490	425	550	475	92	615	535
	250		220	100	325	285	445	385	500	435	83	560	485
	225		195	90	295	255	400	350	450	390	75	505	440
	200		175	80	260	225	355	310	400	350	67	450	390
	175		150	70	230	200	310	270	350	305	58	300	340
	150		130	60	195	170	265	230	300	260	50	335	290
	125		110	50	165	140	225	195	250	215	42	280	245
	100		85	40	130	115	180	155	200	175	33	225	195
	75		65	30	100	85	135	115	150	130	25	170	145
	50		45	20	65	55	90	75	100	85	17	110	95
	25		20	10	35	30	45	40	50	45	8	55	50

I OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	① DENSITY ALT. IN FEET	II OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	III OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	IV OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.	① DENSITY ALT. IN FEET	V OPERATING DATA R.P.M.	I.A.S. M.P.H.	I.A.S. KNOTS	M.P. IN. Hg	U.S. G.P.H.	IMP. G.P.H.
						30000																			30000						
						25000																			25000						
						20000																			20000						
2600	222	193	F.T.	98	82	15000	2500	216	188	31	88	78	2300	203	176	28	60	50	2100	191	166	27	51	43	15000	1900	172	149	25	43	
2600	236	205	38.5	112	93	12000	2300	205	181	32	84	70	2300	204	177	28	58	48	2000	196	170	28	50	42	12000	1800	172	149	25	39	
2600	243	211	38.5	116	97	9000	2150	216	185	34	82	68	2200	202	175	28	55	46	1950	193	167	28	47	39	9000	1800	172	149	25	37	
2600	245	213	38.5	113	97	6000	2150	226	195	34	79	66	2200	203	176	28	53	44	1900	193	167	28	45	38	6000	1800	168	146	25	35	
2600	248	215	38.5	108	91	3000	2150	227	197	34	76	63	2250	203	176	28	50	42	1900	191	166	28	42	35	3000	1800	161	140	25	32	
2600	249	216	38.5	106	88	S.L.	2150	227	197	34	73	61	2250	203	176	28	48	40	1900	191	166	28	40	33	S.L.	1800	158	137	24	30	

① INDICATED ALTITUDE CORRECTED FOR FREE AIR TEMPERATURE.

② ALLOW 26 U. S. GALS. 22 IMP. GALS. FOR WARM UP.

TAKE-OFF AND CLIMB TO 5000 FEET ALTITUDE

RETURN FUEL FLOWS TO TANK

USE FUEL FROM TANKS IN THE FOLLOWING ORDER

REFER TO "SPECIFIC ENGINE FLIGHT CHART" FOR ADDITIONAL ENGINE OPERATION DATA.

BOLD NUMBERS: Use Auto-Rich
LIGHT NUMBERS: Use Auto-Lean
WITH TWO SPEED BLOWER: Use high blower above heavy line only

I.A.S.: Indicated Air Speed
M.P.: Manifold Pressure (In. Hg)
U.S.G.P.H.: U. S. Gallons Per Hour
IMP.G.P.H.: Imperial Gallons Per Hour
F.T.: Full Throttle
S.L.: Sea Level

SECTION IV

OPERATION OF OXYGEN EQUIPMENT

1. Operation.

a. Oxygen will be used when operating above 12,000 feet pressure altitude.

b. The pilot's oxygen mask nose may have a rubber bayonet or metal connector. Be absolutely sure that the mask connector will fit the regulator output connection before starting the airplane's engine.

c. The airplane low pressure oxygen bottle is located in the aft part of the fuselage and is accessible through the fuselage access door. (See figure 2.) It is satisfactory for take-off if the gage attached to the neck of the bottle shows a minimum of 300 pounds. The bottle is equipped with a shut-off valve which should be opened before and closed after each flight to prevent possible leakage.

d. Oxygen flow to the pilot is controlled by a regulator located in the floor of the cockpit to the right of the pilot. A small knob for adjustment and a gage calibrated in thousands of feet for flow indication are provided. When oxygen is being taken by the pilot, the knob should be adjusted so that the gage registers equal to the pressure altitude at which the airplane is flying. Some pilots require more oxygen than others and the flow should be increased if the pilot feels any extremity of his body (lobes of the ears, feet or fingers) lacking in sensitiveness or has any tingling sensation.

2. Oxygen Duration.

a. Type F-1 cylinder weighing 7 pounds will supply oxygen for one man as follows:

2-1/4 hours at 25,000 feet with a type A-9A regulator

2-3/4 hours at 25,000 feet with a type A-9 regulator

SECTION V

OPERATION OF COMMUNICATIONS EQUIPMENT

1. Radio Set SCR-283 (P-40D Airplane).

a. Receiver Operation.

(1) The radio receiver is located in the aft part of the fuselage and is accessible through the fuselage access door. (See figure 2.) All tuning dials and switches are located in the pilot's cockpit along the upper right longeron. (See figure 9.)

(a) The receiver may be identified by a large 0-100 calibration dial on the front end.

(b) Spare coils for change of receiver frequency tuning range are mounted near the receiver and may be identified the same way as for the receiver.

(2) Turn ignition switch (figure 10) to "BAT."

WARNING If the airplane is on the ground and the engine is not running, be sure that the switch is NOT on "L" or "R."

(3) Turn receiver volume control selector switch (figure 9) to "MANUAL." Plug phones in jack, and turn volumn control knob (figure 9) to the right until a faint frying noise is heard in the phones. Automatic volume control may be used by setting the selector switch (figure 9) in "AUTO"; this setting is most suitable for hunting a signal.

CAUTION: For all normal (voice or MCW) reception the radio receiver crystal filter selector switch (figure 9) should be set at "BOTH." To receive the radio range without possibility of voice interference, set the selector switch to "VOICE." It is impossible to receive voice when this selector switch is set on "RANGE."

(4) Reception at Different Frequencies.

(a) To receive the U. S. Airways Radio Range 210-398 kilocycles, set the "HI-LO" selector switch (figure 9) at "LO." Refer to CAUTION under paragraph 1.a.(3) above. Adjust tuning dial knob (figure 9) for desired frequency as calibrated on the scale closest to the center of the tuning dial.

(b) Provisions are made for plugging in different coils to cover almost every range of frequency practicable and available for aircraft use. The frequency range in kilocycles, along with the coil-identifying number, is fixed to the handle of every "plug-in" coil. Before starting the airplane's engine, the pilot should check the coil in his receiver, and if its range in kilocycles does not include the desired frequency, the proper coil should be inserted.

(c) For tuning the receiver to any frequency other than the radio range band regardless of the coil that is in use, always set the "HI-LO" switch (figure 9) to "HI." If the frequency range of the coil in the receiver matches the rear (outer) scale frequency calibration on the tuning dial in the cockpit, the tuning to any frequency within the dial calibration will be by direct reading in kilocycles. If the coil does not match the rear (outer) scale on the tuning dial, the intermediate (middle, 0-100) scale will be used for tuning. In this case, there will be found a metal "Frequency in Kc" calibration chart fixed in every cockpit near the tuning dial. Frequency in kilocycles for different coil numbers is plotted on this card against the 0-100 center tuning dial scale. When tuning to any desired frequency in kilocycles, use the vertical column on the card that is headed by the same coil number that is plugged into the receiver, and set tuning dial scale (center scale) at the number found opposite the frequency desired.

(5) To Receive Code (CW).

(a) Straight continuous wave signals cannot be heard on this receiver, as it is not equipped with a beat frequency oscillator.

(b) Modulated CW signals (similar to the airways course signals) may be heard by this receiver by tuning in the same manner as for voice reception with the radio range filter selector switch (figure 9) set on "BOTH" or "RANGE."

(c) The receiver may be turned off by setting the control knob (figure 9) in the "OFF" position.

CAUTION: If there is no further use of electrical equipment in the airplane, turn the ignition switch (figure 10) "OFF" before leaving the cockpit.

b. Transmitter Operation.

(1) General. - The transmitter is located in the aft part of the fuselage and is accessible through the fuselage access door. (See figure 2.) All controls and switches are located in the pilot's cockpit along the upper right longeron. (See figure 9.)

(2) To Transmit Voice Signals.

(a) If airplane is on the ground and the engine is not running, turn ignition switch (figure 10) to "BAT."

(b) Turn transmitter master knob (figure 9) "ON," and allow the transmitter to warm up at least 1 minute before attempting to transmit.

1. Set transmitter emission control switch (figure 9) to "VOICE."

2. To talk, hold microphone directly in front of and within 1/2 inch of the lips, press the button on the rear side, and speak slowly with clean, sharp distinct words. Release microphone button when transmission is ended.

WARNING If a throat microphone is used, it must be adjusted so that its two circular elements are held snugly against each side of the throat just above the "Adam's apple." SPEAK SLOWLY, DISTINCTLY, AND IN A NORMAL TONE OF VOICE. Shouting will seriously distort the voice signal.

(3) To Transmit Code Signals (CW).

(a) Turn ignition switch (figure 10) to "BAT" if airplane is on ground and engine is not running.

(b) Set transmitter emission control switch (figure 9) to "CW."

(c) Operate the transmitting key (figure 9) on top of the transmitter emission control switch box.

(d) When operating in code with any other airplane using the same model transmitting and receiving equipment, set the switch box selector switch (figure 9) to "TONE" and proceed as outlined above.

(e) The transmitting key may be adjusted for travel by regulating the thumb screw on the bottom of the box directly under the key.

2. Radio Set SCR-274-N (P-40E Airplane).

a. Description. - The command set SCR-274-N is designed for short-range operation, and is used for communicating with nearby aircraft for tactical purposes and with ground stations for navigation and traffic control purposes. Three receivers and two transmitters are installed in the rear of the fuselage and are accessible through the fuselage access door. (See figure 2.) All dials and controls are located on remote control units located to the right of the pilot.

b. Receiving.

(1) The receiver remote control unit is divided into three identical sections, each section controlling the particular receiver to which it is electrically and mechanically connected. Reception of a signal of a specific frequency as indicated on the dial is accomplished by the use of the section of the receiver control box which controls the particular receiver involved.

(2) Plug head-set phone jack plug in jack No. . Turn volumn control (figure 9) to the right until a faint "frying" noise is heard in the phones.

(3) Set crystal filter selector switch (figure 9) to "BOTH" for all normal (voice or MCW) reception.

(4) Turn switch (figure 9) on. This switch, in addition to having an "OFF" position, has two selective positions marked "CW" and "MCW," each of which is an "ON" position and indicates the type of signal which is to be received.

NOTE: When tuning receiver for a definite frequency, always turn dial a little to each side of the frequency calibration mark to find the point where the signal is the strongest.

(5) The A-B switches should be left in the "A" position at all times, and need not be turned off when the receiver is turned off.

c. Transmitting.

(1) Before transmitting, adjust radio receiver to the same frequency as the station with which you desire to talk, and listen in to be sure that the operator is not talking to some one else. If the station is transmitting, take advantage of the opportunity to more accurately set the receiver on the assigned frequency, and when the other operator is finished, proceed with your transmission.

(2) Place transmitter master switch (figure 9) in "ON" position.

(3) Select type of transmission desired with switch marked "TONE-CW-VOICE." (See figure 9.)

(a) With the switch in the "VOICE" position, voice will be transmitted when the push-to-talk button is pressed.

(b) With the switch in the "CW" position, a continuous wave, or unmodulated signal, will be transmitted. The microphone is inoperative.

(c) With the switch in the "TONE" position, a modulated tone signal is transmitted. The microphone is inoperative.

NOTE: Greatest effective range can be obtained on "CW." Range is most limited when operating on "VOICE." Transmitting in both "CW" and "VOICE" positions is done by a key located on the end of the transmitter control unit.

(d) To reduce battery drain and to increase dynamotor life, the "TONE-CW-VOICE" switch (figure 9) should be left on "VOICE" unless continued use on "CW" or "TONE" is expected.

3. Radio Set SCR-522A (P-40E Airplane).

a. General.

(1) This equipment is an ultra high-frequency (UHF) command set designed for voice communication only. It is used in conjunction with a contactor

(pip squeak) for identification and navigational purposes. A remote control unit is located in the pilot's cockpit to the right of the pilot.

(2) The radio waves from this equipment travel in straight lines, like beams of light, and do not follow the curvature of the earth. Due to this fact, in order to receive signals from a ground station, it is necessary that an airplane be above a certain altitude which is determined by the distance of the airplane from the ground station.

(a) If the airplane is between 35 and 50 miles away from the ground station, it must be above 1000 feet before reception is possible.

(b) If the airplane is between 80 and 100 miles away from the ground station, it must be above 5000 feet before reception is possible.

(c) If the airplane is between 120 and 160 miles away from the station, it must be above 10,000 feet before reception is possible.

NOTE: If the distance of the airplane from the station differs from any of the above examples, the altitude will change proportionately.

(3) Excessive operation of this equipment on the ground must be avoided unless a battery cart is used to prevent running down the airplane's battery.

b. Operation.

(1) Press the proper channel button on the cockpit control box, for the frequency on which you are to transmit and receive to put the set in operation.

NOTE: Transmission and reception take place on the same frequency.

(2) A green warning lamp adjacent to the channel button, pressed, lights up, whenever the set is in operation.

(3) A white pilot light adjacent to the toggle switch should light up indicating that the set is on "receive."

(4) For throttle microphone button transmission, place toggle switch in "REM" position.

NOTE: "REM" (remote) was marked "V.O." on early control boxes.

(5) Press microphone button, press the throttle "push-to-talk" button, and speak in a loud voice with the microphone against your lips. The white pilot lamp goes out, immediately indicating that the set is on "transmit."

(6) It is also possible to transmit by moving the control box toggle switch to the "T" position, instead of pressing the throttle "push-to-talk" button. However, it must be returned to either the "R" or "REM" position immediately after transmission is completed.

c. Dimmer. - The set is turned off by pushing the "OFF" button. Indicator lamps on the control box are provided with a dimmer mask for night-flying. The mask is operated by movement of a small lever beside the "OFF" push-button.

4. Pip Squeak (Contactor) Operation - RC-96 - (P-40E Airplane).

a. The pip squeak (contactor) can be used with either the SCR-274-N or the SCR-522-A command set.

b. When the contactor clock on the instrument board is turned on, the transmitter is in operation. It sends out a 14-second tone signal once every minute on channel "D" when used with the SCR-522 set and on channel "2" when used with the SCR-274-N set. Transmission of the signal occurs during the period that the hand is moving through the marked quadrant on the face of the clock.

c. Connect contactor clock to radio set by placing switch in the "IN" position.

d. Start clock by placing clock master switch in the "RUN" position.

e. When the clock takes over, the channel selector switch automatically goes to the proper channel and a continuous tone is heard both in the phones and on the ground for 14 seconds. At the end of the 14-second signal period, the selector switch automatically returns to the original channel.

WARNING It is impossible to transmit or receive voice during the 14-second tone signal period.

SECTION VI

ARMAMENT EQUIPMENT

1. Bombing Equipment.

Six bombs may be carried externally, three below each wing. To release them electrically, place selector switch (figure 10) in the "ON" position and press the trigger switch on the control stick grip. They may be manually released by placing the bomb release handle (figure 8) in the full forward position. If a 300-or 500-pound bomb is carried instead of a belly tank, it can be dropped by pulling belly tank release handle. (See figure 8.)

2. Gunnery Equipment, P-40D Airplane.

a. General. - Two .50-caliber fixed machine guns are mounted in each wing panel, and fire clear of the propeller arc. They are charged by placing the control valves (figure 8) in the "ON" position. Should the electric hydraulic pump fail, pressure may be retained by use of the auxiliary hand pump. (See figure 9.) Structural provisions are made for external attachment of two 20-mm cannon, one on the bottom surface of each wing. A miniature gun camera may be mounted on the gun sight.

b. Operation.

(1) The guns are fired by placing the selector switch (figure 10) in the "ON" position and pressing the trigger switch on the control stick grip. All guns are either "ON" or "OFF."

(2) To operate the gun camera, place the gun camera safety switch (figure 10) in the "ON" position and press the trigger switch on the control stick grip.

(3) To operate the electric gun sight, open the cover on the sight lens (figure 11), turn ignition switch to "BAT" and adjust rheostat control (figure 10) until the sight lines can be seen by looking through the small reflection glass centrally located just behind the windshield in line with the pilot's eyes.

3. Gunnery Equipment, P-40E Airplane.

a. General. - Three .50-caliber machine guns are mounted in each wing panel, and fire clear of the propeller arc. No provisions are made for the installation of cannon. The installations of the gun camera and gun sight are the same as for the P-40D airplane.

b. Operation. - Operation of the guns, camera, and gun sight is the same as for the P-40D airplane. Refer to paragraph 2.b. above.

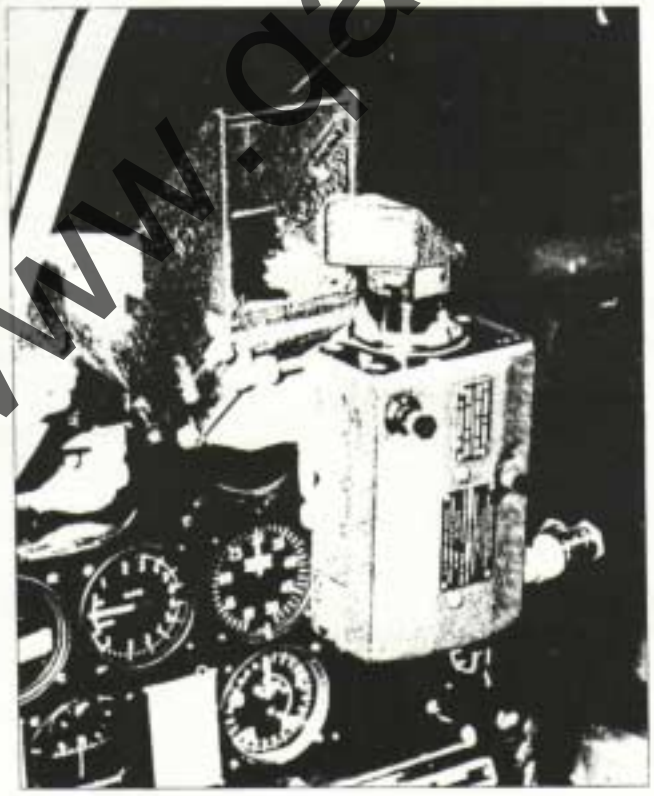


Figure 11 - Gun Sight and Gun Camera Installed

APPENDIX

COLD WEATHER OPERATION

1. Engine Oil Dilution System.

a. General.

(1) Oil dilution provides a method of diluting or thinning the engine oil with gasoline at the end of each engine run in order to facilitate starting the engine in cold weather.

(2) The engine oil should be diluted prior to stopping the engine when there is a possibility of the engine oil temperature dropping below approximately 5°C (41°F) during the period the engine is to be inoperative.

b. Operation.

(1) Maintain a speed of 800 rpm. If a higher speed is maintained, the oil temperature will exceed the maximum temperature limit set for the diluting period. Fuel vapor blown from the breather outlets to the exhaust stacks by the propeller blast also creates a great fire hazard.

NOTE: It is impossible to dilute the engine oil unless the engine is running.

(2) Maintain the oil temperature below 50°C (122°F) during the dilution procedure. The ideal temperature is 40°C (104°F). If the oil temperature exceeds 70°C (158°F), the gasoline will evaporate as rapidly as it is introduced into the oil and will leave the oil with its original viscosity. If the oil temperature exceeds 50°C (122°F) when the airplane is landed, the engine must be stopped and the oil allowed to cool to approximately 35°C (95°F) before the engine is started again to accomplish oil dilution.

(3) Hold the oil dilution switch (figure 10) in the "ON" for about 4 minutes with an engine speed of 800 rpm. The engine must be stopped at the end of the dilution period by moving the mixture control (figure 8) to the "IDLE CUT-OFF" position. If a sharp decrease in fuel pressure is not noted during oil dilution, check the electrical oil dilution circuit, the oil dilution valve, and the pressure gage for the source of the trouble.

2. Portable Ground Heater (Type D-1).

a. When operating under freezing conditions and if weather conditions require preheating of the engine, use type D-1 portable heaters.

b. It requires approximately 15 minutes to heat up the engine at -17.8°C (0°F) and approximately 30 minutes at -34.4°C (-30°F). The heater is equipped with three flexible warm air ducts.

c. The heater weighs approximately 210 pounds, is equipped with two rubber wheels and a skid and is easily handled by one man.

CAUTION: Whatever method is used for preheating the engine, extreme care must be taken to prevent accidental ignition of the gas fumes from the engine breathers, caused by vaporization of the gasoline in the oil.

3. Cold Weather Starting of Engine.

When the engine is to be started for warm-up, or is to be repeatedly started and stopped for ground test purposes or "alert," the engine will be primed and the oil dilution system operated in accordance with instructions given in paragraph 1.b. of this section.

WARNING: In warming a cold engine in extremely cold weather, start with radiator shutters closed. Do NOT gun engine to more than 800 rpm until oil has reached a temperature of 40°C (104°F).

4. Batteries.

Energizers or battery carts are generally used for cold weather starting, as this is more practicable than heating the batteries. Batteries should be maintained at not less than -12.2°C (10°F). Lower voltage at extremely low temperatures causes malfunctioning of all electrical equipment.

NOTE: To safeguard battery, remove it from the airplane and store it in a heated place when the airplane is to be idle overnight.

5. Frost or Ice Removal.

When it is necessary to remove frost or ice from areas of the airplane, melt a small area of the ice-covered surface at a time using hot water, then flush this area with denatured alcohol before the hot water freezes. Pay particular attention to hinges and controls. Alcohol should be used for cleaning frost off windshield and canopy.

6. Mooring.

If, due to extreme cold weather, mooring stakes cannot be driven into the ground, use a pick or other sharp instruments and dig a hole approximately 8 inches deep and 8 inches square. Into this hole place two deeply notched stakes crosswise, and then tie the mooring rope to the stakes. Fill the hole with water which will freeze the stakes and rope fast. If stakes are unavailable, dig the hole, coil the rope in the bottom of it, and then fill with water.

7. Communications Equipment.

The following equipment is adversely affected by extreme cold weather.

Dynamotor. - The increased viscosity of bearing lubricants may prevent the dynamotor from starting, resulting in blown fuses. If this occurs, grease should be removed and oil substituted as a lubricant.

Controls, Hand Switches, Etc. - Stiffness of operation may occur. Oil should be removed in order to prevent drag and binding.

Batteries. - Cracking occurs around the edge of the case. Batteries should be kept charged above 1.290 specific gravity to prevent cracking.

Microphones. - The hand microphone is unsatisfactory for use in cold weather. Moisture collects and freezes in the small holes of the microphone cap. Throat type microphones should be used for all cold weather operations.

Transmitter. - In certain types of transmitters, frequency shifts occur with wide changes in temperature. Consequently the transmitter must be retuned and checked until a relatively stable temperature is reached.

Plugs (Jacks). - Cracking occurs on type PL-54. No remedy can be effected.

APPENDIX

EMERGENCY OPERATING INSTRUCTIONS

1. Emergency Take-off.

If the oil was properly diluted when the engine was previously stopped, no trouble should be experienced in maintaining oil pressure within the limits set forth on the SPECIFIC ENGINE FLIGHT CHART in section III. However, the engine may be flown as soon as it will "take" the throttle, the oil dilution system being operated sufficiently to overcome oil pressure above or below the limits. There is very little danger of overdilution, so operate the system as the oil pressure gage (figure 10) indicates. Refer to paragraph 8. of section II for routine take-off procedure.

2. Engine Failure During Take-off.

a. Nose down immediately.

b. Belly tank (if installed) - Pull release lever immediately.

c. Mixture control - "IDLE CUT-OFF."

d. Ignition switch - "OFF."

e. Put nose of airplane well down and maintain a gliding speed of approximately 110 mph STRAIGHT AHEAD.

CAUTION: LAND AIRPLANE ON ITS BELLY. DO NOT ATTEMPT TO LOWER LANDING GEAR.

3. Engine Failure During Flight.

a. Drop nose of ship immediately.

b. Ignition switch "OFF."

c. If belly tank is installed, pull release lever immediately.

d. Fuel selector valve "OFF."

e. Lower flaps manually with auxiliary hand pump.

f. If a suitable landing field is available, the landing gear may be lowered. IF NOT, KEEP LANDING GEAR UP AND LAND AIRPLANE ON ITS BELLY.

4. Emergency Take-off if Landing is not Completed.

a. Open throttle and after propeller rpm has stabilized, increase rpm to 2800.

b. Do not retract flaps until above 500 feet.

5. Emergency Exit.

a. In Flight.

(1) Canopy. - An emergency canopy release handle is located on the upper forward beam of the canopy in front and above the pilot. To release the canopy pull down on it. This will break the lock wire on the release mechanism and the slip stream will tear off the canopy.

(2) Kick-out Panel. - The kick-out panel on the left side of the canopy may be opened by pulling inward and aft on the release handle.

b. Turnover on Ground. - The kick-out panel may be opened from the inside by pulling inward and aft on the release handle and pushing out on the panel. It may be opened from the outside by pulling outward and forward on the handle.

6. Emergency Operation of Landing Gear.

a. If the electrical system doesn't work, the landing gear can be operated by placing the landing gear control handle (figure 8) in the desired position and then pumping the auxiliary hand pump. (See figure 9.)

b. Should the auxiliary hand pump fail, the landing gear may be operated by means of the emergency hydraulic hand pump. (See figure 9.) The emergency system may be operated by removing the handle from the auxiliary hand pump and placing it on the emergency hand pump. The hand shut-off valves on the floor of the cockpit must be opened before operating the emergency system.

WARNING A "tail high" landing must be made when the emergency hydraulic system is used, as the tail wheel can not be moved by the emergency system.

7. Emergency Operation of Wing Flaps.

If the electric hydraulic pump doesn't work, the flaps may be lowered manually be placing the flap control handle (figure 8) in the "DOWN" position, and pumping the auxiliary hand pump. (See figure 9.) The emergency hydraulic system does not operate the flaps.

8. Emergency Bomb Release.

The bombs are released manually by placing the bomb release handle (figure 8) in the forward position.

9. Belly Tank Release.

The belly tank (or belly bomb, if installed) can be released by pulling up on the belly tank release handle. (See figure 8.)

APPENDIX

GLOSSARY

U.S.	BRITISH
Air field	Aerodrome
Battery storage	Accumulator
Beam, landing	Approach beam
Ceiling	Cloud height
Course	Track angle
Empennage	Tail unit
Filter, air	Air cleaner
Glass, bullet proof	Armour glass
Gyro, directional	Gyroscopic turn indicator
Horizon, gyro	Artificial horizon
(to) Land	(to) Alight
Lean	Weak
Left	Port
(to) Level off	(to) Flatten out
Line handling	Handling guy
Line, Mooring	Mooring guy
Mast radio	Rod aerial
Nose-heavy	Bow-heavy
Pressure Manifold	Boost pressure
P-40D, -E	Kittyhawk I or IA
Reticle	Graticule
Right	Starboard
Roll, snap	Stick roll
Set, command	Pilot controller set
Speed, indicated air	Air-speed-indicator reading
Stabilizer, horizontal	Tail plane
Stabilizer, vertical	Fin
Tab, trim	Trimming tab
Tachometer	Engine speed indicator (E.S.I.)
Tube, radio	Valve
Wing	Main plane

CURTISS P-40F

U. S. Army Pursuit Plane