

RESTRICTED

TECHNICAL ORDER
No. 01-65BC-1

PRELIMINARY HANDBOOK
OF
OPERATION AND FLIGHT INSTRUCTIONS

(CONTRACTOR'S UNEDITED INSTRUCTIONS ISSUED IN ACCORDANCE WITH PAR. 6, T. O. No. 00-5)

FOR THE

MODEL P-47B PURSUIT AIRPLANE

MANUFACTURED BY

REPUBLIC AVIATION CORPORATION

FARMINGDALE, LONG ISLAND, N. Y.

NOTE: The instructions contained in this publication apply to and describe the P-47B Airplanes AC-41-5900 and up.
Contract W535 ac-15850 **Model Specification 96**



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PRELIMINARY HANDBOOK

OPERATION AND FLIGHT INSTRUCTIONS

MODEL P-40 PURSUIT AIRPLANE

REPUBLIC AVIATION CORPORATION

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To Be Issued When Available

FIG. 1

3/4 LEFT REAR VIEW

SECTION IINTRODUCTION AND REFERENCES

1. This Technical Order is the operation and flight instructions for the Model P-47B Pursuit Airplane. Pilots and other personnel who are required to understand the operation of these airplanes will read and be familiar with the information contained herein.

2. Reference has been made in this Handbook to the following Technical Orders which contain applicable data and instructions:

T. O. No.

01-1-60	Use of Flaps
02-1-5	Operation of Carburetor Heaters
02-10GA-1	Operation and Flight Instructions R-2800-21 Engines
03-10DA-2	Operation and Service Instructions for Turbine Driven Superchargers
03-10G-1	Operation of Carburetor Mixture controls
03-20B-1	Preliminary Handbook of Instructions with Parts Catalog for Curtiss Electric Propellers
06-1-2	Fluids for Hydraulic Equipment

3. Notes for British users of U.S. Army Air Forces Technical Orders.

General

It should be realized by British readers of this Handbook that it is produced for American personnel and, consequently, it contains a number of items of phraselogy and technical terms which may be misleading unless care is taken to ensure that the British equivalent is understood. A table is given at the end of these notes which indicates the corresponding British terms for some of the American technical terms which may not be understood.

Identification of U.S. Army Air Forces Technical Orders

The Technical Orders are identified by a code number, for example, 01-20EC-1. The first two numbers (that is "01", in the example) indicate the subject and the following list gives the chief subjects and their corresponding code numbers:

<u>Code</u>	<u>Subject</u>
00	General matters
01	Aircraft
02	Engines
03	Aircraft accessories
05	Aircraft instruments
06	Fuels and lubricants
08	Electrical equipment
10	Photographic equipment
11	Aircraft combat material
18	Special tools
19	Flying field and hangar equipment

NOTE: There are many other subjects with their corresponding code numbers but the above are those which are most commonly referred to in aircraft Handbooks.

The second group of numbers and letters in the full code (that is "20EC", in the above example) indicates the manufacturer and the type of aircraft or engine in the case of aircraft and engine Technical Orders.

The third number (that is "-1", in the above example) is added to identify separate publication on the same aircraft, engine, etc. In the case of aircraft publications, the third number indicates the main Handbooks as follows:

Early arrangement

-1	Operation and Flight Instructions
-2	Service Instructions
-3	Overhaul Instructions
-4	Parts Catalog

Later arrangement

- 1 Pilots' Operating Instructions
- 2 Erection and Maintenance Instructions
- 3 Instructions for Structural Repair
- 4 Parts Catalog

Note I. Up to -4 the arrangement is always as above.

After -4 the numbers are not related to any standardised arrangement and merely identify supplemental publications which may be on any subject related to that particular aircraft.

Note II. The later arrangement includes repair instructions (corresponding to a British Volume II, Part 3) and the service and overhaul instructions have been combined to form a complete maintenance manual (corresponding to a British Volume I).

Capacity measure

SPECIAL WARNING: Any capacity quoted is always in "U.S. gallons" even if it is referred to as "gallons" without the prefix "U.S." The "U.S. gallon" is considerably smaller than the "Imperial gallon" and to convert "U.S. gallons" to "Imperial gallons" the following formula should be used:

Imperial gallons = U.S. gallons X 0.8345.

(That is, one U.S. gallon is approximately equal to five-sixths of an Imperial gallon.)

LIST OF CERTAIN AMERICAN TERMS SHOWING CORRESPONDING BRITISH NOMENCLATUREAmerican nomenclatureBritish nomenclatureGeneral

(1)	Accumulator (hydraulic)	Should not be confused with electrical accumulator or battery (see item 2).
(2)	Battery (electrical)	Electrical accumulator.
(3)	Check valve (hydraulic)	Non-return valve.
(4)	Cotter pin	Split pin.
(5)	Clevis	Fork or knuckle joint.
(6)	Cylinder (hydraulic)	Jack
(7)	Dump valve	Jettison valve
(8)	Gasoline	Petrol
(9)	Ground (electrical)	Earth
(10)	Kerosene	Paraffin
(11)	Panel wing - Centre or inboard panel	Centre section
	Outboard panel	Outer plane
(12)	Propeller	Aircrew
(13)	Reticule (gun sight, etc.)	Graticule
(14)	Ship	Aircraft
(15)	Stabilizer - Horizontal	Tail plane
	Vertical	Fin
(16)	Tube (radio)	Valve
(17)	Valve (fuel or oil)	Cock

Crew members

(18)	Bombardier or bomber	Bomb-aimer
(19)	Co-pilot	Second pilot

Instruments

(20)	Flight indicator	Artificial horizon
(21)	Gyro horizon	Artificial horizon
(22)	Gyro pilot	Automatic pilot
(23)	Tachometer	Engine speed indicator
(24)	Turn indicator	Direction indicator

SECTION IIDESCRIPTION1. Airplane.

a. General. - The P-47B Pursuit Airplane is a single-place low-wing monoplane of all-metal construction, incorporating retractable landing gear and N.A.C.A. slotted trailing edge flaps. It is powered with a type R-2800-21 engine. The overall dimensions in normal position at rest are: 40 feet, 9-5/16 inches, Length with thrust line horizontal 34 feet, 10 inches, Height (normal, with propeller blades in 45° position) 12 feet, 8 inches.

b. Wing. - (1) General: The wing is of full-cantilever stressed-skin construction, built in two main panels and two tip sections. The main panels contain the landing gear retraction wells, the trailing edge flaps, and the ailerons. The left hand panel also houses one Type B-1 aircraft landing lamp. The removable wing tips contain the position lights.

(2) Ailerons: The ailerons are of the Frise type, incorporating dynamic, aerodynamic, and complete static balance, and extend from the outer end of the flaps to the wing tips. The left aileron is equipped with a trailing edge trim tab which is controllable in flight. The ailerons are of all-metal construction.

(3) Flaps: Wing flaps are of the N.A.C.A. slotted trailing edge type. They extend from the fuselage to the inboard end of the ailerons, are of all-metal construction and have three hinges of a trapezoidal-linkage type. Doors are provided to close the lower side of the flap slots when the flaps are up. Each wing panel has six such doors, three of them, located at the hinge stations, being quite small. These doors are operated by the flap operating mechanism. The three main doors open slightly to permit the initial movement of the flap and then move upward to a position where they form the forward surfaces of the slot.

c. Empennage. - (1) Horizontal Stabilizer: The horizontal stabilizer is of aluminum alloy and is of all-metal construction, including the cover. It is of the cantilever type with continuous spars, the right and left sides forming one unit. It is bolted to the vertical stabilizer and the complete assembly is then placed on the fuselage tail and bolted in position. Aft of the rear spar of the stabilizer and supported by it is the elevator trim control mechanism consisting of cables, chains and sprockets.

(2) Elevators: The elevators are of corrosion resisting steel construction with fabric covering and are equipped with trim tabs which are operable in flight. They are in complete static and dynamic balance. The two halves of the elevator are connected through the control horn which is attached to both right and left torque tubes and thus serves also to couple them together.

(3) Rudder: The rudder is of corrosion resisting steel construction with fabric covering and is equipped with a controllable trim tab which is operable in flight, and which is also used as a balancing tab. A cable-operated control horn is located at the base of the rudder near the center line of the airplane. The rudder is in complete static and dynamic balance. The rudder carries the aft position light.

(4) Vertical Stabilizer: The vertical stabilizer is of aluminum alloy and aluminum alloy covered and is of all-metal construction including the cover. It is of the cantilever type and is bolted to the horizontal stabilizer spars. The complete assembly is then bolted to the fuselage. Aft of the rear spar of the vertical stabilizer and supported by it, is the rudder trim tab control sprocket housing.

d. Fuselage. - The fuselage is of semi-monocoque construction, its structure consisting of transverse frames and continuous longitudinal stringers, with a stressed skin of aluminum covered aluminum alloy, the skin varying in thickness from .032" to .051". The engine mount is of welded steel tube and is detachable as a unit. The firewall is of stainless steel and a crash protector of aluminum alloy construction is provided.

Both the main fuel tank and the auxiliary fuel tank are located in the fuselage. The main tank is located beneath the cockpit floor at the forward end; the auxiliary tank is just aft of the main tank and both tanks are removable through the bottom of the fuselage.

A rear compartment is provided in the fuselage aft of the pilot's compartment. This compartment is accessible through a door on the right side and in it are located the radio communications set, the oxygen tank and other equipment. The compartment provides access to the upper ducts, the upper side of the inter-cooler and supercharger, and to portions of the empennage control installation.

The tail wheel retracts into a well near the tail of the airplane; with the wheel retracted, this opening is closed by doors which operate automatically.

e. Landing Gear. - (1) General: The landing gear is of the fully retractable type, hydraulically-operated and consisting of right and left hand units. At the left of each unit is an air-oil shock strut with its upper end connected to the wing by a hinge. Drag loads are taken through this hinge and side loads are taken by a down-lock pin. Retraction is accomplished by a hydraulic mechanism which pushes each strut inboard, upward and slightly rearward until it comes to rest completely inside the wing. During retraction the shrinkage strut reduces the length of the shock strut, and holds the shock strut in this contracted position while inside the wing. Fairing attached to the shock strut closes the major part of each opening. The remainder is closed by a door hinged to the inboard rib on each side and actuated by a separate hydraulic cylinder working in synchronism with retraction and extension of the gear.

The landing gear may be retracted or extended hydraulically either by engine pump or the hand pump. It can also be extended and locked by gravity. For operation of the landing gear see Section III, Paragraph 2. b.

(2) Locks: A spring latch engages each shock strut when retracted; this latch is connected to the control handle in such manner that movement of the handle to the down position releases the latch. Each strut is locked in the down position by means of a spring actuated locking pin which engages an arm on the strut. This lock pin is released by means of a small hydraulic cylinder which is operated in sequence with the retracting mechanism.

(3) Warning Horn: A landing gear warning horn is provided. A switch on each landing gear leg, and one at the tail wheel, in combination with a switch operated by the throttle control rod, cause a horn to sound if the throttle lever is moved towards the "Closed" position when the landing gear is not in the fully extended and locked position for landing.

(4) Position and Lock Indicator: An electrically operated landing gear position indicator is provided in the cockpit to show the position of main and tail wheels and the main landing gear locks. The position transmitter units for the main wheels are mounted in the structure of the wing and are actuated by arms connected (through linkage) to the air-oil struts. Lock indications is accomplished by use of switches actuated by each lock.

(5) Brakes and Wheels: Bendix wheels with drum-type hydraulic brakes and 34" x 9" high pressure tires are provided. The brakes are operated by Warner master brake cylinders which are provided with integral reservoirs and expansion chambers to compensate for temperature changes while parked.

(6) Tail Wheel: (a) The tail wheel is of the steerable type, interconnected with the rudder controls, with a 14-1/2" smooth contour tire, and is fully retractable in flight. When the tail wheel mechanism starts to retract, the steering control disconnects automatically to prevent restriction of rudder movement. When the wheel is retracted it automatically locks in the center position and it extends locked, automatically returning the cockpit handle to the "locked" position. When the wheel is set "Steerable" a "kick-out" disconnects the coupling to the pedals in case of a sudden side thrust on the tail.

(b) The tail wheel is extended and retracted hydraulically and operates simultaneously with the main gear. The tail wheel enclosing doors are linked to the tail wheel mechanism and operate with it. The up lock consists of a spring-loaded latch which engages a roller on the Vee brace of the tail wheel mechanism and held locked by a toggle mechanism. This latch is connected to the landing gear operating lever in the cockpit and is released when the lever is moved to "Down".

2. POWER PLANT

a. Engine. - See Section V for description.

b. Propeller. - The propeller is a four-blade Curtiss Electric Controllable constant speed type 12' -2" diameter.

c. Oil System. - (1) General: The oil tank is located in the upper part of the engine compartment; the filler is located on the left end of the tank and is accessible through the cowl door marked "Oil". The tank has a total capacity of 28.6 gallons of which 19.1 gallons is normal, and 9.5 gallons is overload. The overload capacity is obtained by filling until oil drips from the normal level petcock in the left end of the tank below the filler. An oil dilution system is provided for cold weather operation.

(2) Oil Coolers: Two oil coolers are installed one on each side, in the lower part of the engine compartment with their exit air ducts leading to an exit in the bottom cowl. In these ducts are adjustable split doors electrically operated and controlled from the cockpit.

d. Fuel System. - Refer to Figure 2.(1) Tanks: The fuel system includes a main tank and an auxiliary tank both of which are in the fuselage under the floor of the pilot's compartment; part of the main tank also extends somewhat above the floor level forward of the compartment. Both tanks are self-sealing in event of puncture, the tank walls being formed of a composition faced with neoprene. If a tank is punctured the composition swells upon contact with gasoline, thus closing the opening.

The main or normal supply tank has a total capacity of 310 gallons including the reserve supply of 25 gallons; the auxiliary or overload tank has a capacity of 100 gallons and the total capacity of the system is 310 gallons. Reserve supply is obtained by means of a standpipe in the main tank. Each tank is filled by means of a standard filler cap on the right side of the fuselage. Provision for grounding the fuel filler nozzle to the airplane consists of a pair of jacks located behind a door in the fuselage between the two filler caps. This door is marked "Ground Here".

(2) Operation of System: The fuel is supplied to the carburetor by means of a pump mounted directly on the engine, assisted by an electrically operated two-stage "Booster" pump in the sump of each fuel tank. By means of a combined booster pump and Aero Supply Type PG-3 selector valve, 12-1140-23 style G, the fuel can be drawn from either the normal or reserve outlets of the main fuel tank sump or from the auxiliary tank sump. Connection to the reserve outlet is direct and the reserve supply does not pass through the booster pump. From the selector valve all fuel passes through the Lunkenheimer M-4551 Type C-3 strainer, to the engine pump, thence to the vapor eliminator and to the carburetor.

e. Turbine Supercharger Installation. - (1) Supercharger Unit: The turbine supercharger unit is a General Electric Company Type C-1 which includes an exhaust gas turbine direct-coupled to a centrifugal blower type of supercharger. This unit is located in the fuselage supported from frames 267.5 and 285 and serves to boost the pressure of the air entering the carburetor. It is designed to maintain a constant air pressure at the carburetor up to an altitude of 25,000 feet.

(2) Duct System and Intercoolers: From the exhaust collector ring of the engine the gases are carried aft to the turbine through two ducts running in recesses in the lower part of the fuselage. A waste gate is installed in each duct just ahead of the firewall to provide a means of controlling the amount of exhaust gases allowed to reach the supercharger. Fresh air is supplied to the supercharger unit and to the intercoolers through a duct extending from inside the lower center of the nose ring. Air leaving the blower is directed through intercooler radiators in order that excess heat may be removed before the air reaches the carburetor.

(3) Regulator Unit: Within the range selected by the pilot through use of his supercharger control level the degree of supercharging is controlled by an Eclipse Type A-114 supercharger regulator mounted on the forward face of the firewall at the cross tie and in the center near the bottom of the fuselage. This regulator contains a vacuum bellows which pulls against another bellows connected, by piping, to the exhaust duct. Movement of the two bellows operates a piston valve controlling the application of engine oil pressure to a cylinder-and-piston mechanism which, in turn, controls the position of the waste gates in the exhaust ducts. The operation of the unit is such that the waste gates are opened or closed by variations in the exhaust back pressure and the degree of supercharging is thus controlled by the exhaust back pressure. The pilot's control of the supercharging range is provided by varying the pressure applied to a spring which limits the free movement of the two bellows. When this control lever is set all of the way over to "Off" the waste gate is held full open.

3. EQUIPMENT.

a. Flight Controls. - Conventional stick and rudder pedal flight controls are provided. The rudder pedals are adjustable fore and aft through a range of five positions or four inches. The adjustment lever is toe operated and is located on the outboard side of each pedal. Rocking the pedals, by toe pressure, applies the brakes. All flight controls are locked by means of a single lever located on the right of the control stick cradle.

b. Electrical System. - An electrical wiring diagram, Republic Drawing 89X82101 is included in the data case of the airplane. The system is of the one-wire grounded return type throughout.

c. Fuselage Equipment. - (1) Seat: A standard pilot's seat and a type B-11 safety belt are provided. The seat has a four inch vertical adjustment.

(2) Map Case: A map case is mounted on the right side of the cockpit near the pilot's seat.

(3) Flight Report Holder: Flight reports 1 and 1A are carried in the Map Case.

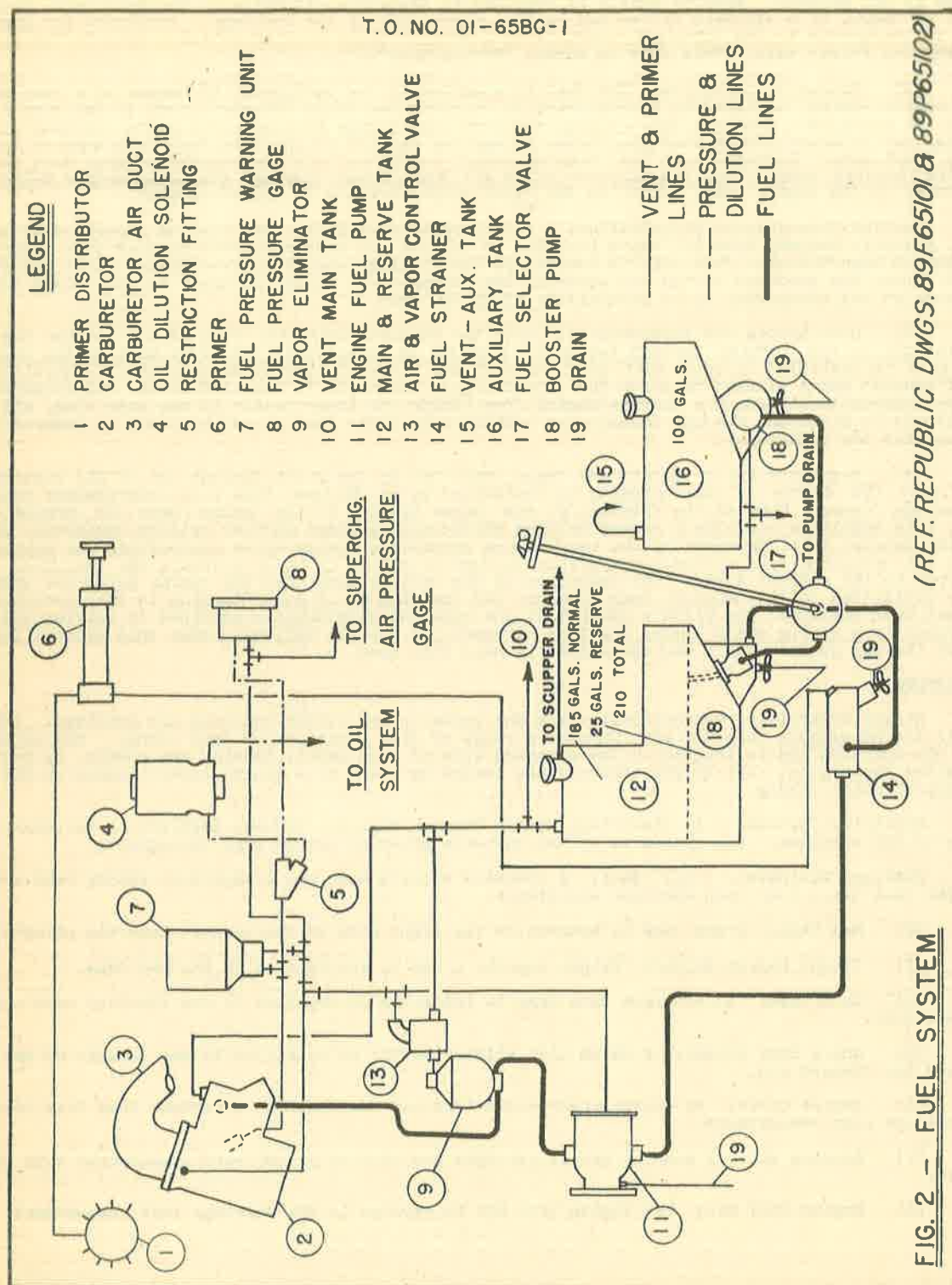
(4) Data Case: An airplane data case is installed on the back of the fuselage rear compartment access door.

(5) Check List Holder: A check list holder 39D3921 is installed in the cockpit on the right side toward the forward end.

(6) Engine Cover: An engine cover is provided and carried as an alternate load item in straps in the fuselage rear compartment.

(7) Mooring Kit: A mooring kit is provided and carried in the rear compartment with the engine cover.

(8) Engine Tool Kit: The engine tool kit is carried in the fuselage rear compartment.



(9) Rear Compartment: A rear compartment entered by a door on the right side, is provided in the fuselage to provide service access to the rear installations. Provision is made in this compartment for carriage of a limited amount of baggage or other articles.

(10) Cockpit Enclosure: (a) The cockpit enclosure consists of three parts: The windshield, the sliding canopy and emergency exit section, and the rear window section.

(b) Windshield: A safety-glass windshield of streamline form is used. Aft of the windshield is a $1\frac{3}{4}$ " thick panel of bullet-proof glass.

(c) Sliding Canopy Section: The sliding canopy section encloses the space between the windshield and the rear window. It moves fore and aft on rails by means of rollers and is provided with quick release panes for exit in emergency. It is operated by a handle at the forward end near the top and can be locked in any one of five positions. For emergency exit and access through this canopy, see Section III, Paragraphs 2. d. (5) and 2. d. (6) respectively.

(d) Rear Window Section: The rear window section consists of fixed panes of flexible transparent sheet carried in a fixed aluminum alloy frame.

d. Ventilating System. - A cockpit ventilating system admits fresh air through a 2" tube running from the leading edge of the right wing into the cockpit. The control of fresh air is maintained by push-pull control operating a sliding door located on the right side of the cockpit.

e. Oxygen Equipment. - A low pressure gaseous oxygen system is installed with provision for Type F-1 oxygen cylinder in the forward part of the fuselage rear compartment. A type A-9 regulator is located on the right side of the cockpit adjacent to the instrument board.

f. Communications Equipment. - Command Set SCR-283 is provided with fixed wire antenna. Control boxes are in the cockpit; transmitting and receiving sets are located in the front part of the fuselage rear compartment. A push-to-talk button control located on the throttle arm changes the Command Set from "Receive" to "Transmit".

g. Gun Equipment. - (1) Guns: Provision is made for the installation of eight .50 caliber Model M-2 guns, four in each wing just outboard of the landing gear and outside of the propeller disc. Only six guns and ammunition, however, are included in the airplane design useful load. Two guns and ammunition are alternate load. No rounds indicators are provided.

(2) Gun Sight: A type N-3A gun sight (Drawing No. 3906436) is installed substantially in accordance with Method A, Drawing No. H3905342. As the Vee type windshield prevents installing the gun sight on the center line of the airplane, provision is made for mounting the sight on either side thereof to suit the convenience of the pilot.

(3) Gun Control: Control of all guns is by means of a type B-1A control stick switch assembly (Drawing No. 0169221) in combination with Type G-4A solenoid assemblies for the guns. The trigger switch fires all guns simultaneously. The safety switch is a Type B-5A installed on the switch box on the left wall of the cockpit.

Gun Charging is by means of Bendix #76862 hydraulic gun chargers controlled by four Bendix #76861 valves located on the left wall of the cockpit at the side of the seat. Reading from front to rear the valves control the guns from left to right thus:

Front: Left wing guns 3 and 4
Left wing guns 1 and 2

Right wing guns 1 and 2
Rear: Right wing guns 3 and 4

h. Armor. - Provision is made for the installation of removable steel armor behind the pilot, extending from the bottom of the seat to the top of the head and through an angle of 20 degrees to either side of the pilot's body, and a front sheet of $\frac{3}{8}$ " armor plate (also removable) extending from the top of the fuel tank to approximately $1\frac{3}{8}$ " above the fuselage skin contour.

SECTION IIIGENERAL INSTRUCTIONS1. LOCATION OF CONTROLS.

(Refer to Figures 4 and 5)

- a. Flight Controls. - Stick and Rudder Pedals - Conventional position.
- Aileron Trim Tab - Edge of wheel projecting from box on left side of the cockpit.
- Rudder Trim Tab - Edge of wheel projecting from box on left side of the cockpit.
- Elevator Trim Tab - Crank on box on left side of cockpit.
- Flaps - Lever on left side of the cockpit.
- Surface Controls Lock - Lever on right side of control stick cradle.
- b. Landing Gear Controls. - Retracting Valve Control - Lever at left side of cockpit near engine controls.
- Hand Pump - Long Lever at left side of cockpit.
- Brakes - Rudder pedals.
- Parking Brake - Knob on bracket in center below instruments.
- Landing Gear Warning Horn Release - Switch on main switch box.
- c. Power Plant Controls. - Throttle, Mixture, Supercharger and Propeller - Levers grouped at left side of cockpit.
- Fuel Cock Control - Lever on left side of cockpit.
- Fuel Booster Pumps - Speed regulating rheostat on main switch panel.
- Oil Cooler Controls - Switch on main switch panel.
- Engine Primer - Knob on small panel to the right of instrument board.
- Ignition Switch - Left side of instrument panel.
- Starter Control - Double throw switch in the upper right corner of instrument panel.
- Cowl Flaps - Valve handle on small panel to the right of instrument panel.
- Intercooler Flaps - Switch on main switch panel.
- Oil Dilution Switch - On main switch panel on left of cockpit.
- Rudder Pedal Adjustment Release - Outboard side of each pedal.
- Seat Height Adjustment Lever - On right side of seat.
- Ventilation Control - Push-pull knob near floor on right side of cockpit.
- Oxygen Regulator - On small panel to the right of instrument board.
- Radio Transmitter and Receiver Controls - Grouped together on right wall of cockpit.
- Landing Lamp Control - On main switch panel.
- Sliding Canopy Release - Lever on crossbar handle at top front inside with extension through canopy to permit operations from outside.
- Emergency Exit - Push-out mullion between the two forward panes on each side of the canopy, and a locking lever to safety the "push-out".
- Dead Lock For Emergency Exit - Locking bar at operating mechanism for push out.
- Dead Lock for Canopy - Cylinder lock at sliding canopy release lever.

2. OPERATION OF CONTROLS.

a. Flight Controls. - (1) General: Operation of the stick and rudder pedals is conventional.

(2) Aileron, Rudder and Elevator Trim Tabs: Rotate the control until the desired position is indicated by the pointer.

(3) Flaps: (a) Flaps are for use during take-off and landing only. They may be fully extended for landing and may be extended a few degrees for take-off and initial climb. For additional instructions refer to T. O. No. 01-1-60.

(b) To extend the flaps move the control lever to "Down" position. The flaps will stop when fully extended.

(c) To move the flaps to partially extended positions, move the control lever back to "Neutral" when the desired position is indicated.

(d) To raise wing flaps place the control lever in the "up" position with engine running.

CAUTION: When full flaps are used for take-off, the pilot should be very careful not to pull the ship off the ground at too low an airspeed since it will be found that in this condition, there is hardly sufficient rudder control at speeds near the stall. With the flaps in the "down" position, the position of the flaps will depend upon the airspeed. Up to approximately 140 mph they will remain full down and will raise as speed is increased until they are practically up at 200 mph. The flap handle should be moved to "up" prior to attainment of 200 mph indicated airspeed to relieve pressure from the hydraulic system.

NOTE: It will be found that 15° or more flaps will improve the take-off. The shortest take-off is gained by the use of full flaps. However, this is recommended only for the purpose of short field take-offs due to the fact that the airplane picks up speed very slowly after it is airborne.

(4) Control Lock: To lock the flight controls, push the stick full forward, pull back on the locking lever, and adjust the stick until the locking plate engages. To release the lock, push forward the locking lever.

b. Landing Gear Controls. - (1) As a safety measure, to prevent accidental retraction of the landing gear while the airplane is resting on the ground, a safety lock is installed on the control lever which prevents the lever from being moved "Up" unintentionally. No restriction is placed on the "Down" shift of the control valve. A trigger is attached to the safety lock which permits the lock to be released at the direction of the pilot or mechanic. This trigger lock, however, should never be released on the ground except when the airplane is supported by jacks and it is desired to check the function of the gear.

(2) To retract the landing gear and tail wheel trip the safety latch and move the landing gear control valve lever to the "Up" position.

(3) To extend the landing gear and tail wheel move the control valve to the "Down" position.

(4) In the event of failure of the engine driven hydraulic pump proceed as follows:

(a) To retract the landing gear and tail wheel move the control valve in the usual manner and operate the hand hydraulic pump located at the left side of the seat until the position indicator shows that the gear is up and locked.

(b) To extend the landing gear and tail wheel move the control lever in the usual manner. This will release the gear which should drop into position and lock due to its weight. If it does not fully attain the locked down position operate the hand pump until the "Locked" signal is given.

(5) To extend the landing gear and tail wheel in event of hydraulic system failure, move the control lever as in the above paragraphs. This motion releases the gear which drops, due to its own weight, and usually falls to the fully extended and locked position. In case air pressure prevents one wheel from fully attaining the locked position, it can be shaken into place by such a degree of yaw to each side as is found necessary.

(6) Warning Horn: If at any time the throttle is retarded when the wheels are not in position for landing, a warning horn (located behind the pilot) will sound. If it is desired to disconnect the horn for a long glide with the wheel "Up" trip the switch release where it engages the throttle control rod. When the throttle is open the catch will re-engage, sounding the horn when the throttle is again moved toward the closed position.

Figure 3Cockpit Arrangement and Controls - Left

To be issued when available

Figure 4Cockpit Arrangement and Controls - Right Side

To be issued when available

(7) Tail Wheel: The tail wheel may be set "locked" or "steerable" by use of a lever on the floor of the cockpit at the right. When the wheel starts to retract while the lever is set on "steerable" the steering control is automatically disconnected and a spring mechanism returns the wheel to the center position. When the wheel is subsequently extended (if the lever is set on "steerable") it remains centered and the lever returns automatically to "locked". A "kick-out" mechanism disconnects the wheel from the pedals and permits it to swivel in case of a sudden thrust on the tail.

(8) Brakes: Service brakes are independently operated by toe pressure applied to the rudder pedals. To lock the brakes, press down on the toe of the pedals and pull the parking brake knob; hold the knob while releasing the brake pedals, then release the parking knob. To release the parking brake, press the toe of the pedals; the brakes will release when this pressure is removed.

c. Power Plant Controls. - (1) General: Operation and Flight Instructions pertaining to the R-2800-21 engines are contained in T. O. No. 02-10GA-1, T. O. No. 02-1-5 on the Operation of Carburetor Heaters and to T. O. No. 03-10G-1 on the Operation of Carburetor Mixture Controls.

(2) To Start the Engine: To start the engine the following sequence of Operations should be followed:

(a) See that the emergency exit dead lock is released (Refer to paragraph 2. d. (4) of this section.

(b) If the engine has been standing idle, turn it over four or more revolutions by pulling the propeller through by hand. If it requires abnormal effort to pull the propeller through by hand remove a spark plug from each of the lower cylinders so that any accumulated fuel or oil may readily escape. Then turn over as instructed above and replace the plugs.

(c) Reach into the supercharger flight hood and spin the turbine wheel by hand to be sure it revolves freely.

(d) Open the throttle to a position which will give about 600 to 800 R.P.M.

(e) Set the mixture lever on "IDLE CUT-OFF".

(f) Set the supercharger control to "OFF".

(g) Set the propeller lever to "INCREASE RPM".

(h) Set the booster pump switch on "Start and Altitude".

(i) Turn the fuel cock to "MAIN". This automatically starts the booster pump operating for this tank. Wait until pressure gage shows 9 to 11 pounds.

(j) Prime the engine with the primer pump, two to four strokes. (The amount of priming varies with conditions, mainly air and engine temperatures.) See T. O. No. 02-10GA-1.

(k) Turn the ignition switch to "BOTH ON".

(l) Move the starter switch lever to the left and hold until the inertia starter comes up to speed.

(m) Move the starter switch lever to the right to engage the clutch and hold in this position as long as necessary.

(n) Approximately 3 seconds after the engine fires move the mixture control lever to "AUTOMATIC RICH".

WARNING: If the mixture control is moved out of "IDLE CUT-OFF" while the booster pump is running and the engine is not running, fuel will be forced through the fuel injection jets into the blower housing and the engine will be flooded. Should it be found necessary to supply fuel to the engine without the use of the booster pump, set the fuel selector valve on "RESERVE". "RESERVE" is the only position in which the booster pump does not operate.

(o) As soon as the engine comes up to speed, the fuel pressure should be 14 to 16 pounds.

(p) After warming the engine up check its operation with the fuel cock set on "RESERVE" and "AUXILIARY".

(q) In checking magnetos, the engine should be operated on one magneto as short a time as possible and should never be more than 15 seconds per magneto or 30 seconds total in checking both magnetos. This magneto check should be made at a manifold pressure of not more than 30" Hg.

(3) To Warm Up the Engine: See the general instructions in Pratt & Whitney "Operators' Handbook".

(4) Propeller: Complete operating instructions for the propeller are contained in T. O. No. 03-20B-1.

(5) Use of Cowl Flaps: These flaps provide a means of controlling air flow around the engine and should be full open for all engine runs on the ground (including warm-up runs) all taxiing and for climbing. During the take-off run, however, they should be set closed to about 15 degrees in order to reduce the drag. They should be closed or partly closed in level flight and in gliding as dictated by cylinder head temperature. To operate, pull the valve knob to open or push it to close and hold until the desired position is reached. Intermediate settings can be obtained by releasing the knob when the desired opening has been reached. The knob will automatically return to neutral position and the cowl will remain in the intermediate position.

(6) Use of Oil Coolers Control: The left and right oil coolers are controlled by a switch and electric motor which operates a door and a flap in each cooler outlet duct and is provided with a position indicator. The doors provide means whereby the air flow can be completely shut off in each cooler when it is desired to warm the oil in the shortest possible time. The flaps provide means whereby additional air can be made to flow through the coolers during a long climb or ground operation. When the indicator reads "Closed" both the doors and flaps are closed. When it reads "Normal" the doors are open but the flaps are closed; when it reads "Open" both doors and flaps are open.

Care must be exercised in the use of this control as improper settings at low temperatures might cause oil to so congeal in the cooler as to interfere with normal flow even after the engine oil has been warmed up. For all ordinary flight conditions the indicator should be set at "Normal", correct oil temperature being maintained by the automatic valve in each cooler.

(7) Use of Booster Pumps: The main and auxiliary tank booster pumps are installed to insure sufficient head at the engine pump inlet when flying in any attitude and at any altitude.

(8) Use of the Fuel Gage: The fuel quantity gage will not indicate correctly unless the airplane is in level flight position. This gage is of the electric type and indicates the contents of either tank as selected by the fuel selector valve and fuel gage switches. To read correctly the fuel selector valve and fuel gage switches must be set on "Main" or "Auxiliary" positions and the ignition switch on "Battery", "Left Mag", "Right Mag" or "Both". A Three Point Calibrated Card is mounted on the instrument panel. This card is used to interpret the readings on the fuel quantity gage while the airplane is on the ground.

(9) Use of Oil Dilution Valve: Use of this valve is required only in cold weather. Before the engine is stopped in cold weather, close the dilution switch for about 4 minutes, with the engine idling. Refer to T. O. No. 02-10GA-1.

(10) Use of Supercharger Control: The airplane is equipped with an exhaust-driven turbo supercharger. For Take-offs, it will be found that under standard atmospheric conditions, full throttle will give approximately 47" Hg. manifold pressure at 2,700 R.P.M. or approximately 1,775 H.P. Full military horsepower (2,000 H.P.) may be used for take-off by additional boost from the turbo supercharger to 51" Hg. manifold pressure. For general instructions on the operation of the supercharger, see T. O. No. 03-10DA-2. Attention is called particularly to the warning against over-speeding the supercharger, as given in the above Technical Order (No. 01-10DA-2).

d. Other Controls and Adjustments. - (1) Pedal Adjustments: To adjust the rudder and brake pedals hold one pedal in a fixed position with one foot; with the other foot press outboard on the adjustment lock lever located on the outboard side of the other pedal. This releases the lock whereupon the pedal can be moved freely to the desired position. A spring serves to draw the released pedal closer to the pilot if foot pressure is eased. While holding the adjustment lever, adjust the pedal to the desired position, release the lever and move the pedal slightly until the locking pin re-engages. Repeat this operation to adjust the other pedal. The adjustment provides five positions for each pedal.

(2) Seat Adjustment: The seat is constructed to Air Corps Specification No. 25266. It may be raised or lowered by pulling up the lock release handle on the right side and it may be locked in any one of nine positions.

(3) Window Adjustment: The sliding canopy may be set in any one of several positions by releasing the locking overhead handle, moving the canopy to the desired position and adjusting the position until the lock pins re-engage the nearest hole. The canopy can be moved to any position in flight but it is not intended to be used for ventilating the cockpit. See Section II, paragraph 3. d.

(4) Dead Locks: To release the dead lock of the emergency exit, swing locking bar 180° aft on both sides. The dead lock of the sliding canopy is released by unlocking the cylinder lock when first opening the canopy.

(5) **Emergency Exit in Flight:** Release the canopy flaps by pulling down the handle on the right forward edge of the canopy. (This is necessary only at high speed.) Push the canopy all of the way back in the usual manner.

(a) **For emergency release of Side Panels from Inside:** Turn the emergency release handle 180° until it snaps into place. Push out the mullion between the windows. Push out the windows.

(6) **For Emergency Access to the Cockpit through the Canopy from either Side:** Remove the red cover plate at the lower edge of the canopy, pull out the handle thus exposed. Pull out the mullion between the two panes by means of the ring located at its lower end. Pull out the panes.

(7) The cal. .50 wing guns are charged by means of a hydraulic system, the major components of which are Bendix charging valves mounted on the left rear corner of the cockpit and Bendix charging cylinders mounted on the guns. A shutoff valve is mounted immediately inboard of the charging valves which when closed disconnects the entire gun charging system from the remainder of the hydraulic system in the airplane. It is desirable that the shutoff valve remain closed when the charging system is not likely to be used. Be certain the landing gear and wing flap hydraulic selector valve control levers are in the neutral position before operating the gun charger valves. Then place the shutoff valve handle in the up or open position. Guns, if likely to be used, should be charged before take-off. Turn the charger valve handle clockwise until it hits the interval stop and depress as far as it will go, remove the hand; a complete charging cycle will be accomplished and the handle will return to the raised position. If the handle is turned counter-clockwise against the stop and depressed, the gun will remain in the rear or "Safe" position. When the valve is turned back clock-wise to the other stop the gun will return to the forward or "Battery" position. The order in which the four charging valves control the guns is given in Section II paragraph 3. g. (3). Do not depress more than one valve at a time. Wait until a complete charging cycle has been accomplished by the valve first depressed before depressing another. When completing flight return all guns to rear or "Safe" position as described above, and close the shutoff valve.

NOTE: THERE IS A DEFINITE AND POSITIVE STOP AT THE "SAFE" AND "BATTERY" POSITIONS OF THE GUN CHARGING HYDRAULIC CONTROL VALVE. THE VALVE HANDLE MUST NOT BE LEFT IN ANY POSITION BETWEEN THE TWO CORRECT SETTINGS.

CAUTION: ALWAYS RETURN THE GUN SAFETY SWITCH TO THE "OFF" POSITION AND TURN THE GUN CHARGING HYDRAULIC VALVE CONTROL TO "SAFE" BEFORE ATTEMPTING TO LAND THE AIRPLANE. FAILURE TO FOLLOW THIS PRECAUTION MAY RESULT IN ACCIDENTAL FIRING OF GUNS.

SECTION IV

SPECIAL INSTRUCTIONS

1. FLIGHT LIMITATIONS.

a. **Flaps.** - Do not exceed 190 miles per hour with the flaps down. The flaps should be closed immediately after landing and prior to taxiing in order that they may not be damaged by gravel, ice or other materials likely to be thrown back by the propeller.

b. **Landing Gear.** - Do not exceed 250 miles per hour when the landing gear is extended. Do not exceed 200 miles per hour while the landing gear is in operation. The usual warning horn indicates that landing gear is up when throttle is removed toward "Closed" position.

c. **Climb.** - Cowl flaps, oil cooler flaps and shutters and intercooler flaps should be open in climbs. Military power is permitted for 5 minutes only. It has been found that 165 mph is the most satisfactory climbing speed.

Booster pumps should be placed in "Start and Altitude" position around 10,000 feet. It may be left in that position throughout the entire flight, or may be turned off at lower altitudes. In case of fuel pressure failure or fluctuation, at any altitude, use Emergency position and adjust fuel pressure by rheostat.

d. **Level Flight.** - Level flight below critical altitude will normally be accomplished with cowl flaps "Closed", oil temperature regulator flaps "Neutral" and intercooler flaps "Neutral". Start and Altitude booster pump must be turned on above 10,000 feet.

CAUTION: Full power should not be used above 25,000 feet pressure altitude due to over-speeding of turbo supercharger. It is recommended that the manifold pressure be reduced to 2" Hg below military power, per thousand feet above 25,000 feet.

e. Stalls. - Wheels and flaps up, the airplane stalls at approximately 105 mph power off and about 98 mph power on. An aileron buffet is noticed just before the stall is reached. There is no violence or fast rolling as the stall is reached.

Wheels and flaps down, the speed of the stall is approximately 95 mph power off and about 85 mph power on. The above figures are at normal load conditions.

It will be noticed that a complete stall is difficult, or even impossible to obtain with wheels and flaps down and full power on, due to the effect of torque and the inability to hold the airplane straight with the rudder.

f. Spins. - Preliminary spin tests indicate a conventional spin and recovery technique. However, the most satisfactory recoveries have been accomplished by using full rudder and aileron simultaneously, against the spin. The stick should be pushed against the spin direction from about the neutral position. Intentional spins of more than one turn are prohibited.

g. Landing. - The speed should be reduced to 200 mph or less before lowering the landing gear. Press the button on the end of the landing gear control lever and place the lever full down. The lever is left in this position until it is again desired to retract the gear.

NOTE: The Neutral position is used only in case of failure of the engine driven hydraulic pump permitting the landing gear to be lowered by gravity. In this case, after the gear is locked, the landing gear handle may be placed in "Neutral", and the flaps lowered by use of the hand operated hydraulic pump.

CAUTION: This airplane is extremely heavy and pilots should keep that fact in mind until such time as thorough familiarity with the airplane has been achieved. Turns at low altitudes at under 150 mph should be made with extreme care.

h. Gliding. - The gliding speed is about 130 to 135 mph power off, which can be reduced to as low as 115 mph if power is used.

SECTION V

POWER PLANT

1. ENGINE.

a. General. - This airplane is powered with a Pratt & Whitney R-2800-21 twin row, supercharged air cooled engine. The propeller gear ratio is 0.5:1 crankshaft speed. The built-in supercharger impeller gear ratio is 7.6:1 crankshaft speed. The built-in supercharger is located between the carburetor and cylinders in the conventional manner. An exhaust turbine-driven supercharger unit is also provided and is completely separate and remotely installed as described in Section II paragraph 2. e., of this Handbook. For general instructions covering operation of the Pratt & Whitney model R-2800-21 engines see T. O. No. 02-10GA-1.

b. RATINGS. - (Using 100-octane gas)

	B.H.P.	R.P.M.	Manif. Press. Max. In. Hg.	Alt. Ft.	Time Limit
Takeoff	2000	2700		S.L.	5 min.
Military	2000	2700		25,000	5 min.
Cruising (Desired)	1100	2250			
Normal	1625	2550			

Maximum Diving Speed - 3060 R.P.M. for 30 seconds duration.

SECTION VIFLYING CHARACTERISTICS

(Will be issued when available)

SECTION VIIWEIGHT DATA

1. ESTIMATED AND ACTUAL

	<u>OVERLOAD</u>	<u>NORMAL</u>
Weight Empty (including radio and oxygen equipment)		9483 lbs.
Useful Load (Design)		2925 lbs.
Crew One at 200 lbs.		200 lbs.
Fuel (One main Tank = 210 Gal. One Aux. Tank = 100 Gal. Total 310 Gal.)		
Normal Load incl. reserve 210 Gal.		1260 lbs.
Additional 100 Gal	600 lbs.	
Oil (One Tank = 28.6 Gal.)		
Normal Load 19.1 Gal		143 lbs.
Additional 9.5 Gal	72 lbs.	
Armament		
Guns, Fixed, Wing - 6 - .50 Cal.		420 lbs.
Guns, Fixed, Wing - 2 - .50 Cal.	140 lbs.	
Ammunition, 3000 Rounds .50 Cal.		900 lbs.
Ammunition, 1000 Rounds .50 Cal.	300 lbs.	
Miscellaneous Equipment		
Engine Cover	25 lbs.	
Tool Kit	7.0 lbs.	
Mooring Kit	11.2 lbs.	
Gross Weight		12408 lbs.
Wing Loading, Normal Gross Weight 12408/300=		41.36 lbs.
Power Loading Normal Gross Weight 12408/2000=		6.20 lbs. H.P.

SECTION VIIICALIBRATED SPEED AND GAS CONSUMPTION CURVES

(Will be issued when available)

RANGE CHART

(Will be issued when available)

STANDARD

FOR THE YEAR 1900

AND THE FIRST QUARTER OF 1901

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