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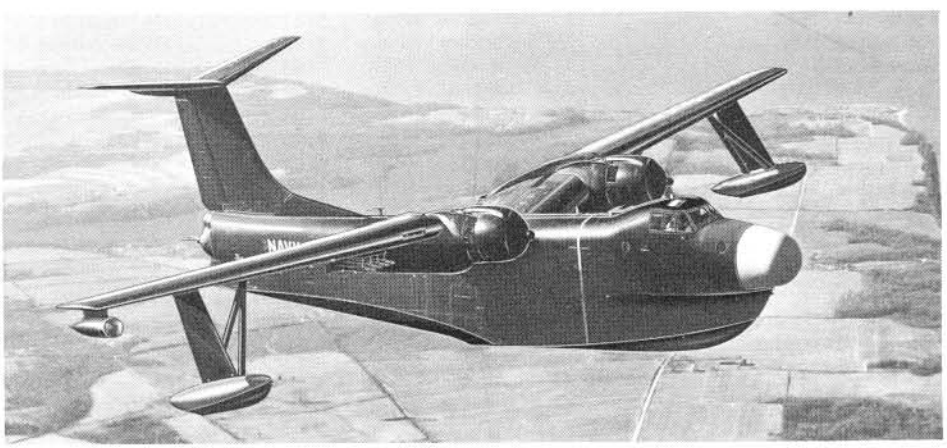
AN 01-35EJB-1

FLIGHT HANDBOOK

NAVY MODEL

P5M-2 AIRCRAFT



PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE AND THE CHIEF OF THE BUREAU OF AERONAUTICS

15 December 1955

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AN 01-35EJB-1
3 JANUARY 1957

FLIGHT HANDBOOK INTERIM REVISION No. 8

Navy Model P5M-2 Aircraft

PUBLISHED BY DIRECTION OF THE CHIEF OF THE BUREAU OF AERONAUTICS

Of paramount interest to pilots. To be read by all pilots operating these aircraft

1. CANCELLATION. None.

2. PURPOSE. To set forth additional instructions on use of hydro-flaps.

3. The following change is made to the Flight Handbook, Navy Model P5M-2 Aircraft, AN 01-35EJB-1, of 15 December 1955, revised 15 September 1956

Section II, page 53, under "TAXIING INSTRUCTIONS". The following is added after the first paragraph on HYDRO-FLAPS:

> Do not use hydro-flaps during take-off after directional control can be maintained with flight controls or during landing until the aircraft is "off the step". If use of hydro-flaps is absolutely necessary at higher speeds than described above, it is important that opening be only to the minimum degree required to obtain the desired correction.

END

AN 01-35EJB-1
30 OCTOBER 1956

FLIGHT HANDBOOK INTERIM REVISION No. 7

Navy Model P 5M-2 Aircraft

PUBLISHED BY DIRECTION OF THE CHIEF OF THE BUREAU OF AERONAUTICS

Of paramount interest to pilots. To be read by all pilots operating these aircraft

1. Cancellation: None

2. Purpose: To change manual leaning procedure in P5M-2 Flight Handbook AN 01-0135EJB-1.

3. Starting with the right hand column of page 148, change to read as follows:

The following manual leaning procedure is recommended:

With aircraft trimmed and stabilized in the desired cruising condition in Normal mixture:

1. Move the mixture control toward RICH until the Torque Pressure reaches a maximum and starts to fall off.

NOTE

If Torque Pressure does not fall-off before reaching RICH position actuate primer to obtain additional enrichment.

2. If the rise in Torque Pressure in step (1) is between 7 and 12% of Torque Pressure observed in the NORMAL position, return the mixture control to NORMAL.

3. If the rise in Torque Pressure in step (1) above is less than 7% or more than 12% of the normal position Torque Pressure, the mixture should be manually leaned as follows:
(a) With mixture at "Best Power" in step (1), adjust throttle to obtain Torque Pressure approximately 10% higher than desired Torque Pressure.
(b) Manually lean to obtain desired Torque Pressure.

NOTE

The use of 10% in step 3a actually amounts to a 9.1% drop in Torque Pressure from "Best Power". Specific fuel consumption is virtually constant for mixtures over the range from 7 to 12% drop in Torque Pressure. Mixtures leaner than 12% drop from Best Power may cause roughness, instability, and early lead-fouling of spark plugs. Mixtures richer than 7% drop waste fuel and cause unnecessarily high exhaust gas temperatures. If operationally feasible, it is favorable to spark plug performance to operate briefly at "BEST POWER" (step 1 or 3a condition) before increasing power after a prolonged period of cruising. The resulting higher core nose temperatures tend to facilitate lead scavenging and assist the plugs in accepting the higher manifold and compression pressures without misfiring. RICH mixture is not suitable for this purpose because combustion temperatures in this position are as cool if not cooler than in the NORMAL or MANUAL LEAN position.

END

AN 01-35EJB-1
9 OCTOBER 1956

FLIGHT HANDBOOK INTERIM REVISION No. 6

Navy Model P5M-2 Aircraft

PUBLISHED BY DIRECTION OF THE CHIEF OF THE BUREAU OF AERONAUTICS

Of paramount interest to pilots. To be read by all pilots operating these aircraft

1. Cancellation: None

2. Purpose: To set forth revised air starting procedures for reciprocating engines.

3. Revise Note under step b, Unfeathering Procedure, page 65, AN 01-35EJB-1 to read as follows:

NOTE

Mixture - Use PRIMER FLOW to start engine, change mixture to RICH and note torque or speed decrease, indicating carburetor has taken over. Release Primer. (Use of primer will fill carburetor and prevent lean metering during start). Operate engine at 1,000 rpm until satisfactory cylinder head and oil temperatures are obtained.

Cowl Flaps	"Control to head temp."
Oil Cooler Flaps	"Control to oil temp."
Re-Trim	"As necessary"
A-C and D-C Switches	On

Reduce power on the operating engine.

END

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FOREWORD

IMPORTANT

TO GAIN THE MAXIMUM BENEFITS FROM THIS FLIGHT HANDBOOK, READ THESE PAGES CAREFULLY

This handbook is prepared primarily to assist flight crews to better understand the aircraft, its equipment, operation, and characteristics in sufficient detail so that they can intelligently, safely, and efficiently complete a flight. The handbook informs the flight crew of available equipment and operating procedures that can be used to advantage in coping with possible emergencies.

The information herein will be kept current by frequent revisions which normally appear every 90 days; however, since much time is expended in the incorporation of revision material, flight crews must stay abreast of the pertinent technical directives. These directives frequently cover critical flight restrictions or new techniques which have not been incorporated in the flight handbook.

Other information concerning the airplane can be obtained from the following P5M–2 publications.

AN 01–35EJB–1A	Supplemental Flight Handbook for Navy Model P5M–2 Aircraft
AN 01–35EJB–2	Maintenance Instructions Handbook for Navy Model P5M–2 Aircraft
AN 01–35EJB–502	Supplemental Operation, Maintenance, Repair Instructions with Parts Breakdown for Navy Model P5M–2 Aircraft
AN 01–35EJB–3	Structural Repair Handbook for Navy Model P5M–2 Aircraft
AN 01–35EJB–4	Illustrated Parts Breakdown Handbook for Navy Model P5M–2 Aircraft
AN 01–35EJB–6	Inspection Requirements Handbook for Navy Model P5M–2 Aircraft

ARRANGEMENT OF HANDBOOK

This handbook is divided into nine sections, an appendix, and an index as follows:

SECTION I, DESCRIPTION. This section covers the airplane, and all systems and controls which contribute to the actual flying of the airplane. Emergency equipment which is not part of an auxiliary system is also included.

SECTION II, NORMAL PROCEDURES. The procedures and operations required for a safe and efficient non-tactical flight are contained in this section, in proper sequence, from the time the pilot approaches the airplane until he leaves it either beached or moored.

SECTION III, EMERGENCY PROCEDURES. The red border pages of this section cover the techniques to be employed in coping with any emergency that can reasonably be expected, but do not include those related to auxiliary equipment.

SECTION IV, DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT. Auxiliary equipment which aids in the performance of special functions but does not contribute to actual flight is described in this section. In addition, the normal and emergency operating procedures are discussed. Description and operation of Confidential equipment installed on the airplane is found in the Supplemental Flight Handbook, P5M–2, AN 01–35EJB–1A.

SECTION V, OPERATING LIMITATIONS. This section covers all limitations which must be observed during normal flight.

SECTION VI, FLIGHT CHARACTERISTICS. General and specific flight characteristics are discussed in this section.

SECTION VII, SYSTEMS OPERATION. The operation of the various airplane systems is covered in this section.

SECTION VIII, CREW DUTIES. This section covers the duties of the crew members.

SECTION IX, ALL-WEATHER OPERATION. Instructions for flying under cold and hot weather conditions are discussed in this section.

APPENDIX I, OPERATING DATA. The Appendix contains charts and curves required for mission planning. Explanatory text and sample problems illustrating the use of the data are included.

Figure 1–1. P5M–2 Airplane

SECTION I
DESCRIPTION

THE AIRPLANE.

GENERAL. The P5M-2 airplane, manufactured by Glenn L. Martin Aircraft Company, is a twin-engine, high gull wing, medium range flying boat, designed for: A.S.W. (anti-submarine warfare) Mine Laying, and Ferry operations. The airplane is powered by two 18 cylinder compound engines, Wright R3350-32W, turning two Hamilton Standard Hydromatic propellers. The airplane is readily recognized by the outstanding features of the protruding radome on the bow, high full cantilever wing, a single vertical tee tail and the long after-body of the hull. The approximate overall dimensions are as follows:

- Length (including detecting head)—101 feet 0-3/4 inches
- Span (including wing tip lights)—118 feet 2-1/8 inches
- Width (including beaching gears)—15 feet 7 inches
- Height (on beaching gears)—30 feet 11 inches
- Propeller clearance (at rest on water at load condition)—4 feet 5-3/4 inches

The tail group includes fin-rudder, stabilizer-elevator combination with trim tabs. Bomb bays are symmetrically located on the underside of the center wing immediately aft of the engine nacelles. A metal droppable bomb bay fuel tank may be carried in each bomb bay. A fixed float is installed on each outer wing. A hydraulic pneumatic operated spoiler aileron is located inboard of the conventional aileron. Each aileron is fitted with a controllable tab. The flaps are of the full trailing edge single slotted type and are located as follows: outer wing flaps between the aileron and nacelles, center wing flaps between the nacelles and hull.

The main beaching gears are located externally at the left and right beaching gear hatches. The tail beaching gear is located externally at the aft end of the hull on the right side.

The normal flight crew of seven is located as follows:

Pilot	At the left of pilot's deck
Co-pilot	At the right of pilot's deck
Radio Operator	Aft end of flight deck
Navigator-Bomber	Forward center of flight deck
Radar Operator	Left forward end of flight deck
RCM-MAD Operator	Aft end of flight deck
Tail Gunner	At the tail turret

The aircraft is designed to operate in the temperature range of −54°C(−65°F) to +70°C(+160°F) except as noted in the following text.

HULL ARRANGEMENT. (See figure 1-2.)

The interior of the hull is divided into fourteen compartments and each is accessible to all flight crew members.

The compartmentation and outstanding associated equipment is as follows: The bow compartment contains the radar scanner, pilot's transceiver, windshield defogging ducts, vapor dilution bottles and bow mooring fittings.

The forward entrance compartment contains a crew station box, heat duct, fire extinguisher, oxygen bottles, batteries, bilge pump, bilge pump hose, anchor hatch, anchor, anchor line locker, buoy hook and radar components.

The pilot's compartment contains the usual manual and electrical controls and furnishings.

The flight deck compartment contains predominantly radio and electronic equipment and controls. Other items installed in this compartment are portable oxygen bottles, crew seats, heating and ventilating air outlets, navigator's locker, water breaker, fire extinguishers, navigator's instrument panel, radio panel, radar panel, armament panel, a-c and d-c electrical systems controls and six parachute stowages.

The electronic compartment contains remote radio and electronics equipment. The galley, drift sight standpipe and windshield anti-icing tank are also located here.

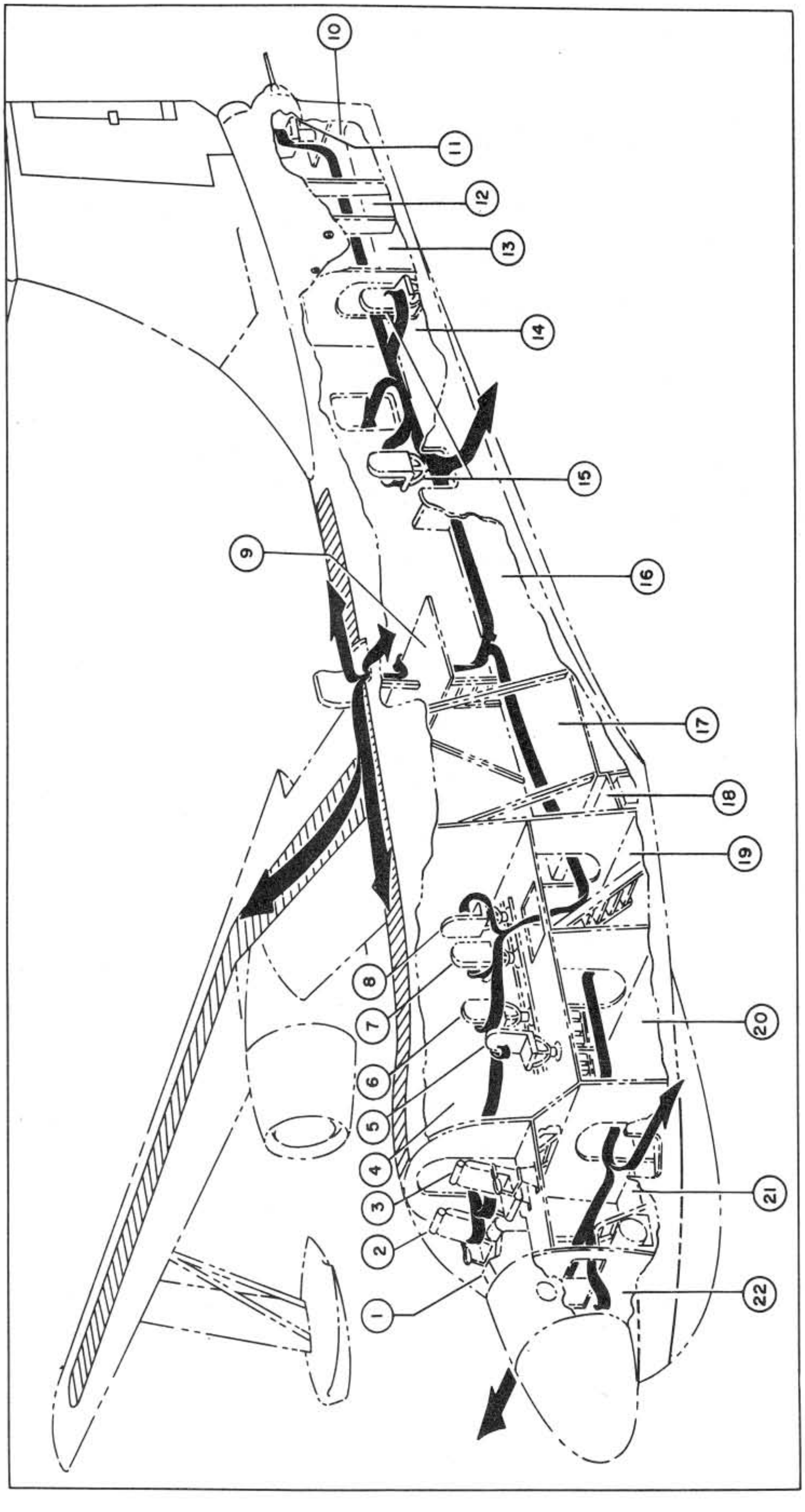
The beaching gear compartment contains the pressure fueling control box and connections, main power center, trailing antenna standpipe, beaching gear hatches, camera power supply, and flight deck access ladder.

The fueling compartment contains the cabin heater, cabin ram air duct, gravity fuel filler, hand fire extinguisher, fuel trunk, and one hull tank.

The sonobuoy compartment contains the center wing fuel trunk, sonobuoy chutes, sonobuoy stowage, retro-marine marker stowage, flood light stowage, air bottles, hull fuel tanks, parachute flares and jato bottles.

The auxiliary power unit compartment contains the auxiliary power unit, APU fire extinguisher, APU hatch, ladders, aileron servo unit and air intake doors.

The forward waist compartment contains a hydraulic accumulator air bottle, main hydraulic reservoir, main



1 Pilot's Compartment
2 Co-Pilot
3 Pilot
4 Flight Deck Compartment
5 Radar Operator
6 Navigator-Bombardier
7 R.C.M. and M.A.D. Operator
8 Radio Operator
9 Auxiliary Power Unit Compartment
10 Tail Gunner Compartment
11 Tail Gunner
12 Hydraulic Compartment
13 Stowage Compartment
14 Aft Waist Compartment
15 Observers—Aft Waist Compartment
16 Forward Waist Compartment
17 Sonobuoy Compartment
18 Fuel Compartment
19 Beaching Gear Compartment
20 Electronics Compartment
21 Forward Entry Compartment
22 Bow Compartment

Figure 1–2. Compartments and Crew Movement Diagram hydraulic pumps, most of the hydraulic valves, transceiver, boarding ladder (stowed), crew station box, signal light, first aid kits, loop antenna, flasher pod, retro-marine marker launcher, bollard, bunk, emergency food container, life raft, life raft transmitter, water bucket stowage, left aft entrance hatch, left jato mounts on the entrance hatch, and toilet facilities.

The aft waist compartment contains a loop antenna, access to radio compass unit, ditching station, ditching equipment stowage, crew station box, signal light, bunks, fire extinguishers, right-hand hatch jato mounts, right aft entrance hatch, bollard, camera pod and stowage, sea anchor line stowage, observer windows, observer seats, parachute stowages, blackout curtains, and ditching web.

The stowage compartment contains the control surface boost system and hydraulic reservoir, parachute stowage, crew station box, ditching webs, and ditching equipment stowage.

The hydraulic compartment contains rudder and elevator hydraulic boost system components, elevator servo unit, rudder tab actuator and hydroflap system.

The tail gunner's compartment contains the tail turret and its associated equipment, junction box, portable oxygen bottles, tail beaching gear hatch and rudder servo unit, rudder tab actuator and hydroflap system.

Watertight interior doors are installed in the bulkhead at the aft end of the forward entrance compartment, in the bulkhead at the aft end of the electronic compartment, and in the bulkhead at the aft end of the beaching gear compartment.

On airplanes No. 135536 and subsequent as delivered, and on airplanes No. 135474 through 135535 after service change No. 354, webbed ditching seats are furnished for two additional crew members in the forward waist compartment. A seven-man life raft, emergency radio transmitter, food container, and Plane Captain's ditching board are stowed on the flight deck as additional ditching equipment (figure 3-1B).

MOVEMENT OF FLIGHT PERSONNEL. (See figure 1-2).

Personnel are mostly concentrated on the flight deck when at flight stations, however, it is possible to move within the hull from the bow to the tail through the aisle in the hull interior. There are two hatches at the bow and two hatches at the waist compartment for boarding, and general utility purposes. In order to gain access to the top of the wing a hatch is located above the auxiliary power unit. Two permanently installed ladders furnish easy access to this hatch. Access to the flight deck is obtained by use of a permanently installed ladder in the beaching compartment.

POWER PLANT.

GENERAL. This airplane is powered by two air cooled, compound, radial, reciprocating engines, Model R-3350-32W. Each of these eighteen cylinder engines incorporate three blow down turbines for exhaust gas power recovery. Each is equipped with two speed supercharger, impeller injection fuel metering system, a low flow torquemeter, low tension ignition system. The direction of rotation viewed from aft to forward is clockwise. Spark advance is automatic.

An unusual feature of this engine is the power recovery turbines system. The three turbines extract energy from the exhaust gases as they leave the cylinders and direct this power to the engine crankshaft.

The engine accessory section contains nine drive pads on which are mounted seven units; d-c generator, fuel pump, starter, a-c generator drive, tachometer generator, de-icer pressure pump and de-icer vacuum pump. The two remaining drive pads are unused.

MAIN ENGINE POWER CONTROL SYSTEM.

The main engine power control system is comprised of hand operated levers (1, figure 1-3) on the pedestal and are connected to their respective engine through a system of push pull rods, quadrants and cables.

The POWER CONTROL levers are moved forward to the OPEN position, and midway aft to a mechanical stop at IDLE, then farther aft to REVERSE IDLE and OPEN REVERSE. To move the POWER CONTROL levers from IDLE to REVERSE IDLE, the reverse lever between the POWER CONTROL levers must be moved from FLIGHT to TAXI position. A friction lock for the POWER CONTROL levers is located on the left side of the pedestal.

To adjust the friction lock, place the friction release lever ON and rotate the friction adjusting knob clockwise until maximum amount of friction is obtained, but not so tight as to prevent disengaging and re-engaging the friction release lever. To obtain maximum friction, place the friction release lever ON and rotate adjusting knob clockwise as far as possible; however, in this position the friction release lever can be released, but cannot be returned to the friction ON position.

Note

If friction adjusting knob is tightened when the friction release lever is in the OFF position, the release lever will not operate.

CARBURETORS AND CARBURETOR CONTROLS.

Direct-metering pressure type carburetors, Chandler-Evans, Model 58CPB-11, are used on both engines. The ratio of fuel to air forces remains constant; therefore, any change in air flow to the engine will result in a proportionate change in fuel flow. To compensate for decrease in weight of a volume of air as altitude and/or temperatures are increased, an automatic mixture control is furnished. The automatic mixture control consists of an altitude valve controlled by an oil- and nitrogen-filled bellows, placed in series with the boost venturi. Loss of air

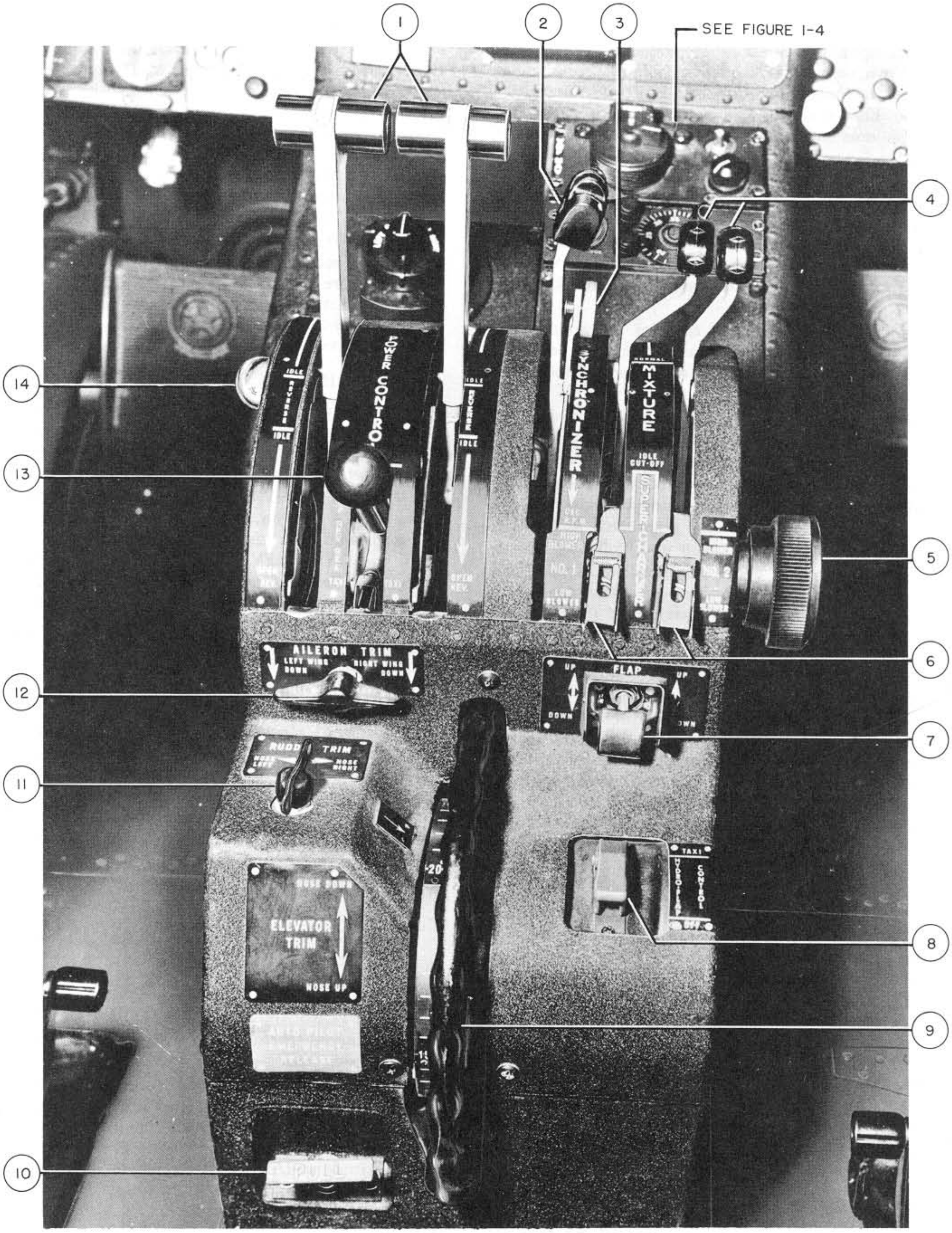


Figure 1–3. Pilot's Pedestal

KEY TO FIGURE 1-3

1 Throttle Control Levers
2 Propeller Synchronizer Control Lever
3 Propeller Synchronizer Lock Control Lever
4 Mixture Control Levers
5 Throttle Friction Adjustment Knob
6 Supercharger Control Switches
7 Wing Flap Control Switch
8 Hydroflap Control Switch
9 Elevator Tab Control Wheel
10 Automatic Pilot Emergency Release Handle
11 Rudder Trim Tab Control Switch
12 Aileron Trim Tab Control Switch
13 Propeller Reverse Release Lever
14 Friction Release Control Lever

density causes the bellows to expand, moving the altitude valve further into its seat.

There are six jets in the carburetor to automatically take care of varying mixture proportions called for by changing engine operating conditions. Under engine idling conditions, the desired mixture varies from that controlled by the metering system. The idling mixture is controlled by a throttle-operated idle valve in the fuel discharge passage in conjunction with a linkage adjustment between the throttle arm and idle valve arm.

At twenty-nine psi fuel pressure, manual selection of various fuel-air mixtures is automatically maintained regardless of air density or temperature by an automatic mixture control (altitude valve).

Satisfactory operation for cruising will be experienced with a fuel pressure of as low as 14 psi, however, this fuel pressure is abnormal and should be corrected as soon as possible.

Air flow to the engine is controlled by the throttle setting and measured by the venturi within the carburetor. A boost venturi is used to amplify the air flow measurement. The air flow through the boost venturi is directly proportionate to the amount of air consumed by the engine. The air flow, as determined by the venturi vacuum, is used to control the flow of fuel to the engine by means of the pressure regulator in the carburetor. This regulator consists of a valve and three diaphragms in series.

As the throttle is opened, the venturi vacuum increases, causing the carburetor valve to open and permit more fuel to enter the regulator chamber until the fuel pressure against the regulator diaphragm balances the metered suction differential on the air diaphragm and the discharge fuel pressure on the fuel balance diaphragm.

To compensate for slow reaction of the fuel metering system at rapid acceleration, a piston is installed at the rear of the idle valve. Sudden throttle opening forces a fuel charge into the balance diaphragm of the regulator valve and results in additional fuel necessary for rapid acceleration.

PRT COOLING SHIELDS (Figure 1-3A).

Altitude limitations of P5M-2 airplanes with R3350-32W compound engines (to ensure adequate turbine cooling under all normal flight conditions) are as follows:

Limited 13,000 Ft.

A. R3350-32W (all low ratio 6.52:1), with straight outlet cooling shield in conjunction with Martin Double Outlet Exhaust Hood.

Limited 15,000 Ft.

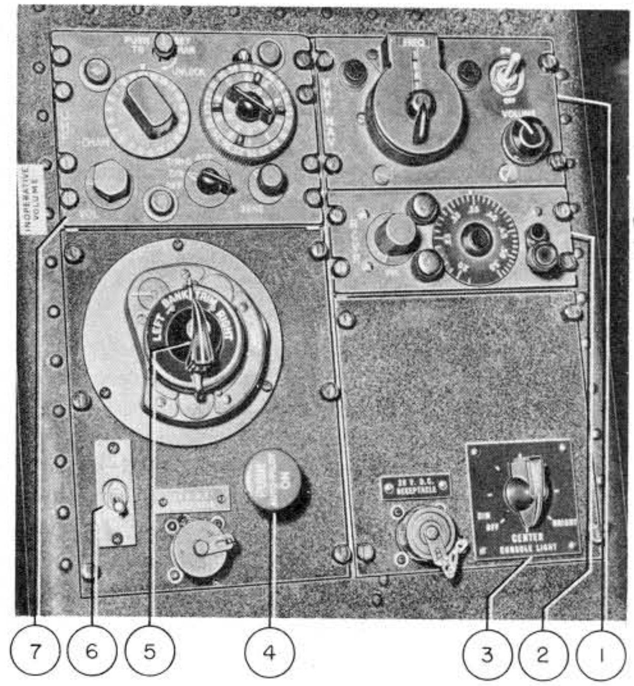
B. R3350-32W, with concentric tangential cooling shield in conjunction with Martin Double Outlet Exhause Hoods.

Unlimited

C. Using either standard straight outlet cooling shield or concentric tangential cooling shield in conjunction with Martin Single Outlet Exhaust Hood.*

Note

*Armored PRT protection incorporates the single-outlet exhaust feature, to be backfitted on all P5M-2 aircraft.



1 Control Panel, AN/ARN-14E
*2 Control Panel, AN/ARC-5
3 Switch, Center Console Panel Light
4 Knob Engage, Automatic Pilot
5 Controller, Automatic Pilot
6 Switch, Power Control Automatic Pilot
7 Control Panel, AN/ARC-27A

* Removed from Airplane No. 135474 and subsequent after service change.

Figure 1-4. Pilot's Center Console Panel

MIXTURE CONTROLS.

The selection of RICH, NORMAL, or IDLE-CUT-OFF mixture is obtained by actuating the manual mixture control levers (4, figure 1-3) on the pilot's pedestal. Each of these levers is connected to its respective carburetor through a system of push pull rods, quadrants and cables.

The pilot selects the desired positions by moving the control levers to that position as indicated on the nameplates adjacent to the levers. The exact setting can be indicated when the mixture lever drops into a detent at each position.

CARBURETOR AIR CONTROLS.

Hot air required for carburetor anti-icing is supplied from the engine cylinders through an opening in the bottom of the air scoop. The selection of HOT or COLD air is made by means of two speed toggle switches (58 and 60, figure 1-5) on the co-pilot's sub-panel which in turn energize a motor-driven screw-jack connected to a movable door in the air scoop. When the switch is actuated to the first stop in COLD position, the actuator will operate slowly to position the door to admit ram air directly into the carburetor and block off the opening under the scoop. When the switch is actuated to the second stop in COLD position, the same result is obtained but at a faster rate of speed. When the switch is actuated to the first stop in HOT position, the actuator will slowly position the door to admit hot air through the opening under the air scoop and block off the entrance of ram air. When the switch is actuated to the second stop in HOT position, the same result is obtained but at a faster rate of speed. Limit switches in the actuator, limit travel of the door.

The selection of "HOT" or "COLD" air will depend on a variety of conditions, one of which is indicated by the carburetor air temperature as shown on the dual indicator on the co-pilot's instrument panel (61, figure 1-5). This indicator is energized when d-c power is supplied to the bus. The resistance bulb in the carburetor air scoop detects the temperature and transmits it to the indicator which is calibrated in degrees centigrade.

FUEL PRESSURE INDICATOR.

Fuel is supplied to the carburetors under pressure generated by the boost and/or engine driven pumps. Fuel flow meter transmitters are connected in the engine fuel lines to measure consumption. The indicators (52 and 54, figure 1-5) are located on the co-pilot's instrument panel, and are calibrated in pounds.

Fuel pressure at the carburetors is directed to transmitters which transmits the value electrically to a dual indicator on the co-pilot's instrument panel (51, figure 1-5). The indicator is calibrated in pounds per square inch.

MANIFOLD PRESSURE INDICATOR.

The dual manifold pressure indicator (17, figure 1-5) located on the pilot's instrument panel is electrically operated and is calibrated in inches of mercury. This gage will read barometric pressure when the engines are not running or shut down. With the engines operating, an indication of, from below barometric pressure, up to take-off pressure, will be registered depending on throttle position.

TACHOMETER INDICATOR.

The self-contained tachometer system, used to indicate engine rpm, is composed of an engine driven generator connected electrically to a dual tachometer indicator (16, figure 1-5) on the pilot's instrument panel. Each tachometer generator is also connected to the propeller synchronizer unit.

TORQUE PRESSURE INDICATORS.

The torquemeters system used to indicate torque pressure, is composed of an autosyn type pressure transmitters on each engine connected to a dual indicator (30, figure 1-5) on the co-pilot's instrument panel. Power to operate this system is supplied by the 26 volt a-c bus through fuses located on the pilot's distribution panel. The indicators are calibrated in pounds per square inch.

SUPERCHARGERS.

Each engine has an internal two speed supercharger to boost the manifold pressure. The main discharge of metered fuel from the carburetor is introduced at the impeller.

The supercharger impeller is driven through a double planetary gear train and uses a stationary, oil operated clutch to restrict the turning of the secondary pinion carrier for high blower operations. A supercharger clutch control valve solenoid actuates the external oil valve whose position determines the supercharging stage selected. The solenoids are controlled by a double pole switch, No. 1 and No. 2 (6, figure 1-3) on the pilot's pedestal. When the supercharger control switch is placed in "HIGH" position (closed), the corresponding supercharger control unit solenoid on the lower left side of the engine compartment will be energized and will actuate the clutch control valve for high blower operation. Also, when the supercharger control switch is placed in "LOW" position (open), the corresponding supercharger control unit solenoid on the lower left side of the engine compartment, will be de-energized and will actuate the clutch control valve for low blower operation.

CAUTION

When shifting from "LOW" to "HIGH", engine RPM should not be greater than 1600 rpm. Reduce manifold pressure to a maximum of 20" Hg. Shift from high to low at any RPM.

With the engines operating, in either "HIGH" or "LOW" position, manifold pressure is indicated on the dual manifold pressure indicator (17, figure 1-5) on the pilot's instrument panel.

ENGINE COOLING.

To smooth out the air and direct it more evenly to and around the engine cylinders, a diffuser cowling on the engine front section is installed for engine cooling. To control the engine temperatures that occur at different points under different conditions, cowl flaps are installed on each engine. Five movable flaps are attached to each cowl ring, two flaps are on the left side of the ring, two at the bottom right side and one at the top right side. The cowl flaps are electrically operated and controlled by control switches on the co-pilot's instrument panel. The cowl flaps can be stopped in any desired position between fully opened and fully closed position.

Therefore, by frequently observing the engine cylinder temperature indicators, cooling of the engines can be controlled by use of the cowl flap switches.

Each cowl flap control switch is entirely independent. Electrical power to operate each cowl flap actuator is supplied from the main d-c bus, through corresponding circuit breakers on the cockpit distribution panel.

IGNITION CONTROLS.

The main engine ignition system is a remote controlled, low tension, high altitude type. A master ignition switch unit (14, figure 1-8) located on the cockpit overhead panel contains an individual control switch for each engine and an emergency button to stop both engines. In addition, a remote ignition unit and a starting coil (vibrator) unit are located in each nacelle. The remote control feature of the system is designed so that the cockpit ignition switches energize solenoids in the remote ignition unit which in turn, ground or unground the magnetos. There is no direct connection between the cockpit switches and the magnetos. With this system, it is possible to remotely control ignition only if the circuit between the cockpit switches and the remote ignition unit is functioning properly. The ignition switches require positive actuation to change their position. Failure of the ignition control circuit or the main electrical system while the engines are running will result in the engines continuing to run but electrical control of the ignition from the cockpit will be lost.

When the master ignition switch is pushed in, the ignition system is controlled by the two ignition switches located on the pilot's overhead panel. Pulling out the master ignition switch stops the engines by groundling all magnetos. A plastic guard is installed on the ignition switch panel surrounding the ignition switches. The addition of this protective guard prevents inadvertent operation of the switches by personnel moving in or out of the pilot's or co-pilot's seat.

Power is supplied to the master switch unit from the 28-volt d-c cockpit distribution panel bus No. 1 through a 5-ampere IGNITION circuit breaker located on the cockpit distribution panel.

PRIMER CONTROLS.

Fuel is admitted through a solenoid valve into primer lines which discharge at three points into the induction system directly under the carburetor. The necessary pressure is supplied by the fuel boost pumps. The solenoid valve is controlled by momentary switches (3, figure 1-8) located on the pilot's overhead panel.

Power to operate the primer circuit is supplied from the main d-c bus system through two primer circuit breakers on the cockpit distribution panel.

STARTER CONTROLS.

A direct-cranking starter on the accessory section of each engine is energized when a momentary starter switch (17, figure 1-8) on the cockpit overhead panel is depressed. Simultaneously, starting vibrators generate and induce low tension current into the engine distributors. Power for the starter circuits is derived from the 28-volt d-c cockpit distribution panel busses No. 1 and 2 through two circuit breakers marked STARTER ENG. NO. 1 and ENG. NO. 2. Power to operate the starters is furnished from the 28-volt d-c engine No. 1 and No. 2 nacelle busses which are connected to the main d-c bus system through fuses in the main power center. Starter control switches on the cockpit overhead panel are marked ENGINE CONTROLS: NO. 1 and NO. 2.

ENGINE FIRE EXTINGUISHING SYSTEM.

The engine fire extinguisher system is used to spray methyl bromide (poisonous) into the main engine accessory compartment, the carburetor air scoop, and the generator blast tube when intense heat or fire is detected in these areas. Intense heat or flame converts the methyl bromide into a dense smothering gas.

Note

Trifluorobromomethane replaces methyl bromide as engine fire extinguishing fluid on airplanes No. 135538 and subsequent on delivery, and on 135474 through 135537 after service change. The extinguisher bottles are relocated from the right outer wing to the center hull section, on the right side, between station 374 and 398. Trifluorobromomethane is less toxic than carbon dioxide but normal safety precautions should be taken.

CAUTION

When the system has been discharged and as soon as possible after completion of flight, the engines should be operated to induce air flow through the various engine sections. This will evaporate any liquid which may have collected. Methyl-bromide in the presence of moisture, forms a highly corrosive acid which must be removed within five hours of the original contact.

Control of the fire extinguisher system is through two switches (8, figure 1-8) on the FIRE CONTROL panel on the cockpit overhead panel, one for each engine. When either switch is placed in BOTTLE NO. 1 or BOTTLE NO. 2 position, a circuit is completed to the corresponding fire extinguisher bottle and the contents will be released to the corresponding engine or engines.

CAUTION

Engines must not be restarted (with fire extinguisher switches in bottle-firing position) by manually over-riding fuel valves.

ENGINE FIRE DETECTOR SYSTEM.

An electrical fire detector system is installed for each engine compartment. Six fire warning lights are installed on the pilot's overhead switch panel (figure 1-8). A red light indicates the presence of fire in the particular engine compartment. A test switch (10, figure 1-8) is installed in the cockpit overhead panel for testing the fire detection circuits. If the

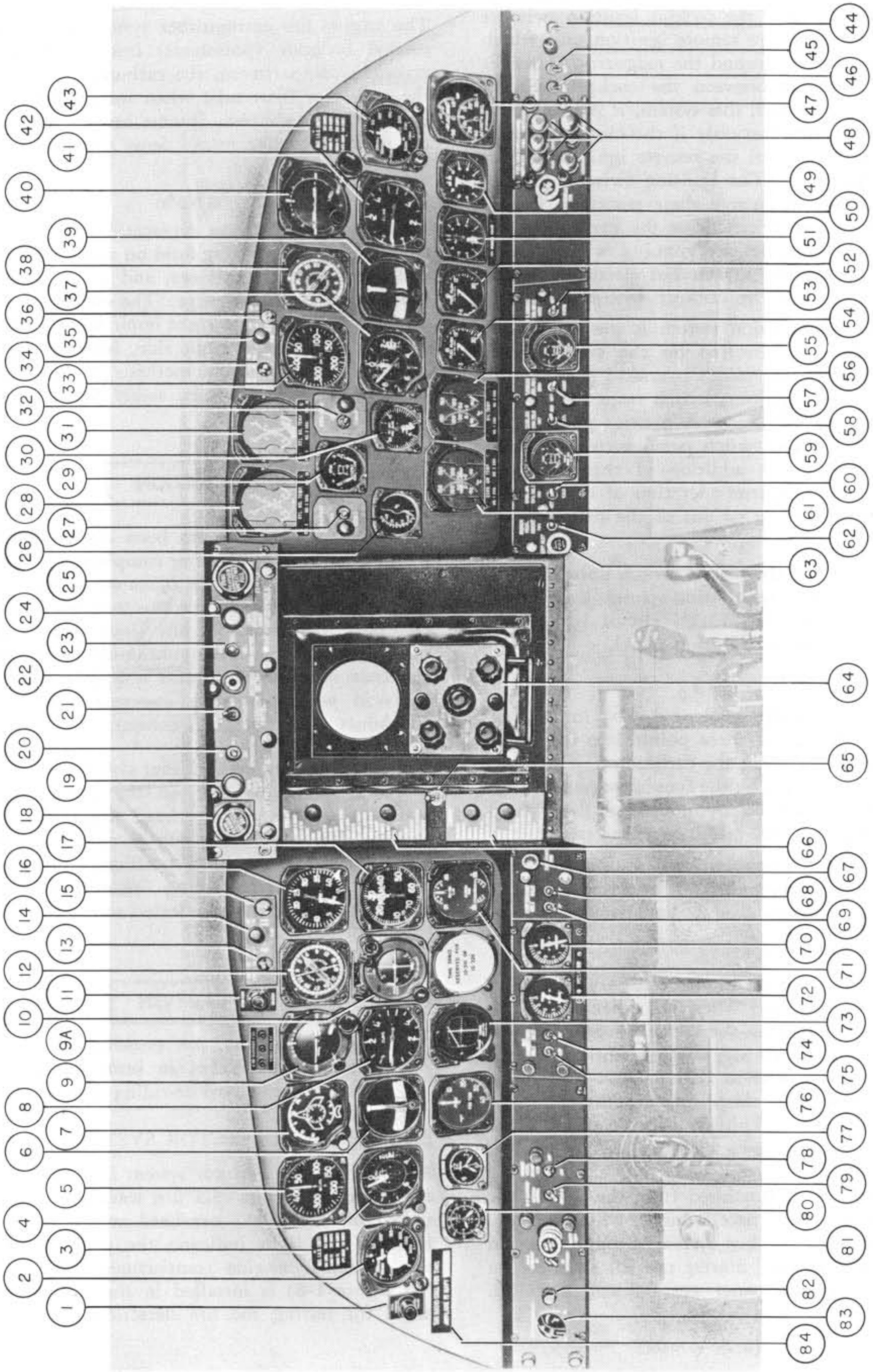


Figure 1–5. Pilot's and Co-Pilot's Instrument Panel

KEY TO FIGURE 1-5

1 Stall Warning Indicator Light
2 Radio Altimeter Indicator
3 Nameplate—Maximum I.A.S. Limits
4 Altimeter
5 Air Speed Indicator
6 Bank and Turn Indicator
7 G-2 Compass Master Direction Indicator
8 Rate of Climb Indicator
9 Gyro-Horizon Indicator
9A AC Power Failure Indication Light
10 Course Indicator
11 Hydro Flap Warning Light
12 Course Indicator
13 AN/ARA-25 and AN/ARN-6 Switch
14 AN/ARN-14 Indicator Light
15 AN/ARN-14 and AN/ARN-21 Switch
16 Tachometer Indicator
17 Manifold Pressure Indicator
18 Feather Control Button—Left Propeller
19 RPM Range Limit Warning Light Left Propeller
20 RPM Control Switch—Left Propeller
21 Master Synchronizer Control Switch
22 Re-Synchronizer Button Control—Propeller
23 RPM Control Switch—Right Propeller
24 RPM Range Limit Warning Light—Right Propeller
25 Feather Control Button—Right Propeller
26 Free Air Temperature Indicator
27 Cowl Flap Switch—Left Engine
28 Cylinder Head Temperature Indicator—No. 1 Engine
29 Cowl Flap Position Indicator
30 Torque Pressure Indicator
31 Cylinder Head Temperature Indicator—No. 2 Engine
32 Cowl Flap Switch—Right Engine
33 Air Speed Indicator
34 AN/ARA-25 and AN/ARN-6 Switch
35 AN/ARN-14 Indicator Light
36 AN/ARN-14 and AN/ARN-21 Switch
37 Altimeter
38 Course Indicator
39 Bank and Turn Indicator
40 Gyro Horizon Indicator
41 Rate of Climb Indicator
42 Nameplate—Maximum I.A.S. Limits
43 Radio Altimeter Indicator
44 Low Intensity Light Control Switch
45 Oil Dilution Control Switch—No. 2 Engine
46 Oil Dilution Control Switch—No. 1 Engine
47 Searchlight Indicator
48 Fuel Tank Empty Warning Lights
49 Windshield Air Control
50 Oil Pressure Indicator
51 Fuel Pressure Indicator
52 Fuel Flow Indicator—Right Engine
53 Oil Cooler Control Switch—No. 2 Engine
54 Fuel Flow Indicator—Left Engine
55 Oil Cooler Flap Indicator
56 Oil Temperature Indicator
57 Oil Cooler Control Switch—No. 1 Engine
58 Carburetor Air Control Switch—No. 2 Engine
59 Carburetor Air Flap Indicator
60 Carburetor Air Control Switch—No. 1 Engine
61 Carburetor Air Temperature Indicator
62 Rudder Pedal Adjustment Control Switch
63 Heat Control—Cockpit
64 AN/APS-44A Range Azimuth Indicator
65 Check Off List Light Switch
66 Check Off List
67 Radio Altimeter Range Control Button
68 Flight Booster Pump Control Switch—No. 2
69 Flight Booster Pump Control Switch—No. 1
70 Hydraulic Pressure Indicator—Booster
71 Trim Tab Position Indicator
72 Hydraulic Pressure Indicator—Main
73 Approach Indicator
74 Main Hydraulic Pump Control Switch—No. 2
75 Main Hydraulic Pump Control Switch—No. 1
76 Wing Flap Position Indicator
77 Clock—8 Day
78 Rudder Pedal Adjustment Control Switch
79 G-2 Compass Control Switch
80 Clock—Elapsed Time
81 Heat Control—Cockpit
82 MK-8 Gunsight Control Switch
83 MK-8 Gunsight Rheostat Control
84 Name plate—Radio Call Number

fire detector circuits are functioning properly, the red warning lights should come on when the test switch is placed in "PUSH TO TEST" position. If all the lights do not come on within 15 seconds, the fire detection circuit is deficient.

AUXILIARY POWER UNIT (APU) FIRE EXTINGUISHER SYSTEM.

A carbon dioxide (CO_2) fire extinguisher system is installed for extinguishing fires in the auxiliary power unit. Spray nozzles and a fire detector thermocouple are closed in the accessory section of the APU. The APU fire extinguisher system is controlled by a switch on the radio operator's overhead panel (figure 1-10).

AUXILIARY POWER UNIT (APU) FIRE DETECTOR SYSTEM.

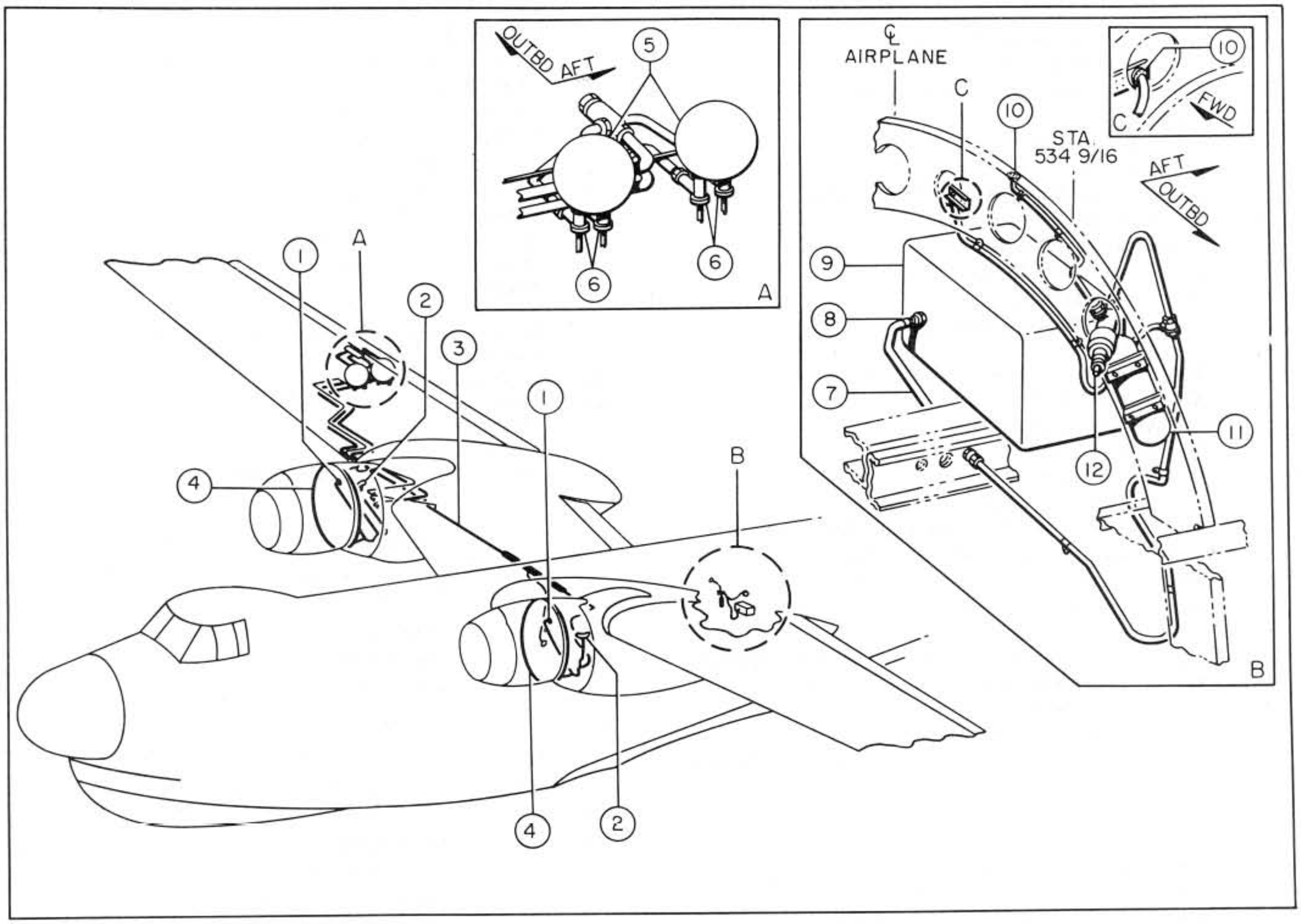
An electrical fire detector system is provided for the APU enclosure. A red fire warning light (3, figure 1-10) on the radio operator's panel indicates the presence of fire in the enclosure.

A fire detector test switch (3, figure 1-10) on the radio operator's panel is used for testing the entire circuit. The red indicator warning light should come on within a few seconds after closing the test switch if the system is operating correctly. If the light does not come on within 15 seconds the fire detection circuit is defective.

PROPELLERS.

A four-bladed hydromatic, constant speed, reversible full feathering Hamilton Standard nickel plated aluminum alloy blade propeller is installed on each engine. Each blade leading edge is covered with a rubber resistance type electric blanket for de-icing. Each propeller is controlled by an engine-driven governor mounted on the engine nose case, and the governors are regulated and synchronized by a master synchronizer unit installed on the right side of the electronic compartment.

Electrical controls (18 through 25, figure 1-5) for the



1	Carburetor Connection
2	Blast Tube—Generator
3	Piping—Fire Extinguisher—Main Engine
4	Piping—Fire Extinguisher—Nacelle
5	Sphere—Methyl Bromide
6	Bonnet—Actuating Mechanism
7	Piping—Fire Extinguisher—APU
8	Connection—Fire Extinguisher—APU
9	Auxiliary Power Unit
10	Blow-Out Plug
11	Cylinder CO_2—APU
12	Solenoid Valve—Electrically Operated

Figure 1-6. Main Engine and APU Fire Extinguisher System

propellers are on a switch panel between the pilot's and co-pilot's instrument panels.

PROPELLER REVERSING CONTROLS.

Propeller reversing is controlled by the power control levers on the pilot's pedestal in conjunction with the PROP. REV. REL. lever. When the throttles are moved over the IDLE stop into a reverse range, they actuate a pair of micro-switches in the pedestal.

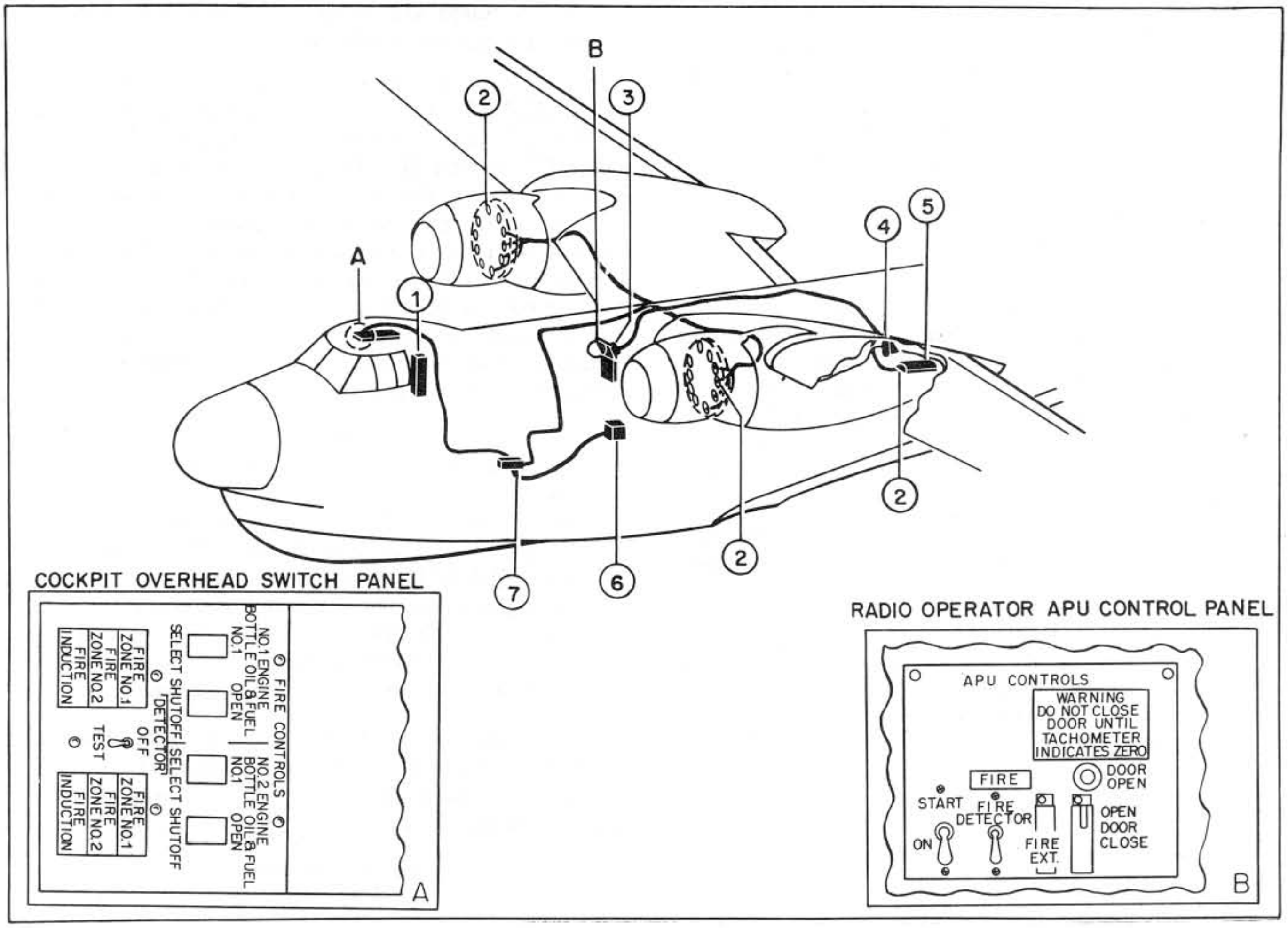
Note

The throttle levers can not be moved into the reverse range until the throttle lever is placed in the "TAXI" position.

Actuation of the micro-switches energizes the propeller reversing relay, which causes the auxiliary pump to operate the propeller in reverse pitch. The blades are held to reverse pitch by governor oil pressure after the auxiliary pump shuts off when the propeller reaches the reverse position. Further aft movement of the throttle increases reverse pitch thrust. Electrical power to operate the auxiliary pump is supplied from the main three-phase a-c cross tie bus system.

PROPELLER UNREVERSING CONTROLS.

Movement of the throttles forward, out of "REVERSE PITCH" range over the "IDLE" position returns the micro-switches in the pedestal to the normal position. This de-energizes the propeller relay, which de-energizes the decrease solenoid valve and operates the auxiliary pump, returning the blades to normal pitch range. As the propeller blades reach their normal pitch range the No. 1 blade switch will close and the No. 2 blade switch will open, causing de-energiza-



1 Cockpit Distribution Panel
2 Thermocouple Detectors, Induction Cylinders No. 5 and No. 6 and Around Engine Baffle
3 Control Box, Aft of Radio Operator Control Panel
4 Valve Solenoid, Fire Extinguisher Cylinder—APU
5 Auxiliary Power Unit (APU)
6 Main Power Center
7 Thermal Control Box, Electronic Compartment—Right Side

Figure 1–7. Main Engine and APU Fire Detection System

tion of the reversing relays. This action stops operation of the auxiliary pump and returns the propeller to normal operation, and the governor will take over control.

Power to operate the unreversing and reversing circuits is supplied from the main d-c bus through three circuit breakers on the cockpit distribution panel. Power to operate the auxiliary pump is supplied from the main three-phase a-c cross-tie bus system.

PROPELLER GOVERNOR CONTROL.

The propeller governors are controlled mechanically by a conventional "PROP SYNCHRONIZER" master lever on the pilot's pedestal. This lever is used to regulate the rpm of both engines simultaneously.

PROPELLER SYNCHRONIZER CONTROL.

Synchronize and unsynchronize rpm control is centered in a three-position "SYNCHRONIZER CONTROL" switch on the propeller control panel. When either engine rpm control switch (20 and 23, figure 1-5) is held in "INC". or "DEC". position, and with the synchronizer control switch in either of its three positions, the corresponding engine speed will automatically increase or decrease, through the synchronizer governor, operation.

When the synchronizer control switch is placed in the "MASTER LEVER and SYNCH" position and a difference of more than 100 rpm between propeller speeds exists, the "RE-SYNCH" button (22, figure 1-5) should be momentarily pressed. This will bring the propeller speeds towards synchronization in increments of approximately 100 rpm until the propellers are synchronized.

Power to operate the synchronizer system is supplied from the main d-c bus through a synchronizer control breaker on the cockpit distribution panel.

PROPELLER RPM CONTROL.

Individual rpm control of the engine is attained by the manipulation of a three-position momentary RPM CONTROL switch (20 and 23, figure 1-5) on the propeller control panel. By holding the switch in the "INC." position, the engine rpm will increase, and holding the switch in the "DEC." position, will decrease the engine rpm. When the switch is released, it will return to the "OFF" position automatically.

AN RPM RANGE LIMIT light (19 and 24, figure 1-5) on the propeller control panel will come on when the propeller governors seat against either their high or low rpm stops. This will result when the master control lever is moved to the take-off position or when the control switches are held in either position long enough for the propeller speeds to reach their high or low rpm limits.

Power to operate the system is supplied from the main d-c panel through an rpm control circuit breaker on the cockpit distribution panel.

PROPELLER FEATHERING CONTROLS.

CAUTION

Remove a-c and d-c generators of the "dead" engine from the busses before feathering the engine.

To feather either the left or right propeller during flight, proceed as follows:

a. If propeller is overspeeding severely, immediately reduce airplane speed.

b. Close the throttle of the malfunctioning engine and press the applicable feathering button (18 and 25, figure 1-5) on the propeller control panel. A holding coil will hold the button in until the propeller is feathered.

When the "FEATHER" button is pushed in, a circuit is completed which starts the auxiliary pump to feather the propeller blades. When the blades are in the full feather position, the built-up hydraulic pressure will actuate a pressure switch in the governor to break the circuit and release the feathering button. This stops the auxiliary pump.

Note

On airplanes Nos. 135521 and subsequent and on 135474 through 135520 after service change, the propeller feathering switches have an indicator light in the cap of the switch which illuminates when the auxiliary pump relays are energized, indicating that the pumps are operating.

c. Shut down malfunctioning engine. Refer to "PROCEDURE ON ENCOUNTERING ENGINE FAILURE" and "ENGINE FAILURE DURING FLIGHT, Section III. If the feathering button fails to release when the propeller reaches full feathered position, pull out feathering button manually to neutral position. If feathering button is closed inadvertently, the feathering action can be stopped by pulling out feathering button to its neutral position; if this accidental operation of the feathering button results in complete feathering, the propeller can be unfeathered in the usual manner.

Note

In event propeller does not feather properly and engine fails to stop, ascertain that the throttle is CLOSED and the mixture in IDLE CUT-OFF and accomplish an UNFEATHER and FEATHER operation alternately. If propeller cannot be feathered, place the rpm control switch (20 or 23, figure 1-5) in full "DECREASE RPM" position in order to reduce windmilling drag to a minimum.

To unfeather either propeller during flight, refer to "EMERGENCY PROCEDURE", Section III.

To feather, check the feathering and unfeathering system. (Refer to "PROPELLER", Section II.)

CAUTION

Do not hold feathering button out for longer than 2 seconds and/or operate feathering button in 1 second spurts until the propeller starts to windmill at approximately 200 to 400 rpm.

JET ASSIST TAKE OFF (JATO) SYSTEM.

The jato system is controlled by arming switches on the cockpit overhead panel. When either switch is placed in "ARM" position and the rocket control switch is in "SAFE" position, a circuit is completed to two jato power relays in the cockpit distribution panel. The two red jato armed warning lights on the cockpit overhead panel will illuminate. Upon pressing the pilot's rocket and jato firing switch on the pilot's control wheel, the two jato firing relays will be energized, and will close the power circuits to the jato units on each waist entrance hatch.

Each waist hatch mounts two (Model 14AS-1000, MK2; or 15KS-1000, MK6) jato units. These units are connected to an electrical firing plug on the exterior of the hatch. When either of the waist hatches are in the open position, the firing circuits are automatically broken, preventing accidental discharge.

The installation is designed to be readily reloadable from within the airplane. The units may be jettisoned from inside by pulling respective release levers without opening the hatches.

There are no provisions for remote jettisoning.

WARNING

The jato units should not be jettisoned until orders are given from the pilot. Do not release jato units in restricted or congested areas. Always release lower units first.

OIL SYSTEM. (See figure 1-9.)

The oil system in this airplane is divided into three individual systems: the two main engine oil systems and the main engine manual oil transfer system.

The main engine supply of oil is contained in a synthetic rubber tank behind each engine in the center wing, with the filler opening located on top of the nacelle above the tank. Each tank has a total capacity of 148 gallons and a usable capacity of 87 gallons.

Each engine oil system contains two oil coolers located in each outer wing and incorporating regulator valves and a sequence valve. The flow of air through the oil coolers is regulated by oil cooler flaps, located on each outer wing upper surface. Control of the exit air is obtained by an electrical motor driven screw jack driving a hinged flap. The flaps are controlled by momentary switches on the co-pilot's sub-panel adjacent to the indicators (53 and 57, figure 1-5). The flaps are operated from the OPEN position as desired to regulate the oil temperatures.

The sequence valve in the oil system automatically directs flow of oil returning from the engine to the warm-up chamber or main portion of the tank as dictated by oil temperature. This process accelerates warming of oil to running temperature.

The oil temperature indicator system consists of resistance-type temperature bulbs installed in the engines and connected to a dual indicator on the co-pilot's instrument panel (56, figure 1-5). This indicator is calibrated in degrees centigrade.

The oil quantity indicating system consists of a capacitor-type transmitter located within each oil tank connected by wiring to indicators (1 and 2, figure 1-13) (calibrated in pounds) on the pilot's aft control panel. Oil quantity may be measured by a dip stick located adjacent to the tank fillers.

Main engine oil pressure is indicated by means of a 26-volt a-c autosyn system composed of transmitters connected by wiring to a dual indicator, (50, figure 1-5) (calibrated in pounds per square inch) on the co-pilot's instrument panel.

Power to operate the flap motors and indicators is obtained from the d-c bus through circuit breakers on the pilot's distribution panel.

OIL DILUTION.

Oil is diluted by feeding fuel into the oil through the sequence valve mounted on the oil tank sump. The fuel is obtained from the engine fuel supply through a restrictor fitting on the firewall. A manually operated (self locking) valve is close to the fuel take-off fitting. A solenoid valve is contiguous to the sequence valve. Admission of fuel into the oil system is controlled by switches (45 and 46, figure 1-5) on the co-pilot's sub-panel.

Power to operate the oil dilution system is supplied from the main d-c bus through circuit breakers on the pilot's distribution panel.

Note

When using oil grade 1065, dilution is not required. (Refer to Oil Dilution, Section IX.)

OIL TRANSFER SYSTEM. (See figure 1-9.)

The oil transfer system transfers oil from one oil tank to the other when one engine is consuming more oil than the other. Oil is transferred by operating the oil transfer valves control switches on the right side of the rear spar bulkhead to OPEN. This causes transfer valves on each tank to open. The manual selector valves (31 and 32 figure 1-9) are then operated to the desired selected position. The actual transfer of oil is accomplished by operating the manual hand pump (28, figure 1-9) allowing oil to be pumped to the engine oil tank requiring the greater supply. When transfer is completed, secure all valves to OFF.

Power to operate the electrical valves is supplied from the main d-c bus through a circuit breaker on the sonobuoy distribution junction box.

FUEL SYSTEM. (See figure 1-12.)

FUELING OPERATION.

Filling the tanks may be done by the secondary method of gravity filling or by means of the primary single-point pressure fueling system. Pressure fueling is the desired method. Refer to Section VII for Pressure Fueling. Under the conventional or gravity filling method, the hull tanks are filled through the filler cap on the left side of the airplane, the center auxiliary tanks are filled through the filler cap on the upper surface of each center wing. The service tanks are then filled from the auxiliary tanks by using the fuel transfer manifold and operating the booster pumps in the auxiliary tanks, or from the hull tanks. This is done by turning on the auxiliary tank transfer pump switches (See

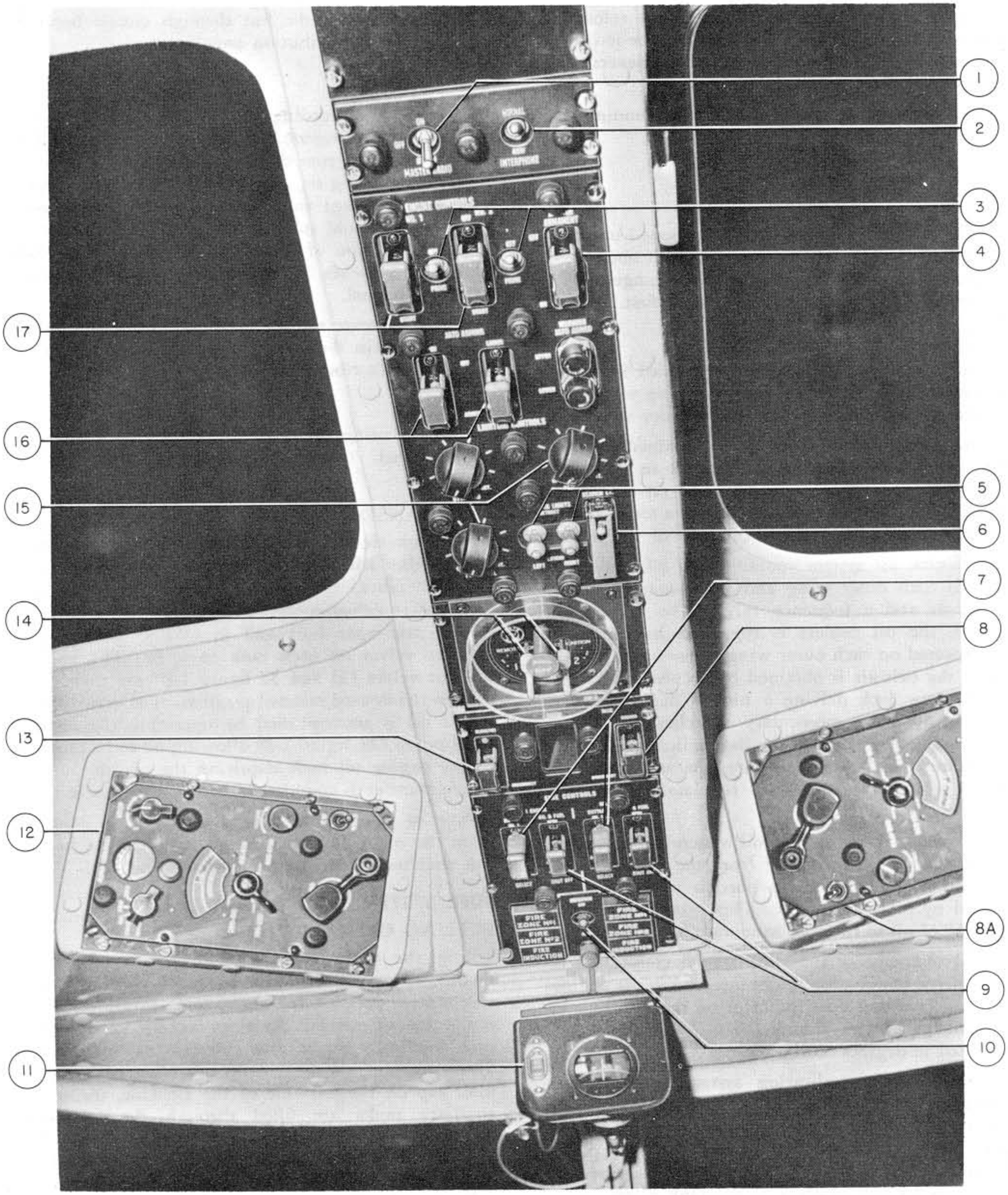


Figure 1-8. **Cockpit Overhead Switch Panel**

KEY TO FIGURE 1-8

1 Master Radio Control Switch
2 ASW Interphone Control Switch
3 Engine Primer Control Switches
4 Master Armament Control Switch
5 Landing Light Control Switches
6 Searchlight Jettison Switch
7 Fire Control Switches, Engine
8 Rudder Boost Disconnect Switch
*8A Radio Compass Control Unit, AN/ARN-6, No. 2
9 Fire Control Switches, Oil and Fuel
10 Fire Detector Test Control Switch
11 Magnetic Compass Light Control Switch
12 Radio Compass Control Unit, AN/ARN-6, No. 1
13 Elevator Boost Disconnect Switch
14 Ignition Control Switches, Engine
15 Panel Lighting Control, Rheostats
16 Jato Arming Control Switches
17 Starter Control Switches, Engine
* After service change

figure 1-11) on the fuel flow panel which will start the booster pumps in operation, and turning on the service tanks transfer switches, on the fuel flow panel, to open the service tanks transfer valves. Bomb bay tanks, if used, are filled from the auxiliary tanks. This is done by turning on the auxiliary tank transfer switches on the fuel flow panel, to start the booster pumps in operation, and turning on the droppable tank fueling switch on the pilot's aft control panel. (See figure 1-13.) This switch opens the main fueling valve and closes the hull tanks fueling valve.

Note

The auxiliary tanks fueling valves are normally open under this condition.

For normal operations, fuel is carried in three hull tanks below the floor of the fueling and sonobuoy compartments. Two engine service tanks and two auxiliary wing tanks are within the center wing section (figure 1-12). For ferrying operations, two additional droppable bomb bay tanks may be installed. (See figure 1-12.)

For fuel grades and specifications, refer to servicing diagram (figure 1-20).

The fuel supply is also used to operate the auxiliary power unit and the combustion heaters.

FUEL SYSTEM MANAGEMENT.

Instructions for transfer, crossfeed, defueling, and jettison are contained in Section VII.

FUEL QUANTITY INDICATION.

Fuel quantity of all tanks except the droppable bomb bay tanks is measured by a capacitance-type system for each tank. Seven indicators in the fuel flow panel translate tank unit capacitance (determined by actual fuel quantity) into terms of pounds of fuel available. (See figure 1-11.) A test switch is on the pilot's aft control panel to test each system. Closing any one of these switches will cause a corresponding indicator pointer to move toward the empty end of the scale. Returning the switch to OFF will cause the pointer to return to its former position, indicating the system is energized and working properly. Failure of the indicator to respond in this way is a signal that power is interrupted or a fault has occurred. Power to operate the fuel quantity indication system is supplied from the 115-volt, 400-cycle a-c bus in the pilot's aft control panel through seven 5-ampere circuit breakers on the panel.

ELECTRICAL POWER SUPPLY SYSTEM.

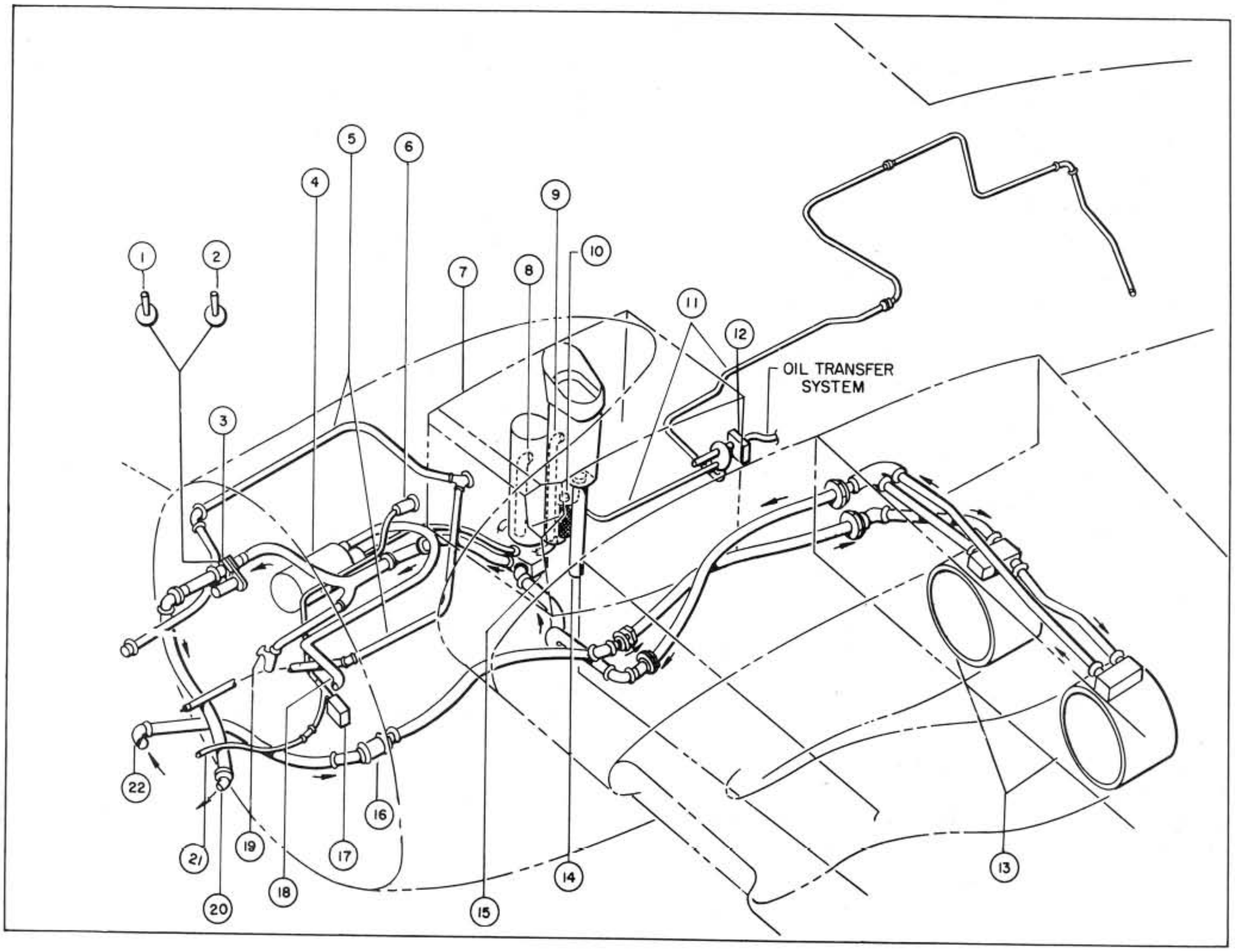
The electrical power supply consists of a-c and d-c sources. A-C power is supplied by three 208/120

FUEL QUANTITY DATA TABLE

TANK	NUMBER OF TANKS	GALLONS (EACH)	GALLONS (TOTAL)	POUNDS (TOTAL)
Left Auxiliary Tank	1	510	510	3060
Right Auxiliary Tank	1	508	508	3048
Bomb Bay Tanks	2	583	1166	6996
No. 3 Hull Tank	1	408	408	2448
No. 2 Hull Tank	1	571	571	3426
No. 1 Hull Tank	1	285	285	1710
Left Service Tank	1	262	262	1572
Right Service Tank	1	265	265	1590
Total Normal Tank Usage	7	—	2809	16,854
Total Maximum Tank Usage	9	—	3975	23,850

NOTE: 1. Three percent expansion space is allowed in hull tanks, when fuel quantity indicators show above number of pounds.
2. All fuel weights are based on standard weight of 6 pounds per gallon of Grade 115/145 fuel.
3. Fuel supplied to the engines from the service tanks is replenished by using the above tank sequence.

Figure 1-8A. Fuel Quantity Data Table



1	Switch—Fire Control	12	Valve—Elect. Operated Slide Type
2	Switch—Emergency Shut-Off	13	Oil Coolers
3	Valve—Firewall Shut-Off	14	Tank Unit—Oil Quantity Gage
4	Feathering Pump	15	Valve—Sequence
5	Vent Line—Oil Tank	16	Valve—Check
6	Transmitter—Oil Pressure	17	Switch—Pressure
7	Oil Tank	18	Propeller Feathering Line
8	Oil Return to Hopper	19	Valve—Oil Drain
9	Oil Return to Tank	20	Oil In Line
10	Cap—Filler	21	Oil Pressure Line
11	Scupper Drain Outlet	22	Oil Out Line

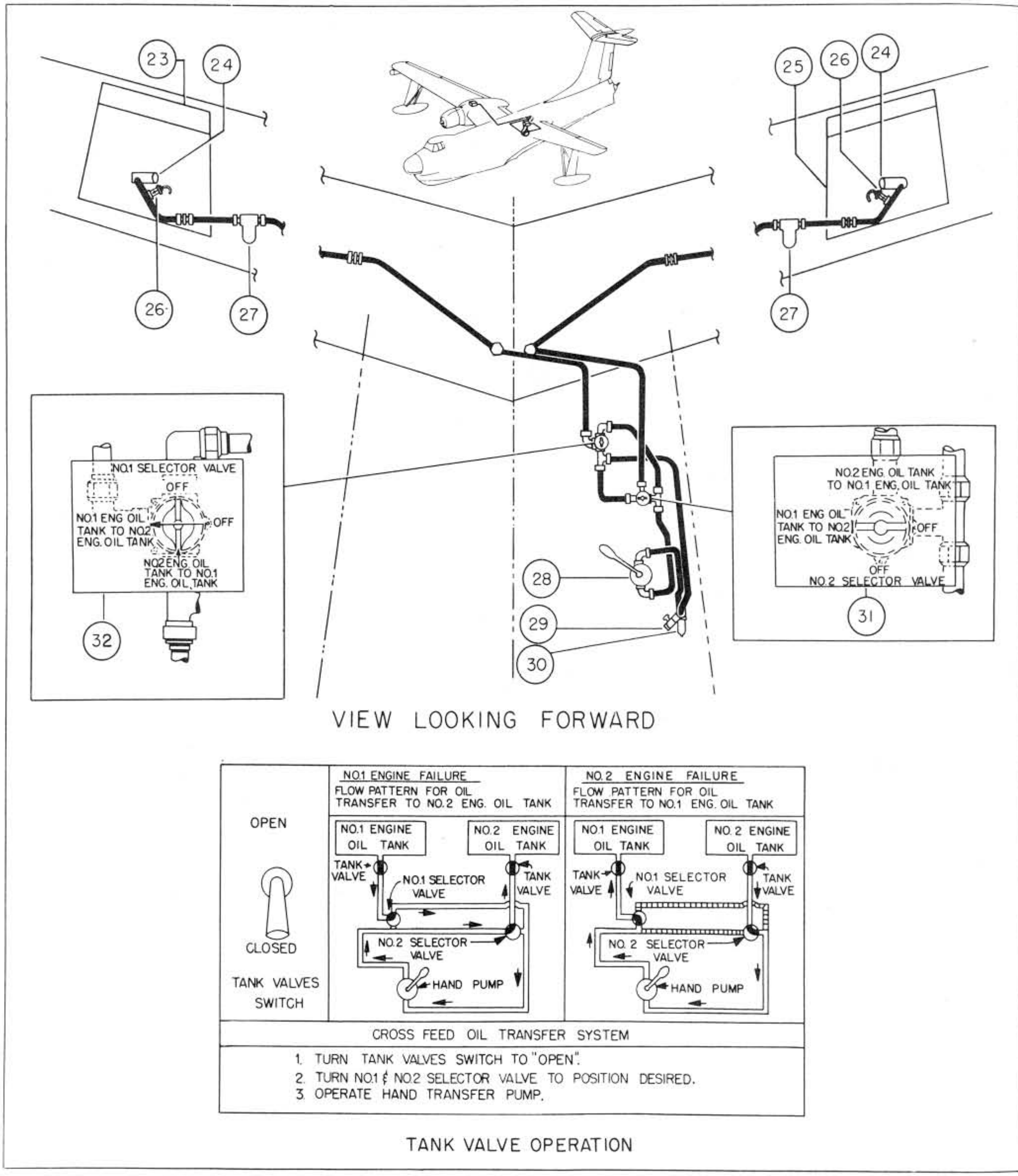
Figure 1–9. Oil System—Main Engine (Sheet 1 of 2)

volt, 3 phase, 400 cycle, a-c generators each rated at 40 kva. The generators supply power to busses that are "Y" connected in a 4 wire grounded neutral system with 200 volts between busses and 115 volts from bus to ground. Each a-c generator contains a built-in, direct connected d-c exciter to supply power to the rotating a-c generator field. An a-c generator is mechanically connected through a constant speed drive to each of the two main engines. The third a-c generator is connected to a gas turbine type of auxiliary power unit and is used as a source of a-c power during moored or water operations of the airplane when the engine generators are inoperative.

Note

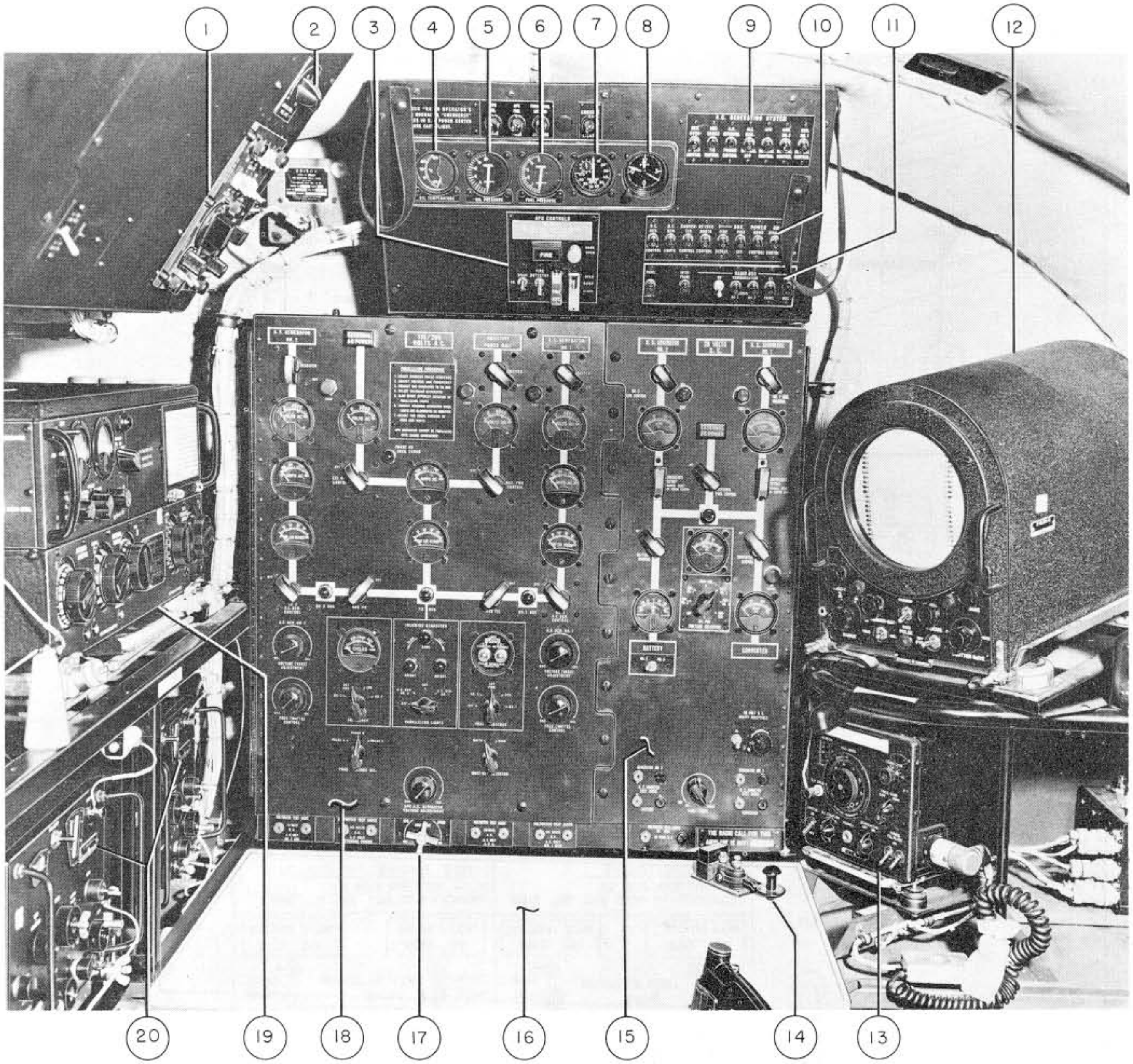
During certain operating conditions, the APU power system requires assistance from the engine driven a-c generators to prevent overloading the APU power system. For procedures, refer to Section II for Starting Auxiliary Power Unit.

The switches, meters and most of the control relays for operating the a-c power system are located at the radio operator's station. The power relays and busses are located in the main power center in the beaching compartment. The three a-c generator voltage regu-



23 Tank—No. 1 Engine Oil Tank
24 Valve—Elect. Operated Slide Type
25 Tank—No. 2 Engine Oil
26 Valve—Vacuum Relief
27 Filter
28 Pump—Hand
29 Valve—Drain
30 Filter
31 Valve—No. 2 Selector
32 Valve—No. 1 Selector

Figure 1-9. Oil System—Main Engine (Sheet 2 of 2)



1	Panel, ICS Control	11	Panel, Radio Communication Circuit Breaker
2	Switch, Interphone Panel Lights	12	Oscilloscope, AN/APS-44A
3	Panel, APU Controls	13	Meter, LM Series Frequency
4	Indicator, APU Oil Temperature	14	Key, Transmitting
5	Indicator, APU Oil Pressure	15	Panel, D-C Generator Control
6	Indicator, APU Fuel Pressure	16	Table, Radio Operator's
7	Indicator, APU Tachometer	17	Valve, APU Speed Adjustment
8	Clock	18	Panel, A-C Generator Control
9	Panel, A-C Generating System Circuit Breaker	19	Receiver, AN/ARR-15
10	Panel, APU and D-C Generator Circuit Breaker	20	Transmitter, AN/ART-13

Figure 1-10. Radio Operator's Station

lators are located on the right side of the electronics compartment. The main a-c bus is split into three main sections with the sections connected by two three phase connectors that may be opened or closed from the a-c control panel at the radio operator's station. The No. 1 and No. 2 generators are connected through three-phase contactors, to the No. 1 and No. 2 busses respectively. The APU generator is connected through a three-phase contactor to the center or cross-tie bus, allowing variable loading.

WARNING

The output of the a-c power generators is high voltage at 400 cps. Extreme care must be exercised by personnel to avoid contact with conducting elements. Severe shock or loss of life may result from failure to do so.

The primary source of d-c power is the two engine driven d-c generators. Power is also obtained from the a-c system through a 200-ampere regulated converter.

Each d-c generator has a continuous rating of 200 amps at 30 volts, being regulated by carbon pile voltage regulators. The regulators are located on the right side of the electronics compartment. The 200 amp. regulated converter consists of a transformer rectifier combination used to change the 200/115 volts, 3 phase input to 28 volt d-c. The converter is complete with regulator, cooling blower and overheat safety switches. The converter and the shunt for its ammeter are located on the lower right side of the electronics compartment. One of the functions of the d-c system is to control the a-c power system. The a-c and d-c external power receptacles are located in the main beaching gear compartment.

The searchlight power system uses a series of relays plus two resistors and a rectifier to isolate the No. 2 d-c generator from the main bus and uses it to supply the required additional voltage to operate the searchlight. During operation of the searchlight it is necessary to have the No. 1 generator and the 200-ampere converter connected to the main 28 volt d-c bus as well as having the No. 2 d-c generator operating. The No. 1 generator and converter are necessary to carry the normal ship's load in addition to the searchlight load while the No. 2 generator is disconnected from the main bus.

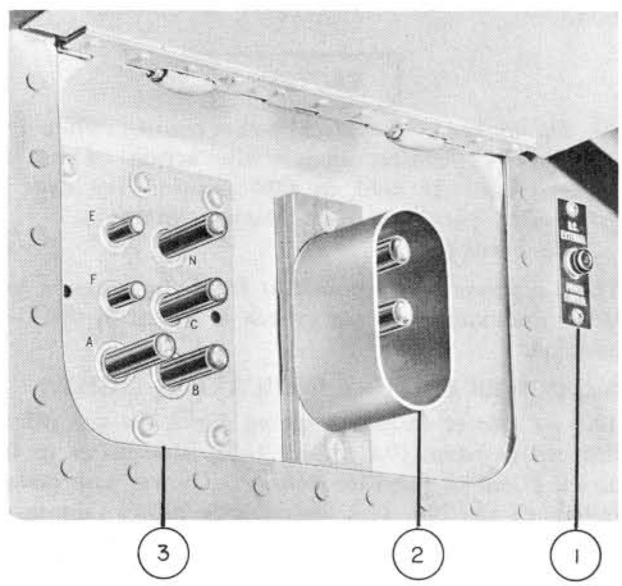
The 70 volts dc required to operate the searchlight is obtained by the use of the normal 28-volt dc from the main bus in series with the increased output from the No. 2 generator (approximately 46 volts dc) with an approximate 4-volt line drop. Thus a 70-volt supply is available to operate the searchlight.

Due to the inability of the No. 2 generator and regulator to maintain the increased voltage as generator speed decreases it is necessary that the generator be operated at an engine speed of 1800 rpms or above when the searchlight is operated.

BATTERIES.

Two 36-ampere, 24-volt batteries are installed in a battery compartment located on the right side of the bow compartment. The No. 1 and No. 2 batteries are connected to the main d-c bus through the external power and battery reverse current circuit breaker on the main power panel in the beaching gear compartment. A corresponding No. 1 and No. 2 battery control contactor is located in the battery junction box on the right side of bow compartment. An ammeter and two test jacks are connected to the battery shunt and are located on the radio operator's control panel. The ammeter, with a center zero position, indicates the amount of charge or discharge. The test jacks provides a means to test the battery charge or discharge current by an external ammeter. If the battery and external power reverse current circuit should open, the energized battery control contactors will be de-energized to protect the batteries in case of a battery lead fault. When the generators are not operating electrical power from the battery bus is supplied to operate the anchor lights, boarding lights and emergency power for the periscopic sextant light.

The battery control contactor coil circuits are protected by a "BATTERY NO. 1 POWER" and "BATTERY NO. 2 POWER" circuit breaker on the battery junction box.



1 External Power Control, D-C Circuit Breaker
2 Receptacle, D-C
3 Receptacle, A-C

Figure 1-10A. External Power Receptacle

D.C. EXTERNAL POWER RECEPTACLE.

A 28-volt d-c external power receptacle is provided on the aft side of the main power center, on the right side of beaching gear compartment (figure 1-10A), and is connected to the main d-c bus through the external d-c power contactor and the external power and battery reverse current circuit breaker. With a 28-volt d-c external power supply plugged into the receptacle. The external power warning light on the main power center and the external d-c power light on the radio operator's control panel will illuminate. The receptacle permits attaching an external source of d-c power for engine starting or for ground operation of electrical equipment when the engines are not operating.

A-C EXTERNAL POWER RECEPTACLE.

An a-c external power receptacle is installed on aft side of the main power panel in the beaching gear compartment (figure 1-10A). After an external source of a-c power is connected to the receptacle, the external power switch on the radio operator's a-c panel must be positioned ON, which closes the external power contactor and connects it to the cross tie bus. Before a-c power is delivered to any electronic equipment it is subject to following conditions.

a. The external power source must be of three-phase, four-wire, a-c power with minimum frequency (390 cycles, 115 volts), and with a correct phase sequence of 1, 2, 3.

b. That no a-c generator control switch or main line circuit breaker contactor is closed.

c. If the condition in paragraph (a) above is not met, or if an a-c generator control switch is ON when operating the external power switch, the external power switch will automatically return to OFF position.

CAUTION

Do not hold the external power control switch in ON position against the action of its solenoid. If held in ON position for extended period of time, damage to the solenoid will result.

The a-c power is disconnected from the cross-tie bus when the external power switch is placed in the OFF position.

A-C POWER FAILURE INDICATION LIGHT.

The a-c power failure warning light, on the pilot's instrument panel (9A, figure 1-5), illuminates to indicate a loss of fixed-frequency a-c power and power failure of the No. 1, 2, or cross-tie busses (single or three phase). When the a-c busses have a power supply, relays in the main power center will close a series of d-c power supply circuits to the a-c power failure relay coil. This energized relay will retain an open a-c power failure light circuit and the warning light will not illuminate.

When power failure occurs in a bus (single or three phase), the corresponding de-energized a-c bus indicator relay will open the failure relay coil circuit, which will close the failure light circuit and cause the light to illuminate.

Electrical power is supplied to the a-c power failure indicator light from the 28-volt d-c bus through a 5-ampere circuit breaker on the main power center panel.

CAUTION

A-C power failure warning light will come on when any one phase is disconnected; therefore, this should not be used as a check that all power has been removed from all phases of the bus.

D-C POWER DISTRIBUTION SYSTEM.

D-C power is distributed from the main d-c power bus, in the main power center, to the following individual busses:

Cockpit Distribution Panel A-C Bus No. 1
Cockpit Distribution Panel D-C Bus No. 2
Pilot's Aft Control D-C Bus No. 1
Pilot's Aft Control Panel D-C Bus No. 2
Navigator's Distribution Panel D-C Bus
Main Power Panel D-C Bus
Radio Operator's Panel Bus
Radar Operator's D-C Bus
Sonobuoy Distribution Box D-C Bus
Tail Distribution Box D-C Bus
Left Nacelle Junction Box Bus
Right Nacelle Junction Box Bus

When the main d-c power bus is energized, the individual busses above are also energized. In all cases, the individual bus feeders are connected at the main power bus through fuses for circuit protection. The main d-c power bus is energized from the following power sources: two engine-driven d-c generators, one 200-ampere regulated converter, two batteries, and an external power receptacle.

The only special circuit in the d-c distribution system is the power feed to the radio operator's bus. This circuit is operated through a bus power relay in the radio operator's control box through two fuses marked NORMAL and EMERGENCY in the main d-c power center. Under normal conditions, the radio bus power relay is energized to supply power from the NORMAL fuse to the radio operator's bus. If the NORMAL fuse opens because of an overload or short circuit, the radio bus power relay will be de-energized, closing another set of contacts in the radio bus power relay, causing power to be supplied from the EMERGENCY fuse through the normally closed relay contacts to the a-c system and to the emergency portion of the radio operator's bus.

A-C POWER DISTRIBUTION SYSTEM.

A-C power distribution from the main a-c power center distribution panel busses is as follows:

Bus No. 1 supplies three-phase power to the following busses and equipment:

Left Bomb Bay Heater Blower
Left Auxiliary Tank Fuel Pump
Left Droppable Tank Fuel Pump
Hull Tanks Fuel Pump
A-C Bus No. 1 Indicator Light
Main Power Center Panel Bus
Tail Distribution Box A-C Bus No. 1
Sonobuoy Distribution Box A-C Bus No. 1
Cockpit Distribution Panel A-C Bus No. 1

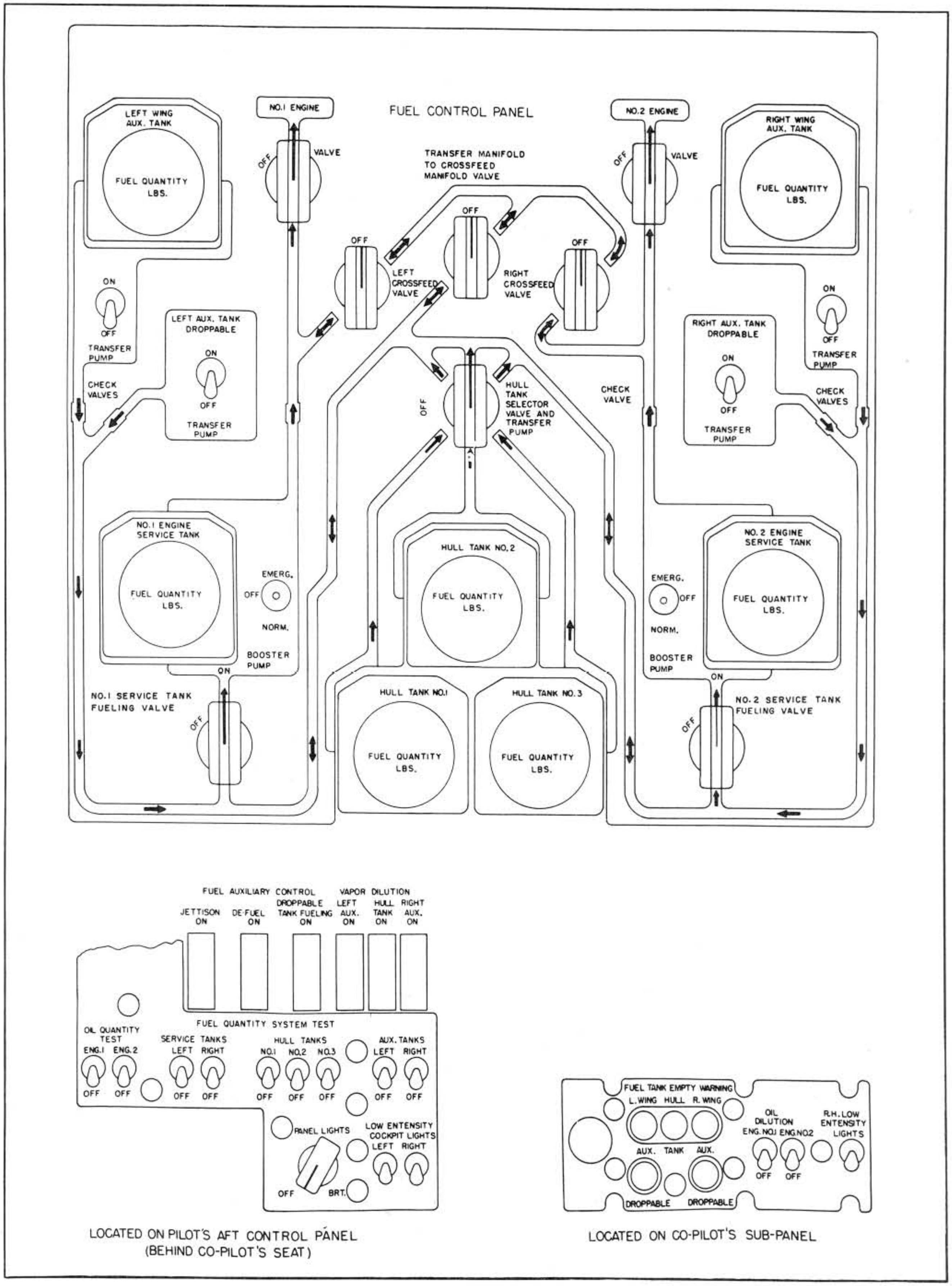


Figure 1–11. Fuel Flow Control Diagram

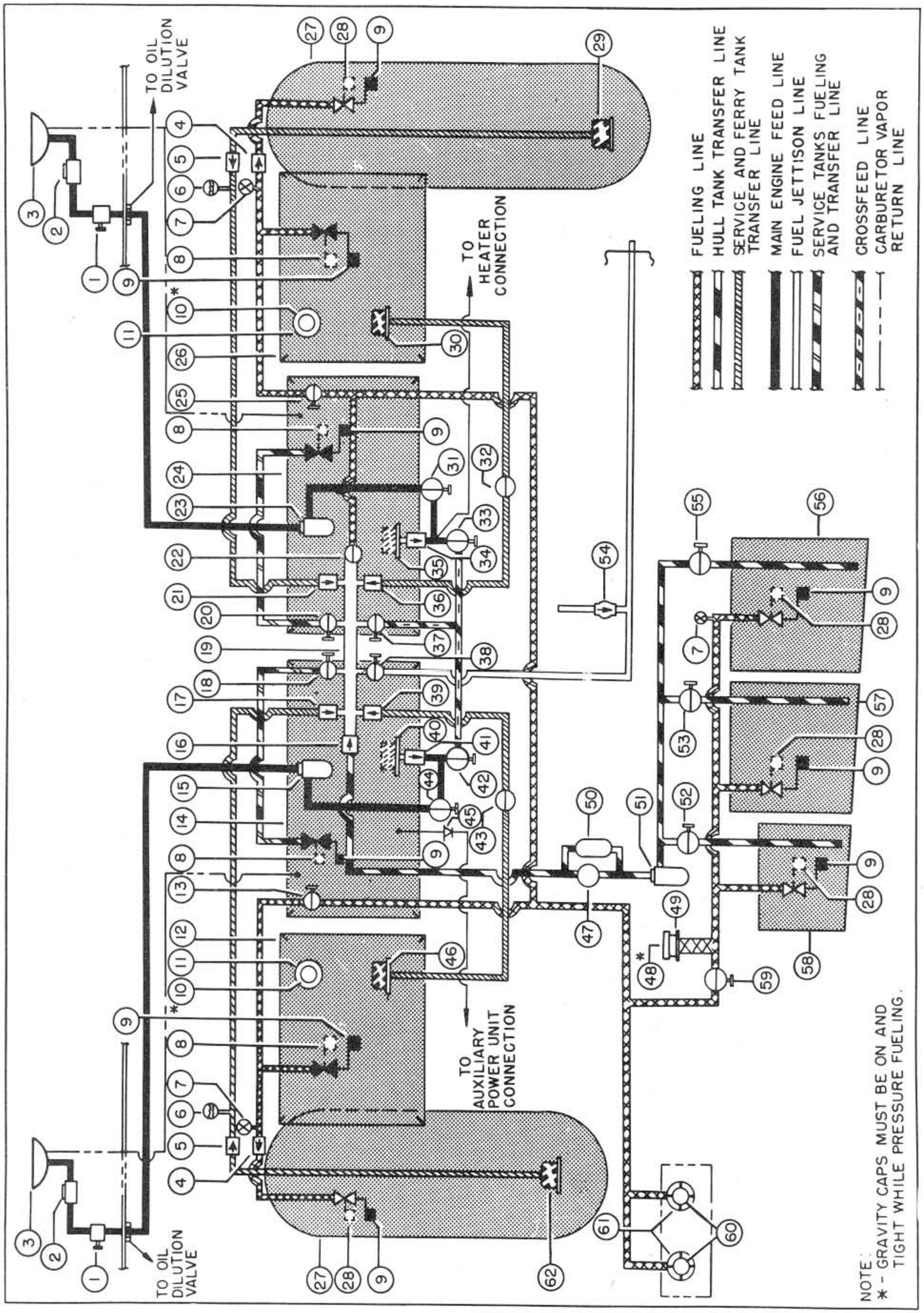


Figure 1–12. Fuel System Schematic Diagram

KEY TO FIGURE 1-12

1	Pump, Engine Driven	32	Valve, Right Auxiliary Tank Manual
2	Flowmeter	33	Valve, No. 2 Engine Crossfeed
3	Carburetor	34	Valve, No. 2 Engine Service Tank Check
4	Valve, Droppable Tank Fuel Check	35	Pump, No. 2 Engine Service Tank Booster
5	Valve, Droppable Tank Outlet Check	36	Valve, Right Auxiliary Outlet Check
6	Switch, Pressure	37	Valve, Manifold Crossfeed
7	Valve, Fueling Manifold Vacuum	38	Valve, Jettison
8	Valve, Primary Level Control	39	Valve, Left Auxiliary Outlet Check
9	Switch, Secondary Level Control	40	Pump, No. 1 Engine Service Tank Booster
10	Cap, Auxiliary Tanks Gravity Filler	41	Valve, No. 1 Engine Service Tank Check
11	Adaptor, Auxiliary Tanks Gravity	42	Valve, No. 1 Engine Crossfeed
12	Tank, Left Auxiliary	43	Valve, Right Auxiliary Tank Manual
13	Valve, Left Bomb Bay and Auxiliary Fueling	44	Valve, No. 1 Engine Shut-Off
14	Tank, No. 1 Engine Service	45	Valve, APU Manual Fuel Shut-Off
15	Strainer, No. 1 Engine	46	Pump, Left Auxiliary Transfer
16	Valve, Hull Transfer Check	47	Pump, Electric Transfer
17	Valve, Left Bomb Bay Outlet Check	48	Cap, Hull Tanks Gravity Fillers
18	Valve, No. 1 Engine Service Tank Fueling	49	Adaptor, Hull Tanks Gravity Filler
19	Manifold, Transfer and Fueling	50	Pump, Manual Transfer
20	Valve, No. 2 Engine Service Tank Fueling	51	Strainer, Hull Tank
21	Valve, Right Bomb Bay Outlet Check	52	Valve, No. 1 Hull Tank Selector
22	Valve, Main Service Tank Fueling	53	Valve, No. 2 Hull Selector
23	Strainer, No. 2 Engine	54	Valve, Jettison Air Dilution Check
24	Tank, No. 2 Engine Service	55	Valve, No. 3 Hull Tank
25	Valve, Right Bomb Bay and Auxiliary Fueling	56	Tank, No. 3 Hull
26	Tank, Right Auxiliary	57	Tank, No. 2 Hull
27	Tank, Droppable Bomb Bay	58	Tank, No. 1 Hull
28	Valve, Primary Level Control	59	Valve, Hull Tanks Fueling
29	Pump, Right Bomb Bay Transfer	60	Cap, Single Point Fueling Safety
30	Pump, Right Auxiliary Transfer	61	Valves, Single Point Fueling
31	Valve, No. 2 Engine Shut-Off	62	Pump, Left Bomb Bay Transfer

Flight Boost Pump No. 2
Main Hydraulic Pump No. 1

Bus No. 2 supplies three-phase power to the following busses and equipment:

Right Bomb Bay Heater Blower
Right Auxiliary Tank Fuel Pump
Right Droppable Tank Fuel Pump
A-C Bus No. 2 Indicator Light
Sonobuoy and Tail Distribution Box A-C Busses No. 2
Navigators A-C Bus Armament and Distribution Panel
Radar Operators A-C Bus
Cockpit Distribution Panel A-C Bus No. 2
Flight Boost Pump No. 1
Main Hydraulic Pump No. 2

The Cross-Tie bus supplies three phase power to the following equipment:

Main Converter
Cabin Heater Blower
Cross-Tie Bus Indicator Light
No. 2 Propeller Auxiliary Pump
No. 1 Propeller Auxiliary Pump
Propeller De-icing

Whenever the main three-phase busses are energized, the individual 115/200 volt three-phase a-c busses are also energized. The equipment connected to the main three phase busses will be energized when their respective control switches are turned on to complete the circuits to the various equipment. In all cases, the individual bus feeders are connected to the main power busses through fuses for circuit protection.

The 26 volt single phase transformers in the cockpit distribution panel are connected (one to each phase) to the cockpit distribution panel 115 volt three phase bus. These transformers supply power to the cockpit distribution panel and radio operator's panel 26 volt single phase busses for operation of the autosyn instruments.

Two special transformers are included with the a-c distribution system which convert 200 volt three-phase power to 115-volt three phase power of reverse phase rotation. One of these transformers, located in the navigator's distribution box and connected to the navigator's three-phase bus supplies power to the G-2 compass. The other transformer located in the cockpit distribution panel three-phase bus, provides for the autopilot system.

A-C CONTROL PANEL, RADIO OPERATOR'S. (See figure 1-10.)

The a-c control panel contains all the control switches, meters, and indicators to properly operate the a-c power system to supply correct a-c power to the distribution panel busses in the main power center.

Note

In order to clarify the following text, it is suggested that regular reference be made to the a-c schematic diagram or the control panel.

Switches and meters are arranged in such a manner that power from any source can be readily traced (by means of diagramatic lines on the panel) to the bus, or busses being energized at the time. Indicator lamps for each bus show which busses are energized, and trip lamps call attention to power sources which have been automatically removed from the line for any reason. All switches, meters and indicator lamps in the left engine a-c generator system are grouped in the order generally used, on the right of the panel, and connect to the number one bus. All switches, meters, and indicator lamps in the right engine a-c generator system are grouped in the order generally used, on the left of the panel, and connect to the number two bus. The APU generator and external power source controls and meters are combined on the center of the panel, and connect one at a time to the tie bus. Bus tie switches are provided to connect the three busses together as required. The switches, meters, and indicator lamps, common to two or more of the power sources, are grouped together at the lower center of the panel. A check chart on the panel lists briefly, the steps to be taken to provide parallel operation of the engine driven a-c generators.

A-C GENERATOR AND CONSTANT SPEED DRIVE OVERHEAT INDICATION SYSTEM.

Note

On airplanes No. 135520 and subsequent as delivered and on airplanes No. 135474 to 135519 after service change.

DESCRIPTION OF A-C GENERATOR AND CONSTANT SPEED DRIVE OVERHEAT INDICATION SYSTEM.

The system consists of indicator lights, test switch and thermal switches. The indicator lights are on the pilot's center console and the redio operator's sloping panel. The test switch is on the radio operator's sloping panel. The thermal switches are mounted on the a-c generator's and the step above the constant speed drive units. The system indicates an overheated condition of either the a-c generator or the constant speed drive unit.

Power to operate system is obtained from the 28-volt, d-c bus No. 2 in the cockpit distribution panel through a 5 ampere circuit breaker.

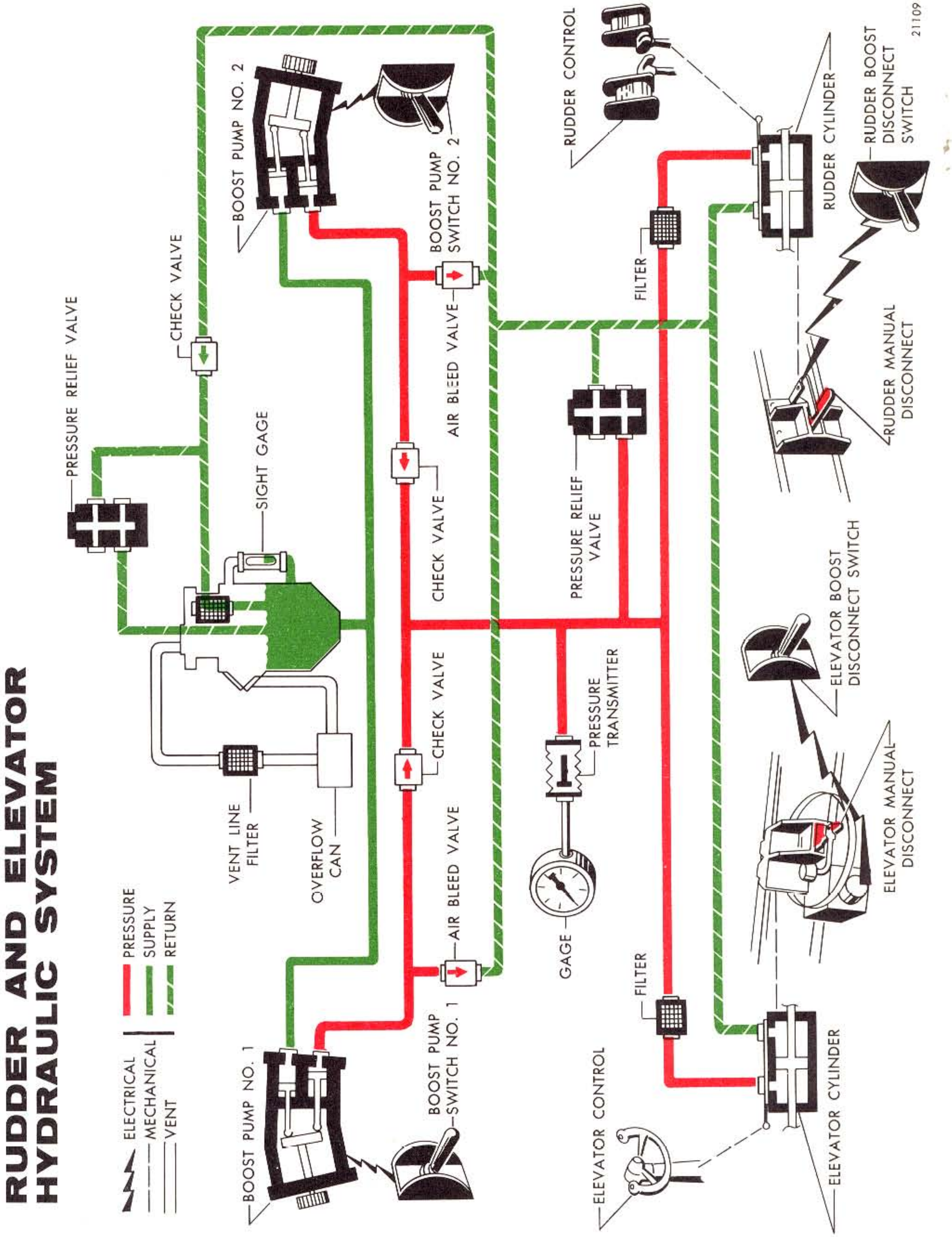


Figure 1–12A. Elevator and Rudder Hydraulic Systems

Before any source of a-c power is connected to any bus, it is essential that the electrical characteristics of the power source be checked; that is, 115 volts, 400 cycles, proper phase rotation, etc.

D-C CONTROL PANEL, RADIO OPERATOR'S. (See figure 1-10.)

The d-c control panel at the radio operator's station contains the control switches and meters to operate the d-c power system to supply power to the main d-c distribution panel bus in the main power center.

Note

In order to fully comprehend the following text, it is recommended that regular reference be made to the control panel.

Control switches and meters are arranged in such a manner that power supplied from any source can readily be traced by means of diagramatic lines on the panel to the bus indicator light, which will come on whenever the d-c bus is energized. TRIP lights adjacent to the generator control switches will indicate when a generator has been removed from the bus due to a fault when the generator control switch is closed.

A NO-OUTPUT indicator light located adjacent to the converter control switch will indicate when the converter has been removed from the bus or when the converter is not putting out, and then only if the converter control switch is in the ON position. A voltmeter together with a selector switch provides selection of the power source to be connected to the voltmeter. Located on the lower section of the panel are the ammeter test jacks, the radio operator's panel light control switch, and the 28-volt d-c utility receptacle together with its control switch. The external power warning light, on the main power center panel, and the external d-c power indicator light will illuminate when the external power is connected and with the external power switch in the ON position. An EMERGENCY CUT OUT switch for each generator is used to remove the generator from the bus in the event of an emergency.

HYDRAULIC POWER SUPPLY SYSTEM (See figures 1-12A and 1-17.)

There are four hydraulic systems in the airplane: the main hydraulic system, the surface control booster hydraulic system, the tail turret hydraulic system, and the AN/APS-44A Search Radar hydraulic system. See figure 1-20, for system oil grade specification.

MAIN HYDRAULIC SYSTEM.

The main hydraulic system is a closed-center 3000 psi system, obtaining its pressure from two variable volume a-c motor-driven pumps. This main system regulates pressure to operate the wing flaps, spoiler-ailerons, hydroflaps, bomb bay doors, and the sonobuoy door. Either or both pumps may be selected to operate by closing either or both switches on the pilot's sub-panel (74 and 75, figure 1-5). The system is of a conventional nature with reservoir, filters, valves, cylinders, accumulators, etc. The pressure indicator, calibrated in psi, is located on the pilot's sub-panel (72, figure 1-5).

SURFACE CONTROL BOOST HYDRAULIC SYSTEM.

The surface control boost hydraulic system (figure 1-12A) is a 3000 psi closed-center system obtaining its pressure from two a-c motor-driven pumps. The system, located in its entirety in the tail section, is energized by closing either or both pump switches on the pilot's sub-panel (68 and 69, figure 1-5). The pumps provide hydraulic pressure to the mechanically moved slide valve which directs the pressure to either side of the boost cylinders. The cylinders, in turn, move the rudder and elevators. Upon arrival of the rudder and elevator to its desired position, a mechanical follow-up linkage returns the slide valve to neutral, thereby causing the system flow to IDLE. The pressure gage for this system is located on the pilot's sub-panel (70, figure 1-5).

TAIL TURRET HYDRAULIC SYSTEM.

The tail turret hydraulic system is an integral unit. Power for movement of the turret is provided by an a-c, motor-driven, variable-volume hydraulic pump connected to the operator's controller slide valves. The azimuth and elevation motors are in turn connected to the operator's controller with a return to the hydraulic power unit. All controls for the turret are contained within the tail turret junction box and on the operator's controller. Power to operate the turret hydraulic stystem is supplied from the main d-c and a-c bus system through circuit breakers on the tail turret distribution box and through the turret control switch box on the right side of the airplane.

SEARCH RADAR HYDRAULIC SYSTEM.

See Publication AN 01-35EJB-1A, Supplemental Flight Handbook for Navy Model P5M-2.

FLIGHT CONTROL SYSTEMS. (See figure 1-14A.)

The primary flight control surfaces (ailerons, elevators, and rudder) are mechanically operated by torque tubes, bellcranks, quadrants, and cables to dual controls. (See figure 1-14A.) Spoiler ailerons, on top of the wings and inboard of the ailerons, are automatically actuated when conventional aileron control is applied. The pilot's effort on the rudder and elevator controls is greatly reduced by a hydraulic boost system. Elevator trim tabs are mechanically operated. The aileron and rudder trim tabs are electrically operated, incorporating a mechanical crank control for emergency operation.

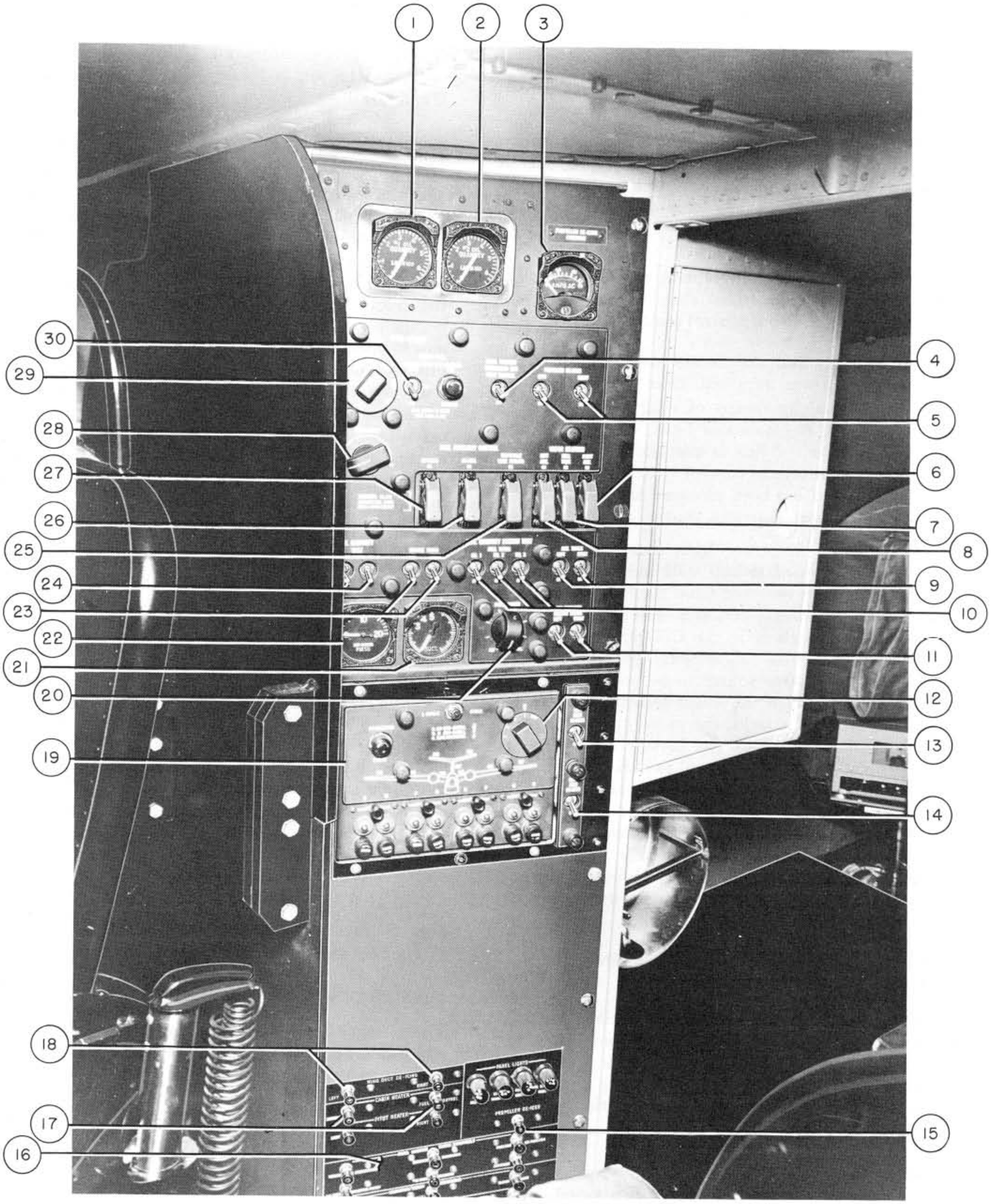


Figure 1–13. Pilot's Aft Control Panel

KEY TO FIGURE 1-13

1 Oil Quantity Indicator, No. 1 Engine
2 Oil Quantity Indicator, No. 2 Engine
3 Properler De-icing Current Indicator
4 Stall Warning Transducer and Pilot Heater Switch
5 Propeller De-icing Control Switches
6 Right Auxiliary Tank Control Switch, Vapor Dilution
7 Hull Tank Control Switch, Vapor Dilution
8 Left Auxiliary Tank Control Switch, Vapor Dilution
9 Fuel Quantity Test Control Switches, Auxiliary Tanks
10 Fuel Quantity Test Control Switches, Hull Tanks
11 Low Intensity Cockpit Light Control Switches
12 Selector Switch, De-icing System
13 Duct De-icing Control Switch, Left
14 Duct De-icing Control Switch, Right
15 Propeller De-icing Control Circuit Breaker
16 Fuel System Valve Controls Circuit Breaker
17 Cabin Heater Fuel Control Circuit Breaker
18 Wing Duct De-icing Circuit Breaker
19 De-icing System Control Panel
20 Panel Lights, Rheostat Control Switch
21 Suction Indicator Gage, De-icing System
22 Pressure Indicator Gage, De-icing System
23 Fuel Quantity System Test Switches, Service Tank
24 Oil Quantity System Test Switches, No. 1 and No. 2
25 Droppable Tank Fueling Control Switch
26 De-Fuel Control Switch
27 Fuel Jettison Control Switch
28 Cabin Heater Thermostat Control Switch
29 Selector Switch, Cabin Heating
30 Master Starter Switch, Cabin and Bomb Bay Heater

CONTROL WHEELS.

Dual controls for pilot and copilot are the wheel-and-column type and are conventional in operation. On the left grip of the pilot's control wheel are the switches for rocket and jato release, interphone control, and stores release; on the right grip, the autopilot disconnect. The copilot's wheel has the same switches except for the rocket and jato release button. A stall warning shaker motor is mounted on the copilot's control column. (See Stall Warning System.)

SURFACE CONTROL LOCK SYSTEM.

The surface control lock system secures the ailerons, elevators, and rudder in the neutral position. These controls are locked with individual lock assemblies connected by cable to a lock handle lever. This lever, on the left side of cockpit below the window sill, has a release button on the hand grip. The lock handle pivots forward from its stowed position to the lock position across the pilot's control wheel.

Note

The control column must be at or forward of the center position before the control lock handle can be placed in the locked position.

ELEVATOR CONTROL.

The elevators mounted on the high T-tail are clear of water spray, and provide positive lateral control, especially during takeoff or landing. The maximum elevator travel from the neutral position is approximately 19° up and 17° down. The elevators are conventionally controlled by either pilot and are 85 percent assisted by a hydraulic boost system.

ELEVATOR TRIM CONTROL. The elevator trim tabs are mechanically operated by an elevator trim wheel, centrally located on the pilot's pedestal (9, figure 1-3). An indicator attached to the trim wheel indicates position of trim tabs through 22° of travel either side of neutral.

ELEVATOR AND RUDDER HYDRAULIC BOOST SYSTEM. The elevator and rudder hydraulic boost system is self contained into two separate units (figure 1-12A) and energized by two a-c motor-driven hydraulic pumps. Either pump will provide the required 3000 psi pressure to operate the elevator and rudder boost simultaneously. On the pilot's sub-panel is a hydraulic boost pressure gage and two switches for controlling the No. 1 and No. 2 Flight Boost Pumps. Conventional movement of the elevators or rudder actuates the corresponding hydraulic boost unit through mechanical linkage. Each control can be disconnected, electrically or manually, from the boost system.

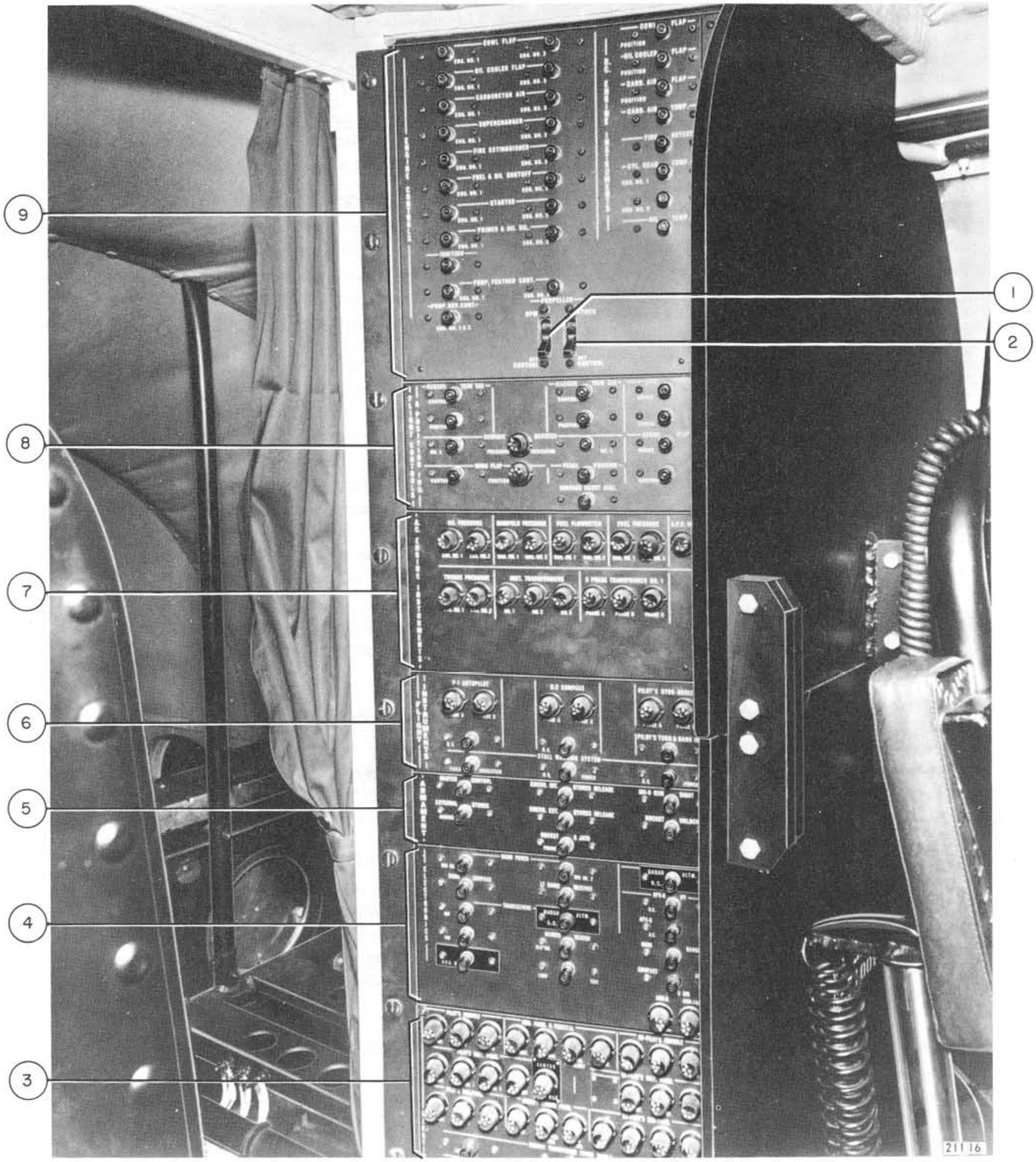
ELEVATOR BOOST ELECTRICAL DISCONNECT.

A momentary hydraulic boost disconnect switch on the cockpit overhead panel, when placed in ELEVATOR DISCONNECT, energizes a solenoid disconnect mechanism in the elevator hydraulic boost unit.

ELEVATOR BOOST MANUAL DISCONNECT. The elevator boost unit in the overhead hydraulic compartment has a manual disconnect which is easily identified by its guarded red lever. Manual disconnect is accomplished by moving the end of the lock pin solenoid arm to the right and pushing the red lever arm aft.

RUDDER CONTROL.

The rudder is conventionally controlled by a dual set of pedals and 65 percent assisted by a hydraulic boost system. The toe brakes on the rudder pedals operate the hydroflaps, used simultaneously as water brakes, or independently as water rudder. Individual pedal positioners (figure 1-5) adjust each set of rudder pedals to suit the operator's leg length. Fore and aft movement of the momentary switches on the pilot's and copilot's sub-panel, position the pedals accordingly. Power is supplied from the main d-c bus through a pedal positioner circuit breaker on the cockpit distribution panel.



1 Propeller RPM Control Switch
2 Propeller Synchronizer Control Switch
3 Lighting Circuit Breaker Panel
4 Electronic Circuit Breaker Panel
5 Armament Circuit Breaker Panel
6 Flight Instruments Circuit Breaker Panel
7 A-C Instrument Circuit Breaker Panel
8 Flight Controls and Position Inidicator Circuit Breaker Panel
9 Engine Controls and D-C Engine Instrument Circuit Breaker Panel

Figure 1-14. Cockpit Distribution Panel

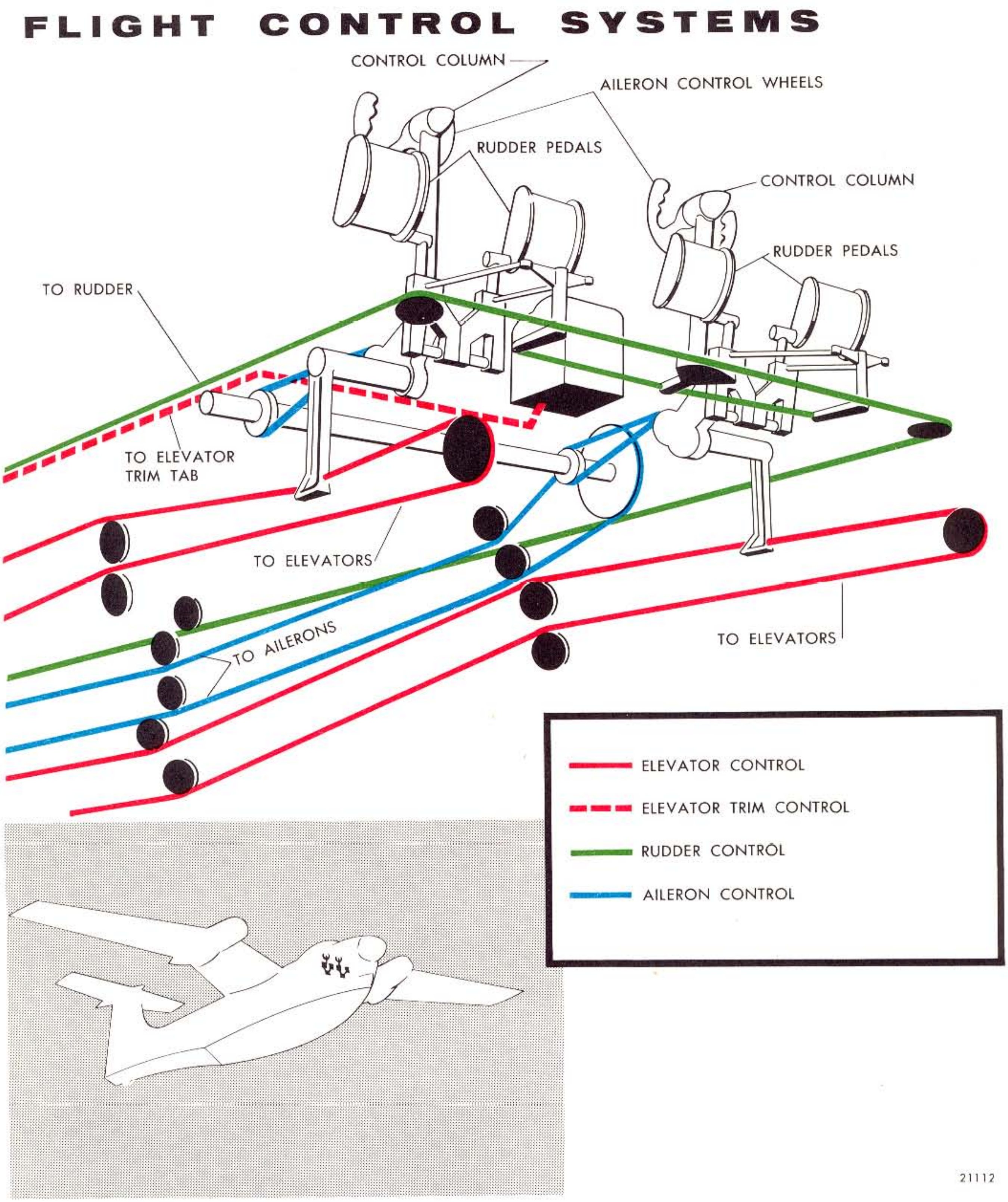


Figure 1-14A. Flight Control System (Sheet 1)

AILERON & SPOILER CONTROL SYSTEMS

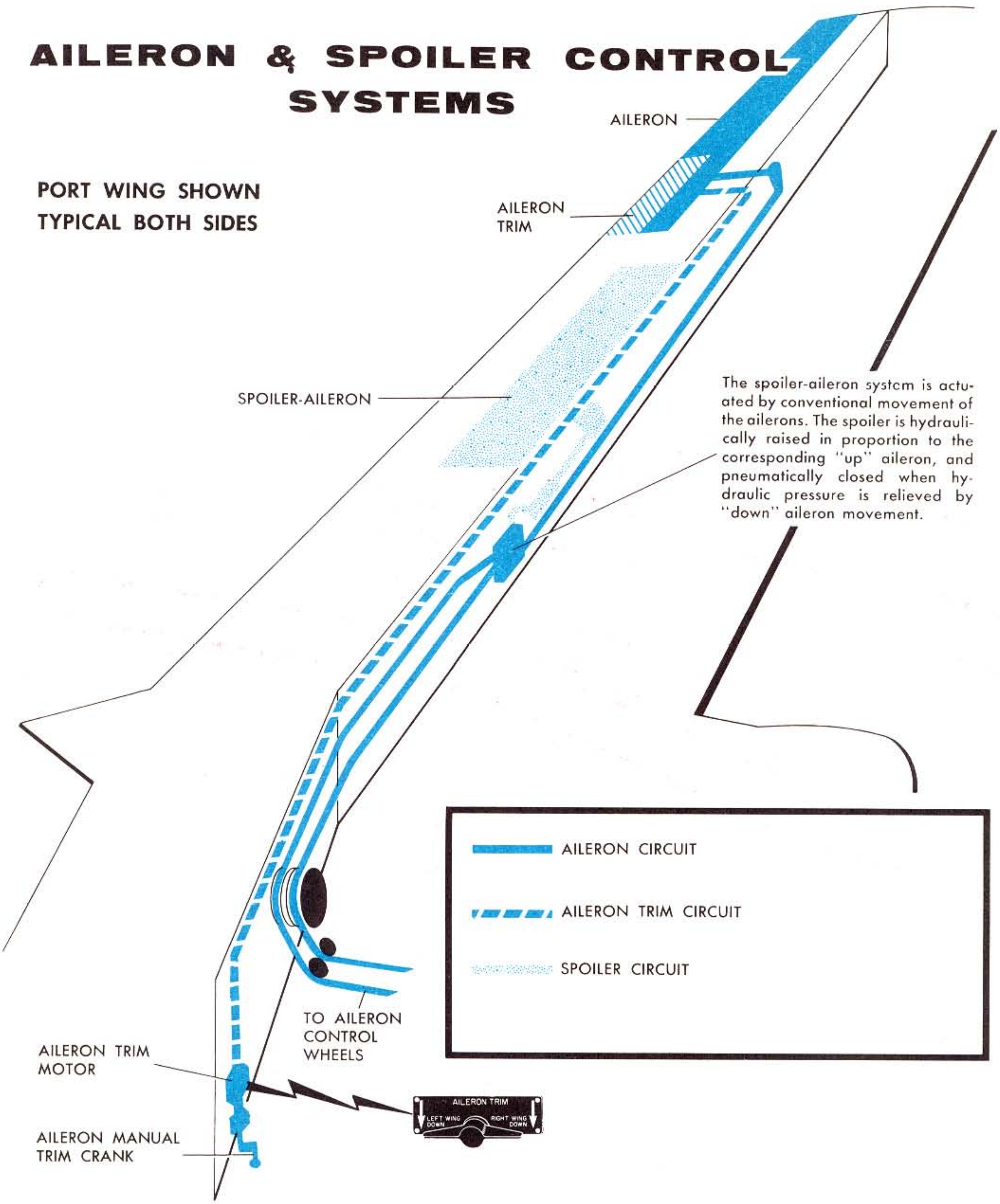


Figure 1–14A. Flight Control System (Sheet 2)

ELEVATOR AND RUDDER CONTROL SYSTEMS

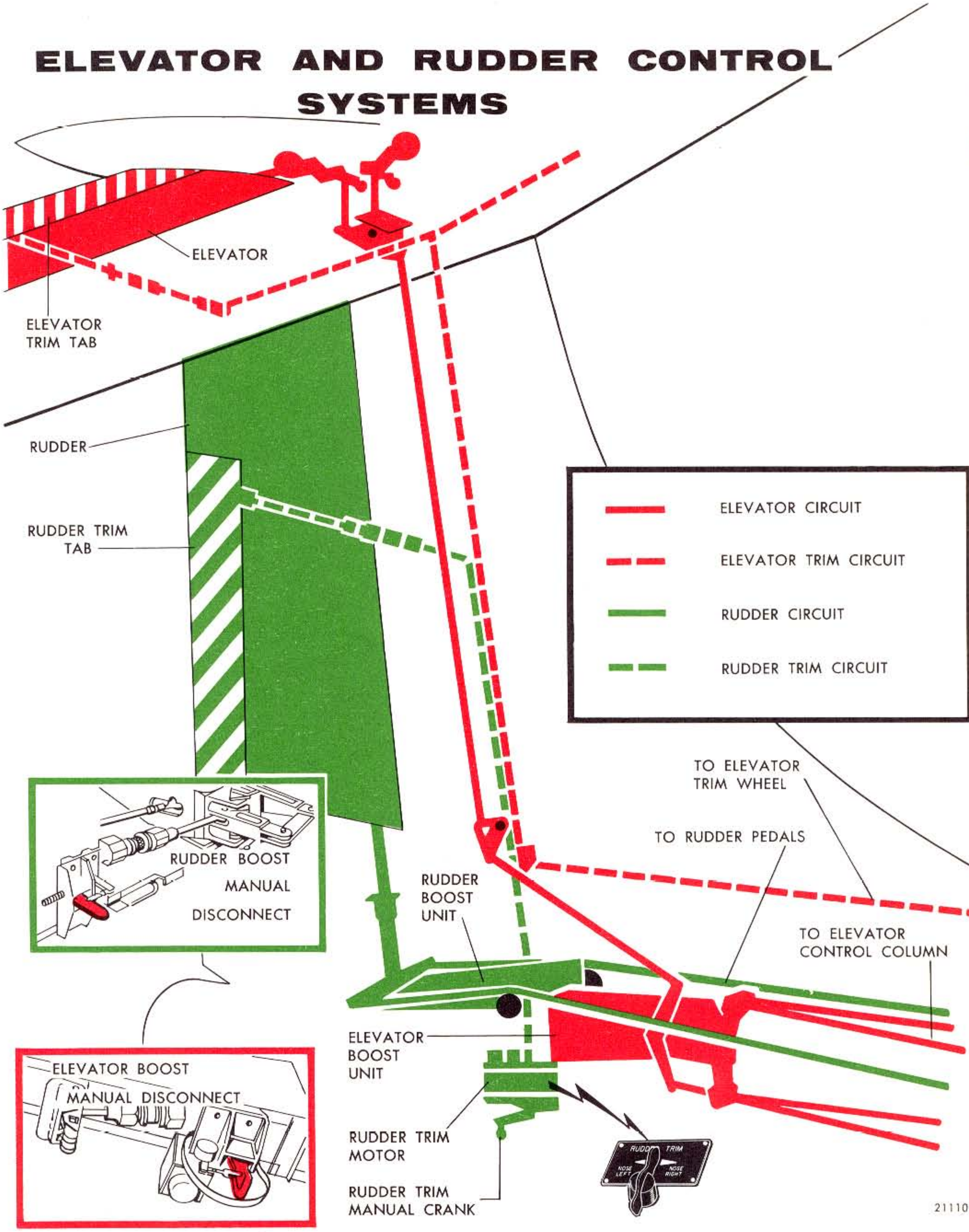


Figure 1–14A. Flight Control System (Sheet 3)

RUDDER TRIM CONTROL. The rudder trim tab is electrically controlled by the rudder trim switch on the pilot's pedestal (figure 1-3). Rudder trim position is indicated on a dual gage (rudder and aileron trim) on the pilot's instrument panel. Power for the rudder tab actuator is supplied from the main d-c bus through a circuit breaker on the cockpit distribution panel. If electrical failure occurs, the rudder tab can be manually operated by a hand crank on the actuator motor, located in the hydraulic compartment (figure 1-14A). Position of the rudder trim during manual operation is indicated on a dial below the hand crank.

RUDDER BOOST ELECTRICAL DISCONNECT. A momentary hydraulic boost disconnect switch on the cockpit overhead panel, when placed in RUDDER DISCONNECT, energizes a solenoid disconnect mechanism in the rudder hydraulic boost unit.

RUDDER BOOST MANUAL DISCONNECT. The rudder boost unit in the tail gunner's compartment, has a red lever arm disconnect which is moved forward manually to release the rudder boost.

AILERON CONTROL.

The ailerons are mechanically controlled by the pilots' control wheels. Stops on the aileron surfaces restrict the wheel travel to 158° either side of neutral, or 120° whenever the spoiler-aileron system is pressurized.

AILERON TRIM CONTROL. The aileron trim tab is electrically controlled by the aileron trim switch on the pilot's pedestal (figure 1-3.) The aileron trim position is indicated on a dual gage (rudder and aileron trim) on the pilot's instrument panel (figure 1-5). Power for the aileron trim actuator motor is supplied from the main d-c bus through a circuit breaker on the cockpit distribution panel. If an electrical failure occurs, the aileron trim tab can be manually operated by a hand crank on the actuator motor on the crown of the forward waist compartment. Position of the aileron trim during operation is indicated on a dial on the actuator motor.

SPOILER-AILERON CONTROL.

A spoiler-aileron on each outer wing upper surface, inboard of the ailerons, increase the rate of roll of the airplane, particularly at low speeds with flaps down. Movement of the aileron control actuates the spoiler system. This system hydraulically raises the spoiler an amount proportional to the corresponding "up" aileron, and pneumatically closes the spoiler. A hydraulically operated stop cylinder on the aileron torque tube restricts movement of the conventional aileron to approximately 12° up to 10° down when the spoiler hydraulic system is pressurized. However if malfunction of the spoiler-hydraulic system occurs, adequate bank control is still available with an increase of aileron travel to 20° up and 15° down.

WING FLAPS.

The wing flaps are of the full trailing-edge type, across the wing span from aileron to aileron. One flap is on each center wing, and one on each outer wing trailing edge. Each flap is connected mechanically to the others through a system of torque and push-pull tubes. A hydraulic cylinder in each center wing extends and retracts the flaps from 0° in full up position to 40° in full down position. Power to operate the hydraulic cylinders is supplied from the main hydraulic system through an electrically operated valve. Flap position control is achieved by a switch on the pilot's pedestal (7, figure 1-3). Flap position is shown by a wing flap indicator on the pilot's instrument panel (76, figure 1-5). This instrument is calibrated in degrees.

A wing flap safety switch is included in the rocket release circuit to prevent firing rockets unless the flaps are between the full up position and 4° ± 1° down.

Figure 1-15. D-C Power Distribution System

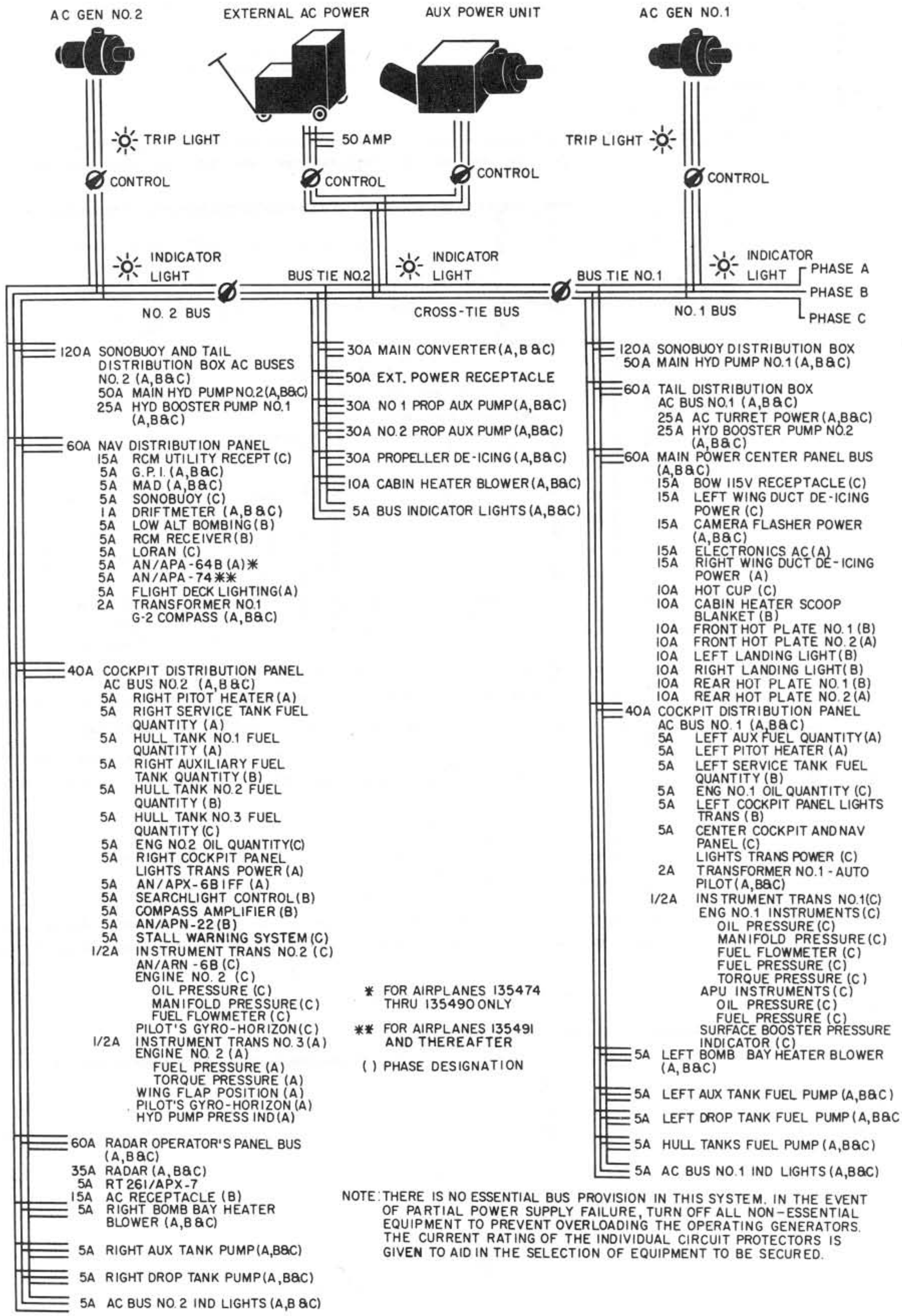


Figure 1–16. A-C Power Distribution System

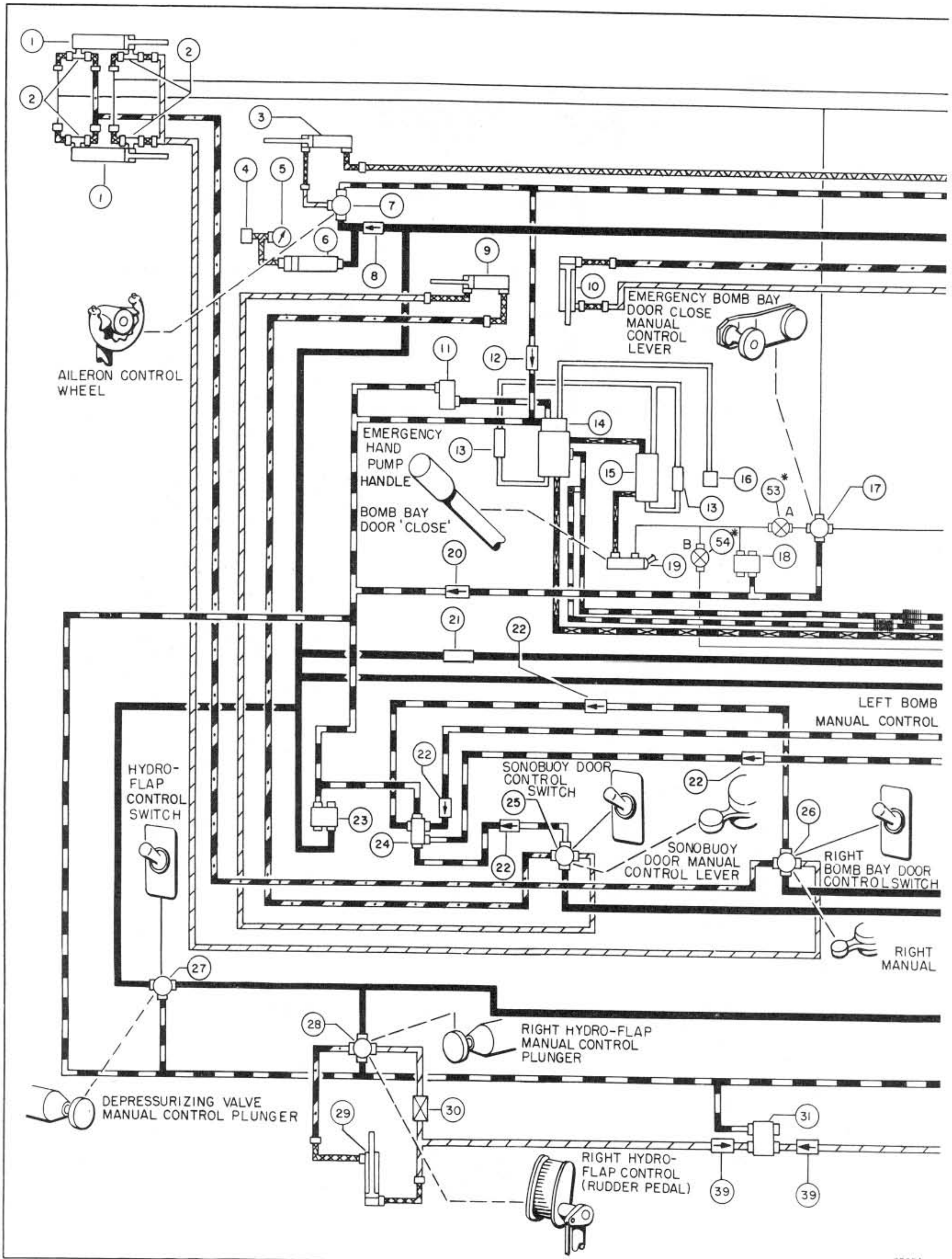


Figure 1-17. Hydraulic System (Sheet 1 of 2)

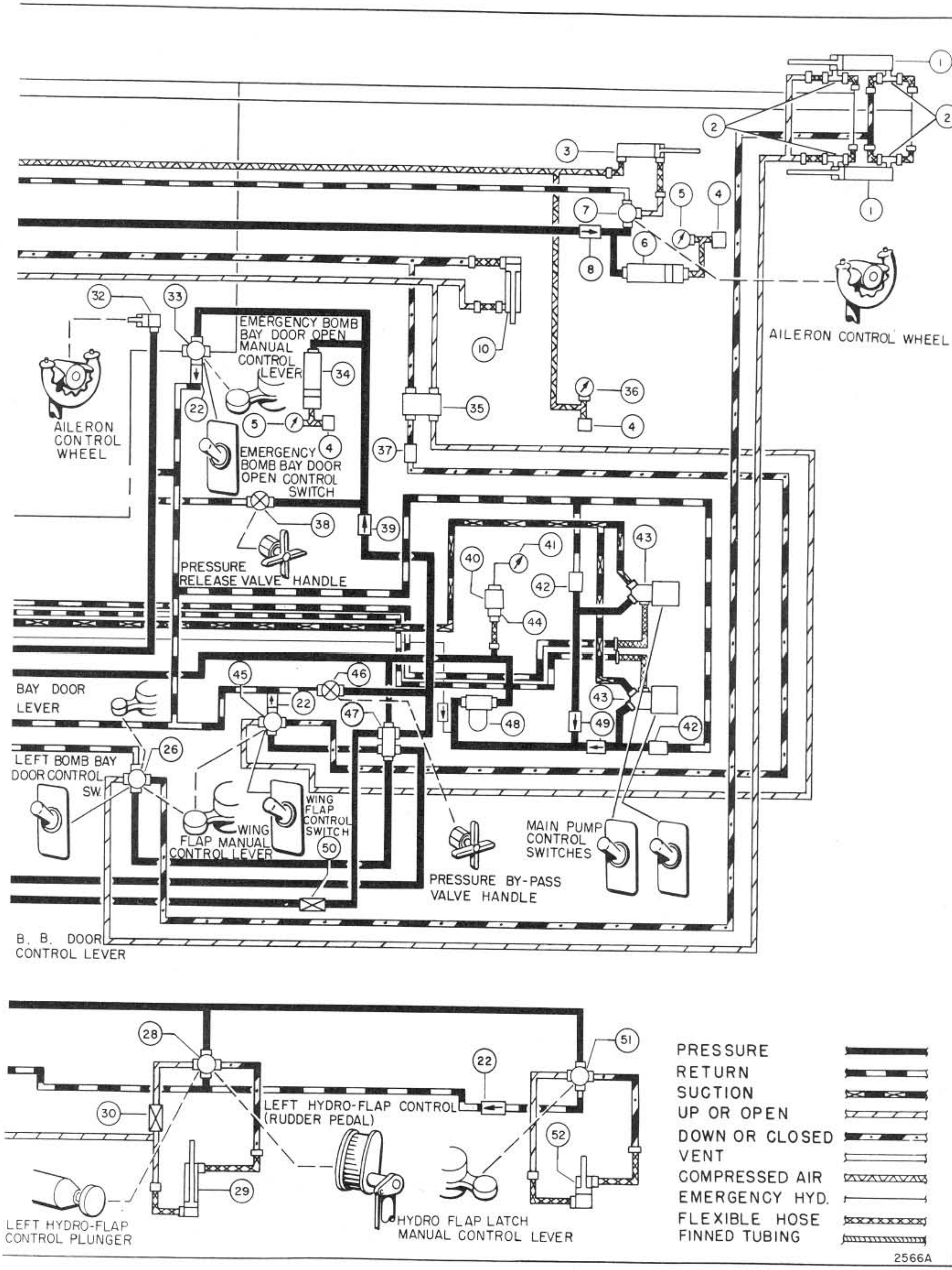


Figure 1-17. Hydraulic System (Sheet 2 of 2)

KEY TO FIGURE 1-17

1 Cylinder, Bomb Bay Door
2 Valve, Shuttle
3 Cylinder, Spoiler Aileron
4 Valve, Air Filler
5 Gage, Accumulator Pressure
6 Accumulator, Spoiler
7 Valve, Aileron Spoiler Control
8 Valve, Check
9 Cylinder, Sonobuoy Door
10 Cylinder, Wing Flap
11 Valve, Reservoir Pressure Relief
12 Valve, Check
13 Gage, Sight
14 Reservoir, Main
15 Reservoir, Emergency Bomb Bay Door
16 Filter, Vent
17 Valve, Emergency Bomb Bay Door Close
18 Valve, Emergency Bomb Bay Door Pressure Relief
19 Pump, Emergency Bomb Bay Door Hand
20 Valve, Check
21 Fuse, Hydraulic
22 Valve, Check
23 Valve, Main Pressure Relief
24 Manifold, Return
25 Valve, Sonobuoy Door Control
26 Valve, R.H. and L.H. Normal Bomb Bay Door Control
27 Valve, Hydro Flap Depressurizing
28 Valve, R.H. and L.H. Hydro Flap Control
29 Cylinder, R.H. and L.H. Hydro Flap
30 Restrictor, Fixed
31 Valve, Hydro Flap Pressure Relief
32 Cylinder, Aileron Quadrant Stop
33 Valve, Emergency Bomb Bay Door Open
34 Accumulator, Emergency Bomb Bay Door
35 Valve, Wing Flap Lock
36 Gage, Spoiler Air Spring
37 Restrictor, Filtered
38 Valve, Emergency Pressure Release
39 Valve, Check
40 Transmitter, Autosyn Pressure
41 Indicator, Pressure
42 Valve, Air Bleeder
43 Pump, Main
44 Snubber, Pressure
45 Valve, Wing Flap Control
46 Valve, Pressure By-Pass
47 Manifold, Pressure
48 Filter, Line
49 Valve, Check
50 Restrictor, Filtered
51 Valve, Hydro Flap Latch
52 Cylinder, Hydro Flap Latch
*53 Valve, Shut-off
*54 Valve, Shut-off

* On Airplanes No. 135513 and subsequent and on all airplanes after service change.

A wing flap position potentiometer, installed on the right side of center wing rear spar, is directly connected to the stall warning system. As the stall speed of the airplane varies with the wing flap position, the wing flap potentiometer (controlled by the wing flaps) will increase or decrease to compensate for the stall speed deviation. Power to operate the electrical portion of the system is supplied from the main d-c bus through a circuit breaker on the cockpit distribution panel.

HYDROFLAP SYSTEM.

The hydroflap system consists of two hydroflaps below the water line on the aft portion of the hull bottom. The hydroflaps are used as brakes after the airplane has landed on water or for maneuvering the airplane while taxiing. Each hydroflap is controlled by a potentiometer geared to the pilot's and co-pilot's rudder foot pedals. A HYDROFLAP CONTROL switch on the pilot's pedestal (8, figure 1-3) must be placed in the TAXI position before the flaps can be operated. The hydroflaps are hydraulically operated and are connected to an electrical bridge circuit which directs hydraulic pressure from the main hydraulic system to the actuating cylinders to extend or retract the hydroflaps. The hydraulic actuating system includes a load-limiting feature, which allows the hydroflaps to retract sufficiently to prevent damages if they are subjected to excessive water loads. Accidental operation in the air, up to full simultaneous deflection, produces a negligible trim change. If either or both flaps are opened, a red FLAP UNLOCKED indicator light on the pilot's instrument panel will come on (11, figure 1-5).

STALL WARNING SYSTEM.

The stall warning system is used to warn the pilot of the approaching stall of the airplane. This warning is felt through the shaking of the control column by the control shaker motor mounted on the co-pilot's control column, whenever the stall warning speed is 1.10 to 1.15 times the airplane's actual stalling speed. The warning system operation depends directly upon the airflow pressure on the lift transducer detector vane, located on the left outer wing, and the position of the wing flaps.

KEY TO FIGURE 1-18

1 Switch, Stores Release
2 Switch, Rocket and Jato Release
3 Switch, Automatic Pilot Clutch Disconnect
4 Columns, Elevator Control
5 Panel, Instrument Lighting Control
6 Wheel, Aileron Control
7 Motor, Stall Warning Shaker
8 Pedals, Rudder
9 Positioner, Rudder Pedal
10 Switch, Interphone Control

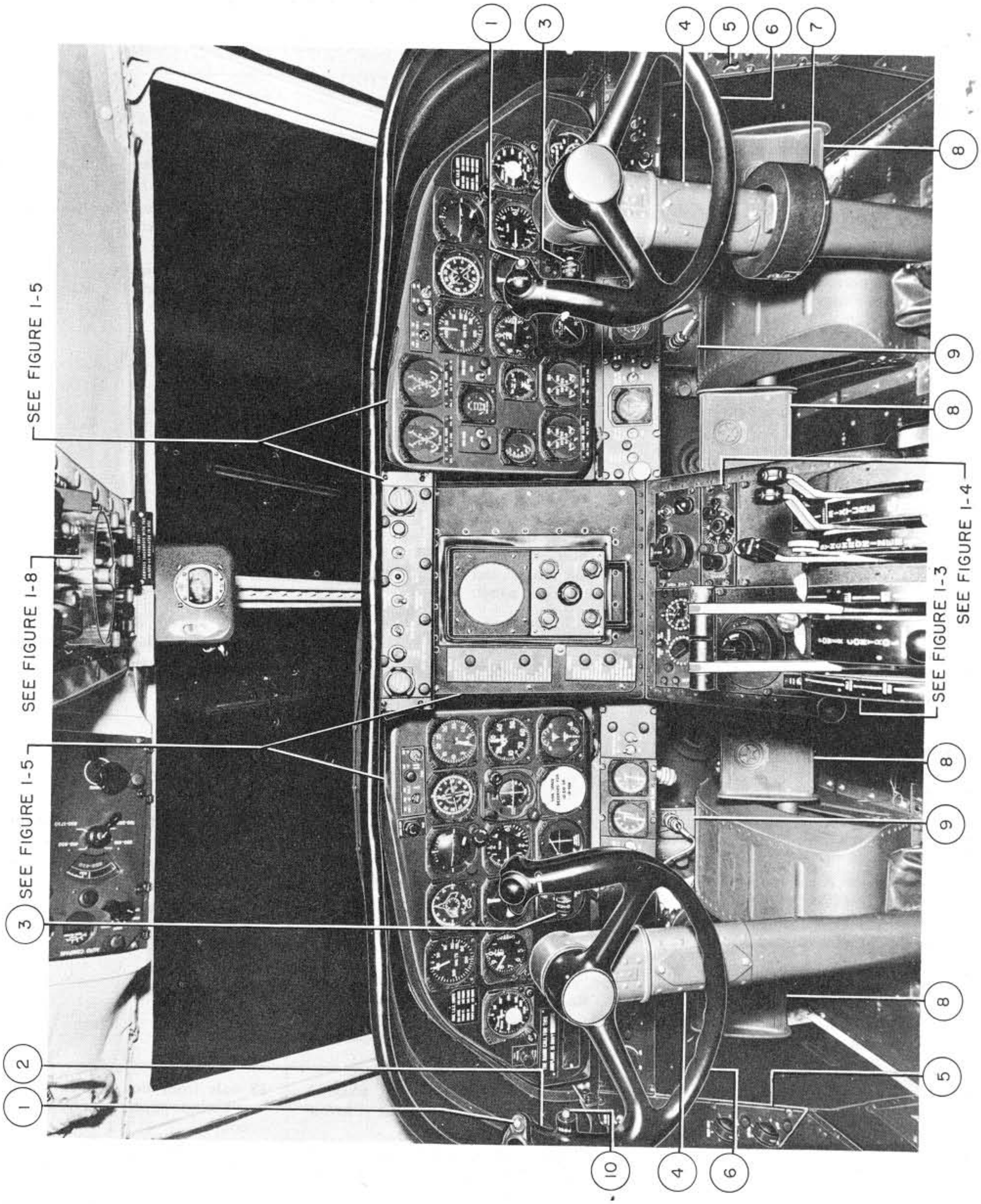


Figure 1-18. Pilot's Compartment (View Looking Forward)

SOURCE OF POWER FOR COCKPIT INSTRUMENTS

EQUIPMENT	ELECTRICAL POWER SOURCE	
	A-C	D-C
ENGINE INSTRUMENTS		
1. Carburetor Air Temperature Indicator (Co-pilot's instrument panel)		28 volt from Bus No. 1, cockpit distribution panel.
2. Cylinder Head Temperature Indicator No. 1 (Co-pilot's instrument panel) Cylinder Head Temperature Indicator No. 2		28 volt from Bus No. 1, cockpit distribution panel. 28 volt from Bus No. 2, cockpit distribution panel.
3. Oil Temperature Indicator (Co-pilot's instrument panel)		28 volt from Bus No. 2, cockpit distribution panel.
4. Torque Pressure Indicator (Co-pilot's instrument panel)	26 volt, single phase, 400 cycle, from Bus No. 1 and No. 2, cockpit distribution panel.	
5. Fuel Pressure Indicator (Co-pilot's instrument panel)	26 volt, single phase, 400 cycle, from Bus No. 1 and No. 2, cockpit distribution panel.	
6. Oil Pressure Indicator (Co-pilot's instrument panel)	26 volt, single phase, 400 cycle, from Bus No. 1 and No. 2, cockpit distribution panel.	
7. Manifold Pressure Indicator (Pilot's instrument panel)	26 volt, single phase, 400 cycle, from Bus No. 1 and No. 2, cockpit distribution panel.	
8. Fuel Flowmeter Indicator Engine No. 1 and Engine No. 2 (Co-pilot's instrument panel)	26 volt, single phase, 400 cycle, from Bus No. 1 and No. 2, cockpit distribution panel.	
FLIGHT INSTRUMENTS		
1. Pilot's Turn and Bank Indicator (Pilot's instrument panel)		28 volt from Bus No. 2, cockpit distribution panel.
2. Pilot's Gyro Horizon Indicator (Pilot's Instrument panel)	26 volt, phase A, 400 cycle Bus No. 2, cockpit distribution panel, and phase C Bus No. 3.	
INSTRUMENTS (OTHER THAN FLIGHT OR ENGINE)		
1. Cowl Flap Position Indicator (Co-pilot's instrument panel)		28 volt from Bus No. 1, cockpit distribution panel.
2. Oil cooler Flap Position Indicator (Co-pilot's instrument panel)		28 volt from Bus No. 1, cockpit distribution panel.
3. Carburetor Air Flap Position Indicator (Co-pilot's sub-panel)		28 volt from Bus No. 1, cockpit distribution panel.
4. Free Air Temperature Indicator (Co-pilot's instrument panel)		28 volt from Bus No. 2, cockpit distribution panel.
5. Hydraulic Pressure Indicators:		
(a) Main Hydraulic Pump Pressure (Pilot's sub-panel)	26 volt, single phase, 400 cycle, Bus No. 3, cockpit distribution panel.	
(b) Flight Booster Pump Pressure (Pilot's sub-panel)	26 volt, single phase, 400 cycle, Bus No. 1, cockpit distribution panel.	
FLIGHT CONTROL INSTRUMENTS		
1. Automatic Pilot (Co-pilot's Turn and Bank—Gyro Horizon and Fluxgate compass Indicator)	115 volt, 3 phase, 400 cycle, phase A and C, Bus No. 1, cockpit distribution panel.	28 volt from Bus No. 2, cockpit distribution panel to power junction box.
2. G-2 Compass.	115 volt, 3 phase, 400 cycle, phase A and C, Bus No. 1, cockpit distribution panel.	28 volt from Bus No. 1, cockpit distribution panel to amplifier.
3. Wing Flap (Pilot's instrument panel)		28 volt from Bus No. 1, cockpit distribution panel.
4. Trim Tabs Position Indicators: (Pilot's instrument panel)		
(a) Rudder		28 volt from Bus No. 1, cockpit distribution panel.

SOURCE OF POWER FOR COCKPIT INSTRUMENTS—Continued

EQUIPMENT	ELECTRICAL POWER SOURCE	
	A-C	D-C
FLIGHT CONTROL INSTRUMENTS (Cont.)		
(b) Aileron		28 volt from Bus No. 2, cockpit distribution panel.
5. Flight Boost Pumps:		
(a) No. 1 Pump	Pump operation—phase A, B, C, 115/200 volt Bus No. 2, Tail distribution box.	28 volt from Bus No. 2, cockpit distribution panel.
(b) No. 2 Pump	Pump operation—phase A, B, C, 115/200 volt Bus No. 2, Tail distribution box.	28 volt from Bus No. 1, cockpit distribution panel.
6. Rudder Pedal Positioner		28 volt from Bus No. 2, cockpit distribution panel.
MAIN HYDRAULIC PUMPS (Pumps actuates the following mechanisms: Wing flaps, spoilers, aileron-travel limiter, bomb bay doors, sonobuoy doors and hydroflaps.)		
1. (a) No. 1 Pump	Pump operation—phase A, B, and C, 115/200 volt, Bus No. 1 sonobuoy distribution box.	28 volt from Bus No. 1, cockpit distribution panel.
(b) No. 2 Pump	Pump operation—phase A, B, and C, 115/200 volt, Bus No. 2 sonobuoy distribution box.	28 volt from Bus No. 2, cockpit distribution panel.
2. Hydro-Flap Control		28 volt from Bus No. 1, cockpit distribution panel.
Hydro-Flap—Power		28 volt from Bus No. 2, cockpit distribution panel.
ENGINE CONTROL CIRCUITS		
1. Main Engine Starters		
(a) Engine No. 1		28 volt from Bus No. 1, cockpit distribution panel.
(b) Engine No. 2		28 volt from Bus No. 2, cockpit distribution panel.
2. Cowl Flap Control		28 volt from main power center panel bus for power and from Bus No. 1 and No. 2, cockpit distribution panel for control.
3. Carburetor Air Control		28 volt from Bus No. 1 and No. 2, cockpit distribution panel.
4. Oil Cooler Flap Control		28 volt from Bus No. 1 and No. 2, cockpit distribution panel.
5. Supercharger Control		28 volt from Bus No. 1 and No. 2, cockpit distribution panel.
6. Propeller (H.S.P.), Synchronizer and RPM Control		
(a) Propeller rpm control and propeller No. 2 feather control		28 volt from Bus No. 2 cockpit distribution panel.
(b) Synchronizer, reverse and propeller No. 1 feather control		28 volt from Bus No. 1, cockpit distribution.
(c) Propeller auxiliary pumps	115/200 volt, crosstie bus phase A, B, and C, 400 cycle main power center.	
7. Tachometer Indicator (Pilot's instrument panel)	Self-Powered	

During normal flight, the transducer vane will be actuated by the airflow pressure. When the airplane is at the stall warning air speed, the reduced air pressure will release the detector vane in the lift transducer causing the d-c power relay to close. With the throttle below take-off position, throttle limit switches in the pilot's pedestal will close causing the control shaker motor to operate. Accordingly, when the airplane decreases to a sub-stalling air speed at approximately 70 knots, the differential pressure switch on the aft side of the pilot's bulkhead will open the control shaker motor circuit.

A red stall warning system failure indicator light, on the left side of the pilot's instrument panel (1, figure 1-5), will illuminate in event of a-c or d-c power failure.

Proper operation of the control shaker motor and the d-c power supply control components is checked by placing the stall warning test switch on the pilot's sub-panel (3, figure 18A) in TEST position.

Electrical power to operate the stall warning system is supplied from 28 volt d-c cockpit distribution bus No. 1 and No. 2 through two 5 ampere circuit breakers, and from the 115 volt a-c 400 cycle phase C through a 5 ampere circuit breaker on the cockpit distribution panel.

INSTRUMENTS. (See figure 1-5.)

On aircraft No. 135474 through No. 135508 prior to service change there are two electric turn and bank indicators, one each on the pilot's and co-pilot's instrument panels. The instruments, each a combination of a turn indicator unit and a bank indicator unit, are used as aids to maintaining level flight and proper banking in turns.

On aircraft No. 135509 and subsequent and on aircraft No. 135474 through No. 135508 after service change, there is an electrically operated turn and

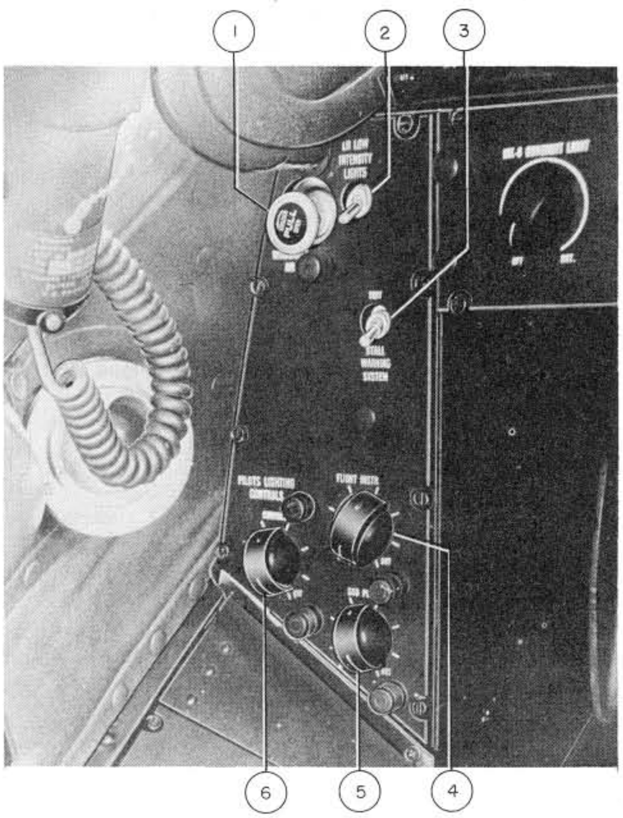


Figure 1-18A. Pilot's Sub-Panel

KEY TO FIGURE 1-18A

1 Windshield Air Control
2 Low Intensity Light Switch
3 Stall Warning System Test Switch
4 Flight Instrument Lighting Rheostat
5 Sub-Panel Lighting Rheostat
6 Console Lighting Rheostat

bank indicator on the pilot's instrument panel and an air driven indicator, operated by suction from the boot de-icer system, on the co-pilot's instrument panel.

Note

The turn and bank indicator on the pilot's instrument panel on aircraft No. 135509 and subsequent and aircraft No. 135474 through No. 135508 after service change and the indicator on the co-pilot's instrument panel on aircraft No. 135474 through No. 135508 prior to service change are components in type P-1 autopilot system.

The pilot's free air temperature indicator, is on the co-pilot's instrument panel. A resistance type temperature bulb is used to detect the temperature. Power to operate the indicator is supplied from the main d-c bus system through a circuit breaker on the cockpit distribution panel.

The navigator's free air temperature indicator is on the navigator's instrument panel (2, figure 1-19). A resistance type temperature bulb is used to detect the temperature. Power for this circuit is supplied from the main d-c bus system through a NAV. FREE AIR TEMP circuit breaker on the navigator's distribution panel.

The gyro horizon indicators are on the pilot's and co-pilot's instrument panels (9 and 40, figure 1-5). Power for the gyro horizon indicator is supplied from the 26 volt, single phase, a-c cockpit distribution panel buses, phase A and phase C through two fuses located on the cockpit distribution panel marked PILOT'S GYRO HORIZON—PHASE A and PHASE C.

a. The co-pilot's gyro horizon provides pitch and bank signals for operation of the automatic pilot.
b. The gyro is mounted within gimbals in such manner as to permit 100 degree freedom in left or right bank, 85 degrees in dive and 60 degrees in climb.

The sensitive altimeters are on the pilot's

KEY TO FIGURE 1-19

1 Light, Table
2 Panel, Navigator's Instrument
3 Rheostat, Chart Light
4 Rheostat, Instrument Panel Lights
5 Rheostat, Overhead Lights
6 Pilot's Sight Stowage
7 Indicator, ID-6B/APN-4
8 Table, Navigator's
9 Thermostat, Cabin
10 Inclinometer
11 Breaker, Water
12 Locker, Navigator's
13 Parachute Stowage

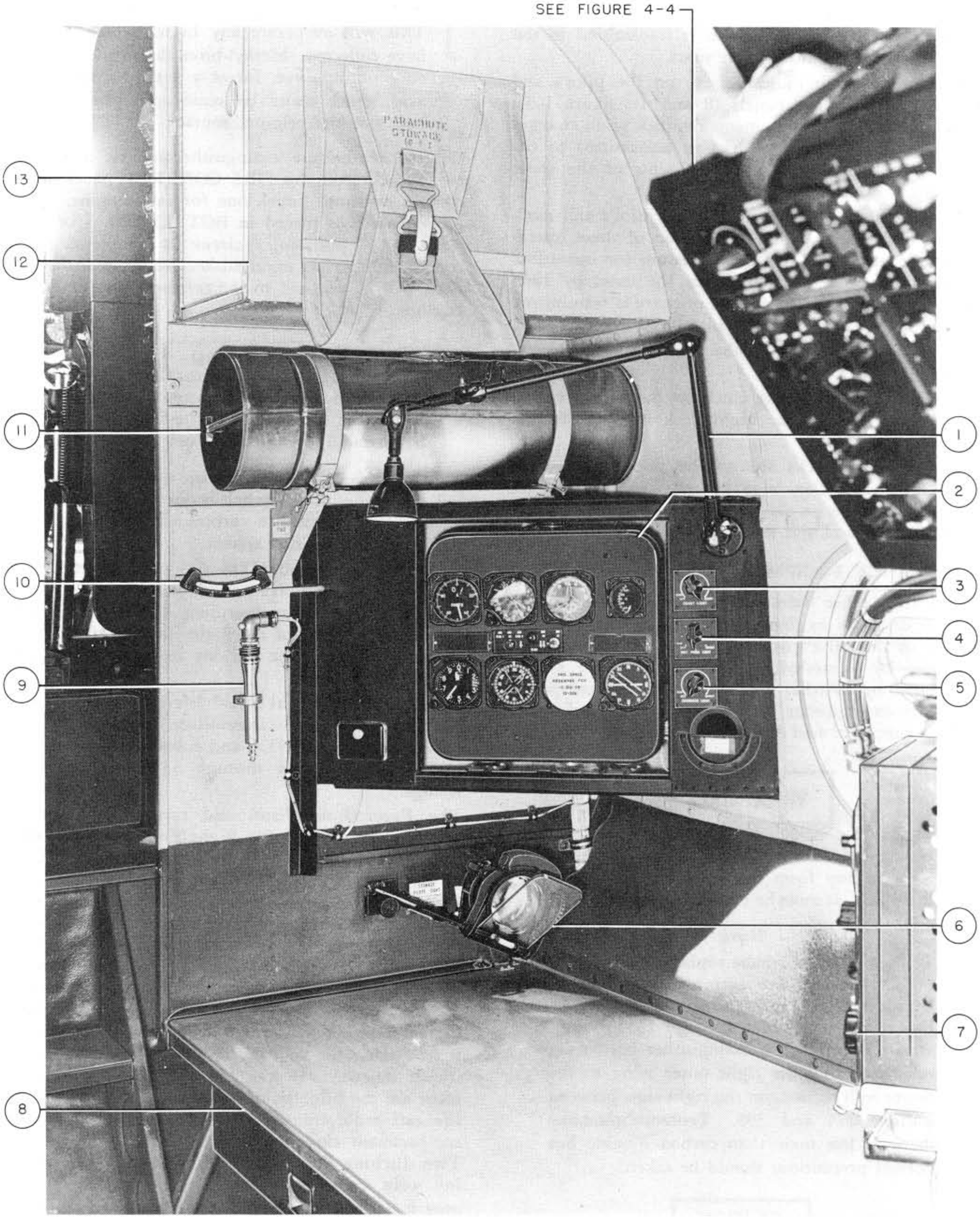


Figure 1-19. Navigator's Station

co-pilot's, and navigator's instrument panels. Operation of these instruments is dependent upon changes in atmospheric pressure which is transmitted to the cases by tubing from the static vents.

The rate of climb indicators are on the pilot's and co-pilot's instrument panels (8 and 41, figure 1-5). Operation of these instruments depends upon changes in atmospheric pressure which is transmitted to the cases by tubing from the static vents of the static pressure system.

The air speed indicators are on the pilot's and navigator's instrument panels. Operation of these instruments depends on differential pressure for operation. Static pressure is transmitted to the cases by lines from the static vents and pitot pressure is transmitted to the cases by lines from the pitot heads.

The civil date clock is on the navigator's instrument panel.

There is an elapsed time clock on the pilot's instrument panel and on the flight deck rack at the rcm operator's station.

The eight-day clocks are on the pilot's instrument panel, the radio operator's panel, and at the rcm operator's station on the flight deck radio rack. These clocks are wound and set by hand.

EMERGENCY EQUIPMENT. (See figure 3-1.)

Main engine fire detection is provided by a system of fire detectors in the engine nacelles and indicator lights in the pilot's overhead panel. Fire control is attained by a methyl bromide extinguisher system energized by switches on the pilot's overhead panel. The fire extinguisher system, when energized, shuts off the supply of fuel and oil to the engine affected.

WARNING

Methyl Bromide is very poisonous. Exposure to it in any form can result in permanent disability. It must be treated with care.

Note

Trifluorobromomethane replaces methyl bromide as engine fire extinguishing fluid on airplanes No. 135538 and subsequent on delivery, and on 135474 through 135537 after service change. The extinguisher bottles are relocated from the right outer wing to the center hull section, on the right side, between stations 374 and 398. Trifluorobromomethane is less toxic than carbon dioxide but normal precautions should be taken.

CAUTION

When the system has been discharged and as soon as possible after completion of flight, the engines should be operated to induce air flow through the various engine sections. This will evaporate any liquid which may have collected. Methyl-bromide, in the presence of moisture, forms a highly corrosive acid which must be removed within five hours of the original contact.

Control of the fire extinguisher system is through two switches on the FIRE CONTROL panel on the cockpit overhead panel, one for each engine. When either switch is placed in BOTTLE NO. 1 or BOTTLE NO. 2 position, a circuit is completed to the corresponding fire extinguisher bottle and the contents will be released to the corresponding engine or engines.

CAUTION

Engines must not be restarted (with fire extinguisher switches in bottle-firing position) by manually over-riding fuel valves.

The APU is also protected by a fire dectector system. The energizing switch is on the radio operator's panel which operates a carbon dioxide (CO_2) bottle in the fire extinguisher system.

There are four hand (CO_2) fire extinguisher bottles within the hull: a five pound bottle is on the bulkhead in the fueling compartment. Two-pound bottles are on the left side of the flight deck, one in forward entrance compartment and one in the aft waist compartment.

There is an additional MK-7 life raft, food container and emergency radio transmitter on the flight deck on airplanes No. 135536 and subsequent as delivered and on No. 135474 through 135535 after service change.

The Pyrotechnic Pistol and cartridge holster are on the left side of the flight deck near the radio operator's station. There are three signal lamps, one in the forward entrance compartment, another in the forward waist compartment, and a third in the aft waist compartment. Six parachute stowages are on the flight deck, three in aft waist compartment and two in the tail. There is one water breaker installed on the flight deck, and one in the galley. One first aid kit is stowed on the flight deck and one is provided in the forward waist compartment. The emergency axe is stowed on the floor of the flight deck near the entrance stairway. In the forward entrance compartment are the bilge pump and hose. The life raft and life raft radio transmitter are in the forward waist compartment close to the emergency food container. Two ditching positions are provided with the ditching webs stowed or in place. One station for four men is at the aft end of the forward waist compartment, and a position for one man is at the aft end of the aft waist compartment. There is a water tight door in the bulkhead at the aft end of the forward

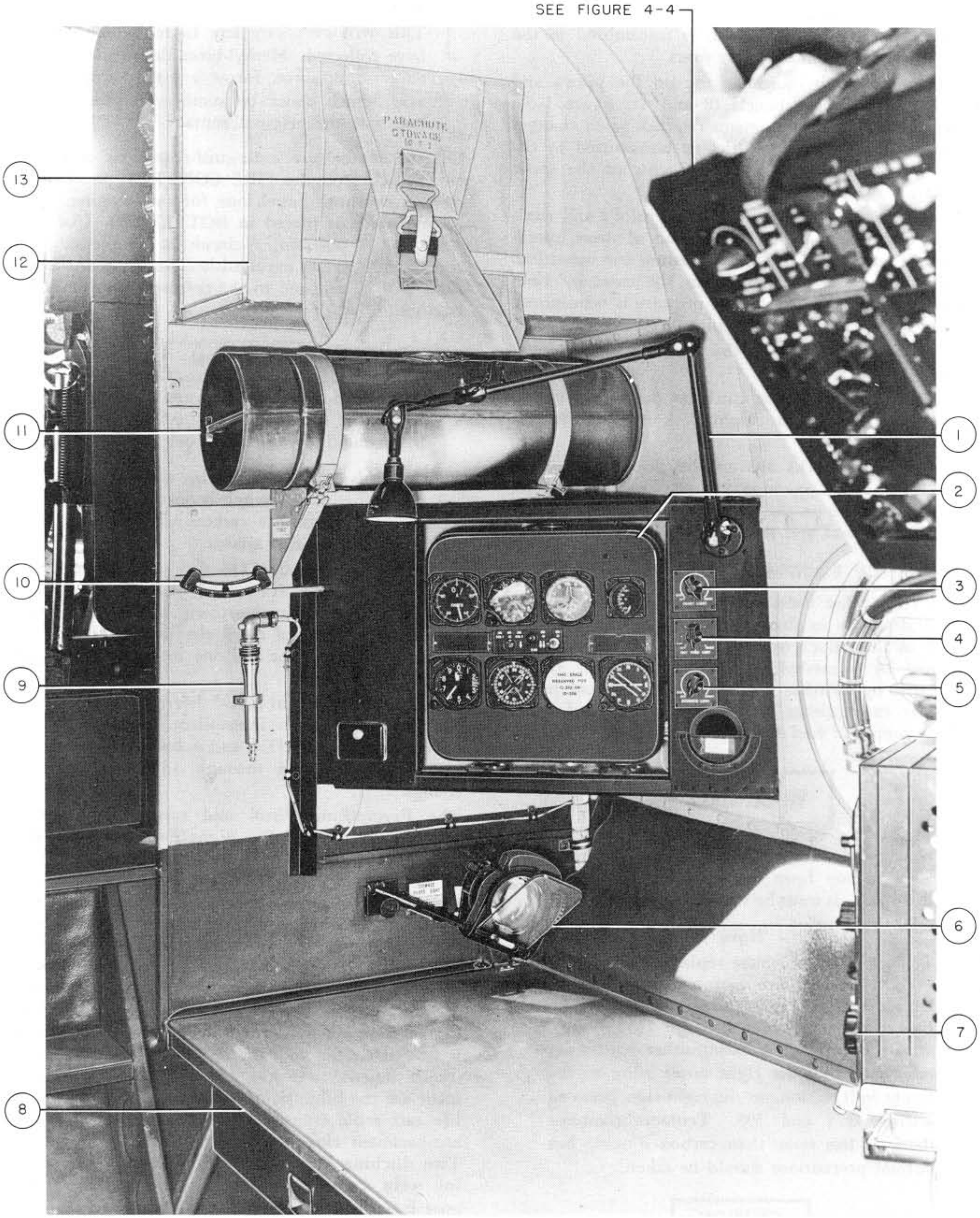


Figure 1-19. Navigator's Station

co-pilot's, and navigator's instrument panels. Operation of these instruments is dependent upon changes in atmospheric pressure which is transmitted to the cases by tubing from the static vents.

The rate of climb indicators are on the pilot's and co-pilot's instrument panels (8 and 41, figure 1-5). Operation of these instruments depends upon changes in atmospheric pressure which is transmitted to the cases by tubing from the static vents of the static pressure system.

The air speed indicators are on the pilot's and navigator's instrument panels. Operation of these instruments depends on differential pressure for operation. Static pressure is transmitted to the cases by lines from the static vents and pitot pressure is transmitted to the cases by lines from the pitot heads.

The civil date clock is on the navigator's instrument panel.

There is an elapsed time clock on the pilot's instrument panel and on the flight deck rack at the rcm operator's station.

The eight-day clocks are on the pilot's instrument panel, the radio operator's panel, and at the rcm operator's station on the flight deck radio rack. These clocks are wound and set by hand.

EMERGENCY EQUIPMENT. (See figure 3-1.)

Main engine fire detection is provided by a system of fire detectors in the engine nacelles and indicator lights in the pilot's overhead panel. Fire control is attained by a methyl bromide extinguisher system energized by switches on the pilot's overhead panel. The fire extinguisher system, when energized, shuts off the supply of fuel and oil to the engine affected.

WARNING

Methyl Bromide is very poisonous. Exposure to it in any form can result in permanent disability. It must be treated with care.

Note

Trifluorobromomethane replaces methyl bromide as engine fire extinguishing fluid on airplanes No. 135538 and subsequent on delivery, and on 135474 through 135537 after service change. The extinguisher bottles are relocated from the right outer wing to the center hull section, on the right side, between stations 374 and 398. Trifluorobromomethane is less toxic than carbon dioxide but normal precautions should be taken.

CAUTION

When the system has been discharged and as soon as possible after completion of flight, the engines should be operated to induce air flow through the various engine sections. This will evaporate any liquid which may have collected. Methyl-bromide, in the presence of moisture, forms a highly corrosive acid which must be removed within five hours of the original contact.

Control of the fire extinguisher system is through two switches on the FIRE CONTROL panel on the cockpit overhead panel, one for each engine. When either switch is placed in BOTTLE NO. 1 or BOTTLE NO. 2 position, a circuit is completed to the corresponding fire extinguisher bottle and the contents will be released to the corresponding engine or engines.

CAUTION

Engines must not be restarted (with fire extinguisher switches in bottle-firing position) by manually over-riding fuel valves.

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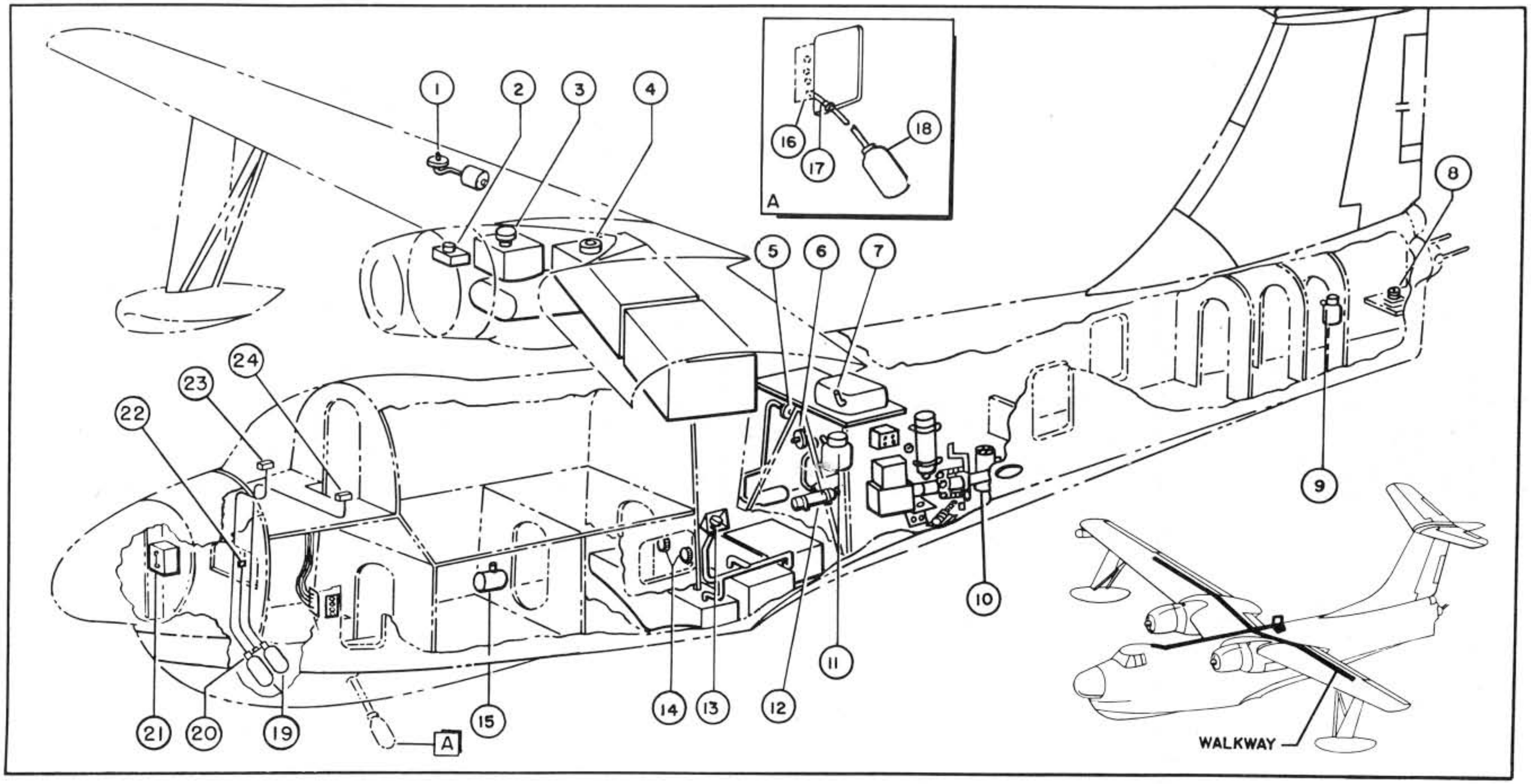
There are four hand (CO_2) fire extinguisher bottles within the hull: a five pound bottle is on the bulkhead in the fueling compartment. Two-pound bottles are on the left side of the flight deck, one in forward entrance compartment and one in the aft waist compartment.

There is an additional MK-7 life raft, food container and emergency radio transmitter on the flight deck on airplanes No. 135536 and subsequent as delivered and on No. 135474 through 135535 after service change.

The Pyrotechnic Pistol and cartridge holster are on the left side of the flight deck near the radio operator's station. There are three signal lamps, one in the forward entrance compartment, another in the forward waist compartment, and a third in the aft waist compartment. Six parachute stowages are on the flight deck, three in aft waist compartment and two in the tail. There is one water breaker installed on the flight deck, and one in the galley. One first aid kit is stowed on the flight deck and one is provided in the forward waist compartment. The emergency axe is stowed on the floor of the flight deck near the entrance stairway. In the forward entrance compartment are the bilge pump and hose. The life raft and life raft radio transmitter are in the forward waist compartment close to the emergency food container. Two ditching positions are provided with the ditching webs stowed or in place. One station for four men is at the aft end of the forward waist compartment, and a position for one man is at the aft end of the aft waist compartment. There is a water tight door in the bulkhead at the aft end of the forward



1 Spoiler, Aileron Accumulator Precharge Valve-Left and Right Wing
2 Constant Speed Drive Filler—Left and Right Wing
3 Engine Oil Tank Filler MIL–O–6082 Grade 1100 (s) 1065 (W) Left and Right Wing
4 Auxiliary Fuel Tank Gravity Filler—MIL–F–5572 Grade 115/145
5 Small Sonobuoy Air Tank Filler Valve
6 Float Light Air Tank Filler Valve
7 Auxiliary Power Unit Oil Filler—MIL–O–6086 Medium or MIL–O–6086 Light
8 Tail Turret Hydraulic Filler—MIL–O–5606
9 Booster Hydraulic System Reservoir—MIL–F–7083 (AER)
12 Bomb Bay Door Accumulator Precharge Valve
13 Hull Tanks Gravity Filler—MIL–F–5572 Grade 115/145
14 Fuel Tanks Pressure Fillers—MIL–F–5572 Grade 115/145
15 Windshield Anti-icing Filler—MIL–F–5566 or MIL–A–6091
16 Vapor Dilution Filler and Discharge Indicator
17 Purge Line, CO_2
18 Purge Cylinder, CO_2
19 Cylinder Oxygen 514 Cu. In. (Each)
20 Valves, Oxygen Check
21 AN/APS–44A Hydraulic Reservoir—MIL–O–5606
22 Valve, Oxygen Filler
23 Bag, Oxygen Mask Stowage, Co-Pilot
24 Bag, Oxygen Mask Stowage, Pilot

Figure 1–20. Servicing Diagram

1 Cushion, Head Rest
2 Cushion, Back
3 Arm Rest
4 Handle, Recline
5 Handle, Shoulder Harness
6 Cushion, Seat
7 Vertical Adjusting—Handle
8 Fore and Aft Adjusting—Handle

Figure 1-21. Pilot's and Co-Pilot's Seat

entrance compartment, at the aft end of the electronic compartment, and at the aft end of the beaching gear compartment.

SEATS. (See figure 1-21.)

The pilot's and co-pilot's seats are symmetrically mounted on dual tracks and are furnished with a fore and aft adjusting handle close to the floor. A handle to raise or lower the seat is on the right side. The reclining lever is on the left side aft of the hinged arm rest. The seats are equipped with a conventional lap safety belt and shoulder harness combination, the harness reel lock lever being on the left side at seat height. The inboard arm rests can be upraised for easier access to the seats.

KEY TO FIGURE 1-22

1 Windshield
2 Glareshield
3 Seat, Co-pilot
4 Panel, Sliding Side Window
5 Compass, Pilot's Standby
6 Sunshade
7 Seat, Pilot's
8 Breaker, Water
9 Parachute, Radar Operator
10 Parachute, RCM
11 Parachute, Navigator
12 Parachute, Pilot
13 Seat and Table, Navigator
14 Bottle, Navigator's, Portable Oxygen
15 Bottle, RCM Operator's Portable Oxygen
16 Parachute, Co-pilot
17 Bottle, Portable Fire Extinguisher
18 Seat, RCM Operator
19 Bottle, Radio Operator's Portable Oxygen
20 Seat, Radio Operator
21 Table, Radio Operator
22 Parachute, Radio Operator
23 Bottle Stowage, Portable Oxygen
24 Bottle Stowage, Jato
25 Power Supply, Photo Flasher
26 Driftmeter Stowage
27 Bottle, Radar Operator's Portable Oxygen
28 Locker, Food and Hot Plate, Galley
29 Jug, Galley Thermos
30 Seat, Radar Operator
31 Boat Hook Stowage
32 Buoy Hook Stowage
33 Anchor Stowage
34 Signal Light Stowage
35 Bilge Hose, Lizard Line, Buoy Line, Stabilizer Safety Line and Handling Line Stowage
36 Pump, Bilge
37 Locker, Stowage Battery
38 Cylinder, Pilot's and Co-pilot's Oxygen
39 Towing Line
40 Periscopic Sextant Stowage
41 Auxiliary Power Plant
42 Boarding Ladder Stowage
43 Ditching Belt Stowage
44 Parachute Stowage, Spare
45 Parachute Stowage, Beam Observer's (RH)
46 Curtain, Black-Out
47 Seat, Beam Observer's (LH)
48 Sea Anchor, Tow and Trip Line Stowage
49 Parachute Stowage, Beam Observer's (LH)
50 Parachute Stowage, Tail Gunner
51 Seat, Tail Gunner
52 Bottle, Tail Gunner's Portable Oxygen
53 Curtain, Black-Out
54 Seat, Beam Observer's (LH)
55 Pod and Support, Camera
56 Bunks, Aft Waist Compartment
57 Flashlight Stowage
58 Transmitter, Life Raft
59 Kit, First Aid
60 Water Bucket Stowage
61 Bunk, Forward Waist Compartment
62 Life Raft
63 Toilet
64 Curtain, Toilet

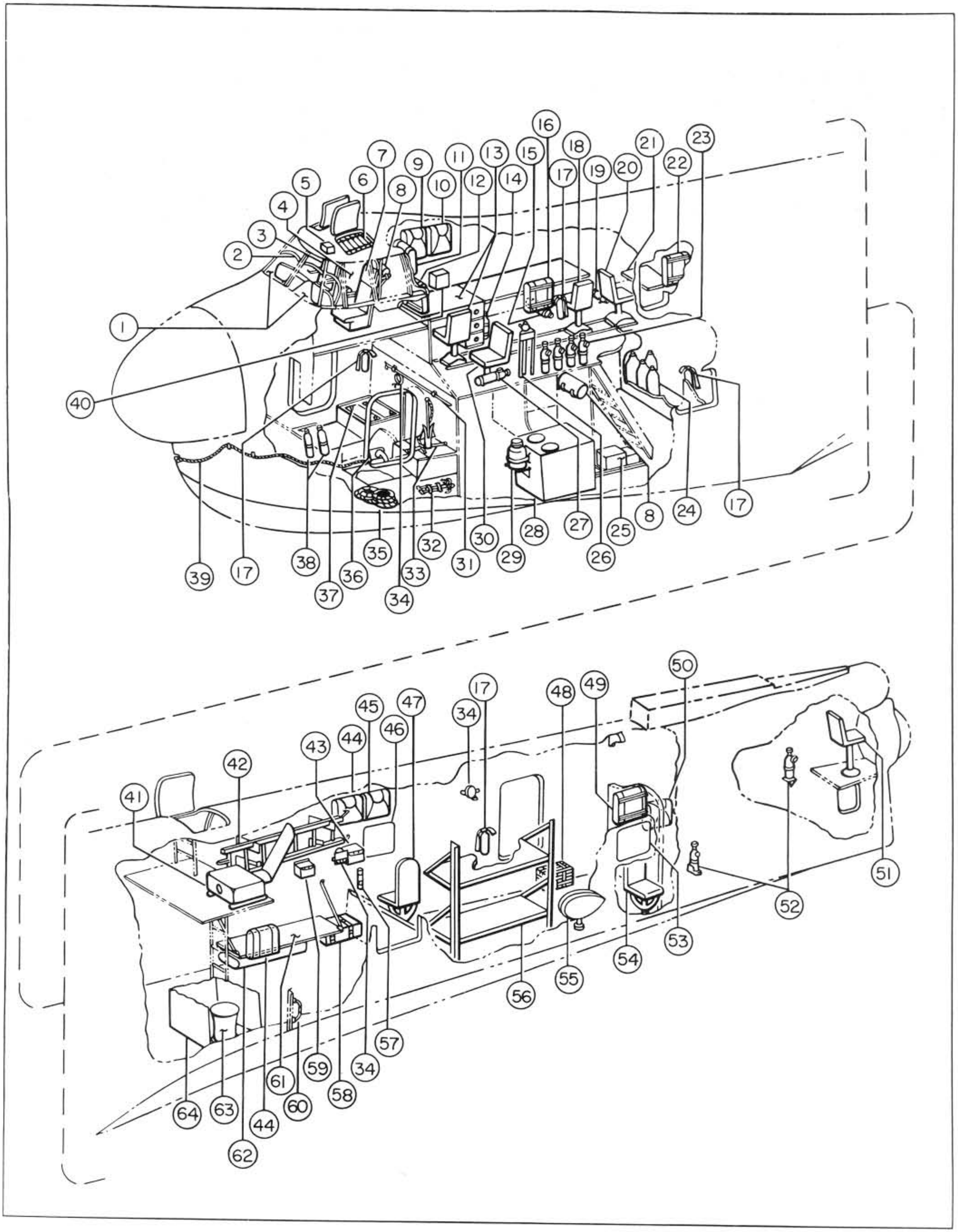


Figure 1-22. Auxiliary Equipment

AUXILIARY EQUIPMENT. Refer to Section IV.

HEATING SYSTEM

VENTILATING SYSTEM

ANTI-ICING AND DE-ICING SYSTEM

COMMUNICATIONS AND ELECTRONIC EQUIPMENT

LIGHTING EQUIPMENT

OXYGEN SYSTEM

AUTOMATIC PILOT EQUIPMENT

NAVIGATION EQUIPMENT

AUXILIARY POWER UNIT

ARMAMENT EQUIPMENT

GUNNERY EQUIPMENT

BOMBING EQUIPMENT

ROCKET EQUIPMENT

PHOTOGRAPHIC EQUIPMENT

MISCELLANEOUS EQUIPMENT

SECTION II
NORMAL PROCEDURES

BEFORE ENTERING THE AIRPLANE.

FLIGHT RESTRICTIONS.

For aircraft limitations, refer to Section V of AN 01–35EJB–1A.

CRUISE CONTROL.

The fuel, air speed, power settings required to complete a proposed mission will be found in the Appendix I of AN–01 35EJB–1A.

WEIGHT AND BALANCE.

Check gross weight and center of gravity location for take-off and for anticipated loading for landing. Loading data are furnished in the Handbook of Weight and Balance Data, AN01–1B–40, and are supplemented by a Load Adjuster. Make a check to ascertain that required ammunition, bombs and stores are properly loaded, and that crew and fuel are properly distributed. Refer to Section VII for normal fuel filling and usage sequence.

CHECK LISTS.

It is of utmost importance that the pilot ascertain that all control switches and engine control levers are in their proper positions prior to landing and take-off. Landing and Take-Off Curves and Charts will be found in the Appendix I of AN 01–35EJB–1A. (See figures A–8 to A–9 and A–14.)

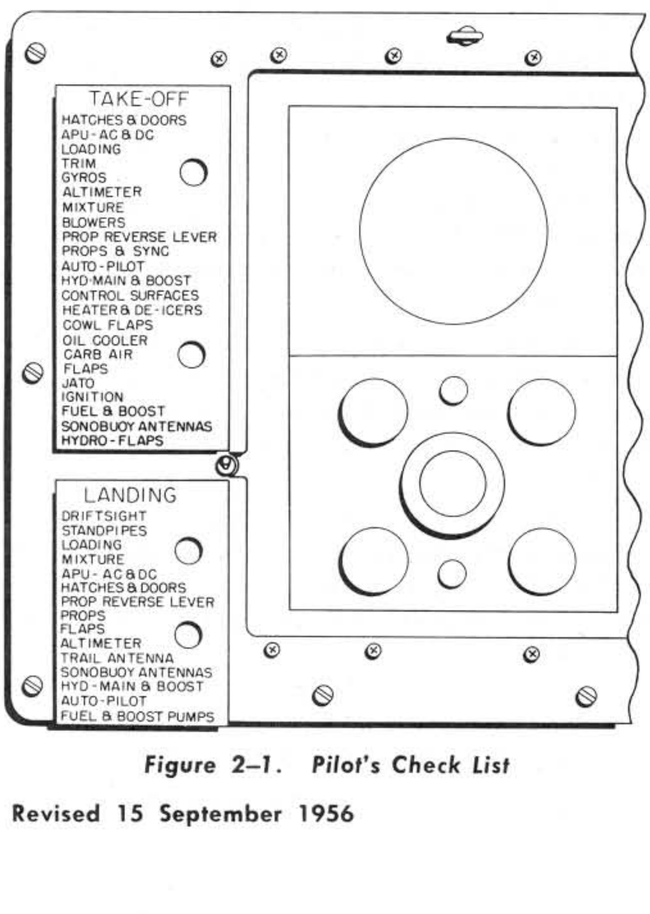


Figure 2–1. Pilot's Check List

EXTERIOR INSPECTION (ON LAND). (See figure 2–2.)

Prior to the exterior inspection, consult the navy yellow sheet forms for status and certification of airworthiness. With the aircraft on beaching gear and starting with the left wing, check for flight integrity and obvious discrepancies. Continue to check to clockwise around the aircraft to the tail, thence to the left wing or point of beginning. This inspection should include the entire hull bottom and lower tail surface.

A few of the obvious flight integrity items are:

- Cowling for security of installation.
- Inspection access doors and hatches are closed and secured.
- Exterior of hull and surfaces for general conditions and lack of obstructions.
- Aircraft free from tie down lines.
- All fueling provisions removed and fueling door secured.
- Stores in place.
- Beaching gear tires sufficiently inflated.
- External leakage of fuel, oil and hydraulic fluid.
- Antennas for security and rig.
- Pitot covers removed.
- CO_2 discharge indicators in place.
- Propellers for general condition.
- Check hull crown from bow to stern including the tail surfaces.
- Check entire top wing surface from left to right including the power plant and ailerons for security of access doors, fuel and oil filler caps and for other obvious defects.

EXTERIOR INSPECTION (WATERBORNE). (See figure 2–2.)

Prior to the exterior inspection, consult the navy yellow sheet forms for status and certification of airworthiness. With the aircraft in the water and starting with the left wing, check for flight integrity and obvious discrepancies. Continue to check clockwise around the aircraft to the tail, thence to the left wing or point of beginning. This inspection should ininclude accessible hull bottom and lower tail surface. This check should be made by circling the aircraft in a boat.

A few of the obvious flight integrity items are:

- Cowling for security of installation.
- Inspection access doors and hatches are closed and secured.
- Exterior of hull and surfaces for general conditions and lack of obstructions.

Aircraft free from tie-down lines (excluding buoy lines).
All fueling provisions removed and fueling door secured.
Stores in place.
Beaching gears removed.
External leakage of fuel and oil from engines.
Pitot head covers removed.
CO_2 discharge indicators in place.
Propellers for general condition.
Check entire top wing surface from left to right; including the power plant and ailerons for security of access doors, fuel and oil filter caps and for other obvious defects.

ENTRANCE.

Entrance to this aircraft is normally made through either the left or right waist entrance hatches. Each waist door may be locked or unlocked with the same key. The boarding ladder is stowed in the forward waist compartment; this ladder may be positioned in fittings on the left side of the hull and used for access to the hatches. Entrance to this aircraft when on the water may be gained through either the left or right waist hatches or through either of the forward entrance hatches. Hand grips are in the proximity of the hatch openings.

ON ENTERING THE AIRCRAFT.

INTERIOR CHECK (All Flights).

Upon entering the airplane, from either the left or the right waist entrance hatch, begin the interior check from the tail compartment and work forward to the bow, flight deck, and pilot's compartment. Throughout the check, be sure that all necessary equipment is serviceable and stowed as required (first aid kits, fire extinguishers, fire axe, portable oxygen bottles, etc.).

Life Raft and Transmitters	Stowed
Emergency Food Containers	Stowed
ASW Equipment	Stowed and supplies available
Fire Extinguishers (Portable)	Stowed
Windshield Anti-Icer Reservoir	Supply of Fluid
Water Breakers	Full
First Aid Kits	Stowed
Pyrotechnic Pistol and Cartridges	Stowed and supply available
Emergency Axe	Stowed
Oxygen Cylinders	For Supply
Bilge Pump and Hose	Stowed
Two Ditching Stations (Safety Belts, Ditching Boards, and Web)	Stowed
Bunks and Pads	Stowed
Main Engine Oil Transfer Valves	OFF
APU Oil Quantity	Full
Hydraulic Reservoirs	Full Level
Fuel Transfer Valves	OFF
Bilges	Free of Water
Air Pressure Containers	Charged to Required Pressure
Hydraulic Accumulators	Charged to Required Pressure

All auxiliary and radio equipment switches OFF prior to Engine Start.

With one crew member at the tail surfaces and another at the pilot's station, operate the elevators, rudder, ailerons, and aileron tabs manually, and check for correct direction of movement.

A few obvious flight integrity items are:
Inspection Access Doors and Hatches Secured.
Antenna leads in place.
Seats and shoulder harnesses adjusted.
Control surfaces free from exterior locks.
Oil and fuel tank caps secured.
Stores in place.
Engine controls operable.

Check the hull interior for all equipment and stores in place and properly secured. Bollards in place and compartments for freedom from any loose or foreign equipment.

Prior to connection of the external power source ascertain that all switches are OFF (sometimes referred to as "clearing the bus") and all circuit breakers ON. Plug in the external a-c and d-c source to the external receptacles in the main beaching gear compartment.

The existance of external d-c power is indicated by the glowing of the indicator light on the radio operator's d-c control panel. D-c power then may be applied to the bus by operating the switch marked EXT. PWR.

The existance of the correct a-c power phase is indicated by the glowing of the PHASE SEQUENCE INDICATOR light marked 1-2-3. There is also an a-c external power indicator light on the a-c control panel.

Note

A-c power cannot be applied to the bus until the phase and frequency are correct.

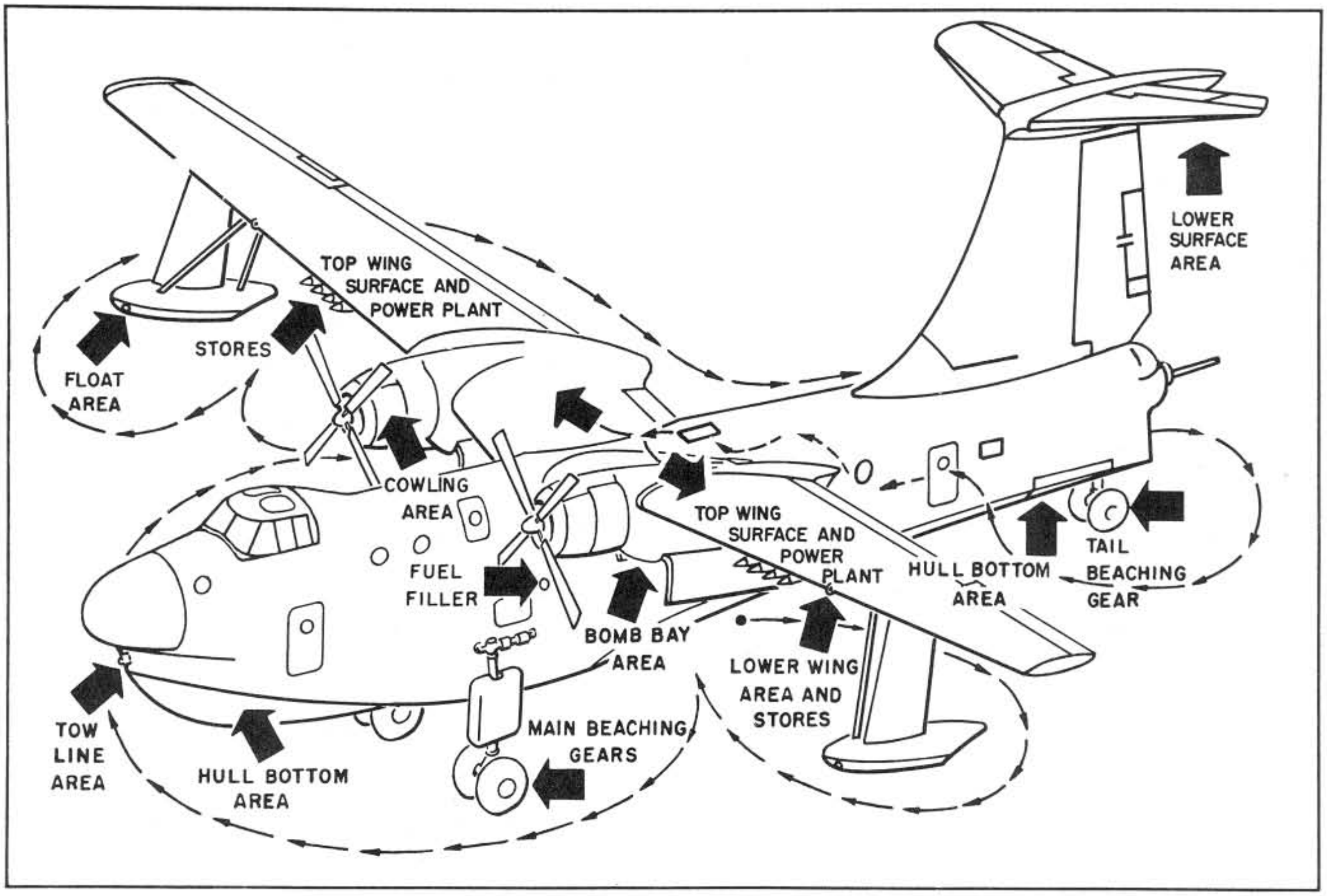


Figure 2–2. Exterior Inspection Diagram

With power applied check the operation of the control surfaces, hydro-flaps and aileron spoilers. Test fire detector system.

INTERIOR CHECK (Night Flights).

In addition to the check points covered in the preceding paragraphs, check the flashlight stowed in the navigator's locker and all interior and exterior lighting including the landing lights and the searchlight.

WARNING

The searchlight must not be on for more than 30 seconds.

The list of lights are as follows:

- Exterior Lights
- Landing Lights
- Anchor Lights
- Boarding Lights
- Tail Compartment Red Lights
- Forward Hull and Flight Deck Dome Lights
- Center and Aft Hull Dome Lights
- Anti-Glare and C-4A Lights
- Navigator's and RCM Panel Lights
- Radio and Radar Operator's Panel Lights
- Center Cockpit and Navigator's Panel Lights
- Right Cockpit Panel Lights
- Left Cockpit Panel Lights
- Cockpit Low Intensity Lights

STARTING AUXILIARY POWER UNIT.

a. Check the oil level, which should reach the "FULL" mark on the dipstick when the airplane is waterborne and 1 in. below the "FULL" mark when airplane is on beaching gear. Unit holds approximately 4 quarts of lubricating oil.

Lubricating oil, Specification MIL-0-6086, shall be used whenever possible. The permissible oil temperature ranges for use of this and other oils, which should not be exceeded, are as follows:

Type of Oil	*Approx. Ambient Temp. Range*
MIL-O-6086, Medium	7° to 55°C (45° to 130°F)
MIL-0-6086, Light	-10° to 30°C (15° to 85°F)
MIL-0-6081, Grade 1010	-26° to 3°C (-15° to 35°F)
MIL-0-6081, Grade 1005	-54° to -26° (-65° to -15°F)

Minimum Starting Oil Temp.	*Maximum Allowable Oil Temp.*
7°C (45°F)	124°C (255°F)
-10° (15°F)	99°C (210°F)
-26°C (-15°F)	71°C (160°F)
-54° (-65°F)	38°C (100°F)

Note

To prevent operation at too high an oil level, wait 15 minutes after APU is stopped, then check oil level. Too high an oil level could damage the generator if oil enters the brush housing through the cooling air blast tube. The 15-minute interval allows the oil to settle out of the cooler tubes, etc.

CAUTION

Do not start APU while its rotor is still turning as serious damage to the unit could occur.

b. Position APU a-c exciter switch and generator control switch to OFF (on the radio operator's a-c control panel).

c. Energize d-c busses.

d. Open air intake doors.

e. Speed adjustment valve on the radio operator's panel should be closed until approximately 70% rpm, then opened to control speed.

f. Open manual fuel supply valve in the forward waist compartment.

Note

Before starting the APU, check the voltage of both batteries by switching from No. 1 to No. 2 battery. Read voltage on indicator on the radio operator's d-c control panel. (Battery Power Control circuit breakers on battery junction box must be in ON position.) If a difference of more than two volts is indicated, start the APU on the single, most fully charged battery.

CAUTION

Be sure, at all times, that a fully charged and discharged battery are not paralleled. Battery unbalance is usually due to: ground or water maintenance requirements and/or operation of anchor and compartment lights when operating from a seaplane tender.

g. Position APU starting switch momentarily on START, then at ON. A normal starting procedure should be completed in 90 seconds. Adjust (close) speed adjustment valve to bring APU up to proper speed.

Note

A discharged or faulty battery may be disconnected from service (isolated) by opening its respective circuit breaker in the battery junction box, in the bow compartment.

Note

To ensure that both batteries are kept fully charged at all times, the batteries should be operated alternately during flight.

Note

Two batteries are automatically parallelled when the APU starter switch is placed in the START position, providing additional power to the starter.

h. When the APU is up to speed, position the APU exciter switch to ON and check the frequency (400 cycles), voltage (115), and phase rotation (1-2-3). Minor speed adjustments can be made only by opening or closing the speed adjustment valve.

Note

If air line between the speed adjustment valve at the radio operator's panel is ruptured or damaged, APU speed control can be obtained by breaking the lock wire and adjusting the speed control valve at the APU.

i. Position the bus tie switches and the APU generator control switches ON to energize the a-c busses and the APU fuel and oil pressure instruments.

CAUTION

Refer to RADIO OPERATOR'S A-C CONTROL PANELS, SWITCH POSITIONS in Section II; or EMERGENCY ELECTRICAL A-C and D-C in Section III, before energizing the busses.

j. Check the fuel and oil pressures, oil temperature, etc., which should read:

CAUTION

Stop unit by pushing switch to the OFF position, if oil pressure gage fails to indicate oil pressure within 5 seconds after energizing main a-c bus.

AT NO LOAD

Fuel Pressure	- - - 60-90 psi
Oil Pressure	- - - 70 - 100 psi
Oil Temperature	- - - 65°C (150°F) to 93°C (200°F)

Note

APU Manual fuel shut-off valve at the left service tank should be turned off after completion of flight.

These values are based on no air being released by the reduced speed air valve and are maximum and minimum for ambient air temperatures ranging between 5°C (40°F) and 39°C (100°F) at sea level.

k. At load operation and at NORMAL output (shaft speed 100% rpm) the operating values should be as follows:

Fuel Pressure - - -	200 - 240 psi
Oil Pressure - - -	60 - 80 psi
Oil Temperature - - -	65°C (150°F) to 94°C (200°F)
Output Shaft Speed	100% rpm

The figures given are for full rated load operating under the upper limits specified herein. Lower values result when less power is being delivered and when the ambient air temperature condition is less severe.

During certain operating conditions, the APU power system requires assistance from the engine a-c generators. Overload conditions exist only during the worst weather conditions while the airplane is waterborne and the APU is the only source of power. During flying conditions, when engine driven power sources are available, the system capacity is adequate for all operations as well as supplying additional power for reserve. For the above reasons, it is recommended that the following procedures be used to prevent overloading the APU power system.

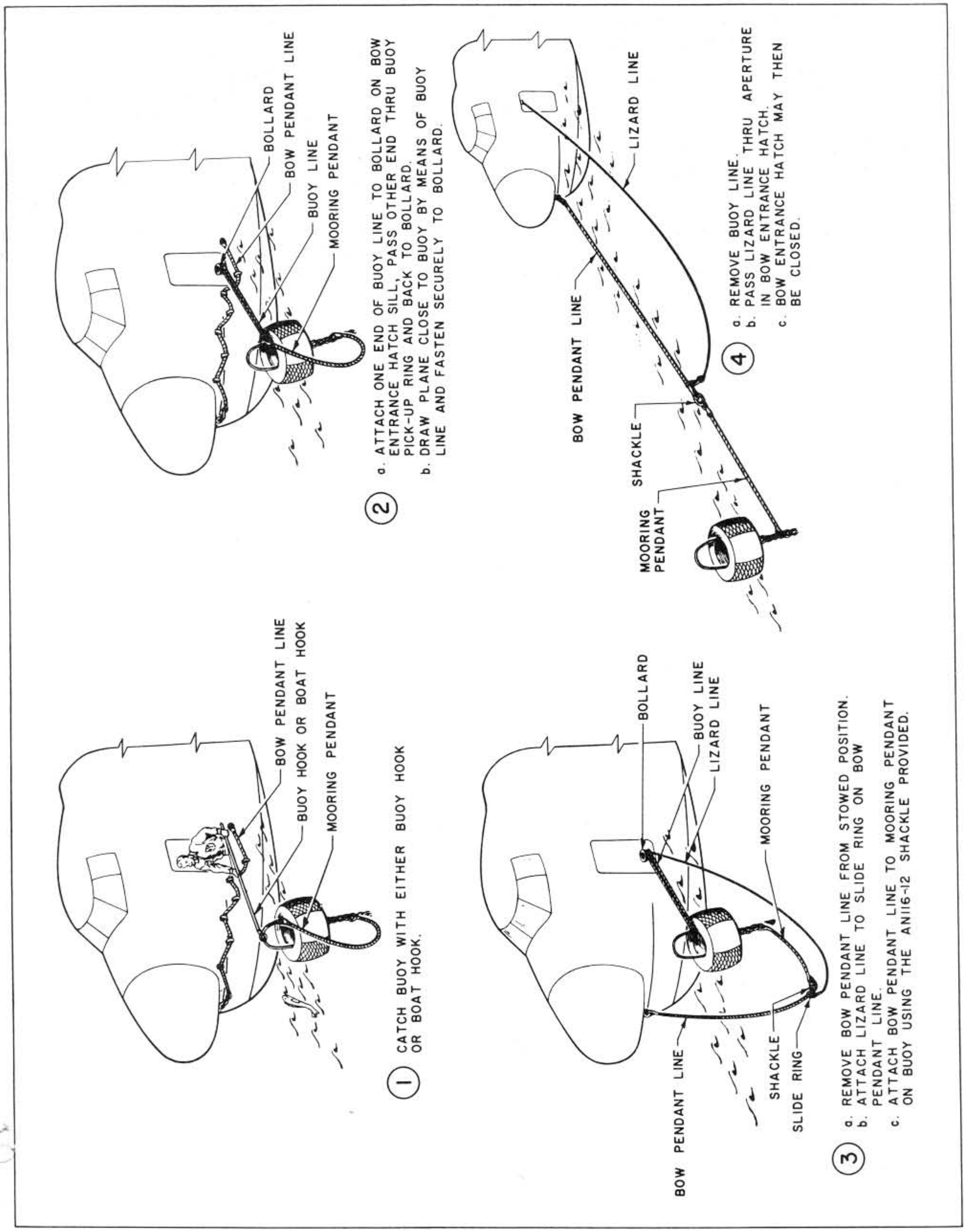


Figure 2–2A. Mooring Operation

Note

In case of APU flame out the stop switch should be turned "OFF" before speed drops to 35% to prevent reengagement of starter and damage to APU.

a. At loading and anchor under a night-icing condition, the d-c system is operating at full rating. To prevent exceeding the 200 ampere rating, do not operate the bilge pump while checking the search radar.

b. During taxiing on a warm day, the overload is very slight. Observation of the airplanes meters and care in adding loads, will prevent any loads in excess of 200 amperes.

c. During a night icing condition with the search radar working, it will be necessary to maintain an engine speed of approximately 1100 rpm to allow the engine generators to share the load.

d. During a night-icing taxi condition with the search radar operating, it will be necessary to maintain an engine speed of 1100 rpm to allow the engine a-c generators to assist in carrying the load. Hydroflaps may be used to maintain a reduced water speed if necessary.

BEFORE STARTING ENGINES.

Ascertain that fire watches on the center-wing and on the ground are properly positioned, equipped and ready and the CLEAR signal has been given and acknowledged. With the ignition switch "OFF", mixture levers to "IDLE CUT OFF" and the throttle levers about 1/8 open turn the propeller through at least 14 blades with the starter. If there is unusually high compression, remove the spark plugs from the lower cylinders and drain all liquid as the presence of any quantity of liquid in a combustion chamber is likely to cause serious damage.

PRE-STARTING ENGINES.

To start either engine, the following procedure must be adhered to in the sequence listed:

a. Check the fuel and oil supply.

b. Check engine for liquid lock.

c. Examine the engine controls for smooth movement and full travel.

d. Set the controls as follows:

Cowl Flaps	"OPEN"
Oil Cooler Flaps	"CLOSED"
Carburetor Air	"DIRECT"
Ignition Switch	"OFF"
Mixture	"CUT-OFF"
Propeller	"INCREASE RPM"
Supercharger	"LOW"

STARTING ENGINES.

1. Propellers—Full INC RPM (check limit light)
2. Throttle—Closed
3. Fuel Booster Pumps—Low ("NORMAL")
4. Starter—Engage
5. Ignition Switch — Both — after propeller has turned two revolutions (eight blades).
6. Primer Switch—Place in prime and hold steadily in the PRIME position.

Note

With a hot engine, or hot weather starts, the engine may fire initially without priming, but must be primed to keep it running. If the engine appears to be loaded up, release prime switch until the engine fires, then immediately reapply and hold until RPM stabilizes. (A discharge of fuel from the engine blower section drain is not, in most cases, an indication of over-priming.) If backfiring occurs when the engine is being started on the primer, it is usually caused by advancing the throttle too rapidly or too far.

CAUTION

If engine backfires, release starter and stop priming. After engine stops, pause before attempting to restart.

7. When engine fires, gradually and slowly open throttle until engine is running.
8. Reduce throttle and adjust to stabilize RPM at about 1000.
9. Mixture—RICH after the engine is firing smoothly on prime. Continue to operate steady prime until drop in RPM indicates mixture control is taking over.

Note

If the engine fails to start within 30 seconds, let the starter cool and then repeat the starting procedure.

10. Throttles—Set 1200–1400 RPM.
11. Oil Pressure—Stop the engine if the oil pressure does not register within 10 seconds or reach 40 psi within 20 seconds.

CAUTION

If extended ground operations are anticipated, the aircraft should be headed into the wind to obtain adequate cooling.

ENGINE GROUND OPERATION.

WARM-UP.

1. Conduct a thorough warm-up at approximately 1200 to 1400 rpm before making performance checks.
2. The operating data table of values is as follows:

Idle	600 rpm
Warm-up	1200-1400 rpm
Full-Power	2900 rpm
Full-Power MAP	61.0 in Hg.
Oil Pressure (desired)	70 psi
Fuel Pressure (desired)	29 psi
Oil "IN" Temperature (Max)	95°C

Cyl. Temp. (Max)	260°c
Governor Cut-In	1400 rpm
De-icer Vacuum	5 in. Hg.
De-icer Pressure	15 psi

3. For all ground operation unless indicated otherwise, keep the cowl flaps "OPEN", the propeller control in full "INCREASE" rpm position, the mixture control in "RICH", and the supercharger control in "LOW".

4. Oil Pressure—Adjust the oil pressure if necessary so that the oil pressure gage reads 70 ± 5 psi when the oil inlet temperature is 85°C(185°F) and the engine is operating between 1500 and 1800 rpm.

5. Open the throttle to obtain 30" Hg. manifold pressure. If the oil pressure drops or fluctuates as the engine speed is increased, extend the warm-up period.

6. Fuel pressure—Adjust the fuel pressure relief valve if necessary to 29 psi desired when the engine is operating at approximately 1700 rpm.

Note

Boost pumps must be "OFF" for this check.

7. Magneto Check—Check the "OFF" position of the ignition switch to assure proper connection of the grounds.

a. Run the engine at approximately 700 rpm.

b. Turn the ignition switch to "OFF" momentarily to see if the engine stops firing.

c. Return the ignition switch to the "BOTH" position.

d. With the propeller set against the low pitch stops, open the throttle until MAP equals to field barometric pressure (MAP gage reading before start).

e. Place the ignition switch in the "LEFT" position and observe the rpm.

f. Return the switch to the "BOTH" position in order to stabilize speed.

g. Repeat this procedure with the ignition switch in the "RIGHT" position.

Note

Atmospheric conditions will influence the readings obtained, however, a drop of 30 rpm or less or an increase of 10 rpm when operating on one magneto is considered satisfactory providing no engine roughness is encountered.

8. Idle Adjustment Check

a. With the mixture control in the "RICH" position, adjust the throttle so that the engine idles at 600 rpm. If this rpm cannot be obtained by retarding the throttle, back off the carburetor throttle stop until 600 rpm can be obtained.

b. Lock the throttle in this position.

c. Check the idle mixture as follows:

Flick the primer switch momentarily and note any change in manifold pressure and rpm. A momentary decrease in manifold pressure accompanied by a corresponding increase in rpm indicates that the mixture is lean. If the idling mixture is either correct or rich, a momentary decrease in rpm and increase in manifold pressure will occur when the primer is energized. To determine if the mixture is too rich or at best power, proceed as follows:

Slowly move the mixture control toward the "CUT-OFF" position until a change in rpm and manifold pressure is noted. A decrease in manifold pressure with an increase in rpm indicates that the mixture is too rich. If a decrease in rpm and increase in manifold pressure occurs, then the mixture is at the desired best setting.

d. Readjust the carburetor idle mixture setting if the above checks reveal the mixture to be either too lean or too rich.

e. Reset the throttle to obtain 600 rpm, repeat the above checks and readjust the idling mixture setting on the carburetor if necessary. The desired point of operation is when 600 rpm is obtained with the minimum manifold pressure.

Note

Maintain at least 125°C (257°F) cylinder head temperature while making the above checks.

f. With the throttle in the "CLOSED" position, reset the carburetor throttle stop to give the minimum idle speed desired. Wind conditions which affect the propeller load and consequently the rpm reading, should be taken into consideration.

9. Propeller.

a. Check reverse pitch operation by closing the throttle and moving the throttles into the reverse thrust range, RETURN THROTTLES TO NORMAL POSITION.

b. Place the master propeller lever in the full "INCREASE RPM" position and set throttles to obtain 1700 rpm. Place the synchronizer switch in the "OFF" position, move the master propeller lever towards the "DECREASE RPM" and note that the limit lights remain on and that the rpm does not change. Return the master propeller lever to the full "INCREASE RPM" and place the propeller synchronizer switch "ON".

c. Hold the propeller governor switches in the "DECREASE RPM" position until the limit lights go out. Move the master propeller lever at least 1/2 inch in the "DECREASE RPM" direction, then return it to the full "INCREASE RPM" position and note that the limit lights come on again and that the rpm returns to 1700.

d. Move the master lever propeller to the full "DECREASE RPM" position. Note that the limit lights go out then come on again and that the rpm has been reduced to 1300 ± 50.

e. Advance the master engine propeller lever to obtain 1600 rpm on the master engine (No. 1). Press the synchronizer button and note that the slave engine follows by 50 to 150 RPM.

f. Adjust the throttle of the master engine (No. 1) to obtain 1000 rpm and note that the slave engine follows by approximately 100 rpm (50 to 150 rpm drop is considered satisfactory). Press the resynchronize button and again note a drop of approximately 100 rpm of the slave engine.

g. Advance the throttle of the master engine to obtain 1600 rpm and note that the slave engine again follows in increments of approximately 100 rpm each time the resynchronize button is pressed.

h. Return the master propeller lever to the full "INCREASE RPM" position and note that the propeller limit lights come on.

i. Reset both engines to 1700 rpm with the throttles.

j. Hold the propeller governor switches in the full "DECREASE RPM" position. Note that the limit lights go out then come on again and rpm is 1300 ± 50.

k. Pull out feathering button to unfeather position. RPM should increase 50 to 100 and remain steady until the button is released.

l. Hold the propeller governor switches in the full "INCREASE RPM" position. Note that the limit lights go out then come on again and that the rpm returns to 1700.

m. Press the feathering button for each engine until a drop of approximately 300 rpm is noted, then pull the feathering button out and note a recovery to 1700 rpm.

To check the UNFEATHERING system, move the master synchronizing control lever to full decrease position (approx. 1200 rpm).

a. Press applicable feathering button until rpm drops approximately 300 rpm.

b. Pull out feathering button to unfeather position and hold for five seconds.

CAUTION

The 5-seconds button hold out period is for PREFLIGHT test only. When unfeathering in flight, do not hold the button in unfeather position for more than TWO seconds as this could cause the propeller to reverse.

c. If, when button is held out, propeller does not continue towards feather, engine speed increases above the original 1200 rpm and propeller does not go into reverse, the unfeathering system is functioning.

When the unfeathering circuit is closed, a relay is energized which causes the governor solenoid valve to operate and direct high pressure oil to unfeather the blades. At the same time the relay energizes the auxiliary oil pump to provide the necessary pressure. As soon as the propeller blades are within 5° of the low pitch stop, the number one blade switch opens and de-energizes the unfeathering relay which in turn will cause the solenoid valve and pump to be de-energized.

10. Supercharger Clutch Operation.

a. Set engine speed to 1600 rpm with the throttle (Propeller control in full INCREASE rpm position.)

b. Move the supercharger control switch to the HIGH position.

c. Open the throttle to obtain 30" Hg. MAP and note rpm.

d. Move the supercharger control switch to the LOW position. A sudden decrease in MAP when shifting from the HIGH to the LOW position indicates that the two-speed mechanism is working properly. Do not repeat the supercharger clutch shift check at less than five minute intervals.

GROUND TESTS.

Note

It is recommended that the main engines and APU be operated for this test only to ascertain that the functioning of the equipment will be proper in flight. All other equipment operation will be conducted from an external power source.

CLEARING A FOULED ENGINE.

The spark plugs may sometimes become fouled during a period of extensive ground operation, particularly if the idle mixture is too rich or if the engine is allowing an excessive amount of oil to enter the cylinders. The much used procedure of running the engine at high power in an attempt to unfoul spark plugs has probably worked in a number of cases, but in more instances the plugs have been fouled to a greater degree because of the deficiency of air in

the rich mixtures used for high powers and by a hardening of the substance already on the plugs. Plugs that are marginal in firing ability have their ability to fire lessened by increasing the heat and pressure in the cylinders. Because of these factors, the recommended procedure for "burning out" the engine is as follows:

a. Reduce the engine rpm to the idle range (800 to 1200 rpm).

b. Pull the mixture control back toward "IDLE CUTOFF" until a 25-50 rpm drop-off in idle speed is obtained. The resulting mixture will contain excess air for burning off the carbon and oil deposits.

c. Idle for 2 minutes.

d. Replace mixture control to "RICH" and repeat the magneto check.

SPARK PLUG FOULING PREVENTATIVE METHOD.

140 BMEP OPERATION OR (FOR ENGINES NOT EQUIPPED WITH TORQUE INDICATING SYSTEMS) FIELD BAROMETRIC PRESSURE.

In order to prevent excessive build-up of carbon deposits on the spark plugs during prolonged ground operation, the following procedure is recommended as a supplement to the procedure outlined above:

Cowl Flaps .... "OPEN"
Mixture .... "LEAN"
Propeller .... "FULL INCREASE RPM" (Low pitch)
RPM .... As necessary to obtain 140 BMEP or 30-32 inches MAP. (Do not violate propeller RPM restrictions for operation in cross-wind.)

Operate the engine at this power setting 1 minute for each 10 minutes of ground operation, but do not exceed 200°C CHT.

Note

Insure mixture control is in RICH position for take-off.

HYDRAULIC SYSTEMS.

Place the MAIN HYDRAULIC PUMP switches located on the pilot's sub-panel (74 and 75, figure 1-5), to ON and check for hydraulic pressure on the indicator near the switches.

a. Operate the wing flaps 1 full cycle.
b. Operate the bomb bay doors 1 full cycle.
c. Operate the spoiler aileron 1 full cycle.
d. Operate the sonobuoy door 1 full cycle.
e. Operate the hydro-flaps 1 full cycle.
f. Switch from one pump to the other and check for continuation of pressure.

Note

Under extended flight conditions, the boost pumps run continuously without pumping against a load. Therefore, when the boost system is pumping against a load, they should be used intermittently by switching from boost No. 1 to No. 2 and vice-versa. It is recommended that this be done approximately every thirty minutes to equalize the wear on the pumps.

Place the FLIGHT BOOST PUMP switches on the pilot's sub-panel (68 and 69, figure 1-5) to ON and check for proper indication of hydraulic pressure on the indicator close to the switches.

a. Operate the rudder 1 cycle.

b. Operate the elevator 1 cycle.

c. Switch from one pump to the other and check for continuation of pressure.

AUTOMATIC PILOT.

With a-c and d-c power on the busses, the fluxgate compass transmitter, gyro horizon control, turn and bank control and the gyro fluxgate amplifier should function. Allow five minutes for gyros to reach operating speed.

a. Uncage the gyro horizon.

b. With the clutch switch off, turn the automatic pilot power switch ON, disengage the surface control lock and operate all flight controls manually for free operation.

c. One minute after turning on the power switch, center the controls and press the clutch switch to the "ON" position. The automatic pilot must hold the controls rigidly in the position they are in when the clutch is energized.

d. Move the TURN control knob 20° clockwise. Observe the control surfaces for the following action:

Small degree of right rudder movement.
Right aileron up—left aileron down.
Small degree of up elevator movement.

e. Move the TURN control 20° counter clockwise. Observe controls for the following action:

Small degree of left rudder movement.
Left aileron up, right aileron down.
Small degree of up elevator movement.

Return TURN control to center. Controls should return to the original position.

f. Turn the BANK-TRIM adjustment clockwise. The right aileron should move up and the left aileron down. Turn the BANK-TRIM adjustment counterclockwise. The left aileron should move up and the right aileron down. Return the BANK-TRIM adjustment to center.

g. Move the PITCH-TRIM control counter clockwise (toward "DOWN" mark). The elevators should move down.

h. Move the PITCH-TRIM control clockwise (toward the UP mark). Elevators should move up. Return the PITCH-TRIM control to the center position.

i. Move the caging knob on the gyro horizon control to the cage position. The automatic pilot must disengage immediately.

j. Apply a load to the servos by overpowering or attempting to overpower the auto-pilot with the manual controls.

Pull the "EMERGENCY" disconnect lever on the pilot's pedestal. The auto pilot must disengage immediately and the controls must be completely free.

Reset the servos by moving both disconnect latches away from the cable guide. Each servo must be reset individually.

k. With the automatic pilot re-engaged and operating, again disengage from the control system by:

Depress the disconnect switch on the pilot's control wheels.

Cage the gyro horizon control.

Note

Both of the above actions will disconnect the automatic pilot and allow the controls to move freely.

OIL TRANSFER SYSTEM. (See figure 1-9.)

To transfer oil from the left tank to the right tank proceed as follows:

a. Turn the NO. 1 SELECTOR valve on the "A" frame to "No 1 oil tank to No. 2 oil tank".

b. Turn the NO. 2 SELECTOR valve on the "A" frame to "No. 1 oil tank to No. 2 oil tank".

c. Move the oil transfer switch on the right side of the rear spar bulkhead to the "OPEN" position.

d. Operate the hand pump until the desired amount of oil is transferred.

e. Observe oil quantity indicator.

f. To reverse the transfer, change the manual selector valves to the opposite positions and operate the hand pump.

Note

Oil transfer system is used only as "emergency" when engine failure occurs or when conditions are such that one engine is consuming more oil than the other.

DE-ICER SYSTEM.

With the main engines operating, and electrical power on the busses, check the function of the de-icer system as follows:

a. Observe the de-icer vacuum and pressure gages adjacent to the electronic timer. With the boots inoperative, the vacuum should be 5" Hg. and the pressure approximately zero.

b. Set the de-icer timer, in the pilot's aft control panel to position No. 1. Pressure gage should indicate 15 psi and vacuum gage should indicate 5" Hg. Press the button marked "SINGLE CYCLE". All boots should inflate once and come to rest. (Allow about twenty seconds for the tubes in the electronic timer to warm up before this check.)

c. Set the de-icer timer switch to No. 2 and check for a one minute pause between cycles.

d. Set the de-icer timer switch to No. 3 and check for no pause between cycles.

e. Set the de-icer timer switch to No. 4 and check for no pause between cycles and a "50% increase" time of operation.

f. Set the de-icer timer switch to No. 1 and operate the individual toggle switches. Check the boot group indicator for reactions.

Note

The timer is set up so cycling is started automatically on the Nos. 2, 3, 4 positions. To start a cycle in the No. 1 position the "SINGLE CYCLE" button must be depressed. Boot inflation will continue until the cycle is completed and all boots returned to the uninflated position.

GROUND TEST OF DRIFTMETER.

The driftmeter installed on the left side of the flight deck is a navigational aid. It projects a picture optically, of objects on the earth's surface onto a screen, and this screen is rotated right or left until the objects appear to travel in a line across the screen parallel to the sight lines. The angle of drift is read directly from the scale surrounding the screen and is used to correct the compass course.

A light is incorporated in the driftmeter unit to illuminate the scale for easier and more accurate reading. The driftmeter contains the reticle which is supported on and maintained in a vertical position by a self-erecting gyroscope. Electrical power to operate the light and gyroscope is supplied from the 115/200 volt three phase a-c bus system through a circuit breaker on the navigator's distribution panel.

When the driftmeter is not in use, the electrical plug is disconnected and stowed on a dummy receptacle. The unit itself is stowed by sliding it upwards. Check as follows:

a. With the main a-c bus No. 2 energized, turn on the driftmeter and check that the light and gyroscope are operating satisfactorily.

b. With power on and the plug installed on the driftmeter, check light visually and check that gyroscope is operating by listening for its characteristic noise of rotation. Stow the plug in the dummy receptacle when driftmeter is not in use.

GROUND TEST OF THE SEXTANT.

The periscopic sextant is in the flight deck crown sighting window. Figure 4-8. The circuit consists of wiring up to the sextant disconnect receptacle which is located adjacent to the sextant port in the flight deck. When the sextant is being used, the cable furnished with the sextant is plugged into this receptacle. Electrical power is supplied from the navigator's d-c distribution bus when the sextant light switch is in NORMAL position, and from the d-c battery bus when the switch is in EMERGENCY position.

Check as follows:

a. With power on the navigator's distribution bus and the sextant light switch in NORMAL position, there shall be 28 volts d-c available at the sextant power supply receptacle.

b. Placing the switch in EMERGENCY position, there shall be 28 volts d-c available at the sextant power supply receptacle as supplied from the battery bus.

c. When the sextant is not in use, the receptacle shall be covered by the removable cap.

G-2 COMPASS GROUND TEST.

With a-c and d-c power applied to their respective busses operate as follows:

a. Move the G–2 compass switch, marked FREE D. G.—COMPASS CONTROL on the pilot's sub-panel, to COMPASS CONTROL (79, figure 1–5.)

b. After a five minute interval, depress the resetting knob on the face of the master indicator and turn the knob to set the stabilized heading to coincide with the correspondence dial, then carefully pull the knob out. Check that the gyro indication remains coincident with the correspondence indication.

c. Re-engage the resetting knob and set the gyro heading off 10° in either direction and pull out the knob. The gyro heading and correspondence heading must coincide in four minutes. Set the gyro off heading 10° in the other direction and pull out knob to check recovery in this direction.

d. Repeat the above check and observe that the navigator's repeater follows the pilot's master indication reading.

STALL WARNING DE-ICER HEATER. (Ground Test.)

a. Close the three stall warning circuit breakers on the cockpit distribution panel which will energize the 28 volt d-c bus No. 1 and No. 2 and the 115 volt a-c, 400 cycle phase C bus.

b. Place the pitot-tube-stall warning transducer switch in ON position, the de-icer heater will heat. Hold hand on transducer, at the detector vane area, to detect heat emitted by the heater.

c. Place the pilot's stall warning system test switch, on the pilot's sub-panel in ON position, the control shaker motor on co-pilot's control column, will operate.

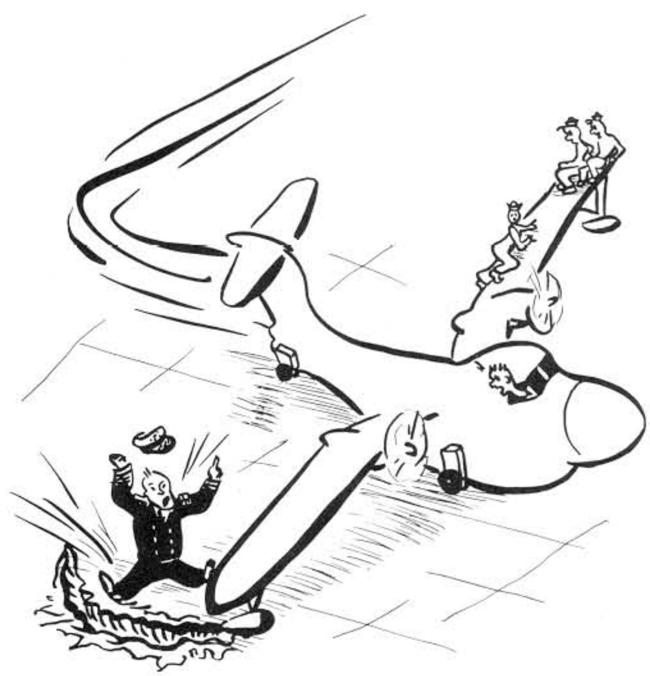
d. Upon opening the stall warning system a-c power circuit, the red stall warning system failure indicator light, on the pilot's instrument panel, will illuminate.

CAUTION

The transducer heater switch should be on for the shortest length of time possible, since there is a possibility of burning out the elements in the pitot tube heater when there is no air stream flowing over the heating element.

TAXIING INSTRUCTIONS

CAUTION



Do not taxi on beaching gear at speeds in excess of 5 mph straight forward or 2 mph during a 90° turn. Avoid obstructions which might subject beaching gear to loads beyond specified limits. Avoid operation between 2250 and 2750 rpm.

The HYDRO-FLAPS on this aircraft increase maneuverability and permit short radius turns while taxiing. Maneuvering, in restricted water, is accelerated by use of these underwater rudders. The angle may be set as great as 65 degrees.

CAUTION

Under full load conditions at certain speeds, the bow spray will be projected in the propellers and cause blade erosion. Do not prolong taxiing under these conditions. Avoid operation between 900 and 1200 rpm and between 2550 and 2750 rpm.

Under smooth sea and gentle wind conditions, normal taxi and balanced power can be attained with hydro-flaps. Under rough sea and high wind conditions, hydro-flaps may be supplemented by the sea anchors to maintain direction.

The engine cowl flaps should be OPEN at all times while taxiing. Oil cooler position, while taxiing, should be adjusted to maintain normal operating temperatures. All taxiing that is not directly into the wind should be done with the wing flaps in the full up position.

OFF-STEP taxiing should be done at as low a speed as possible so that too much power will not be developed by the engines for a long period of time. Whenever possible set the engine power to hold the approximate heading desired and use the hydro-flaps and air rudder to make any correction.

When the wind velocity is over 25 knots it may be necessary to reverse the propellers to reduce maneuvering speed and facilitate a buoy approach.

ON-STEP taxiing should be practiced up wind and cross-wind to determine the trim angle that gives the greatest acceleration and easiest control.

The airplane has excellent longitudinal hydrodynamic stability characteristics. Any porpoising that should develop will be self damped by placing the elevator within the stable ranges. Normally if a high angle porpoise develops it can be readily stopped by allowing the column to move forward slightly, thereby lowering the hull angle into a stable range. In order to achieve the fastest possible dampening of the porpoising once the hull angle is in the stable range, apply a slight amount of back pressure on the elevator as the nose of the airplane nears the top of its oscillation, and then lower the nose until it's within the stable trim range. The approach to the low angle limit can be noticed by a hydrodynamic sucking action on the nose of the airplane and an increase in the water noise at the bow.

Note

Keep speed as low as possible and use hydro-flaps when making a buoy approach.

BEFORE TAKE-OFF.

PRE-FLIGHT ENGINE CHECK LIST.

Cowl Flaps	OPEN
Oil Cooler Flaps	OPEN
Carburetor Air	COLD
Mixture	RICH
Propeller	FULL INCREASE RPM
Supercharger	LOW
Boost Pumps	EMERGENCY
Magneto Switches	BOTH
Oil Temperature	See Note

Note

No minimum oil temperature is specified for take-off. When the oil temperature has risen at least 6°C(42°F) above the pre-starting temperature and the oil pressures are stabilized, it is permissible to take-off. Do not take-off with oil temperatures higher than the maximum of 95°C.

Head Temperature	No minimum
Fuel Pressure	29 lbs./sq. in. (30 psi max. in emergency position)
Oil	70 lbs/sq. in.

PRE-FLIGHT AIRCRAFT CHECK LIST.

Pre-flight check the aircraft as follows:

APU	OPERATING
All A-C Bus Switches	ON
Watertightness	ALL STATIONS REPORT—SECURE
Fuel System	BOOSTER PUMPS EMERGENCY
Service Tanks	ON
Gyro Instruments	SET AND UNCAGED
Trim Tabs	TAKEOFF
Flaps	TAKEOFF (30°)
Heaters	OFF
De-Icer	OFF
Autopilot	OFF
All Lines	SECURED
Sea Anchor	STOWED
Hydroflap Switch	OFF
Hydraulic Boost and Main Switches	ON
Flight Controls	UNLOCKED AND OPERATE FREELY
Personnel	READY
Altimeter	SET
Loading	NOTED
Jato	ARMED
Rocket Switch	SAFE
Sonobuoy, Float Light, and Marine Marker Launcher Door	CLOSED
Trailing Antenna	RETRACTED
Sonobuoy Antennae	RETRACTED
Propeller Reversing Release	FLIGHT

With the above checks completed, accelerate each engine individually and check that propellers are not in reverse pitch. Return the propeller reverse release lever to FLIGHT.

A-C POWER SYSTEM PROCEDURE BEFORE AND DURING TAKEOFF.

The following will outline a suggested procedure for controlling the a-c power system before and during takeoff.

a. After entering the airplane, energize the d-c bus from the airplane's batteries or an external power source, if available.

b. Start the APU and when it is up to speed, close the APU generator exciter control switch.

c. Check output of APU generator, frequency (400 cycles), voltage (115 volts), and phase rotation (1-2-3), and close APU generator control switch. The cross-tie bus power indicator light should go on.

d. Close both cross-tie switches to energize the No. 1 and No. 2 busses.

Note

After the APU is up to speed, the No. 1 main a-c bus should be energized within 15 seconds to supply power to the APU fuel and oil pressure indicators.

e. Close the converter switch on the d-c control panel to energize the d-c bus and prevent running down the batteries.

f. Before takeoff, with the engines running above 850 rpm, close both a-c generator exciter switches to allow generator output to be checked. Frequency should be 400 cycles, voltage 115 volts, and phase rotation 1-2-3. The exciter switches should be returned to OFF before the engines are returned to IDLE.

g. After the takeoff run is started, with engines operating above 1400 rpm and a-c control panel switches positioned for normal day taxiing, first open the No. 2 cross-tie switch and immediately afterwards close the No. 2 generator control switch. The switches should be operated as close together as possible to avoid a lengthy interruption of power to the No. 2 bus.

h. Complete the takeoff and maintain the above arrangement until adequate single-single altitude is reached. The No. 1 bus should be left connected to the APU to supply power for the APU instruments in case of an engine generator or engine failure during takeoff.

TAKEOFF: INITIAL RUN.

a. Head aircraft into the wind and apply takeoff power.

b. Keep airplane at controllable attitude when high speed planing is reached.

c. Maintain relatively normal trim angle at first and then pull off at the lowest airspeed possible.

NORMAL TAKEOFF.

Advance POWER CONTROL (Throttle) levers to takeoff power at 2900 rpm to obtain the desired power in accordance with the recommended operating schedule charts in Appendix I. Do not exceed takeoff manifold pressure (or torque pressure) or hold for longer than 5 minutes.

Cowl Flaps and Oil Cooler Doors—Set at 3/4 OPEN or adjust as required to maintain cylinder and oil temperatures within range limits.

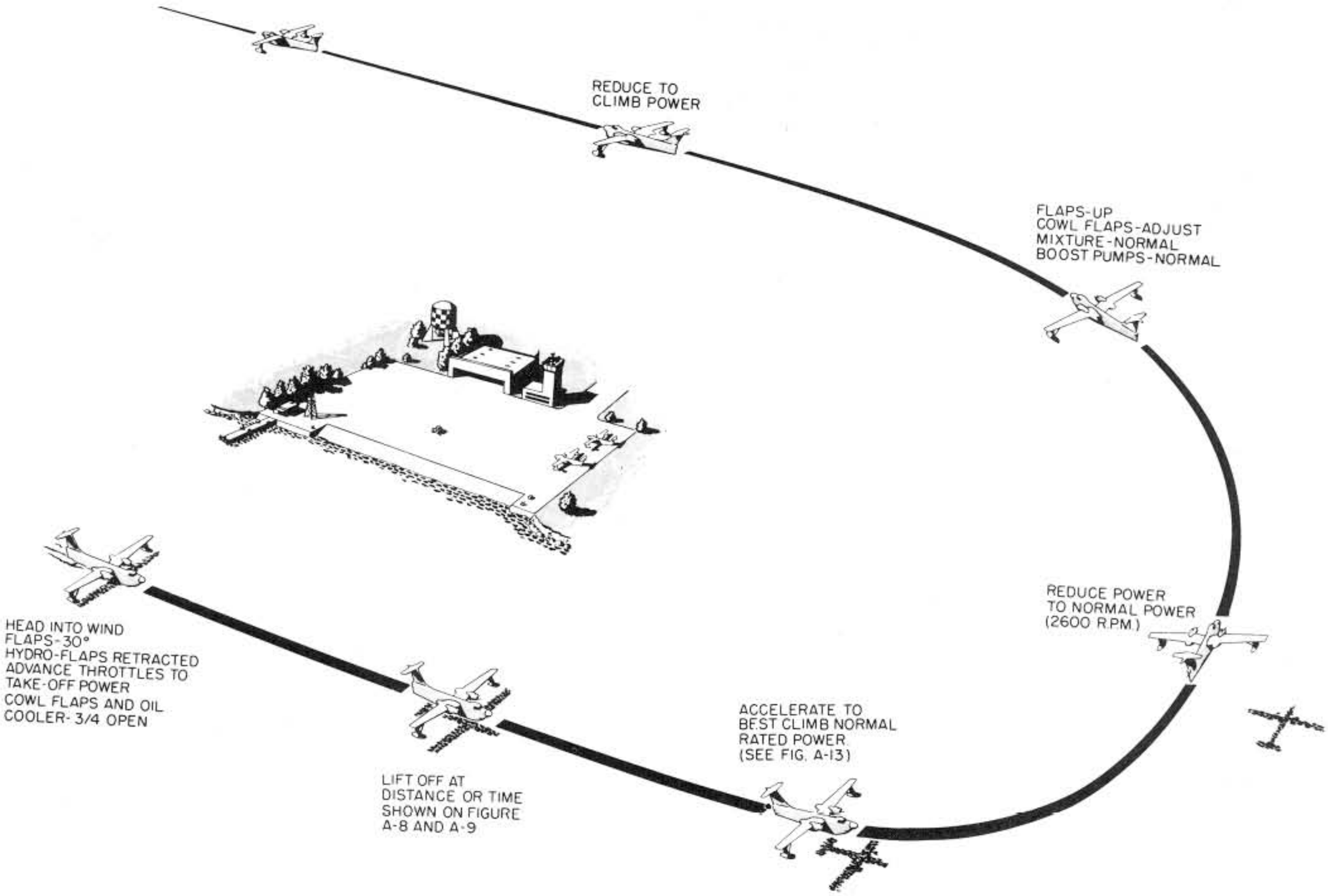


Figure 2–3. Take-off Pattern Diagram

Carburetor Air—Maintains the COLD AIR position.
Mixture Control—RICH
Fuel Boost Pump—EMERGENCY
Wing flaps—Lowered to 30° when normal sea conditions exist.
Propeller—Advance to full RPM.

The two hydraulic pumps in the main and booster system must be in operation for take-off and landing. Only one pump in each system should be operated during flight, unless an emergency arises in the system, then both pumps must be operated.
In event of an emergency during take-off, refer to Section III for Emergency Procedures.

ASSIST TAKE-OFF.
Initiate a normal take-off. Fire the jato bottles in pairs or all four at once in accordance with the take-off times quoted in figure A–9 of Appendix I Section of this manual. To fire the Jato bottles proceed as follows:

a. Both LH and RH waist entrance hatches must be closed and secured.

b. Select upper, lower or both arming switch positions on pilot's overhead panel (16, figure 1–8.) The jato power red indicator lights will come ON.

c. Pressing the trigger switch on pilot's control wheel will fire the corresponding pair of jato bottles on each door (2, figure 1–18.) No unusual trim reactions will result from firing the jato bottles.

RADIO OPERATOR'S A-C AND D-C CONTROL PANELS, NORMAL SWITCH POSITIONS. -(Figure 2–6.)

a. On TAKE-OFF or LANDING, always start the APU and position the a-c control panel switches in the following sequence:

No. 2 Bus Tie	OFF
No. 2 Exciter	ON
No. 2 Generator Control	ON
No. 1 Bus Tie	ON
No. 1 Generator Control	OFF
No. 1 Exciter	OFF
APU Exciter	ON
Auxiliary Power Control	ON

Note

Do not hold the a-c exciter, generator or external power control switches in the "ON" position against the action of its return solenoid, as damage to the solenoid could result.

b. On TAKE-OFF or LANDING, position the d-c control panel switches as follows:

No. 1 Generator Control	"ON"
No. 2 Generator Control	"ON"
Battery Control	"ON"
Convertor Control	"ON"

Note

In an emergency, the d-c generator can be removed from the bus by the use of its corresponding "EMERGENCY CUT-OUT" switch, located on the radio operator's d-c panel. This opens the reverse current circuit breaker in the main power center, which must be reset manually before power can be restored to the bus through the "EMERGENCY CUT-OUT" switch.

c. When adequate single engine altitude is reached the APU generator control is positioned "OFF" and the No. 1 generator control switch positioned "ON" in order to check the generators for synchronization. The a-c control panel switches are now positioned, as follows:

Aux. Power Control	"OFF"
No. 1 Exciter	"ON"
No. 1 Generator Control	"ON"
No. 1 Bus Tie	"ON"
No. 2 Exciter	"ON"
No. 2 Generator Control	"ON"
No. 2 Bus Tie	"OFF"
APU Exciter	"ON"
APU Starter	"ON"

d. Before paralleling check the a-c generators for synchronization. Turn the paralleling indicator lights switch to No. 2 generator, the paralleling lights will come on and will appear to rotate unless the two generators are synchronized. If the lights appear to rotate, the speed of the incoming generator will have to be increased or decreased until the lights hold steady and are illuminated as indicated. The apparent direction of rotation of the three lights will indicate the type of speed correction to be made. When the lights are stationary and illuminated as labeled (insofar as practicable) the generators can now be paralleled.

WARNING

The a-c generators must be parallel at all times during flight. Exception can be made only in an emergency and at the pilot's discretion. If unparallel operation is attempted, all crew members should be alerted to this condition.

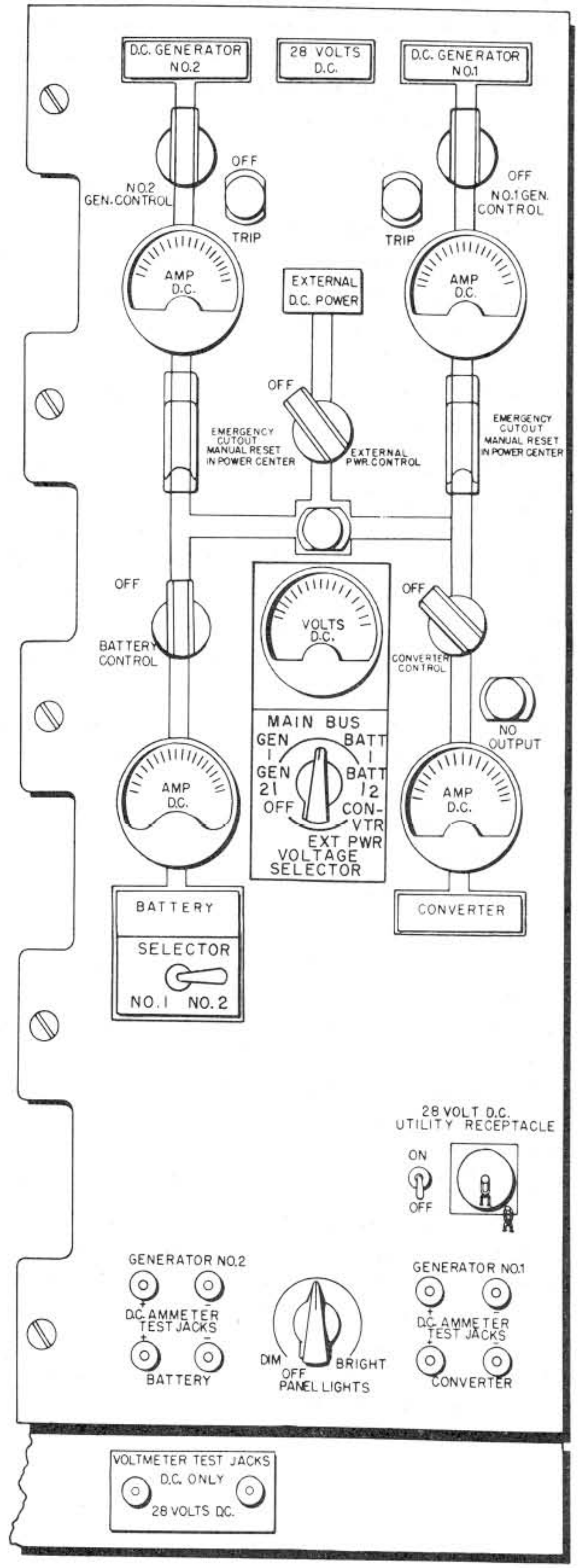


Figure 2-4. Radio Operator's D-C Control Panel—Set for Normal Flight

e. To PARALLEL the engine a-c generators, the No. 2 bus tie switch is positioned "ON". Paralleled position of the a-c control panel switches, with the APU operating but not connected to the bus, are as follows: (See figure 2-5).

Auxiliary Power Control	"OFF"
No. 1 Exciter	"ON"
No. 1 Generator Control	"ON"
No. 1 Bus Tie	"ON"
No. 2 Exciter	"ON"
No. 2 Generator Control	"ON"
No. 2 Bus Tie	"ON"
APU Exciter	"OFF"
APU Starter	"ON"

f. With the generators paralleled, the loads should be balanced by adjusting the speed. Watts and vars adjustments will have some small effect on the system frequency and voltage, and should be taken care of to balance the loads in a manner that will maintain as nearly as possible, the correct system frequency and voltage. The APU starter switch is then positioned "OFF".

g. During NORMAL CRUISE, position the d-c control panel switches as follows: (See figure 2-4.)

No. 1 Generator Control	"ON"
No. 2 Generator Control	"ON"
Converter Control	"OFF"
Battery Control	"ON"

h. Before landing the above procedure should be reversed. Start the APU and connect its generator to the cross-tie and No. 1 bus, being careful to open (switch "OFF") the No. 2 cross-tie switch and No. 1 generator control switch before the APU generator control switch is closed (switch "ON"). After completing the landing, the No. 2 generator may be removed from the bus and the APU generator used to supply all power for operation while on the water.

i. CRUISE/COMBAT, for the purposes of the electrical power configurations, is defined as the period during which the aircraft is being tactically deployed at low altitude and/or when combat is imminent, actual or simulated. The APU is operated "STANDBY" (otherwise at the discretion of the pilot) and the a-c and d-c control panel switches are positioned as shown in table, Figure 2-6.

For control panels switch positions under emergency conditions, refer to "EMERGENCY ELECTRICAL A-C" and "D-C", Section III.

AFTER TAKE-OFF.

Start raising wing flaps when indicated airspeed is approximately 110 knots. Flaps should be fully raised when indicated airspeed reaches approximately 140 knots.

When airborne and clear of obstacles, reduce power to desired climb setting by retarding the following controls in sequence:

Power Control (Throttle)	"CLIMB" "CLIMB TORQUE"
Propeller	"CLIMB RPM"
Mixture	"NORMAL"
APU	"OFF" (See Caution Note)
Engine Generators	"ON"
Booster Pumps	"NORMAL" (Service Tanks)
Retrim Tabs	"AS NECESSARY"
Wing Flaps	"UP"
Hydraulic—Main	One Pump "OFF"
Hydraulic—Boost	One Pump "OFF"
Assist Take-Off Units	Release in unrestricted area
Cowl Flaps	Closed as Dictated by Temperatures

Note

The electrically operated trim tab (rudder and aileron) must be used cautiously to prevent over-trimming. Quick flicks of the switch are recommended as an operating method.

STOPPING THE AUXILIARY POWER UNIT.

Position APU Starting switch to "OFF", unit should come to a complete stop within two minutes.

CAUTION

Do not close the APU manual fuel supply valve when airborne; in an emergency it could cause serious delay in starting the APU.

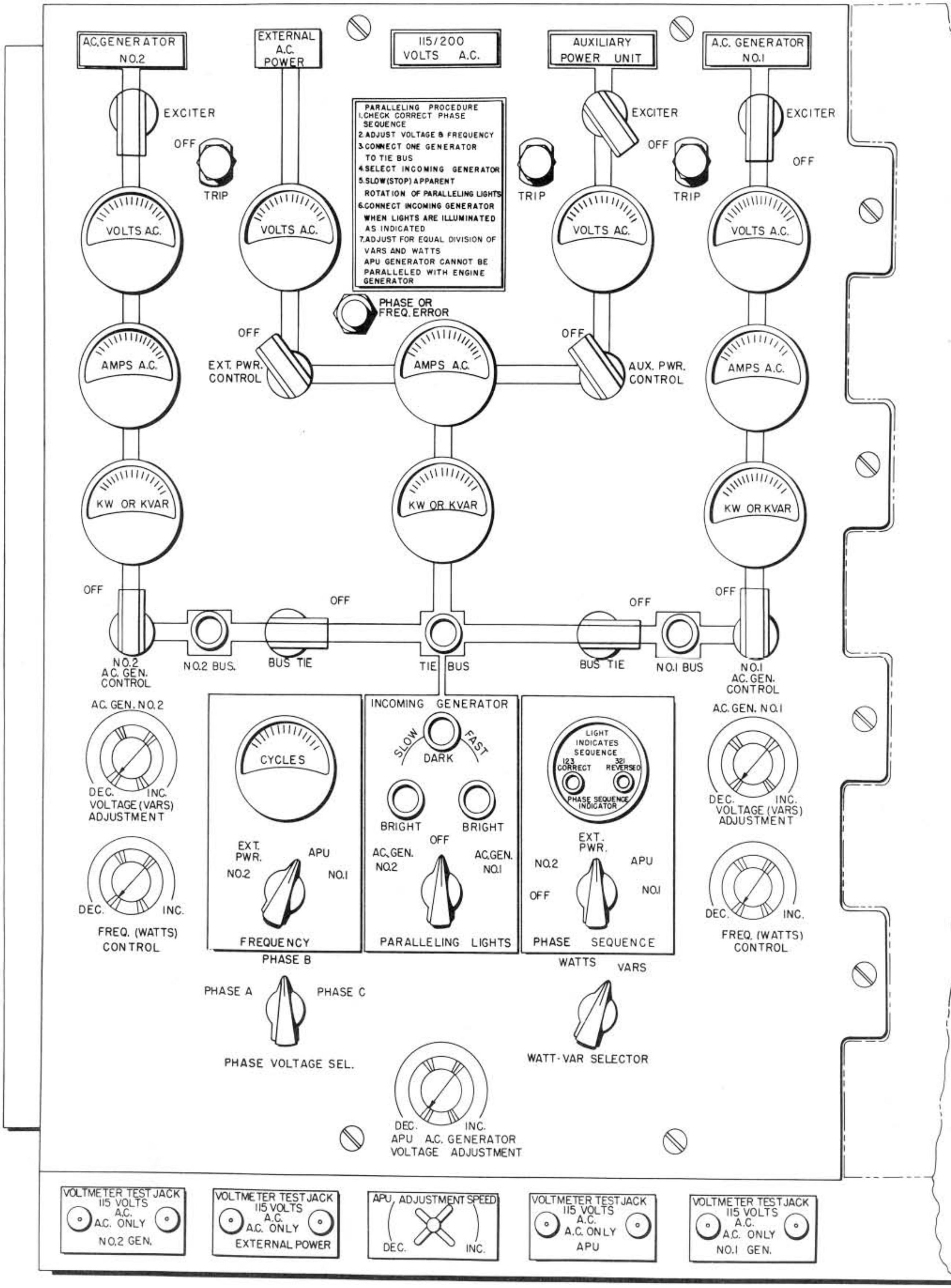


Figure 2-5. Radio Operator's A-C Control Panel—Generator's Paralleled

OPERATION	A-C SWITCHES					D-C SWITCHES			
	A-C GEN No. 2	BUS TIE SWITCH No. 2	A-C GEN APU	BUS TIE SWITCH No. 1	A-C GEN No. 1	BATTERIES	D-C GEN No. 1	D-C GEN No. 2	CONVERTER
STARTING ENGINES	Exciter OFF Control OFF	ON	Exciter ON Control ON	ON	Exciter OFF Control OFF	Control ON	Control OFF	Control OFF	Control ON
TAXI NORMAL DAY	*Exciter ON Control OFF	ON	Exciter ON Control ON	ON	*Exciter ON Control OFF	Control ON	Control ON	Control ON	Control ON
TAXI NIGHT-ICING	Exciter ON Control ON	OFF	Exciter ON Control ON	ON	*Exciter ON Control OFF	Control ON	Control ON	Control ON	Control ON
TAKE OFF AND CLIMB	Exciter ON Control ON	OFF	Exciter ON Control ON	ON	Exciter ON Control OFF	Control ON	Control ON	Control ON	Control ON
CRUISE	Exciter ON Control ON	ON	Exciter OFF Control OFF (Secured)	ON	Exciter ON Control ON	Control ON	Control ON	Control ON	Control OFF
CRUISE COMBAT	Exciter ON Control ON	ON	Exciter ON Control OFF (Stand By)	ON	Exciter ON Control ON	Control ON	Control ON	Control ON	Control ON
DESCENT AND LANDING	Exciter ON Control ON	OFF	Exciter ON Control ON	ON	Exciter ON Control OFF	Control ON	Control ON	Control ON	Control ON

NOTE: 1. To safely supply the load while the APU is secured during flight, the A-C generators must be maintained in parallel operation. If unparalleled operation is attempted, all crew members should be alerted to this condition.

2. For TAKE-OFF and CLIMB until adequate single engine altitude is reached and for DESCENT and LANDING, the APU is operated split-bus with A-C generator No. 2.

*3. During TAXI operation position engine generator exciter switch "OFF" if engine speed drops below 850 RPM for any period of time, to prevent damage to the transformer in the Constant Speed Drive Junction Box.

Figure 2–6. Radio Operator's A-C and D-C Control Panels—Normal Switch Positions

CLIMB.

Rated power climbs shall be conducted with NORMAL mixture when the cylinder head temperature can be kept below 245°C (475°F). When the cylinder head temperature cannot be held below these limits, shift mixture control to RICH and adjust power controls (throttles) to correct MAP.

CAUTION

Avoid operation between 2600 and 2800 rpm at indicated airspeeds below 140 knots. (Operation at 2600 rpm is permissible.)

It is imperative that the cowl flaps and oil cooler flaps be kept as near closed as possible without exceeding the engine temperature limits. Slight buffeting may occur with cowl flaps full open.

Note

Operating at or near the limiting cylinder head temperatures is not encouraged.

When shifting from LOW to HIGH, reduce manifold pressure to 20 in. Hg, then reduce engine speed to 1600 rpm. Move supercharger controls rapidly and evenly from the LOW to HIGH positions. Make this a quick and positive action. Readjust power setting as desired.

CAUTION

Do not shift blowers through a complete cycle more than once in five minutes.

Before shifting from HIGH to LOW blower reduce manifold pressure. Adjust power after moving blower lever from HIGH to LOW.

Climb at the recommended speeds shown on curves for various gross weights in Appendix I.

FLIGHT CHARACTERISTICS.

Refer to Section VI for flight characteristics.

SYSTEMS OPERATION.

Refer to Section VII for additional information regarding the operation of various systems.

PRE-TRAFFIC PATTERN CHECK LIST.

Prior to entering the traffic pattern check the following:

APU	ON
Auto-Pilot	OFF
Trailing Antenna	RETRACTED
Sonobuoy Antennae	RETRACTED
Pyrotechnic Pistol	STOWED
Periscopic Sextant	STOWED
Turret	LOCKED
Internal Stores	STOWED
Sonobuoy Door	CLOSED
Marine Marker Launcher Tube Door	CLOSED
Driftsight	STOWED
Standpipes	CLOSED
Turret Guns	UNLOADED
Turret Switch	OFF
Pilot's Master Armament Switch	OFF

Safety belts fastened and shoulder harness locked.

TRAFFIC PATTERN CHECK LIST.

When in the traffic pattern check the following:

Form F of Weight and Balance	Correct landing weight
Watertightness	All stations report SECURE
Other Traffic	CLEAR
Booster Pumps	EMERGENCY
Mixture	NORMAL
Supercharger	LOW
Altimeter	SET
Carburetor Air	COLD
Main and Boost Hydraulic Systems	ON
APU, AC and DC	Operating and on the bus
Radio Altimeter	ON
Main Engine Generators	ON
Propeller Reversing Release	FLIGHT

NORMAL LANDING PATTERN.

Refer to Figure 2–7.

NORMAL LANDING.

Normal landing of the airplane can be made with or without the use of reversible pitch propellers. However, in using the reverse pitch propeller, the landing distance is shortened by approximately three-fourths the normal landing distance. With wing flaps lowered 40° and no wind, power-on or power-off landings can be satisfactorily made with little change in speed. But in all cases, the pilot should continue to "fly" the airplane until after contact with the water and with a trim angle of seven degrees. Plane-off of the airplane remains trimmed at or below the stall angle while the lateral and longitudinal control surface remain effective as the airplane re-enters the water under control at a trim angle of nine degrees. After water contact is made, the hydroflaps can be used to reduce the landing run approximately 100 feet.

The APU should be started at least 5 minutes prior to anticipated landing or just before going over the landing check list. After APU is started, the APU generator should be connected to the No. 1 and the Cross-tie bus leaving the other engine generator on the No. 2 bus. Also, immediately after landing, connect the APU generator to all busses.

In addition to the above recommended landing instructions, complete the following check list:

Cowl Flap	"HALF OPEN"
Propellers	"DECREASE RPM"
Mixture	"RICH"
Power Controls (Throttles)	"CLOSED"
Flaps	"40°—NO WIND"
Trim	"LANDING"
De-icer Boot	"OFF"
Crew	"READY FOR LANDING"
Tail Turret	"LOCKED" Station Vacated

WARNING

The maximum flap down airspeed is 150 knots.

Refer to Section III for procedure to employ in the event of an emergency during landing.

OPEN SEA LANDINGS.

Normal Landing.

a. Make initial pattern at any desired speed. If desired, use about 10 degrees wing flap and 130 knots IAS.

b. On initial approach slow to 120 knots and lower 20 to 30 degrees of wing flaps.

c. On final approach lower full wing flaps (40°) and maintain at least 100 to 108 knots airspeed, dependent upon gross weight. Full power off approaches may be accomplished but normal technique will call for 15 to 25 inches of manifold pressure to be used during the final approach.

d. The airplane may be landed throughout its full range of hydrodynamic trim angles, from relatively low angles (3°) up to its full stall. After water contact, the airplane should be held within its stable hydrodynamic range (3° to 15°). In general, stable hydrodynamic limits will be maintained if the control column is held approximately half way between neutral and full aft. If porpoising should develop the same technique outlined under the Take-Off write up should be utilized.

ROUGH SEA LANDINGS.

In choppy or short pattern seas running up to five feet, best results are obtained by landing and take-off into the wind regardless of the sea pattern. Landing contact should be made at the lowest possible airspeed. After water contact is made the airplane should be held at a relatively high trim angle.

a. The airplane should be touched down at the slowest possible air speed.

b. A stalled landing should be very carefully planned and executed lest a stall intended to drop a few inches on to the crest of a swell, miss the crest and fall eight or ten feet into the trough.

c. With winds of less than twenty knots the direction of the wind is a consideration to the pilot definitely second to the necessity of planning a landing or take-off run with regard to the swell alone.

d. The best landing approach is a regularly formed sea with light winds in parallel to the swell touching down on the crest of the swell.

e. The second best landing heading is in a well formed and regular swell. Down swell touching on the crest of a swell or within a few feet beyond it and making every effort to prevent the airplane from being thrown high in the air as it planes up over successive swells. To accomplish this, the nose should be deliberately pushed down as the airplane races up the back of a swell and approaches the crest. As the airplane starts to fall back on again, the nose should again be pulled up.

f. A landing should be made into a fast swell only when the wind is blowing from that direction with a force so great that a landing on any other heading will be very hazardous due to the wind.

g. A landing quartering the swell is better than a landing directly into the face of the swell.

h. The pilot's final decision on his landing direction should be a compromise between first, attempting to land parallel to the swell or down swell and without running into the face of a second wave system possibly concealed beneath the first, and second, bringing as much of the prevailing wind ahead as possible.

i. The pilot should, if possible, study the sea from a height of about two thousand feet to detect any large ocean swell which might be concealed by the swell which is the only one apparent at low altitude. He should then observe the sea at about twenty or thirty feet on headings all around the compass to note on which headings the sea appears easiest. The direction of the wind, unless it be twenty knots or more, should always be considered a hazard secondary to the sea conditions in planning a landing.

j. The final approach for the landing should be observed from a low altitude a mile or so short of the proposed landing spot with the propellers in low pitch and the flaps down full. This approach should be made at not to exceed fifteen knots above the stall speed of the airplane as loaded. A careful watch should be kept on the sea swell ahead during this run; and if the sea ahead suddenly appears relatively smooth the airplane should be stalled on as quickly and as short as possible. Running the airplane's speed out on the landing can be done with the airplane's nose very high or dragging the nose slightly, but the pilot should in either case be alert to play the nose

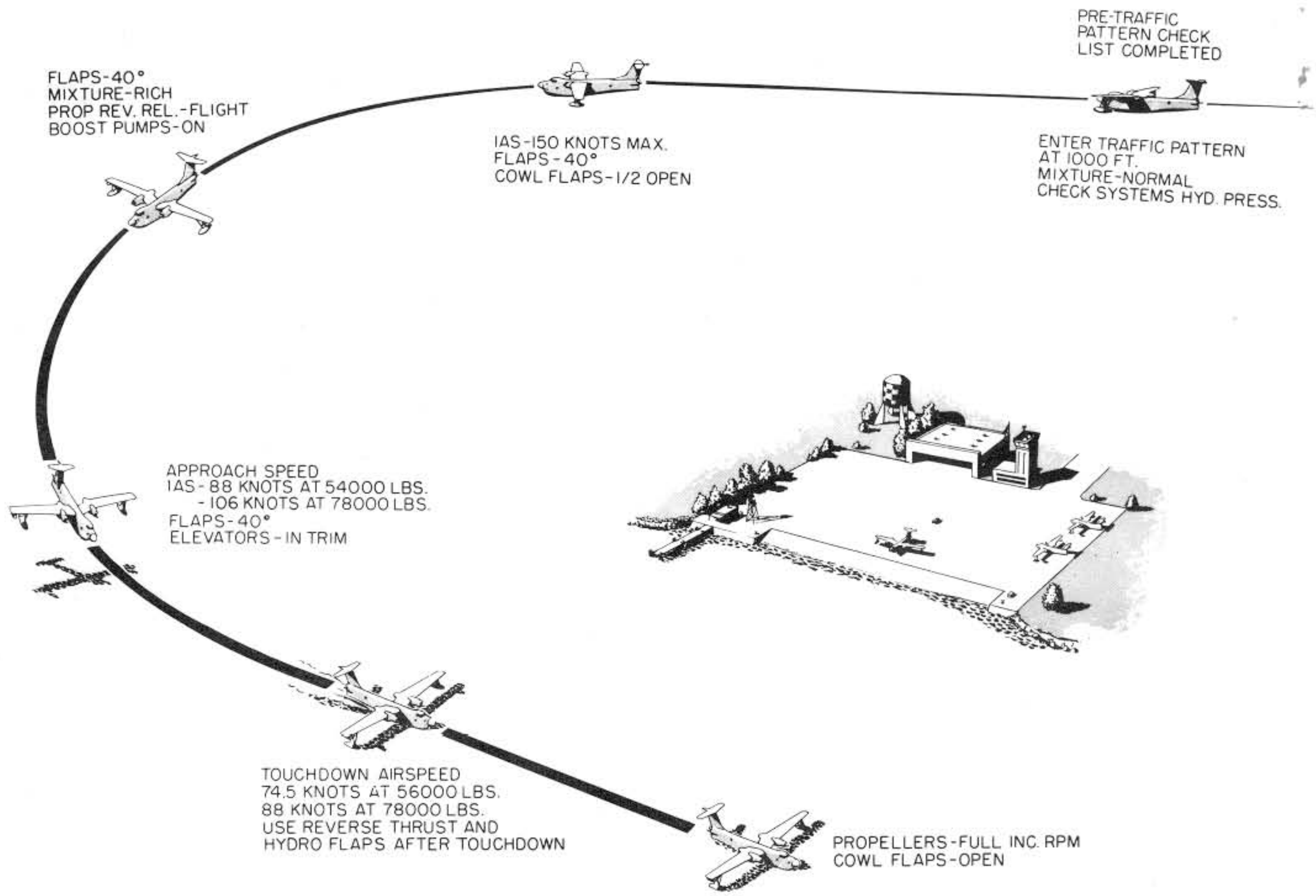


Figure 2–7. Landing Pattern Diagram

of the airplane up and down to reduce the shock of its impact with waves and to avoid planing off the top of any wave higher than is absolutely necessary as long as he has control with his elevators.

GO AROUND.

If it becomes necessary to pull up and go around from a normal approach (both engines operating and flaps 40°) operate as follows:

a. Apply power with 2900 rpm (MAP of 61.5 Hg.) and pull up to best climbing speeds.

b. Retract wing flaps to 30° take-off flap position.

c. Adjust trim, cowl flaps and oil cooler flaps as necessary to keep within specified limits.

d. Increase to best climb speeds (Reference Appendix I, Figure A–10 and A–12).

e. Proceed as during a normal take-off.

AFTER LANDING.

Flaps	UP
Hydro Flaps Switch	ON
Propeller	FULL INCREASE RPM
Cowl Flaps	FULL OPEN
Propeller Reversing Release	TAXI
During Taxiing:	
Anchor	READY
Sea Anchors	READY
Hydro Flaps	USE AS NECESSARY FOR DIRECTIONAL CONTROL

CAUTION

If a hard or an extremely rough sea landing is made with the external stores loaded, the airplane should be inspected prior to the next flight for structural damage. See figure 2–2 for Exterior Inspection.

POST FLIGHT ENGINE CHECK.

Immediately upon completion of flight the crew shall accomplish a post flight engine check as required. The crew shall note any unusual observations, deficiencies, and unsatisfactory conditions on the approved post flight forms. All post flight forms must be turned over to responsible ground crew personnel for corrections.

STOPPING OF ENGINES.

Note

For cold weather stopping, refer to Section IX for oil dilution procedure. If the engines have been warmed by taxiing, idle for two minutes until the cylinder head temperatures drop to approximately 150°C (300°F).

Accomplish the engine stopping procedure as follows:

Boost Pumps	"OFF"
Cowl flaps	SEE NOTE
Carburetor Air	"COLD"
Propellers	"FULL INC." rpm
Superchargers	"LOW"
Power Control (Throttles)	"Set for 600 rpm"
Mixtures	"IDLE CUT-OFF"
Ignition (after engine stops running)	"OFF"
Throttle (after engine stops running)	"CLOSED"
APU	"OFF"
Fuel Switches	"OFF"

STOPPING THE AUXILIARY POWER UNIT.

Position APU starting switch to "OFF". Unit should come to a complete stop within 2 minutes.
Close the APU manual fuel supply valve.

Note

Cowl flaps are to be in the "FULL OPEN" position until fifteen minutes after stopping the engines or the engine has cooled to 150°C (300°F).

BEFORE LEAVING AIRCRAFT.

Ascertain that the following are:

Aircraft Interior	SHIPSHAPE
Surface Control Lock	LOCKED
Cowl Flaps	CLOSED
Oil Cooler Doors	CLOSED
Exhaust Outlets	COVERED
Fresh Air Vents	CLOSED
All Switches	OFF
Pitot Heads	COVERED
All Electrical Power	OFF
Confidential Equipment	LOCKED UP
Hatches	SECURED
Beaching Gear Brakes	ON
Tie Down Lines	SECURED

The boarding ladder may be left in place if the aircraft is on land. If the aircraft is moored, a watch must be left and the anchor lights turned on at sunset. When inclement weather is forecasted, the airplane protective covers should be installed. Refer to Section IX for location of protective covers.

SECTION III
EMERGENCY PROCEDURES

ENGINE FAILURE.

FLIGHT CHARACTERISTICS ON ONE ENGINE.
The flight characteristics on one engine are entirely normal, and adequate control exists to perform all essential maneuvers. Sufficient trim is available to trim the airplane for hands off flight on one engine. The best climb speed ranges from 125 knots to 110 knots depending on the weight. At weights above 64,000 it may be necessary to resort to Maximum Endurance Power to continue flight. Refer to figure A–26 of Appendix I.

PROCEDURE ON ENCOUNTERING ENGINE FAILURE.
The following procedure is recommended for stopping an engine and feathering the propeller in flight:

a. Determine propeller to be feathered.
b. Advance power on the operating engine.
c. Shut down inoperative engine as follows:

Power Control (Throttle)	CLOSED
Mixture	CUT-OFF
Feathering Switch	Feather
Fuel Valve	OFF
Fuel Boost Pump	OFF
Oil Cooler Flaps	CLOSED
Carburetor Air	COLD
Ignition Switch	OFF
Cowl Flaps	CLOSED
Firewall Valve Switches	CLOSED
Trim Airplane	AS NECESSARY
A-C and d-c switches on the inoperative engine	OFF

d. If engine FIRE occurs follow step procedure in MAIN ENGINE FIRE IN FLIGHT.

CAUTION

Do not restart the inoperative engine until it has been decided the engine is reasonably safe for continued operation. If restarting is warranted, follow step procedure in UNFEATHERING PROCEDURE.

UNFEATHERING PROCEDURE.
The following procedure is recommended for UNFEATHERING the propeller in flight:

a. If the propeller has been feathered for a considerable length of time operate the starter until the propeller has turned two revolutions. This procedure will indicate the presence of a liquid lock, if any, and will preclude damage to the engine.

Propeller Control	FULL DECREASE RPM
Carburetor Air	COLD
Fuel Supply	ON
Booster Pump Switch	NORMAL
Firewall Shut-off Valves	OPEN
Power Control (Throttle)	CLOSED
Ignition Switch	ON
Feathering Switch	UNFEATHER
Mixture Control	IDLE CUT-OFF

WARNING

When UNFEATHERING the propeller, the feathering button must not be held out for longer than two seconds. Holding feathering button out for more than two seconds could place the propeller in reverse pitch.

b. Pull out the spring-loaded feathering button, hold for one or two seconds, then release. The propellers should start to windmill; however, if it does not, wait ten seconds and repeat; several attempts may be necessary.

Under cold weather conditions the propeller may windmill for a considerable length of time without reaching the minimum rpm setting. If it is desired to increase this rpm, the push button switch may again be held out momentarily as discussed in step "b". Also, the engine may be started if the rpm is high enough for it to fire. This power increase will bring the speed up to the governed rpm.

When propeller rpm is approximately 200 to 400 the propeller governor assumes control and completes the unfeathering operation.

Note

Mixture Control RICH, when the engines speed reaches 600 to 800 rpm. The control must be shifted from CUT-OFF to RICH as quickly and smoothly as possible. Operate the engine at 1000 rpm until satisfactory cylinder head and oil temperatures are obtained.

Cowl Flaps	"Control to head temp."
Oil Cooler Flaps	"Control to oil temp."
Re-Trim	"As necessary"
A-c and d-c switches engine.	"ON"

Reduce power on the operating engine.

ENGINE FAILURE DURING TAKE-OFF.

If one main engine fails during the take-off run or on take-off, the airplane will swerve. The other engine should be cut immediately and a landing made.

DO NOT TRY TO CONTINUE TAKE-OFF. The minimum control speed is 92 knots.

ENGINE FAILURE DURING FLIGHT.

Refer to figures A-24 to A-34 in Appendix I to obtain single engine cruise control. Refer to "Procedure on Encountering Engine Failure" for instructions regarding shut-down procedure.

a. Apply necessary power to remaining engine.

b. Shut-down malfunctioning engine.

Note

If propeller fails to feather, a considerable increase in performance can be obtained by placing the governor control of the windmilling propeller in full decrease RPM position.

c. Raise flaps carefully, if they are down.

d. Close cowl flaps on dead engine.

e. Start APU and position a-c and d-c control panel switches for single engine landing. Refer to "EMERGENCY ELECTRICAL, A-C and D-C" in this section.

f. Jettison fuel and loose gear.

g. Land as soon as possible. Refer to "SINGLE ENGINE LANDING".

Note

At military power the airplane may be flown at a gross weight of 70,000 pounds for 30 minutes, at sea level.

ENGINE FUEL PRESSURE DROP.
DURING GROUND OPERATION.

If the fuel pressure drops below normal operating pressure, but the engine continues to operate normally, stop the engine. *Do not take off.* Investigate the cause and correct.

DURING FLIGHT.

If the fuel pressure drops below the operating limits during flight, but the engine continues to operate normally, the cause may be one or more of the following: primer leakage; oil dilution solenoid leakage; engine driven fuel pump bypass valve leakage; clogged pressure line; instrument failure; or line leakage. Possible courses of action, depending on the cause of the pressure drop, are listed below.

a. CUT THE ENGINE IMMEDIATELY. Do this if the power is not necessary to sustain flight or to reach a safe destination.

b. CONTINUE OPERATING THE ENGINE NORMALLY. This may be done if it can be unquestionably determined that the indicated fuel pressure drop has not resulted from a fuel leak.

c. KEEP THE AFFECTED ENGINE IN OPERATION AT OR ABOVE CRUISING SPEED WHILE MAINTAINING WATCH FOR FIRE. This can be done if it cannot be determined whether or not an actual leak exists and the engine is required to either sustain flight or maintain the required altitude for arrival at a safe destination. However, prior to power reduction for entrance to the landing pattern cut the affected engine completely (by means of the mixture control, not by retarding the throttle) and accomplish a partial power landing. Unless the added power is absolutely essential to effect a safe landing, do not reduce airspeed until the affected engine is shut down. This required procedure is based on the fact that air flow over the engine and nacelle, due to its cooling dispersing effect, will frequently keep a fire from breaking out, even though an actual fuel leak exists, that is, until the speed of the airplane is reduced sufficiently as during landing.

Note

All other factors being equal, the recommendation in sub-paragraph "a" is generally the best. However, action to be taken depends entirely upon the circumstances existing at the time. Such factors as the known condition of the airplane and the remaining engines, stage and requirements of the mission, and power requirements of the aircraft should be considered.

MAXIMUM GLIDE.

In order to obtain the best glide ratio, proceed as follows:

a. Close cowl and oil cooler flaps.

b. Feather propellers.

c. Retract landing flaps.

d. Glide at:

Gross Weight	*Calibrated Airspeed*
55000	124 knots
60000	129 knots
65000	134 knots
70000	140 knots

SINGLE ENGINE LANDING.

If one engine fails during flight and immediate landing is anticipated, the following procedure is recommended. Accomplish all of the necessary steps referred to in "Procedure on Encountering Engine Failure". Head the airplane into the wind, fully extend wing flaps, trim airplane surfaces as necessary, and proceed with normal landing approach.

Attention must be given to the inoperative engine side, as the wing and airplane must be trimmed enough to relieve the weight of the dead engine and to keep the airplane on a level flight course. Just prior to being waterborne increase the stall angle, as necessary to suit sea conditions. Complete the landing of the airplane, using a normal landing operating technique. When completely waterborne the hydro-flaps can be used to induce drag and to decrease the landing distance.

NO FLAPS LANDING.

The following procedure is recommended with a maximum gross load of 72,000 lbs.

a. Use normal approach until final approach.

b. In final approach maintain an IAS of 125 knots, 20" MAP and RPM set for 2600.

c. Flare out low to the water and maintain a level attitude (slightly nose high).

d. Touch down at 105 to 110 knots. (Flare out is utilized to decrease rate of descent.)

SINGLE ENGINE GO-AROUND.

If it becomes necessary to pull up and go-around on a single engine approach, proceed as follows:

a. Use take-off rpm.

b. Apply full. power of 2900 rpm and pull up to best climbing speeds. (Refer to Appendix I, Figure A–24.)

c. Use discretion of flap operation.

d. Adjust cowl flaps and oil cooler flaps as necessary.

e. Proceed as during a normal climb with reference to Appendix I, Figures A–24 and A–25.

PRACTICE MANEUVERS ON SINGLE ENGINE. All normal flight maneuvers including turns up to a 45°, bank into and away from the "dead" engine, may be accomplished with one engine propeller feathered.

FAILURE OF ASSIST TAKE-OFF UNITS.

Failure of all or part of the Jato Assists units will have no undesirable results other than lengthening the take-off distance. Failure of both units on one side will have very little asymmetric power effect.

PROPELLER OVERSPEEDING.

GENERAL. Propeller overspeeding is generally described as a condition wherein the propeller governor fails to maintain the engine speed within the maximum limit setting. Overspeed should not be confused with power surges, in which the engine speeds may momentarily exceed maximum limits. A power surge may sometimes occur on take-off if the throttles are advanced too rapidly; however, this surge will ordinarily be controlled by the governor within a few seconds. Overspeeding exists when the tachometer exceeds 2990 RPM. If the governor has failed, the engine speed will rapidly increase and unless immediate corrective action is taken, a critical flight condition may occur together with the possibility of seriously damaging the engine. If a mechanical failure in the governing system occurs, excess air speed will hamper corrective action. Therefore, the air speed must be rapidly reduced, as much as safety will permit, in order that correct action may be more easily accomplished. The following procedure is recommended for correcting propeller overspeeding:

ON TAKE-OFF: If propeller overspeeding occurs during the take-off run, every attempt should be made to stop. If the overspeeding occurs after take-off or too late in the take-off run to permit a rejection of the take-off:

a. Retard throttle on the malfunctioning engine so as to derive as much power as possible without overspeeding the engine above approximately 3000 RPM.

b. Reduce air speed to approximately 15 knots above the critical single-engine flight speed for the gross weight of the airplane.

c. If the propeller overspeed cannot be controlled by the above steps, feather the overspeeding propeller and return to the seadrome.

IN FLIGHT. If overspeeding occurs in flight and it is desirous to obtain power from the malfunctioning engine:

a. Retard throttle on the overspeeding engine so that the RPM limit is not exceeded and reduce air speed to approximately 120 knots.

b. If propeller cannot be controlled, initiate feathering procedure.

FAILURE OF PROPELLER UNREVERSING CONTROLS. If the propellers are in reverse pitch and a-c electrical power is lost: move the throttle forward to increase engine RPM, and prop governor oil pressure enough to force the propellers into forward pitch.

WARNING

Do not exceed 2000 RPM during this operation.

If the propeller reversing and unreversing control circuit fails, return the propellers to forward pitch by placing the throttle forward of the reverse detent and depressing the prop feathering button long enough to move the prop to forward pitch, but not to feather. If the desired results are not achieved; pull the reversing circuit "BREAKER" (if it is not disengaged) and repeat the foregoing procedure.

MAIN ENGINE FIRE WHEN STARTING.

Fires, which occur during start of a reciprocating engine can usually be extinguished by quickly opening the throttle. If this action fails, the fire watch should use a hand fire extinguisher or advise personnel in the pilot compartment to determine the zone location of the fire and operate the applicable switches on the overhead fire control panel (8, figure 1–8) to place the aircraft's fire extinguisher system in operation.

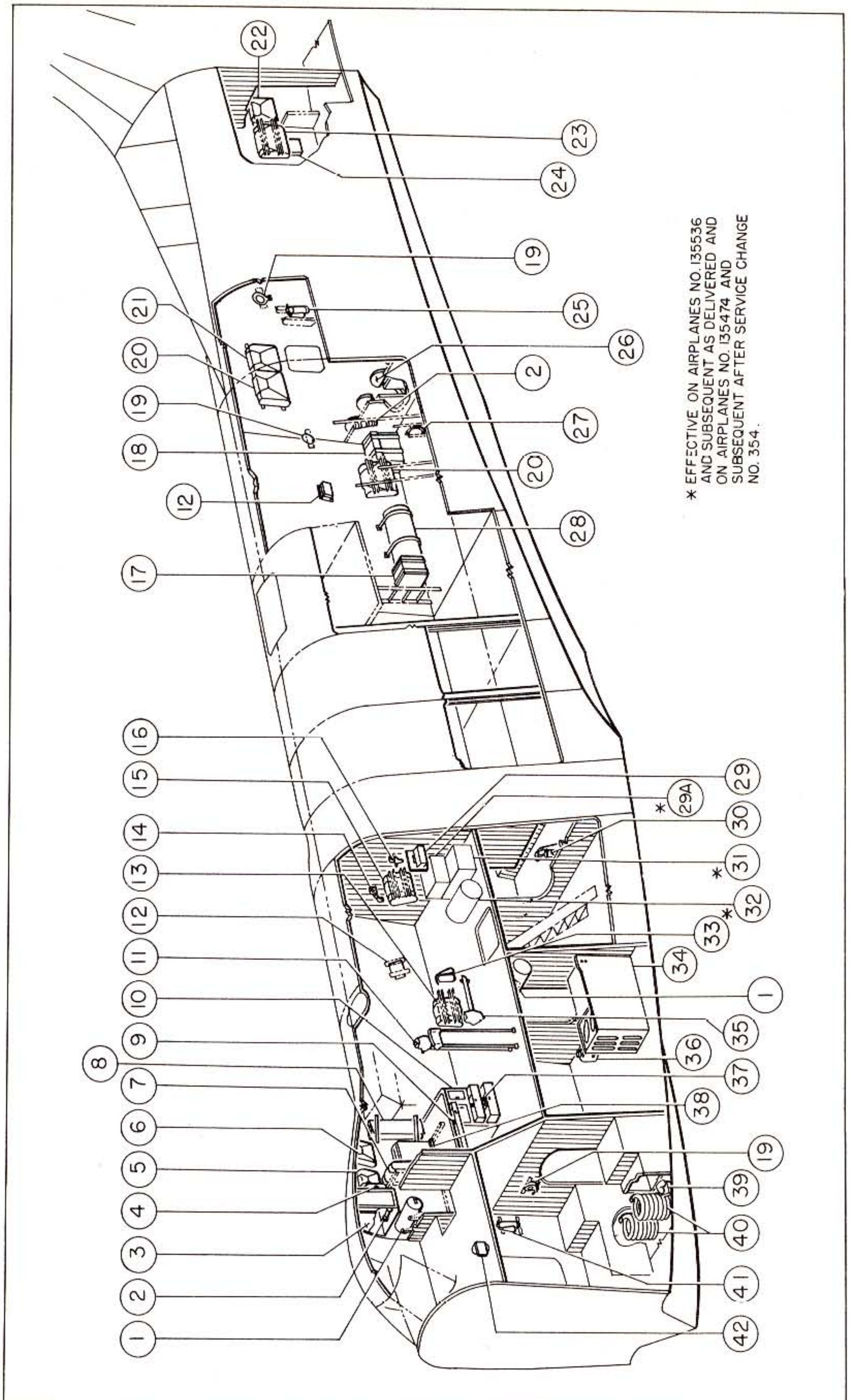


Figure 3-1. Emergency Equipment

KEY TO FIGURE 3–1

1 Breaker, Water
2 Light, Flash, Stowage
3 Cabinet, Navigator's
4 Parachute, Navigator's
5 Parachute, Radar Operators
6 Parachute, Radio Operators
7 Parachute, Pilots
8 Ditching Net, Stowage
9 Watch, Stowage, Navigators Table
10 Computer, Plotter Stowage
11 Driftmeter, Stowage
12 Kit, First Aid
13 Parachute, Copilot's
14 Mount, Signal Pistol
15 Parachute, Radar Countermeasure Operator's
16 Holster, Signal Pistol Stowage
17 Food Container, Emergency
18 Transmitter, Life Raft Stowage
19 Light, Signal
20 Parachute Stowage, Spare
21 Parachute, Observers R.S.
22 Parachute, Tail Gunner's
23 Parachute, Observers L.S.
24 Ditching Cushion, Stowage, Tail Gunner
25 Extinguisher, Portable (Aft Hull)
26 Pads, Head Rest, Safety Belt, Ditching
27 Bucket Emergency
28 Life Raft, Stowage
29 Cartridge Stowage Signal Pistol
*29A Emergency Food Container
*31 Emergency Radio Transmitter
*32 Life raft
32 Board Stowage, Ditching, Flight Deck (Forward)
33 Extinguisher, Portable Flight Deck
34 Food Locker, Stowage
35 Axe, Escape
36 Jug, Thermos
37 Binoculars
38 Sextant, Stowage
39 Pump, Bilge
40 Hose, Bilge Pump, Stowage
41 Extinguisher, Portable (Fwd Hull)
42 Holder, Check List

* Effective on Airplanes No. 135536 and subsequent as delivered and on airplanes No. 135474 and subsequent after service change No. 354.

WARNING

Methyl Bromide is poisonous to personnel. Notify the fire watch to vacate his position. Purge the system with dry air as soon as possible after the fire is out.

FIRE.

MAIN ENGINE FIRE IN FLIGHT. (Refer to "Engine Failure During Flight".)

a. Shut down the engine.

b. Fire bottle No. 1.

c. If fire persists, fire bottle No. 2.

d. Do not restart engine.

Note

The engine fuel shut-off valves and oil shut-off valves operate when the bottle selector switch is closed. The fuel valves will shut-off immediately, the oil valve will shut-off when the oil pressure has dropped to 15 lbs. per square inch.

APU FIRE. (See figure 1–10.)

In the event of a fire in the APU the radio operator will:

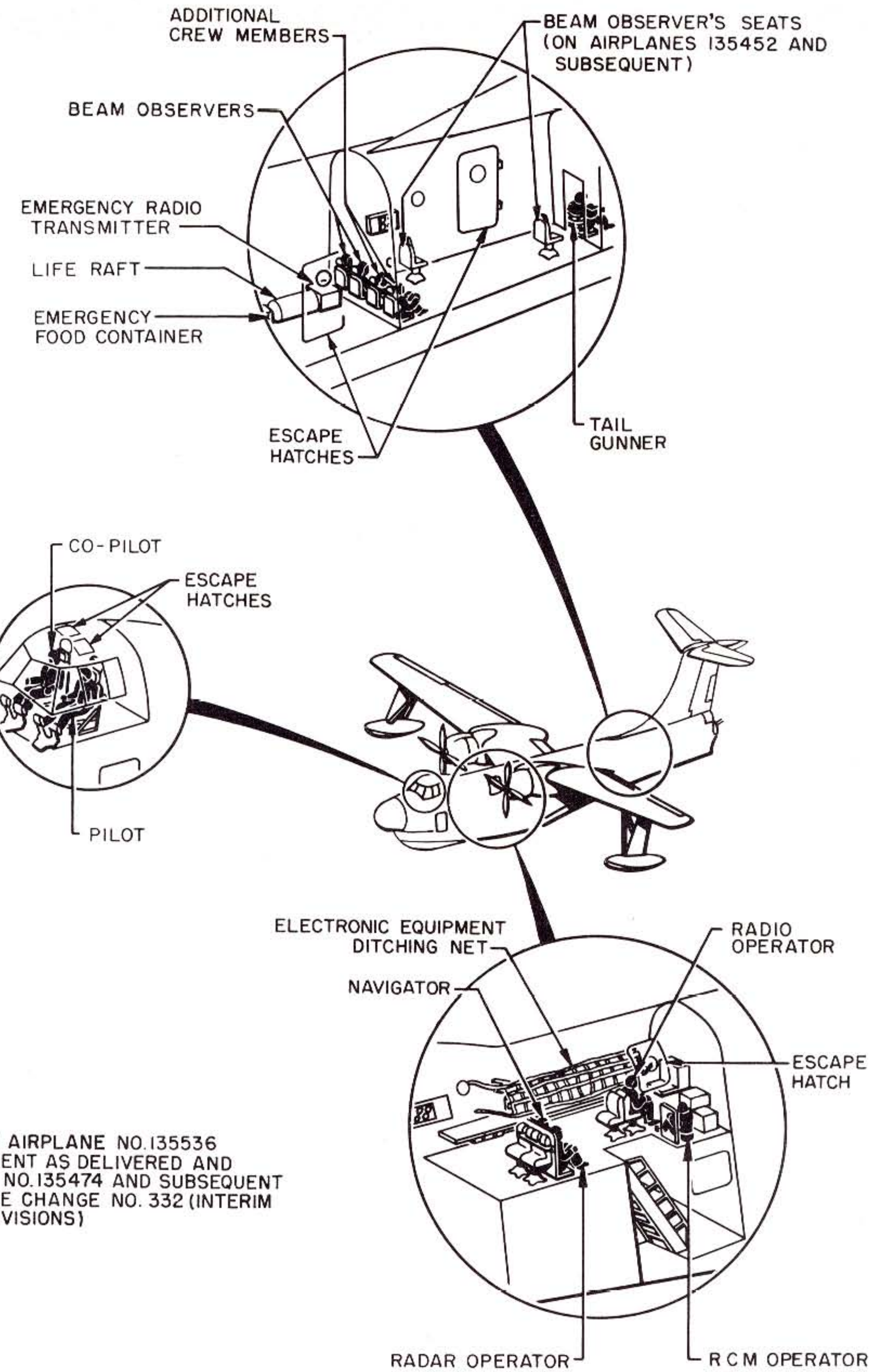
a. Actuate APU control switch on radio operator's panel to OFF position.

b. Close air intake door.

c. Discharge APU CO_2 extinguishing system.

d. Shut-off manual fuel valve.

e. If fire is in aft section puncture hole in upper corner with fire-axe and utilize CO_2 bottles.



NOTE:
EFFECTIVE ON AIRPLANE NO. 135536 AND SUBSEQUENT AS DELIVERED AND ON AIRPLANE NO. 135474 AND SUBSEQUENT AFTER SERVICE CHANGE NO. 332 (INTERIM DITCHING PROVISIONS)

Figure 3-1A. Interim Ditching Provisions.

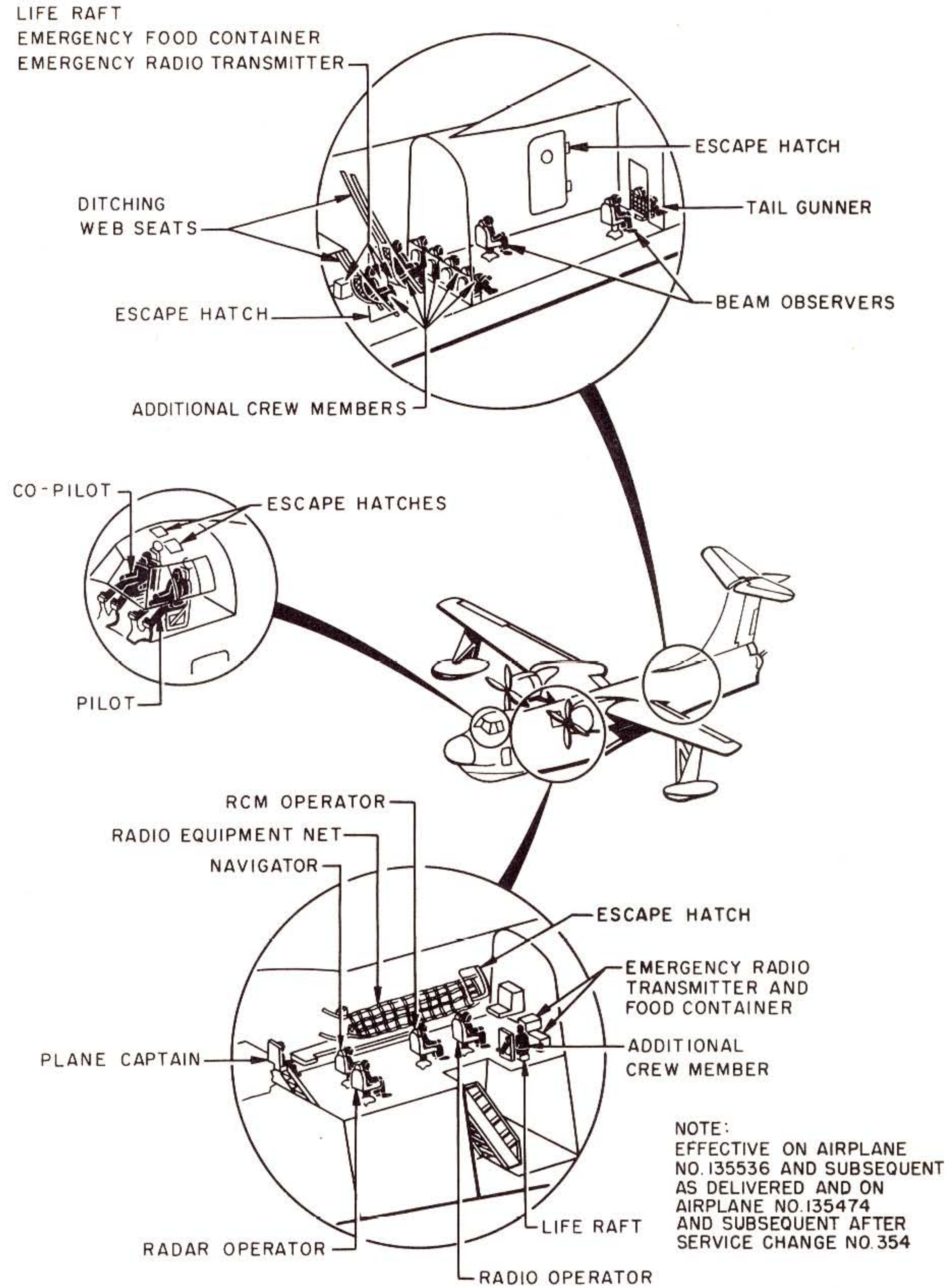


Figure 3-1B. Ditching Provisions.

HULL FIRE. (See figure 3-1.)

If a fire occurs within the hull, immediately discharge the hull tank vapor dilution system by placing the VAPOR DILUTION HULL TANK switch (on the pilot's aft control panel) ON. All sections of the hull are accessible to fire-fighting personnel.

Fire fighting equipment furnished with the airplane includes; an emergency axe on the flight deck, portable CO_2 fire extinguisher on the flight deck, in the forward entrance compartment and in the forward and aft waist compartments. (figure 3-1). These fire extinguishers bear instructions for use.

There is a first aid kit on the flight deck and another in the forward waist compartment.

CAUTION

Do not re-enter an area in which a fire has occurred until CO_2 fumes and/or smoke have dissipated.

WING FIRE.

If a wing fire occurs, determine the cause. If it is a system fire, shut down the system.

If it is a bomb bay fire, jettison the stores.

If it is a nacelle fire, operate the engine extinguisher system.

If the fire persists, land immediately, the wings are inaccessible in flight.

ELECTRICAL FIRE.

If a fire occurs within an electrical system or because of a fault in the system isolate the circuit affected by shutting off power to this circuit.

To extinguish the fire follow the procedure outlined in the foregoing applicable paragraph.

Note

The CO_2 extinguishers supplied on this airplane may be used for electrical fires.

LANDING EMERGENCY.

If the decision is made to effect an emergency landing, the following procedure should be immediately initiated:

a. The pilot should give the order to standby for an emergency landing and advise the crew if landing will be immediate or deferred.

b. If possible, the bomb bay stores should be jettisoned. If bomb bay fuel tanks contain considerable unjettisoned fuel as the emergency landing becomes imminent, the tanks should also be jettisoned. However, it is advisable to jettison the fuel, but retain the tanks to increase the buoyancy of the aircraft when it is afloat.

c. The pilot and co-pilot should attach and tighten their safety belts and shoulder harnesses.

d. Release all emergency hatches.

e. Crew members should go to ditching stations.

f. If landing in enemy territory or in an area of doubtful security, fire the IFF destructors.

g. Do not jeopardize the lives of the crew by attempting to save the airplane. Crew safety should dictate all decisions during forced landing.

h. Lower the flaps for a full-flaps normal approach. If landing is made after dark, drop parachute flares, and use landing lights.

i. If power is available, make a nose-high, power-on landing, keeping the forward speed as low as possible. Warn the crew just before contact is made.

j. After landing, cut the ignition and all electrical switches to reduce fire hazard.

k. When landing with a damaged hull, if the damaged area is accessible, use the bunk mattress to fill the holes. After landing, if abandonment of the airplane is unnecessary, remove water with the bilge pump. Close the water-tight doors as necessary.

EMERGENCY ENTRANCE.

There are five cut-out areas for emergency entry. One is on the pilot compartment crown aft of pilot escape hatch. A second is at the flight deck escape hatch. A third is at the APU hatch. A fourth and fifth are on the right and left side of the hull in the forward waist compartment. On the exterior of the hull plating, the corners are marked with yellow bands, and each of the four sides have markings which read CUT HERE FOR EMERGENCY RESCUE. (See figure 3-2).

SMOKE ELIMINATION.

To eliminate smoke and toxic fumes from interior of airplane (not including Flight Deck) open the following:

All connecting doors between compartments (Flight Deck Access Door to remain closed).

Bow compartment ram air intake.

Anchor compartment and galley exhaust grilles.

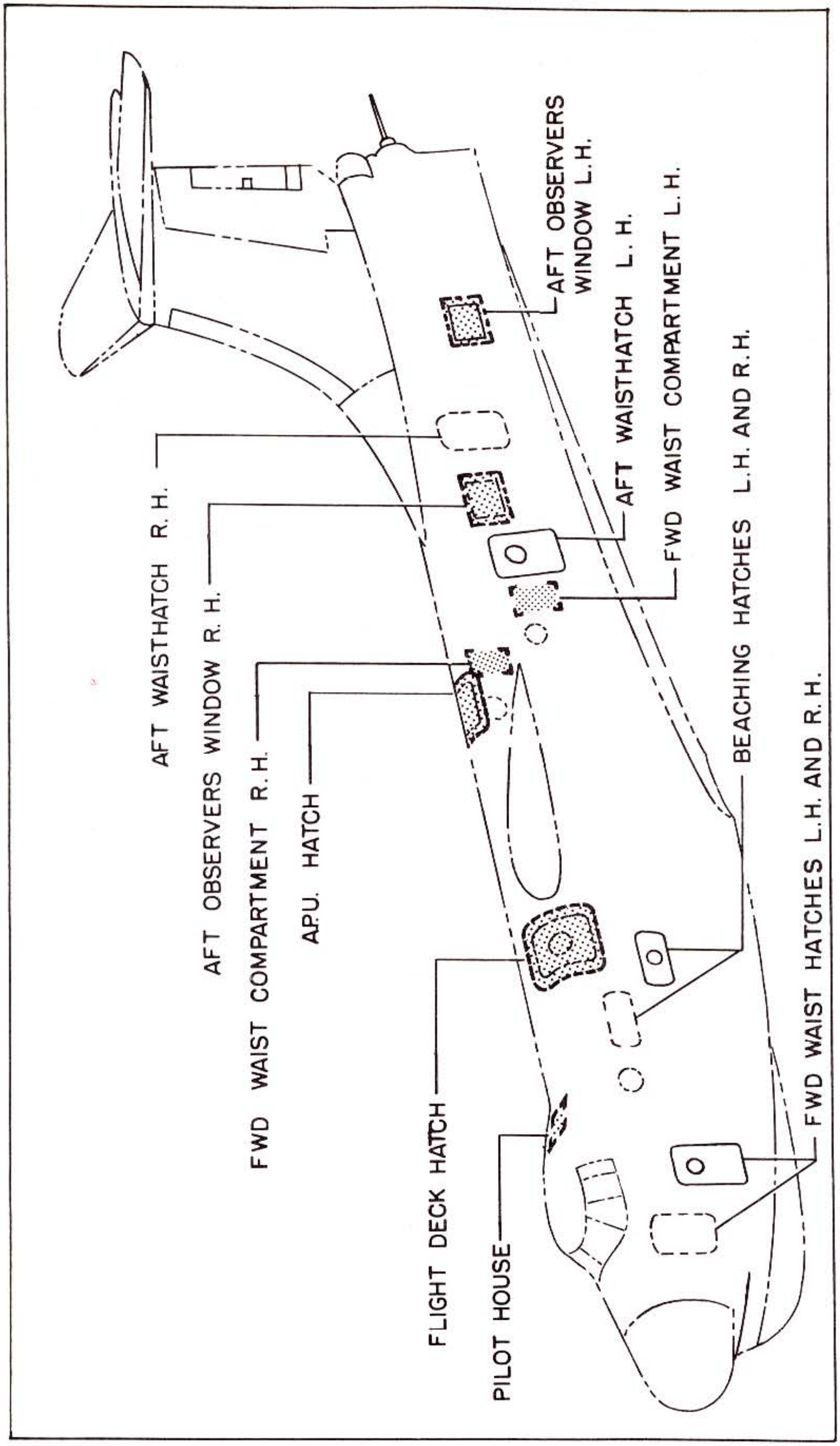


Figure 3-2. Emergency Entrance Areas

Retractable plastic vents at crew bunks (turn to exhaust air).

Two hinged panels in tail gunner's window.

Tail gunner's retractable plastic vent (turn to exhaust air).

To eliminate smoke from Flight Deck and Cockpit:

Turn Heating and Ventilating selector switch ON. Open pilots' overhead exhaust grille and fresh air vents. Open flight deck exhaust grille and flight deck access door (if there are no fumes or smoke in hull). Purge hull.

BAIL OUT. (See figure 3-3A.)

If the decision is made to abandon the airplane in flight, the pilot should initiate the following procedure immediately:

a. Alert the crew via the interphone system to stand-by to abandon the airplane.

b. Direct crew members to get assigned parachutes and advise pilot that they are standing by. Parachutes are stowed in the flight deck compartment for the pilot, co-pilot, navigator, radio operator, ECM operator and radar operator. The tail gunner and the observers may obtain their parachutes from their aft compartment stowage positions. See figure 3-1.

c. The pilot should make certain that each crew member has been alerted before giving the command to bail out. Crew members should not bail out until ordered to do so by the pilot. Bail-out exits to be used are shown in figure 3-3A.

d. Slow the airplane and head toward an uninhabited area, if possible.

e. Give the command to bail out. After the crew have completed bail-out, the pilot and co-pilot will then proceed to either beaching gear hatch and bail out.

WARNING

Do not use either pilot's escape hatches for bail-out.

DITCHING. (See figure 3-3.)

Ditching as an emergency procedure, should take place when an emergency arises which allows time for the preparation. Some emergencies which arise make the choice of ditching preferable to bail-out and more advantageous to personnel especially in a mid-sea rescue. If a minor emergency arises and landing conditions are favorable, it is to the flight crew's advantage to remain in the airplane. They would have a greater chance of survival until rescued. The decision of the airplane commander will determine the course to follow.

WARNING

Make sure emergency food container is secured in inflated life raft after ditching.

DITCHING PREPARATIONS.

Prior to each over sea flight make a thorough inspection of all emergency equipment. Such items as the life raft, life raft transmitter, first aid kits, life jackets and other emergency equipment (listed in figure 3-1) should be checked and defective items replaced. Each crew member should be assigned specific items of equipment to carry out of the airplane when the airplane is ditched. Refer to chart in this section for listing of recommended crew member ditching duties.

PRE-DITCHING.

Ditching, requires more coordinated effort by the crew than any other operation. It is important that an exact ditching procedure be followed and ditching drills be diligently practiced at every opportunity.

When sustained flight is impossible and ditching becomes the only alternative, advantage should be taken of time and altitude.

Jettison fuel from bomb bay, auxiliary and hull tanks. Fuel remaining in service tanks will feed the engines to permit power-on touch down. Jettisoning empty bomb bay tanks, however, is not recommended since their buoyancy will aid the plane to stay afloat after landing.

Jettison internal and external stores and loose equipment that could injure personnel during landing.

Alert the crew. Have necessary equipment properly stowed and assign post ditching duties to personnel. Refer to ditching operations chart in Section III. At the pilot's command all crew members shall proceed to their assigned ditching stations. Refer to figure 3-3. Impact, as the plane strikes the water, may thrust crew members forward causing head or neck injuries. This may be prevented if crew members properly brace their bodies and clasp their hands behind their necks. Clothing that can be worn or carried during or following ditching will offer protection against shock or weather during the time spent on the water awaiting rescue.

DITCHING AND BAIL-OUT AURAL WARNING SYSTEM.

Note

On airplanes No. 135531 and subsequent as delivered and on airplanes No. 135474 through 135530 after service change.

DESCRIPTION OF DITCHING AND BAIL-OUT AURAL WARNING SYSTEM.

The ditching and bail-out aural warning system consists of three horns, a three position control switch, (for intermittent or steady blast) and a 5-ampere circuit breaker. The horns are on the flight deck at station 173, in the galley at station 271 and in the waist compartment at station 679. The control switch is on the cockpit overhead panel and the circuit breaker is on the battery junction box. The system is used to warn crew members to prepare for ditching or bail out.

Power to operate system is obtained from the battery bus through a 5-ampere circuit breaker on the battery junction box.

It is recommended that the radio operator remain at his station on the flight deck (on aircraft number 135474 and subsequent, the radio operator's regular station becomes a ditching station after service change) inasmuch as the A-C power control panel should be monitored and available power should be distributed where necessary. Refer to Figure 3-8. Broadcast "fix" position and distress signals, as long as possible, to ground control or air sea rescue stations stating location and time of ditching.

If radio contact is made with rescue stations, immediately alert these stations of any change in status or plan even if ditching is found unnecessary. If ditching does occur secure the APU and all other power in the airplane.

To facilitate search and rescue operations, the pilot should immediately broadcast position with the emergency radio transmitter in the life raft. Effort should be made to keep the raft within the area from which the last pre-ditching broadcast was made.

NIGHT DITCHING PROCEDURE.

Advise crew members of the possibility of ditching. Use pre-ditching procedures listed in this section.

If electrical power is available, turn on all navigational and interior lights that will not blind the pilot, drop parachute flares and use landing lights to examine the sea surface. If conditions are favorable, choose a ditching heading as recommended in Open Sea Landings, Section II. After ditching heading is established, release float lights in a straight line pattern. Float lights burn for approximately 40 minutes.

CAUTION

To prevent flooding, secure float light launcher watertight cover before landing.

If it is impossible to judge the sea conditions, head into the wind and use existing knowledge of the prevailing winds or a wind fix. Drop remaining parachute flares in line, turn and land alongside the flares and/or float lights.

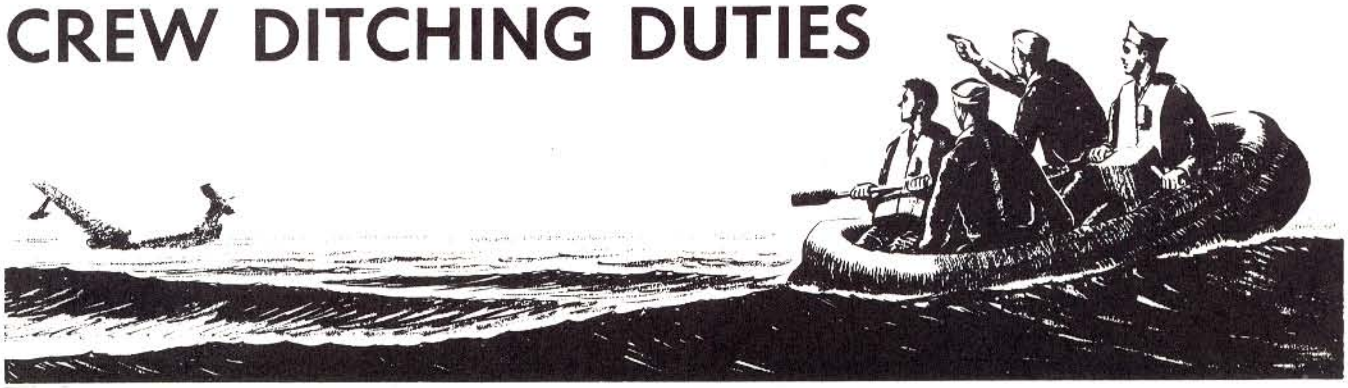
Hold the airplane level and make a normal instrument letdown at the lowest possible speed until water contact is made.

On landing approach, lower wing flap full 40° and maintain at least 100 knots airspeed, dependent upon gross weight.

The trailing antenna full out will aid in judging the height while leveling off. The radio operator will inform the pilot when the trailing antenna grounds out.

Use normal landing technique procedures and hold airplane within its stable hydrodynamic range limits of 3° to 15°.

CREW DITCHING DUTIES



Duty	After Ditching	Ditching Position	Exit
PILOT			
1. Give "Prepare For Ditching order to crew on interphone.	Supervise securing emergency equipment and life raft.	Pilot Seat	Overhead escape hatch.
Sound aural warning signal (on airplanes No. 135531 and subsequent as delivered and on airplanes No. 135474 through 135530 after service change.)	Ascertain that all crew members are accounted for. **Have rafts tied together. Assume command of rafts.		
2. Turn main hydraulic pumps "ON".			
3. Turn hydraulic surface booster pumps "ON".			
4. Salvo internal and external stores. Close bomb bay doors.			
5. Direct radio operator to transmit distress signal and position report.			
6. Direct crew to jettison loose or unnecessary equipment.			
7. Lower flaps.			
8. Fasten safety belt and shoulder harness.			
9. Order "Brace for Crash" at minimum of 50 feet.			
10. Accomplish ditching landing.			
CO-PILOT			
1. Relay instructions for ditching from pilot to crew (by interphone) and keep pilot advised of crew preparation status.	Assist as directed by pilot.	Co-Pilot Seat	Overhead escape hatch.

Duty	*After Ditching*	*Ditching Position*	*Exit*
2. Jettison all fuel except that in service tanks. Retain bomb bay tanks for buoyancy.			
3. Shut down engines with idle cut-off.			
4. Assist pilot as directed.			
5. Open and secure overhead escape hatches.			
6. Fasten safety belt and shoulder harness.			
7. Perform approach duties as directed by pilot.			
NAVIGATOR			
1. Acknowledge "Prepare For Ditching" order.	Provide celestial navigation aids and binoculars. Provide flashlight.	*Forward ditching position on flight deck.	Flight deck escape hatch.
2. Determine position and advise radio operator.		**Navigator's seat.	
3. Direct jettisoning of expendable equipment.			
4. *Assume ditching position next to radar operator. **Return to regular station, face seat aft, and fasten safety belt.			
RADAR OPERATOR			
1. Acknowledge "Prepare For Ditching" order.	**Launch and inflate life raft (stowed on flight deck).	*Forward ditching position on flight deck next to Navigator.	Flight deck escape hatch.
2. Shut down equipment.			
3. *Align seat with navigator's seat (both facing forward); attach ditching board across back of seats.		**Radar operator's seat.	
4. Assist in jettisoning expendable equipment and ditching preparations.			
5. **Assume ditching position, face aft, and fasten safety belt.			
RADIO OPERATOR			
1. Acknowledge "Prepare For Ditching" order.	Operate emergency radio transmitter in raft.	Radio Operator's Seat.	Flight deck escape hatch.
2. Transmit emergency signal and position reports as directed by pilot.			
3. Start APU; provide a-c and d-c power for flight and engine control circuits.			

Duty	*After Ditching*	*Ditching Position*	*Exit*
4. Position a-c and d-c panel control switches for ditching. 5. Face seat aft, fasten safety belt.			
PLANE CAPTAIN			
1. Acknowledge "Prepare For Ditching" order. 2. Assist with ditching preparations and supervise collection of emergency gear. 3. **Install ditching board, seat cushion and safety belt in pilot house doorway. 4. Assume ditching position and fasten safety belt.	Assist with life raft handling. Assist any injured crew member. Provide water breaker.	**Ditching Position atop steps to pilot house.	Flight deck escape hatch.
RCM OPERATOR			
1. Acknowledge "Prepare For Ditching" order. 2. Shut down equipment. 3. *Install electronic equipment ditching net. Install ditching board and RCM seat cushion on floor of flight deck aft of stairwell guard rail. Lock RCM operator's seat back to back with Radio Operator's seat.	**Place emergency radio transmitter and food container in life raft (these items are stowed on flight deck). Provide signal pistol and cartridges. Provide First Aid Kit.	*Left side of plane aft of stairwell guard rail on flight deck. **RCM Operator's seat.	Flight deck escape hatch.
TAIL GUNNER			
1. Acknowledge "Prepare For Ditching" order. 2. Secure turret. 3. *Install aft ditching net, seat cushion and safety belt in passageway at station 873. 4. Assist in ditching preparations. 5. Assume ditching position facing aft and fasten safety belt.	Close APU fuel valve in fwd waist compartment. Launch and inflate life raft and secure it to airplane near waist hatch. Place emergency radio transmitter in raft. Provide flashlight.	*Ditching position on floor in doorway in aft end of waist compartment.	Waist hatch.
BEAM OBSERVERS			
1. Acknowledge "Prepare For Ditching" order. 2. Assist with jettisoning and ditching preparations. 3. **Return to seat; face aft and fasten safety belt.	Assist with life raft. Place emergency food container in raft.	**Ditching bulkhead. Beam observer's seats.	Waist hatch.

Duty	*After Ditching*	*Ditching Position*	*Exit*
ADDITIONAL CREW MEMBERS			
1. Acknowledge "Prepare For Ditching" order.	Assist as directed. Provide First Aid Kit.	**Net seats in forward waist compartment (for two men).	Waist Hatch
2. *Assist with installation of ditching pads, seats, head-rests and safety belts on aft side of bulkhead station 679 in aft waist compartment. **Install net ditching seats and safety belts at stations 571 and 635 in forward waist compartment.	Provide parachute.	*Aft side of bulkhead at station 679 in aft waist compartment (for four men).	
3. Assist with ditching preparations and jettisoning as directed.			
4. **If necessary to remove side waist hatches, remove quick release pins.			
5. Occupy vacant ditching positions and fasten safety belts.			

*On airplanes No. 135474 through 135535 as delivered. (Interim ditching provisions, figure 3–1A.)

**On airplanes No. 135536 and subsequent as delivered and on airplanes No. 135474 through 135535 after service change No. 354. See figure 3–1B.

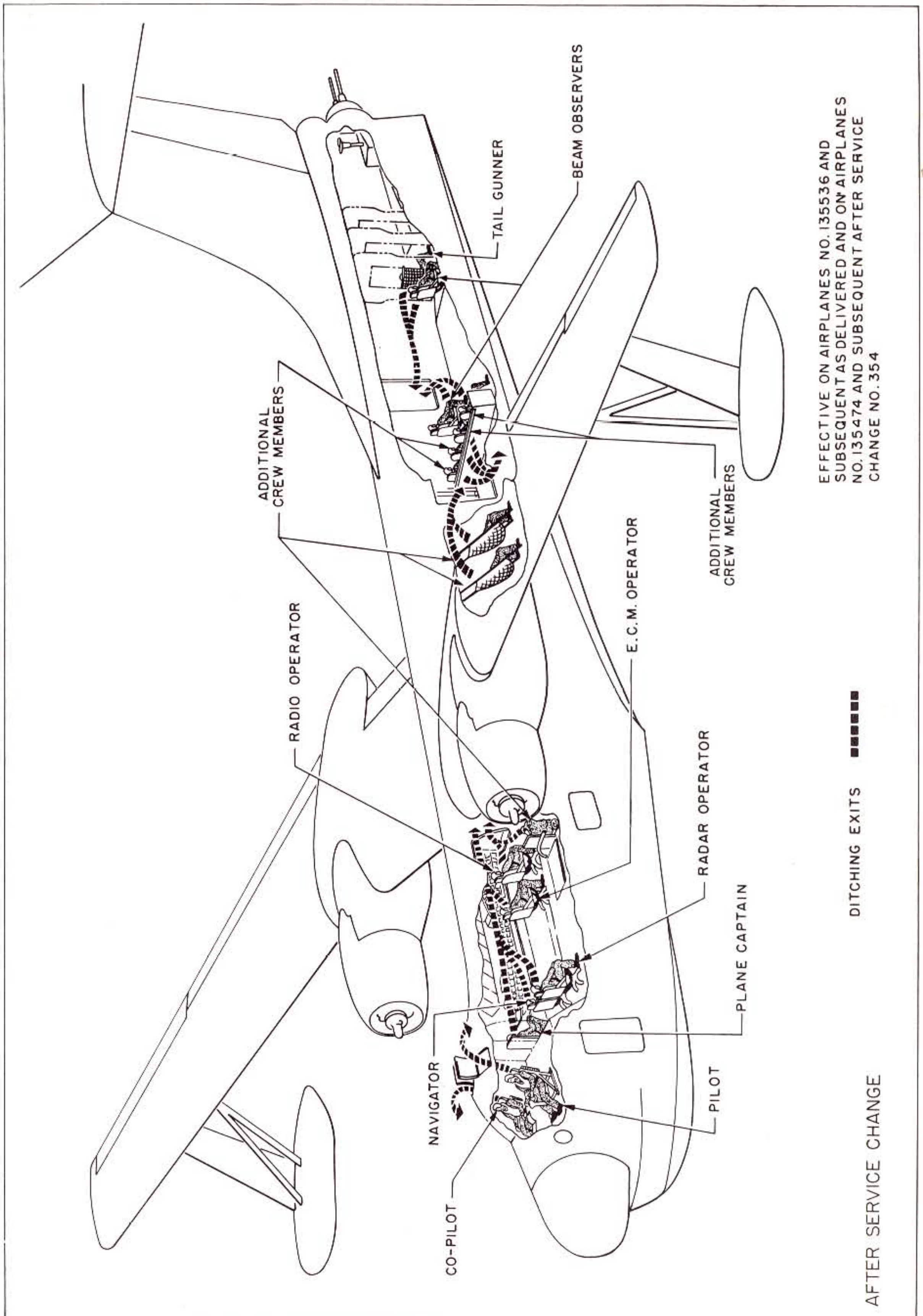


Figure 3-3. Emergency Exits.

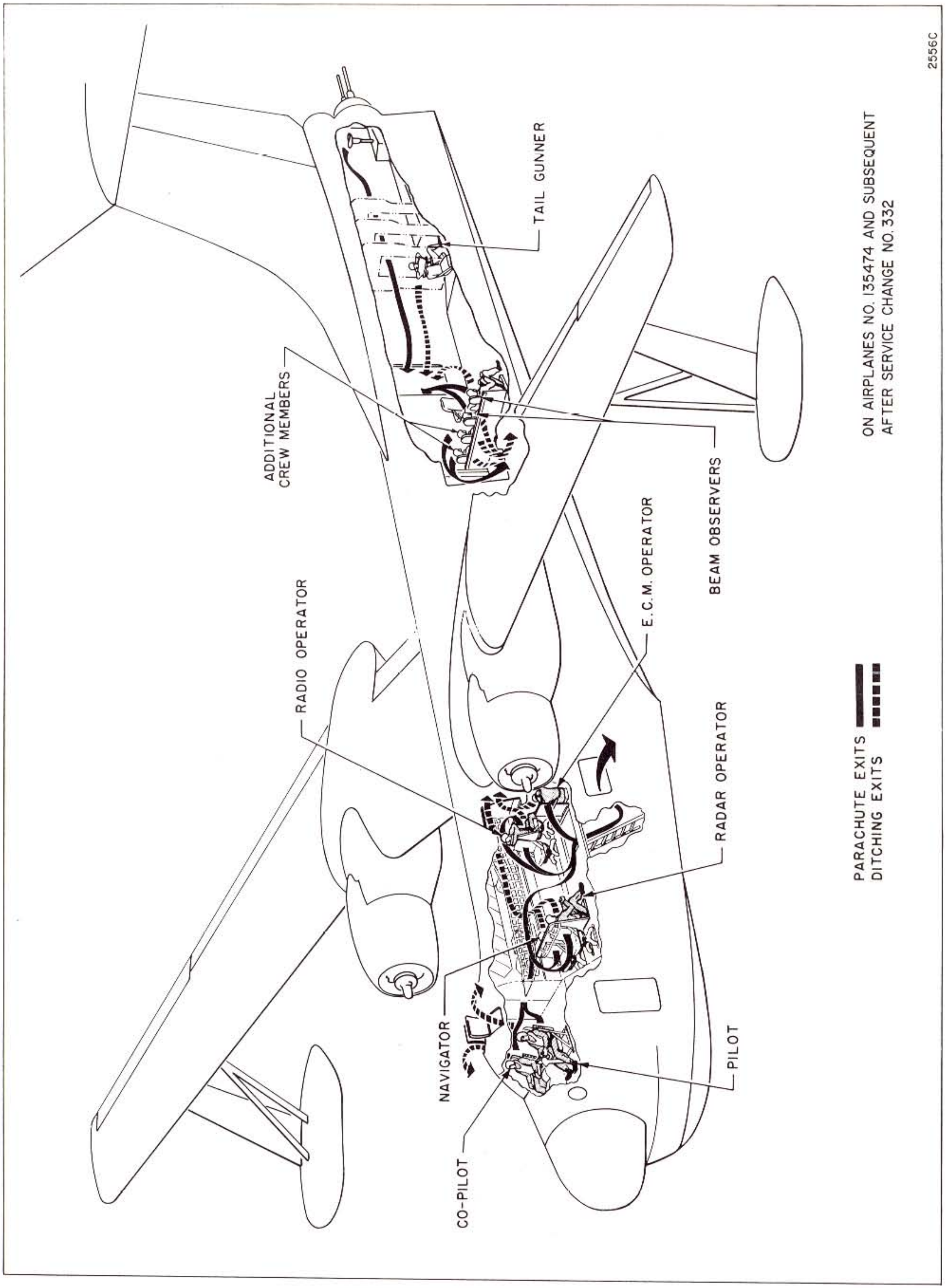


Figure 3-3A. Emergency Exits

EMERGENCY FUEL USAGE. (See figure 3-4.)

Fuel consumption for single engine operation is of extreme importance to the pilot, and its carefully regulated usage deserves repeated emphasis. As an example, the airplane range when flying single engine is roughly half the range of that attainable with both engines operative. This is because fuel flow quadruples (approximately) if power is doubled on an engine, starting from cruise power, (see Appendix I, figures A-24 through A-33 of AN 01-35EJB-1A). If the airplane was flying heavy when a single engine emergency occurred, an over-laboring engine or loss of altitude would necessitate a rapid reduction in gross weight some of which might be jettisonable fuel. Depending on the stage of flight when fuel is jettisoned, range to base may be seriously affected by the increased rate of fuel consumption due to single engine operation. The pilot should be fully cognizant at all times of the fuel required to return to base should engine failure occur at any moment.

EMERGENCY COURSE OF FUEL USAGE. (See figure 3-4.)

SINGLE ENGINE OPERATION.

Assuming that one engine is inoperative and:

- Bomb bay tanks' fuel has been jettisoned
- Auxiliary tank's fuel has been jettisoned

Fuel is transferred to the operating engine by:

- Normal hull tank selection to the service tank.
- Crossfeed from the opposite service tank.
- Turn inoperative engine valve switch OFF.
- Turn inoperative engine Service Tank Booster Pump Switch ON.
- Turn No. 1 and No. 2 Crossfeed Valve Switch ON.

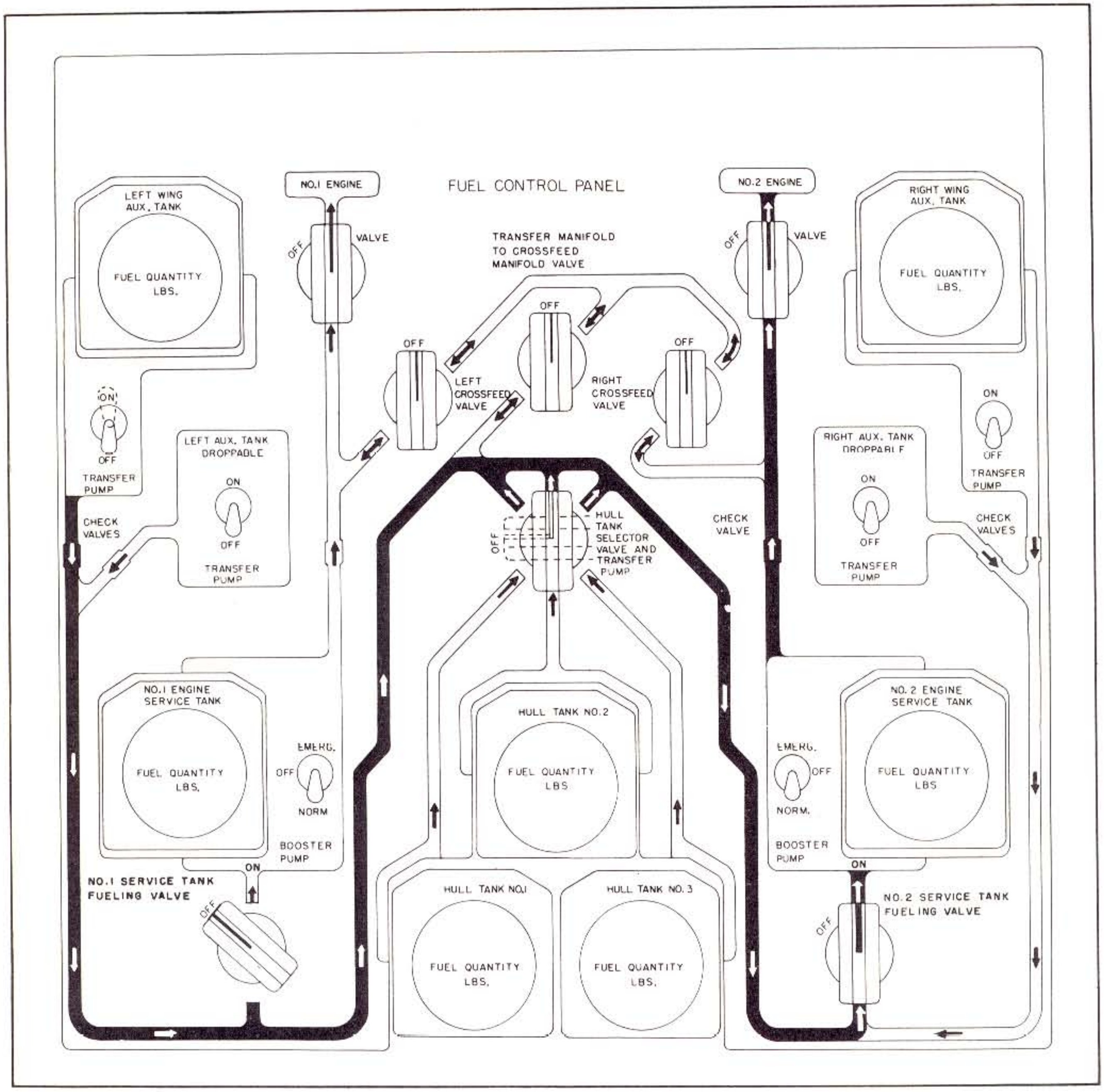


Figure 3–4. Emergency Course of Fuel Flow Diagram

Turn LEFT and RIGHT Transfer Valve Switches "OFF".

FROM THE LEFT WING TO THE RIGHT.

Assuming an arbitrary condition of crossfeed from the LEFT AUX. tank to the RIGHT SERVICE tank, proceed as follows:

Left Aux. Tank Transfer Pump Switch	"ON"
Left Transfer Valve Switch	"OFF"
Hull Tank Selector Switch	"OFF"
No. 1 Engine Crossfeed Valve Switch	"OFF"
Cross Feed Manifold Valve Switch	"OFF"
No. 2 Engine Crossfeed Valve Switch	"OFF"
Right Transfer Valve Switch	"ON"

EMERGENCY FUEL MANAGEMENT.

To Jettison the Bomb Bay Tanks:
Drop by using the bomb system

To Jettison Fuel from the Aux. Wing Tanks:
JETTISON Switch "ON"

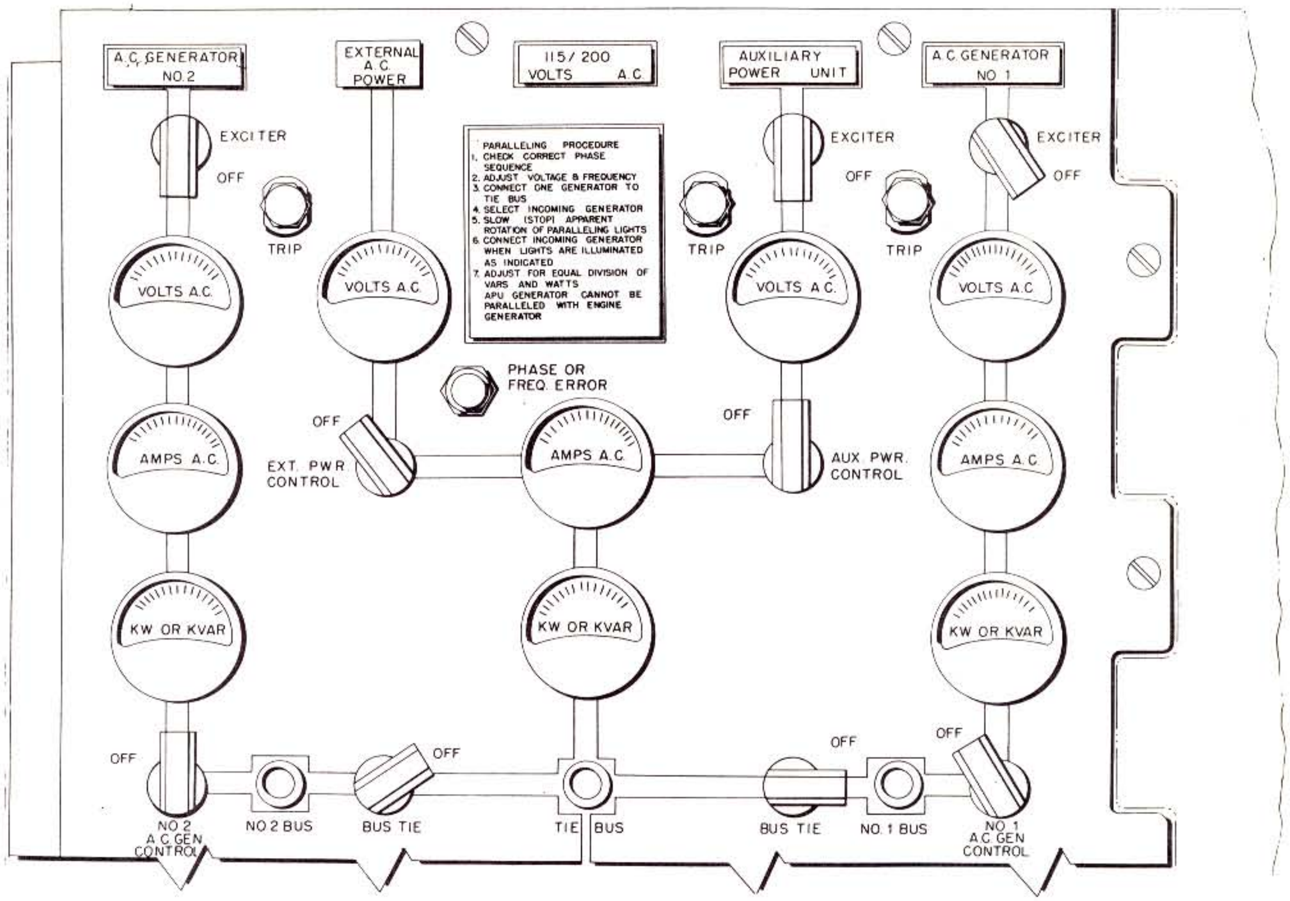


Figure 3–5. Radio Operator's A-C Control Panel—Before Landing, with No. 1 Engine Inoperative

LEFT TRANSFER VALVE switches	OFF
CROSS FEED VALVE switches	OFF
BOOST PUMPS	ON

To Jettison Fuel from the Hull Tanks:

JETTISON switch	ON
Selected HULL TANK valve switch	ON

EMERGENCY FUEL HAND PUMP.

Using the fuel control valve manual overrides, select the flow desired and operate the manual pump to pump fuel from all three hull tanks.

EMERGENCY HYDRAULICS.

To switch over from one surface control booster pump to the other, the switches on the pilot's sub-panel (68 and 69, figure 1–5) will be operated as follows:

Inoperative pump switch	OFF
Remaining pump switch	ON

In the event of a fault in one of the main hydraulic system pumps, the other pump is selected by operation of the switches on the pilot's sub-panel (74 and 75, figure 1–5) as follows:

Inoperative pump switch	OFF
Remaining pump switch	ON

In the event of turret hydraulic failure, the manual hand cranks will be operated.

Emergency opening of the bomb bay doors is accomplished by positioning the EMERGENCY BOMB BAY DOORS open switch on the pilot's console to OPEN.

If the normal bomb bay door control will not close the bomb bay doors, the emergency hydraulic hand pump, located near the Marine Marker Launcher, must be operated to close the doors.

Refer to Section IV BOMB BAY DOOR CONTROLS.

EMERGENCY ELECTRICAL A-C.

There are no essential or monitored bus provisions in the A-C or D-C electrical power distribution systems. Should a loss of one or more of the primary power sources occur, secure all nonessential equipment to prevent overloading the remaining power units.

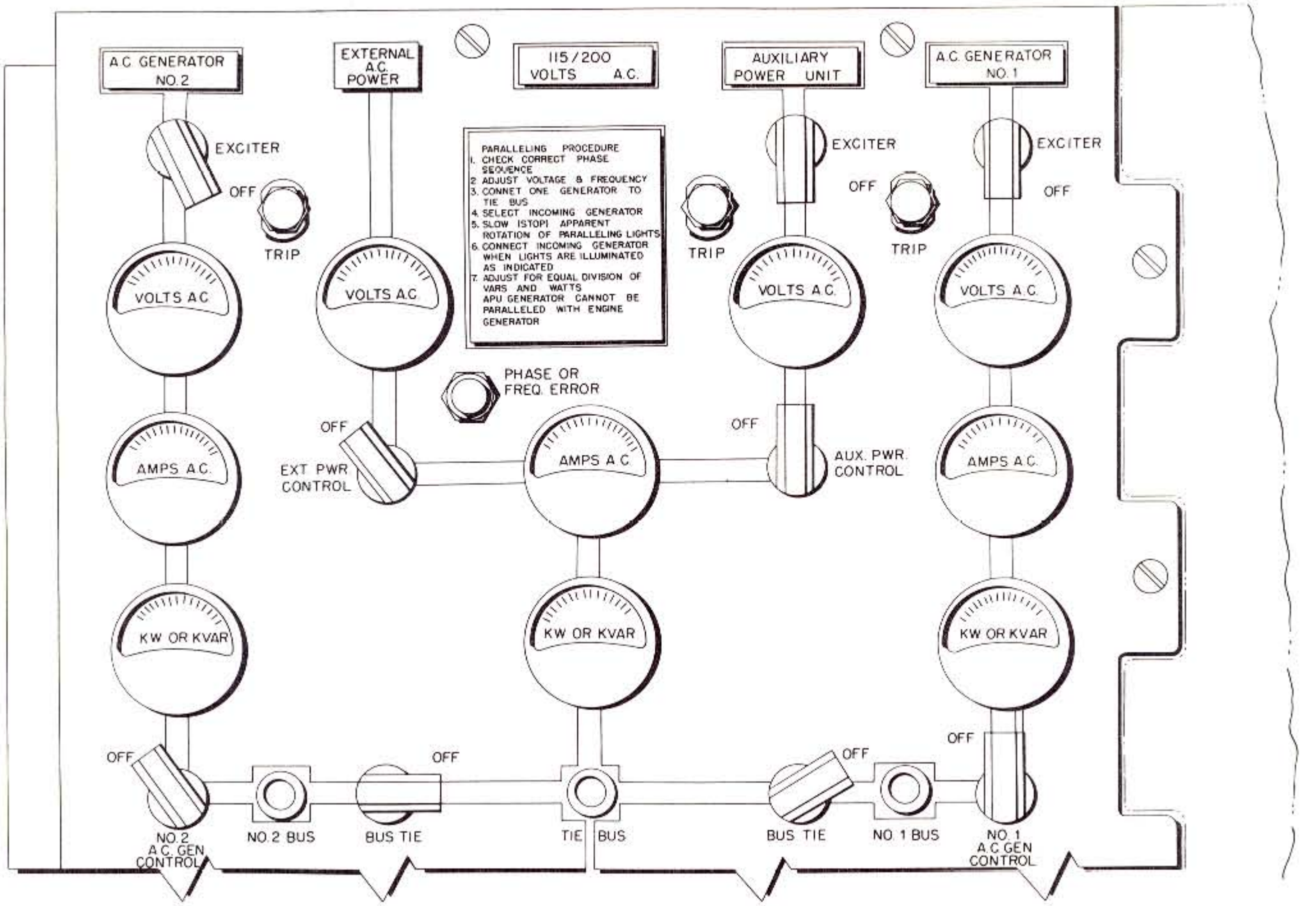


Figure 3–6. Radio Operator's A-C Control Panel—Before Landing, with No. 2 Engine Inoperative

Protective elements integral to the a-c electrical system will protect the system in event of an overload or short circuit.

BEFORE LANDING, with No. 1 engine inoperative, start APU and position a-c control panel switches in the following sequence: (See figure 3–5.)

No. 2 Bus Tie	"OFF"
No. 2 Exciter	"ON"
No. 2 Gen Control	"ON"
No. 1 Bus Tie	"ON"
No. 1 Exciter	"OFF"
No. 1 Gen Control	"OFF"
APU Exciter	"ON"
Aux Pwr Control	"ON"

BEFORE LANDING, with No. 2 engine inoperative, start APU and position a-c control panel switches in the following sequence: (See figure 3–6.)

No. 1 Exciter	"ON"
No. 1 Gen Control	"ON"
No. 1 Bus Tie	"OFF"
No. 2 Bus Tie	"ON"
No. 2 Exciter	"OFF"
No. 2 Gen Control	"OFF"
APU Exciter	"ON"
Aux Pwr Control	"ON"

BEFORE LANDING, with both a-c engine generators inoperative, start APU and position a-c panel control switches in the following sequence:

APU Exciter	"ON"
APU Gen Control	"ON"
No. 1 Bus Tie	"ON"
No. 2 Bus Tie	"ON"
No. 2 Exciter	"OFF"
No. 2 Gen Control	"OFF"
No. 1 Exciter	"OFF"
No. 1 Gen Control	"OFF"

When a DITCHING landing has been determined, position the a-c control panel switches as shown in Figure 3–8.

On SINGLE ENGINE flight position the a-c control panel switches as shown in Figure 3–8.

EMERGENCY ELECTRICAL D-C.

There are no essential or monitored bus provisions in the A-C or D-C electrical power distribution systems. Should a loss of one or more of the primary power sources occur, secure all nonessential equipment to prevent overloading the remaining power units.

Protective elements integral to the d-c electrical system will protect the system in event of an overload or short circuit.

In an emergency, the d-c generators can be removed from the bus by the use of its corresponding EMERGENCY CUT-OUT switch, on the radio operator's d-c panel. This opens the reverse current circuit breaker in the main power center, which must be reset manually before power can be restored to the bus through the EMERGENCY CUT-OUT switch.

BEFORE LANDING, with No. 1 engine inoperative, position d-c panel control switches as follows:

No. 2 Gen Control	ON
No. 1 Gen Control	OFF
Converter Control	ON
Battery Control	ON

BEFORE LANDING, with No. 2 engine inoperative position d-c panel control switches as follows:

No. 1 Gen Control	ON
Converter Control	ON
No. 2 Gen Control	OFF
Battery Control	ON

BEFORE LANDING with BOTH d-c generators inoperative, position d-c panel control switches as follows:

Battery Control	ON
Converter Control	ON
No. 1 Gen Control	OFF
No. 2 Gen Control	OFF

When a DITCHING landing has been determined, position the d-c control panel switches as shown in Figure 3-8.

On SINGLE ENGINE flight, position the d-c panel control switches as shown in Figure 3-8.

CAUTION

D-C generator voltage/equalizing adjustments are maintenance adjustments and should not be altered in flight except in an emergency. Failure of the generators to equalize the load closely should not be considered a flight emergency. Such action would normally be justified in flight only if the overload of one generator was imminent due to faulty equalizing. The voltage control adjustment should never be used for load equalizing adjustments.

EMERGENCY FLIGHT CONTROL SYSTEM.

AUTOPILOT DISENGAGEMENT.

If the autopilot fails, or malfunctions, it can be disconnected immediately by depressing the AUTOPILOT temporary disconnect button on either pilot's control wheel (figure 1-3). For normal failures, however, the autopilot should be mechanically disengaged by pulling out the autopilot emergency release handle on the cockpit pedestal.

EMERGENCY RUDDER AND AILERON TRIM.

If either the rudder or aileron trim switches (figure 1-3) malfunction because of electrical failure, both flight controls can be trimmed manually as follows:

Rudder Trim:

a. Send a crew member aft to the tail compartment to rotate the rudder trim hand crank.

b. Crew member will use the interphone to receive instructions from the pilot.

c. Rotate the hand crank in the respective direction (marked above the crank) the number of degrees directed by the pilot.

Aileron Trim:

Same as Rudder Trim paragraph. The aileron trim control is mounted on the crown of the forward waist compartment.

FLIGHT CONTROL HYDRAULIC BOOST FAILURE.

If the hydraulic surface boost system fails, the rudder and/or elevator controls can be disconnected by closing the corresponding boost switch on the cockpit overhead panel. To regain normal hyrdaulic control, the respective boost disconnect must be reset manually. If manual disconnect is desired, a lever on each hydraulic boost unit can be used. (See figure 1-14A.)

Elevator Boost Disconnect:

a. Push end of lock pin solenoid arm to right.

b. Move red lever aft to disconnect hydraulic boost.

Rudder Boost Disconnect:

a. Move red lever forward to disconnect hydraulic boost.

If the boost system fails, a maximum force of approximately 60 pounds is required to move the elevators, depending on the rapidity of retrimming the elevators. There is sufficient trim available with loss of boost to provide adequate control in the landing approach, even during flare-out, where forces are comparatively high.

Note

Under extended flight conditions, the boost pumps run continuously without pumping against a load. Whenever the boost system is pumping against a load, the boost pumps should be used intermittently by switching from Flight Boost Pump No. 1 to No. 2 and vice-versa approximately every 30 minutes. Intermittent use will equalize wear on the pumps.

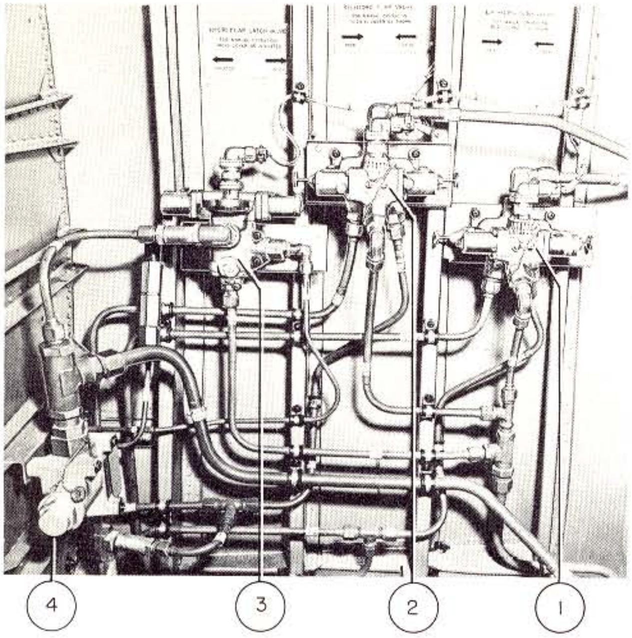
SPOILER-AILERON FAILURE.

If the spoiler-ailerons fail, adequate bank control is still available with the ailerons during normal flight.

OPERATION	A-C SWITCHES					D-C SWITCHES			
	A-C GEN No. 2	BUS TIE No. 2	A-C GEN APU	BUS TIE No. 1	A-C GEN No. 1	BATTERIES	D-C GEN No. 1	D-C GEN No. 2	CONVERTER
FAILURE OF APU									
TAXI	*Exciter ON Control OFF	ON	Exciter OFF Control OFF	ON	Exciter ON Control ON	Control ON	Control ON	Control ON	Control ON
FLIGHT	Exciter ON Control ON	ON	Exciter OFF Control OFF	ON	Exciter ON Control ON	Control ON	Control ON	Control ON	Control ON
SINGLE ENGINE OPERATION									
FLIGHT Eng. No. 1 Operative.	Exciter OFF Control OFF	ON	Exciter ON Control ON	OFF	Exciter ON Control ON	Control ON	Control ON	Control OFF	Control ON
Eng. No. 2 Operative.	Exciter ON Control ON	OFF	Exciter ON Control ON	ON	Control OFF Exciter OFF	Control ON	Control OFF	Control ON	Control ON
BOTH ENGINES OPERATIVE, INOPERATIVE OR SINGLE ENGINE OPERATION									
DITCHING	Exciter OFF Control OFF	ON	Exciter ON Control ON	ON	Exciter OFF Control OFF	Control OFF	Control OFF	Control OFF	Control ON
FAILURE OF APU DURING SINGLE ENGINE OPERATION									
FLIGHT AND TAXI Eng. No. 1 Operative.	Exciter OFF Control OFF	ON	Exciter OFF Control OFF	ON	Exciter ON Control ON	Control ON	Control ON	Control OFF	Control ON
Eng. No. 2 Operative.	Exciter ON Control ON	ON	Exciter OFF Control OFF	ON	Exciter OFF Control OFF	Control ON	Control OFF	Control ON	Control ON
FAILURE OF DC GENERATORS AND CONVERTERS									
TAXI	Exciter OFF Control OFF	ON	Exciter ON Control ON	ON	Exciter OFF Control OFF	Control ON	Control OFF	Control OFF	Control OFF
FLIGHT	Exciter ON Control ON	OFF	Exciter ON Control ON	ON	Exciter ON Control OFF	Control ON	Control OFF	Control OFF	Control OFF
FAILURE OF AC GENERATORS AND APU									
FLIGHT AND TAXI	Exciter OFF Control OFF	OFF	Exciter OFF Control OFF	OFF	Exciter OFF Control OFF	Control ON	Control ON	Control ON	Control ON

NOTE:
*During TAXI operation, position engine generator exciter switch "OFF" if engine speed drops below 850 RPM for any period of time, to prevent damage to the transformer in the Constant Speed Drive junction box.

Figure 3–8. Radio Operator's A-C and D-C Control Panels—Emergency Switch Positions



1 Valve, Hydroflap Circuit—Left
2 Valve, Hydroflap Circuit—Right
3 Valve, Hydroflap—Latch
4 Valve, Hydroflap—Relief

Figure 3–7. Hydroflap Emergency Control Valves

EMERGENCY OPERATION OF HYDROFLAPS.

In the event of electrical failure in the hydroflap circuit, or in the circuit to the control valves only, it is possible to operate the hydroflaps by manual control, provided this procedure is followed by qualified personnel only. Maneuvering the airplane on water by manual hydroflap control requires close coordination between pilot and crew. The pilot must communicate his instructions, by interphone, to personnel stationed at the depressurizing valve in the forward waist compartment and at the hydroflap control panel in the hydraulic compartment (figure 3–7) so crewmembers can operate the levers on the valves in accordance with his directions.

To operate the hydroflaps manually during an electrical failure in one or more of the control valve circuits:

a. Hydroflap Control Switch—TAXI.

b. Remove electrical plugs from control valves.

Note

So long as there is electrical power to the depressurizing valve, the hydraulic lines can be pressurized by placing the control switch in TAXI . Since the control valves operate in conjunction with the action relay and bridge circuits when energized by the control switch, it is necessary to prevent electrical operation of the valves(s) not at fault by removing plugs from the right, left, and latch hydroflap control valves.

c. Move latch lever to UNLATCH to unlock both hydroflaps. (figure 3–7.)

d. Depress individual hydroflap plungers (marked OPEN) as directed by the pilot. To stop flaps in any intermediate position, release plunger.

To close and lock the hydroflaps:

a. Depress each hydroflap plunger (marked CLOSE) until flaps are fully closed.

b. Move latch lever to LATCH to lock hydroflaps in closed position.

EMERGENCY OPERATION OF BOMB BAY DOORS.

The following method may be used to operate the bomb bay doors if the main hydraulic pumps become inoperative.

Place the emergency bomb bay door switch, on the pilot's console, (14 Figure 4–6) in BOMB BAY DOORS EMERG position. This action will open the emergency bomb bay door control valve and hydraulic accumulator pressure will open both bomb bay doors. To close the bomb bay doors it is necessary to manually operate the emergency close valve and hand pump in the waist compartment. (17, 19 Figure 1–17). On airplanes No. 135513 and subsequent on delivery and on 135474 to 135512 after service change, the emergency hand pump may also be used for pressure when needle valve "A" (to emergency bomb close valve) is opened and needle valve "B" (to main hydraulic system) is closed. (See Figure 1–17). The normal system may be used with hand pressure thus permitting the pilot to control the valves while a crew member operates the pump.

Note

Place the emergency close valve in normal position before reverting to the normal system.

EMERGENCY HAND PUMP OPERATION OF MAIN HYDRAULIC SYSTEM.

On airplanes No. 135513 and subsequent on delivery and on 135474 to 135512 after service change, any part of the main hydraulic system may be operated by pressure from the hand pump. This may be done by opening needle valve "B", closing needle valve "A", and using the hand pump. These placarded valves and pump are on the left side of the forward waist compartment.

EMERGENCY OPERATION OF WING FLAPS.

In case of failure of the electrical control circuit, the wing flaps may be actuated manually. A handle on the wing flap hydraulic valve, when rotated, pressurizes the wing flap circuit. The valve is in the waist compartment on the port side of the airplane. The hydraulic system can be operated by pressure from a hand pump in the forward waist compartment. There are no provisions for raising or lowering flaps if the hydraulic system fails.

SECTION IV
DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT

HEATING AND VENTILATING SYSTEM.
(See figure 4-1.)

GENERAL. There are three heating and ventilating systems in this airplane. One system serves the pilot's compartment and flight deck, another the left bomb bay, and a third the right bomb bay. The heating and ventilating systems are described in following paragraphs.

CABIN HEATING AND VENTILATING SYSTEM.

In flight, ram air is supplied to the system from an intake in the leading edge of the left center wing. When the system is operated, with ram air lacking, a pressure switch automatically causes a damper to move, shifting the inlet to within the fueling compartment and starts a blower (25, figure 4-1.)

In either case, the air passes through the 200,000 BTU per hour combustion heater (26, figure 4-1) and a system of ducts which distribute it to the pilot's compartment and flight deck for heating and/or ventilating, and to the pilot's windshield and side window panels for defogging or defrosting.

System operation is controlled by the selector switch (12, figure 1-13) on the pilot's aft control panel. This switch has four positions: OFF, VENT, AUTO and MAN. In the OFF position the entire system is shut down.

With the switch in the "VENT" position the heater does not operate. Ventilating air is supplied as a result of either ram or fan action.

The heater operates when the selector switch is in either the AUTO or MAN position. In both cases the heater must be started manually by operating the MASTER FUEL switch (30, figure 1-13) on the pilot's aft control panel.

When the switch is placed in the AUTO position, the cabin temperature control box (28, figure 4-1) at the aft end of the flight deck, automatically interprets the signals from a cabin thermostat in the forward end of the flight deck.

When the signals indicate that heat is required, the control box causes the heater fuel valve to open and the heater ignition unit to operate, thus starting the heater. When the signals indicate that sufficient heat is present, to satisfy the thermostat setting, the heater will be automatically shut off.

The MAN position of the selector switch by-passes the automatic features. Once started, the heater will continue to operate until shut off by moving the MASTER FUEL switch to the OFF position or by the automatic action of the Hi-Heat cycling thermo switch when duct temperature reaches 149°C (300°F).

In event the manual Hi-Heat cycling thermo switch fails to shut off the heater, when operating either MANUAL or AUTOMATIC control, the emergency over heat cut-off thermostat switch will open when the heater duct temperature reaches approximately 210°C (410°F), and shuts off the main heater fuel supply.

Fuel for the heater is obtained from the right hand service tank through a manual shut-off valve, a solenoid operated shut-off valve in the fuel trunk and a pump. Operation of the solenoid valve and pump is controlled by either the MASTER FUEL switch or automatically, dependent on the position of the selector switch. A fuel pressure gage, calibrated in psi, is provided on the aft flight deck bulkhead. This gage should normally show approximately 15 psi with the heater operating. If the pressure should drop to 10 psi, the LOW PRESSURE indicator light on the pilot's aft control panel will come on.

Electrical power to operate the cabin blower is supplied from the main three phase a-c cross tie bus through three fuses in the main power center. Electrical power to control the heater system is supplied from the main d-c bus through the cabin heater control (17, figure 1-13).

To operate the heater:

MASTER FUEL switch	START
LOW PRESSURE light	OUT
MASTER FUEL switch	ON
SELECTOR switch	AUTO or MAN
THERMOSTAT switch	SELECT

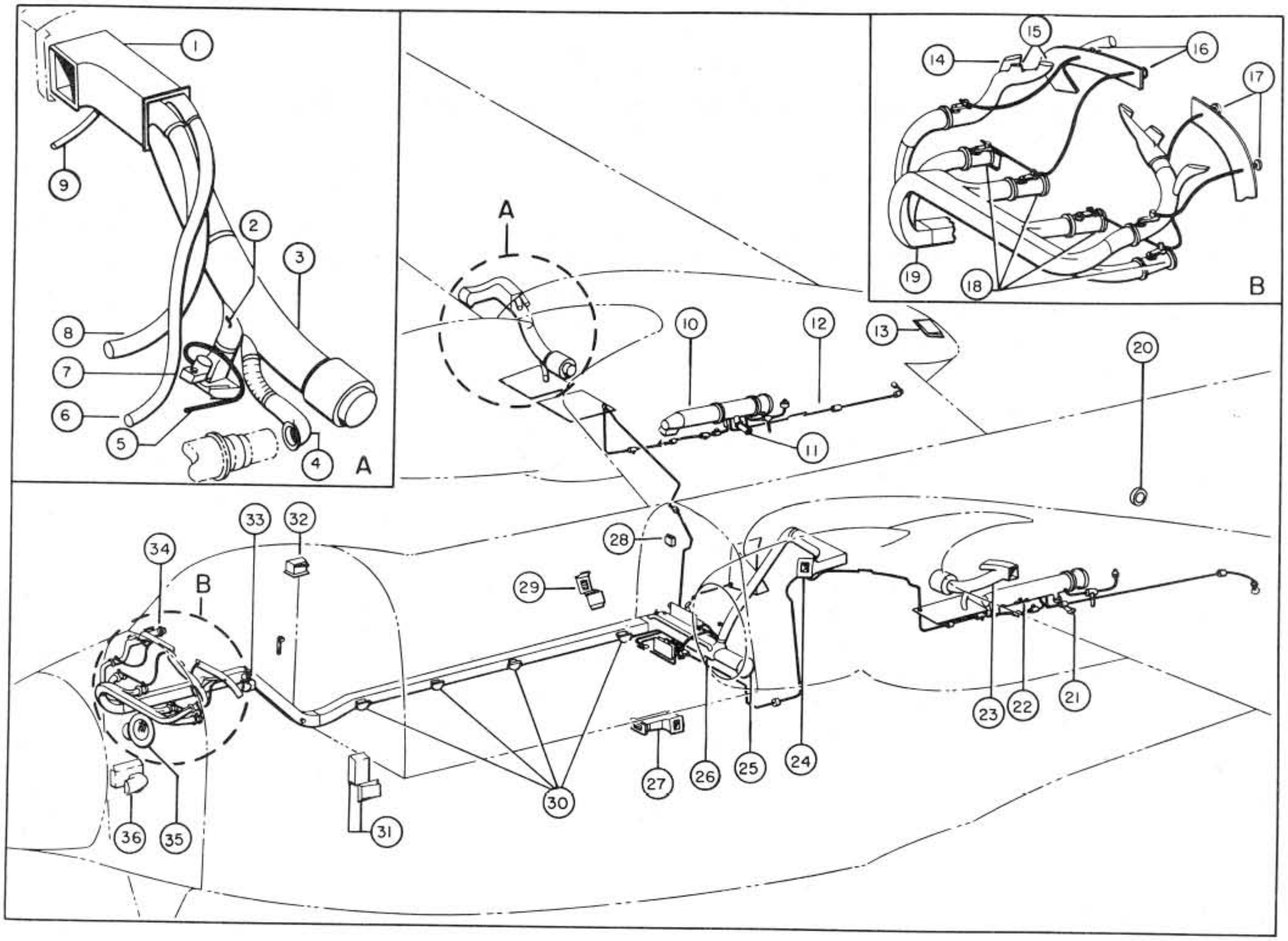
To ventilate:

MASTER FUEL	OFF
SELECTOR	VENT

BOMB BAY HEATING AND VENTILATING SYSTEM.

The bomb bay heating and ventilating systems in the left and right bomb bays are identical so the following description will apply to both. The bomb bay systems are provided to maintain the temperature in the bomb bays between 16°C (60°F) to 27°C (80°F) for the purpose of keeping certain armament stores in an operative condition. The system is automatic, controlled only by bomb bay ON-OFF temperature control switches on the navigator's armament panel (15, figure 4-4). When the control switch is in the OFF position, the systems will be inoperative and the air intake dampers will be closed.

When bomb bay air temperature gauge located on the navigator's armament panel indicates excessive temperatures, the navigator can ventilate the bomb bay



1 Duct, Ram Air Intake—R.H.S.
2 Duct, Bomb Bay Cooling
3 Duct Assembly, R.H. Nacelle
4 Duct to Constant Speed Drive
5 Duct to De-icer Pressure
6 Duct to De-icer Pump Shroud
7 Damper
8 Duct to D-C Generator
9 Drain Line, Ram Air Intake Duct
10 Heater Bomb Bay—R.H.S.
11 Exhaust, Bomb Bay Heater—R.H.S.
12 Drain Line, Bomb Bay Heater
13 Vent Nacelle
14 Duct, Side Window De-Fogging
15 Ducts, Windshield De-Fogging
16 Damper Controls, Co-pilot
17 Damper, Controls, Pilot
18 Ducts, Pilot's Compartment Outlet
19 Duct from Cabin Heater
20 Ventilator, Bunk
21 Exhaust, Bomb Bay Heater—L.H.S.
22 Heater, Bomb Bay—L.H.S.
23 Duct, Ram Air Intake—L.H.S.
24 Duct, Ram Air Intake, Cabin Heater
25 Blower, Cabin Heater
26 Cabin Heater
27 Vent, Galley
28 Control Box, Vapor Heating
29 Vent, Flight Deck
30 Outlets, Flight Deck
31 Vent, Electronic Compartment
32 Vent, Cockpit
33 Scoop Assembly, Cockpit Vent, Pilot's
34 Punkalouvre, Co-Pilot's
35 Exhaust Fan, Bow Compartment
36 Scoop Assembly, Bow Compartment

Figure 4–1. Heating and Ventilating Diagram

by placing the switch marked TEMP. CONTROL to ON. This operation will open the bomb bay ventilating air damper which then remains open until temperatures have been lowered to approximately 27°C (80°F) (temperature setting of ventilating control thermo switch.) If the bomb bay temperatures are below 16°C (60°F) and heater operation is required, the MASTER FUEL switch on the pilot's aft control panel (30, figure 1–13) must be turned ON in addition to the TEMP. CONTROL switch on the navigator's armament panel. The heater will continue to operate and cycle at approximately 93°C (200°F) until the heating control thermo switch is satisfied. An overheat red indicator light for each bomb bay is provided on the same panel as the temperature control switches. This overheat light will come on at approximately 132°C (270°F) if heater cycling switch fails. An overheat switch set at 149°C (300°F) will then shut down the heater. The heater will remain off until it cools down to 49°C (120°F) when the heater thermo switch will reclose and restart the heater if the control switch is still "ON". Located adjacent to the temperature control switches is a bomb bay air temperature selector switch which is operated to determine the bomb bay temperatures forward and aft.

Note

Bomb bay heater blowers will not operate when carrying bomb bay fuel tanks.

Electrical power to operate the bomb bay heaters is supplied from the main d-c bus No. 1 through two circuit breakers (Left and Right Bomb Bay Heater Control and Left and Right Bomb Bay Heater Ignition) on the navigator's distribution panel. Electrical power to operate the left and right bomb bay blowers is supplied from the main three phase a-c cross tie bus through fuses in the main power center.

To operate the bomb bay heaters:

Navigator's "TEMP. CONTROL" switch	"ON"
Pilot's "MASTER FUEL" switch	"ON"

To ventilate the bomb bays:

In flight, navigator's "TEMP. CONTROL" switch	"ON"
When moored, bomb bay doors	"OPEN"

WING AND TAIL DE-ICING SYSTEM.
(See figure 4-2.)

An electrically controlled, boot type de-icer system is installed to remove the ice formations from the leading edge of the wings, stabilizers and fin.

Two engine drive air pumps supply pressure to inflate the boots and two engine driven vacuum pumps supply suction to deflate and hold down the boots. When the system is turned off, the two pressure pumps exhaust overboard through a combination regulator, unloading valve and oil separator (2, figure 4-2). When the system is turned on, the combination unit directs the flow of air into a pressure manifold system, maintains 15 psi in the manifold system and exhausts excess air overboard. A pressure gage and a vacuum gage (22, and 21, figure 1-13) are installed in the pilot's aft control panel. The pressure gage is calibrated in psi and the vacuum gage is calibrated in inches of mercury.

The alternate inflation and deflation of the boots is controlled by the electronic timer (12, figure 1-13) on the pilot's aft control panel through seven solenoid operated distributor valves. There are three distribution valves for each wing and one for the empennage. Each valve controls one group of boots.

The timer operates the distributor valves in sequence at the intervals selected in setting the cycle selector control switch on the time panel. This switch has five positions: "OFF", "1", "2", "3", and "4". When placed in the "OFF" position the system is shut down. When placed in position "1" the system is turned on. When the adjacent "Single Cycle" push button is pushed in, the system will operate through one cycle in approximately 47 seconds and stop until the button is again pressed in. This position is normally used for light icing conditions.

Positions "2", "3", and "4" are automatic and do not require the use of the push button. Position "2" provides for a pause of 60 seconds betwen cycles, while position "3" operation is similar except that the pause is eliminated.

Under conditions where sufficient air pressure for normal operation is not available due to engine failure, altitude, position "4" may be selected. In this position continuous cycles are completed at a 50% extension of time.

When operating in positions "2", "3", or "4" the control switch must be moved to the "OFF" position to stop system operation.

The row of toggle switches along the bottom of the timer panel may be used to inflate individual groups of boots without interrupting a cycle. They may also be used in event of failure of automatic control. Two or more of these switches cannot be operated at one time.

Indicator lights, directly above the toggle switches, glow when the circuit is completed to their associated distributor valves. A light on the upper left portion of the timer panel is automatically turned on at any time the control switch is not in the "OFF" position.

Electrical power for operating the boot de-icing controls is supplied from the main d-c bus system through a circuit breaker on the radio operator's panel marked "DE-ICER BOOTS CONTROL".

MISCELLANEOUS HEAT AND VENTILATING.
(See figure 4-1.)

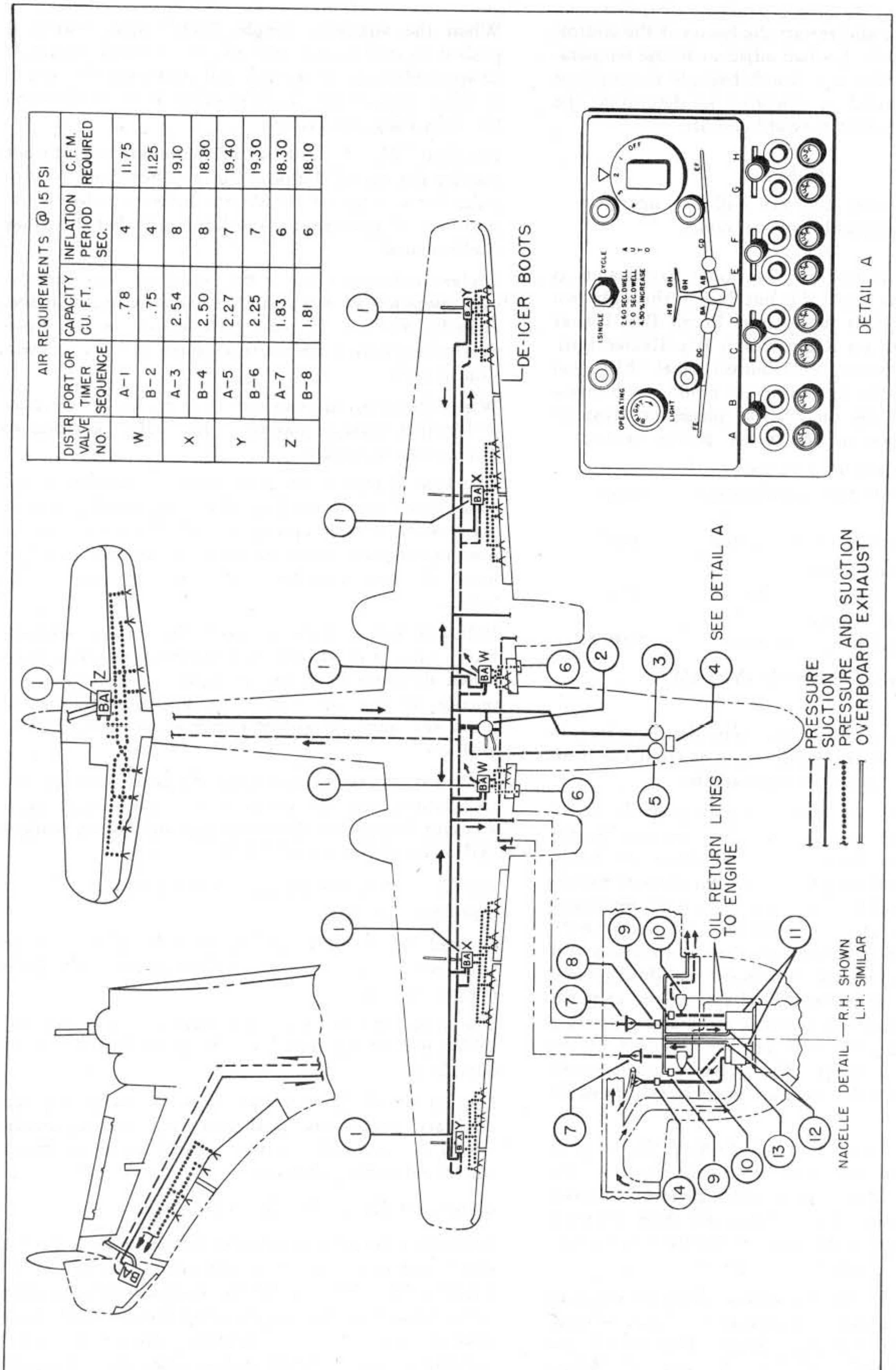
Located in the bow compartment is a scoop type ventilator which is opened in flight and must be closed before landing.

The pilot and co-pilot each have a "punka-louvre" which may be adjusted for a direct air blast from the outside air.

Located on the pilot's and co-pilot's sub-panels and auxiliary panels are push-pull type control knobs which are operated to obtain heated air to the windshield and to the pilot's feet.

WING DUCT DE-ICING. (See figure 4-2.)

Located in the left center wing leading edge is a cabin heater and accessory ram air duct protected by "ELECTRO-FILM". Located in the leading edges of each outer wing is an accessory cooling ram air duct. Each duct lip is covered with an electrically heated rubber de-icing blanket. The control switches for each system are on the pilot's aft control panel (13 and 14, Figure 1-13).



AIR REQUIREMENTS @ 15 PSI				
DISTR VALVE NO.	PORT OR TIMER SEQUENCE	CAPACITY CU. FT.	INFLATION PERIOD SEC.	C.F.M. REQUIRED
W	A–1	.78	4	11.75
	B–2	.75	4	11.25
X	A–3	2.54	8	19.10
	B–4	2.50	8	18.80
Y	A–5	2.27	7	19.40
	B–6	2.25	7	19.30
Z	A–7	1.83	6	18.30
	B–8	1.81	6	18.10

1 Valve, Distribution
2 Combination Regulator, Unloading Valve and Oil Separator
3 Gage, Suction
4 Timer, Electronic
5 Gage, Pressure
6 Spoiler
7 Valve, Check
8 Valve, Suction Relief
9 Valve, Safety
10 Separator, Primary Oil
11 Pump, Engine Driven
12 Plug, Fusible
13 Shroud, Cooling
14 Valve, Suction Relief

Figure 4–2. De-Icer System

Protective devices in this system will render the blankets inoperative unless sufficient ram air is present.

Power to control the system is supplied from the main d-c bus through two circuit breakers (left and right) on the pilot's aft control panel. Power for blanket operation is supplied from the main a-c bus through three circuit breakers on the main power center panel.

Normal Operation:

"LEFT DUCT DE-ICING" switch	"ON", the cabin heater and the left accessory duct blanket will heat up.
"RIGHT DUCT DE-ICING" switch	"ON", the right accessory duct blanket will heat up.

CAUTION

Do not attempt to hold the blankets on for any appreciable length of time or they will burn out.

PROPELLER DE-ICING SYSTEM.

Propeller de-icing is accomplished by resistance heater blankets installed on the leading edge of each propeller blade. Opposite blade heaters on each propeller are wired in series and each pair of heaters are connected to power through a separate fuse so that in event of failure of one heater its opposite heater will also be inoperative, thus keeping the propeller balanced at all times. A timer unit, located in the pilot's aft control box, is provided to alternate de-icing from one propeller to the other and to give an interval between each de-icing impulse.

Propeller de-icing is controlled by two switches (one for each propeller) located on the pilot's aft control panel (5, figure 1-13). Closing either de-icing control switch will cause the timer to operate and energize the corresponding propeller heater blankets in a cycle of 25 seconds on and 75 seconds off. Closing both de-icing control switches will cause the timer to operate and energize both sets of propeller heater blankets in the following cycle: one propeller on for 25 seconds, both off 25 seconds, other propeller on 25 seconds and both off 25 seconds. An ammeter is located on the pilot's aft control panel to give an indication of propeller de-icing current. The ammeter should indicate approximately 35 amperes when only two of the blade heaters of a propeller are operating and approximately 50 amperes when all four of the blade heaters of a propeller are operating.

Power to control this system is supplied from the main d-c bus through circuit breaker on the aft control panel. Power to operate this system is supplied from the main phase a-c cross tie bus and is converted from 3 phase to 2 phase 115 volt by scott-connected transformers in the main power center through seven fuses in the main power center.

OPERATION OF PROPELLER DE-ICING SYSTEM.

CAUTION

Do not operate the system unless the propellers are rotating, as permanent damage to the de-icing blankets may result.

To start system, place "PROPELLER DE-ICING" control switches on the pilot's aft control panel to "ON". Check ammeter indication.

To stop system, return the "PROPELLER DE-ICING" control switches to "OFF".

PITOT TUBE DE-ICER HEATERS.

The pitot tubes, one on each side of the cockpit, are electrically heated by means of heaters incorporated within the pitot tube unit. Heating of the pilot tube is required to prevent icing of the projecting tube during flight.

The heaters are controlled through two poles of the four pole pitot tube and stall warning transducer switch (the other two poles of this switch simultaneously control the stall warning heaters) on the pilot's aft control panel (4, figure 1-13). Power to operate the pitot heaters is supplied from the main a-c bus system through two pitot heater circuit breakers on the pilot's aft control panel.

CAUTION

Pitot tube heaters should not be on when there is no air stream flowing over them, as there is a possibility of burning out the elements.

STALL WARNING DE-ICER HEATER.

The stall warning heater, located inside the stall warning lift transducer, on the left outer wing, consist of an electrical heating element which will de-ice the detector vane area.

The heater is controlled by the pitot tube and stall warning transducer heater switch on the pilot's aft control panel. Power to operate the heater is supplied from the volt 28 d-c distribution bus No. 2 through a 5 ampere circuit breaker on the cockpit distribution panel.

Refer to Section II for operation of the Stall Warning De-Icer Heater.

WINDSHIELD WIPER AND ANTI-ICING SYSTEM.

The windshield wiper motors, under the windshield, operate the pilot's and co-pilot's windshield wiper. The motors are controlled by a rheostat, located on the pilot's and co-pilot's console (10, figure 4-3) which provides a selection of high, medium and low wiper speed, wiper parking and an "OFF" position.

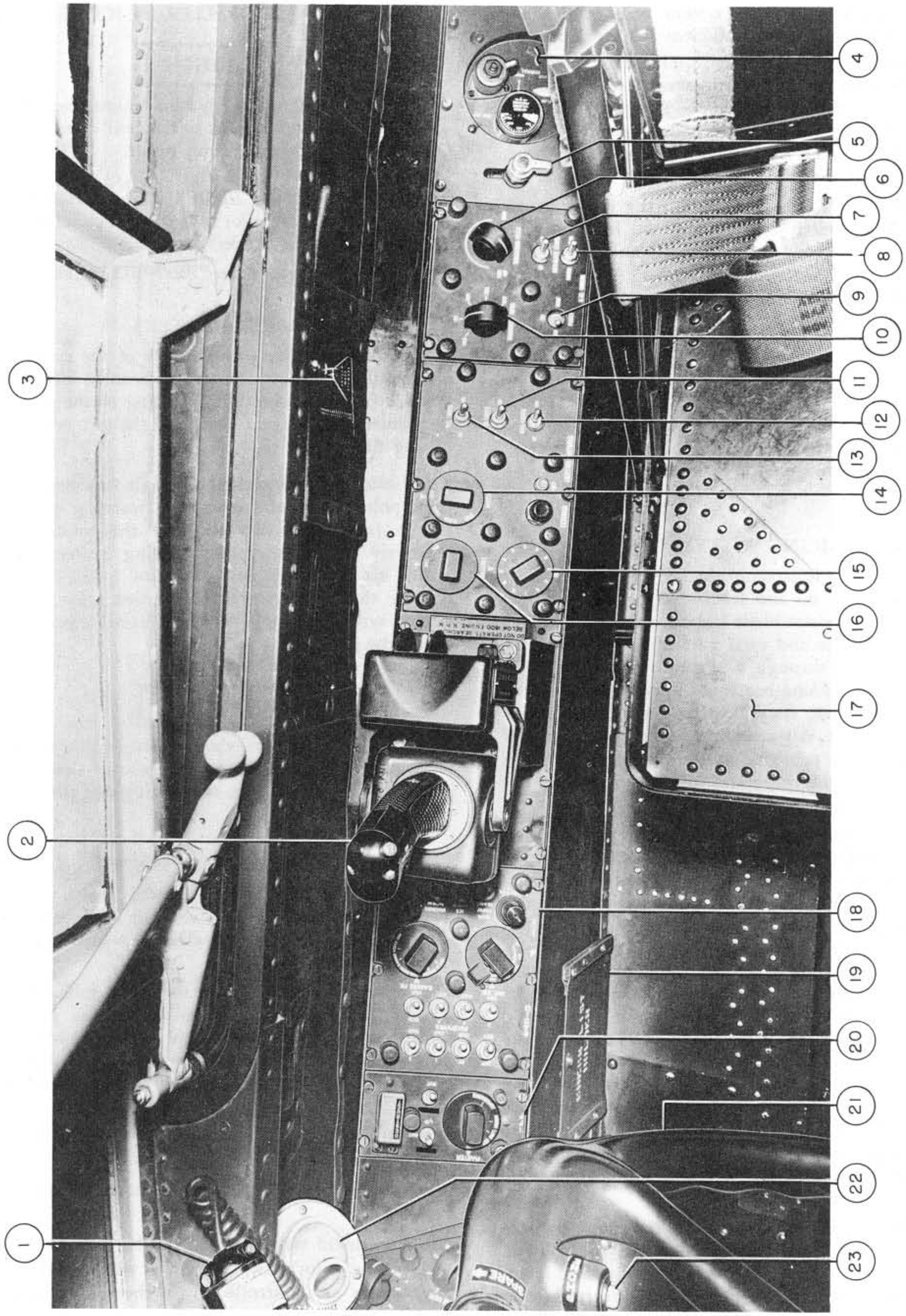


Figure 4-3. Co-Pilot's Side Console Panel

KEY TO FIGURE 4-3

1 C-4A Spot Light
2 Searchlight Controller
3 Oxygen Mask Stowage
4 Oxygen Regulator
5 Oxygen Main Supply Valve
6 Windshield Spray Rheostat
7 Anti-Glare Light Control Switch
8 Camera Control Switch, K-25
9 Camera Master Power Control Switch, K-25
10 Windshield Wiper Rheostat
11 Wing Lights Control Switch, Exterior Lighting
12 Hull Lights Control Switch, Exterior Lighting
13 Tail Lights Control Switch, Exterior Lighting
14 Master Control Switch, Exterior Lighting
15 Code Control Switch, Exterior Lighting
16 Brilliance Control Rheostat, Exterior Lighting
17 Co-Pilot's Seat
18 Radio and Inter-Communication Control Panel
19 Check List Holder
20 Identify Friend or Foe Control Panel
21 Aileron Control Wheel
22 Fresh Air Vent
23 Interphone Control Switch

When the wiper control switch is placed in PARK position, the windshield wiper motor will operate at medium speed until the wiper is actuated to a parking position. A mechanically actuated switch at the wiper motor will close, thereby stopping the wiper in the parked position.

The windshield anti-icing spray is used to partially de-ice the windshield or to clean the windshield in conjunction with the windshield wipers. The spray pump motor in the left forward end of the electronics compartment is controlled by a rheostat on the co-pilot's console. This rheostat, which has an OFF position, varies the pump motor speed, thereby varying the spray intensity.

Electrical power to operate the spray pump and wiper motors is supplied from the main 28-volt d-c bus No. 1 and bus No. 2 through separate circuit breakers on the cockpit distribution panel.

Operate the windshield anti-icing system as follows:

a. Turn windshield spray rheostat from slow to fast position until the desired spray intensity is obtained.

b. After ice has been softened by the spray, operate the wiper rheostat switch to either HIGH, MEDIUM or LOW speeds (depending on condition of ice formation).

c. To stop the spray, turn the windshield spray rheostat to OFF position.

d. To stop the wiper, turn the windshield wiper control switch to OFF position.

Note

The windshield wiper control switch must be returned to the OFF position upon windshield wiper parking.

e. Operating wipers too slow or on a dry windshield may stall the wipers, which may result in damage to the electric motor.

CAUTION

Do not operate windshield wiper on dry glass, as damage will result to wiper blades and to windshield surface. If wiper should stall, correct condition immediately to prevent damage to motor.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

AN/AIC-5B INTERCOMMUNICATION SYSTEM. The AN/AIC-5B intercommunication system provides general control of all radio equipment in addition to providing a means of communication between crew members. The pilot, co-pilot, and radio operator are provided with console control units while the remainder of the crew are provided with station control boxes. The interphone system is divided into two groups as follows:

FLIGHT CREW	*GUN CREW*
Pilot	Forward Entrance Compartment
Co-Pilot	Electronic Compartment
Radio Operator	Main Beaching Compartment
Radio Operator	Sonobuoy Compartment
Navigator-Bomber	Right Aft Entrance Hatch
RCM-MAD Operator	Left Aft Entrance Hatch
Tail Gunner	Tail Beaching Gear Hatch
Observer, Left and Right	Aft Waist Compartment

There are eight switches on each console control unit labeled COMMUNICATION which control the audio circuit of the receivers for that particular station. The receivers will be operating at all times but will be heard only when the switches on one of the console control units are in the up position. The switches marked "1" and "2" control the two AN/ARR-15 high frequency receivers; the switch marked "3" controls the radio operator's AN/ARC-5 low frequency receiver. Switches marked "4", SP1 and SP2 are not connected. Switch marked UHF controls the AN/ARC-27A transceiver. Switch marked BEACON controls the AN/ARN-12 marker beacon receiver. The PHONES switch is used in the event of an isolation amplifier failure. For normal operation, this switch is in the NORMAL position. If one of the three isolation amplifiers fails, this switch must be placed in the ALT position. The pilot's alternate is the co-pilot's amplifier; the co-pilot's alternate is the radio operator's amplifier; and the radio operator's alternate is the pilot's amplifier.

TABLE OF COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT

Type	*Designation*	*Function*	*Primary Operator*	*Range*	*Location of Controls*
Interphone equipment	AN/AIC-5B	Intercommunication of crew	Crew members	Crew stations within airplane	Control panel at each crew station
Interphone equipment	AM-40/AIC	Used with sono-buoy interphone	Pilot and navigator	Two stations within airplane	Cockpit overhead and navigator's overhead panels
UHF transceiver	AN/ARC-27A	Two-way voice communication	Radio operator	225 to 400 mc	Radio operator's station and pilot's center console
Direction finder	AN/ARA-25	Indicate relative bearing of radio signals	Pilot and radio operator	225 to 400 mc	Pilot's center console and radio operator's station
*Range receiver	AN/ARC-5	Radio range navigation	Pilot	190 to 550 kc	Pilot's center console
HF liason receiver	AN/ARR-15A	Two units for medium range voice reception	Radio operator	1500 to 18,500 kc	Front panel of receivers
Liaison transmitter	AN/ART-13A	Medium range voice, CW transmission	Radio operator	2000 to 18,100 kc HF 200 to 600 kc LF	Radio operator's station
Frequency meter	LM Series	Frequency checks	Radio operator	125 to 20,000 kc	Front panel
Radio compass	AN/ARN-6	Homing and position finding	Pilot and navigator	Variable	Above pilot's windshield, navigator's overhead panel
Marker beacon	AN/ARN-12	Receives signals from ground transmitter	Pilot	75 mc	Pilot's console
VHF navigation receiver	AN/ARN-14E	Receives signals from VOR station	Pilot	108 to 136 mc	Pilot's center console
Radar altimeter	AN/APN-22	Measure altimeter clearance	Pilot Co-Pilot	0 to 10,000 ft. overland 0 to 20,000 ft. overwater	Pilot and co-pilot instrument panel
Low altitude bombing	AN/APA-16	Bomb run control and bomb release	Navigator	50 to 500 feet altitude 50 to 400 knots velocity	Navigator's station
Loran	AN/APN-4	Indicates mapping fixes for distance, location, and courses	Navigator	Day 700 miles night 450-1400 miles	Navigator's station
Wire recorder	IC/VRW-7	Records sonobuoy signal reception	Navigator		Navigator's station
Sonobuoy receiver	AN/ARR-26	Sonobuoy signal reception	Navigator		Navigator's station
MAD	AN/ASQ-8	Detection	RCM-MAD operator		RCM-MAD operator's station
Radar Receiver	AN/APR-9B	Receives and identifies radar and radio signals	RCM-MAD operator		RCM-MAD operator's station
*Homing equipment	AN/APA-70C	Home on radar signals	RCM-MAD operator		RCM-MAD operator's station
Video Signal Analyzer	AN/APA-74	Measure pulse frequency, width and rise time of radar signals	RCM-operator	Line of sight	RCM operator's station
IFF (Recognition Set)	AN/APX-7	Reception and transmission of identification signals	Radar operator	Line of sight	Radar operator's station (provisions only)
IFF (Identification Set)	AN/APX-6B	Interrogates transponder and receives identification signals	Co-Pilot	Line of sight	Co-Pilot's console
Search radar See Publication AN 01-35EJB-1A	AN/APS-44A	Radar search and navigation detection of surface objects	Radar operator		Radar operator's station

* Deleted after service change.

The "RANGE FILTER" switch governs the use of the AN/ARN-6 radio compass on the "1" or left side of the switch, and governs the use of the Pilot's AN/ARC-5 range receiver on the "2" or right side of the switch.

The "ICS-NORMAL-DISC" switch is operable by the pilot and radio operator only and is used to disconnect all interphone equipment for special radio reception. This condition is overriden by an emergency interphone transmission.

The "MIC SEL" switch is used to select the desired transmitter; the SP position is for the AN/ART-13 HF transmitter, the VHF position is for the AN/ARC-1 VHF transceiver, the "ICS CREW" position connects only the flight crew, the "ALL ICS" position connects the entire airplane crew with the exception of the pilot and radio operator in the event either has disconnected himself from the interphone system by the "ICS NORMAL DISC" switch. The "ICS EMG" position is used to override any switch position of all interphone boxes.

The "GUN CREW" switch when placed in the "TRANSMIT" position will allow any member of the gun crew to transmit on VHF if desired.

Each station control unit has four switch positions. The "ICS CREW" position connects only the members of the respective crew, i.e., flight crew members can talk only to other gun crew members. The "ICS ALL" position permits any crew member to talk with the entire airplane crew, subject to the pilot's and radio operator's disconnect feature. The "TRANS. 1" position permits operation of the AN/ARC-1 VHF transceiver upon placing the "GUN CREW TRANSMIT" switch on one of the main console control units in the up position. The "RADIO" position is operable on the RCM-MAD operator's station box only and provides a connection whereby he may hear the audio from the AN/APR-9 mixer amplifier.

Power to operate the interphone system is supplied from the 28 volt d-c radio operator's panel bus through a 5 ampere circuit breaker on the radio operator's sloping panel marked "INTERPHONE". Closing this circuit breaker supplies power to the interphone operating assembly via the main interphone junction box.

Note

Any instructions given in this publication on transmission are subject to local limitations regarding radio silence.

The "MIC SEL" switch selects the transmitter to be used and does not affect the use of other transmitters of other stations with the exception of the "ICS EMG" position. Control of the VHF transmitter may be given to gun crew member by placing the "GUN CREW" switch in "TRANSMIT" position.

SONOBUOY INTERPHONE SYSTEM.

The sonobuoy interphone system is a two-station system used by the pilot and navigator. It is divorced from the normal interphone system and consists of an AM-40/AIC interphone amplifier, a sonobuoy recorder signal relay, and two selector switches.

The selector switches, one on the navigator's overhead panel (4, figure 4-4), marked "NORMAL"—"ASW INTERPHONE", and one on the cockpit overhead panel (2, figure 1-8) marked "NORMAL"—"ASW INTERPHONE", are used by the navigator and pilot to switch from the normal interphone system to the sonobuoy interphone system. The sonobuoy recorder signal relay in the interphone junction box is used to feed either sonobuoy interphone audio, or sonobuoy receiver audio to the sonobuoy wire recorder. This relay is energized when the pilot or navigator place their selector switches in "ASW INTERPHONE" and operate their microphone switches. When the selector switches are in "NORMAL" position, both pilot and navigator are on the main interphone system.

Also when the selector switches are in "ASW INTERPHONE" position and the pilot's and navigator's microphone switches are not operated, AN/ARR-26 sonobuoy receiver audio is fed to the sonobuoy recorder.

When the selector switches are in "ASW INTERPHONE" position and the pilot or navigator operates his microphone switch, AN/ARR-26 sonobuoy receiver audio is disconnected and sonobuoy interphone audio is fed to the sonobuoy recorder.

Power to operate the sonobuoy interphone amplifier is supplied from the 28 volt d-c navigator's distribution panel bus through a 5-ampere circuit breaker on the panel marked "SONOBUOY INTERPH".

AM-40/AIC INTERPHONE AMPLIFIER.

The AM-40/AIC interphone amplifier is a two channel amplifier used in the sonobuoy system, between the pilot and the navigator, and which provides relatively constant power per headphone regardless of the number of headphones connected to the amplifier output at any one time, provided the total number of headphones is within the maximum assigned to the interphone system. Controls on the amplifier are not to be used by the crew during normal flights. The controls on the front panel permit operation by crew members under emergency conditions only. The interphone amplifier is located on the right lower shelf in the electronic compartment.

Power to operate the amplifier is supplied from the 28 volt d-c navigator's bus through a five ampere circuit on the navigator's distribution panel.

The function of the controls on the front panel are as follows:

a. Leave power switch on amplifier in ON position.

b. When an altitude switch unit is not provided (inside unit), place altitude switch in OUT. When unit is provided and the airplane's altitude is under 10,000 feet, place the altitude switch in OUT. When the altitude is above 10,000 feet, place altitude switch at IN.

c. The AMPLIFIER GAIN adjustment controls the overall gain to the amplifier unit. It is adjusted at initial installation of the amplifier in the airplane.

DIRECTION FINDER GROUP AN/ARA-25.

The Direction Finder Group AN/ARA-25 indicates relative bearing, or homes on radio signals received by Radio Set AN/ARC-27A. Essentially, the AN/ARA-25 and AN/ARC-27A equipments combine to form an automatic radio compass at UHF. With Radio Set AN/ARC-27A in operation the control function switch is turned to ADF. Turning the function switch to ADF actuates a solenoid relay to remove the AN/ARC-27A antenna and place the AN/ARA-25 antenna in the circuit to the AN/ARC-27A. At the same time, plate voltage is supplied from the UHF transceiver to the Electronic Control Amplifier. The directional antenna, on the bow compartment crown, contains a switch which automatically reverses the fed and terminated ends of the antenna at a rate of 100 cycles per second. The incoming signal is fed to the receiver where it is demodulated and sent to the Electronic Control Amplifier. The Electronic Control Amplifier amplifies the voltage to energize the a-d-f antenna drive motor. This antenna drive motor turns the antenna in a direction to null the 100 cycle square wave modulation of the incoming signal. When the incoming signal is nulled, antenna rotation ceases and the indicators will show the correct relative bearing to the received station.

To obtain direction finding information on the course indicators, selector switches at the pilot's, copilot's, and navigator's panel must be placed in ARA-25 position. These switches connect the respective course indicator into the system and may be operated independently.

Power to operate the AN/ARA-25 equipment is supplied from the cockpit 28-volt d-c bus.

AN/ARC-27A UHF TRANSCEIVER.

Transceiver AN/ARC-27A provides two-way, amplitude-modulated, radio-telephone communication between aircraft in flight, aircraft and ship, and aircraft and shore. It is possible to monitor one predetermined guard channel in the 238.0 to 248.0 megacycles band.

UHF RADIO CONTROL PANEL.

Radio Control Panel C-1015/ARC-27A, placarded UHF, is on the center console. This panel provides the pilot with 20 preset channels, 1750 manual channels, or the guard channel, all of which are selected from the 1750 frequency channels in the range of 225 to 400 megacycles.

The channel selector (CHAN) provides selection of 1 through 20 preset channels, the guard channel, (G) or the manual position (M). In the manual position (M), the three concentric dials (frequency selectors), on the right side of the panel, control the equipment frequency directly. The outer dial sets the first two digits of the frequency; the center dial, the third digit; and the inner dial, the digit to the right of the decimal point.

The frequency of preset channels is normally set by maintenance personnel. However, the procedure is as follows:

a. Set the channel selector (CHAN) to the desired preset channel number.

b. Set the three concentric dials (frequency selectors) to the desired frequency.

c. Turn the preset button (PUSH to SET CHAN) in the direction shown by the arrow next to word UNLOCK, until a stop is felt, and then push the button into panel until another stop is felt.

A standard function switch provides for mode of operation as follows:

Setting	*Function*
OFF	Set inoperative.
T/R	Transmitter and Main Receiver in operation. Guard Receiver in standby. ADF in standby.
T/R + G	Transmitter and Main Receiver in operation. Guard Receiver in operation. ADF in standby.
ADF	Transmitter in standby. Guard Receiver in standby. ADF in operation through Main Receiver.

Note

The pilot's UHF Control Box contains a standard volume control knob which is not connected to the UHF system. Volume for the UHF is controlled by the pilot's and copilot's master radio volume controls.

Components of this equipment include a Receiver Transmitter on the right side of the Electronic Compartment, and a Radio Set Control on the pilot's console. Antenna AT-141/ARC-27 is used for this equipment as well as for AN/ARC-27. The 28-volt d-c power for this equipment is supplied from the cockpit distribution panel, a double-pole relay, and a circuit breaker to the Receiver-Transmitter. The double pole relay is energized by the Master-Radio Switch on the cockpit overhead panel. The function switch on the Radio Set Control must be switched to the desired function before the set will operate.

OPERATION OF RADIO SET AN/ARC-27A.

a. Close the master radio switch.

b. Rotate the function switch on Radio Set Control C–1015/ARC–27A to the T/R position.

c. Allow one minute for warm up. Signals above the squelch level will be heard.

VOICE TRANSMISSION AND RECEPTION.

a. Rotate the CHAN channel selector to the desired preset channel.

b. Reception of an incoming signal on the frequency preset on the channel selected is now possible.

c. Use VOL volume control to adjust the level of the audio signal at the headset.

d. The SENS sensitivity control provides a vernier adjustment of the sensitivity of the RT–178/ARC–27 Receiver-Transmitter. The control is connected in such manner that the remote operator cannot adjust the main receiver to be less sensitive than that resulting from the original adjustment of the sensitivity control on the front panel of the RT–178/ARC–27 unit.

e. With the CHAN selector in the M or manual position, the three frequency selector knobs have direct control of the equipment frequency.

f. Press the microphone push-to-talk button, or the throttle switch, to energize the transmission circuits.

g. Release the microphone button, or the throttle switch, at the end of each transmission. This is necessary to hear incoming signals and to reduce the load on the dynamotor.

STOPPING THE EQUIPMENT.

a. Turn the OFF—T/R—T/R+G—ADF function switch to the OFF position.

b. If the equipment is to be out of service for an extended period of time, open the master radio switch.

AN/ARC-5 RANGE RECEIVER.

Note

The AN/ARC-5 Range Receiver is removed from airplanes No. 135518, 135521 and subsequent on delivery and from airplanes No. 125474 to 135517, 135519, 135520 after service change.

This range receiver operates in the frequency band of 190 kc to 550 kc. It is operated for C.W. and voice by a remote control panel in the pilot's center console. The receiver is above the radar operator's table. Audio output is fed through the interphone system to the pilot's co-pilot's and radio operator's interphone control units and may be heard in the headsets when the RANGE FILTER switch on one of the console control units is in either BOTH 2, RANGE 2, or VOICE 2 positions.

Power to operate the receiver is supplied from the 28 volt d-c cockpit distribution panel bus No. 2 through a 25 ampere circuit breaker on the panel marked RADIO POWER—BUS NO. 2. Power is then fed through a relay in the cockpit distribution box to the cockpit distribution panel bus No. 2 and through a 5 ampere circuit breaker on the panel marked LF RANGE RECEIVER to the receiver. The relay is energized by the bus changeover switch on the cockpit overhead panel marked MASTER RADIO. This switch must be in the ON or ALT. ON position to operate the AN/ARC-5 range receiver.

OPERATION OF AN/ARC-5 RANGE RECEIVER.

To start equipment, place the MASTER RADIO switch on the cockpit overhead panel in either the ON or ALT. ON position.

a. Turn RANGE FILTER switch on interphone control unit to desired position on the "2" side.

b. Turn CW-VOICE switch to desired position.

c. Tune to desired frequency with dial and crank.

d. Adjust SENS knob to the desired signal output.

e. Trim receiver tuning for best signal output.

f. Keep the SENS control at a setting for the weakest usable signal.

AN/ARR-15A HF LIAISON RECEIVERS.

The AN/ARR-15A receivers provide reliable reception of voice, cw, or mcw signals over a long range within the frequency band of 1500 kc to 18,500 kc. The receivers are pre-tuned on ten frequencies, any of which may be selected by a selector switch on the front panel. The receivers are on the radio operator's rack and controls are on the front panel of each receiver.

Audio output of the receivers is fed through the interphone system to the pilot's, co-pilot's, and radio operator's console control units. The interphone system must be operating and switches marked COMM. "1" and COMM. "2" on the interphone console control units must be in the up position when using AN/ARR-15A receivers. In case of an interphone failure an H-4/AR headset may be plugged into the PHONES jack on the front panel of each receiver.

Either the fixed wire antenna or the trailing antenna can be used with the receivers. The antenna feed comes from the receivers post on the AN/ART-13 transmitter to a receiver selector switch on the radio operator's radio rack. This switch has three positions HIGH FREQ., HIGH AND LOW FREQ. and LOW FREQ. With this switch the antenna can be fed to either the AN/ARR-15A HF receivers, the AN/ARC-5 LF receiver, or to all three at the same time.

Power to operate the receivers is supplied from the radio operator's 28 volt d-c radio bus through two 10-ampere circuit breakers on the panel marked COMMUNICATION RECEIVER NO. 1—NO. 2. The ON-OFF switch adjacent to the circuit breakers must be in the ON position to energize the radio bus.

OPERATION OF AN/ARR-15A

The controls for the AN/ARR-15A receivers are on the panels of the receivers. No remote control of these units is used. These receivers are on the radio rack at the aft end of the flight deck (28, figure 4-4).

a. Insert headphone cord plug into the PHONES jack.

b. Rotate ON-OFF switch to ON position.

c. Wait one minute for set warm-up.

d. Select channel by CHANNEL selector switch.

e. Set CW-MCW-CAL switch to desired reception.

f. Regulate volume by VOLUME control.

g. Press ON-OFF switch in to shut off set.

TO CHANGE TO NEW SETTING OF AN/ARR-15A LIAISON RECEIVERS.

The controls used to change the frequency setting of the receiver for any position of the CHANNEL selector switch are on the receiver panel.

a. With set on and warmed up, move CHANNEL selector switch to frequency to be changed.

b. When cycle is completed, unlock AUTOTONE stop rings by rotating the locking key on the BAND switch control, and the locking key above the TUNING control two revolutions in a counterclockwise direction.

c. Operate BAND switch to band that contains the desired frequency and set CW-MCW-CAL switch to MCW-CAL.

d. Rotate TUNING control until main dial shows desired frequency.

e. Rotate BFO-CALIBRATE control so calibration dial shows last two digits of the desired frequency.

f. While listening to the receiver output, rotate TUNING control until exact zero beat is obtained.

g. Carefully lock AUTOTONE by rotating clockwise until tight.

h. Return the CALIBRATE control to O.

i. Repeat for other setting.

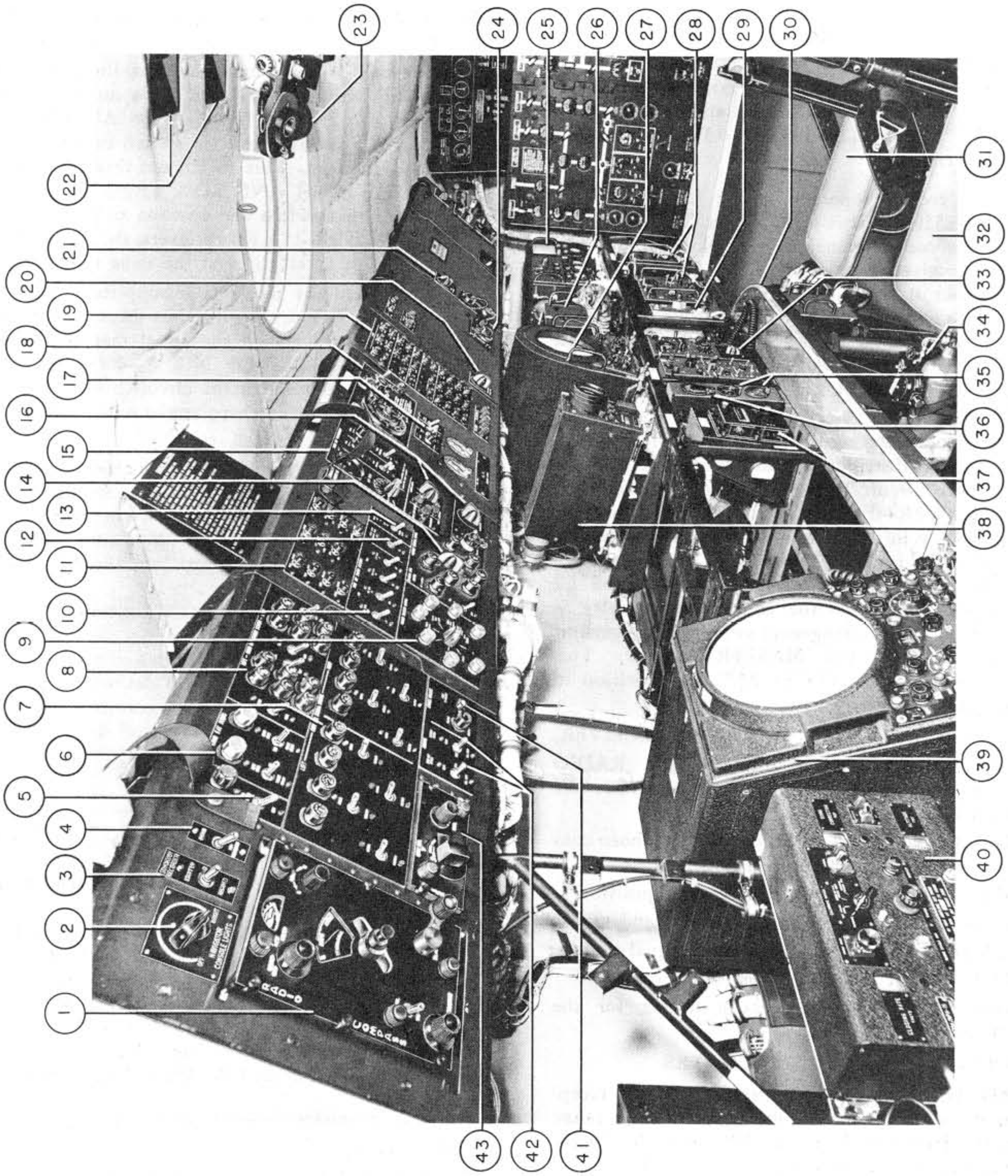


Figure 4–4. Navigator's and Radar Countermeasure Control Panels

KEY TO FIGURE 4-4

1 Panel, Radio Compass Control
2 Rheostat, Radio Compass Control Panel Light
3 Switch, Sonobuoy Recorder
4 Switch, ASW Interphone
5 Switch, Marine Marker Air Compressor
6 Panel, Bomb Bay Doors Switch
7 Panel, External Stores Status and Switch
8 Panel, Bomb Bay Stores Status and Switch
9 Panel, Master Selector Control—Armament
10 Panel, Bomb Bay Station Selection Switch
11 Panel, Armament Circuit Breaker
12 Switch, Stores Status Indicator Light
13 Switch, Intervalometer Selector
14 Switch, Sonobuoy Selection Control
15 Panel, Bomb Bay Temperature Control
16 Rheostat, Console and Panel Lights
17 Panel, Camera Control Switch
18 Intervalometer
19 Panel, Navigator's Power Control
20 Rheostat, AN/APR-9 and AN/ASQ-8 Panel Lights
21 Rheostat, RCM panel Lights
22 Lights, Instrument Panel Red
23 Mount, Periscopic Sextant
24 Panel, ICS Control
25 Transmitter, AN/ART-13
26 Power Supply Unit AN/ASQ-8
27 Range Azimuth Indicator IP-161/APS-44
28 Receivers, AN/ARR-15
29 Box, Antenna Reel Control
30 Table, RCM Operator
31 Seat, Radio Operator
32 Seat, RCM Operator
33 Panel, Control—Communication Receiver AN/APR-9
34 Cylinder, RCM Operator's Oxygen
35 Clocks
36 Indicator, Course ID-304/APA-70C
37 Compensator, Magnetic AN/ASQ-8
38 Indicator, Approach AN/APR-9
39 Oscilloscope, AN/APS-44A
40 Controller, AN/APA-16
41 Button, Stores Release
42 Switches, Arming—Bomb Bay and External Stores
43 Panel, ICS Control

Note

If CW reception is wanted, rotate CALIBRATE dial a few divisions for peak audio

To start the equipment, the ON-OFF switch on the RADIO BUS section of the radio operator's sloping panel must be in the ON position to energize the radio bus. Then rotate the ON-OFF switch on the front panel of each receiver in a clockwise direction until it catches. To stop the equipment, push the ON-OFF switch all the way in toward the panel.

If an emergency shut down of the equipment is necessary, the circuit breakers on the radio operator's sloping panel marked COMMUNICATION RECEIVER—NO. 1—No. 2 may be pulled out. It is not recommended that the ON-OFF switch adjacent to the circuit breakers be placed in the OFF position to shut down the AN/ARR-15A receivers as other radio equipment will be disabled.

AN/ART-13 TRANSMITTER.

This equipment is used as a communications transmitter to cover the frequency range from 200 kc to 600 kc and from 2000 kc to 18,100 kc. The frequency range of 2000 to 18,100 kc is covered, using either the fixed wire antenna or the trailing wire antenna. An O-16/ART-13 low frequency oscillator is installed in the transmitter and a CU-25/ART-13 antenna loading coil is installed external to the transmitter to permit operation in the frequency range of 200 to 600 kc.

The transmitter employs the autotune system of frequency change, which is an electrically controlled mechanical system for positioning the transmitter tuning element. Manual frequency change and tuning adjustments may be made without disturbing the autotune stop-ring adjustments if the channel selector switch is placed in MANUAL position and the autotune system allowed to operate. Eleven autotune positions are available, permitting transmission on any one of 10 preset H.F. and one preset L.F. frequencies. The transmitter is located at the radio operator's station; operating controls are on the front panel of the unit.

When low frequency operation has been selected, the AN/ART-13 antenna relay is energized to change the antenna from the antenna post on the transmitter to the antenna post on the loading coil.

The transmitter may be keyed by the telegraph key on the radio operator's table when the KEY SELECTOR switch on the radio operator's overhead panel is in the ART-13 position.

Sidetone output is fed through the transmitter keying relay (when in the transmit position) to the pilot's, co-pilot's and radio operator's interphone control units. This output may be heard in the headsets by placing the "1" and "2" (AN/ARR-15A) interphone control unit selector switches in the up position. Sidetone output is also fed through the AN/ARC-5 communication receiver keying relay to the interphone control units. This output may be heard in the headsets by placing the "3" (AN/ARC-5) interphone control unit switch in the up position. Both the transmitter keying relay and the AN/ARC-5 keying are energized when the transmitter is set to transmit. This connects the external audio circuits of all three receivers in parallel. When the transmitter is not set to transmit, these relays are de-energized and the receiver audio circuits are isolated from each other.

Power to operate the equipment is supplied from the 28-volt d-c RADIO BUS on the radio operator's sloping panel through a 35-ampere circuit breaker on the panel marked H. F. TRANS. This power source is fed to the DY-12/ART-13 dynamotor which is on the right side electronic rack. The ON-OFF circuit breaker switch adjacent to the circuit breaker must be in ON position to energize the radio bus.

OPERATION OF AN/ART-13 TRANSMITTER.

a. To start the equipment, place the ON-OFF circuit breaker switch on the radio operator's sloping panel in the ON position.

b. Place the LOCAL-REMOTE switch on LOCAL.

c. Place EMISSION switch on VOICE, CW OR MCW in accordance with type of emission desired.

d. Set CHANNEL switch on channel desired; the calibration card on the panel shows the frequencies corresponding to the CHANNEL switch positions.

For low frequency operation (200 to 600 kc) the trailing antenna must be used. To connect the trailing antenna place the antenna selector switch on the radio operator's overhead panel in HF TRAIL, LORAN FIXED position. Refer to Fixed and Trailing Wire Antenna System.

To stop the equipment, place the EMISSION switch in the OFF position.

SETTING CONTROLS FOR AN/ART-13 TRANSMITTER.

Refer to calibration tables when setting transmitter controls.

Antenna Selector Switch—FIXED ANT.

Microphone, key, and throttle switch (T.S.) jack circuits—Open.

Local—Remote Switch—LOCAL.

Emission Switch—VOICE.

Meter switch to BATTERY-VOLTAGE. (check for usable primary voltage within the light shaded area under BATTERY).

Channel Switch—Desired channel. (For manual operation Channel Switch in MANUAL.) If the autotune system begins to run, allow completion of cycle of operation. The red pilot light on the transmitter will light when the autotune cycle is completed.

Unlock all five tuning controls by holding the dial and turning the locking bar 1/4 turn in a counterclockwise direction. (For Manual operation, do not loosen the locking bars.)

Set control C on position 1.

Set control A to the position corresponding to the number in column A at this crystal check point. *The setting of controls A and C are critical.* The transmitter will not operate if controls are not set properly. Set control B to the position corresponding to the number in column B at this crystal check point.

Power Level Switch—CALIBRATE. After rotating control B for zero beat, leave control in that position and turn the Power Level Switch to TUNE.

Use Corrector Knob to set the movable indicator mark to the reading of control B found in column B at this crystal check point.

Set control B to the reading obtained from calibration table.

Lock control A by first noting its reading, rotating dial counterclockwise 1/4 turn, then rotating it clockwise to, but not past the reading on which it has been set. Hold the knob and turn the locking bar clockwise until it is tight. Repeat procedure for control B. If further pressure, during clockwise rotation, causes the dial to move beyond the original setting, unlock and repeat the locking procedure. Make certain the original dial settings are used. (For Manual operation the locking bars should not be bothered.)

Emission Switch—CW.

Place the Meter Switch on P.A. GRID, close the Test Switch, and note the reading on the meter. Reading should be in, or slightly above, the light-shaded area marked P.A. GRID for normal operation.

Meter Switch—P. A. PLATE.

Set Controls C, D, and E to the positions indicated in the table of approximate dial settings for the desired frequency.

If control C is on position 7 or below:

Hold Test Switch closed and adjust control E to resonances indicated by plate current dip.

Power Level Switch—OPERATE.

If the plate current meter reading is above the area marked CW, move control D a few divisions lower and readjust control E for minimum plate current. Repeat until the plate current reading is in the area marked CW. If the plate current meter reading is below the area marked CW, move control D a few divisions higher and readjust control E for minimum plate current. Repeat until the plate current reading is in the area marked CW. Do not leave the controls on any position other than that at the resonance dip. Lock controls, C. D. and E.

If control C is on position 8 or above:

Hold TEST switch closed and adjust control D to the position at resonance indicated by the dip in plate current.

Power Level Switch—OPERATE.

If the plate current meter reading is above the area marked CW, move control E a few divisions lower and readjust control D for minimum plate current. Repeat until the plate current reading is in the area marked CW. If the plate current meter reading is below the area marked CW, move control E a few divisions higher and readjust control D for minimum plate current. Repeat until the plate current reading is in the area marked CW. *Do not leave the controls on any position other than that at the resonance dip.* Lock controls C, D, and E.

AN/ARN-6 RADIO COMPASS RECEIVER.

The AN/ARN-6 Radio Compass Receiver (a second AN/ARN-6 Radio Compass will be added to the airplane effective on Airplane Nos. 135518, 135521 and thereafter and on Airplane Nos. 135474 through 135517, 135519, 135520 after service change) provides visual and aural navigational information reception. The AN/ARN-6 No. 1 receiver is on a shelf in the upper right hand side of the aft waist compartment and the AN/ARN-6 No. 2 receiver is on the APU deck. Controls for the receiver consists of four control units (two for AN/ARN-6), one above the pilot's windshield (AN/ARN-6 No. 1), one above copilot's windshield (AN/ARN-2 No. 2) and two on the navigator's panel (one for each AN/ARN-6).

Selection of AN/ARN-6 No. 1 and AN/ARN-6 No. 2 is made through the use of the Radio Compass Selector Switch which is on the navigator's panel. This switch has 3 positions for each AN/ARN-6 for the reception of voice signals, range signals or both.

Range and/or voice signals may be selected through the use of the Filter Selector Switch and the range filter which are on the cockpit center console. The range filter will suppress undesirable signals, depending upon the position of the Filter Selector Switch. When the selector switch is in "RANGE" position, the range section of the filter will suppress voice signals and transmit only the 1020 cycle range tone to the interphone system. The "MIC SEL" switch on the navigator's panel must be in the "RADIO" position.

Power to operate the equipment is supplied from the 28 volt d-c cockpit distribution panel bus No. 1 through a 50-ampere circuit breaker on the "RADIO POWER" panel section marked "BUS NO. 1". Power is then fed through the contacts of a double-pole relay in the cockpit distribution box to the 28 volt d-c communication bus No. 2. From this bus, power is fed to both AN/ARN-6 control units through two 10 ampere circuit breakers on the panel section marked "RADIO COMPASS". The circuit breakers will be identified as AN/ARN-6 No. 1 and AN/ARN-6 No. 2. The relay is energized by the bus change-over switch on the cockpit overhead panel. This switch is marked "MASTER RADIO" and must be in the "ON" or "ALT. ON" position to operate the AN/ARN-6 radio compass.

OPERATION OF AN/ARN-6 RADIO COMPASS RECEIVER.

To start the equipment, place the "MASTER RADIO" switch on the cockpit overhead panel in either the "ON" or "ALT ON" position. Then rotate the function switch to "COMP", "ANT" or "LOOP" as desired.

This is a dual control installation and it is necessary to determine which control box is in command. Select either control box. Turn the "DIAL LIGHT" control knob fully clockwise; if the dial and tuning meter become illuminated or there is a deflection of the tuning meter pointer away from its clockwise stop (after a 15 second interval) the control box, under observation, is in command. If control is not indicated: push "CONTROL" button. To stop this equipment, turn function switch "OFF".

AN/ARN-12 MARKER BEACON RECEIVER.

The Marker Beacon Receiving Set is an airborne radio navigation aid which receives signals transmitted by a ground beacon transmitter and delivers an aural and visual indication of the received signal to the pilot. From these indications the pilot can accurately check his position with respect to a particular radio range station. The Marker Beacon Receiver, AN/ARN-12 is capable of receiving 75 megacycle signals modulated by either 400, 1300 or 3000 cps signals. The AN/ARN-12 receiver is on a radio rack on the right side of the Electronic Compartment.

OPERATION OF AN/ARN-12 MARKER BEACON RECEIVER.

a. To start the equipment, place the circuit breaker switch in "ON" position on the pilot's console panel.

b. Place the Marker Beacon master control switch on the pilot's console in "ON" position.

c. Power to operate the receiver is supplied from the 28 volt d-c cockpit distribution panel bus No. 1 through a 5 ampere circuit breaker.

d. To stop the equipment, place the master control switch in "OFF" position. The receiver is automatically turned off when the electrical system of the airplane is shut down by means of the master control switch.

EMERGENCY OPERATION OF AN/ARN-12 MARKER BEACON RECEIVER.

This equipment has but one mode of operation, however, it supplies information in several ways, each of which may be used independently. Should the audio signal alone fail, the visual indicator may be utilized to receive the marker beacon signals. Should both the visual and aural remote indications fail due to faulty cable, head phones inserted in the "TEST JACK" may yield the marker beacon signal. If operating difficulties occur, place "HI-LOW" sensitivity switch in "HI" position.

AN/ARN-14E RECEIVER (VOR SYSTEM).

The AN/ARN-14E is an airborne VHF navigation receiver by which the pilot may fly a selected radial course to a visual omnidirectional range station (VOR) within receiving range. If facilities are provided at an airbase, the VHF omni-range is used to guide the pilot over a predetermined area for a landing. Voice communications can also be received via the VOR system in the 112 to 136 megacycle spectrum.

Controls for the AN/ARN-14E equipment consist of a control panel on the pilot's center console; three course indicators on the pilot's, copilot's and navigator's instrument panel; a receiver, compass signal power amplifier, with receiver; a radio indicator control in the electronic compartment; and a deerhorn-type antenna on the hull crown of the sonobuoy compartment.

OPERATION OF AN/ARN-14E RECEIVER.

a. Place required circuit breakers in ON position on cockpit distribution panel.

b. To start equipment, place the Master Radio switch on the cockpit overhead panel in either ON or ALT ON position.

c. Turn ON-OFF switch on control panel in pilot's center console to ON position.

d. Adjust local VHF transmitter frequency.

e. Plug headset into interphone jack box.

f. Identify station from coded signal in headset. Adjust the volume control to the desired output level.

Power for the AN/ARN-14E equipment is supplied from the 28-volt d-c communication bus No. 2 at the cockpit distribution panel through a 25-ampere circuit breaker marked RADIO POWER BUS NO. 2 through a double-pole relay. The relay is actuated by the Master Radio switch on the cockpit overhead panel from the 28-volt d-c bus No. 1 in the cockpit distribution panel, when the switch is in ON position or from the 28-volt d-c bus No. 2 in ALT ON position. From the 115-volt, 400-cycle, a-c, phase B bus No. 2 at the cockpit distribution panel power is supplied through a 5 ampere circuit breaker, marked COMPASS AMP, to the compass amplifier. At the amplifier it is converted into 26-volt, 400-cycle ac and fed through two separate fuses for distribution to indicators. Power to operate the dynamotor is supplied with 28-volt dc at the cockpit distribution panel through a circuit breaker marked OMNI RANGE.

To stop equipment, place ON-OFF switch on control panel to OFF.

RADIO NAVIGATION SET AN/ARN-21.

The AN/ARN-21 is an airborne navigation unit which incorporates the interrogator-responser principle in conjunction with surface beacons such as the AN/URN-3. This system enables an aircraft to obtain a continuous indication of its bearing and distance from any selected surface beacon up to 195 nautical miles line-of-sight. The bearing and distance are presented on separate azimuth and range indicators. (figure 4-4A.)

Note

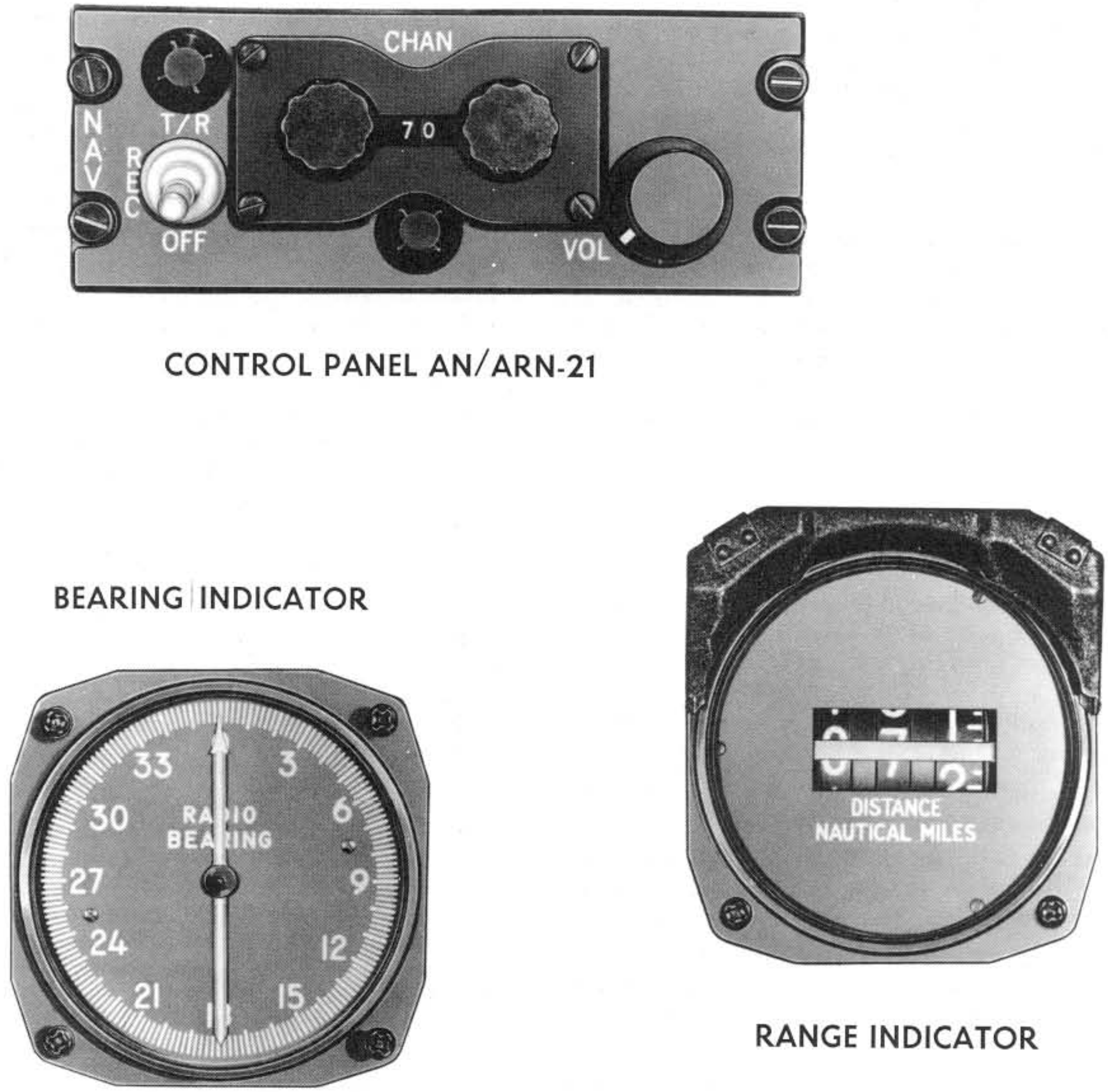
Radio Set AN/ARN-21 is installated on airplanes No. 135539 and subsequent as delivered, and on airplanes No. 135474 through 135538 after service change.

RANGE. Both the airborne and surface units use a transmitter-receiver which emits a pulse signal at a low pulse repetition frequency. The signal transmitted by the airborne equipment is known as the interrogation pulse. This signal triggers the surface station, which emits a distance reply pulse. When this reply pulse is received, special circuits measure the elapsed time between the interrogation and the response. This time difference is registered on the range indicator as nautical miles. While the unit is searching, or when the signals are too weak to give accurate indications, a red flag partially obscures the reading.

BEARING. The surface beacon continuously transmits a series of coded and modulated radio frequency pulses that provide a reference bearing signal and a variable bearing signal. The phase difference between the reference and variable bearing signals is measured and this phase difference is shown on the azimuth indicator as the bearing from the beacon in degrees.

LIMITATIONS. The coverage of the system is limited to line-of-sight range because of the high frequencies involved. The frequency range is 1025 to 1150 megacycles with the assigned channels (total of 126 channels) 1 megacycle apart. The units are designed to enable over 100 aircraft to fully utilize each channel. The power output of the AN/ARN-21 is automatically reduced above 35,000 feet but it is still sufficient to cause flashover, which limits set operation to altitudes up to 50,000 feet.

BEACON IDENTIFICATION. The surface beacon transmits a series of pulse signals that are keyed with International Morse Code characteristics at regular intervals. These signals are detected and reproduced as an audio tone for identification.



21113

Figure 4–4A. AN/ARN–21 Control Panel and Indicators

WARNING

Exposure to direct radiation of radar equipment may result in severe injury to personnel and may also cause severe damage to equipment or material of an explosive or combustible nature. Personnel are to take all necessary precautions to prevent such injuries or damage.

OPERATION. There are only three operating controls for the AN/ARN–21. (figure 4–4A.) Of those three, incorrect settings of the OFF–REC–T/R switch or the VOL control would probably not cause serious error. Incorrect setting of the OFF–REC–T/R switch could only prevent a display of distance information or break radio silence. Improper setting of the VOL control could only interfere with the pilot hearing the beacon's identification signals. The only control whose incorrect setting could probably cause serious misunderstanding is the CHAN control.

CAUTION

Check the CHAN setting on the pilot's control box to ascertain that displays on the indicators of Radio Set AN/ARN-21 are those initiated by the desired AN/URN-3 beacon and are not displays of a different beacon, which may have been selected in error.

The starting and stopping of the AN/ARN-21 is controlled by the OFF-REC-T/R switch on the NAV panel. When this switch is in OFF position, all power is off. When the switch is in either the REC or the T/R position, the equipment is turned on. The control panel illumination is controlled by the aircraft lighting system and does not indicate the condition of the equipment.

Note

When the equipment is turned on, there is a warm-up delay of 90 seconds. There is no delay when changing from REC to T/R.

When the equipment is turned on, it is operated in the following manner:

a. Set the CHAN dials on the NAV panel at the desired beacon channel number.

b. Turn the switch marked OFF-REC-T/R to REC or T/R to receive the bearing of the selected beacon; this will appear on the Bearing (Azimuth) Indicator.

c. Turn the switch marked OFF-REC-T/R to T/R. Distances between the aircraft and the selected beacon (from 0 to 195 miles) will appear on the Range Indicator.

d. Adjust the VOL control on the control panel to receive the call letters (in International Morse Code) of the selected beacon.

CAUTION

Do not, at any time, set the CHAN dial below channel 1 or above 126.

AN/APN-22 RADAR ALTIMETER.

The AN/APN-22 Radar Altimeter is a microwave altimeter which measures absolute height (terrain clearance) for the pilot and copilot, with the transmitting and receiver antenna on the lower right surface of the outer wing. FM signals are directed to the terrain, reflected by the terrain and received at the airplane. The time element is electronically measured to determine distance of the airplane above the ground. The equipment operates in the 4200-4400 mc band and operates over land, with ranges of 0-10,000 feet, and over water with ranges of 0-20,000 feet.

Power to operate the equipment is supplied from the 115-volt, 400-cycle a-c bus at the cockpit distribution panel through a circuit breaker to the Electronic Control Amplifier. D-C power, to operate the Electronic Control Amplifier, is supplied from the 28-volt d-c bus at the cockpit distribution panel bus No. 2 through a circuit breaker. Lights in the altitude indicators are controlled by the pilot's and copilot's flight instruments lighting switch and are furnished separate power from the 28-volt, d-c battery.

OPERATION. The equipment is turned on when airplane primary power sources are turned on. To operate the equipment, turn ON the ON-LIMIT control on the front of height indicator. The equipment will start operating in approximately three minutes.

CAUTION

Allow 12 minutes for equipment warm-up time after start to insure final accuracy. If the temperature is below —40°C (—40°F), allow 25 minutes.

To stop the equipment, turn OFF the ON-LIMIT control on the height indicator.

AN/APA-16 RADAR EQUIPMENT.

The AN/APA-16 is a low altitude radar bombsight attachment for use with the search radar, AN/APS-44A. It is primarily used in bombing surface targets, but can be used against any target visible to the search radar equipment. It furnishes a range mark with which target echoes on the radar indicator can be "tracked". Tracking consist in maintaining coincidence between the range mark and the target echo as the target is approached. Information so obtained, together with altitude and ballistic information manually set in the control unit by the operator, is utilized in electrical circuits to compute the release range and to release the bomb automatically when the airplane reaches the release position. The AN/APA–16 is connected in the bomb release system, by normally open contacts of a bomb release relay in the Range Marker limit and parallel the stores release switches. When the equipment energizes its release relay, the release circuits normally operated by the stores release switches are by-passed and stores are automatically released.

Power to operate the AN/APA–16 equipment is supplied to the Range Marker Unit from the 115 volt a-c, single phase, 400 cycle and obtained from 115/200 volt a-c, three phase, 400 cycle, at the navigator's distribution panel phase B bus. A five-ampere circuit breaker protects the bus.

OPERATION OF AN/APA–16 RADAR EQUIPMENT.

Refer to BOMBING EQUIPMENT, Section IV, for operational procedure in releasing stores, before, during and after bombing run.

STOPPING THE EQUIPMENT.

When it is no longer desired to employ the AN/APA–16 equipment, it can be stopped merely by placing the POWER SWITCH on the Control Unit to the "OFF" position. Shutting down the equipment does not affect the continued operation of the search radar system.

AN/APN–4 LORAN EQUIPMENT.

The AN/APN–4 Loran is airborne navigation equipment used to determine the geographic position of the aircraft. The overall Loran system includes the ground system which provides special radio signal pattern and the receiving system in the airplane which receives these signals and translates them into useful information on the indicator scope.

The equipment consists of a R–9B/APN–4 Receiver located below the navigator's table, a ID–6B/APN–4 Indicator located on the navigator's table, and a Model 2A Antenna Matching Unit located on the radio operator's relay panel (overhead). Controls are located on the front panels of the receiver and indicator.

The antenna may be either the fixed wire or trailing antenna. Either antenna is connected to the receiver through an antenna matching unit which is used to match the fixed antenna to the input of the Loran receiver. For selection of antennas refer to Fixed and Trailing Wire Antenna System.

Power to operate the equipment is supplied from the 115 volt single phase 400 cycle a-c navigator's overhead panel bus through a 5-ampere circuit breaker on the panel marked "LORAN".

STATION SELECTOR.

The station selector is a rotary type switch located on the indicator unit. With the "STATION" selector switch in any one of its eight positions, pulses of several size and shapes may appear on the indicator screen. By moving the "STATION" selector switch through its eight positions, one setting will be found when the longest and most regular pulses are stationary. These are the proper ones for use in calculating the position of the airplane.

LEFT-RIGHT SWITCH.

The left-right switch, located on the indicator unit, is used to move the indicated pulses to the left or to the right as desired.

COARSE CONTROL.

The coarse control, located on the indicator unit, is used to make coarse alignments of the B-pedestal and B-pulse. Move the coarse control until the B-pedestal is directly under the B-pulse.

FINE CONTROL.

The fine control, located on the indicator unit, is used to make fine adjustments of the B-pedestal and B-pulse. Move the fine adjustment control until the extreme left end of the B-pedestal is under the B-pulse.

AMP BALANCE CONTROL.

The amp balance control, located on the indicator unit, is used to vary the amplitude of the A and B pulse. Adjust the amp balance control until the two pulse forms equal each other in height.

GAIN CONTROL.

The gain control is located on the indicator unit. The control is used to adjust the pulse for desired amplitude.

CRYSTAL PHASING CONTROL.

The crystal phasing control is located on the indicator unit. If the received pulses drift slightly, adjust the crystal phasing control until they remain stationary.

INTENSITY CONTROL.

The intensity control is used to adjust the brightness of the received traces.

FOCUS CONTROL.

The focus control is used to obtain a clear definition of pattern.

PRR H-L SWITCH.

The PRR H-L switch is located on the indicator unit. Adjust the PRR H-L switch to the position which synchronizes the indicator with the available ground station.

SWEEP SPEED CONTROL.

The sweep speed control provides 8 sweep speeds. Positions 1 through 4 are used to position the A and B pulses. Positions 5 through 8 are used in calculating the time differences, in micro-seconds, between the A and B pulse.

OPERATION OF AN/APN-4 LORAN EQUIPMENT.

a. Energize equipment by placing "PWR. ON-OFF" switch on Radio Receiver to "ON".

b. Set "SWEEP SPEED" on indicator to position "1".

c. Place the "AMP. BALANCE" control at the center position and adjust "GAIN" control for desired pulses.

d. Use the "STATION" selector switch (on the indicator) to select the desired position.

e. Adjust "PRR H-L" switch to the position which synchronize the indicator with available ground stations.

f. Adjust "INTENSITY" control until a suitably brilliant trace pattern appears on the indicator screen; then adjust "FOCUS" control to provide a clear definition of pattern.

Note

After the airplane is in the air, let out 60 to 70 turns of the trailing antenna. Adjust the length of the trailing antenna to give maximum signal input.

STOPPING THE EQUIPMENT.

To stop the equipment, return "PWR. ON-OFF" switch on receiver to "OFF" position.

IC/VRW-7 WIRE RECORDERS.

The wire recorder, IC/VRW-7, is designed to record audio frequency signals magnetically. The recording medium is a stainless steel wire, wound on reels and supplies 33 minutes of continuous operation at 200 rpm. However, since the motor, which moves the wire through the mechanism, operates only when the controlling switch is in the "RECORD" position, the elapsed time for a spool of wire at either speed will be considerably greater than the continuous times mentioned above.

The wire recorder located at the navigator's station, is normally used to record sonobuoy receiver output but may be used to record pilot-navigator sonobuoy interphone conversation when pilot and navigator are on sonobuoy interphone and their microphone switches are actuated. This recorder is controlled by a three-position switch on the navigator's overhead panel marked "STAND-BY-OFF-RECORD". When the control switch is placed in the "STAND-BY" position, the recorder is turned on for warm-up and is ready for instant recording. When the switch is operated from "STANDBY" to "RECORD", the equipment begins to record.

Power to operate and control the wire recorder is supplied from the 28 volt d-c bus system through a 5-ampere circuit breaker on the navigator's overhead panel marked "RECORDER SONOBUOY".

AN/ARR-26 RADIO RECEIVING SET.

The AN/ARR-26 radio receiving set is used to receive information from sonobuoys. The receiver operates on any one of sixteen channels and can also receive both AM and FM signals. Radio bathythemograph equipment signals can also be received provided it is within the frequency range of the receivers.

Components of the system are the C-610/ARR-26 control unit located on the navigator's radio rack, the R-316/ARR-26 receiver and the PP-468/ARR-26 power supply which are located on the right side electronic rack. Two retractable watertight antennas, AT-446/ARR-26, are located on the hull bottom, left side, in the beaching gear compartment. Space for the PT-108/ARR-26 indicator plotter is provided on top of the navigator's AN/APS-44A indicator on the radio rack.

Power to operate the equipment is supplied from the a-c 115 volt 400 cycle phase A and phase C buses of the navigator's distribution panel through two 5-ampere circuit breakers on the panel marked "SONOBUOY-AC PHASE A" and "SONOBUOY-AC PHASE C". D-c power is also fed to the control unit and is supplied from the 28 volt d-c navigator's distribution panel bus through a 5-ampere circuit breaker on the panel marked "SONOBUOY-DC".

STARTING THE RADIO SET AN/ARR-26.

It is assumed that the set has been checked and adjusted and that the equipment is in proper operating condition. It is not necessary to make any preliminary setting of the controls before turning on the equipment. However, the operator should make certain that the "AFC" switch on the Radio Receiver R-316/ARR-26 is in the "ON" position, and that the "Receiver Test" selector switch is in the "OFF" position. No other adjustment of these controls should be made by operating personnel. To start the equipment, it is only necessary to set the "PWR" switch to "ON".

NORMAL OPERATION OF RADIO RECEIVING SET AN/ARR-26.

CAUTION

Retract sonobuoy antennas and stow prior to take-off and landing.

Before operating the equipment, it is necessary to know the frequency chanenls to which the listening sonobuoys, are adjusted. A channel number, 1 through 16, is marked on each sonobuoy. The operator should determine the channel numbers on the units to be dropped, so that the AN/ARR-26 can be operated on these channels. After the "PWR" switch has been turned "ON", operate the equipment according to the following procedure:

a. Adjust the "DIMMER" control for desired illumination of the front panel of the Radio Set Control C-610/ARR-26.

b. Set "CHAN A" switch to the channel number of one sonobuoy and set "CHAN B" switch to the channel number of the other sonobuoy. When more than two Listening Sonobuoys have been dropped, these controls should be switched in turn to the channels of the other units, as underwater targets are located.

If it is desired to listen to the hydrophone information from a AN/SSQ-2 sonobuoy, set the controls of the Radio Set Controls C-610/ARR-26 as follows:

a. Set the "RCVR A"—"RCVR B" switch to either position, depending upon which R-316/ARR-26 Radio Receiver is to be monitored.

b. Set the "BFO" switch to lower position.

c. Set the "HI-PASS FILTER" switch to lower position.

d. Set the "BAND PASS FILTER" switch to lower position.

e. If the Sonobuoy is not received, adjust "F" (fine tuning) control for the receiver being monitored, until a signal is heard.

f. Adjust "AUDIO GAIN" control for a comfortable level in the headphones.

g. If signal should disappear due to frequency drift in the Sonobuoy, readjust "F" control.

STOPPING THE RADIO RECEIVER AN/ARR-26.

To stop the equipment, set the "PWR" switch to "OFF" position.

AN/APR-9B RADAR RECEIVER SET.

Radar Set AN/APR-9B receives radio and radar transmission. The received signals are presented aurally by means of a headset, and visually by means of a panoramic oscilloscope.

The equipment consists of three pairs of antennas in the bow section of the airplane, a ID-226A/APR-9 Indicator and a C-654/APR-9B Control unit at the RCM-MAD operator station, a PP336/APR-9 Power Supply, PP337/APR-9 Auxiliary power unit, CV-43/APR-9 Mixer Amplifier, and four r-f tuning units; TN-128/APR-9, TN-129B/APR-9, TN-130/APR-9 and TN-131/APR-9 are in the bow compartment.

Controls for the equipment are on the front panels of the Indicator and the Control Unit at the RCM-MAD operator's station. Any one of the tuning units may be selected by the "BAND SWITCH" on the Control Unit. Tuning unit switching is accomplished by a special four position coaxial and multi-pole relay.

Antenna selection is accomplished through the "ANTENNA SELECTOR" switch at the RCM-MAD operator's station. This switch controls a number of coaxial relays which switches the different antennas to the tuning units. The "BAND SWITCH"

on the Control Unit and the "ANTENNA SELECTOR" switch must be correlated in order to select the proper tuning and antenna for the frequency range to be covered.

Audio output of the CV-43A/APR-9 mixer amplifier is fed to the interphone station box at the RCM-MAD operator's station. Placing the station box switch in "RADIO" position will permit the audion output to be heard through the RCM-MAD operator's headset.

Video output of the CV-43A/APR-9 mixer amplifier is fed to the switch assembly where it is converted to a suitable voltage to operate the ID-24/APN-9 approach indicators.

Power to operate the equipment is supplied from both 115 volt 400 cycle a-c and 28 volt d-c navigator's overhead panel busses through two 5-ampere circuit breakers on the panel marked "RCM RECEIVER"—"AC"—"DC".

OPERATION OF AN/APR-9B RADAR RECEIVING SET.

a. Set controls on the C-654/APR-9B Control Unit as follows:

Control	*Setting*
Power	Off
Sector Sweep-Manual	Manual
Fixed Osc.	Off
I-F Attn'n.	Maximum clockwise (odb)
Bandwidth	Wide
Band Switch	Set to frequency range corresponding to r-f tuner in use
AGC	Off
Audio Gain	Maximum clockwise
Panel Lights	Maximum clockwise
BFO	Off

WARNING

Observe safety precautions while operating this high voltage equipment.

c. After setting the controls as indicated in steps a and b, place the "POWER" switch to "ON". Allow about one minute for warm-up.

CAUTION

If the brightness of the trace on the scope is too high, turn the "INTENSITY" control counterclockwise to prevent burning of the cathode ray tube screen.

d. To stop the equipment, place the "POWER" switch on the control unit to "OFF".

AN/APA-74 SIGNAL ANALYZER.

The AN/APA-74 equipment, consisting of signal analyzer indicator IP-37/APA-74 and power supply PP-384/APA-74, is designed to analyze the video signal of any standard intercept receiver.

Note

AN/APA-74 is installed on airplanes No. 135528 upon delivery and on airplanes No. 135474 through 135527 after service change.

This airborne equipment on the RCM rack on the flight deck and is used in conjunction with AN/APR-9B Radar Set.

Pulse analysis information is displayed on all the traces of a five-gun cathode ray tube contained in the signal analyzer indicator IP-37/APA-74. Each trace has a different calibrated time base and scales are provided to permit direct measurement of pulse repetition frequency, pulse width and rise time. A watch may be used to determine modulation pattern and scanning rate of the received signal.

Power to operate this equipment is supplied by both 115 volt, 400 cycle a-c and 28 volt d-c navigator's overhead panel busses through two 5-ampere circuit breakers on the RCM operator's panel.

OPERATION OF AN/APA-74 SIGNAL ANALYZER.

Prior to Take-Off

a. Energize Radar Set AN/APR-9B.

b. Set "PWR" switch to "PWR" position.

c. Set "POLARITY" switch to either positive or negative position as required by the Radar Set.

d. Set "STRETCH" switch to "STRETCH" position.

e. Place "SCALE" switch at "BRT", "OUT" or "DIM" as convenient.

f. Allow signal analyzer AN/APA-74 to be energized for about fifteen minutes to reach stable operating temperature.

g. Tune the Radar Set AN/APR–9B to receive some convenient signal.

h. Adjust the GAIN control to provide a readable display (approximately one-half inch high) on the signal analyzer indicator IP–37/APA–74. A display should be present on each of the five sweeps whenever a signal is apparent. For a sweeping radar, the display will appear and disappear as the pulse bursts are fed to the signal analyzer indicator.

i. Place PWR switch in OFF position. Do not disturb the other controls.

j. Turn off control unit of Radar Set AN/APR–9B.

Prior to Use

Approximately one hour before the expected use of the AN/APA–74 signal analyzer proceed as follows:

a. Turn on Radar Set AN/APR–9B.

b. Set "PWR" switch to "PWR" position.

c. Set SCALE switch to position furnishing cursor with suitable illumination.

OPERATION DURING USE

a. Set the AGC switch control unit C–64/APR–9B to AGC.

b. Adjust the GAIN control of signal analyzer indicator IP–37/APA–74 to provide a readable display. If rise time measurement is desired adjust the GAIN control so that the display occupies the height between the origin mark and the 100% mark on the top scale.

c. Interpret the display.

d. When measuring pulse widths in excess of 50 microseconds, set the STRETCH switch to the OFF position.

e. Secure equipment by setting PWR switch to OFF position.

Note

In an emergency, the signal analyzer group AN/APA–74 may be turned off by removing the D.C. fuse on the front panel of power supply PP–384/APA–74.

AN/APA–70C HOMING EQUIPMENT.

The AN/APA–70C equipment, used in conjunction with AN/APR–9B radar receiving set, permits homing on radar signals. Components of this equipment include three pairs of antennas and an SA–240/APA–70C switch in the bow of the airplane, two 304/APA–70C indicators (one on the pilot's instrument panel and one on the RCM operator's panel) and coaxial relays for antenna selection.

Note

Airplanes No. 135531, 135534 and subsequent and 135474 through 135530, 135532 and 135533 after service change are not equipped with Homing Equipment AN/APA–70C.

The signals picked up by the port and starboard antennas are alternately fed to the APR–9B mixer amplifier through the APA–70C switch assembly. The video output of the mixer amplifier is returned to the switch assembly and ultimately appear as visual information on the APA–70C indicators (ID–304/APA–70C). The position of the vertical pointer on the indicators enables the pilot to accurately direct the airplane toward the source of the received signal while the horizontal pointer indicates signal strength.

Power to operate the equipment is supplied from both a-c and d-c busses. 115 volt a-c 400 cycle power is supplied from the navigator's overhead panel bus through a two-ampere fuse on the panel. This power supply is fed to the switch assembly through the contacts of a control relay. To energize this relay the RCM-HOMING-OFF switch on the RCM-MAD operator's panel must be placed in RCM HOMING position. 28 volt d-c power is supplied from the navigator's overhead panel bus through a two-ampere fuse on the panel marked RCM-HOMING-DC. This power is fed through the RCM HOMING-OFF switch to the SA–240/APA–70C switch assembly.

OPERATION OF AN/APA–70C HOMING.

a. To start the equipment place the RCM HOMING-OFF switch RCM HOMING position. Allow fifteen minutes for the equipment to reach stable operating temperature.

b. Energize the AN/APR–9B receiving equipment. Tune the receiver until a signal is received, as indicated by deflection of the VM meter. Use the meter as a tuning indicator.

c. Reduce the setting of the sensitivity control, if necessary, to bring the deflection of the VM meter to about one-quarter of full scale. Readjust the tuning of the receiver to peak the signal.

d. To stop the equipment, place the RCM HOMING-OFF switch to the OFF position.

AN/APX–6B RADAR IDENTIFICATION SET.

This equipment is an airborne identification set and is one of several equipments which may be operated together to provide a system of electronic identification and recognition. The purposes of the AN/APX–6B are:

a. To identify the airplane in which it is installed as friendly when correctly challenged by friendly shore, shipboard, and airborne radars.

b. To permit surface tracking and control of aircraft in which it is installed.

OPERATION OF AN/APX–6B RADAR IDENTIFICATION SET.

All controls required for operation of the AN/APX–6B equipment are on the C–1159/APX–6B control unit on the forward section of the co-pilot's console. Operate as follows:

a. To start equipment, rotate MASTER selector to NORM.

b. To maintain the equipment ready but inoperative, rotate the MASTER selector to STDBY.

c. The detent position labeled LOW on the MASTER selector should not be used except upon proper authorization.

d. The switches labeled MODE should be set to their OUT positions.

e. To secure the equipment, rotate the MASTER selector to OFF.

EMERGENCY OPERATION OF AN/APX–6B RADAR IDENTIFICATION SET.

To indicate an emergency or distress, press red dial stop on the control unit, and rotate the MASTER selector to EMERGENCY.

AN/APX–6 RADAR IDENTIFICATION SET.

Functionally, the AN/APX–6 receives challenges initiated by an interrogrator-responsor and transmits replies back to the responsor where they are displayed, along with the associated radar targets, on the radar indicators. When the radar target is accompanied by a proper IFF reply, as transmitted by the AN/APX–6 the target is considered friendly.

OPERATION OF AN/APX–6 RADAR IDENTIFICATION SET. (See figure 4–4B.) The first three controls listed are on the front panel of Receiver Transmitter RT–82/APX–6 on the left side of the electronics compartment, and the remaining controls are on Radar Set Control C–629/APX–6. These controls are installed on the forward section of the co-pilot's console.

a. Place MASTER control (on the Radar Set Control C–629/APX–6) in OFF position.

b. On the Receiver-Transmitter RT–82/APX–6:

1. Set the RECR-FREQ counter to the number on the calibration chart that corresponds to the frequency control on which the equipment is to receive interrogation signals.

2. Turn the LO-FREQ counter (controlling the local oscillator) to the numerical setting for the same channel. This establishes an intermediate frequency of 59.5 megacycles.

3. Set the TRANS-FREQ counter to the calibration chart reading for the channel on which the transponder is to transmit reply signals.

c. On the Radar Set Control C–629/APX–6:

1. Rotate the MASTER control to STDBY, LOW or NORM position as required.

2. Set the MODE 2 control to required position.

3. Set the MODE 3 control to required position.

4. EMERGENCY. Press the dial stop and rotate the MASTER control to the EMERGENCY position.

5. To secure the AN/APX–6 equipment, rotate the MASTER control to the OFF position.

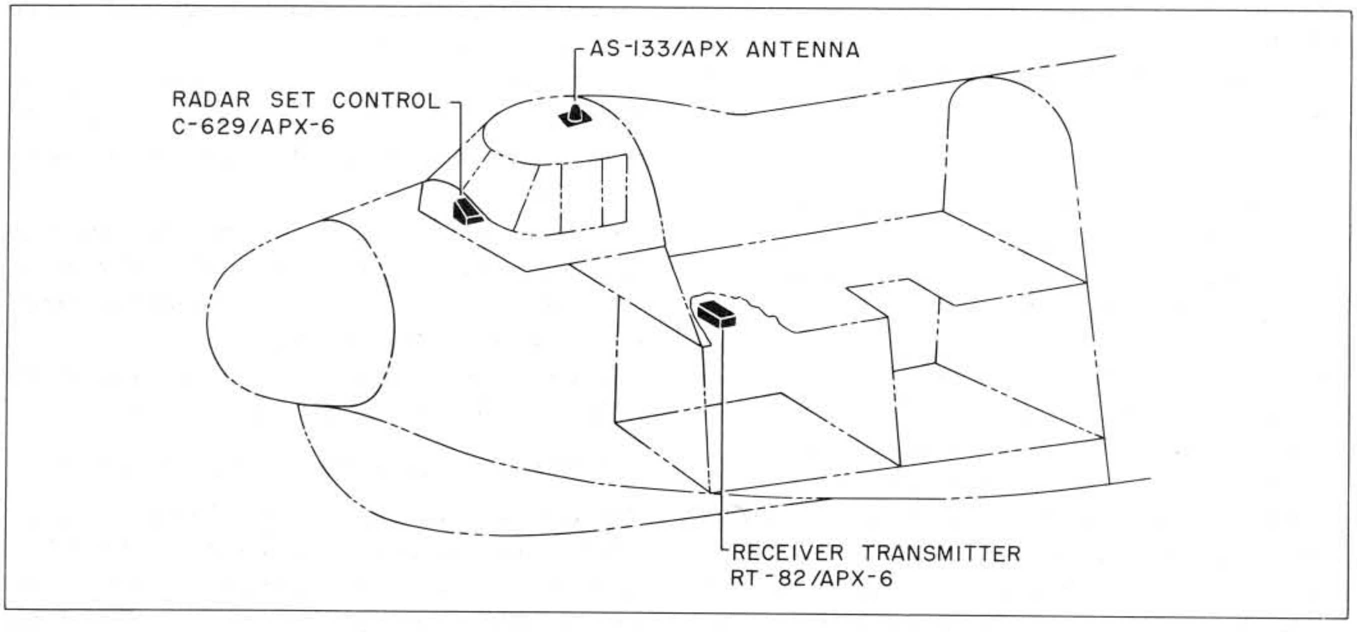


Figure 4–4B. AN/APX–6 Set Control

AN/APX-6 ANTENNA SYSTEM. The omni-directional antenna AS-133/APX-6, used for both receiving and transmitting, is mounted directly to the skin of the aircraft above the cockpit (figure 4-5A) and is connected to the ANTENNA recptacle on the front panel of the receiver-transmitter. This antenna is essentially a broad-band half-wave radiator coupled to a three-quarter-wave matching section. It is vertically polarized and requires no adjustment over the operating frequency band of 950 to 1150 megacycles.

AN/APX-7 RADAR RECOGNITION SET.

The AN/APX-7 Radar Recognition Set is an airborne IFF (Identification, Friend or Foe) set designed to operate in conjunction with AN/APS-44A Radar Set. The primary purpose of the AN/APX-7 equipment is to challenge the identity of other aircraft and ships and to trigger characteristic replies from friendly aircraft or ships equipped with an IFF Transponder AN/APX-6B (or equivalent). Replies are received from the Transponder in the target aircraft by the AN/APX-7 equipment and video outputs are developed for display on the radar operator's and navigator's Radar Indicator. The AN/APX-7 is synchronized with the AN/APS-44A Radar Set for proper display of the IFF Video with respect to detected targets.

The components of the AN/APX-7 system are: Radar Receiver-Transmitter RT-261/APX-7; Coder Synchronizer KY84/APX-7, and Radar Set Control C-1040/APX-7. An AS-133/APX Antenna on the bow, below the radome serves for reception and transmission.

CAUTION

Keep CHALL and RELAY MODE switches in OUT at all times. To challenge, operate the applicable IFF switch on the radio operator's or navigator's radar indicator.

The system is powered from the 115 volt, single phase, 400 cycle bus through three circuit breakers and the 28 volt d-c bus through a circuit breaker on the radar operator's control panel.

OPERATION OF AN/APX-7 RADAR RECOGNITION SET.

Note

The following procedure is for operation of AN/APX-7 only in conjunction with AN/APS-44A Radar set.

a. To operate the system, place the circuit breakers on the radar operator's panel in ON.

b. Place POWER switch in ON.

c. Select the type of video desired.

d. To challenge, operate the applicable IFF Mode switch on either the radar operator's or navigator's indicator.

e. Adjust the GAIN control to desired intensity for correct PPI display.

NORMAL SHUTDOWN OF THE AN/APX-7 RADAR RECOGNITION SET.

a. Set IFF switches, on both indicators, in OFF.

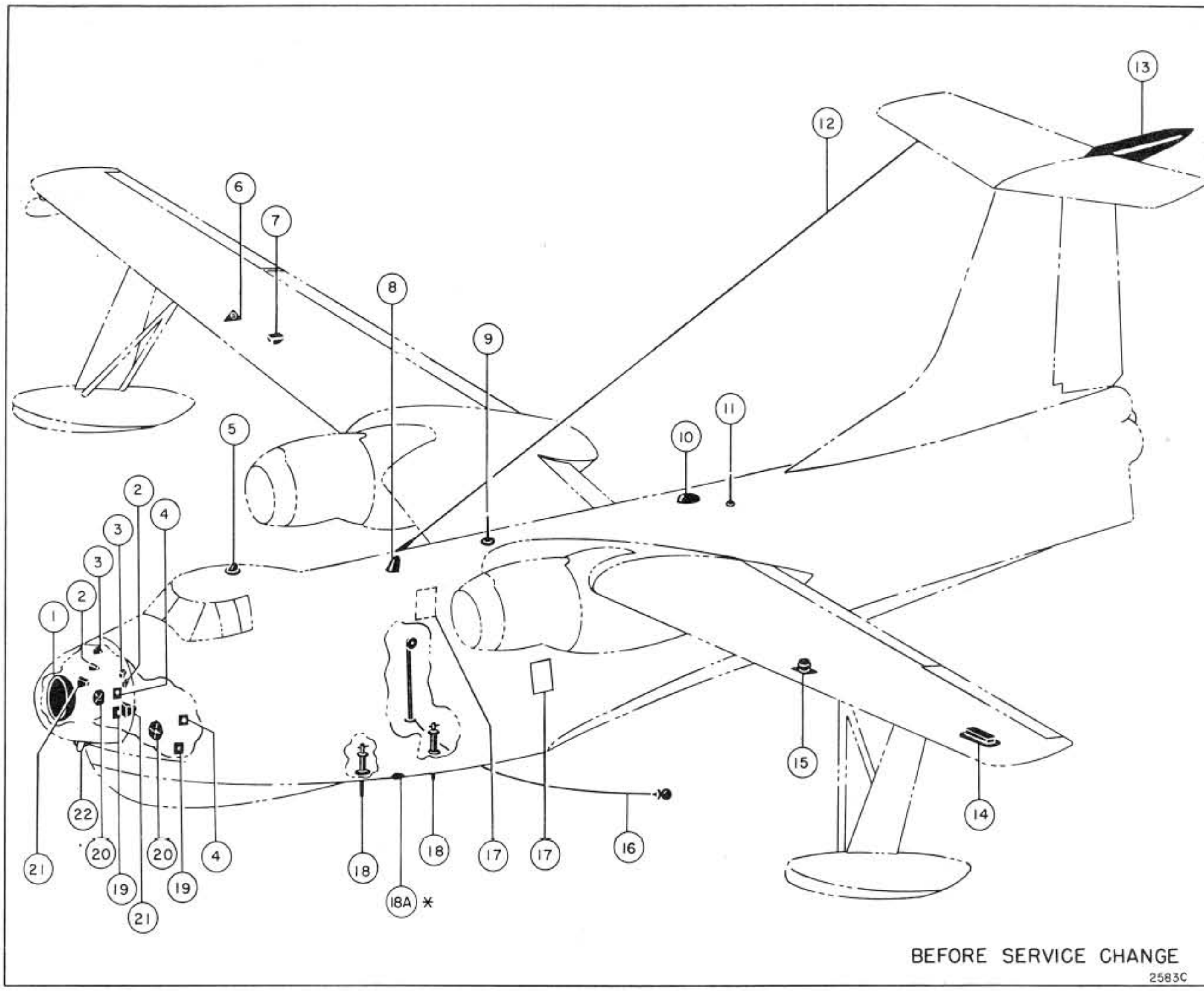
b. Set Video switch in RADAR.

c. Rotate GAIN control maximum distance counterclockwise.

d. Place PWR switch in OFF.

EMERGENCY SHUTDOWN OF AN/APX-7 RADAR RECOGNITION SET.

In an emergency, set PWR switch on the front panel of the Radar Control Set to OFF.



1 Scanner, AS-562/APS-44A
2 Antenna, AT-306/APA-70
3 Antenna, AT-307/APA-70
4 Antenna, AT-304/APR-9
5 Antenna, AS-133/APX-6
6 Radar Receiver Transmitter, AN/APN-22
7 Electronic Control Amplifier, AN/APN-22
8 Antenna, AT-141A/ARC
9 Antenna, AN/ARC-5
10 Loop Antenna, AS-313/ARN-6, No. 1
11 Sense Antenna, AN/ARN-6, No. 1
12 Fixed Wire Antenna, AN/ART-13
13 Detecting Head, AN/ASQ-8
14 Marker Beacon Antenna, R-122/ARN-12
15 Flux Gate Transmitter, R-88-T-1910
16 Trailing Antenna, RL-42B
17 Antenna, AT-495/ARN-14E
18 Sonobuoy Antenna, AN/ARR-26
*18A Antenna AN/ARN-21
19 Antenna, AT-303/APR-9
20 Antenna, AT-302/APR-9
21 Antenna, AT-305/APA-70
22 Antenna, AS-133/APX-7

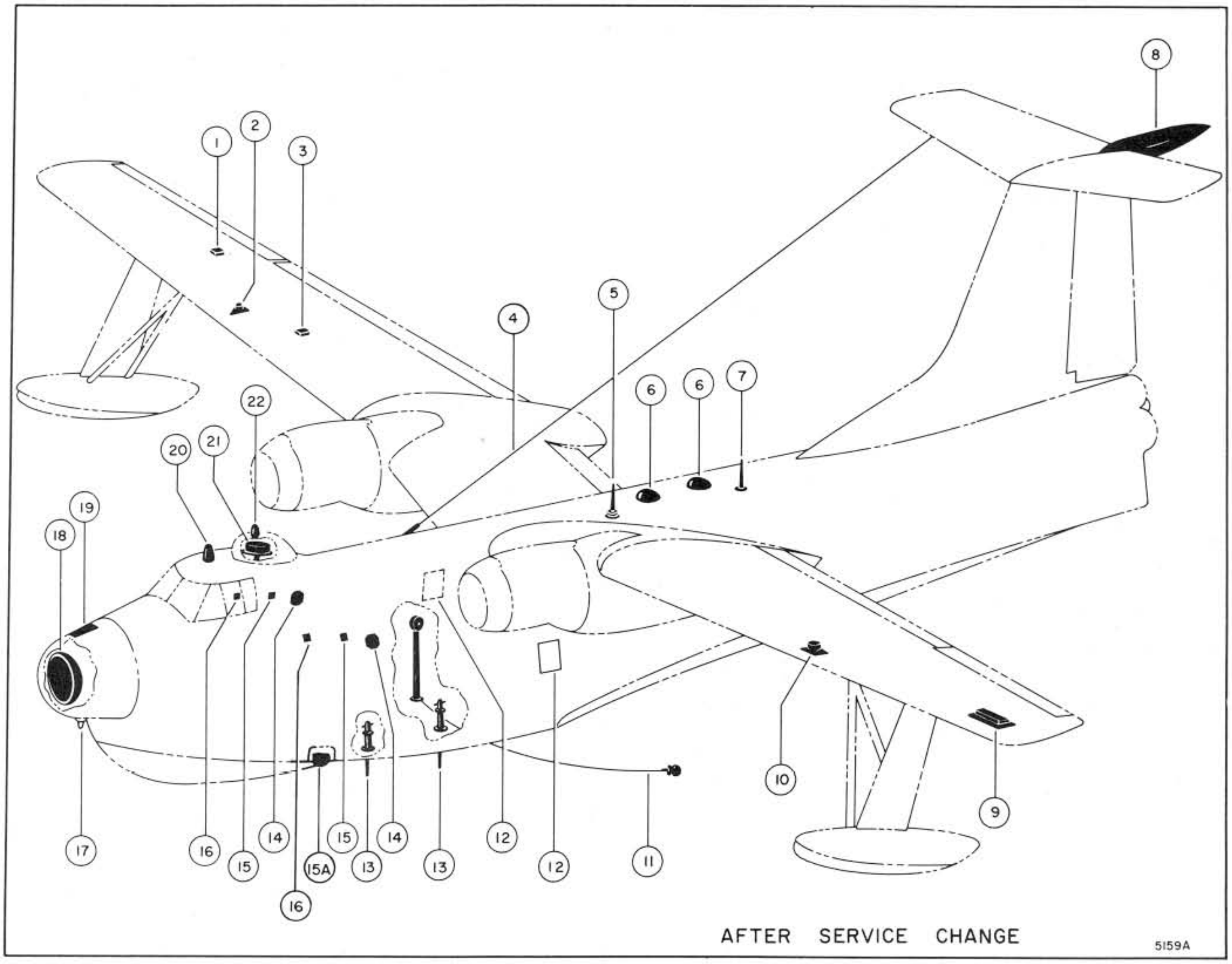
* On Airplanes No. 135539 and up as delivered and on No. 135474 through 135538 after service change.

Figure 4-5. Antenna System

FIXED AND TRAILING WIRE ANTENNA SYSTEM. (See Figure 4-5.)

The liaison and loran radio equipment share the fixed wire antenna and the trailing antenna but not simultaneously. This sharing of antennas is accomplished by means of an antenna selector switch and two antenna relays. The antenna selector switch is on the radio operator's overhead panel marked HF TRAIL, LORAN FIXED and HF FIXED, LORAN TRAIL.

The trailing wire antenna is wound on a motor-driven antenna reel which is controlled by a reel control unit on the radio operator's rack. The control unit contains a control switch; a counter wheel, which indicates the footage of wire trailing; and an indicator light, which will come on when the antenna is not fully retracted.



1	G-2 Compass Transmitter	13	AN/ARR-22, AT-446/ARR Antenna
2	Radar Receiver Transmitter AN/APN-22	14	AT-302/APR-9 Antenna
3	Electronic Control Amplifier AN/APN-22	15	AT-303/APR-9 Antenna
4	AN/ART-13 Fixed Wire Antenna	15A	AN/ARN-21 Antenna
5	Co-Pilot's AN/ARN-6 Sense Antenna AT-563/ARN	16	AT-304/APR-9 Antenna
6	AN/ARN-6 Loop Antenna AS-313/ARN-6	17	AN/APX-7, AS-133/APX Antenna
7	Pilot's AN/ARN-6 Sense Antenna AT-563/ARN	18	Scanner (170°) AS 562/APS-44A
8	AN/ASQ-8 (DT-37/ASQ-8) Detecting Head	19	AS-578/ARA-25 Antenna
9	Marker Beacon Antenna, R-122/ARN-12	20	AN/ARC-27, AT-141A/ARC Antenna
10	Flux Gate Transmitter, R-88-T-1910	21	AN/ARA-69 Antenna
11	RL-42B Trailing Antenna	22	APX-6, AS-133/APX Antenna
12	AN/ARN-14E Antenna, AT-495/ARN-14E		

Figure 4-5A. Antenna System

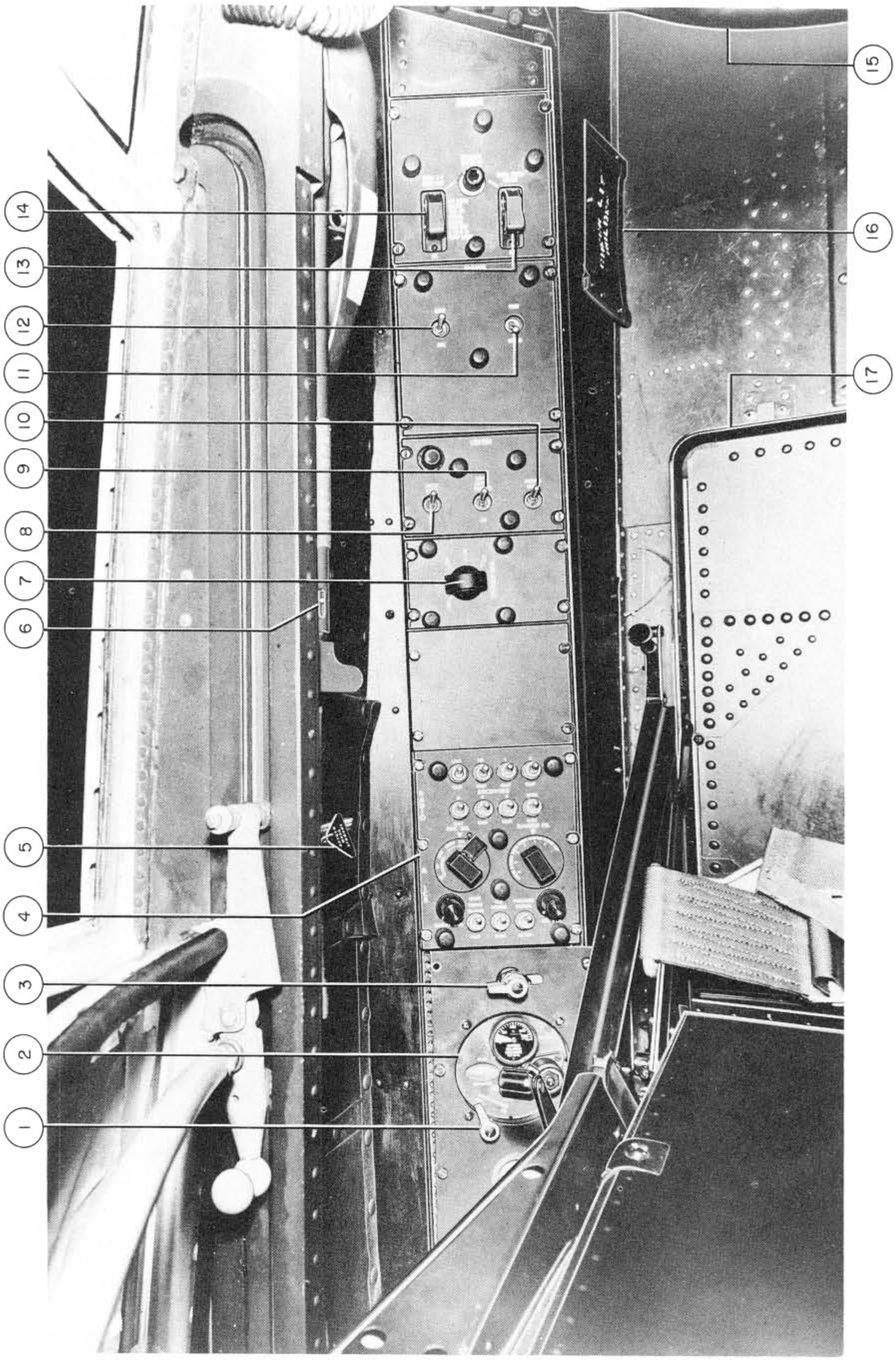


Figure 4-6. Pilot's Side Console Panel

KEY TO FIGURE 4-6

1 Valve, Oxygen Safety Pressure
2 Regulator, Oxygen
3 Valve, Oxygen Main Supply
4 Panel, Radio Inter-Communication Control
5 Stowage, Oxygen Mask
6 Gust Lock, Surface Control
7 Rheostat, Windshield Wiper
8 Switch, Anchor Light Control
9 Switch, Master Lighting Control
10 Switch, Boarding Light Control
11 Switch, Rocket, Pairs and Singles Control
12 Switch, Rocket Ready and Safe Control
13 Switch, Emergency Stores Release
14 Switch, Emergency Bomb Bay Open Control
15 Wheel, Aileron Control
16 Holder, Check List
17 Seat, Pilot's

Power to operate the antenna reel drive motor is supplied from the radio operators 28 volt dc radio bus through a 10-ampere circuit breaker and a one-ampere fuse on the radio operator's sloping panel marked "ANT. REEL". The "ON-OFF" switch on this same section of panel must be in the "ON" position to energize the "RADIO BUS".

OPERATION OF FIXED AND TRAILING WIRE ANTENNA SYSTEM.

When the selector switch is in the "HF FIXED, LORAN TRAIL" position the antenna relays are normally de-energized and the AN/ART-13 HF transmitter is connected to the fixed wire antenna and the loran receiver is connected to the trailing antenna.

When this switch is in the "HF TRAIL, LORAN FIXED" position, the antenna relays are energized and the AN/ART-13 HF transmitter is connected to the trailing antenna and the loran receiver is connected to the fixed antenna.

LIGHTING EQUIPMENT.

INTERIOR LIGHTS.

CENTER COCKPIT AND NAVIGATOR'S PANEL LIGHTS.

The red illumination lighting system for the center cockpit and navigator's panels, including panel lights, lucite panel lighting, and instrument mask lights, is energized from the main 115 volt a-c bus system. This bus voltage is reduced to 26 volts for operating the various groups of lights through transformers which have tapped secondaries. Each transformer secondary has its taps connected to one or more brilliance switches, which in addition to an "OFF" position, control the corresponding lights through seven stages of light intensity.

The overhead panel lights transformer, located in the cockpit distribution box, is connected to the overhead switch panel lights brilliance switch in the cockpit overhead panel (15, figure 1-8). This switch controls the lucite lighting for the engine control, fire control, interphone and radio control boost disconnect, and AN/ARC-5 panels in the cockpit overhead panel group. The pedestal and fuel panel lights transformer, located in the cockpit distribution box, is connected to two brilliance switches in the cockpit overhead panel. The pedestal floodlight brilliance switch controls the pedestal floodlight which is mounted to the forward end of the overhead switch panel and the fuel panel lights brilliance switch controls the lucite lighting and the instrument mask lights on the fuel panel. Each group of lights and each transformer secondary used for center cockpit lighting has a fuse mounted in the cockpit distribution panel for circuit and equipment protection.

The navigator's instrument panel and pilot's aft control panel lights transformer, located in the pilot's aft control box, is connected to two brilliance switches. One of them, located in the navigator's light control panel, controls the instrument mask lights and the AN/ARN-14E panel light on the navigator's instrument panel. The other switch is located on the pilot's aft control panel (20, figure 1-13) and controls the instrument mask lights, lucite lighting, and boot deicer controller illumination lights on the pilot's aft control panel. Each group of lights and transformer secondary used for this lighting circuit has a fuse mounted in the pilot's aft control panel for circuit and equipment protection.

The cockpit and navigator's panel lights circuit breaker on the cockpit distribution panel provides circuit protection for the primary side of the above mentioned transformers.

RIGHT COCKPIT PANEL LIGHTS.

The red illumination lighting system for the right cockpit panels, including lucite panel lighting and instrument mask lights, is energized from the main 115 volt a-c bus system. This bus voltage is reduced to 26 volts for operating the various groups of lights through transformers which have tapped secondaries. Each transformers secondary has its taps connected to one or more brilliance switch which, in addition to "OFF" position, controls the corresponding lights through seven stages of light intensity.

The co-pilot's instrument panel lights transformers located on the cockpit distribution box, is connected to three brilliance switches; engine instrument lights, flight instrument lights, and console light which are located on the co-pilot's sub-panel. The engine instrument lights brilliance switch controls the engine instrument mask lights on the co-pilot's instrument panel. The flight instrument lights brilliance switch controls the flight instrument mask lights and the AN/ARN-14E panel light on the co-pilot's instrument panel. The co-pilot's sub-panel and console lights brilliance switch through one bank, controls the lucite lighting on the AN/APX-6B section of the co-pilot's console.

The co-pilot's sub-panel console lights transformer also located in the cockpit distribution, is connected to one bank of the co-pilot's sub-panel and console lights brilliance switch located on the co-pilot's sub-panel. This bank of the switch controls the lucite lighting on the exterior lights section, the miscellaneous section, and AN/AIC-5B section and the AN/AVQ-2A section of the co-pilot's console; it also controls the lucite lighting on the fuel control section, instrument section, and lighting section of the co-pilot's sub-panel and the lucite lighting on the cowl flap switch section of the co-pilot's instrument panel. The center console lighting switch controls the AN/ARN-14E section, AN/ARC-27A section and the AN/ARC-5 section of the center console.

The right cockpit panel lights circuit breaker on the cockpit distribution panel provides circuit protection for the primary side of the transformers. Each group of lights and each transformers secondary in this lighting system has a fuse mounted on the cockpit distribution panel for circuit protection.

LEFT COCKPIT PANEL LIGHTS.

The red illumination lighting system for the left cockpit panels, including lucite panel lighting and instrument mask lights, is energized from the main 115 volt a-c bus system. This bus voltage is reduced to 26 volts for operating the various groups of lights through transformers which have tapped secondaries. Each transformer secondary has its taps connected to one or more brilliance switch which, in addition to an "OFF" position, controls the corresponding lights through seven stages of light intensity.

The pilot's instrument panel and check off lights transformer, in the cockpit distribution box, is connected to the pilot's flight instrument lights brilliance switch on the pilot's sub-panel which controls the instrument mask lights, lucite lighting of the propeller control panel above the instrument panel and the magnetic compass lighting which has an additional "ON"—"OFF" switch mounted on the compass support bracket. This transormer also supplies power (no brilliance control) to operate the pilot's check off list lucite lighting which is controlled by a switch, located on the check list panel (65, figure 1-5) in such that when the switch is in "TAKE-OFF" position the take-off check list is illuminated, when the switch is in "LAND" position the landing check list is illuminated, and when the switch is in "OFF" position neither side is illuminated.

The pilot's sub-panel console lights transformer, located in the cockpit distribution box, is connected to a brilliance switch "pilot's console panel lights" which is located on the pilot's sub-panel. The console panel lights switch controls the lucite lighting in the armament and lighting control section, the windshield wiper section and the various radio control sections of the pilot's console panel. The pilot's sub-panel lights transformer, also located in the cockpit distribution box, is connected to a brilliance switch, "PILOT'S SUB-PANEL LIGHTS", which is located on the pilot's sub-panel. The sub-panel lights switch controls the lucite lighting and instrument mask lights on the compass control lighting section and booster control section of the pilot's sub-panel.

The left cockpit panel lights circuit breaker on the cockpit distribution panel provides circuit protection for the primary side of the transformers. Each group of lights and each transformer secondary in this lighting system has a fuse mounted on the cockpit distribution panel for circuit and equipment protection.

COCKPIT LOW INTENSITY LIGHTS.

The cockpit low intensity lighting system is provided to furnish mild red illumination for entering the cockpit and to supplement the panel lucite lighting for locating switch toggles and knobs. This lighting system is provided in two circuits—one for the pilot's section of the cockpit and one for the co-pilot's.

The pilot's low intensity lighting circuits consists of three lights mounted under the pilot's sill for illuminating the left side of the cockpit and two lights mounted on the forward side of the cockpit distribution panel for illuminating the pilot's aft control panel. These lights are controlled by either one of two switches the left cockpit low intensity lights switch on the pilot's aft control (11, figure 1-13) or the pilot's low intensity light switch on the pilot's sub-panel.

KEY TO FIGURE 4–6

1	Valve, Oxygen Safety Pressure
2	Regulator, Oxygen
3	Valve, Oxygen Main Supply
4	Panel, Radio Inter-Communication Control
5	Stowage, Oxygen Mask
6	Gust Lock, Surface Control
7	Rheostat, Windshield Wiper
8	Switch, Anchor Light Control
9	Switch, Master Lighting Control
10	Switch, Boarding Light Control
11	Switch, Rocket, Pairs and Singles Control
12	Switch, Rocket Ready and Safe Control
13	Switch, Emergency Stores Release
14	Switch, Emergency Bomb Bay Open Control
15	Wheel, Aileron Control
16	Holder, Check List
17	Seat, Pilot's

Power to operate the antenna reel drive motor is supplied from the radio operators 28 volt dc radio bus through a 10-ampere circuit breaker and a one-ampere fuse on the radio operator's sloping panel marked "ANT. REEL". The "ON-OFF" switch on this same section of panel must be in the "ON" position to energize the "RADIO BUS".

OPERATION OF FIXED AND TRAILING WIRE ANTENNA SYSTEM.

When the selector switch is in the "HF FIXED, LORAN TRAIL" position the antenna relays are normally de-energized and the AN/ART–13 HF transmitter is connected to the fixed wire antenna and the loran receiver is connected to the trailing antenna.

When this switch is in the "HF TRAIL, LORAN FIXED" position, the antenna relays are energized and the AN/ART–13 HF transmitter is connected to the trailing antenna and the loran receiver is connected to the fixed antenna.

LIGHTING EQUIPMENT.

INTERIOR LIGHTS.

CENTER COCKPIT AND NAVIGATOR'S PANEL LIGHTS.

The red illumination lighting system for the center cockpit and navigator's panels, including panel lights, lucite panel lighting, and instrument mask lights, is energized from the main 115 volt a-c bus system. This bus voltage is reduced to 26 volts for operating the various groups of lights through transformers which have tapped secondaries. Each transformer secondary has its taps connected to one or more brilliance switches, which in addition to an "OFF" position, control the corresponding lights through seven stages of light intensity.

The overhead panel lights transformer, located in the cockpit distribution box, is connected to the overhead switch panel lights brilliance switch in the cockpit overhead panel (15, figure 1–8). This switch controls the lucite lighting for the engine control, fire control, interphone and radio control boost disconnect, and AN/ARC–5 panels in the cockpit overhead panel group. The pedestal and fuel panel lights transformer, located in the cockpit distribution box, is connected to two brilliance switches in the cockpit overhead panel. The pedestal floodlight brilliance switch controls the pedestal floodlight which is mounted to the forward end of the overhead switch panel and the fuel panel lights brilliance switch controls the lucite lighting and the instrument mask lights on the fuel panel. Each group of lights and each transformer secondary used for center cockpit lighting has a fuse mounted in the cockpit distribution panel for circuit and equipment protection.

The navigator's instrument panel and pilot's aft control panel lights transformer, located in the pilot's aft control box, is connected to two brilliance switches. One of them, located in the navigator's light control panel, controls the instrument mask lights and the AN/ARN–14E panel light on the navigator's instrument panel. The other switch is located on the pilot's aft control panel (20, figure 1–13) and controls the instrument mask lights, lucite lighting, and boot de-icer controller illumination lights on the pilot's aft control panel. Each group of lights and transformer secondary used for this lighting circuit has a fuse mounted in the pilot's aft control panel for circuit and equipment protection.

The cockpit and navigator's panel lights circuit breaker on the cockpit distribution panel provides circuit protection for the primary side of the above mentioned transformers.

RIGHT COCKPIT PANEL LIGHTS.

The red illumination lighting system for the right cockpit panels, including lucite panel lighting and instrument mask lights, is energized from the main 115 volt a-c bus system. This bus voltage is reduced to 26 volts for operating the various groups of lights through transformers which have tapped secondaries. Each transformers secondary has its taps connected to one or more brilliance switch which, in addition to "OFF" position, controls the corresponding lights through seven stages of light intensity.

The co-pilot's instrument panel lights transformers located on the cockpit distribution box, is connected to three brilliance switches; engine instrument lights, flight instrument lights, and console light which are located on the co-pilot's sub-panel. The engine instrument lights brilliance switch controls the engine instrument mask lights on the co-pilot's instrument panel. The flight instrument lights brilliance switch controls the flight instrument mask lights and the AN/ARN-14E panel light on the co-pilot's instrument panel. The co-pilot's sub-panel and console lights brilliance switch through one bank, controls the lucite lighting on the AN/APX-6B section of the co-pilot's console.

The co-pilot's sub-panel console lights transformer also located in the cockpit distribution, is connected to one bank of the co-pilot's sub-panel and console lights brilliance switch located on the co-pilot's sub-panel. This bank of the switch controls the lucite lighting on the exterior lights section, the miscellaneous section, and AN/AIC-5B section and the AN/AVQ-2A section of the co-pilot's console; it also controls the lucite lighting on the fuel control section, instrument section, and lighting section of the co-pilot's sub-panel and the lucite lighting on the cowl flap switch section of the co-pilot's instrument panel. The center console lighting switch controls the AN/ARN-14E section, AN/ARC-27A section and the AN/ARC-5 section of the center console.

The right cockpit panel lights circuit breaker on the cockpit distribution panel provides circuit protection for the primary side of the transformers. Each group of lights and each transformers secondary in this lighting system has a fuse mounted on the cockpit distribution panel for circuit protection.

LEFT COCKPIT PANEL LIGHTS.

The red illumination lighting system for the left cockpit panels, including lucite panel lighting and instrument mask lights, is energized from the main 115 volt a-c bus system. This bus voltage is reduced to 26 volts for operating the various groups of lights through transformers which have tapped secondaries. Each transformer secondary has its taps connected to one or more brilliance switch which, in addition to an "OFF" position, controls the corresponding lights through seven stages of light intensity.

The pilot's instrument panel and check off lights transformer, in the cockpit distribution box, is connected to the pilot's flight instrument lights brilliance switch on the pilot's sub-panel which controls the instrument mask lights, lucite lighting of the propeller control panel above the instrument panel and the magnetic compass lighting which has an additional "ON"—"OFF" switch mounted on the compass support bracket. This transormer also supplies power (no brilliance control) to operate the pilot's check off list lucite lighting which is controlled by a switch, located on the check list panel (65, figure 1-5) in such that when the switch is in "TAKE-OFF" position the take-off check list is illuminated, when the switch is in "LAND" position the landing check list is illuminated, and when the switch is in "OFF" position neither side is illuminated.

The pilot's sub-panel console lights transformer, located in the cockpit distribution box, is connected to a brilliance switch "pilot's console panel lights" which is located on the pilot's sub-panel. The console panel lights switch controls the lucite lighting in the armament and lighting control section, the windshield wiper section and the various radio control sections of the pilot's console panel. The pilot's sub-panel lights transformer, also located in the cockpit distribution box, is connected to a brilliance switch, "PILOT'S SUB-PANEL LIGHTS", which is located on the pilot's sub-panel. The sub-panel lights switch controls the lucite lighting and instrument mask lights on the compass control lighting section and booster control section of the pilot's sub-panel.

The left cockpit panel lights circuit breaker on the cockpit distribution panel provides circuit protection for the primary side of the transformers. Each group of lights and each transformer secondary in this lighting system has a fuse mounted on the cockpit distribution panel for circuit and equipment protection.

COCKPIT LOW INTENSITY LIGHTS.

The cockpit low intensity lighting system is provided to furnish mild red illumination for entering the cockpit and to supplement the panel lucite lighting for locating switch toggles and knobs. This lighting system is provided in two circuits—one for the pilot's section of the cockpit and one for the co-pilot's.

The pilot's low intensity lighting circuits consists of three lights mounted under the pilot's sill for illuminating the left side of the cockpit and two lights mounted on the forward side of the cockpit distribution panel for illuminating the pilot's aft control panel. These lights are controlled by either one of two switches the left cockpit low intensity lights switch on the pilot's aft control (11, figure 1-13) or the pilot's low intensity light switch on the pilot's sub-panel.

The co-pilot's low intensity lighting circuit consists of three lights mounted under the co-pilot's sill for illuminating the right side of the cockpit and two lights mounted on the forward side of the pilot's aft control panel for illuminating the cockpit distribution panel. These lights are controlled by either one of two switches—the right cockpit low intensity lights switch on the pilot's aft control panel (11, figure 1-13) or the co-pilot's low intensity light switch on the co-pilot's sub-panel.

Power to operate both light circuits is supplied through the cockpit low intensity lights circuit breaker on the cockpit distribution panel.

TAIL COMPARTMENT RED LIGHTS.

Red lights are located throughout the tail section of the airplane to furnish a mild illumination for personnel moving through that portion of the airplane and for the aft beaching gear compartment. These lights are controlled by a two way switch arrangement in which either of two switches may be used to operate the lights. One switch is located in a switch box in the aft waist compartment. The other switch is in the tail gunner's switch box. Three of the lights are incorporated in lighting fixtures which also include white dome lights in the tail. A small panel type lights is under a shelf in the beaching gear compartment.

Power for operating the tail compartment red lights is supplied through a circuit breaker on the tail distribution box.

FORWARD HULL AND FLIGHT DECK DOME LIGHTS.

These lights are provided to furnish general illumination for various work areas and are controlled as a group by the pilot's master white lights control switch on the pilot's console panel (9, figure 4-6). This switch can be used by the pilot to turn off all the white lights at once if conditions warrant. However, when the switch is closed it energizes a forward dome light relay which in turn, delivers power to the individual lights or groups of lights and their controlling switches which are listed as follows:

Light Name	*Switch Location*
Forward Entrance Light (1)	Right Forward Entrance Switch Box
Electronics Work Table Light (1)	In Light Base
Bow Compartment Light (1)	Under Pilot's Floor
Electronics Compartment Lights (4)	Bulkhead 285 Switch Box
Beaching Gear Compartment Light (1)	Bulkhead 285 Switch Box
Flight Deck Dome Lights (3)	Lower Stairway Switch Box and Upper Stairway Switch Box
Galley Light (1)	On Light Bracket

The navigator's chart light, included in this system but not controlled by the master white light switch and which is mounted above the navigator's lights control panel, is controlled by a rheostat (with "OFF" position) on the navigator's lights control panel (16, figure 4-4). A red lens is provided with this light for use when white lighting is prohibited.

The main power center dome light, included with this system but having no electrical connection with it, operates from the battery bus and is controlled by a switch inside the main power center.

Electrical power for the master white lights control circuit is supplied from the main d-c bus system through the master dome light circuit breaker on the cockpit distribution panel. Power to operate these lights, except the main power center dome lights, is supplied from the main d-c bus system through the forward hull and flight deck dome lights circuit breaker on the main power center panel.

CENTER AND AFT HULL DOME LIGHTS.

The center and aft hull dome lights are provided to furnish general illumination for the aft portion of the airplane. These lights, in addition to the forward hull and flight deck white lights are controlled as a group by the pilot's master white lights control switch on the pilot's console panel (9, figure 4-6). This switch can be used by the pilot to turn off all the white lights at once if conditions warrant. However, when the master switch is closed it energizes a center and aft hull dome lights relay, in the sonobuoy distribution box, when in turn, delivers power to the individual light control switches.

The two sonobuoy compartment dome lights are controlled by a two-way switch arrangement in which either of two switches may be used to operate the lights. One switch is located in one switch box and the other on a nearby switch box. The left aft entrance dome light is controlled by a switch on the left aft entrance switch box. The two right aft entrance dome lights are controlled by a switch on the right aft entrance switch box. The two tail compartment dome lights and the tail beaching gear compartment white lights are controlled by a two way switch arrangement in which either of two switches, one located in aft waist compartment switch box and the other on the tail gunner's switch box, may be used to operate the lights. The three bunk lights are controlled individually by switches mounted on their bases.

Electrical power for the master white lights control circuit is supplied from the d-c bus system through the master dome light circuit breaker on the cockpit distribution panel. Power to operate these lights is supplied from the main d-c bus system through the center and aft hull dome lights circuit breaker on the sonobuoy distribution box.

ANTI-GLARE AND C-4A LIGHTS.

Two anti-glare lights, mounted above the cockpit door, are provided to furnish general illumination within the cockpit and for use under certain lighting conditions which have a tendency to cause glare on the instrument dials. These lights are controlled by a switch on the co-pilot's console panel. (See figure 4-3.)

Two C-4A lights, one mounted under the pilot's lower sill left side and the other mounted under the co-pilot's lower sill right side are provided for cockpit spot lighting and for chart reading lights. These lights have individual rheostats (with "OFF" position) mounted in the light assemblies for light intensity control and also a push button switch for momentary lighting. Red lenses are provided for use with these lights under conditions prohibiting white light.

Power for operating the anti-glare and C-4A lights is supplied through a circuit breaker on the cockpit distribution panel.

NAVIGATOR'S AND RCM PANEL LIGHTS.

(See figure 4-4.)

The navigator's and RCM operator's panel lighting consists of general illumination of the panels as a group and lucite lighting of special individual panels, all of which provide red light. Four lights are in the flight deck crown for furnishing general illumination on the navigator's group of panels and these lights are controlled by a rheostat (with "OFF" position) on the navigator's armament panel (16, figure 4-4). The navigator's table light, mounted on the flight crown over the table, is controlled by a rheostate (with "OFF" position) on the navigator's light control panel. Lucite lighting of the navigator's radio compass AN/AIC-5B is controlled by a rheostat (with "OFF" position) on forward end of navigator's armament panel. The four lights located in the flight deck crown for furnishing general illumination of the RCM operator's group of panels are controlled by a rheostat (with "OFF" position) on the RCM panel. Lucite lighting of the AN/APR-9B, AN/AIC-5B, INDICATOR, AN/ASQ-8 RECORDER and AN/APS-44A control panels is controlled by a rheostat with "OFF" position on the navigator's panel and table lights and RCM panel lights, on the navigator's distribution panel. Mask Lighting for the RCM instrument panel is controlled by the RCM operator's instrument lights rheostat (with "OFF" position) on the RCM overhead panel. Power to operate these lights is supplied from the main d-c system through two circuit breakers on the navigator's distribution panel.

RADIO AND RADAR OPERATOR'S PANEL LIGHTS.

The radio and radar operator's panel lights consists of four lights in the crown of the flight deck compartment along the radio operator's panel, one light in the crown over the radar operator's table, the frequency meter light on left side of the radio operator's table looking forward and the lucite lighting on the radio operator's interphone control panel. All of these lights provide red general illumination. Control for these lights are through three rheostats (all with "OFF" position). Their location and the lights they control are as follows: one on the upper right corner of the radio operator's overhead panel marker "INTERPHONE CONTROL PANEL LIGHTS"—"OFF"—"BRIGHT", controls the lucite lighting of the radar operator's interphone control panel; one on the d-c control panel marked "PANEL LIGHTS"—"OFF"—"DIM"—"BRIGHT", controls the frequency meter light and four lights in the crown above the radio panel; one on the radar operator's control panel marked "OVERHEAD LIGHTS"—"OFF"—"DIM"—"BRIGHT". Power to operate and control the radio operator's panel lights is supplied from the 28 volt d-c radio operator's sloping panel marked "PANEL LIGHTS". Power to operate and control the radar operator's light is supplied from the 28 volt d-c radar operator's bus through a 5 ampere circuit breaker on the radar operator's panel marked "RADAR OPER. LIGHTS".

FLIGHT DECK PANEL LIGHTS.

The flight deck panel lights consists of red illumination lighting system for the AN/APS-44A radar indicator lights, AN/APS-44A set control lights, AN/44A navigator's indicators lights and AN/AIC-5B control box lights. Control for this group of lights consists of three brilliance switches as follows: One for the AN/APS-44A navigator's indicator located on the navigator's armament and distribution panel marked "NAVIGATOR'S CONSOLE LIGHTS", one for the AN/APS-44A radio operator's indicator lights located on the rack on left side of ship above cabinet marked "RADIO OPERATOR'S AN/APS-44A CONSOLE LIGHTS". One for the AN/APS-44A set control, AN/APS-44A radar indicator, AN/APX-7 control unit and AN/AIC-5B station box lights located on the radar station panel marked "RADIO OPER'S CONSOLE LIGHTS".

Electrical power to operate the flight deck panel lights is supplied from the 115/200 volt, 3 phase, 400 cycle bus through a flight deck lighting transformer circuit breaker on the navigator's armament panel. Each group of lights and each transformer in this lighting system is protected by a fuse on the navigator's armament end distribution panel.

BOARDING LIGHTS.

Red boarding lights are provided throughout the airplane to furnish illumination for entering or moving through the airplane. These lights are controlled by a four-way switch arrangement in which either one of the four switches may be used to turn on the lights. The switches are located in the pilot's console (10, figure 4-6) right forward external entrance switch box, right aft entrance switch box, and left aft entrance switch box.

There is one light in the forward entrance compartment, four lights in the electronics compartment, one light in the beaching gear compartment, two lights by the aft entrances, two lights in the electronics compartment by the interphone box, one light each in the forward and aft sonobuoy compartments two lights each at the left observer's and two lights at the right observer's interphone boxes and three lights in the flight deck. The flight deck boarding lights can be controlled also by a switch in the stairway switch box provided that the main boarding lights circuit is energized. There are two small red lights near the top of the flight deck stairs which come on whenever the flight deck hatch is opened and remain on as long as the hatch is kept open. Most of the red boarding lights are incorporated in lighting fixtures which also include the white dome lights.

Power to control and operate the boarding and stairway lights is supplied from the battery bus, which is energized at all times through two boarding light circuit breakers on the battery junction box.

Note

The boarding light control circuit breaker also supplies power to operate the main power center dome light.

BOMB BAY AND WING COMPARTMENT LIGHTS.

Compartment lights are provided in the bomb bay, nacelle area and outer wing compartments of each wing to furnish general work area illumination. The lighting circuit for both wings is identical.

The nacelle light and its controlling switch are located on the forward side of the front spar in the nacelle. The outer wing compartment light and its controlling switch is located in oil cooler area between front and center spars. The three bomb bay lights are controlled by a two way switch arrangement, one switch being located in the forward lower outboard part of the bomb bay and the other switch is located in the aft upper outboard part of the bomb bay.

Power to operate these lights is supplied through two compartment light circuit breakers (left wing and right wing) on the main power center panel.

EXTERIOR LIGHTS. (See figure 4-3.)

The exterior lighting system provides the required navigation position lights for formation flying and a special flasher coder set up which uses these lights to signal the airplane's identification to other aircraft and to ground forces. Controls for the exterior lighting system consist of a group of switches on the copilot's console panel and a manually operated flasher coder unit in the pilot's aft control box.

NAVIGATION POSITION LIGHTS.

The airplane is equipped with a conventional navigation light arrangement consisting of a red light on the left wing tip, a green light on the right wing tip and a white and yellow light cluster located on the right and left side of the hull below the tail gunner enclosure. Since the wing tip navigation lights will be obscured during flight, a vertical reflector lense is installed on each wing tip inboard and above the light. The lights are controlled by a master switch (14, figure 4-3) and two toggle switches (11 and 13, figure 4-3) on the exterior lighting control panel.

HULL LIGHTS.

The hull lights include three white section lights, one on the hull crown aft of the auxiliary power plant hatch and one on each side of the hull forward of the waist compartment entrance hatches. The hull lights are controlled by a master switch (14, figure 4-3) and by a single toggle switch (12, figure 4-3) on the exterior lighting control panel.

The hull lights and tail lights have individual control switches on the panel; however, none of these switches will operate the corresponiding lights unless the exterior lights master switch is turned to one of its operating positions—"CODE", "FLASH", or "STEADY". With the master switch in "CODE" position, the flasher coder unit will operate and cause the three hull lights to blink in a predetermined code as selected on the code selector switch while the wing tip lights and tail lights will be on continuously. With the waster switch in "FLASH" position, the flasher coder unit will operate and cause the yellow tail lights, the white tail lights and wing tip lights to flash alternately while the hull lights remains on continuously. With the master switch in "STEADY" position all the navigation lights will be on continuously unless individually turned off. A keying switch is provided on the panel to manually flash the hull lights but, for keying, the hull lights switch must be in the "OFF" position. There is also an indicator light on the panel which lights whenever the keying switch closes the circuit to the hull lights.

On the control panel is a brilliance switch with two positions—"DIM" and "BRIGHT" which simultaneously controls the brilliance of the hull lights, wing tip lights, and tail lights.

Power for the exterior lighting system is supplied from the main a-c bus system through two circuits breakers on the cockpit distribution panel.

LANDING LIGHTS.

There are two landing lights on the airplane, each located flush in the retracted position with the lower surface of each outer wing. They are controlled individually by a corresponding landing light switch in the cockpit overhead control panel (5, figure 1–8). When the control switch is placed in the EXTEND position, a motor in the light assembly will operate to extend the light until the control switch is turned off or until the light reaches its fully extended position. In this position the "extend" limit switch, within the light assembly, will open to shut off the motor and stop further movement of the light in that direction. When the control switch is placed in the RETRACT position, the motor will operate to retract the light until the control switch is turned off or until the light reaches its fully retracted position. In this position the "retract" limit switch, within the light assembly, will open to shut off the motor. The landing light will automatically come on as soon as the light is extended approximately 10 degrees from the fully retracted position and remain lighted until it is returned beyond this point. Turning the control switch to OFF at any time while the light is extended or retracting will stop the light in that position.

Power for controlling the position of the landing lights is supplied through a landing lights control circuit breaker on the cockpit distribution panel. Power for operating the landing light lamp is supplied through a left and right landing light circuit breaker on the main power center panel.

ANCHOR LIGHTS.

Each wing tip of the airplane has two white anchor lights, one on upper surface and one on lower surface, to be used whenever the airplane is anchored at night. These lights are controlled by a two-way switch arrangement, one switch on the pilot's console (8, figure 4–6) and the other beside the right forward entrance on the outside of the airplane. Either of the switches may be used to operate the lights. Whenever the anchor lights are turned on, a red indicator light on the pilot's console panel will light.

Power for the anchor lights is supplied from the battery bus, which is energized at all times, through a circuit breaker on the battery junction.

AN/AVQ–2A SEARCHLIGHT.

The AN/AVQ–2A searchlight is a high intensity, carbon arc-type searchlight of not less than 70,000,000 candle power. The searchlight is mounted on a special shackle fastened to the underside of the right outer wing near the wing tip and is used by the copilot to illuminate possible targets for identification during a night bombing run prior to bomb release. A trigger on the hand control unit is used to fire the searchlight arc. Illumination is produced by the vaporization of the positive and negative carbons. The vaporization of the carbons by the arc creates a luminous ball of burning gas in a crater in the tip of the positive carbon. This crater is automatically kept at the focal point of the reflector by controlling the speed of advance of the positive carbon. A reflector focuses the heat rays from the arc through the blades of a thermostat which close if the crater moves from the focal point, thereby shorting out a resistor in series with the positive carbon drive motor and speeding it up to return the carbon to its proper position.

The searchlight power system consists of a series of relays plus two resistors and a rectifier to isolate the No. 2 generator from the main bus and use its output supply the required additional voltage to operate the searchlight. During operation of the searchlight it is necessary to have the No. 1 generator and the 200 ampere converter connected to the main 28-volt d-c bus as well as having the No. 2 generator operating. The No. 1 generator and converter carry the normal airplane's load, in addition to the searchlight load, while the No. 2 generator is disconnected from the normal bus system. The 70 volts dc required to operate the searchlight is obtained by connecting the 28 volts from the main d-c bus in series with the increased voltage of the No. 2 generator after it is isolated from the normal d-c system.

Note

During searchlight operation, maintain engine speed at 2000 rpm or above.

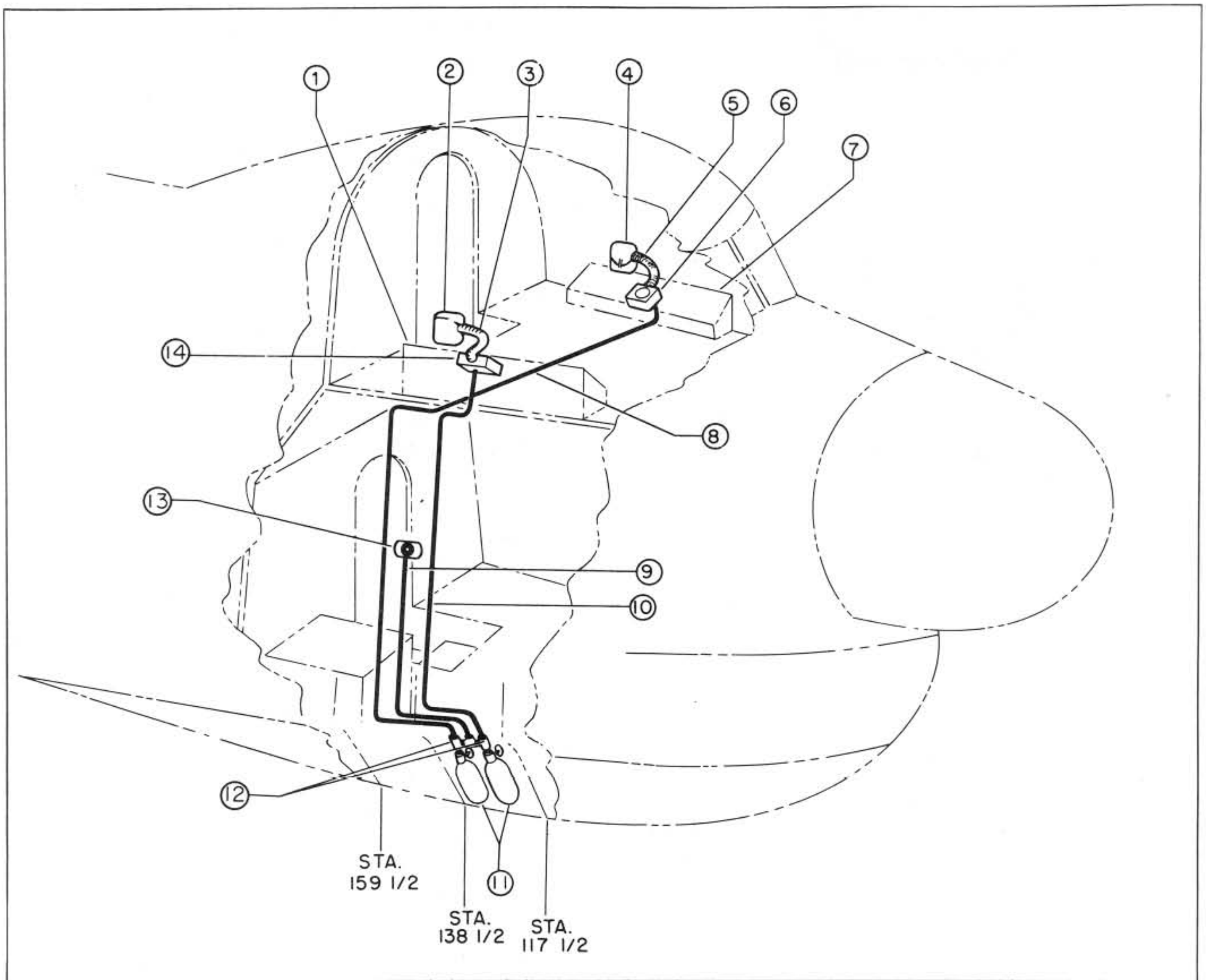
Power to operate the system is supplied from the d-c armament bus through two circuit breakers and from the a-c armament bus through one circuit breaker on the cockpit distribution panel.

SEARCHLIGHT CONTROLS. Control of the searchlight is through a manually operated controller at the copilot's station (2, figure 4–3.) The controller handle swivels for azimuth and elevation movement of the searchlight and contains a thumb-operated automatic release button and finger operated trigger switch to turn the light on. Visual indication of the direction in which the light is aimed, is furnished by an indicator on the copilto's panel which is calibrated in degrees of azimuth and elevation. The searchlight can be jettisoned by a switch on the pilot's overhead panel (6, figure 1–8).

CAUTION

Do not operate searchlight trigger switch in rapid succession as this can cause damage to the searchlight and the d-c generators. The searchlight trigger switch, once closed, should be held closed for a minimum of 5 seconds.

SEARCHLIGHT OPERATION. To prepare the light and put it in READY position, place the master armament switch ON, move the switch on the side of the controller to START, and allow 1 minute for warm-up. Any time after the warm-up interval, the controller handle will position the light. The light will operate when the trigger switch is actuated and come up to full brilliance in about 2 seconds.



1	Console, Co-Pilot	8	Oxygen Tubing, Pilot
2	Bag, Oxygen Mask Stowage, Co-Pilot	9	Oxygen Tubing, Filler
3	Breathing Tube, Co-Pilot	10	Oxygen Tubing, Co-Pilot
4	Bag, Oxygen Mask Stowage, Pilot	11	Cylinder, 514 cu. in (each)
5	Breathing Tube, Pilot	12	Valves, Check
6	Regulator, Oxygen Pilot	13	Valve, Filler
7	Console, Pilot	14	Regulator, Oxygen, Co-Pilot

Figure 4-7. Oxygen System—Pilot's and Co-pilot's

CAUTION

In view of the extreme heat generated during operation of the searchlight, it should not be on longer than 30 seconds, with a minimum of 4½ minutes between any one operation.

Normal operation of the searchlight is as follows:

Check Circuit Breakers For	"ON"
Master Armament Switch	"ON"
	"START"
Azimuth and Elevation	Position of Controller Handle
Trigger Switch	"SQUEEZE"
After 30 Seconds Operation	"RELEASE"

WARNING

It is mandatory that the pilot watch his instruments when the searchlight is turned on so that his night adaptation will not be lost.

The searchlight may be jettisoned by checking that the "SEARCHLIGHT-JETTISON" circuit breaker on the cockpit distribution panel is closed and placing the "SEARCHLIGHT" switch, on the cockpit overhead switch panel, in the "JETTISON" position.

PILOT'S AND CO-PILOT'S OXYGEN SYSTEM. (See figure 4-7.)

The pilot's and co-pilot's oxygen system is a high pressure fixed system consisting of the following units; two 514 cubic inch oxygen cylinders which are interconnected and charged to 1800 psi; two oxygen check valves, a high pressure oxygen filler valve, two diluter demand regulators, and the necessary supply lines. A fabric bag for oxygen mask stowage is furnished for each operator.

The oxygen cylinders are on the right side of the forward entrance compartment, beneath the compartment flooring. To gain access to the cylinders it is necessary to remove the removable floor panels in this compartment.

The cylinders are recharged through a filler valve inside and on the right of the forward entrance compartment. The filler line extends from this valve to a "tee" connection with connecting lines to the cylinders. Cylinders can be filled at the same time through check valves installed at the cylinders.

The supply line from the oxygen cylinder runs through a high pressure check valve to the pressure regulator at each operator's station.

The oxygen regulators are conveniently located on each console in the pilot's compartment.

FLIGHT OPERATION OF OXYGEN SYSTEM.

Oxygen shall be used constantly during flights when over 10,000 feet, during night flights when above 5,000 feet, and when on combat missions and training missions simulating combat. During flight the following procedure must be followed:

a. Turn on oxygen supply pressure if not already on (3, figure 4-6). Pressure gage should read 1,800 psi, when cylinder is fully charged.

b. Set air valve to "NORMAL OXYGEN" for all normal flight conditions.

c. Put on mask. Fully engage mating portions of disconnect coupling to connect mask to oxygen system breathing tube and attach clip to parachute harness sufficiently high on the chest to permit free movement of head.

d. Check mask fit by placing thumb over the disconnect at end of the mask tube and inhaling lightly. If there is no leakage, the mask will adhere tightly to the face and resistance to inhalation will occur. If leakage is apparent, tighten the mask suspension straps.

CAUTION

Never obstruct free flow of oxygen from regulator while emergency (SAFETY PRESSURE) valve is on.

e. While on oxygen, frequently check:
The cylinder pressure gage for oxygen supply.
The oxygen flow indicator for flow of oxygen through regulator.
The mask fit for leak tightness.
The disconnect coupling to insure that it is fully engaged.

EMERGENCY CONDITIONS.

a. Should anoxia symptoms occur, or the regulator becomes inoperative, immediately turn on safety pressure valve and descend below 10,000 feet.

b. If excessive carbon monoxide or other noxious or irritating gas is present or suspected; set the air valve at "100% OXYGEN" position and use undiluted oxygen until danger is passed or flight is completed.

If brief removal of mask from the face is necessary at high altitude, use the following procedure:

a. Take three or four deep breaths of 100 percent oxygen (air valve lever to 100% OXYGEN).

b. Hold breath and remove mask from face.

c. As soon as practicable, replace mask to face and take three or four deep breaths of 100 percent oxygen.

WARNING

All personnel using oxygen equipment should familiarize themselves thoroughly with the symptoms of anoxia. If the regulator should be inoperative, immediately turn on the emergency valve and descend below 10,000 feet altitude. When used, the emergency valve should be opened slowly to obtain minimum flow required.

d. Reset air valve lever to "NORMAL OXYGEN" position.

CAUTION

Do not exhaust supply cylinder below 300 psi except in an emergency. Upon completion of flight, turn off oxygen supply.

Note

The emergency valve shall be closed at all times except in an emergency, then open emergency valve slowly to minimum flow required.

ENDURANCE OF OXYGEN SUPPLY.

The following table may be used to determine the number of man hours of oxygen available at various altitudes with two 514 cubic inch oxygen cylinders at 1800 psi.

Airplane Altitude in Feet	Air Valve "ON" (Normal) Oxygen)	Air Valve "OFF" (100% Oxygen)
10,000	17.64	2.26
15,000	16.60	2.86
20,000	13.34	3.64
25,000	8.30	4.64

OXYGEN SYSTEM, PORTABLE.

The airplane is equipped with ten portable oxygen units of 295 cubic inch capacity, which are used for crew members, other than pilot and co-pilot, five of which are carried as replacements. (See figure 1-22.) These units are stowed at points in the airplane convenient to operating personnel.

The principal components of each portable unit are: a cylinder support bracket, an oxygen cylinder, a breathing tube, and a diluter-demand oxygen regulator assembly which incorporates a cylinder pressure gage, a flow indicator, an emergency valve, and an air dilutor valve manual lever. A strap which fits over the user's shoulder, is attached to the cylinder support assembly, so that it may conveniently be carried around while in use. This same strap, is utilized for stowing the units, by looping the strap through the tie-down rings provided at the stowage points.

The oxygen diluter-demand regulator automatically mixes the air and oxygen to meet the requirements for oxygen at the altitude the airplane is flying. Each regulator has a blinker flow indicator, a diluter valve and an emergency valve. With the diluter valve lever in "NORMAL OXYGEN" position the regulator automatically mixes air with oxygen in correct proportions until an altitude of approximately 28,000 to 30,000 feet is reached. Above the 30,000 feet altitude, 100 percent oxygen is delivered. In event of failure of the oxygen regulator, the emergency valve may be used. Turning this valve counterclockwise, allows pure oxygen to be supplied directly to the mask, by completely by-passing the regulator, regardless of the position of the diluter valve.

ENDURANCE OF OXYGEN SUPPLY.

The oxygen endurance table gives in tabular form the endurance hours of oxygen available, allowing for a drop in pressure from 1800 to 300 psi from a 295 cubic inch capacity cylinder.

Altitude in Feet	*Diluter-Demand Valve "ON"*	*Diluter-Demand Valve "OFF"*
5,000	4.0 man hours	1.0 man hours
10,000	4.9 man hours	1.2 man hours
15,000	5.8 man hours	1.5 man hours
20,000	5.2 man hours	1.9 man hours
25,000	3.7 man hours	2.8 man hours
30,000	2.8 man hours	2.8 man hours

AUTOMATIC PILOT. (See figure 1–4.)

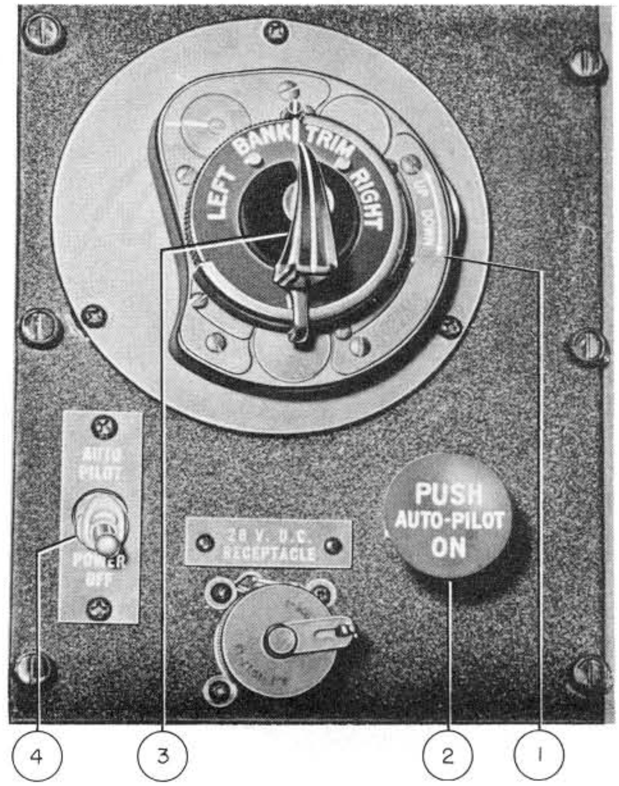
The P–1 automatic pilot is a system of automatic controls operating in conjunction with the co-pilot's master direction indicator, turn and bank indicator, and gyro-horizon indicator. While under automatic pilot control, the airplane can be made to climb, dive, and execute perfectly banked turns. Place the automatic pilot controller on any selected heading. The airplane will seek the selected heading without over swing and simultaneously keep the aircraft stabilized in pitch and bank.

Power to operate the automatic pilot is supplied from the 115 volt a-c system through two fuses on the cockpit distribution panel, and from the 28 volt d-c system through a circuit breaker on the cockpit distribution panel. The power switch on the pilot's center console actuates a solenoid which closes the a-c circuit supplying the servo amplifier. The d-c circuit supplies the clutch solenoids and the filament tube heaters. After a warm up of approximately two minutes, the autopilot may be engaged by pushing in the automatic pilot clutch switch on the pilot's pedestal (5, figure 1–4) and may be disconnected by a momentary type switch mounted on each aileron control wheel.

A caging relay prevents automatic pilot operation, if the control gyros are caged.

CONTROLLER.

The autopilot controller, (3, figure 4–7A), which includes a turn, bank trim and a pitch trim knob is on the pilot's center console panel (5, figure 1–4). By manipulating these controls the airplane can be made to dive, climb, make coordinated turns, or any combination of these. When the turn knob is moved out of the detent position in either left or right direction, the airplane will begin to turn. The amount of bank



1 Trim Control
2 Clutch Switch
3 Controller
4 Power Switch

Figure 4–7A. Automatic Pilot Control Panel

and rate of turn will be proportional to the displacement of the turn knob. When the turn knob is returned to the detent position, the airplane will resume straight and level flight. The airplane can be made to dive or climb by moving the pitch knob in the desired position.

MANUAL DISCONNECT LEVER.

The manual disconnect handle, which is cable operated, is on the pedestal (10, figure 1–3). When the handle is pulled out, the autopilot servo pulleys are disengaged from the servo drive shafts so that the pulleys are free to turn with the control cable movement. When using this method of disengagement, the clutches must be manually reset to re-engage servo's.

AUTOMATIC PILOT OPERATION.

a. Erect gyros by first caging and then uncaging the knob on the pilot's vertical gyro control.

b. Autopilot clutch switch—OFF.

c. Autopilot power switch—ON.

d. Allow two minutes for the amplifiers to warm up.

e. Center the turn control knob in its detent position.

f. Center the pitch trim control and bank trim adjustment on the controller.

g. Trim the airplane in the desired flight attitude.

CAUTION

Do not engage the autopilot while in turns, climbs, or dives of more than 10 degrees. Sufficient trim adjustment may not be available at the controller to return the airplane to level flight.

h. Engage the autopilot by pushing the clutch switch in.

i. To climb, turn the pitch trim control in a counterclockwise direction.

j. To dive, turn the pitch trim control in a clockwise direction.

k. To trim bank, turn the bank trim adjustment in a clockwise direction to raise the left wing or in a counterclockwise direction to raise the right wing.

l. To turn or trim course, move the turn control knob out of its detent position either to the left or right until the desired heading is reached and return the turn control to the detent position. The airplane will return to level flight at the new heading.

m. After any sudden change in load distribution, disengage the autopilot by pulling out the clutch switch, retrim the airplane on manual flight, then re-engage the autopilot.

CAUTION

Do not adjust the trim tabs while the autopilot is engaged. Do not allow the airplane to get too far out of trim. The airplane should be re-trimmed on manual flight at frequent intervals.

n. Return to manual flight is achieved by pulling out the clutch switch. The power switch may be turned off, if desired.

o. In an emergency, the autopilot system may be disengaged by pulling the emergency mechanical release handle, on the pilot's pedestal to the RELEASED position.

NAVIGATION EQUIPMENT.

B-6A DRIFT METER. (See figure 4-10.)

A type B-6A drift meter is installed on the left side of the flight deck for use in determining the angle of drift, terrestrical bearings of objects relative to the heading of the airplane and ground speed. The drift meter is a telescopic tube containing the optical lens and a gyro stabilized grid lined reticle permitting drift meter readings that are free from error caused by pitch and roll of the airplane. When the drift meter is not in use, it is stowed by sliding the unit upwards on the vertical support tubes and locked. A drift meter reticle light is incorporated for easier and more accurate reading of the scale. The gyroscope is driven electrically by power supplied from the 115 volt, 400 cycle, a-c bus No. 2 through a circuit breaker on the navigator's distribution panel.

To remove or install the drift meter in the airplane it is necessary that access door be removed on the hull crown above the drift meter.

WARNING

Be sure that driftmeter standpipe cover is closed for take-off and landing.

PERISCOPIC SEXTANT.

The periscopic sextant is mounted on its adapter located in a window panel on the crown of the flight deck compartment. (See figure 4-8.)

B-6A DRIFTMETER CONTROLS.

GYRO POWER SWITCH.

The gyro power switch which starts and stops the driftmeter, is located on the stationary pedestal case. To put the driftmeter in operation, turn power switch to "ON" position and allow a ten minute warm-up period prior to uncaging gyro.

RETICLE LIGHT SWITCH.

A rheostat light switch, when turned to "DIM" or "BRIGHT" position, is used to control the intensity of the reticle field and is located on the top of the upper gyro housing.

GYRO CAGING KNOB.

The gyro caging knob is used to cage and uncage the gyro, and is located on the lower gyro housing. When the driftmeter is not in use, gyro must remain caged. When in use, allow a ten minute warm-up period before uncaging gyro after power switch is turned on.

CAUTION

Do not uncage gyro during taxiing, take-off or landing. Do not uncage gyro when roll or pitch exceeds 35 degrees.

AZIMUTH DRIVE KNOB.

The azimuth drive knob located on the side of the pedestal case, adjacent to the rotary power switch, provides a means of five adjustment of rotation of the driftmeter after the line of sight is obtained. By pulling out the azimuth drive knob, which moves through a keyway to disengage the gear, the rotating section of the driftmeter is made to swing free in the pedestal case until the desired line of sight is obtained.

LINE OF SIGHT HANDLE.

The line of sight handle which protrudes from the line of sight case, mounts a scale on the handle. Rotating the handle controls the prism angle in the objective end of the driftmeter which records the vertical angle of sight.

FILTER SELECTOR HANDLE.

The clear glass and polarized filters selector handle is located on the line of sight case. Movement of the handle to "SHADE GLASS" position will reduce the intensity of light when the ground image is too bright.

EYEPIECE ADJUSTING RING.

The eyepiece adjusting ring which is mounted on the top of the gyro optics case, permits interchanging of eyepiece assemblies. The spare eyepiece is stowed in a bracket on the side of the pedestal case. By rotating the adjusting ring clarity of focus is obtained.

The sextant and case is stowed above the radar operator's table when not in use. Sextant power source for bubble and dial illumination is supplied from the airplane's 28 volt d-c navigator's distribution bus through a 5 ampere circuit breaker on the navigator's overhead panel. Also an emergency source of power for the sextant is provided from the 28 volt d-c battery junction box through a 5 ampere circuit breaker on the same junction box. To illuminate sextant place "NORMAL"—"EMERG." switch on the navigator's overhead panel to position required, turn sextant switch ON and adjust sextant rheostat to brilliance desired.

Install sextant mount with the shutter lever forward and the knob-counter mechanism aft. Eight screw through the topside of the window secures the mount to the window glass.

The periscopic sextant can be installed by the following procedures:

a. Insert sextant into mount with arrows on the tube and mount aligned.

b. Turn the lower ring of the mount counterclockwise until the plunger locks it in retracted position.

c. Place the sextant in operating position by moving the lever of the mount to the open position of the shutter.

d. Push the sextant up until it locks in the operating position.

e. Connect the power supply to mount.

f. Attach electrical cable between the mount and the sextant.

To correct a lubber's line error between 1/4° and 10° proceed as follows:

a. With the sextant installed and locked on an object and the relative bearing of the object set on the azimuth counter, loosen the four hexagon lubber's line clamp screws which will allow a limited rotation of the lubber's line of 10 degrees in either direction.

b. Grasp the counter and supporting bracket of the mount and rotate the lubber's line ring and azimuth scale as a unit until "O" degree or "N" mark coincides within 1/4 degree with the sextant vertical retical which is locked on target.

c. Lock the lubber's line in this position by tightening the four hexagon screws.

PRE-FLIGHT INSTRUCTIONS—PERISCOPIC SEXTANT.

To pre-flight check periscopic sextant R88-S-400-050-000 proceed as follows:

1. Insertion of Sextant in Mount.

a. With the line of sight locking lever on mount unlocked, insert the sextant into the mount as far as possible with arrows on tube and mount aligned.

b. Hold the sextant firmly and rotate the lower ring of mount counterclockwise (looking up, toward mount) until it meets a stop.

c. Pull out knob marked "TO INSERT, REMOVE —PULL".

d. Rotate lower ring on mount permitting knob to seat. Be sure the sextant can not rotate in either direction with the line of sight locking lever locked.

Note

Stops in the retracted position of the sextant are intended only to prevent its being dropped during insertion or removal. It is not advisable to leave the sextant in the retracted position for any extended period, particularly during rough weather. When not in use the sextant should be stowed above the radar operator's table.

e. Open the mount shutter with lever.

f. Insert sextant further until knob marked TO RETRACT SEXTANT—PULL snaps into place.

g. With switch in the ON position adjust the intensity of illumination with the rheostat.

2. Checking the Sextant.

a. Determine free rotation of sextant when the line of sight locking lever is unlocked.

b. Depress averager winding lever.

c. Depress actuating lever and permit the averager to run for its full two-minute period. A shutter should fall across the field of view at the end of this time.

d. Determine that the altitude knob turns freely and that the indication of altitude angle changes as the knob is turned.

3. Projection Lens Adjustment.

Note

It is mandatory that the following pre-flight check be performed prior to *each* flight.

a. Set 000.0 degrees in the azimuth counter.

b. With sextant in operating position and line of sight locking lever open, sight forward. Focus on reticle image by turning eyepiece. Sighting through the eyepiece and ignoring all other objects, the azimuth scale read against the lubbers line should agree to wihin 0.1 degree with the setting on the azimuth counter. This assures proper alignment of the mount.

c. Check for possible parallax between the lubbers line and the vertical line of the reticle.

Note

Parallax is the apparent movement of the image of the lubbers line (or azimuth scale) relative to the vertical line of the reticle, or vice versa, as the operator's head is moved from side to side. Parallax is to be avoided.

d. Select an object whose relative bearing to the mount is known. The object should be at least 60 feet away.

Note

Relative bearing is the angle between the aircraft's longitudinal axis and the line of sight to the object.

(1) Crank the azimuth counter to read the relative bearing of the object selected as measured from the mount.

(2) With the sextant in the mount, the line of sight locking lever open and the bubble centered in the field, sight on the object previously selected (averager winding lever must be depressed to clear the field of view) and lock the line of sight locking lever. Sighting may involve adjustment of the altitude control knob and rotation of the sextant in azimuth.

(3) When sighting, the vertical line of the reticle, object and 0 degrees ("N") on the azimuth scale should coincide and the azimuth counter should have the reading previously set in.

(4) If an error exceeding 1/40 exists between the sighted object and 0° on the azimuth scale as viewed through the eyepiece, it may be corrected, by rotating the projection lens atop the bubble cell. This may be done as follows:

(a) Loosen lock ring.

(b) Sight through the eyepiece and rotate the projection lens in either direction until the 0° mark of the azimuth scale coincides with the vertical line of the reticle and the object.

Note

Rotation of the projection lens will cause the image of the azimuth scale and the lubbers line ring to appear to move in an elliptical path, giving two settings (high and low) where coincidence will occur. The higher setting should be selected.

(c) Secure the projection lens with the lock ring. For additional information consult applicable handbook.

MISCELLANEOUS NAVIGATIONAL EQUIPMENT.

The navigator's table, on the right forward side of the flight deck compartment, is used for navigational computations and stowage of navigational gear. Stowed in it are; one plotter, one plotting board, one computer, one navigational watch and case, one navigational stop watch and case, and one parallel ruler. In the bottom drawer on the right side are stowed one pair of binoculars and one firing key. Miscellaneous charts, maps, log books, paper, pencils, etc., are stowed in the large center drawer. The instrument panel is corveniently installed above the table and is equipped with necessary navigational instruments.

NAVIGATOR'S FLIGHT INSTRUMENTS.

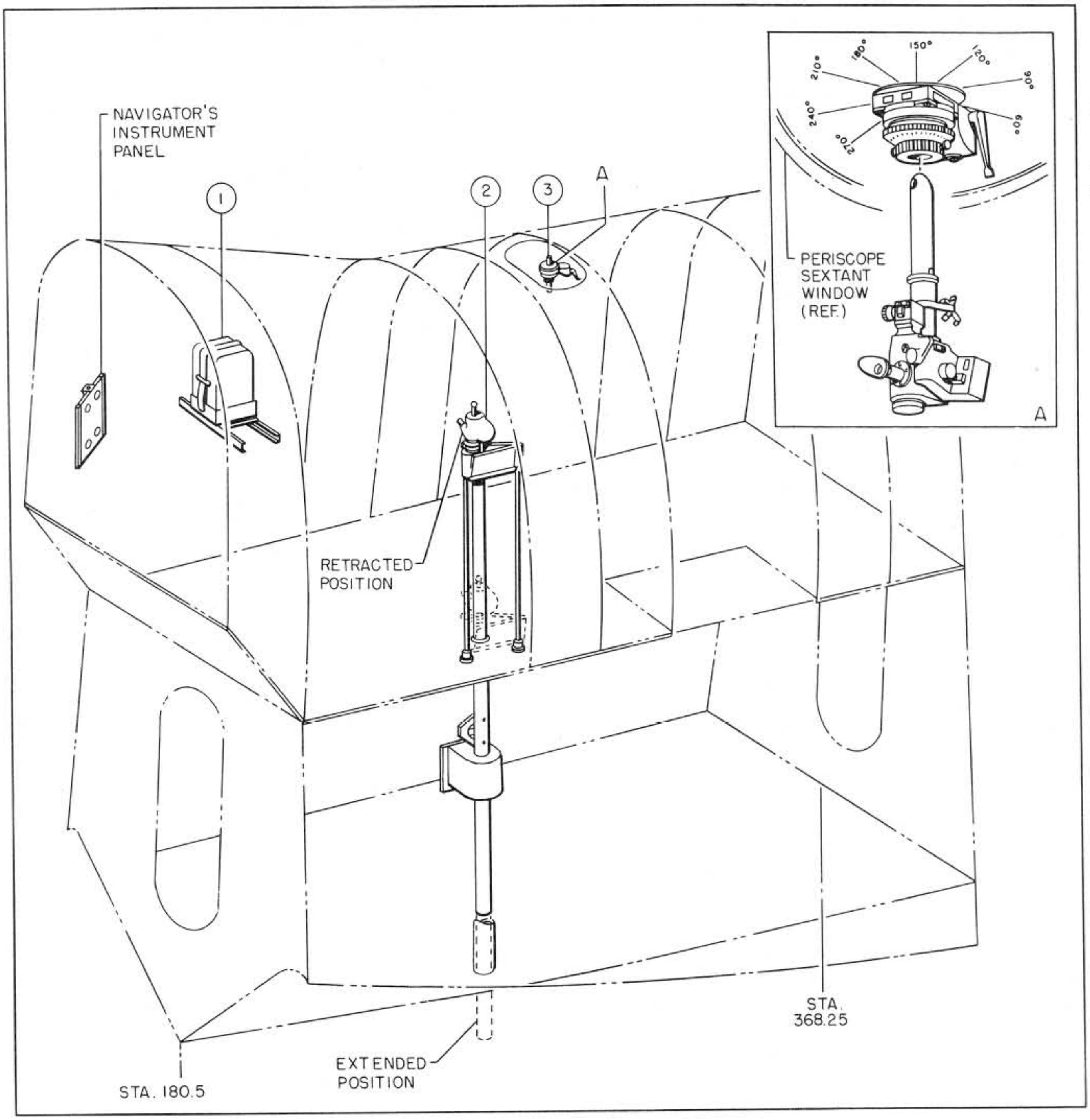
The navigator's instrument panel located at the forward end and above the navigator's table contains the following instruments: (See figure 1-18.)

a. Airspeed Indicator.
b. Course Indicator.
c. Air Temperature Indicator.
d. Altimeter.
e. G-2 Compass Repeater Indicator.
f. Civil Date Clock.

G-2 COMPASS SYSTEM.

The G-2 compass system is designed to provide an accurate stabilized magnetic indication heading of the airplane in azimuth at all times. The parts of this system which must be observed and operated by the pilot are the master direction indicator, G-2 compass, pilot's instrument switch and compass control switch. A switch located on the pilot's sub-panel makes it possible to disconnect the magnetic element from the gyro element and thus using the instrument as a directional gyro in magnetically unreliable areas. A remote compass transmitter is located in the right outer wing. A remote compass repeater type indicator on the navigator's instrument panel duplicates the gyro stabilized reading of the master direction indicator on the pilot's panel for the navigator's use.

The system also includes an amplifier which is located on the right side of the electronics compartment. The unit amplifies a signal which is then rectified to a



1 Periscopic Sextant Stowage
2 Driftmeter Assembly
3 Periscopic Sextant Mount Installation

Figure 4-8. Periscopic Sextant Location

differential direction current signal, capable of operating the torque motor in the master direction indicator which aligns the directional gyro with the magnetic heading of the airplane.

The remote compass transmitter detects magnetically the heading of the airplane. The location of the remote compass transmitter in the right outer wing is considered desirable as it eliminates most of the undesirable influences of the magnetic field present in other parts of the airplane. The transmitter contains a magnetic element consisting of a pair of bar magnets, fastened to a liquid type float. The low center of gravity and buoyancy of the float makes it remain horizontal at all times. The bar magnets of the magnetic element align themselves with the earth's magnetic field and at the same time the local field of these magnets influence the flux pattern in the core of the transmitter coil causing voltages to be generated in the coil. These unbalanced voltages are transmitted to the master compass indicator detector coil, and corresponding indicator coil in the indicating instrument.

The master direction indicator located on the pilot's panel, includes a directional gyro element, the position of which is indicated by the main dial in terms of heading of the airplane in degrees. The directional gyro elements consists of an electrically gyro wheel. The gyro wheel tends to remain fixed in direction, while the airplane together with the instrument case moves about it. The relative movement between the instrument case and the stable gyro rotor is used to indicate changes in the course of the airplane. As the gyro and indicator precess only four degrees per minute, a resetting knob, located at the lower corner of the master indicator, makes it possible to set the gyro heading to coincide with the magnetic heading when the instrument is started.

Note

Flux gate and G-2 compass inaccurate when landing lights are on.

FLUX GATE COMPASS SYSTEM.

The flux gate compass system consists of the gyro flux gate transmitter located in the left outer wing, a master direction indicator on the co-pilot's instrument panel and the gyro flux gate amplifier under the navigator's table with suitable wiring to connect the three components.

The purpose of the gyro flux gate system is two fold. First, it supplies a stabilized magnetic heading indication for the co-pilot. Second, it provides a directional reference signal for the P-1 automatic pilot system. The direction reference is established by the gyro flux gate transmitter which is an earth inductor compass element, held in a horizontal position by a gyro. The transmitter is located in the left outer wing in order to avoid, as much as possible, the magnetic influences of the airplane which tend to destroy the accuracy of the magnetic compass.

The gyro flux gate amplifier, is the power distributing center for the flux gate system. It also provides voltage and power amplification, for the signals which are fed to it by the transmitter, by way of the master direction indicator.

The amplified direction signal from the amplifier is fed to the Master Direction Indicator which employs it to furnish a visual indication of the compensated magnetic heading of the airplane and at the same time to provide and control a directional signal for the directional control of the airplane by the P-1 automatic pilot.

Power for the gyros in the transmitter and indicator is supplied from the power junction box of the P-1 automatic pilot system.

STANDBY COMPASS.

The standby compass at center above pilot's windshield is a magnetic compass intended to indicate continuously the heading of the aircraft in reference to the earth's magnetic field. It is designed for use in event the gyro flux gate or G-2 compass fail. Mounted near the standby compass is the compass correction card.

AUXILIARY POWER UNIT.

The Air Research auxiliary power unit is a gas turbine type driving a 40 KVA a-c generator. The unit is self-contained and includes the necessary automatic controls, fire detection, and fire protection.

The unit is designed to supply shaft output power of 70 horsepower (normal rated power) at ambient temperatures of +7°C (+45°F to +55°C (+130°F), however, the unit can be operated in temperatures of —9°C (—15°F) to +2°C (+35°F) with the shaft output power varying in proportion to the temperature.

The unit uses fuel from the left service tank through a manual shut-off valve in the left fuel trunk. The oil system is within the unit.

The control of the unit has been designated to the radio-operator, and is centered in two electrical switches and one manual valve located on the radio operator's panel. (Figure 1-10.) A hinged door in the air intake system opens to supply cooling and combustion air to the APU. This door, which must be opened before starting, is controlled by a double throw switch on the radio-operator's panel acting through a d-c electric motor driven screw jack connected to the door. Limit switches in the motor stop the movement at either extreme. When the door reaches the open position, a green indicator light on the radio-operator's panel will come on to indicate "OPEN". The starting system is entirely automatic and by moving the starting switch on the radio-operator's panel (Figure 1-10) to "START" and then released to the "ON" position, the unit will automatically start. To stop the unit, the only operation necessary is to move the "START" switch to "OFF" position. A single length of tubing is run from the radio-operator's panel to the air-bleed manual valve connection on the power unit, and connected to a manual valve at the radio operator's panel. (Figure 1-10.) By opening this valve, air is bled into the line and in turn into the side of the rpm governor within the unit causing a rpm reduction. By closing this valve, the air bleed is shut-off and the governor will maintain automatic preset rpm.

This air bleed is employed when adjusting the output of the a-c generator.

Operating time is indicated and registered on an hourometer bolted to the unit.

APU oil pressure is transmitted through wiring to the autosyn indicator calibrated in pounds per square inch on the radio operator's panel. Power to operate this system is supplied by the 26 volt a-c bus through a fuse on the radio operator's panel. An additional oil pressure gage (direct reading) is mounted near the APU.

APU oil temperature indication is obtained through a resistance type thermometer bulb installed in the APU oil tank connected by wiring to the indicator calibrated in degrees Fahrenheit on the radio operator's panel. Power to operate this system is supplied from the main d-c bus through a circuit breaker on the radio operator's panel. (Figure 1–10.)

APU fuel pressure indication is obtained through an autosyn transmitter connected to an indicator calibrated in pounds per square inch on the radio operator's panel. Power to operate this system is supplied by the 26 volt a-c bus through a fuse on the radio operator's panel. A direct reading fuel pressure gage is also provided near the APU.

Fire detection of the APU is a similar system to the main engine system (Refer to Main Engine Fire Detectors). Fire extinguishing is accomplished by CO_2 and by operating the APU fire extinguisher switch on the radio operator's panel (Figure 1–10), a flood of CO_2 will be directed into the unit. Power to operate the CO_2 system is supplied from the main d-c bus through a circuit breaker on the radio operator's panel.

ARMAMENT EQUIPMENT.

TAIL TURRET. (See figure 4–9.)

The Aero 11D–1 turret in this aircraft consists of an unoccupied ball, mounting two 20MM guns aimed and controlled by a locally positioned gunner through a Mark–18 Mod. 6 lead-computing gunsight.

The gunner's position is in the tail, forward and above the turret, and regardless of the turret movement, his position remains stationary. The sighting head which moves with the guns, is positioned directly in the gunner's view. Scanning is accorded the gunner through a transparent plastic canopy which covers him from the waist up, on all sides, except the rear. The turret is uninhabited, but because of its proximity to the gunner, is considered locally controlled.

Complete fire control is provided by a twin grip hand controller directly in front of the gunner. By manipulation of the controller grips, the gunner can control the turret movement in any direction within structural limitations. The gunner's auxiliary equipment includes a trouble light, suit-heater receptacle, interphone station box and provisions for portable oxygen bottles.

Power for operating the turret and equipment is supplied from the 115/200 volt, three phase, 400 cycle, a-c tail distribution box bus through three 25 ampere circuit breakers on the tail distribution box marked "A-C TURRET POWER"—"PHASE A"—"PHASE B"—"PHASE C", and from the 28 volt d-c tail distribution box through a 35 ampere circuit breaker on the box marked "D-C TURRET POWER".

TAIL TURRET EQUIPMENT.

Turret components, which operate from the a-c power supply, include the hydraulic pump unit, ammunition boosters, gun heaters, and gun firing equipment. Turret components, which operate from the d-c power supply, include the suit heater, sight unit, interphone station box, amplifier and blower, camera, trouble light, and gun charger solenoid.

Power for movement of the turret is provided by Vickers electric motor-driven hydraulic pump units. A Vickers hydraulic transmission and associated drive trains, drive the turret and sight support in azimuth and elevation. The Vickers power unit that generates hydraulic power for operation of the drives is driven by a 200/115 volt, 400 cycle, three phase electric motor. It is mounted on a platform on the deck under the gunner's seat mount. The azimuth hydraulic motor is bolted to the left side of the azimuth drive housing assembly, and through its gear train drives the turret in azimuth. A similar hydraulic motor, mounted on the top extreme aft portion of the upper trunnion housing, through its related gear train, drives the turret in elevation.

Over-drive of the turret, during power operation is prevented by a mechanical limiting mechanism in the base of the azimuth drive housing assembly.

WARNING

Extreme care should be used not to manually crank the turret beyond the limits.

A turret amplifier and blower assembly is installed above and aft of the ammunition box at gunner's right hand side. A dynamotor operated from the 28 volt d-c supply provides operating voltages. The voltage input should be checked to insure that voltages, with gun firing solenoids activated do not drop below 26 volts. Lower voltages will unbalance the amplifier and result in loss of control of the turret. The amplifier is required to convert the signal voltages from the azimuth and elevation control potentiometers into the proper current values for operating the control solenoids, in the hydraulic power unit.

Ammunition is supplied to the guns, through flexible chutes, from separate ammunition boxes on each side of the hull near the turret. Two electrically driven boosters are near the boxes and can be operated independently.

Provisions are made for installation of a camera and camera bracket on the sighting head. A circuit in the control unit enables the camera to be operated simultaneously with the guns.

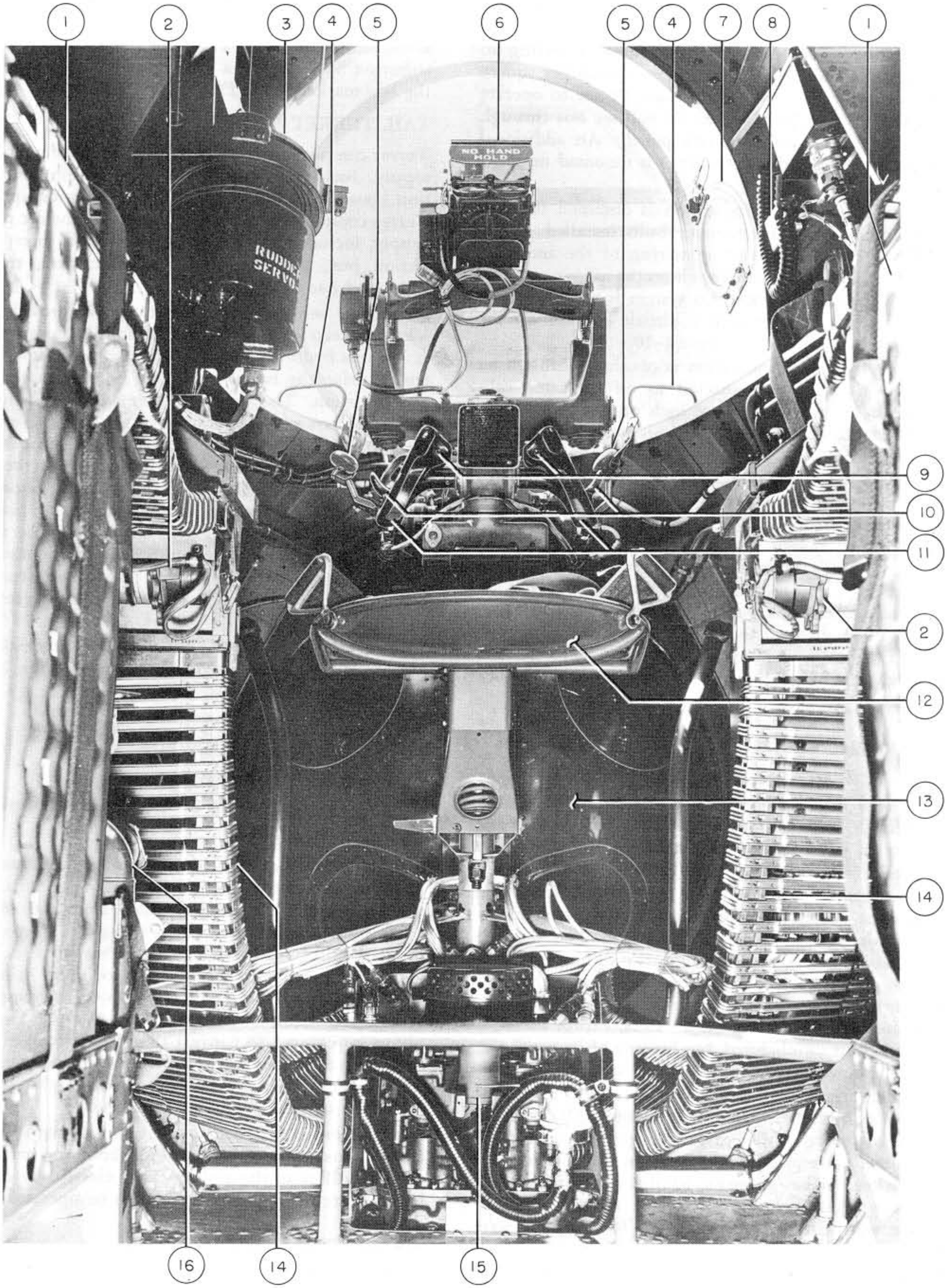


Figure 4-9. Tail Turret Compartment

KEY TO FIGURE 4-9

1 Boxes, Ammunition
2 Booster Motors, Ammunition
3 Servo, Rudder
4 Handgrips, Assist
5 Hand Crank, Manual
6 Sighting Unit
7 Vent, Air
8 Cord, Microphone
9 Switch, Microphone
10 Switch, Action
11 Grips, Control
12 Seat Assembly
13 Turret Ball
14 Chutes, Ammunition
15 Power Unit, Hydraulic
16 Cylinder, Oxygen

TAIL TURRET CONTROLS.

All controls necessary for operation of the turret are accessible to the gunner from his position and are contained in two units, the hand control assembly and the control unit.

The hand control assembly is located on the aft end of the azimuth drive assembly and protrudes into the fuselage to a position easily reached by the gunner, when seated. The hand grips are arranged to rotate about the horizontal axis through their center to control the motion of the turret in elevation, and about a vertical axis to control the azimuth movement. The hand grips contain an action switch (dead man) on the lower outboard side of each grip and a gun firing trigger switch on the back of each grip.

The control unit is adjacent to the gunner's right hip. The front panel and forward end panel mount all of the control switches, circuit breakers and indicator lamps necessary for operation of the turret. Also, on the end panel are the suit heater receptacle and the trouble light assembly. Mounted internally in the unit are the guns power supply, the time delay and other control relays.

To operate the turret manually, proceed as follows:

a. Release manual hand cranks from their stowed position.

b. Engage cranks with manual drive shafts.

Note

Pins in shafts disengage hydraulic motors through a clutching arrangement which allows turret to be driven manually.

c. Rotate cranks to test manual drive in azimuth and elevation.

Note

Do not crank turret past its limits as there are no mechanical limit stops. Overdriving will damage turret and fairing.

d. At end of manual operation return hand cranks to their stowed position.

All electrical turret and control equipment is protected from overloads by circuit breakers at the control unit. Should any of the equipment fail to operate due to temporary circuit overload, the appropriate circuit breaker or circuit breaker group, should be reset to put equipment back into operation. If either gun stops firing, release the trigger switches, then close them again. If the stoppage was caused by a "dud" then manually recharge guns, this will start another round in which guns can be fired again.

If either or both guns become jammed, determine the cause, and remedy the condition at the first opportunity, as the chutes to the turret ball are open, any jams in this section will be readily accessible and can be straightened in the chute.

PRECAUTIONS TO PREVENT INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT.

a. Never enter or leave gunner's station during takeoff or landing.

b. Make certain the MASTER ON-OFF switch on the control unit is in "OFF" position when entering or leaving station.

c. READY-SAFE SWITCH must be kept in SAFE position until guns are ready to be fired.

d. Do not use control handle or sight bracket as hand holds when entering or leaving turret.

Note

If the turret is removed from the tail, an equal amount of ballast must be secured in place in the turret area in order to compensate for the weight of the turret, and to maintain proper weight and balance on the airplane.

BOMB-BAY DOOR CONTROLS.

The bomb bay doors can be operated by either normal or emergency bomb door control. The emergency bomb release system, operating in conjunction with the bomb bay door control, will salvo internal bombs, fuel tanks, external bombs and external stores.

Normal control of the bomb bay doors is accomplished through the left and right bomb bay door control switches on the navigator's armament panel. (6, Figure 4-4.)

With the pilot's emergency bomb bay door open switch in the OFF position and placing either of the navigator's control switches in the OPEN position will actuate the corresponding hydraulic solenoid control valve permitting hydraulic pressure to open the doors. As the doors open, lock switches will cause NOT IN POSITION amber indicator lights on the navigator's panel to come on. These lights will remain on until the doors are fully opened and locked. Similarly if either switch is placed in the CLOSE position, the hydraulic solenoid valve will be actuated to close the doors and the NOT IN POSITION indicator lights will come on and stay on until the doors are closed and locked.

Power for normal operation of the doors is supplied from the 28 volt d-c cockpit distribution panel bus through the navigator's armament bus and a circuit breaker also on the navigator's armament bus.

Emergency operation of the bomb-bay doors is accomplished through the emergency bomb bay door and stores release switches on the pilot's console (13 and 14, figure 4-6). The switch has two positions marked —OFF and EMERG. BOMB BAY DOORS OPEN. Placing the switch in the EMERG BOMB-BAY DOORS OPEN position will cause the emergency bomb-bay door open control valve to actuate, allowing the hydraulic accumulator pressure to open both bomb-bay doors. As the doors open the amber indicator lights on the pilot's console will come on and remain on until the doors are open and locked. This switch position should be used only in the event of hydraulic system pressure failure, or when it is necessary to close the door, by using the hydraulic hand pump located near the marine marker ejector in the waist compartment.

Placing the switch in the EMERGENCY STORES RELEASE position will cause the following:

a. Left and right door control valves to open allowing normal hydraulic pressure to open both sets of doors.

b. Red EMERGENCY CONTROL ON indicator lights to come on.

c. After bomb-bay doors are open the lock limit switches and the door position switches will actuate the bomb salvo relays which in turn will cause all internal (bombs, mines and torpedoes) and external (bomb) stores to be released with exception of rockets as they are released through the normal rocket release system.

d. Two seconds after the stores are released, time delay relays will close and energize the close solenoids on the left and right hydraulic control valves causing hydraulic pressure to close and lock both sets of doors.

Power for the emergency bomb bay operation is supplied from the 28 volt d-c bus through the BOMB BAY DOOR CONTROL and BOMB SYSTEM INDICATOR LIGHTS circuit breakers on the navigator's armament panel (figure 4-4) and the EMERG. STORES RELEASE circuit breakers on the cockpit distribution panel.

BOMBING SYSTEM.

BOMBING EQUIPMENT.

The bombing equipment consists of internal and external stores, pilot's sight and bomb bay heaters.

The airplane is equipped to carry an assortment of bombs, mines, rockets and torpedoes, internally in the bomb bays and externally on the stores carriers. Four bomb stations are in the bomb bays and four combination bomb rack and rocket launchers are on each of the two external stores carriers. Jettisonable fuel tanks may also be carried in the bomb bays. Stores hoisting is accomplished from the top of the wing by using the integral handling fittings and a Aero 14B bomb hoist.

Doors in the upper surface of the wing give access to the stores carrier attachment fittings and electrical connectors. Bomb bay combustion heaters, controlled by the navigator maintain the bomb bay temperature within the operating range limits of 10°C (50°F) to 27°C (80°F).

Controls for the release of the stores and operation of other bombing equipment are at the navigator's, pilot's, and co-pilot's stations, except the searchlight controls, which are at the co-pilot's station. Automatic release of the stores is accomplished through the AN/APA-16 low altitude radar bombing system. Release of ASW equipment can also be accomplished with the bomb release controls.

INTERNAL STORES (BOMB BAY) RELEASE CONTROLS. (See figure 4-4.)

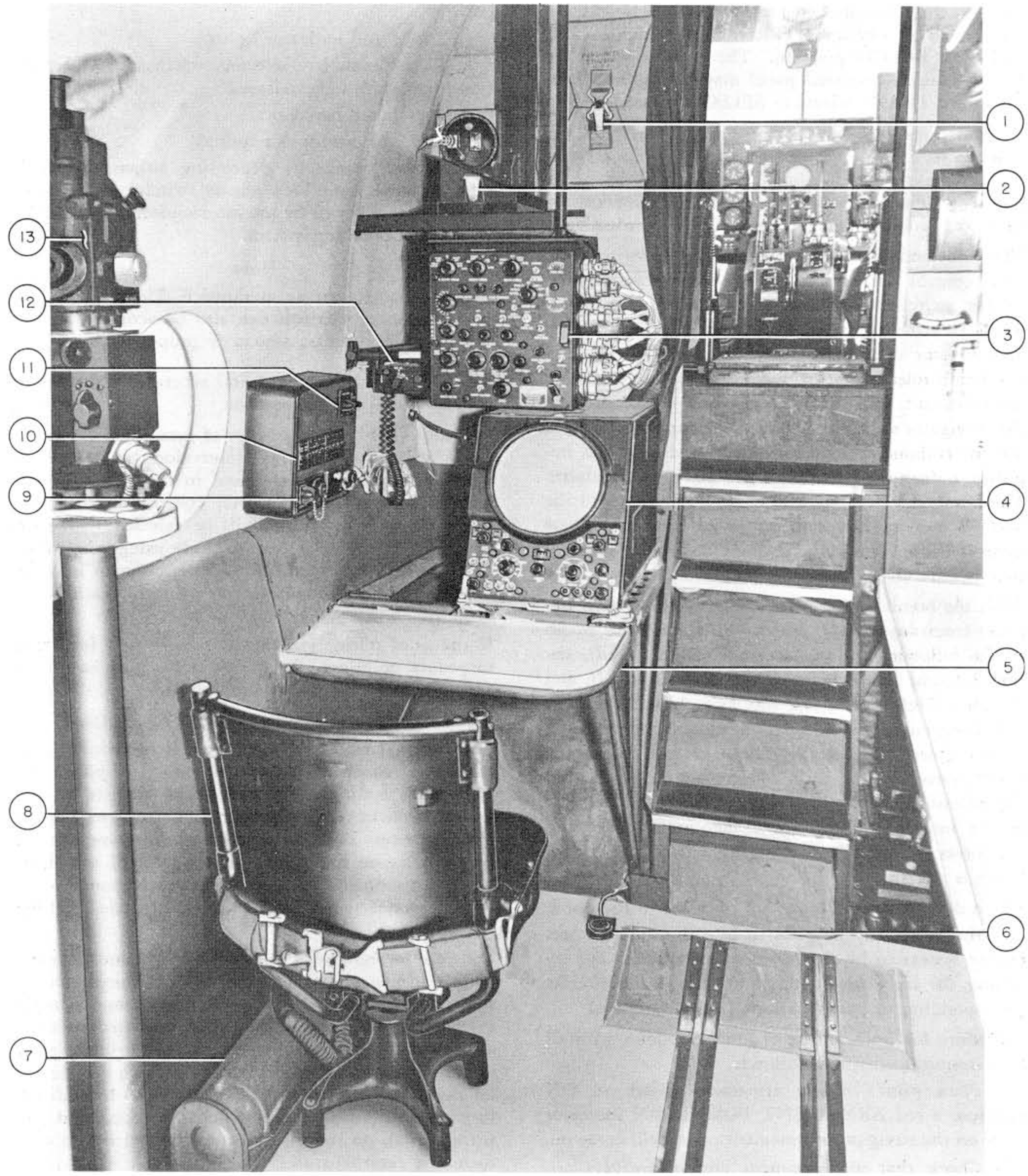
The internal stores release system is electrically controlled and primarily accessible to the navigator, with stores release switches at the pilot's and co-pilot's stations. The stores can also be released through the AN/APA-16 radar bombing system in conjunction with the select or train release intervalometer to release the internal bombs or the droppable fuel tanks. Torpedoes can be released by operating the stores release switch only. Power is supplied through the circuit breakers on the navigator's armament bus located on the navigator's armament panel. The bus is controlled by the pilot's master armament switch on the pilot's overhead panel. (Figure 1-8.)

Loading indication switches and four bomb loading green indicator lights (one for each bomb station), on the navigator's armament panel are used to indicate which bomb stations are loaded.

Four bomb bay selector switches (one for each bomb station), on the navigator's armament panel with adjacent station indicator lights are used to select the stations to be released. These switches, in the ON position, and with the bomb bay doors opened such that the normal release relays are energized through the corresponding bomb bay door lock switches, will complete a circuit from the pilot's release switch to the release unit in the bomb bay, making the circuit ready for a release impulse from the intervalometer or other source.

An arming switch on the navigator's overhead panel is used to arm the bombs and has three positions—SAFE, TAIL ONLY and BOTH. With the switch in the SAFE position, the arming controls will not be energized, in TAIL ONLY position, only the tail arming control on the bomb carriers will be energized, and in the BOTH position, both the tail and nose arming controls on the bomb carriers will be energized.

There is an intervalometer selector switch on the pilot's console for selecting internal stores or rockets to be released through the intervalometer.



1	Stowage, Parachute	5	Table, Radar Operator's	10	Panel, Circuit Breaker
2	Stowage, Periscopic Sextant	6	Switch, Microphone Foot	11	Rheostat, Console Light
3	Panel, AN/APS–44A Oscilloscope Control	7	Cylinder, Oxygen	12	Box, ICS Control
4	Oscilloscope, AN/APS–44A	8	Seat, Radar Operator's	13	Drift Meter, B–6A
		9	Rheostat, Overhead Light		

Figure 4–10. Radar Operator's Station

Selection of external or internal stores is obtained through the intervalometer selector switch by placing the switch in either INTERNAL STORES or EXTERNAL BOMBS position. The intervalometer on the navigator's overhead panel may be set for choosing either TRAIN release or SELECT release.

If train release is desired, the ground spacing knob must be set for interval desired and the bomb counter set for the number of bomb stations desired to be released. If select release is desired, it is necessary to set the intervalometer in the SELECT position only.

The pilot and co-pilot have stores release switches on their control wheels and the navigator has a bomb release switch on the navigator's armament panel. These switches are wired so that either pilot, co-pilot, or navigator may effect bomb release. Operation of any bomb release control, including the AN/APA-16 release circuit, will energize the bomb release relay in the navigator's distribution box to supply power to the intervalometer which in turn sends out the impulses to drop the bombs in a pre-determined pattern. The bomb release relay also completes circuits to the K-25-B camera and camera flasher systems. These items will operate only if their individual control switches are ON.

With the bomb system set for select release, each impulse from any release source will release one bomb in the following order: station 1 (left inboard), station 2 (right inboard), station 3 (left outboard), and station 4 (right outboard); and, as each bomb releases and firing impulse is stopped, the corresponding bomb station green indicator light will go out. With the bomb system set for train release, one impulse from any release source will release all selected bombs at pre-set intervals in the above mentioned order and the corresponding indicator lights will go out as each bomb is released.

When droppable fuel tanks are installed in the bomb bay, the tanks may be released by the internal stores release system or by the salvo release system. For releasing the ferry fuel tanks, only the release circuits corresponding to bomb stations 1 and 2 are used.

Procedure for train release of internal bombs with all four stations loaded is as follows:

a. Place pilot's master armament switch in ON position, a red ARMAMENT POWER ON indicator light on the navigator's armament panel will come on.

b. Check that all armament circuit breakers are closed.

c. Set intervalometer in TRAIN position.

d. Place intervalometer ground spacing knob to interval desired.

e. Place intervalometer BOMBS TO BE RELEASED knob.

f. Place Master Selector Control switch in BOMBS position.

g. Check load indicator lights.

h. Place bomb bay selector switches in ON position for stations to be released.

i. Open bomb bay doors.

j. Arm fusing units as required.

k. Release bombs by depressing either the pilot's release switch, co-pilot's release switch, or the navigator's release key or by the interconnected AN/APA-16 altitude bombing system.

Note

Sonobuoys, marine markers, K-25-B camera and flasher controls can also be actuated by the bomb release system if properly set up.

l. Close bomb bay door and return all switches to normal non-operating position.

Procedure for "Select" release of internal stores is the same except that the intervalometer SELECT-TRAIN switch must be placed in the SELECT position. No other intervalometer controls need be set. However, only one store will be released with each impulse. If "Select" release is made using AN/APA-16 radar release system, the radar equipment must be reset and another bombing run made for each bomb dropped.

If the pilot release switches are to be used for firing torpedoes or mines, the pilot's sight must be set up and adjusted prior to the bombing run.

EXTERNAL STORES RELEASE CONTROLS.

The external stores release system is electrically controlled by release switches at the pilot's, co-pilot's and navigator's stations. The release of rockets is controlled by switches on the aileron control wheel at the pilot's station. External bombs and stores are released by switches on the pilot's aileron control wheel, or by switches on the navigator's armament panel, or by the interconnected AN/APA-16 low altitude bombing system.

Controls for release of external stores from the navigator's armament panel consist of a stores arming switch, eight external stores status switches and eight external stores loaded indicator lights. Control switches at the pilot's station consist of a rocket firing selector switch and a rocket control switch, which are located on the pilot's side console (Figure 4-6). In addition to the side console release switches, a rocket and jato firing switch on the pilot's control wheel is also used to release external stores.

Electrical power for the rocket and external bomb release system is supplied from the 28 volt d-c pilot's armament bus through the EXTERNAL STORES ARMING and the ROCKET UNLOCK circuit breakers, and from the 28 volt d-c cockpit distribution bus No. 2 through a ROCKET AND JATO FIRING circuit breaker.

To maintain safety within firing limits, it is necessary that the following restrictions be adhered to during Aero 6A Rocket Launcher package firing:

a. When mixed loads of Aero 6A Rocket Launcher packages and 5″ HVARs are carried, the Aero 6A Rocket Launcher packages shall be fired before the 5″ HVARs; otherwise, blast damage to the Aero 6A Rocket Launcher package is more likely and may induce misfires.

b. In the interest of increased safety, partial loading of the Aero 14 combination Bomb Rack and Rocket Launchers with Aero 6A Rocket Launchers, leave the inboard launcher positions empty when possible. When inboard launcher positions are fired, the aircraft should be flown with as little yaw as possible.

MARK 90 DEPTH BOMB.

(On airplanes No. 135526, 135532 and subsequent as delivered and on airplanes No. 135474 through 135525 and 135527 through 135531 after service change.) Provisions for the installation of a Mark 90 depth bomb include a control box, circuit breakers, switches, wiring, indicator lights, and a carrier assembly.

BEFORE TAKEOFF CHECK. Prior to takeoff with the Mk 90, check that the carrier safety lock is in the UNLOCKED position. To unlock the safety lock, operate the push rod at the after end of the carrier. This rod is accessible through an access door in the upper surface of the wing. A red warning light next to the Mk 90 controls indicates, when on, that the carrier is not unlocked, providing the emergency bomb release circuit breaker is closed and power is on at the main bus.

RELEASE OF MARK 90 DEPTH BOMB. The Mark 90 depth bomb is released as follows:

a. Close the master armament power control circuit breaker on the cockpit distribution panel.

b. Close the armament power circuit breaker on the navigator's armament panel.

c. Close the MARK 90 power circuit breaker on the navigator's overhead panel.

d. Close the monitor power, heater power, and release power circuit breakers on the navigator's overhead panel.

Note

The circuit breakers listed in steps a. through d. should be closed during normal flight with the weapon aboard.

e. Place the power control switch on the navigator's overhead panel in either the POWER ON or ALTERNATE POWER position.

f. After takeoff, close the armament power switch on the cockpit overhead panel.

g. Position the appropriate controls on the AERO 2B control box on the navigator's overhead panel. Monitor the controls during flight.

h. Open the left bomb bay doors.

i. Actuate the Mark 90 stores release switch on the navigator's overhead panel which energizes the release units on the carrier and drops the store.

j. Close the bomb bay doors and return all switches to their normal, non-operating positions.

RELEASE OF MARK 90 DEPTH BOMB THROUGH NORMAL BOMB RELEASE SYSTEM. The Mark 90 depth bomb can also be dropped through the normal bomb release system:

a. Repeat steps a. through e. in previous paragraph (Release of Mark 90 Depth Bomb).

b. Close the stores release circuit breaker on the navigator's overhead panel.

c. Check that all necessary armament panel circuit breakers are closed.

d. Place pilot's master armament switch in ON position (a red ARMAMENT POWER ON indicator will light on the navigator's armament panel).

e. Set intervalometer in SELECT position.

f. Set intervalometer selector switch in INTERNAL STORES position.

g. Check that load indicator lights are on.

h. Place bomb bay selector switches in ON position for Station No. 1.

i. Position appropriate controls on Aero 2B control box. Monitor controls during flight.

j. Place master selector control switch in SONOBUOY MARKER AND BOMBS position.

Note

The system will also operate if the master armament selector switch is in the SONOBUOY MARKER AND TORPEDOES position.

k. Open left bomb bay doors.

l. Actuate either the pilot's, copilot's, navigator's or RCM operator's stores release switch to drop the weapon.

Note

The store may also be released by the AN/APA-16 radar equipment.

m. Close bomb bay doors and return all switches to normal.

Power for this circuit is 28-volt dc through the navigator's MARK 90 circuit breaker, and through the power control switch when it is placed in POWER ON position. Alternate power for this circuit is 28-volt dc through the MARK 90 ALTERNATE POWER circuit breaker, and through the power control switch when it is placed in the ALTERNATE POWER POSITION.

TESTING OF MARK 90 DEPTH BOMB CIRCUIT. To test this circuit, use AERO 10B flight circuit tester and AERO 1B pull-out harness. (Consult applicable handbook.)

EMERGENCY RELEASE OF MARK 90 DEPTH BOMB. Refer to emergency bomb release system in this section.

STORES RELEASE OPERATION.

Bomb and stores arming is accomplished by the external stores arming switch on the navigator's overhead panel. With the arming switch in "SAFE" position, the arming controls on the external store carriers will be de-energized, maintaining the stores in a "SAFE" condition. Placing the arming switch in the "TAIL ONLY" position, only the tail-arming controls on the external stores carriers will be energized. When the arming switch is in "BOTH" position, both the tail and nose arming controls on the external stores carrier will be energized simultaneously.

When the rocket control switch is placed in "READY" position, the eight rocket unlock solenoids will be energized simultaneously, completing the circuits for a release impulse.

A wing flap actuated safety switch is included in the rocket release circuit to prevent firing of rockets, unless the flaps are in the full up position.

The rocket firing selector switch on the pilot's console is used to choose between firing single rockets or in pairs of rockets from each external stores carrier.

Note

With the pylons loaded with rockets or bombs and the system energized, the possibility of releasing rockets or external bombs in an undesired order is eliminated by the following procedure:

a. Place all external stores stations switches in the OFF position.

b. Place the desired station No. external stores status switch (the first to be released) in the corresponding B (bomb) or R (rocket) position.

c. Place the remaining external stores status switches in the corresponding position.

With the master armament switch on the cockpit overhead panel "ON" and the eight external stores status switches placed in "R" (rocket) position, the green external stores loaded indicator light will illuminate. With the wing flaps up and the rocket firing selector switch placed in the "SINGLES" position for firing single rockets, and the rocket control switch in the "READY" position; each actuation of the pilot's rocket and jato firing release switch will energize a rocket release unit and the corresponding external stores loaded indicator lights will go out in the following order: stations 1, 8, 4, 5, 7, 2, 6, and 3. When the rocket selector switch is in "PAIRS" position, the rocket control switch in "READY" position, for firing rockets in pairs and the circuit set up as above, each time the pilot's rocket and jato firing switch is pressed it will energize two rocket release units and the corresponding external stores loaded indicator lights will go out in the following order: stations 1 and 7, 2 and 8, 4 and 6, 3 and 5. The same results as above will be obtained when the external stores switch is placed in "B" (bomb) position, the external stores arming switch in "BOTH" position, the intervalometer selector in "EXTERNAL BOMBS" position and the intervalometer in "TRAIN" position. One impulse from a stores release switch will release a bomb at time intervals and the corresponding indicator lights will go out in the following order: stations 1, 8, 4, 5, 7, 2, 6, and 3.

External stores or mines can be loaded at stations 2 and 7 on the external stores carrier. Release of the external stores is accomplished in the same manner as with bombs, which can be dropped singly or both at the same time. With stations 2 and 7 stores status switches in "B" (bomb) position, the two green stores loaded indicator lights will illuminate. Placing the external stores arming switch in "BOTH" position, will energize the nose and tail arming mechanisms. Set the intervalometer selector switch in the "EXTERNAL BOMBS" position, and the intervalometer in "SELECT" position for single release, or in "TRAIN" position for time interval release. Upon pressing a stores release switch from either the pilot's control wheel, the release of the external stores, will cause the corresponding indicator lights to go out at stations 2 and 7.

In order to ensure positive selection of dropping sequence of mixed stores carried on the aircraft the following steps should be taken:

(a) Place the station status switch of each station carrying a rocket or rocket package in the rocket position.

(b) Place the station status switch of each station carrying a torpedo in the torpedo position.

(c) Place all other station status switches in the off position.

(d) Place the station status switch of the station from which it is desired to release the first store in the bomb position.

(e) Place the station status switch of the remaining stations from which it is desired to release stores in the bomb position.

(f) Set the intelvalometer control for train release.

(g) Place the arming switch in the desired arming position. For external stores have the pilot place his arming switch in the desired arming position.

(h) Place the master armament selector switch in the bomb position.

(i) Place the master armament switch in the on position.

(j) Release the stores using the desired release switch.

When the AN/APA-16 low altitude bombing system is used for bomb release, and the intervalometer set in "SELECT" or in "TRAIN" position, the operation will be the same except that the release circuit will be automatically closed by the low altitude bombing system.

If release is to be made from the pilot's station for rockets or bombs the pilot's sight should be set up and adjusted prior to the bombing run.

AN/APA-16 RADAR BOMBING CONTROLS.

The AN/APA-16 is a low altitude radar equipment bombsight attachment for use with a synchronizing pulse and a video signal from the AN/APS-44A search radar equipment. It provides a means for establishing a close rate between the radar equipped airplane and a target by furnishing a range mark with which target echoes on the radar indicator can be tracked. Information so obtained, together with altitude and bomb correction setting information set in the control unit by the operator is utilized in electrical circuits to compute the release range and to release either internal or external stores automatically when the airplane reaches the release position.

The equipment consists of a range marker unit, SN-12A/APA-16, a capacitor unit MX-139/APA-16, a control unit C-275A/APA-16 and an adapter unit TD-61/APA-16.

The range marker unit, on the right electronic rack, contains all of the electronic circuits of the AN/APA-16 equipment, and the power supply to furnish plate and filament voltage to these circuits and d-c voltages to the control unit. Fuses in the a-c power supply for this equipment are accessible from the front of the unit.

The capacitor unit, also on the right electronic rack, functions as an integral part of the rate sweep generator circuit of the range marker unit. It is housed separately to prevent excessive heating.

The control unit, on the navigator's radio rack, contains most of the external controls necessary for the calibration and operation of the AN/APA-16 equipment. It also contains the circuits from the electrical computer for determining the release range and other circuits which supply voltages to control the action of the electronic circuits in the range marker unit. These voltages are determined by data set up in the control unit for any particular bombing run.

OPERATION FOR LOW ALTITUDE BOMBING.

Procedure for releasing bombs in "TRAIN" with the AN/APA-16 equipment is as follows: (Assuming the equipment has been properly checked and calibrated by maintenance personnel.)

WHEN AIRBORNE.

a. Turn "POWER" switch on control unit to "ON".

b. Check the "RANGE MARK" knob for proper adjustment.

c. Adjust the dimmer control for desired illumination.

d. Check overall operation of system. (Make certain bomb release system "ARMING" switch is on "SAFE".

e. Check "reference range zero".

BEFORE THE BOMBING RUN.

a. Set bomb release controls in accordance with procedure for train release.

b. Set the "CLOSING RATE" dial to the approximate speed of the airplane.

c. Set the "ALTITUDE" dial to the altitude agreed upon for the bombing run.

d. Select target and confer with pilot concerning tactical details.

e. Check "reference range zero".

f. Set the "BOMB CORRECTION" dial for any allowances that are to be made for "trail" and "spread".

DURING THE BOMBING RUN.

a. Keep the "REC. GAIN" control of the radar indicator adjusted to maintain the minimum intensity that will give good target indications.

b. Keep the pilot informed of the approximate distance and bearing of the target.

c. Check to see that the "CALIBRATE SWITCH" is on "OPERATE", that the "SEARCH-TRACK" switch is on "SEARCH", and that the "BOMB CORRECTION" dial is properly set.

d. When the target is within range of the equipment, throw the "SEARCH-TRACK" switch to "TRACK", begin tracking.

e. Select bombs and arming desired, all armament and circuit breakers on.

f. Assist the pilot in navigating a proper azimuth course.

g. Switch to the shortest range on the indicator as soon as practicable.

h. Discontinue range tracking when the airplane has approached to within one mile to three quarters of a mile of the target.

i. Inform the pilot when the release relay operates (lights go out in the control unit).

AFTER THE BOMBING RUN.

a. Return the ARMING SWITCH to SAFE, and the SEARCH-TRACK switch to SEARCH.

b. Wait at least a few seconds before starting another bombing run, to allow the capacitor unit to recharge.

c. When the bombing mission has been completed, shut down the equipment by turning the POWER switch OFF; this will not affect continued operation of the radar.

d. Place pilot's MASTER ARMAMENT switch in OFF position.

Note

Check the dial lights, if they are not on, the release circuit of the equipment did not reset. Immediately turn SELECTOR switch to ROCKETS and back to BOMBS. If coincidence is lost by throwing the selector switch, re-establish it by turning the position control.

To complete a successful radar bombing run it is necessary that the pilot comply with the following:

a. Keep the airplane in level flight.

b. Fly as closely as possible to the altitude and at the speed agreed upon for the run.

c. Fly a collision course, or a combination collision and pursuit course.

d. Keep in close touch with the radar operator.

e. If the target becomes visible during the run, make necessary corrections from observation, and do not navigate entirely by radar.

f. If the run is made at night and the searchlight is used, keep eyes on instruments to maintain dark adaptation and prevent night blindness.

MARK–8 PILOT'S SIGHT.

The MK–8 pilot's sight is an illuminated dual filament lamp gunsight used when the pilot is firing wing rockets, torpedoes or mines. The pilot observes the image of the reticle, which appears to lie at infinity, in a reflecting plate through which the target is also visible.

To place the gunsight in use, remove it from the "ready" position, and install and lock the sight in the mounting bracket slightly above the pilot's line of sight on the windshield structure. The electrical connector for the sight is then removed from its stowage above the windshield and screwed into place on the sight. Power for operating the gunsight light is supplied from the 28 volt d-c pilot's armament bus through a five-ampere circuit breaker on the cockpit distribution panel. The bus is controlled by the pilot's master armament switch on the cockpit overhead panel. The gunsight light brilliancy is controlled from bright to dim, including an OFF position, by a rheostat on the pilot's sub-panel. Either filament of the light can be used by placing the gunsight switch on the pilot's sub-panel in ON or ALTERNATE ON position as desired.

When the gunsight is not in use, it is stowed at either of two locations depending upon the possibility of use. The gunsight "ready" position is stowed in a bracket on the cockpit overhead panel, and when the use of the gunsight is not anticipated, it is stowed on the aft side of bulkhead forward of the navigator's table.

To check the accuracy of the sight bracket adjustment, proceed as follows:

a. Rotate reflector adjustment knob to indicate 13° down.

b. Observe relationship of reticle image and the fixed post sights on the exterior hull crown forward of the windshield. The illuminated sight and post sight should be in alignment.

MARK–6 FLOAT LIGHT LAUNCHER SYSTEM.

The system consists of a float light pneumatically operated launcher installed in the forward waist compartment, a precharged air bottle of 1500 psi with flexible and rigid tubing from the bottle to the launcher. A solenoid at the top of the launcher, when energized, releases air into the launcher cylinder, thus providing the necessary force to eject the float light. The capacity of the air bottle will provide operating pressure for approximately six launchings. The primary controls to operate the solenoid are on the navigator's armament panel, with secondary controls available to pilot and co-pilot, through the stores release switches on the aileron control wheels. Float lights can be used for any purpose, day or night, which requires a long surface burning marker. Float lights are installed in launcher immediately aft of the small sonobuoy chutes in the sonobuoy compartment.

Electrical power to operate the float light is supplied from the 28 volt d-c navigator's distribution bus through a circuit breaker marked FLOAT LIGHT CONTROL on the navigator's armament panel.

WARNING

Do not remove the square pieces of adhesive tape from the wooden body before launching, or fire may result.

The float lights are loaded as follows:

a. Remove watertight cover.

WARNING

To prevent flooding, do not remove watertight cover when aircraft is waterborne.

b. Pull ejector finger to top of stroke.

c. Release ejector lock at upper end of launcher and swing ejector back.

d. Insert MARK 6 float light and attach lanyard to lanyard adapter which in turn is attached to hook on ejection finger.

e. Coil the lanyard on top of the float light and tape down lightly to keep lanyard from being fouled prior to or during launching.

f. Swing ejector into place and lock.

g. Push ejector finger down against store.

NORMAL FLOAT LIGHT OPERATION. (See figure 4-4.)

To release from the navigator's station:

a. Master Selector Control—Float Light.

b. Stores Release—Press.

To release from pilot's or co-pilot's station:

a. Master Selector Control—Float Light.

b. Stores release button (On control wheel)—PRESS.

EMERGENCY FLOAT LIGHT OPERATION.

a. Repeat float light loading operations as required.

b. Remove spring clip at top of ejector and pull manual valve knob to operate ejector.

CAUTION

A store must be in place when operating the pneumatic ejector.

SMALL SONOBUOY SYSTEM (AN/SSQ-2).

The sonobuoy system with an electrically controlled pneumatic release system is used in conjunction with the AN/ARR-26 receiver. The small sonobuoys, used to send out non-directional signals, are stowed on the left side of the sonobuoy compartment. The sonobuoys are released through six chutes on the right side of the airplane in the sonobuoy compartment. Two compressed air cylinders in the sonobuoy compartment, are used to eject the sonobuoys from the chutes.

The two air cylinders, charged to 1,500 psi, are regulated to emit 750 psi for launchings. Thirty sonobuoys, six in the loading chutes and twenty-four stowed, may be carried in the airplane. The maximum number of launchings is forty-two.

The small sonobuoys can be released singly or in combinations of, sonobuoy and marine marker; sonobuoy and float light; sonobuoy, marine markers and bombs or torpedoes. Selection, for release of sonobuoys in combinations, is made by use of the master selector switch on the navigator's armament panel.

The primary controls are on the navigator's armament panel with secondary controls available to pilot and co-pilot through the control wheel stores release.

Electrical power to release the sonobuoys is supplied from the 28 volt d-c navigator's distribution bus through a circuit breaker, marked SMALL SONOBUOY on the navigator's armament panel.

SONOBUOY LOADING PROCEDURE.

a. Open loading door by actuating black button on the head of the chute.

b. If the ejector finger is not on top, pull the ejector finger to the top of the tube or press the black return button which returns it pneumatically.

c. Remove tape from sonobuoy fins.

d. Insert sonobuoy into chute fins first.

e. Position ejector on end of sonobuoy case.

f. *Close* loading door.

NORMAL SONOBUOY RELEASE OPERATION.

CAUTION

Do not operate without a sonobuoy in place.

SELECT RELEASE.

To release from navigator's station:

a. Master Selector Control	SONOBUOY
b. Power Switch	ON
c. Master Arming Switch	ON
d. Release Button	Press for each sonobuoy

To release from pilot's or co-pilot's stations:

a. Repeat steps a through d of release from navigator's station.

b. Stores Release Switch Button (on control wheels)	Press for each sonobuoy release

EMERGENCY SMALL SONOBUOY OPERATION.

To release manually from the sonobuoy chutes pull the manual release knob on each launcher. The sonobuoys can not be released until the ejection door is open.

CAUTION

Do not operate without a store in sonobuoy chute or damage to the ejector finger may result. Load only with ejection door in closed position.

MARINE MARKER RETRO-EJECTOR SYSTEM.

(See figures 4-11, 4-12.)

The marine marker retro-ejector release system consists of an electrically controlled and pneumatically operated ejector located in the forward waist compartment, with remote and local electrical control, and with an air compressor unit supplying pneumatic power. The ejector accommodates thirteen rounds at one loading which are fired in aft direction approximately 180 degrees to the line of flight. The ejection velocity is variable betwen 90 and 200 knots and is normally equivalent to the ground speed of the airplane. Operating pressure for positioning the rounds is supplied from a 500 cubic inch compressed air storage bottle, capacity rated at 3000 psi working pressure. Stowage location for marine markers is on the left hand side of the sonobuoy compartment.

Note

After air compressor (supplying air pressure to storage bottle) is started, time required for air storage bottle pressure to reach 3000 psi is from approximately 1/2 hour at 13,000 feet altitude to 1-3/4 hours at 40,000 feet altitude. Pilot's master armament switch need not be on to operate the compressor.

Electrical power for ejection is supplied from a 28 volt d-c navigator's armament bus through the "Retro Marker" circuit breaker. Electrical power for the air compressor unit is supplied from the 28 volt d-c sonobuoy distribution bus through an "Air Compressor Power" circuit breaker, and from the 28 volt d-c navigators distribution bus through an "Air Compressor Control" circuit breaker.

MARINE MARKER RETRO-EJECTOR SYSTEM CONTROLS.

The system consists of the following:

a. Remote control box, above navigator's overhead panel.

b. Local control box, left side of forward waist compartment.

c. Release switch, RCM operator's panel. (Figure 4-4.)

d. Ejector door "Not Open" indicator light, navigator's overhead panel.

e. Air compressor control switch, navigator's overhead panel.

f. Release relay, navigator's distribution box.

g. Launching tube door position switch, left side of forward waist compartment.

h. Launching tube, left side of forward waist compartment.

i. Launcher, left side of forward waist compartment.

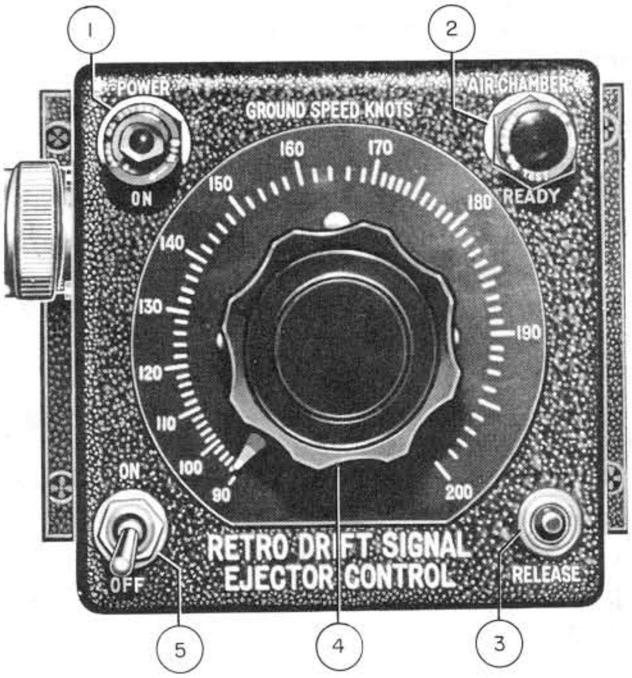
j. Air compressor unit, left side of forward waist compartment.

REMOTE CONTROL BOX, RETRO-EJECTOR

Mounted on the REMOTE control box panel (Figure 4-11) are the "Power On" indicator light, "Ready" indicator light, Release Button, Speed Control Knob and Master Switch. When the master switch is positioned "ON" the amber "power on" indicator light is illuminated and power flows to the Remote Control Box; the green "ready" light is illuminated when a round in the ejector is ready to fire a marker at the ground speed set on the speed control dial; (see Figure 4-13); release button, when pressed, releases a marine marker; speed control knob is used to get the desired ground speed on dial calibrated from 90 to 200 knots.

LOCAL CONTROL BOX, RETRO-EJECTOR

On the LOCAL control box panel (Figure 4-12) are the ground speed gage, air bottle pressure gage, release button, load button, bleed button and switch guard over "Local-Remote' 'switch. The ground speed gage, calibrated from 90 to 200 knots is set at the desired ground speed by pressing either the load (increase speed) or the bleed (decrease speed) button; air bottle pressure gage registers in lbs psi; release button, when pressed, releases a marine marker; "Local-Remote" switch must be on "LOCAL" position if marine markers are to be released from the local control panel and must be on "REMOTE" if release is to be controlled from the remote control panel. A guard, over the



1 "Power On" Light
2 Ready Light
3 Release Button
4 Speed Control Knob
5 Master Switch

Figure 4–11. Remote Control Box, Retro-Ejector

local-remote control switch prevents inadvertent movement of the switch when it is in "REMOTE" position. When magazine is loaded, with pilot's master armament switch "ON", air compressor switch "ON", remote control panel master switch "ON", and local control panel switch "REMOTE", the following automatic cycle of operations occur: (See Figure 4–13.)

a. Storage chamber swings to "out of battery" position, allowing a round to drop into breech.

b. High pressure air actuates injector cylinder forcing round into barrel (firing position).

c. Storage chamber swings to "in battery" position and injector returns to original position.

d. The round is now in firing position and each release of a round repeats the automatic cycle. The rate of release does not exceed 45 seconds between rounds, at maximum ejection velocity.

MARINE MARKER RETRO-EJECTOR LOADING PROCEDURE.

To LOAD rounds into the ejector magazine proceed as follows:

WARNING

Never attempt to load the magazine unless the air pressure is turned "ON", the master switch on the remote control box is positioned "OFF". Make certain the four latches holding the magazine to the ejector are securely locked and that air pressure is applied to the ejector, holding the storage chamber "in battery".

a. Remove the cover from the magazine.

CAUTION

When looking towards the end of the barrel, notice that the sides are defined in the direction in which the round will travel. Always load the left side of the magazine first.

b. Pull follower assembly on left hand side of magazine sufficiently upwards to clear the top of magazine, thereby permitting the rounds to be loaded.

c. Load eight rounds, Marine Marker MK-7, MOD. 1, in left side of magazine. Place each round so that the metal capped end is in position next to the aft casting end of the ejector.

d. Place the "following assembly" on top of the last round in the magazine.

e. Load five rounds in the right side of the magazine, follow procedures a to d for loading right hand side.

f. Replace and secure latch cover assembly to top of magazine.

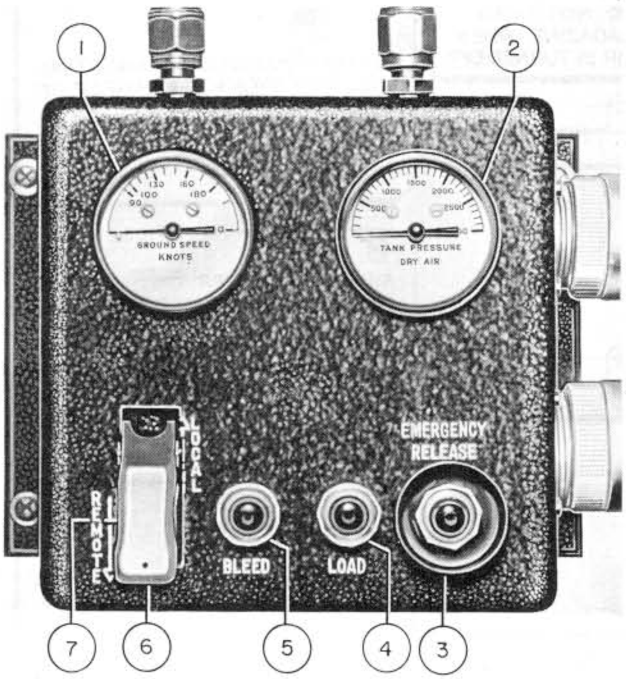
Marine markers may be released normally from the remote control box, the retro marker release switch on the RCM operator's panel or the stores release switches on the pilot's and co-pilot's control wheels.

Note

If the retro marine marker is set up for normal release, the release of a small sonobuoy unit will also release a marine marker.

WARNING

The Marine Marker Retro-Ejector Aero 1A (or 1B) is a gun: respect and treat accordingly. Use every precaution not to direct aim at personnel or property as serious accident or fatal injury may be incurred. Never place fingers or hands within the ejector when power source is "ON".



1 Ground Speed Gage
2 Air Bottle Pressure Gage
3 Release Button
4 Load Button
5 Bleed Button
6 Switch Guard
7 Local Remote Switch

Figure 4–12. Retro Marine Marker Local Control Box, Retro-Ejector

REMOTE CONTROL BOX OPERATION.

To release a marine marker from the remote control box, proceed as follows:

Pilot's Master Armament Switch	"ON"
Ejector Magazine	LOADED
Local-Remote Switch (Local Control Box)	"REMOTE"
Master Switch	"ON"
Power Indicator Light	"ON"
Air Compressor Control Switch	"ON"
Speed Control Knob as	DESIRED
Ejector Safety Door	"OPEN"
Door Indicator Light	OUT
Ready Light	"GREEN"

Each press of the release button on either the remote control or the RCM operator's panel will release one marine marker.

Note

Do not hold release button down after round is fired.

The speed control knob may be changed at anytime. After changing, wait until the air chamber "READY" light illuminates green.

To release a marine marker from the pilot's or co-pilot's station, proceed as follows:

Pilot's Master Armament Switch	"ON"

Follow step procedure on marine marker release from the remote control box.

Each "press" of the stores release switch on either pilot's or co-pilot's control wheel will release one marine marker.

LOCAL CONTROL BOX OPERATION.

If necessary, marine markers may be released from the local control box; to do so, proceed as follows:

Ejector Safety Door	OPEN
Pilot's Master Armament Switch	"ON"
Master Switch	"ON"
Local-Remote Switch	"LOCAL"
Load Button (to increase ground speed)	PRESS
Bleed Button (to decrease ground speed)	PRESS
Emergency Release Button	PRESS

Each "Press" of the emergency release button will release one marine marker.

WARNING

Set Marine Marker Ejector Safety Door Handle in "SAFE" position before leaving airplane.

MARK–5 PARACHUTE FLARE.

The parachute flare may be used for reconnoitering, bombing, or landing. Two flares are stowed in containers on the right forward side of the sonobuoy compartment and are released through the small sonobuoy chutes.

WARNING

MK–5 MOD. 8 parachute flare case is not retained by a retention cable, and falls as a missile hazard and therefore should not be used over friendly territory. See Ordnance Pamphlet 998.

To use the full burning time of the flare to best advantage, the altitude at which it is to be released should be 3000 feet greater than the fuse setting.

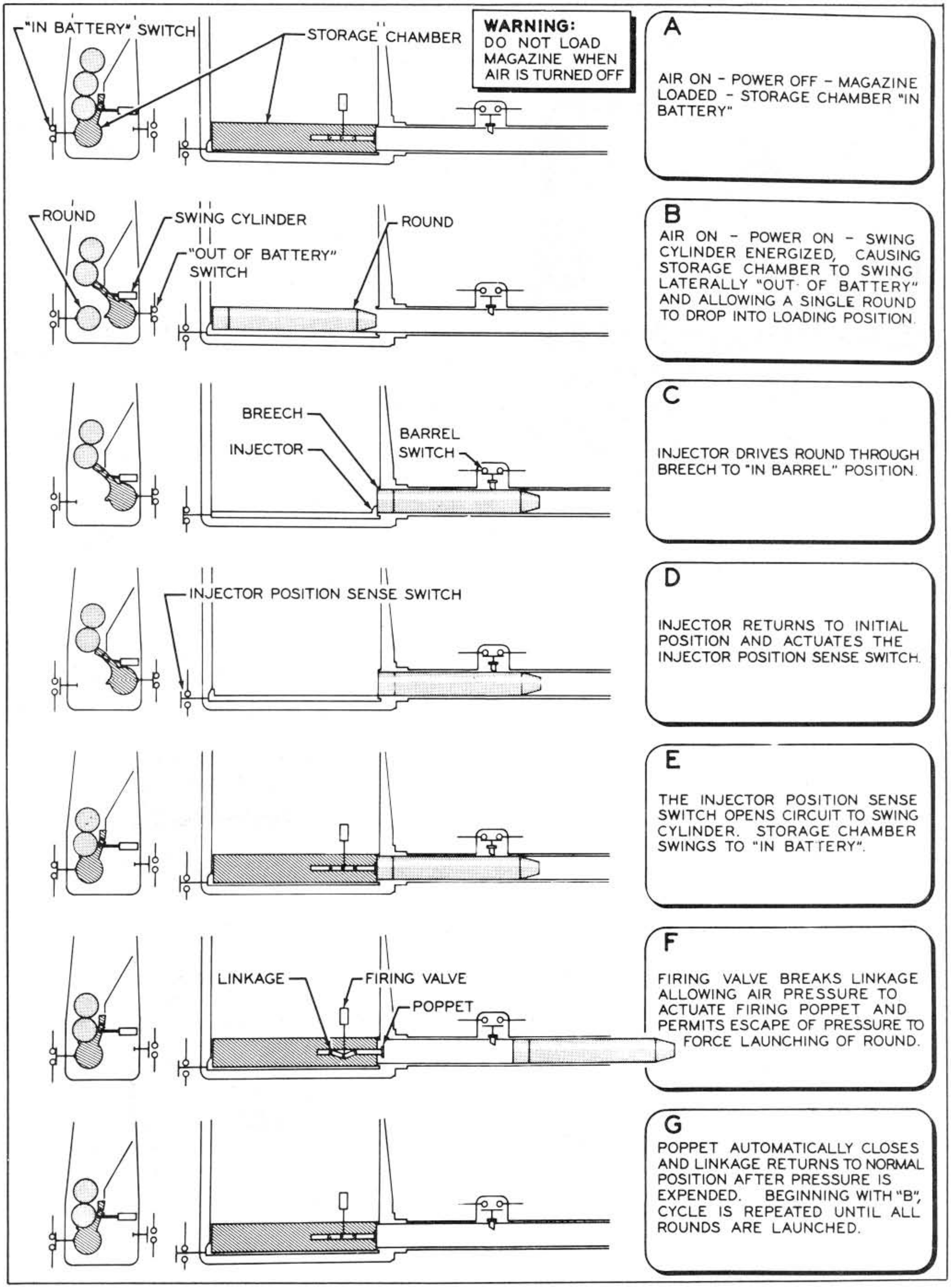


Figure 4–13. Marine Marker Retro-Ejector—Sequence of Operations Diagram

The parachute flare is loaded as follows:

a. Open small sonobuoy chute door.

b. Insert flare, fuse end up.

c. Connect firing lanyard to ejecting lever hook.

d. Close small sonobuoy chute door.

NORMAL PARACHUTE FLARE OPERATION.

The parachute flare is released in the same manner as the small sonobuoys. Refer to SMALL SONOBUOY SYSTEM.

CAUTION

Do not operate without a store in sonobuoy chute or damage to the ejector finger may result.

EMERGENCY PARACHUTE FLARE OPERATION.

The parachute flare is released in the same manner as the small sonobuoys. Refer to SMALL SONOBUOY SYSTEM.

PHOTOGRAPHIC EQUIPMENT.

A K-25B camera is contained in a pod which protrudes from the right aft entrance hatch into the airstream. The F2A-2 flasher unit is contained in a similar pod which protrudes from the left aft entrance hatch into the airstream. The camera and flasher are used for taking photographs during day or night missions to show the results of a bomb release or other special operations. The camera and flasher controls are on the navigator's armament panel (Figure 4-4), and the camera operation controls are on the co-pilot's console panel.

The camera and flasher are stowed in the waist compartment during take-off and landing, while in flight they are positioned on the waist hatches as follows:

a. Open one waist hatch at a time.

b. Remove the camera or flasher from the stowage.

c. Snap camera or flasher pod in place by manipulating the control on hatch.

d. Make electrical plug connections.

e. Set the desired angle with the handcrank as shown by the indicator arrangement on the door.

CAMERA OPERATION.

When operating the camera during the day, the flasher system is by-passed by placing the co-pilot camera control switch in the "DAY" position. With the navigator's camera manual switch in "NORMAL" position for normal camera operation, closing the co-pilot's manual control switch momentarily ("MANUAL" position) will complete a circuit to the camera latching relay in the navigator's distribution box, the latching relay will, in turn, pull in and complete a circuit to the camera delay timer which will run for its preset time and then complete a circuit to the camera timer and the camera motor. The camera timer and the red indicator light will flash on and off continuously until the camera stops running. As the camera timer reaches the end of its operation, the latching relay will return to its original position. For normal camera operation and when the navigator's camera manual switch is in "NORMAL" position, the camera may also be started by pressing the navigator's bomb relase key.

When the co-pilot's camera control switch is in "DAY" position and the navigator's camera manual switch is placed in "RUN" position, both the relay timer and the camera timer are by-passed and a circuit is completed to the camera motor. The camera will run continuously until the navigator's camera manual switch is returned to "NORMAL" position or until the camera has run through its complete cycle.

FLASHER OPERATION.

When operating the camera during the night or under dark conditions, the flasher system is connected into the camera circuit by the co-pilot's camera control switch in the "NIGHT" position, then with the navigator's camera manual switch in "NORMAL" position for normal operation, closing the co-pilot's manual control switch momentarily ("MANUAL" position) will complete a circuit to the camera latching relay in the navigator's distribution box. The latching relay will pull in and complete a circuit to the camera delay timer which will run for its pre-set time and then complete a circuit to the camera timer and the flasher power supply unit. The flasher power supply will cause the camera to operate and the flasher lamp to flash on and off in synchronized operation with the camera until the camera timer has completed its operation cycle. The red indicator light does not operate with the co-pilot's camera control switch in the "NIGHT" position. As the camera timer reaches the end of its operation, the latching relay will return to its original position.

When the co-pilot's camera control switch is in "NIGHT" position and the navigator's camera manual switch is placed in "RUN" position, both the delay timer and the camera timer are by-passed and the camera and flasher will operate in synchronism until the navigator's camera manual switch is returned to "NORMAL" or until the camera has used all the film. Power to operate the camera is from the 28 volt d-c navigator's armament panel bus through a 5 ampere circuit-breaker switch (toggle) on the navigator's armament panel marked "CAMERA POWER"—"ON"—"OFF" and which is controlled by the pilot's master armament switch (Figure 1-8). Power for flasher control is supplied from the 28 volt d-c main power panel bus through a 15 ampere circuit-breaker on the main power panel marked "CAMERA FLASHER"—"CONT". Power to operat the flasher is supplied from the 115/200 volt a-c 3 phase 400 cycle main power center panel through three 15 ampere circuit-breakers

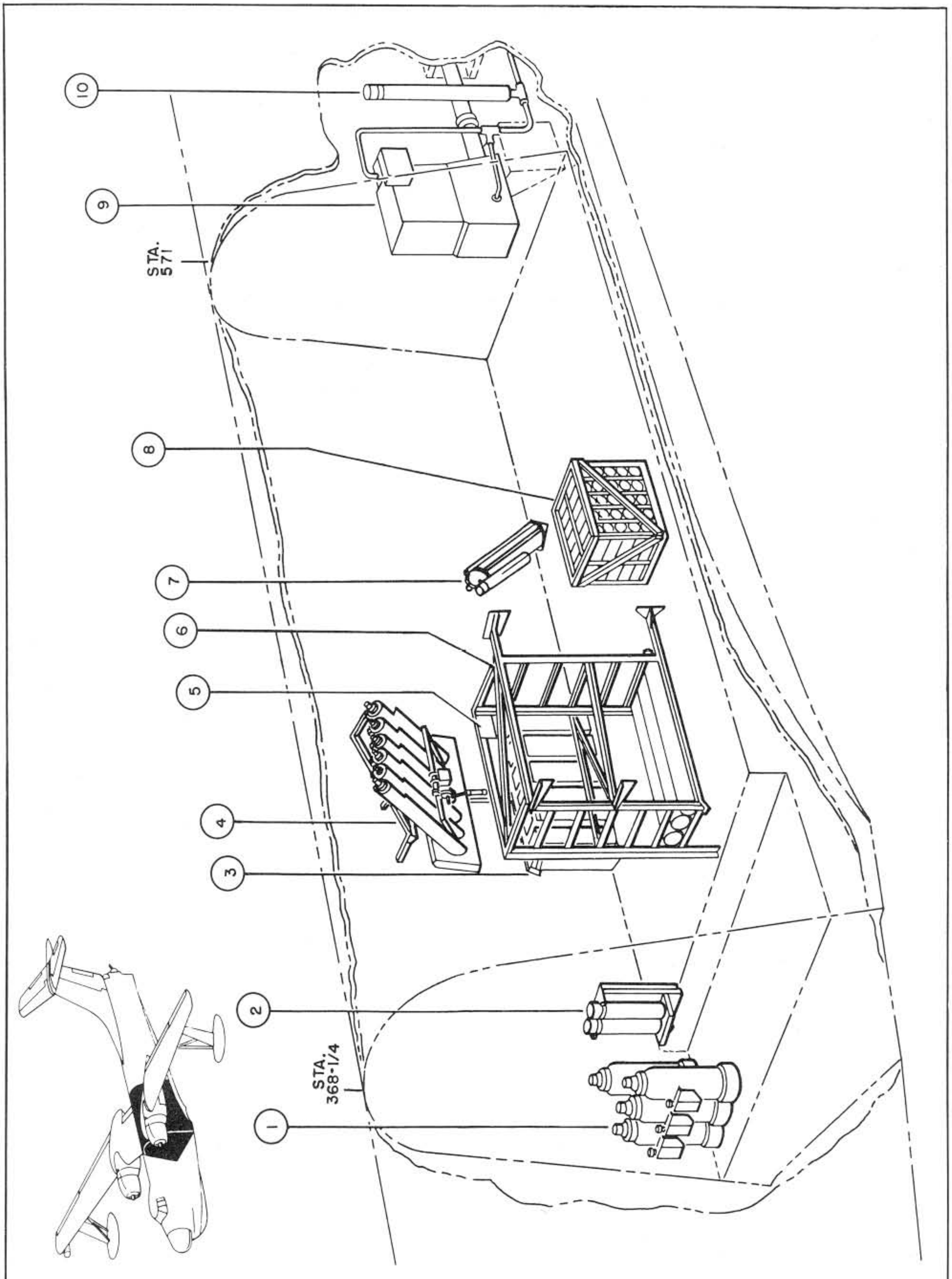


Figure 4-14. Sonobuoy Compartment Equipment

KEY TO FIGURE 4-14

1 Stowage, Jato Bottles
2 Stowage, Parachute Flare
3 Stowage, Float Light
4 Chutes, Small Sonobuoy
5 Instruction Plate, Small Sonobuoy
6 Stowage, Small Sonobuoy
7 Chute, Float Light
8 Stowage, Retro Marine Marker
9 Marker Ejector, Retro Marine
10 Marker Air Bottle, Retro Marine

on the main a-c power panel marked "CAMERA FLASHER"—"PHASE A POWER"—"PHASE B PWR"—"PHASE C PWR".

The camera can also be started by pressing the navigator's bomb release button in conjunction with the bomb system release controls with the co-pilot's "MANUAL-AUTO" switch in the "AUTO" position. To operate the Camera only:

Pilot's master armament switch	"ON"
Place navigator's "CAMERA POWER" switch	"ON"
Navigator's MANUAL switch	"NORMAL" or "RUN" for constant operation
Co-Pilot's POWER SWITCH	"DAY"
Co-Pilot's MANUAL control switch	Press momentarily
Camera Delay Timer	"SET"
Camera Timer	"SET"
Co-Pilot's "MANUAL-AUTO" switch	"MANUAL"

To operate the camera and flasher:

Pilot's master armament switch	"ON"
Place navigator's "CAMERA POWER" switch	"ON"
Co-Pilot's POWER switch	"NIGHT"
Navigator's MANUAL switch	"NORMAL" or "RUN" for constant operation
Camera Delay Timer	"SET"
Camera Timer	"SET"
Co-Pilot's Control Switch	"MANUAL"

MISCELLANEOUS EQUIPMENT.

NAVIGATOR, RCM AND RADIO OPERATOR'S SEAT

A swivel type seat is provided for the navigator, RCM and the radio operator. The swivel release handle, on the left side below the seat, allows the seat to be rotated 360 degrees with stops at intervals of 45 degrees. The seats which are on dual tracks running fore-aft covering most of the flight deck can be adjusted along the track to any desired position. These seats are adjusted for forward-aft movement and swivel only. Each seat includes a conventional lap safety belt.

RADAR OPERATOR'S SEAT.

The seat for the radar operator is a swivel type seat which is similar in construction to the navigator's seat, except that it is stationary and can not be moved in the forward and aft position. The seat is bolted to the flight deck floor, on the left side of the airplane, opposite the navigator's station. The seat is provided with a conventional lap safety belt.

BEAM OBSERVER'S SEAT.

The beam observer's seat is provided in the aft waist compartment, with one seat on the right side and one on the left side of the airplane. These seats are similar in construction to the navigator's seat. The seats are mounted on dual tracks and can be adjusted for transverse movement. A foot pedal on the base assembly of each seat controls the transverse adjustment. Each seat includes a conventional lap safety belt.

TAIL GUNNER'S SEAT.

A saddle type seat is mounted on a tubular post and is installed in the tail turret compartment. The seat is adjustable for elevation only. Folding arm rests hinged on each side of the hull structure is provided at the tail gunner's station. A lap type safety belt is provided with the seat, and a belt type back rest is attached to the hull structure.

1 Lever, Forward and Aft Adjusting
2 Handle, Swivel Release

Figure 4-15. Crew Member Seat

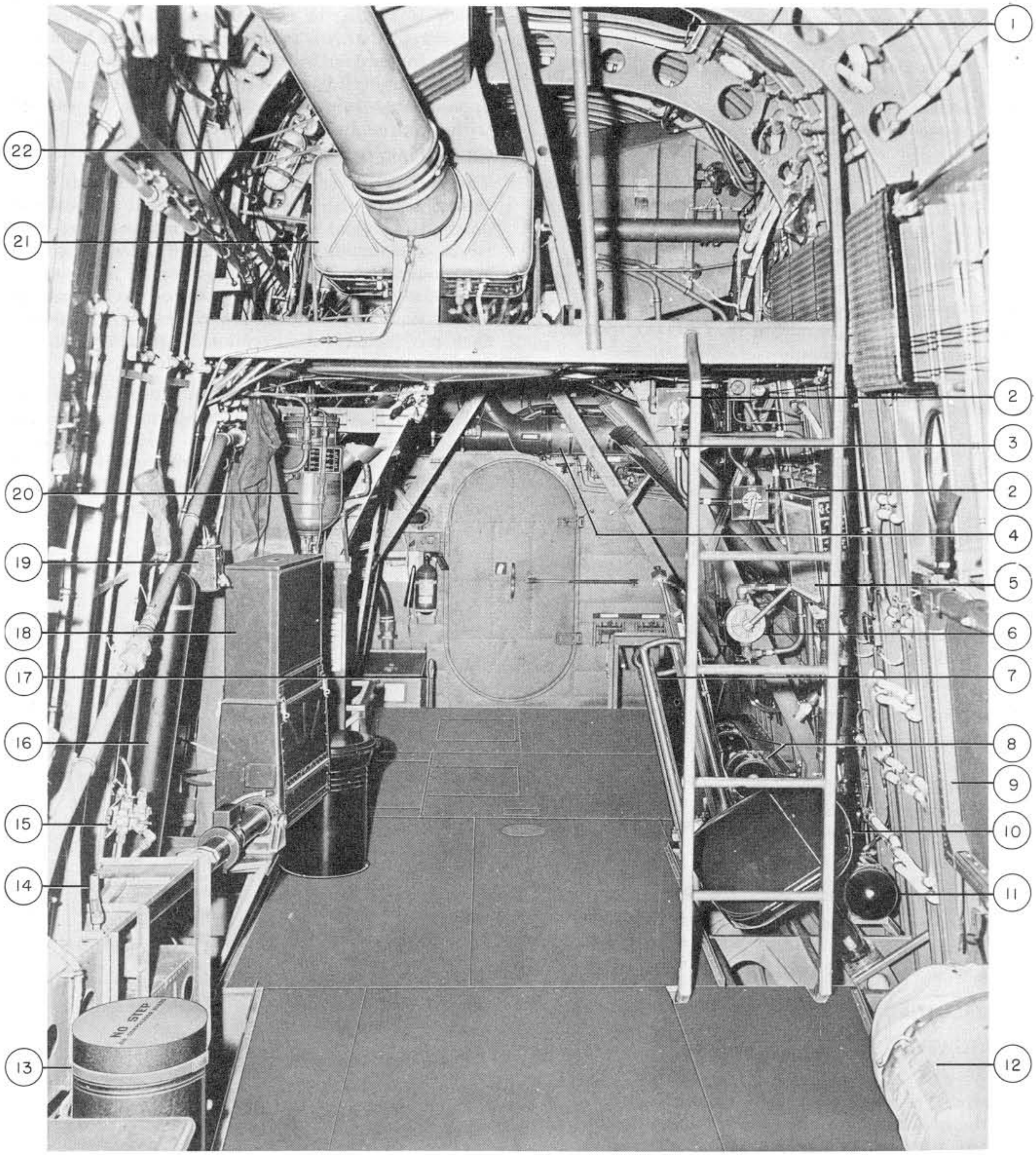


Figure 4-16. Waist Compartment. (View Looking Forward)

KEY TO FIGURE 4-16

1 Exit Hatch, APU Compartment
2 Valve Selector, Engine Oil Transfer
3 Launcher, Small Sonobuoy
4 Heater, Cabin
5 Junction Box, Sonobuoy
6 Hand Pump, Engine Oil Transfer
7 Launcher, Float Light
8 Air Bottles, Small Sonobuoy
9 Bunk
10 Flasher Pod, Stowed Position
11 Air Bottle, Float Light
12 Life Raft
13 Compressor, Marine Marker
14 Control Handle, Marine Marker Launcher Tube Door
15 Valve, Emergency Bomb Bay Door
16 Air Bottle, Marine Marker Retro-Ejector
17 Hand Pump, Fuel Transfer
18 Launcher, Marine Marker Retro-Ejector
19 Control Box, Marine Marker Retro-Ejector
20 Reservoir, Main Hydraulic System
21 Auxiliary Power Unit
22 Bottle, Fire Extinguisher, APU

SUNSHADES, PILOT AND CO-PILOT.
(Figure 1-22.)

Sunshades for the pilot and co-pilot are mounted on rods which are attached to the escape hatch coaming. Each sunshade slides forward and aft on rods and are fastened in a fully drawn or stowed position by snap fasteners.

REST BUNKS.

The airplane is equipped with three bunks, one is on the right side in the forward waist compartment opposite the left waist entrance hatch and two are on the left side in the aft waist compartment opposite the right waist entrance hatch. The bunks are held in a stowed position by snap fasteners on tabs attached to the frames above each bunk.

WATER BREAKER. (Figure 1-22.)

Two 4-1/2 gallon capacity water breakers are provided in the airplane. One is mounted above the forward end of the navigator's table and the other is mounted above the galley stove on the left side of the airplane. Each breaker is equipped with a filler cap and a spigot.

GALLEY.

The galley, located on the left side of the electronics compartment consists of a hot cup receptacle and a two hot plates which are used for warming food to be served to the crew during flight. The hot cup receptacle, which is continuously energized, is used by simply plugging in the hot cup unit. The hot plates are controlled by the galley stove switches, on the front of the galley unit, through three stages of heating—"LOW"—"MEDIUM" and "HIGH"—in addition to the "OFF" position. A red "GALLEY ON" indicator light, on the front of the galley unit, will come on whenever the galley stove switches in any position except "OFF". Electrical power to operate the galley units is supplied from the main a-c system through three circuit breakers (hot cup, hot plate No. 1, and hot plate No. 2) on the main power center panel.

GALLEY THERMOS BOTTLE.

A one gallon capacity thermos bottle is located at the forward end of the galley. The bottle is equipped with a filler cap, a cup, and with a spigot. The bottle is stowed by a strap and buckles attached to the hull structure.

BOARDING LADDER.

A boarding ladder used for entrance or exit from the waist compartment while the airplane is beached is stowed horizontal in the forward waist compartment opposite the left waist entrance hatch.

TOILET AND TOILET CURTAIN.

A toilet consisting of a metal casing with a removable inside dry container is located on the left side of the forward waist compartment. A black cloth curtain is provided for mounting around the toilet and is held in position by hooks and fasteners on supports below the auxiliary power plant flooring.

PROTECTIVE COVERS.

Refer to Section IX for airplane protective covers.

BEACHING GEARS.

The installation and removal of beaching gears can be accomplished with little difficulty, while the airplane is waterborne. With two operations of the manual levers, the gears can be installed or removed with ease and speed. It may be well to note, that the main beaching gears are identified by different colors. The main beaching gear with the green flotation tank must be installed on the "STARBOARD" side, while the beaching gear with the red flotation tank must be installed on the "PORT" side. In order to install or remove the beaching gears with a normal sea condition, the following procedure is recommended:

1. Installation of Main Beaching Gear to Airplane.

a. Attach handling lines to tow line fittings.

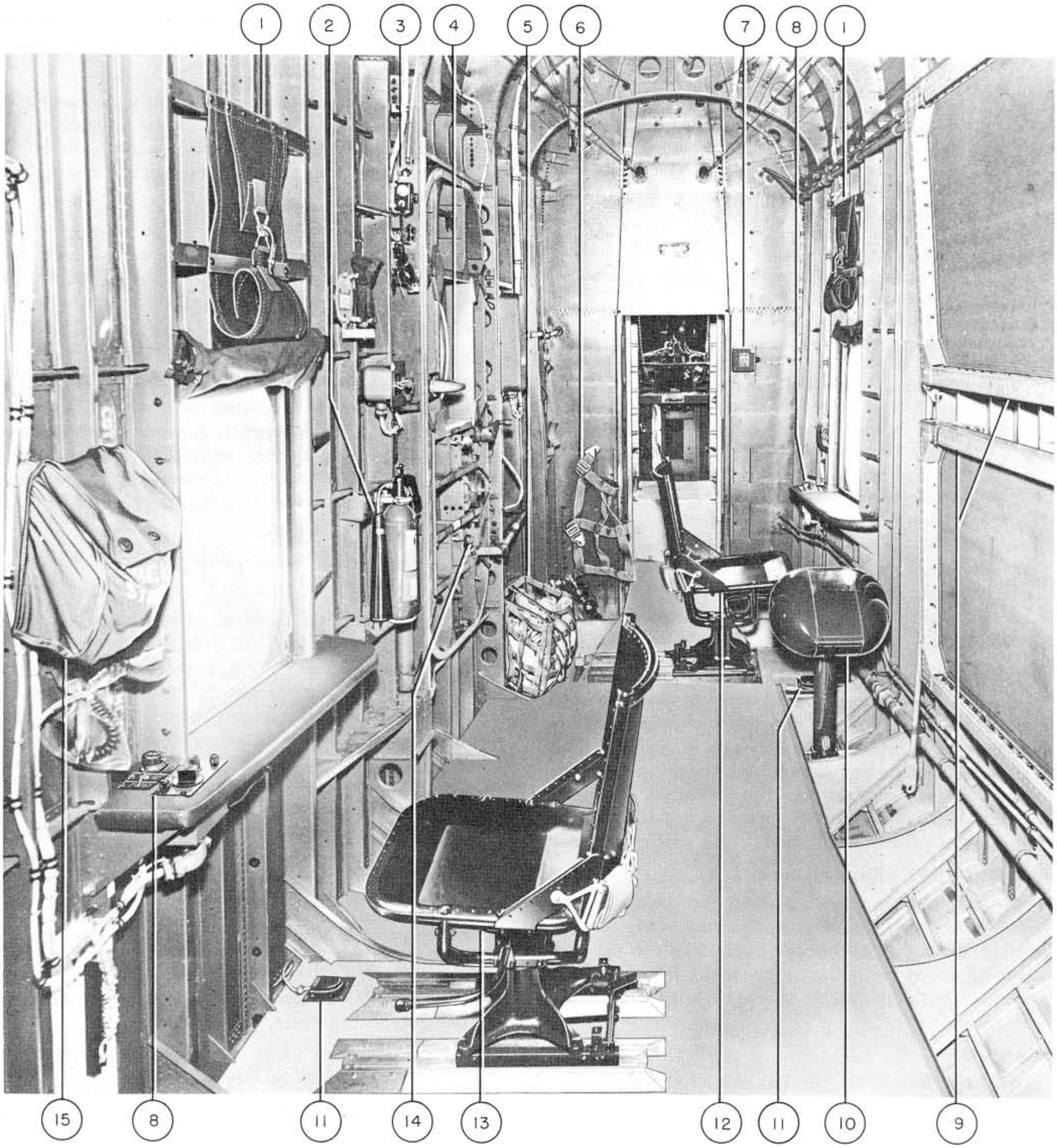
b. Fold and lock brake handle in stowed position before gear enters water.

c. Float the gear close to the airplane and align trunnion with fittings on side of hull.

d. With a man stationed at beaching gear hatch, use handle at top of gear to maneuver gear up to and under the chine of hull.

e. With upper strut aligned, engage trunnion pin by pulling aft on control handle until handle is locked in notched plate. Then insert safety pin through control handle.

f. Apply a slight pressure against the gear and at the same time push down on chine pin control handle until pins are engaged. Then insert safety pins through chine pin control handle.



1	Stowage, Parachute	6	Belt, Ditching	11	Switch, Microphone
2	Bottle, Fire Extinguisher	7	Switches, Compartment Light	12	Seat, Beam Observer—Left Side
3	Jack Box, Microphone and Headset	8	Panel, ICS Control	13	Seat, Beam Observer—Right Side
4	Hatch, Aft Entrance—Right Side	9	Bunks	14	Lever, Jato Release
5	Stowage, Sea Anchor and Lines	10	Pod, Camera	15	Stowage, Ditching Belt

Figure 4–17. Waist Compartment, Aft

2. Installation of Tail Beaching Gear to Airplane.

a. Attach handling lines to tow line fittings.

b. Float the gear to the starboard side of the airplane.

c. With a man stationed at the tail beaching gear hatch, pull the gear close to the airplane and align trunnion to fittings on side of hull.

d. Pull the trunnion pin control handle aft until pins are fully engaged. Then insert safety (tee) pins through control handle.

e. Apply a slight pressure against the gear and at the same time pull chine pin control handle down until spring catch is engaged. Then insert safety (tee) pins through control lever.

CAUTION

Always install the lock trunnion pins first, before attempting to engage chine pins.

3. Removal of Main Beaching Gear From Airplane.

a. Attach handling lines to tow line fittings on each gear before the airplane enters the water. Use handling lines to tow the gear to the ramp.

b. Fold and lock brake handle in stowed position just as the airplane enters the water.

c. Open the beaching gear hatch.

d. With a man at the beaching gear hatch, remove the safety pin from chine pin control handle.

e. Pull up on chine pin control handle, thereby retracting pins from chine fittings.

f. Remove safety pin and pull out on spring-loaded trunnion pin control handle to clear notch in plate, then push forward on handle, thereby retracting pins from hull fittings.

g. Float the gear free of the airplane by pushing it off the hull fittings.

h. Close the beaching gear hatches.

4. Removal of Tail Beaching Gear From Airplane.

a. Attach handling lines to tow line fittings on gear before the airplane enters the water. Use handling lines to tow gear to the ramp.

b. Open the tail beaching gear hatch.

c. With a man stationed at the tail beaching gear hatch, remove the safety pin from chine pin control handle.

d. Release spring catch and pull up on chine pin control handle, thereby retracting pins from the chine fittings.

e. Remove the safety pin from the trunnion pin control handle.

f. Push trunnion pin control handle forward thereby retracting pins from fittings on side of hull.

g. Float the gear free of the airplane by pushing it off the hull fittings.

h. Close the tail beaching gear hatch.

HULL BOTTOM TOWING HOOK.

Note

This hook is on Airplanes No. 140143 and subsequent as delivered.

DESCRIPTION OF HULL BOTTOM TOWING HOOK.

The retractable, hull bottom towing hook is used for towing and mooring the aircraft during refueling operations from a surfaced submarine. This hook is mounted in a housing which is faired into the hull bottom between stations 96.5 and 117.5. The hook is hydraulically operated and equipped with a sensing device which automatically triggers the latch mechanism, causing the hook to close and lock. Either the ladder type of pick-up rig or the single line type, which trails from a surfaced submarine, can be engaged by this hook.

There are two indicators lights on the cockpit overhead panel: one indicates the position of the hook, the other indicates cable engagement.

OPERATION OF HULL BOTTOM RETRACTABLE TOWING HOOK.

To operate the hull bottom towing hook, place the control switch (on the cockpit overhead panel) in HOOK DOWN position. This energizes the hydraulic hook valve solenoid No. 2, which will extend the hook and illuminate the HOOK DOWN indicator light on the cockpit overhead panel. When the hook engages the tow cable, the sensing switch is actuated. Actuation of this switch causes the CABLE ENGAGED indicator light to come on, and also energizes the hydraulic latch valve solenoid No. 2 to extend the latch.

To release the tow cable, place the control switch on the overhead panel to HOOK AND LATCH UP position. This will energize the hook valve solenoid No. 1 and latch valve solenoid No. 1, retracting the hook and latch. When the hook and latch return to the retracted position, both indicator lights will go out.

MISCELLANEOUS NAVIGATIONAL EQUIPMENT.

Following is a list of miscellaneous equipment:

Pilot's locker.

a. Miscellaneous Maps and Data.

Co-Pilot's locker.

a. One pair binoculars.

b. One signal flood light.

Navigator's locker.

a. Three port light covers.

b. One periscopic sextant hatch cover.

c. One flash light.

d. One load adjuster.

e. One filter box, signal flood light.

Navigator's Table.

a. Miscellaneous Charts.
b. One aircraft files kit.
c. One aircraft log book.
d. Two engine log books.
e. Two propeller log books.
f. One handbook, Flight Operating Instructions.
g. One handbook, Maintenance Instructions.
h. One handbook, Weight and Balance Data.
i. One handbook, Engine Service Instructions.
j. One pair binoculars.
k. One firing key.
l. Periscopic Sextant and case.
m. One plotter.
n. One plotting board base.
o. One plotting board.
p. One navigator's case.
q. One computer.
r. One parallel ruler.
s. Two watch boxes.
t. One navigational watch.
u. One navigational stop watch.
v. One divider (effective on airplane 140150 and thereafter, and after service change).

SECTION V
OPERATING LIMITATIONS

MINIMUM CREW REQUIREMENTS.

The airplane can be flown under normal non-tactical conditions with a minimum crew of four. Only under a normal routine flight must a minimum crew be allowed. When the airplane is flown with a useful load, as in an ASW condition, a flight crew of seven is required. Additional crew members may be added at the discretion of the Commanding Officer.

INSTRUMENT MARKINGS.

Operating limitations of functional engine power instrument markings are shown in figure 5-1.

ENGINE LIMITATIONS.

Do not operate engine power above 2600 rpm for more than 30 minutes. Do not exceed 2900 rpm for more than 5 minutes, with torque pressure at 166 psi.

A maximum manifold pressure setting of 61.5 Hg is restricted for sea level takeoff throughout the air temperature range and relative humidity.

Maximum engine limit overspeed is restricted to 3120 rpm.

Do not use idle speed limit below 600 rpm.

SUPERCHARGER CLUTCH OPERATION (Ground Check).

1. Set engine speed to 1600 RPM with the throttle (propeller control in full INCREASE RPM position).

2. Move the supercharger control switch to the HIGH position.

3. Open the throttle to obtain 30" Hg MAP.

4. Move the supercharger control switch to the LOW position. A sudden decrease in MAP when shifting from the HIGH to the LOW position indicates that the two-speed mechanism is working properly. Do not repeat the supercharger clutch shift check at less than 5-minute intervals.

Whenever possible, the engines should be operated on fuel grade 115/145. However, if fuel grade 115/145 is not available, the engines may be operated on fuel grade 100/130, subject to the following restrictions:

a. LOW BLOWER (Takeoff and Military Power).
2770 BHP
52.5 in. MAP
2900 rpm
RICH Mixture

(Normal Power)
2590 BHP
48.8 in. MAP
2600 rpm
RICH Mixture

(Cruise Power)
Same as when operating on fuel grade 115/145 except that RICH mixture is used.

Restrictions and limitations to the R3350-32W Engines when using 115/145 fuel, during all takeoff and flight operations, are listed as follows:

Takeoff	2900 rpm (Sea Level)	277 BMEP	61.5 MAP
RICH Mixture	2400 ft	279 BMEP	60.5 MAP
Military Rated—Normal Mixture			
LOW Blower	2900 rpm (Sea Level)	277 BMEP	61.5 MAP
	2400 ft	279 BMEP	60.5 MAP
HIGH Blower	2600 rpm (10,000 ft)	277 BMEP	50.5 MAP
	17,000 ft	233 BMEP	49.4 MAP
Normal Rated—Normal Mixture			
LOW Blower	2600 rpm (Sea Level)	255 BMEP	51.5 MAP
	4,000 ft	260 BMEP	50.5 MAP
HIGH Blower	2600 rpm (10,000 ft)	218 BMEP	48.5 MAP
	18,300 ft	233 BMEP	47.0 MAP
Maximum Cruise Power—Normal Mixture			
LOW Blower	2200 rpm (Sea Level)	168 BMEP	38.0 MAP
	10,000 ft	176 BMEP	38.0 MAP

Engines are to be limited by BMEP or MAP, whichever occurs first.

b. HIGH BLOWER (All conditions).
1500 BHP
34.0 in. MAP
2900 RPM
RICH Mixture

c. All operation on fuel grade 100/130 in either LOW or HIGH blower must be with RICH mixture.

Refer to Table of Specific Operating Data for other engine limitations.

SUPERCHARGER CLUTCH OPERATION (IN FLIGHT)

When shifting supercharger clutch from LOW to HIGH, engine rpm should be reduced to 1600 rpm. Reduce manifold to 20 inches Hg. before shifting to HIGH. Shifting from HIGH to LOW ratio may be accomplished at any engine operating speed. Do not make more than 2 clutch shifts, from LOW to HIGH, within a 5-minute interval.

PROPELLER LIMITATIONS.

Propeller limitation of rpm's in reverse position is restricted to 2530 rpm with 40 in. MAP.

WARNING

Never put the PROP. REV. REL. lever in the TAXI position in flight. When the lever is in this position, it is possible to reverse the propellers; therefore, the airplane must be waterborne before selecting the TAXI position.

Because of the vibration characteristics of the engine-propeller combination, the following restrictions must be observed:

a. While taxiing, avoid engine rpm between 900 and 1200, also between 2550 and 2750.

b. While on beaching gear, avoid engine rpm between 2550 and 2750.

c. Avoid climbing with engine rpm between 2600 and 2800, at indicated airspeeds below 140 knots. (Operation at 2600 rpm is permissible.)

AIRSPEED LIMITATIONS.

The maximum permissible indicated airspeeds are as follows:

In smooth air:

At 12,000 feet or below	263 knots
At 15,000 feet	248 knots
At 18,000 feet	234 knots
At 21,000 feet	218 knots
In moderately turbulent air	215 knots
With flaps extended	150 knots
With landing lights extended	175 knots

In severe turbulence, speed in the range from 130 to 160 knots is recommended.

ACCELERATION LIMITATIONS.

The maximum permissible acceleration for flight in smooth air at a gross weight of 70,000 pounds or less is 3.0g. When flying in conditions of moderate turbulence, accelerations because of deliberate maneuvers must be limited to 2.0g at a gross weight of 70,000 pounds or less in order to minimize the possibility of overstressing the airplane as a result of the combined effects of gust and maneuvering loads. As gross weights are increased above 70,000 pounds the permissible accelerations decrease. To determine the maximum permissible accelerations at gross weights in excess of 70,000 pounds, multiply the accelerations given above for smooth air or for moderate turbulence by the ratio of 70,000 pounds to the new gross weight.

GROSS WEIGHTS.

The maximum recommended gross weights are as follows:

For routine takeoffs and landings in conditions not exceeding the following:

Slight sea (wave heights 1 to 3 feet)	75,000 lb
Moderate sea (wave heights 3 to 5 feet)	70,000 lb
Rough sea (wave heights 5 to 8 feet)	66,000 lb
Ferry flight takeoffs in sea conditions not exceeding those of a slight sea	78,000 lb

MANEUVERS.

In flight maneuvers are restricted as follows:

The angle of bank shall not exceed 60 degrees.

The flight controls shall not be moved abruptly.

Slipping or skidding shall be avoided at indicated airspeeds in excess of 170 knots. At indicated airspeeds below 170 knots, slipping or skidding is permitted as required in asymmetric powered flight and in landing approaches.

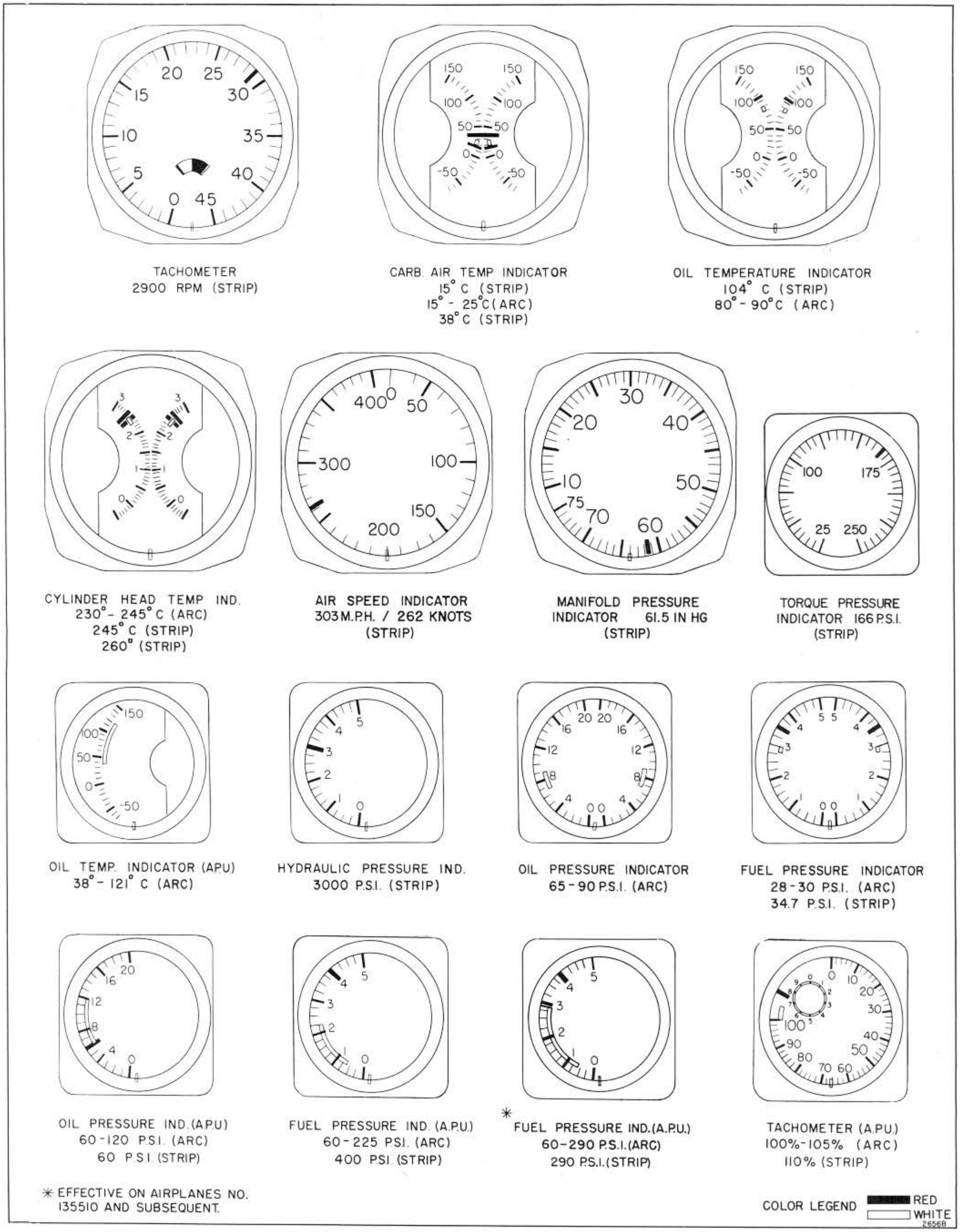


Figure 5-1. Instrument Markings

WRIGHT TURBO COMPOUND ENGINES
TABLE OF SPECIFIC OPERATING DATA
MODEL 878TC18EA1 (R-3350-32W)

Operating Condition	*RPM*	*BHP*	*Critical Altitude Ft.*	*Clutch Control Position*	*Mixture Control Position*	*Maximum Cyl. Hd. Temp. °C.*
Take off .... (5 Minutes)	2900	3400	Sea Level	Low	RICH	260 (500°F)
Military Rated	2900	3400	Sea Level 2400	Low	NORMAL	260 (500°F)
	2900	3420	10,000	Low		
(30 Minutes)	2600	2500	17,000	High	NORMAL	260 (500°F)
	2600	2550	—	High		
Normal Rated	2600	2850	4100	Low	NORMAL	245 (473°F)
(Continuous)	2600	2450	18,000	High	NORMAL	245 (473°F)
70% Normal Rated... Power and Below.....	— —	— —	— —	Low or High	NORMAL	230 (446°F)
Ground Operation ...	—	—	—	Low	RICH	260 (500°F)

NOTE: Maximum engine overspeed 3120 rpm.

Oil-in Temperature—°C

Desired ....85 (185°F.)
Maximum ....104 (220°F.)

Fuel Pressure—PSI

Minimum 28
Maximum 30

Oil Pressure—Psi

Minimum 65
Maximum 90
Minimum allowable at idle speed—15

Torquemeter Pressure—Psi

Maximum at Take off.............166

$$\text{BHP Formula} = \frac{\text{Torque x RPM}}{142}$$

BMEP Formula = TP x 1.66

SECTION VI
FLIGHT CHARACTERISTICS

FLIGHT CHARACTERISTICS.

The overall flight characteristics are very good under all flight conditions. The ease of handling, roomy cockpit and good visibility should help reduce pilot fatigue for long range flying. The airplane is stable under all normal flying conditions, and has excellent instrument flying qualities.

The maximum speed at sea level with a gross weight of 70,000 pounds is 263 knots. The average cruising speed is 136 knots over a normal ASW operating range.

STALLS.

Stalls and recovery are normal. As the stall is approached, warning is exhibited in the form of an increase in the rearward travel of the control column and a shake in the elevator control column. The shake is a mechanical stall warning stick shaker mounted on the co-pilot's control column which will indicate stall warning at 1.15 times the stalling speed. This stall warning continues through the stall speed. A stall is followed by a nosing over tendency and recovery is affected by normal use of the controls without excessive altitude loss. The airplane has a mild tendency to roll at the stall with the flaps down but this is readily controllable. The mechanical stall warning system, as pointed out above, is set up to give stall warning at 1.15 times the stalling speed in the configurations as shown in figure 6-1, Stall Chart. The stall warning system is described in Section I.

DE-ICER BOOTS.

Operation of the de-icer boots at speeds below 126 knots produces buffeting and, at a slightly less IAS, loss in lift will be experienced with rate of descent from 1000 to 2000 fpm. Operation of the boots below this speed should be avoided.

SPINS.

Spins are prohibited. Avoid any flight attitude from which a spin may result.

FLIGHT CONTROLS.

The flight controls are very effective throughout the entire operating range of the airplane. Forces are comfortable and perhaps a bit lower than expected for this category airplane. The elevator and rudder are hydraulically boosted. The ailerons are standard Frize-type ailerons, with an auxiliary aileron hydraulically operated. This combination gives a very high rate of roll with excellent lateral control even at the stall.

With complete loss of the flight control hydraulic system, the airplane can be handled and a landing made with the help of elevator tab.

LEVEL FLIGHT CHARACTERISTICS.

The airplane has satisfactory flight characteristics at slow, cruising and high speed. There is sufficient trim available to trim hands off in any of these conditions.

CHANGES IN POWER SETTINGS.

Power changes are made in the normal manner.

a. To increase power, increase rpm then advance throttle.

b. To decrease power, retard throttle then decrease rpm.

DIVING.

Do not exceed the restrictions as outlined in Section V. Also, see figures 6–2 and 6–3 for indicated altitudes, airspeeds, and dive angles.

FLIGHT WITH EXTERNAL LOADS.

With external loads, such as wing rockets, bombs, and mines, the flight characteristics are unchanged.

The flight characteristics of the airplane, when releasing the external stores, will be added to this handbook when made available.

STALL CHART

POWER OFF

MODEL P5M-2 ENGINES (2) R-3350-32W

GROSS WEIGHT POUNDS		56,000	74,302	78,000
	ANGLE OF BANK DEGREES	STALL SPEED-KNOTS	STALL SPEED-KNOTS	STALL SPEED-KNOTS
CLEAN CONDITION	0	87	100.4	103
	10	87.5	100.9	103.5
	20	90	103.5	106
LANDING CONDITION	0	74.5	86.2	88
	10	75	86.8	89
	20	77	88.8	91
TAKE-OFF CONDITION	0	76.5	87.8	90
	10	77	88.8	91
	20	79	90.8	93
		TRUE AIRSPEED-KNOTS		

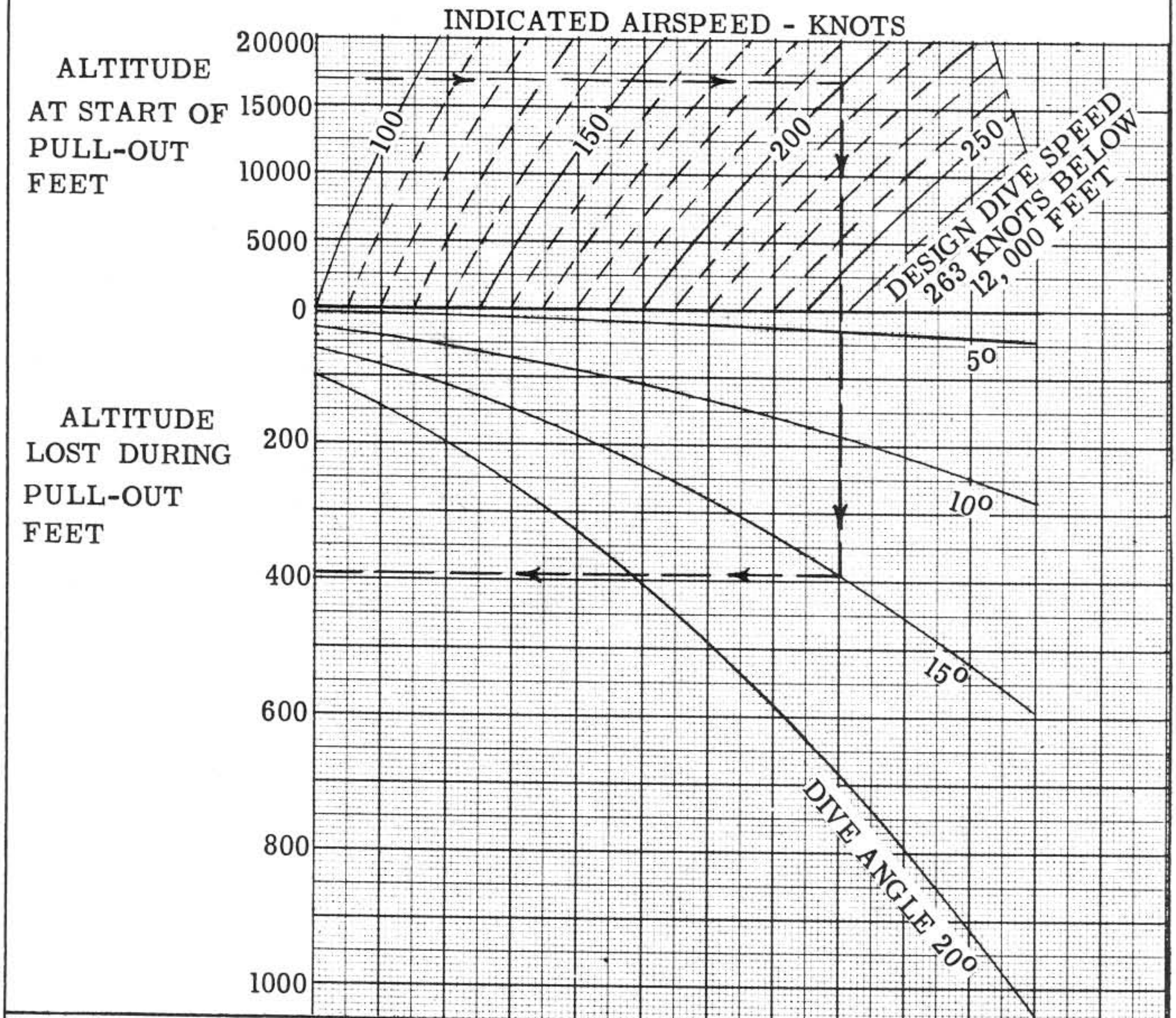
DATA AS OF: 3-12-54

DATA BASIS: ESTIMATED

25083

Figure 6-1. Stall Chart

ALTITUDE LOSS
CONSTANT 1.5 G PULL-OUT



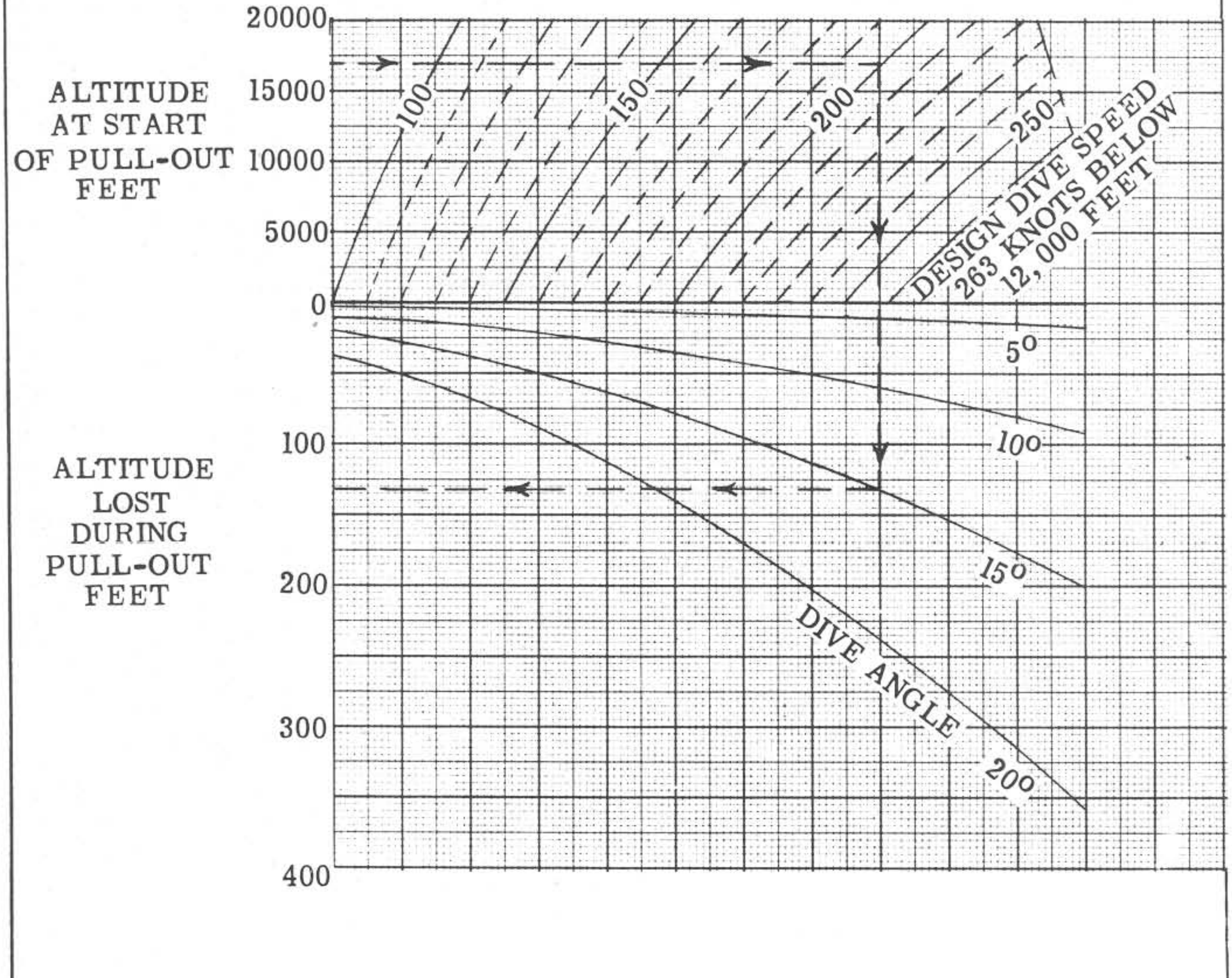
HOW TO USE CHARTS: Select appropriate chart depending upon acceleration (1.5 or 2.5 g) to be held in pull-out; then -

1. Enter chart at actual altitude at start of pull-out (for example 17,000 FT.).
2. Go across to IAS at which pull-out is started (for example 200 knots IAS).
3. Project vertical down to dive angle at start of pull-out (for example 15°).
4. Sight back horizontally to scale at left to read altitude lost during pull-out (for example 390 FEET).

Figure 6-2. Altitude Loss—Constant 1.5 G Pull Out

ALTITUDE LOSS

CONTSTANT 2.5 G PULL-OUT



HOW TO USE CHARTS: Select appropriate chart, depending upon acceleration (1.5 or 2.5 G) to be held in pull-out; then -

1. Enter chart at actual altitude at start of pull-out (for example 17,000 FT.).
2. Go across to IAS at which pull-out is started (for example 200 knots IAS).
3. Project vertically down to dive angle at start of pull-out (for example 15°).
4. Sight back horizontally to scale at left to read altitude lost during pull-out (for example 130 FT.).

Figure 6-3. Altitude Loss—Constant 2.5 G Pull Out

ENGINE OPERATING LIMITS TABLE

115/145 GRADE FUEL

MODEL: P5M-2 **PROPELLERS:** Hamilton Standard 34E60 **ENGINES:** (2) R-3350-32W

		LOW BLOWER						HIGH BLOWER						
RPM	PRESSURE ALTITUDE	SL	2000	4000	6000	8000	10,000	12,000	14,000	16,000	18,000	20,000	22,000	24,000
2900	TP	165	166	158	148	139	130	Takeoff and Military Power Rating are the same. Maximum allowable cylinder head temp 260°C (500°F). Time limit, 30 minutes.						
	MAP	61.5	60.7	57	53	49.4	46							
2600	TP	Military Power maximum allowable cylinder head temp 260°C (500°F). Time limit, 30 min.						136	137	138	134	126	117	109
	MAP							50.2	49.9	49.6	48	44.2	41	38
2600	TP	152	153	154	146	138	130	130	131	132	132	Normal Rated Power max. allow. head temp 245°C (473°F). Time limit, None.		
	MAP	51.2	50.7	50	47	43.8	48.8	48.3	47.9	47.5	47.1			
2500	TP	137	138	139	141	134	126	118	118	119	119	120	113	104
	MAP	45.6	452	45	44.5	42	39	42.2	42.1	41.9	41.5	41.3	39	36
2400	TP	123	124	125	126	127	122	109	105	106	106	107	108	91.5
	MAP	41	40.5	40	39.7	39.2	37.6	35	37.6	37.6	37.5	37.2	36.9	34
2300	TP	112	113	114	115	116	113	100	97.5	98.5	99	100	95	88
	MAP	38.7	38.2	37.9	37.5	37	36.2	33.5	36	36	35.7	35.4	34.4	32
2200	TP	95.5	100	102	103	104	104	96.5	97.5	98	98.5	98	90.5	84
2100	TP	95	96	96.5	97	98	98.5	95	95.5	96.5	97	93	86.5	80.5
2000	TP	94.5	95	95.5	96.5	97	97.5	93.5	94.5	95	95	89.5	83.5	77.5
1900	TP	93.5	94.5	95	95.5	96.5	93	93.5	93.5	94	92	85.5	79.5	74.5
1800	TP	93	93.5	94.5	95	96	92.5	93	93.5	93.5	88.5	82.5	77	71.5
1700	TP	93	93.5	94	94.5	94	92	92	92.5	92	86	80	74	69
1600	TP	93	93.5	93.5	94	91	91	91.5	92	88.5	82	77	71	65.5
2200 & less		Cruising Power: Limit MAP, 36.5" Hg; Max allow. cyl head temp. 230°C; Time limit, None.												

NOTES:

1. Values to right of heavy vertical line are applicable to HIGH BLOWER operation only.
2. Minimum recommended cruising RPM, 1600.
3. While climbing, avoid engine operation between 2600 and 2800 RPM (operation at 2600 RPM is permissible).
4. Torque pressure (TP) values shown above account for —25 BHP loss due to accessory drive.

REMARKS:

1. Tabulated values as shown are limits which must not be exceeded. The limit TP or MAP which is obtained with the least throttle opening determines the maximum permissible power setting under the existing operating condition. In addition, if a difference in MAP of more than 2 in. Hg is obtained between engines when operating at limit TP, power on the engine with the higher MAP must be reduced until the difference is 2 in. MAP or less.
2. For complete sea level and altitude engine calibrations, refer to Engine Operating Limits Curve in Appendix I.

DATA AS OF: 1 DECEMBER 1956 **FUEL GRADE:** 115/145

DATA BASIS: Calculated from Engine Operating Limit Curves, Appendix I **FUEL DENSITY:** 6.0 LB/US GAL

21062

Figure 6-4. Engine Operating Limits—115/145 Fuel

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SECTION VII
SYSTEMS OPERATION

FUEL SYSTEM.

PRESSURE FUELING.

Pressure fueling of all fuel tanks, is primary to the gravity secondary fueling, which is accomplished by connecting an outside fuel supply, which is under pressure, to the pressure fuel connectors in the beaching gear compartment, and turning on the pressure fueling switch on the fueling control panel in the beaching gear compartment. (Figure 7-1.) This switch opens the main fueling valve and the No. 1 and No. 2 service tanks transfer valves in the upper fuel tank. Fuel is then forced by means of the pressure fueling manifold to the hull tanks through the normally open hull tanks fueling valve, to the auxiliary wing tanks and auxiliary droppable tanks (if installed in bomb bays) through the normally open left and right auxiliary tanks fueling valves, and to the service tanks through the transfer manifold and the main fueling valve and service tanks transfer valves.

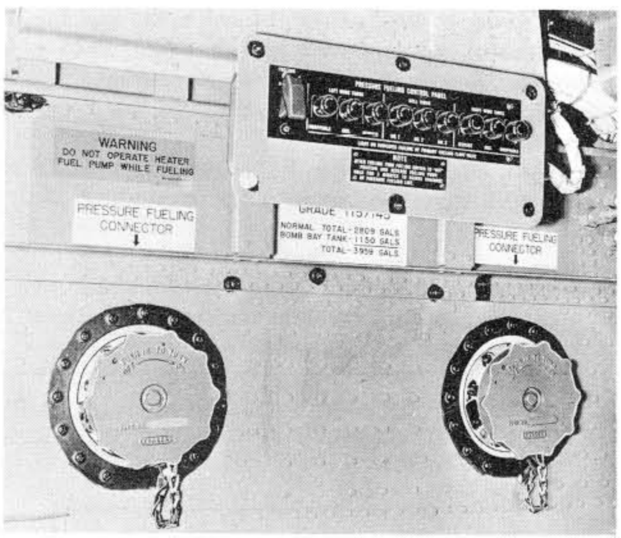


Figure 7-1. Pressure Fueling Control Panel

A primary fuel level control valve (float type) in each tank will act to shut-off the fuel inlet at that tank when it becomes full. In event that a primary valve fails to close when the fuel quantity reaches the proper level, a float operated secondary shut-off switch (one at each tank) will actuate. The secondary shut-off switch will cause the corresponding tank fueling valve to close and a corresponding red indicator light to come on, indicating failure of the primary fueling float valve and that the fuel quantity for the corresponding tank is above the normal full level.

Systematic pressure fueling of hull, wings and droppable bomb bay tanks are operated as follows:

PRESSURE FUELING OF HULL AND SERVICE TANKS

- Turn "ON" pressure fueling switch.
- Opens No. 1 and 2 engine service tank fueling valves.
- Opens service tank main fueling valve.
- Manually override left and right auxiliary wing and droppable bomb bay tank fueling valves to "CLOSE". By disconnecting electrical plugs at each valve and actuating manual override lever.

PRESSURE FUELING SERVICE TANKS, AUXILIARY WING AND DROPPABLE BOMB BAY TANKS.

- Turn "ON" pressure fueling switch.
- Opens No. 1 and No. 2 service tank fueling valves.
- Opens service tank main fueling valve.
- Turn "ON" droppable tank fueling switch.
- Closes hull tank fueling valve.

PRESSURE FUELING-COMPLETE SYSTEM

- Turn "ON" pressure fueling switch.
- Opens service tank main fueling valves.
- Opens No. 1 and No. 2 engine service tank fueling valves.

PRESSURE FUELING OF SERVICE TANKS - ONLY

- Turn "ON" No. 1 and No. 2 engine service tank fueling valves.
- Opens No. 1 and No. 2 engine service tank fueling valves.
- Turn "ON" pressure fueling switch.
- Opens service tank main fueling valve.
- Turn "ON" defueling switch.
- Energizes service tank fueling valve, jettison and defueling relay.
- Closes hull tanks fueling valve.
- Closes right and left auxiliary and droppable bom b bay tank fueling valves.

PRESSURE FUELING OF RIGHT AND LEFT AUXILIARY WING AND DROPPABLE BOMB BAY TANKS-ONLY.

- Droppable tank fueling switch "ON".
- Closes hull tanks fueling valve.
- Opens service tank main fueling valve allowing fuel to flow to transfer and fueling manifold.

NOTE

If bomb bay tanks are not installed, use above procedure for filling right and left auxiliary wing tanks.

PRESSURE FUELING OF HULL TANKS - ONLY

- Manually override right and left auxiliary wing and droppable bomb bay tanks fueling valves to "Close" by disconnecting electrical plugs at each valve and actuating manual override lever.

PRESSURE FUELING OF HULL, AUXILIARY WING AND DROPPABLE BOMB BAY TANKS.

- Turn all switches "OFF".
- Auxiliary wing, droppable bomb bay tank and hull tank fueling valve will open.

Note

It is suggested the fuel system diagram be referred to and used in conjunction with this section, in order to better comprehend this system. (See Figure 1-11.)

FUEL TRANSFER. (See Figure 7-2.)

Transfer of fuel from the auxiliary wing tanks, droppable tanks and hull tanks to the service tanks is accomplished by turning on the No. 1 and No. 2 engine service tank fueling switches and then turning on the switch of the transfer pump for the tank from which fuel is to be transferred. One or more transfer pumps should be kept in continuous duty to maintain a constant fuel pressure at the manifold. Under this system the service tanks are kept constantly full under control of the shut-off valve and the fuel level control valve of each service tank. Each pump being used operates continuously to maintain fuel under pressure at the transfer manifold until the corresponding tank is empty.

Fuel tank empty warning lights on the co-pilot's subpanel will come on when a corresponding tank is empty.

Note

Since the transfer pumps are designed for continuous duty no harm will result from the above described operation.

TRANSFER OF FUEL FROM NO. 1 HULL TANK TO SERVICE TANKS (TYPICAL FOR NO. 2 AND 3 HULL TANK)

- Turn "ON" No. 1 and 2 engine service tank fueling valves.
- Opens corresponding fueling valve.
- Select No. 1 hull tank with hull tank selector and transfer pump switch.
- Opens No. 1 hull tank transfer valve and energizes hull tanks transfer pump.
- Tank empty is indicated by a light, energized through the fuel quantity system.

Each service tank booster pump switch has an "EMERGENCY" position. This position is used to furnish higher fuel pressure required during priming, take-off, during a steep climb, landing, single engine cruise, or in the event of an engine driven pump failure.

Procedure for transferring of fuel and operation of pump switches is conducted as follows:

CAUTION

Do not transfer fuel to auxiliary wing tank after bomb bay tank has been jettisoned.

TRANSFER OF FUEL FROM AUXILIARY WING TO SERVICE TANKS.

- Turn "ON" No. 1 and 2 engine service tank fueling valves.
- Opens corresponding fueling valves.
- Turn "ON" auxiliary tank transfer pump.
- Energizes auxiliary tank transfer pump.
- Tank empty is indicated by a light, energizes through the fuel quantity system.

TRANSFER OF FUEL FROM DROPPABLE BOMB BAY TANKS TO SERVICE TANKS.

- Turn "ON" No. 1 and No. 2 engine service tank fueling valves.
- Opens corresponding fueling valve.
- Turn "ON" droppable bomb bay tank transfer pump switch.
- Energizes transfer pump.
- Tank empty is indicated by a light, energized by a pressure switch, when fuel pressure in droppable bomb bay tank line drops below 1 psi.

FUEL CROSSFEED.

The fuel system is arranged so that if one of the service tanks become empty or inoperative, the engine normally supplied fuel from that tank may be supplied fuel from the opposite service tank or from the transfer manifold. This is accomplished by turning on the corresponding engine crossfeed valve and turning on the opposite engine crossfeed valve or the manifold crossfeed valve as desired. The three valves on the fuel flow panel (figure 7-2), control corresponding valves in the upper fuel trunk boxes. Fuel crossfeed operations are as follows:

Note

Each fuel control valve in the fueling system has a manual override feature which can be used to operate the valves whenever electrical control fails.

CROSSFEED OPERATION (EXAMPLE, No. 2 ENGINE INOPERATIVE AND BOTH FUEL BOOSTER PUMPS "OFF".)

- Place No. 2 engine fuel firewall shut-off switch in "OFF" position.
- Closes No. 2 engine fuel firewall shut-off valve.
- Turn "ON" No. 2 engine crossfeed switch.
- Opens No. 2 engine crossfeed valve.
- Turn "ON" No. 1 engine crossfeed switch.
- Opens No. 1 engine crossfeed valve.
- For climbs or altitudes above 6000 ft. place No. 2 engine booster pump switch in "EMERGENCY BOOST" position.
- Supplies fuel at more than normal rate.

DEFUELING.

Defueling is accomplished whenever the airplane is overhauled or stored. It consists of defueling all tanks, except the service tanks, through the pressure fueling manifold. This is accomplished by connecting a fuel line from the pressure fueling manifold connectors, through a suction pump, to an outside storage tank. The three crossfeed valves, in upper fuel trunk boxes, are normally closed in this condition, preventing defueling of the service tanks.

Defuel tanks as follows:

DEFUELING

Defueling switch "ON".

Opens service tank main fueling valve.

Energizes service tank fueling valve, jettison and defueling relay.

Closes left and right auxiliary tank fueling valve.

Closes hull tank fueling valve.

Insert defueling nozzle in single point fueling connector, select tank and turn on corresponding transfer pump switch.

FUEL JETTISON.

Fuel jettison consists of pumping the contents of all the fuel tanks except, the service tanks overboard through a jettison line outlet at the aft end of the hull.

The jettison switch, when turned to "JETTISON", will automatically cause fuel to be jettisoned from both the left and right auxiliary wing tanks. Hull tank fuel may be jettisoned only by selection of tank desired on fuel flow panel.

Note

Jettison switch overrides the control panel for jettison of the auxiliary wing tank fuel. No control panel setting required for jettison of the auxiliary wing tank fuel.

Operation of fuel jettison is accomplished as follows:

FUEL JETTISON

Jettison switch "ON".

Energizes jettison relay.

Opens fuel jettison valve.

Energizes right and left auxiliary tank transfer pump.

FUEL USAGE.

The following table is predicated on adequate fuel in the tanks and power, etc. Slide the cover panel back from over the fuel control panel and turn the control knobs as follows: (See figures 1-12 and 7-2.)

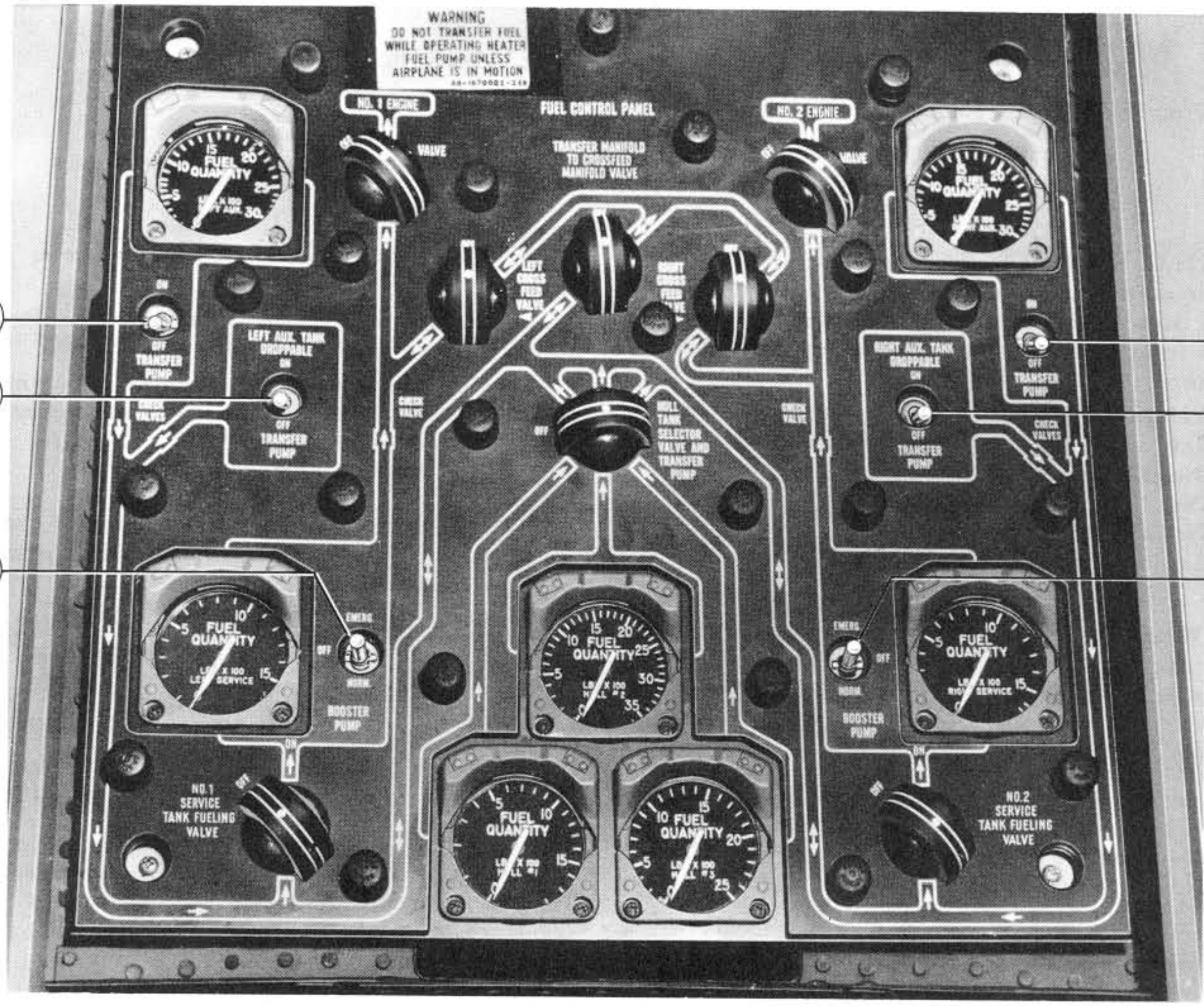
To feed the:

Left Engine	No. 1 Engine Valve Switch	"ON"
	Left Booster Pump Switch	"EMERG" or "NORM."
Right Engine	No. 2 Engine Valve Switch	"ON"
	Right Booster Pump Switch	"EMERG" or "NORM."

To transfer to and feed the:

LEFT SERVICE TANK.

From the Left Auxiliary Tank	Left Auxiliary Transfer Pump Switch	"ON"
	Left Transfer Valve Switch	"ON"
From the Left Bomb-Bay Tank	Left Bomb Bay Transfer Pump Switch	"ON"
	Left Transfer Valve	"ON"
From No. 3 Hull Tank	Hull Tank Selector	No. 3
	Unused Tank Switches	"OFF"
	Left Transfer Valve Switch	"ON"
From No. 2 Hull Tank	Hull Tank Selector	No. 2
	Unused Tank Switches	"OFF"
	Left Transfer Valve Switch	"ON"



1 Transfer Pump Switch, Right Wing Auxiliary Tank
2 Transfer Pump Switch, Right Auxiliary Droppable Tank
3 Booster Pump Switch, Emergency, No. 2 Engine Service Tank
4 Booster Pump Switch, Emergency, No. 1 Engine Service Tank
5 Transfer Pump Switch, Left Auxiliary Droppable Tank
6 Transfer Pump Switch, Left Wing Auxiliary Tank

Figure 7–2. Fuel Control Panel

From No. 1 Hull Tank..................	Hull Tank Selector	No. 1
	Unused Tank Switches	"OFF"
	Left Transfer Valve Switch	"ON"

RIGHT SERVICE TANK.

From the Right Auxiliary Tank...........	Right Auxiliary Transfer Pump Switch	"ON"
	Right Transfer Valve Switch	"ON"
From the Right Bomb-Bay Tank.........	Right Bomb-Bay Transfer Pump Switch	"ON"
	Right Transfer Valve	"ON"
From No. 3 Hull Tank..................	Hull Tank Selector	No. 3
	Unused Tank Switches	"OFF"
	Right Transfer Valve Switch	"ON"

From No. 1 Hull Tank..................	Hull Tank Selector	No. 2
	Unused Tank Switches	OFF
	Right Transfer Valve Switch	ON
From No. 2 Hull Tank..................	Hull Tank Selector	No. 1
	Unused Tank Switches	OFF
	Right Transfer Valve Switch	ON

NORMAL FUEL USAGE SEQUENCE.

Under normal operation, fuel is supplied to the engines from the wing service tanks and must be replenished from the airplane fuel tanks in the following sequence:

Left or Right Auxiliary Wing Tanks
Left or Right Droppable Bomb Bay Tanks
No. 3 Hull Tank
No. 2 Hull Tank
No. 1 Hull Tank
Left or Right Wing Service Tanks

Note

When fuel is transferred to the wing service tanks, it should be taken from tanks on each side of the airplane simultaneously to keep the airplane balanced.

MANUAL LEANING PROCEDURE.

Manual leaning is the positioning of the carburetor mixture control in the NORMAL position. This is the best economy range.

CAUTION

Maintain 1100 pounds (minimum) fuel level in the service tanks during flight.

Normal mixture should result in the specified fuel consumption and reasonably economical operation at all engine speeds. At 2200 RPM or less the setting affords maximum engine fuel economy. At greater than maximum cruising powers the fuel-air ratio is autoatically increased to obtain best power mixtures. The increased fuel consumption in relation to the power developed permits use of higher torque pressure (TP) settings and tends to prevent detonation.

WARNING

D-c power must be connected and all appropriate circuit breakers IN to energize the secondary fuel shut-off system at all times during fueling operations or when transferring fuel within the system.

The amount of fuel supplied to the engine for a given brake horsepower is varied by manual adjustment of the throttles and mixture control levers until the best economy point has been established. This point may or may not be farther towards the CUT-OFF position than the NORMAL position. It should be noted in most cases, however, the NORMAL setting is only slightly richer than that for best economy.

The following manual leaning procedure is recommended:

(1) Set desired RPM and desired torque in NORMAL mixture (both engines).

(2) Move mixture control (of engine being manually leaned) toward RICH until torque pressure peaks or just starts to fall-off again.

Note

Flick primer to obtain additional fuel if peak torque is not obtained before RICH mixture position is reached.

(3) With mixture control at "Best Power" (peak torque), reset torque pressure to 7% in excess of desired final torque by adjusting throttle.

Note

If NORMAL was at or near best economy, little or no adjustment of the throttle will be required.

(4) With throttle and torque adjusted at "Best Power", manually lean until desired final torque is obtained, i.e., approximately 7% drop from "Best Power" torque.

Note

The above procedure requires exceeding, for a brief time, the torque limit specified for prolonged operation with mixtures leaner than best power. For this reason, it is recommended that the mixture be reset to the 7% lean condition as soon as possible.

The use of the procedure will place the mixture in the best economy range. This is desirable since it results in a direct saving in fuel. It has the additional advantage of cooling the engine by means of lower combustion and exhaust temperatures due to the excess air which absorbs some of the heat of combustion.

When operating at or near the critical altitude (ceiling) for the desired cruise power do not use less than 7%. (See C below).

CAUTION

A. Manual leaning is not permitted at power settings above maximum cruise power (2200 RPM). Manual leaning at higher BHP/RPM/BMEP combustions may cause serious damage to the engine.

B. Leaning in excess of 7% TORQUE pressure drop should be avoided since any abnormal distribution of fuel or air to the cylinders can result in serious cylinder to cylinder power differences which are aggravated by extremely lean operation. Back-firing may also result.

C. The use of mixtures richer than 7% TORQUE pressure drop at cruise power in level flight should be avoided since this results in exhaust gas temperatures which may have an adverse effect on engine durability.

D. If engine condition does not permit stable operation when leaned to 7% TORQUE pressure drop, it is recommended that RICH mixture position be used until the engine condition is corrected.

The same TP limits apply when mixture controls set in the manual lean position as apply with mixture controls set in the NORMAL position, and the cruising limit manifold pressure of 36″ Hg. must be observed.

CARBURETOR ALTERNATE AIR OPERATION.

GENERAL. Carburetor alternate air should be used during any conditions conducive to the formation of carburetor ice. This means operation in heavy precipitation, snow, sleet and in cool air of high relative humidity such as flying near clouds. The alternate air system is a low temperature rise system intended to prevent the formation of ice rather than remove it. Therefore, the shift to alternate air should be made before icing conditions are actually encountered. Alternate air should be used when cruising under cold weather conditions to improve fuel vaporization, lessen engine instability and improve specific fuel consumption. Alternate air should not be used during the hot day, high power conditions, especially in high blower, as the high carburetor temperature might cause preignition and/or detonation. When using carburetor alternate air, the carburetor air temperature should not be allowed to exceed 38°C in low blower or 15°C in high blower.

TO SHIFT CARBURETOR AIR—DIRECT TO ALTERNATE.

1. Place the mixture controls on the RICH position.
2. Hold the alternate air switches on the ALTERNATE position, until the desired door position is obtained. Allow the carburetor air temperature to stabilize and readjust the door, if necessary.
3. Return the mixture controls to NORMAL after the desired carburetor air temperature has been obtained.
4. Readjust the throttles as required.

TO SHIFT CARBURETOR AIR—ALTERNATE TO DIRECT.

1. Place the mixture controls on the RICH position.
2. Reduce engine power by 4 or 5 inches Hg.
3. Hold the carburetor air switches in the DIRECT position until the alternate air door is fully closed, as indicated on the carburetor air door position indicator.
4. Return the mixture controls to NORMAL.
5. Readjust throttles as required.

ENGINE FIRE EXTINGUISHER SYSTEM.

Two switches (figure 1-8) on the FIRE CONTROL panel, (cockpit overhead panel) control the Fire Extinguisher System for each engine. When either switch is placed in "BOTTLE NO. 1" or "BOTTLE NO. 2" position, a circuit is completed to the corresponding fire extinguisher bottle and the contents are released to the corresponding engine or engines. A second set of contacts on each fire extinguisher switch simultaneously energizes the engine emergency shut-off relays to close the fuel and oil shut-off valves.

Power to operate the system is supplied from the 28 volt d-c bus in the cockpit distribution panel.

APU FIRE EXTINGUISHER SYSTEM.

The APU fire extinguisher system is controlled by a switch (Figure 1-10), marked FIRE EXT on the radio operator panel. Lifting the switch guard and actuating the switch completes a circuit which releases the contents of the CO_2 bottle into the APU enclosure to smother the fire.

Power to operate the fire extinguisher bottle is supplied from the 28 volt d-c radio operator's bus through a 5 ampere circuit breaker on the radio operator's panel marked FIRE EXT.

ELECTRICAL SYSTEM OPERATION.

To obtain electrical d-c and a-c power from the busses, one of the following sources must be selected.

D-C POWER.

a. Battery.
b. External Power.
c. APU through regulated converter.
d. Left main engine through regulated converter.
e. Right main engine through regulated converter.
f. Both main engines through regulated converter.
g. Left engine d-c generator.
h. Right engine d-c generator.
i. Both engine d-c generators.

A-C POWER.

a. Left main engine a-c generator.
b. Right main engine a-c generator.
c. Both main engine a-c generators.
d. APU generator.
e. External Power.

To apply d-c power to the busses, the radio operator's control panel will be operated as follows: (See Figure 1-10.)

BATTERY CONTROL	ON
EXTERNAL D-C POWER	ON

APU through Regulated Converter

APU (refer to APU)	"ON"
"CONVERTER CONTROL"	"ON"

Left Main Engine through Regulated Converter

"A-C GENERATOR NO. 1"	"ON"
"CONVERTER CONTROL"	"ON"

Right Main Engine through Regulated Converter

"A-C GENERATOR NO. 2"	"ON"
"CONVERTER CONTROL"	"ON"

Both Main Engines through Regulated Converter

"A-C GENERATOR NO. 1"	"ON"
"A-C GENERATOR NO. 2"	"ON"
"CONVERTER CONTROL"	"ON"

Left Engine D-C Generator

"D-C GENERATOR NO. 1"	"ON"

Right Engine D-C Generator

"D-C GENERATOR NO. 2"	"ON"

Both Engine D-C Generators

"D-C GENERATOR NO. 1"	"ON"
"D-C GENERATOR NO. 2"	"ON"

CAUTION

The rated output of the converter is 200 amperes. Do not hold loads of 300 amperes for more than 30 seconds or loads of 400 amperes for more than 10 seconds. The cooling blower integral to the converter operates automatically with the converter. The converter should never be operated without the blower operating.

The a-c busses may be energized from several sources. The correct a-c generator output is: Frequency 400 cycles, Voltages 115/200 volts, Phase rotation 1-2-3.

Note

In order to check frequency etc., the applicable power source must be selected by operation of the meter selector switches. Adjust voltage and frequency if necessary.

In order to apply a-c power to the busses, the radio-operator's control panel (see Figure 1–10) will be operated as follows:

Left Main Engine Constant Speed Generator

"A-C GENERATOR NO. 1"	"ON"
"EXCITER SWITCH"	"ON"

Check—frequency, voltage and phase rotation

"A-C GENERATOR CONTROL NO. 1"	"ON"
"BUS-TIE" switch	"ON"

Right Main Engine Generator

"A-C GENERATOR NO. 2 EXCITER SWITCH"	"ON"

Check—frequency, voltage and phase rotation

"A-C GENERATOR CONTROL NO. 2"	"ON"
"BUS-TIE" switch	"ON"

Left and Right Main Engine A-C Generators (Parallel Operation)

a. Check correct phase sequence.

b. Adjust voltage and frequency.

c. Connect one generator to the bus.

d. Select incoming generator.

e. Slow (STOP) apparent rotation of paralleling lights.

f. Connect incoming generator when lights are illuminated as indicated.

g. Adjust for equal divisions of vars and watts.

Note

APU generator cannot be paralleled with engine generators.

APU POWER.

Start APU (refer to Starting Engines).

Auxiliary power unit.

"EXCITER" switch.	"ON"
Check frequency, voltage, phase.	
"AUX. POWER CONTROL" switch.	"ON"
"BUS-TIE" switches.	"ON"

External Power.

a. Plug in external power and start unit.

b. Check frequency, voltage and phase.

c. "EXT.—PWR.—CONTROL" switch. "ON"

VAPOR DILUTION.

A vapor dilution system is installed to purge the auxiliary wing tanks and the area surrounding the hull tanks. It consists of three carbon dioxide cylinders, two are 7-1/2 pound bottles for the auxiliary wing tanks and one is a 5 pound bottle for the hull tanks area. The bottles are on the left side of the bow compartment. Three thermal discharge indicators are on the hull skin forward of the left forward entrance hatch. A red disc, in each indicator, is blown out when a bottle discharges due to excessive temperatures. The normal discharge indicators are inside the hull forward of the left entrance hatch. A yellow disc is pushed out when a bottle is discharged into its distributing line, this provides visual evidence of system operation. The system is electrically operated by control switches on the pilot's aft control panel.

An adapter fitting on the hull skin forward of the left forward entrance hatch is for initial pre-flight purge of the hull tank cavities under the following conditions:

a. Combat mission.

b. Any mission or flight at the discretion of flight personnel as a safety precaution against fuel tank explosion.

Initial CO_2 purging is accomplished by connecting an 18 pound (Min.) CO_2 bottle to the hose/quick coupler ground connection in the forward entrance compartment.

SECTION VIII
CREW DUTIES

INTRODUCTION.

The purpose of this section is to provide compact operation and crew duty responsibilities in accomplishing a flight mission. It will also help the crew members to become quickly familiar with the operating equipment that is required for landing and take-off. The information has, therefore, been presented in such a way, that each crew member need study only the paragraph with which he is concerned.

Instructions relating to pilot and co-pilot duties are not included in this section, which are already covered in Section II.

AIRPLANE CAPTAIN (FLIGHT ENGINEER).

The airplane captain's duties consist of general supervision of maintenance and handling of the airplane when parked on land, moored in the water or in flight status condition. When the airplane is parked on land or moored on water, he must ascertain that the airplane is properly secured as dictated by weather forecast. When extreme weather conditions exist, precautionary measures must be taken, such as installing protective covers over tail turret, engine and propeller, pilot's enclosure, pitot heads, etc. The following paragraphs are more detailed and pertinent phase of duties required by the airplane captain for flight operations.

BEFORE ENTERING AIRCRAFT.

a. Ascertain that conditions of exterior of airplane is airworthy and no damage occurred while airplane was parked or moored. Inspect airplane with reference to Figure 2–2.

b. Protective covers removed from exterior of airplane. (See Figure 9–2.)

c. All tie-down lines free with exception of bow lines when moored on water.

d. Check previous flight report sheets and make certain that no discrepancies exist.

BEFORE STARTING ENGINES.

a. Auxiliary equipment in place and secured.

b. Provisions aboard for purpose of anticipated flights, such as stores, food, bedding, etc. (including emergency equipment).

c. When the retro marine marker ejector is to be used, make sure pressure gage on the local control box panel (figure 4–12) reads 3000 psi and that the manual bleed valve on the air bottle is closed; inspect all accessible parts of the ejector for damage, also pneumatic lines and connections for leakage; make certain that rounds in the ejector magazine have been loaded correctly; magazine cover assembly must be securely latched.

d. All bilges free of water.

e. Stand by at the mooring lines (bow station).

f. Render assistance to the flight crew at their stations whenever necessary.

g. Stand fire watch during "ENGINE START".

BEFORF TAKE-OFF.

a. With assistance from tail gunner, or other designated crew member, unmoor lines at bow and stern after engine warm-up.

b. Ascertain that marine marker safety door handle is in "SAFE" position. (Door Closed.)

c. Retract anchor at bow, if used.

d. Occupy station for take-off.

DURING FLIGHT.

a. Any special duties to perform as directed by the pilot.

b. General routine duties such as arranging and securing any loose equipment that was used prior to take-off (bow and stern lines, sea anchor, boat hook, etc.).

LANDING.

a. After landing, stand by to use sea anchor.

b. Stand by with an assistant on bow lines.

BEFORE LEAVING AIRPLANE.

a. Visual check interior of airplane being "ship-shape".

b. Protective covers on equipment installed, if required.

c. Ascertain that operational equipment is turned off.

d. Set marine marker safety door handle in "SAFE" position. (Door Closed.)

e. All stores removed. (Rockets, flares, sonobuoys, marine markers, etc.)

f. Double-check for any operational equipment switches left in "ON" position.

g. Required circuit breakers "IN" to battery bus boarding light circuit.

h. All hatches closed.

i. All mooring lines secured to buoys or other anchor points while on water.

j. If airplane is safely secured with tie-down lines and wheels chocked when parked on land.

k. If airplane is to be left on water overnight, turn anchor light switch to "ON".

RADIO OPERATOR.

The radio operator's duties as a crew member are of utmost importance in maintaining flight operations. He is required to man his station during all take-offs, taxiing, and landings. Besides operating the radio transmitters and receivers he is required to start and stop the auxiliary power unit and to operate the a-c and d-c power control panels. He must ascertain that all operating data is available at his station for the required flight. The signal pistol and supply must be available and secure. The flight deck hatch near his station must be checked for easy release and then for security. The radio operator must also operate and monitor the interphone system and take care of necessary antenna switching when the communication system is in operation.

CAUTION

Place switches in "OFF" positions. Do not pull circuit breakers "out" to all operative equipment.

BEFORE STARTING ENGINES.

a. Start auxiliary power unit, to provide electrical power to start main engines and other equipment that requires pre-flight check out.

b. Perform following duties to start APU.

APU control circuit breakers "IN" position.
External power switch "OFF".
Battery power "ON".
APU air intake door "OPEN".
Test APU fire detector system.
APU exciter switch "OFF".
APU power cross-tie bus control switch "OFF".
No. 1 and No. 2 main engine generator control switch "OFF".
Start APU and check rpm's. When up to speed position APU exciter switch "ON".

Note

After APU is up to speed the No. 1 main a-c bus should be energized within 15 seconds to supply power to APU fuel and oil pressure indicator.

Check and adjust voltage (115 volts).
Check and adjust frequency (400 cycles).
Converter control switch "ON".
Close APU generator control switch.
Position No. 1 and No. 2 bus tie switches "ON".
Check APU oil, and fuel pressures and oil temperatures.

c. Notify crew members that a-c and d-c power is available.

BEFORE TAKE-OFF.

a. Trailing antenna in "Retracted" position and locked.

b. Radio receivers and transmitters pre-flight check out, contact with ground station.

c. ICS system, check out with pilot and other crew members.

d. APU operating in required ranges on indicators.

e. Check frequency, voltage, and phase rotation of main engine a-c generators.

f. For a-c and d-c control panel switch positioning, refer to "Radio Operator's A-C and D-C control panels Switch Positions", Section II.

g. Receiver reports from home base station for last minutes instructions.

DURING FLIGHT.

a. PARALLEL the two a-c generators. Refer to "Radio Operator's A-C and D-C Control Panels, Switch Positions", Section II.

WARNING

The a-c engine generators must be PARALLEL at all times during flight. Exception can be made only in emergency and at the pilot's discretion. If unparalleled (split bus) operation is used, all crew members should be alerted to this condition. Under emergency conditions, a-c power can be supplied to No. 1 and No. 2 bus by placing the switches in positions as shown in figure 3-5 and figure 3-6.

b. Position the d-c control panel switches. Refer to "Radio Operator's A-C and D-C Control Panels, Switch Position", Section II.

c. Maintain operation of ICS controls for flight crew.

d. Frequent interval communications with home base when radio restrictions permit.

LANDING.

a. Before landing, start APU.

b. CLOSE No. 1 and No. 2 cross-tie bus switch, before APU generator control switch is closed.

c. After landing, the No. 2 generator circuit may be removed from the bus circuit and the APU generator will now supply power for operation.

d. Radio receivers and transmitters equipment "ON".

e. ICS control system "ON".

BEFORE LEAVING AIRPLANE.

a. Return a-c and d-c generators and control switches to "OFF" position.

b. Cross-tie bus switches to "OFF" position.

c. Exciter switches to "OFF" position.

d. Shut-down APU. Close APU fuel supply valve.

e. Close APU air intake door.

f. Radio communication equipment switches to "OFF" position.

NAVIGATOR-BOMBARDIER.

The general duties of the navigator-bombardier consist of two primary functions: first, plotting and conducting a flight course from the point of departure to a point of destination and determining the airplane's position at any time. Secondly, as a bombardier, to release bombs, sonobuoys, flares and marine markers at enemy objectives. When bomb bay stores are carried on ASW missions, he must ascertain that bomb bay heaters are in operative condition. He is also required to operate the camera and flasher units, and to check the airplane captain on availability of equipment. The navigator-bombardier's additional responsibilities, shall include required navigational equipment and to ascertain that this equipment is stowed in his locker, table drawer or in the vertical compartment cabinet. His duties will require that the water breaker is filled and the driftmeter and periscopic sextant are in their stowed location.

WARNING

Be sure that driftmeter standpipe cover is closed before take-off and landing.

BEFORE STARTING ENGINES.

a. Armament and navigational control switches "OFF".

b. Power circuit breakers on navigator's control panel in "OUT" position.

BEFORE TAKE-OFF.

a. Refer to weight and Balance Handbook, AN-01-1G-40 Form F.

b. Check equipment for operative condition and ICS system with pilot and other crew members.

c. Select the Flight Operating Instruction Chart for the initial gross weight.

d. Plot anticipated flight course from point of departure, to destination and return, with reference to Appendix 1 Curves.

e. Ascertain that required ASW stores are loaded and switches in "SAFE" positions.

f. Consult the load adjuster in navigator's locker if condition warrants.

DURING FLIGHT.

a. Plot mission's flight course at time spaced intervals in reference to quantity of fuel aboard airplane.

b. Select and plot flight course most suitable with gross weight changes in reference to Flight Operation Instruction Charts.

c. Keep abreast of AN/APS-44A radar search indicator, so that the path of a submerged object can be traced quickly and accurately.

BEFORE LANDING.

a. Before landing make sure that all armament switches are in "SAFE" or "NORMAL" position.

b. Check tail gunner for removal of camera pod and flasher pod (if used).

c. Ascertain that float lights are removed and chute covers are installed.

Marker door in "SAFE" position and door secured.

BEFORE LEAVING AIRPLANE.

a. Visual check armament panel radar and communication equipment, by assuring that all switches are placed in "OFF" position before leaving his station.

b. Place all navigational equipment in its respective stowed location.

c. Make deficiency reports on equipment that may have been faulty on previous flight.

RADAR COUNTERMEASURE (RCM) OPERATOR.

The radar countermeasure operator while at his station shall perform such duties as, operating the magnetic airborne detector (MAD) equipment, homing and radar receiver electronic equipment, and antenna selection through the antenna selector switch. He will also be required to operate the marine marker in conjunction with the release of sonobuoys. In addition to his regular duties, he must ascertain that such emergency equipment in the flight deck is usable and stowed in place. This equipment will include the fire axe, first-aid kit, portable fire extinguisher and parachutes.

BEFORE STARTING ENGINES.

a. Check switches to radar detecting and homing equipment for "OFF" position.

b. Marine marker control switches for "OFF" position.

BEFORE TAKE-OFF.

a. With APU operating and/or main engines turning up 1200 rpm, check equipment for operative condition.

b. Check ICS system for being operative.

DURING FLIGHT.

a. Operation of his respective equipment when on an ASW flight mission.

b. Ascertain that marine marker launcher is loaded (if required).

BEFORE LANDING.

Instruct tail gunner to remove float lights and sonobuoys and stow, if used during previous flight.

RADAR OPERATOR.

The radar operator's primary function is to operate the search radar and associated equipment on all long range and ASW flight missions. While in flight, his duties are to locate and detect surface objects or submarines through the use of his equipment. He will also be required to check the supply and stowage of oxygen bottles located near his station.

BEFORE STARTING ENGINES.

Radar and associated equipment switches in "OFF" position.

BEFORE TAKE-OFF.

a. Operate ICS system by contacting pilot and other crew members.

b. Conduct "warm up" test of radar receiver for functional operation.

DURING FLIGHT.

a. Maintain the operation of radar equipment while on search or patrol flight missions.

b. Operate the IFF receiver communication system with approach of unidentified aircraft.

LANDING.

a. Before landing, ascertain that all radar equipment switches are in "OFF" position.

b. After landing render assistance for mooring airplane at bow or stern stations.

c. Assist crew members when beaching gears are attached.

TAIL GUNNER.

The tail gunner's primary function is to operate the tail turret. But as the tail turret is operated only in combat or training, he is required to perform alternate duties. He will ascertain that the tail turret hydraulic system functions properly, and that emergency equipment, such as, first-aid kit, fire extinguisher, parachute and ditching web in the aft tail section is secured in their proper locations.

The emergency escape hatches at this station can be readily opened. He will be required to visually check the equipment at his station and ascertain that such equipment as, ammunition, marine marker sonobuoys and oxygen bottles, are in place. He will also render assistance in launching the airplane and handling of mooring lines. Further detail duties of the tail gunner are as follows:

BEFORE STARTING ENGINES.

All operating equipment switches in "OFF" position at tail gunner's station.

BEFORE TAKE-OFF.

a. Circuit breakers "IN" to hydraulic booster system so surface controls and booster system can be checked out.

b. Check operation of turret.

c. Tail turret in neutral position and locked.

d. Ascertain that gun sight, gun camera and ammunition supply is secured.

e. Assist with stern mooring lines.

f. Hatches in aft tail section are closed and locked.

g. Launch sea anchor for taxiing, if required.

h. Assist with installation of jato bottles, if required for take-off.

i. Occupy waist compartment for take-off.

WARNING

Do not occupy tail turret stations on landing or take-off.

DURING FLIGHT.

The tail gunner will assist with the following equipment installations when on ASW flight mission:

a. Marine marker loaded in a "ready" position.

b. Small sonobuoy chutes loaded.

c. Float light launcher loaded.

d. Camera pod installed on right waist compartment entrance hatch.

e. Flasher pod unit installed on left waist compartment entrance hatch.

f. Operate emergency oil transfer system hand pump and manual control valves.

g. Operate emergency hydraulic hand pump for bomb bay doors.

h. When fuel emergencies arise, he will be required to operate the manual fuel transfer pump, as directed by the pilot.

i. Jettison jato bottles from waist entrance hatches, when directed by the pilot.

j. Operate aileron and rudder tab unit manual control when emergency condition arises.

BEFORE LANDING.

a. Remove and stow the following equipment in their respective location:

Marine markers within launcher.

Float Light and small sonobuoys. Be sure that covers are installed on Float Light launcher prior to landing.

Camera and flasher unit pods.

b. Clear turret guns of ammunition.

c. Position tail turret in neutral and lock.

d. Tail turret hydraulic system switches "OFF".

e. Ascertain that hatches are closed and locked in aft tail section.

f. Equipment in waist and aft tail compartments used during flight are to be secured, such as, bunks and bedding, portable oxygen bottle, etc.

SECTION IX
ALL WEATHER OPERATION

The airplane is designed for all weather tactical operations varying from tropical heat and rainstorms to arctic conditions. Since a majority of cold weather operating difficulties are encountered on the ground, the successful preparation made during the post flight inspection of the engines and airplane for flight, is dependent on the training and diligence of the ground crews. The following procedures and instructions apply to cold weather operating conditions.

In the "ALTERNATE" (HOT) position, an alternate air door in the carburetor air scoop is opened which allows air from within the hood cowling to enter the carburetor and prevents the entry of ram air.

This prevents fouling and clogging of the induction system when icing conditions are encountered. In this position the available power is reduced because of increased carburetor air temperatures and loss of ram air pressure.

The carburetor air control switch should be left in the "DIRECT" (COLD) position, when icing conditions are not encountered or anticipated. If icing conditions exist, place the control switches on the copilot's sub-panel to the "ALTERNATE" (HOT) position, and adjust the throttle as necessary to obtain the desired manifold pressure. The loss of ram plus the increased temperature of the alternate air will require an advanced throttle settling to compensate for the loss of power. If icing conditions are encountered during take-off and landing, operate with the switches in "ALTERNATE" (HOT) position to clear the induction system prior to the take-off or landing, and then switch to the "DIRECT" (COLD) position.

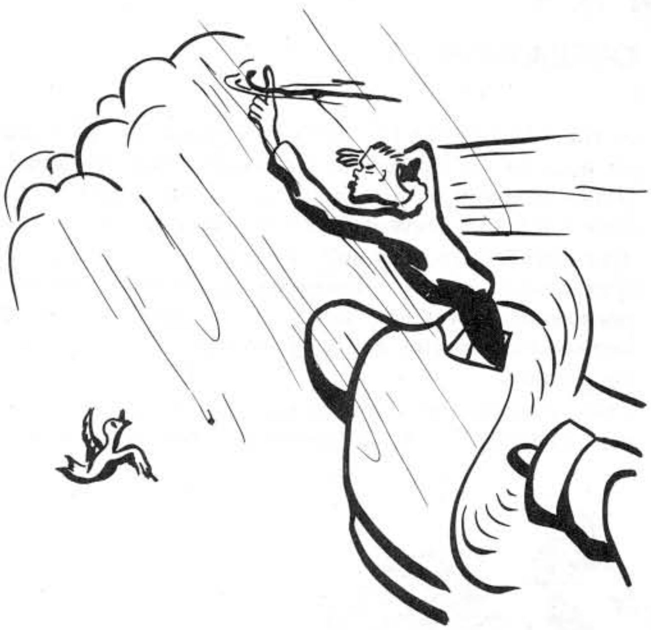
COLD WEATHER PROCEDURES.

CARBURETOR AIR INDUCTION.

Carburetor air induction consists of a carburetor air intake for supplying either warm "ALTERNATE" (HOT) or cold "DIRECT" (COLD) air to the carburetor. The carburetor air is taken aboard through an under-cowl scoop built integral with the upper hood cowling and connected to a duct leading to the carburetor.

In the "DIRECT" (COLD) position, ram air is supplied directly to the carburetor from the air scoop above the carburetor.

Note



The pilot must keep informed of weather ahead. At least 15 minutes before encountering ice forming conditions, take preventive measures. Continue using preventive measures until at least 15 minutes after passing through ice forming atmosphere.

WARNING

Do not take-off or land with the carburetor air control switches in the ALTERNATE (HOT) position.

CARBURETOR ICING.

When flying through visible moisture such as clouds, haze, and during freezing or near freezing weather, carburetor "HOT AIR" position should be used and heat applied as required. Heat to be applied 15 minutes prior to entering icing conditions if practical to do so and the carburetor air temperature should be maintained between 15°C (59°F) and 25°C (77°F) with the hottest cylinder head temperature above 160°C (320°F).

WING AND EMPENNAGE DE-ICING EQUIPMENT.

The boot de-icing system removes ice from leading edges of the wings, stabilizers and fin by alternately inflating and deflating lateral sections of the de-icer boots which cover the leading edges. Engine-driven air pumps supply air pressure through oil separators and a filter to distributor valves, where it is directed to various sections of the inflatable boots in a definite sequence. An electric timer, on the pilot's aft control panel, contains all the controls necessary to automatically operate the entire boot de-icer system.

CAUTION

Do not operate the pneumatic boots during flight, at 120 knots IAS and below.

WINDSHIELD ANTI-ICER.

The windshield anti-icer system is used to partially de-ice the windshield or to clean salt water spray or other foreign matter from the windshield, in conjunction with the windshield wipers.

Note

If icing is encountered, anti-icing fluid should be applied to the windshield to soften the ice before the wiper is operated. Slow speed is recommended under icing conditions.
Do not operate the windshield wiper on dry or ice covered windshield, as damage will result to wiper blades and to windshield surface.

CAUTION

The spray pump motor is controlled by a rheostat, on the co-pilot's console, which varies the pump motor speed, thereby varying the spray intensity. The windshield wiper motor is controlled by a rheostat, on the co-pilot's console, which varies the wiper motor speed, thereby varying the wiper action.

BOMB BAY HEATERS.

The bomb bay heating system consists of an internal combustion heater in each bomb bay. The heaters automatically control temperatures within the bomb bays between 4.4°C (40°F) and 60°C (140°F) so that certain armament stores may be kept in an operative condition. When flights are made in the ASW configuration and when sub-zero weather exists the bomb bay heater control switch on the navigator's armament panel must be placed in the ON position.

CAUTION

Do not operate heaters during refueling, transferring of fuel or when bomb bay tanks are installed while in ground operation.

HEATING SYSTEM (Cockpit and Flight Deck).

A thermostatically controlled cabin heater of 200,000 BTU/Hr. capacity, maintains a 70°F to 80°F inside temperature, when the outside temperature is below 70°F. Air enters the ram air inlet duct in the leading edge of the left hand center wing and flows to the cabin heater wherein the air is heated. Heated air is emitted to the flight deck through four discharger outlets in main hot air supply duct. The pilot's compartment is heated through four outlets taken from the main hot air duct. Two additional take-offs, from the main hot air duct lead to the windshield defogging outlets and to the side window panels.

Operating controls for the cabin heater are on the pilot's aft control panel.

CAUTION

Do not operate heater during refueling or transferring of fuel while in ground operation.

WING DUCT DE-ICING.

The wing duct de-icing system consists of electrically heated blankets on the lip of each duct air scoop in the leading edge of each outer wing. Two ducts de-icing systems are provided, one system operates the cabin heater duct blanket and the left accessory duct blanket while the other system operates the right accessory duct blanket. The de-icing system is used only when ice or sleet has formed on the lip of the ducts during flight, thereby necessitating the application of heat at the de-icing blankets. Each system is controlled by a duct de-icing control switch on the pilot's aft control panel.

CAUTION

Do not attempt to hold de-icer blanket control switch on for any appreciable length of time during ground testing or the blankets will burn out.

PROPELLER DE-ICING.

Propeller de-icing is accomplished by resistance heater blankets built into each blade leading edge. Opposite blade heaters on each propeller are wired in series. A timer energizes these four pair of blankets in rotation. Turn on heat only long enough to loosen the ice formation. Once the ice is loosened, centrifugal forces removes the unmelted outer mass. The de-icing system is controlled by two switches (one for each propeller) on the pilot's aft control panel. Closing either switch will cause the de-icer timer to operate and energize the corresponding propeller heater blankets in a cycle of 25 seconds on and 75 seconds off.

UTILITY RECEPTACLES.

Utility receptacles for the connection of electrically heated flying suits and other portable equipment are installed at all crew stations and elsewhere in the forward and aft hull. An "ON"—"OFF" switch is provided for each receptacle.

PITOT TUBE DE-ICER HEATERS.

Each of the two pitot tubes contain electrical heating elements. Pitot tube heating is required to prevent icing of the projecting tube. The pitot heaters are controlled by two poles of a four pole switch on the pilot's aft control panel. To operate the heaters place pitot heater switch in "ON" position. To stop system, return switch to "OFF" position.

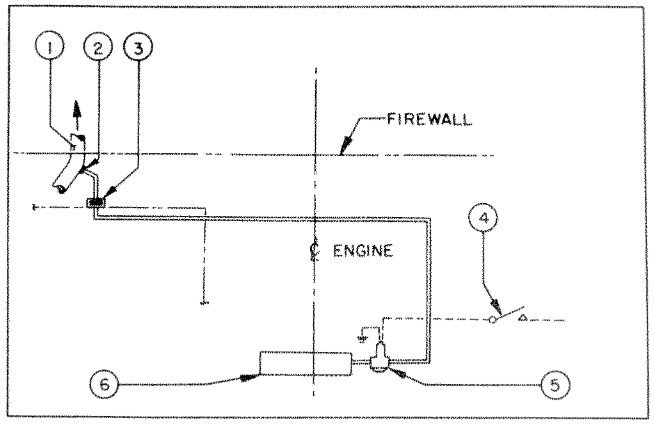


Figure 9–1. Oil Dilution System

1 Engine Fuel Line
2 Restrictor
3 Manual Shut-Off Valve
4 Switch—Co-Pilot's Sub-Panel (See Figure 1–5)
5 Solenoid Valve
6 Sequence Valve at Bottom of Oil Tank

OIL DILUTION. (See Figure 9–1.)

When oil dilution is mandatory, the lubricating oil should be diluted immediately before stopping the engines in accordance with the following procedure.

a. Open the manual operated shut-off valves at the aft side of the firewall.

b. Idle until the oil temperature falls to 40°C (104°F). Operate the oil cooler doors to obtain this temperature.

c. Hold engine speed between 1000 and 1200 rpm during diluting period.

d. Place the oil dilution switch, located on the co-pilot's sub-panel in the "ON" position for the dilution time that corresponds to the lowest temperature at which the next engine start will be conducted. During the last few seconds of the dilution move the mixture control lever to "Idle Cut Off."

e. Dilute the oil to the percentages indicated below:

Grade	%	Hold Switch on	Protects to
1100	10	4.5 min.	—12°C (10°F.)
1100	20	10.3 min.	—30°C (—20°F.)
1065	10	4.5 min.	—30°C (—20°F.)
1065	20	10.3 min.	—46°C (—50°F.)

f. Maintain the oil temperature below 50°C (122°F) and the oil pressure above 15 pounds per square inch during this procedure.

g. Release the oil dilution switch when the engine stops firing.

h. Turn the ignition switch "OFF" after propeller stops rotating.

The propellers on this airplane are hydromatic; therefore, it is necessary to operate the governor control and feathering system several times during the dilution procedure to insure that diluted oil is left in the propeller dome, governing system and feathering lines. When operating the governor control, make sure that the engine rpm is above the minimum governing speed. When operating the feathering system, pull out the feathering switch button after a 300 to 400 rpm drop has been obtained, wait for recovery of rpm, then repeat this procedure.

CAUTION

The oil supply of the engine in which the oil has been diluted should be checked after a thorough warm-up.

When diluting engine oil observe the following precautions:

a. Do not over-dilute.

b. Guard against fire.

c. Dilute only when justified by forecast of temperatures below 2°C (36°F).

d. Keep oil system free of sludge and water.

e. Close the shut-off valve at each firewall as soon as oil dilution is completed. Do not depend on the solenoid valve (operated by the dilution switch) to be free from leakage.

CAUTION

If the oil pressure falls below 15 psi before the oil dilution period is ended, release the oil dilution switch immediately and move the mixture lever to "IDLE CUT-OFF"

Note

If an excessive amount of sludge is found on the oil strainers subsequent to the use of oil dilution the lubricating oil should be changed and the strainers cleaned.

OIL GRADES AND TEMPERATURES.

Grade 1100 lubrication oil shall be used in all reciprocating engines at ground starting temperatures down to 2°C (35°F). When temperatures below 2°C (35°F) are expected, or if it would be necessary to use oil dilution, use grade 1065 lubricating oil. If grade 1065 is not available, use preheat; if preheat is not available dilute as shown in figure 9–1a. When using grade 1065 oil, if temperature falls below 0°F, use preheat if available. If preheat is not available, dilute as shown in figure 9–2a. When using grade 1065 lubricating oil, inlet temperature shall be maintained between 65°C (149°F) and 75°C (167°F) during operation to obtain proper engine lubrication and to prevent accumulation of moisture and volatile products of oxidation in the oil. If it is not possible to maintain these temperature limits, main oil pressure should be maintained within the operating range and oil temperature should be kept above 60°C (140°F).

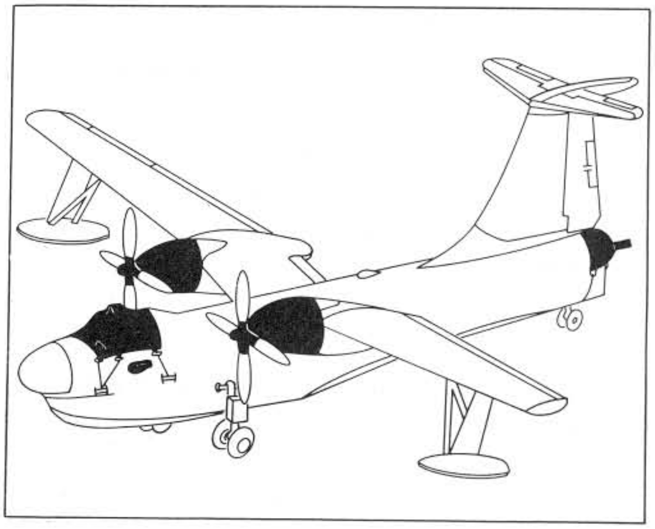


Figure 9–2. Protective Covers

PROTECTIVE COVERS.

Protective covers are furnished for the pilot's enclosure, engine and propeller hub, pitot tube heads, drift meter and tail turret. These are made of water proof duck and are secured by tabs, straps, and draw ropes. These covers should be used for protection against rain, hail, snow or sleet and when the airplane is anchored or parked for an indefinite period of time.

BEFORE ENTERING AIRPLANE.

a. Preheat engines if temperatures are —18°C (0°F) even though oil dilution was accomplished at engine shut down. Preheat may be required at temperatures below 2°C (35°F). Preheat should not be considered adequate until fluid oil will flow from the main oil sump drains, and propellers can be turned by two men.

b. Make sure that the firewall shut-off valves are open.

c. Check all fuel and oil vent lines for freedom from frozen condensate.

d. Remove ice, and snow from exterior of airplane.

WARNING

Snow, frost, and ice on the airplane surfaces constitute a major flight hazard and result in the loss of lift and dangerous stalling characteristics.

e. Do not remove protective covers from airplane, such as pilot's enclosure, pitot tubes, tail turret enclosure and engine hood covers until just before engine start. This should be the last operation before starting the engines.

f. Check exterior for any obvious damage.

g. Turn engines over at least four revolutions.

ON ENTERING AIRPLANE.

a. Install heated batteries, if removed due to freezing temperatures. External power can be connected to the main power center in the beaching gear compartment, if batteries are not fully charged.

CAUTION

If an external source of direct current power is not available, save the battery power for APU start. Starting the APU with the batteries is considered an emergency procedure.

b. Unlock surface controls and operate all movable surfaces four or five times to check ease of operation.

c. Check functioning of instruments that can be checked without engine operation.

d. Radio operator to start APU, using normal starting procedures prior to main engine start.

e. After APU start, notify rspective station operator that power is available and a check out of their equipment can now be made.

f. Check bilges for presence of water or ice.

g. Check auxiliary equipment in compartments for being in place.

BEFORE STARTING ENGINES.

a. Start operation of cabin and bomb bay heaters.

b. Sufficient time should be allowed to heat cockpit and flight deck instruments.

c. Operate all manual engine controls and check for ease of operation.

d. Check removal of ground heater ducts (if installed).

e. Be sure that all necessary circuit breakers are "pushed-in."

STARTING ENGINES.

a. Use the normal starting procedure prescribed in Section II.

b. Under extreme cold conditions, it may be necessary to place the mixture control lever momentarily in RICH during engine cranking to obtain a sufficient amount of vaporized fuel to support combustion.

c. Do not crank continuously for a period longer than 30 seconds. If engine does not start, allow the starter to cool for at least one minute. After the second and succeeding cranking cycles, allow 5 minutes for cooling.

d. Operate the primer switch intermittently until regularity of firing results. It may then be necessary to continue priming for a short time after starting to maintain smooth engine operation.

e. Observe the oil pressure gages. Stop the engines if oil pressure does not register within 10 seconds or reaches 40 psi within 20 seconds.

f. Continue the use of carburetor air preheat until cylinder head temperatures are at least 125°C (257°F). Full "COLD" carburetor air may be used when engine operation temperatures are satisfactory.

ENGINE WARM-UP.

a. Use the normal engine warm-up procedure prescribed in Section II.

b. Operate the following systems through several cycles to assure proper operation:

Wing flaps.
Aileron-spoiler.
Booster system.
Bomb bay doors.
Hydroflaps.
All surface controls including tabs.

c. Check wing and empennage de-icer system through several cycles.

d. Cabin heater defrosting system and bomb bay heaters for operation.

e. Windshield anti-icing pump, spray, and wiper blades for operation.

f. All instruments for proper operation.

g. Turn on pitot heaters if icing is evident.

TAKE-OFF.

WARNING

Do not take off unless wing and tail surfaces are clear of all snow, ice, and frost. Airplane lift and control effectiveness will be impaired unless these surfaces are clean.

a. Cabin heating system in operation so windshield defrosting can be accomplished during take-off.

b. Turn on pitot heaters if icing conditions are anticipated immediately after take-off.

c. Wing and empennage de-icer boot system should be inoperative during take-off in order to maintain stable wing characteristics.

d. Use the normal take-off procedure prescribed in Section II.

AFTER TAKE OFF.

After taking off from slush-covered water, and after reaching an altitude of approximately 500 feet above obstacles, operate the wing flaps and hydroflaps (if used during taxiing) several cycles to prevent their freezing in the retracted position.

CLIMB.

Use the normal climb procedure as described in Section II.

DURING FLIGHT.

a. After sufficient altitude has been obtained and the airplane leveled off, place the de-icer boot system in operation to suit icing condition.

b. Observe carburetor air temperature occasionally. While operating in extremely cold weather, the HOT position should be used and/or applied as required.

Note

Prepare the airplane prior to entering a zone of turbulent air. See Section V for recommended airspeed for flight in severe turbulence.

DESCENT.

APU started and allowed sufficient time to warm up prior to landing.

LANDING.

a. Prior to landing, render the wing and empennage de-icer system inoperative.

b. Use the normal landing procedure check list prescribed in Section II.

STOPPING ENGINES.

a. Use the normal engine stopping procedure prescribed in Section II.

b. Use oil dilution procedure as prescribed in this section.

BEFORE LEAVING AIRPLANE.

a. If oil draining should become necessary (because of temperature conditions or other reasons), proceed as follows:

Idle the engines until the oil temperatures stabilize at 40°C (104°F).

Use the normal procedure for stopping the engines.

Drain the oil into clean containers.

If possible, store the oil in a warm place. If the oil cannot be kept warm, heat it to approximately 75°C (167°F) before it is returned to the tank.

Use the normal starting procedure as soon as the heated oil is returned to the tanks.

b. At freezing temperatures and below, remove the batteries and stow them in a heated room if possible. The batteries should be kept warm at all times.

c. Remove perishable foods and liquids from galley. Also drain water from water containers.

d. Park airplane and chock wheels. Secure airplane at all tie-down fittings on airplane.

e. Install protective covers at all air intake ducts, pilot's enclosure, pitot tubes, engine and propeller and over tail turret dome.

APPENDIX I
OPERATING DATA

INTRODUCTION.

This Appendix contains graphical and tabular data to acquaint the pilot with the operation and performance of the airplane for pre-flight and in-flight mission planning, and text explaining use of the data presented. Whenever possible, it is advisable to formulate operational flight plans on the basis of the data presented on the following pages to achieve maximum utilization of the airplane's performance. A thorough understanding and application of the material in this Appendix will result in worthwhile gains in efficiency and safety of operation.

The P5M–2 airplane was designed primarily for long range patrol and anti-submarine warfare missions. Performance information given on the following pages has been prepared for the basic ASW configuration and applies directly with external rockets and racks and searchlight in place. The performance data can be adapted to other configurations by use of the Drag Conversion Table at the end of this Appendix.

Frequently herein, data is presented in both graphical and tabular form to facilitate use of the charts. This affords the pilot an optional method of calculating performance. However, in planning missions, either the graphical or the tabular data should be used throughout the calculations, but graphical data should not be intermixed with tabular data, since inconsistent answers will result (i.e., graphical climb charts should be used with graphical range data and vice-versa). Adherence to the operating instructions given on the chart will result in the best possible performance under each required condition. Any deviation from the recommended airspeeds or power settings will cause a sacrifice in performance than that indicated by the charts and/or damage to the engines.

Data contained in this Appendix are based primarily on results of Navy P5M–2 flight tests. Complete test data has not been available; consequently, some estimated calculations are necessary. Tabular data derived from such calculated performance are printed in red ink. These will be replaced by black-figure data, representing tabulated flight test results, and the estimated performance curves modified as soon as the results of flight tests are available. As a guide in this respect, a release date for each chart is noted in the lower corner above the term "Data Basis". Those tables and graphs which deal with emergency operation, such as flight with one engine operative, have been identified by red borders.

All performance is based on operation with 115/145 grade fuel, with a nominal density of 6.0 pounds per U.S. gallon.

Airplane performance as shown in this Appendix is representative of normal operation in all cases. No conservatism factors have been included to allow for such factors as formation flight, navigation error, etc. Operational units will, no doubt, establish these and other factors from applicable conditions in the field with more accuracy than will result by incorporating an arbitrary allowance.

The graphical and tabular data contained herein may be divided into four categories:

a. The data of figures A–1 through A–4B and the upper portion of figure A–7 from which the pilot may obtain atmospheric data and various instrument correction factors.

b. The data pertaining to the engine characteristics and limitations in figures A–5 and A–6, and lower portion of A–7.

c. The data necessary to calculate the various performance items of a typical mission, such as time and distance required for takeoff, time and distance required to climb to altitude, range, etc. (figures A–8 through A–33).

d. Miscellaneous figures yield data peculiar to the figure concerned (figures A–17 and A–34).

The text groups: Instrument Corrections, Performance Charts, and Miscellaneous Charts are discussed in the following paragraphs. For brevity, only graphical data are discussed, with the exception of Landing, for reasons mentioned under that heading. A Flight Planning discussion demonstrates the use of the charts as a composite instrumentality aiding in the actual flight itself.

INSTRUMENT CORRECTIONS.

AIRSPEED INSTALLATION CORRECTION CHART.

Airspeed installation corrections for the pilot's and copilot's systems are presented in figures A–2 (in graphical form) and A–3 (tabular form). The effects of configuration and gross weight on the airspeed installation error should be noted.

To use the graphical and tabular performance data most effectively, airspeed must be known accurately and the following nomenclature should be reviewed. Failure to understand the meaning and use of the different terms can lead to misunderstanding and apparent inability to obtain predicted performance. IAS is that indicated airspeed value read on the airspeed instrument and corrected for mechanical error in the instrument. This correction is a function of construction tolerances and must be determined for each individual instrument, preferably by a bench calibration.

CAS (V_C) is the calibrated airspeed obtained by applying the airspeed installation correction to IAS. The correction is a function of airspeed, airplane gross weight, configuration, and location of the static and total lead pressure sources.

EAS (V_E) is equivalent airspeed obtained by correcting calibrated airspeed, for altitude compressibility. V_E is equal to true airspeed multiplied by $\sqrt{\sigma}$, where σ, is the ratio of Air density at altitude relative to sea level $P/P\sigma$ (See figure A-1.)

TAS (V_T) is the true airspeed relative to the air mass and is equal to equivalent airspeed multiplied by $1/\sqrt{}$. The value for $1/\sqrt{\sigma}$ may be obtained from the standard altitude table (figure A-1).

V_G is true speed relative to the ground and is equal to true airspeed corrected for wind component velocity.

The table and graphs of airspeed correction are primarily designed for use in flight to determine calibrated and true airspeeds. To obtain calibrated airspeed, add the correction shown in the right columns of figure A-3 for either pilot's or copilot's systems (as appropriate) to the indicated airspeed IAS (corrected for instrument error) shown in the left column for appropriate flap setting.

COMPRESSIBILITY CORRECTION CHART.

Corrections to the calibrated airspeed to account for altitude compressibility are obtained graphically from figure A-4A for any combination of calibrated airspeed (V_C) and pressure altitude. To obtain equivalent airspeed, enter the curve at V_E and proceed vertically to pressure altitudes. Read at the left the ΔV_C or, in other words, the compressibility correction. Subtract the correction for the applicable speed and altitude combination from the calibrated airspeed to obtain equivalent airspeed.

TEMPERATURE CORRECTION CHART.

Temperature correction for compressibility is shown in figure A-4B for a range of calibrated airspeeds at altitudes up to 50,000 feet. Subtract the correction for the applicable altitude and speed from the indicated air temperature to obtain free air temperature in degrees centigrade.

A density altitude chart (figure A-4) is also provided. Given the ambient temperature (in degrees centigrade) and pressure altitude, the density altitude can be read directly from the curve.

EXAMPLE OF AIRSPEED AND TEMPERATURE CORRECTIONS.

The example given below illustrates the procedure to be followed in the use of the tables and graphs of airspeed and temperature corrections for the following conditions: level cruising flight, 6000 feet pressure altitude, 72,000 pounds gross weight, and indicated OAT −11°C.

	PILOT'S SYSTEM	CO-PILOT'S SYSTEM
1. Instrument reading	138	139.6
2. Correction to instrument reading (assumed for example only)	+2	−1
3. Indicated airspeed (IAS)	140	138.6
4. Installation correction, figure A-3	+2	+3.4
5. Calibrated airspeed (CAS)	142	142
6. Compressibility correction, Figure A-4A	−0.3	−0.3
7. Equivalent airspeed V_E	141.7	141.7

To determine true airspeed, the correct air temperature and density altitude must be known.

Indicated air temperature	11°C (corrected for instr. error)
Correction for adiabatic compression (figure A-4B)	−2.8°C
Pressure altitude	6,000 feet
Density altitude, figure A-4	4,000 feet
$1/\sqrt{\sigma}$, figure A-1, at 4,000 feet	1.061
True airspeed $V_T = V_E \times 1/\sqrt{\sigma}$	150.6 knots

POWER CONSIDERATIONS.

ENGINE OPERATING LIMITS CURVES.

The engine operating limits curves show the calibration of the R3350-32W engine. For a given altitude, the engine operating limits curves present the power provided by the engine for any possible combination of control settings and the approved engine controls setting limits. For this purpose two curves are required, one (figure A-5) showing full throttle operation in low blower, and the other (figure A-6) showing full throttle operation in high blower. Both curves present data based on the use of the fuel grade 115/145.

To understand the following explanation of the engine operating limits curves, frequent reference should be made to figure A-5.

a. The nearly horizontal lines (PART THROTTLE REGION) are lines of constant RPM and indicate maximum brake horsepower or torque pressure permitted for the corresponding RPM.

b. The broken slant lines above maximum cruise power (2200 RPM) are limit lines for manifold pressure (MAP) and should not be exceeded.

c. The broken lines below maximum cruise power, below 2200 RPM, are lines for MAP's necessary to produce the limit BMEP on a standard day for the corresponding RPM. These lines differ from those above maximum cruise power to the extent that they are not to be considered as limiting MAP, which is 36 in. Hg when operating below maximum cruise power.

d. For convenience, interpolation is permitted between lines of constant RPM and between the lines of constant MAP.

e. The lines sloping down and to the right are full throttle lines. The MAP lines in this region are not limit lines but are probable MAP for full throttle operation.

f. The point of intersection of the FULL THROTTLE RPM lines and the PART THROTTLE RPM lines are called the critical altitude.

g. The carburetor intake scoop is positioned in the slip stream in such a way as to gain a supercharging effect, known as "ram," from the velocity pressure of the airstream at high speeds. The effect of "ram," is to increase the altitude at which full throttle occurs at a particular RPM setting. There is no "ram" effect at cruising or climbing velocities for this seaplane.

h. Standard temperature at sea level is 15°C (59°F) and decreases 2°C (3.6°F) for each 1000 feet of altitude. Standard temperature at 5000 feet altitude is 5°C (41°F).

i. Humidity decreases BHP approximately 3% for each 0.01 lb water per lb dry air specific humidity.

j. For engine powers other than limit powers shown directly on the chart, use is made of the lines of constant RPM and constant MAP.

An example of the use of Engine Operating Limits curves is included below to illustrate the procedure to be used in finding the manifold pressure at a specified power, and RPM other than the best power mixture for figure A-5. A similar procedure may be used for figure A-6. Use may also be made of the Engine Operating Limits Tables which appear as figure 6-4 in Section VI.

Many variables affect MAP, such as temperature, humidity, carburetor metering, accessory loads, etc., which are required to produce a desired BHP-RPM. Power should be established by RPM-Torque Pressure, with care taken not to exceed MAP limits (36.5 in. Hg in cruise range) and not more than 2 in. Hg spread in MAP between engines.

EXAMPLE OF USE OF ENGINE CURVES.
(See figure A-5.)

To find the manifold pressure at 5000 feet altitude at a power setting of 1800 BHP and 2500 RPM, enter curve at given altitude, through the circled point at 5000 feet and 1800 BHP on figure A-5, draw line parallel to constant MAP, RPM lines. Proceed along this line until it intersects the 2500 RPM full throttle line at the second circled point. Interpolate between MAP lines to read MAP = 34.5 in. Hg.

TORQUE PRESSURE-BHP RELATIONSHIP:

$$\text{BHP} = \text{Torque Pressure} \times \frac{\text{RPM}}{142}$$

TORQUE PRESSURE-BMEP RELATIONSHIP:

$$\text{BMEP} = \text{Torque Pressure} \times 1.66$$

PERFORMANCE CHARTS.

TAKEOFF PERFORMANCE.

Data showing takeoff performance are presented graphically on figures A-8 and A-9. From these figures, time and distance required for takeoff may be obtained for any airplane gross weight and headwind condition. These data are calculated for optimum sea conditions and represent time and distances attainable with normal operation technique without the benefit of jato. Figure A-9B presents the same data in tabular form and is self-explanatory.

The JATO firing chart, figure A-9A, presents additional tabular data for use when assist takeoff procedures are warranted. For several takeoff headwinds and gross weights, the time (in seconds) and water speed (in knots) are given at which JATO units are to be fired to achieve maximum assist for takeoff at Standard and Navy Hot Day conditions. Again, the data is based on normal operating technique.

The curves of figure A-7 show the gain or loss in horsepower available at takeoff which can be expected as a result of a deviation from standard temperature and specific humidity. This factor is further demonstrated in figure A-7A, which describes the effect of humidity on brake horsepower at constant RPM and MAP.

TAKEOFF DISTANCE AND TIME FOR TAKEOFF. Takeoff times and distances are shown in figures A-8 and A-9. These charts may be used to predict airplane performance at sea level for a variety of gross weight and headwind conditions and, together with figure A-7, takeoff power deviation resulting from non-standard conditions.

These figures give performance without the use of jato. The distances shown do not include any factor of conservatism and apply to normal operations using a 30° takeoff flap setting. To obtain predicted performance, and to eliminate the effect of variation in pilot technique on takeoff distances as much as possible, the following procedures should be used:

a. When in position, run the engine up to takeoff power before commencing the takeoff run.

b. Proceed with normal takeoff procedures given in detail in Section II of Flight Handbook AN 01-35EJB-1.

c. When the aircraft is waterborne, if space permits, accelerate close to the sea surface until the desired climb speed is reached.

WARNING

If, during the takeoff run, one engine fails or the airplane swerves, the other engine should be cut immediately and a landing effected.

As an example of the use of the takeoff charts, assuming a takeoff gross weight of 70,000 pounds (point "A" on figures A-8 and A-9), proceed horizontally to the right to intersect curve at "B". From point "B", proceed vertically downward to point "C", which is the condition for takeoff without any headwind. On figure A-8, point "C" defines a takeoff time of 37 seconds, and figure A-9 shows takeoff distance to be 3050 feet of water run. To find the distance and time for a takeoff into a 20-knot headwind, from point "C", follow the guide lines to point "D" at that headwind. Figure A-8 shows a takeoff time of 24 seconds, and the distance determined from figure A-9 is 1250 feet.

Gross weight at end of takeoff can be calculated by substracting the fuel allowance for starting engines, warm-up, taxiing, takeoff, and accelerate-to-climb from the takeoff gross weight. This fuel allowance is assumed to be the fuel consumed in operating for 10 minutes at normal rated power at sea level, and is equal to 655 pounds. This fuel allowance of 655 pounds is to be used for all calculations. Thus, in the example just given, the gross weight at liftoff is 70,000 minus 655, or 69,345 pounds.

JATO FIRING CHART.

Where conditions warrant the shortening of takeoff run or takeoff time, the "Assist Takeoff" procedure described in Section II of Flight Handbook AN01-EJB-1 may be applied. The jato units are so mounted in the aft section of the hull that they add the thrust of the four jato units to the propeller thrust in overcoming water resistance on takeoff. The jato Firing Chart, figure A-9A, lists time after full throttle is applied and the corresponding airspeed for initiating jato units. Data are given for various gross weight and headwind conditions at Standard Day and Navy Hot Day temperatures. The chart covers smooth water operation only. It does not cover rough water operation because no data are presently available for accurately determining the effect of wave height on the water resistance of the P5M hull. The chart will be revised should data of this nature become available.

The greatest reduction in takeoff time generally occurs when jato is used near the end of the takeoff run. For Standard Day conditions, the chart provides for firing of all 4 bottles 14 seconds before takeoff. Since the bottles furnish thrust for a total of 15 seconds, the thrust will continue for 1 second after takeoff on a Standard Day as a safety factor.

On days when ambient temperatures are those identified with a Navy Hot Day, each jato bottle will deliver about 10% more thrust at any given moment, but will consequently burn out sooner. Thus, for a Hot Day, the chart provides for firing all 4 bottles 13 seconds before takeoff, and; as a safety factor, allowing one additional second of jato thrust after takeoff.

While the majority of gross weight and headwind conditions identified in figure A-9A allow all four jato bottles to be fired simultaneously, there are conditions under which it is preferable to use the jato units in pairs during takeoff. This is done to overcome peaks of resistance and drag which occur at times other than near the end of the takeoff run. This condition generally prevails under the combination of factors of high gross weight and little or no headwind. Such a jato firing procedure is preferred as a means of shortening the takeoff run even more. Thus, the jato firing chart provides for firing the jato units in pairs at the times and speeds indicated by "first two" and "next two".

HUMIDITY CORRECTIONS.

The Engine Operating Limits curves, figures A-5 and A-6, show performance base on operation on a Standard Day in dry-air, Non-standard atmospheric temperatures. Conditions of high humidity have a decided effect on power and this effect becomes particularly important during the takeoff operation. If a takeoff is made in colder than standard weather, the density altitude at the takeoff point is less than standard. Therefore an improvement in takeoff performance can be expected, even if the engine power output is the same as for standard conditions. On the other hand, if higher than standard outside temperatures exist at the takeoff point, an increase in takeoff distances can be expected because of the higher density altitude and inability of the engine to develop full takeoff power without exceeding limit manifold pressures. If the humidity is high, a further loss of power can be expected with a further increase in takeoff distance.

The effects of humidity reduce the weight of air per cubic foot and cause the carburetor to supply a fuel-air mixture to the engine which is richer than in dry air. To partially compensate for these effects at operating altitudes greater than sea level, it is permissible to increase the takeoff manifold pressure over the limit for dry air by an amount equal to the vapor pressure of the humid air. This humidity correction allowance is shown on figure A-7 and may be determined from dewpoint, or wet and dry bulb temperatures. It should be emphasized again, however, that in no case may the sea level limit brake horsepower be exceeded.

Figure A-7 can be used to determine the effect of non-standard operating conditions on takeoff power availability. However, the following values must be determined before accurate predictions can be made: density altitude (figure A-4), free air temperature, specific humidity (from wet and dry bulb temperature or dewpoint readings), and standard power for the existing density altitude (figure A-5 or A-6).

EXAMPLE OF TAKEOFF POWER UNDER NON-STANDARD CONDITIONS.

This example illustrates the use of figure A-7. Assume that the free air temperature (also dry bulb reading) is 30°C (86°F) and that the wet bulb temperature is 20°C (68°F), at sea level. Find the loss or gain in brake horsepower and deviation of torque pressure due to deviation from standard temperature and specific humidity.

Since engine performance is based on standard temperature 15°C (59°F) and dry air, corrections must be made for non-standard temperature and specific humidity. Draw a straight line through 30°C and 20°C on the dry and wet bulb temperature graphs, respectively, to read a specific humidity of 0.010 pounds water vapor per pound of dry air. (See figure A-7 upper right corner.) Enter the lower graph at point "A" at +15°C (since 30°C at sea level is 15°C above standard). Proceed upward to intersect the diagonal curve at "B". From "B", proceed horizontally to the right to point "C". Follow the guide lines to point "D" at 0.010 specific humidity. From "D", proceed horizontally again to intersect the diagonal line at "E". From this point, three deviation values may be obtained. Proceed horizontally to the right to read the percent deviation from standard power 6.8% at point "F". Proceed vertically downward from "E" to read the deviation of brake horsepower from standard, which is 221 BHP (point "G"). Proceed vertically upward from point "E" to read the torque pressure deviation from standard, 10.8 psi (point "H").

An alternate solution is possible from figure A-7 if dewpoint or vapor pressure had been given instead of wet bulb temperature. Specific humidity can be obtained from the curves in the upper left corner of figure A-7 by knowing either dewpoint or vapor pressure. Knowing the free air temperature and specific humidity, the deviation from standard power and deviation of torque pressure due to non-standard temperature and specific humidity is found exactly as shown in the preceding example.

CLIMB PERFORMANCE.

Climb performance data are shown in both tabular and graphical form on figures A-9C through A-13B for two-engine performance using Military Rated Power, Normal Rated Power, and Maximum Cruise Power. The climb charts of figures A-9C, A-9D and A-9E give tabular data for the best climb speed, rates-of-climb, time-to-climb, distance covered during climb, and fuel used for climb to various altitudes. Figures A-10 and A-11 present the graphical equivalent of figure A-9C, showing the horizontal distances traversed during climb, the gross weight at the end of climb, and time to climb to altitude with maximum cruise power. Figures A-12 and A-13 give the same information for climb at normal rated power comparable to that provided tabularly in figure A-9D. Figures A-13A and 13B give the same information for military rated powers as that provided tabularly in Fig. A-9E. The fuel used during climb to cruise altitude is determined from these curves by computing the difference in gross weights at the two altitudes. However, the allowance for fuel used in warm-up, taxiing, takeoff, and climb may also be obtained from the climb charts, figures A-9C, A-9D, and A-9E.

Climbs should be accomplished at the recommended speeds shown on the charts and curves; any increase or decrease in climb speed from the recommended speed will cause a reduction in the rate of climb. The corrections for differences in outside temperature from standard are shown at the bottom of each chart. It is important that the speeds recommended in the climb charts, figures A-9C through A-13B, be maintained during climb. It is also imperative that the airplane drag be minimized by setting the cowl flaps and oil cooler doors as near closed as possible without exceeding the engine temperature limits.

The effect of non-standard temperatures on climb performance may be approximated by entering the charts at density altitude, as determined from the standard atmospheric chart figure A-4, rather than pressure altitude. A more exact correction for temperature will be included when available.

EXAMPLE OF USE OF TWO-ENGINE CLIMB CURVES.

Assume that the aircraft, on an ASW mission, takes off at gross weight of 70,000 pounds, using normal rated power to climb to 10,000 feet altitude. Referring to figure A-12, in the "Remarks," deduct 655 pounds from this gross weight for takeoff allowance, resulting in a gross weight at start of climb of 70,000 minus 655, or 69,345 pounds. Find: (a) Horizontal distance covered in climb and gross weight at end of climb; (b) time required to climb; (c) best calibrated airspeed for climb; and (d) fuel consumed in climb.

a. Enter the Climb Curve—Distance and Fuel, two-engine Normal Rated Power (figure A-12) at 69,345 pounds (point "A"). Proceed upward to the right, parallel to the guide lines to 10,000 feet (point "B"). Proceed horizontally from point "B" to point "C". Read distance covered during climb of 27 nautical miles. Proceed vertically downward from point "B" to point "D". Read gross weight at end of climb of 68,600 pounds.

b. To obtain time required to climb, enter Climb Curve—Time, two-engine Normal Rated Power (figure A-13) at 69,345 pounds (point "A") and follow guide lines to 10,000 feet (point "B"). Read 12 minutes at point "C" by proceeding horizontally from point "B". Point "D" again is 68,600 pounds, the gross weight at end of climb.

c. Best CAS for climb: Enter the Best Climb Speeds curve (upper right corner of figure A-12) at sea level pressure altitude and interpolate the weight curves for a sea level gross weight of 69,345 pounds (point "E"). Read the best CAS of 129 knots. Similarly, enter this same curve at 10,000 feet and interploate the gross weight at 10,000 feet of 68,600 pounds (point "F"). From point "A", proceed vertically downward to point "G". Read best CAS of 124.5 knots. The speed curve on figure A-13 is identical to the one used above, and can be used in exactly the same way.

d. Subtract the gross weight at end of climb, 69,345 pounds from the gross weight at start of climb, 68,600 pounds, to yield the fuel consumed in climb, 745 pounds.

SINGLE-ENGINE CLIMB PERFORMANCE

Single-engine climb tabular charts, figure A-23A and A-23B, are presented for military power and for normal rated power, respectively, and with the dead engine feathered. Similar data are presented graphically in figures A-24 and A-25. Flight with one engine inoperative is considered to be an emergency procedure, and charts for this condition are identified by a red border.

EMERGENCY RATE CLIMB CURVE.

Single-engine rates of climb at sea level versus airspeeds are shown for ASW loading at three gross weights in figure A-32. To determine the rate of climb for a particular operating weight, read the rates of climb for a particular operating weight and the rates of climb corresponding to the airspeed for the desired configuration from the two curves nearest the operating weight. Performance at the desired weight can be obtained closely by linear interpolation.

If an engine fails during flight, the inoperative engine should obviously be feathered at once. Figure A-32 shows single-engine rate of climb curves with the propeller feathered on the dead engine. If, for some reason, it is impossible to feather the propeller, the resulting loss of climb performance and the change in optimum climbing speeds can be determined from this figure. Obtain the rate of climb with propeller feathered; then apply the appropriate correction factor to rate of climb (Δ rate of climb) from the propeller windmilling correction curve in the lower right corner of figure A-32.

EMERGENCY CEILING.

The altitude at which both service ceiling and absolute ceiling can be obtained is plotted versus gross weight on figure A-33 for Standard Day and Navy Hot Day conditions. Curves are shown for single-engine operation at military and at normal rated power, and two-engine operation at normal and military rated power. It should be noted that maximum weight shown for single-engine military power operation, using sea level as the service ceiling, is 73,500 pounds. Using sea level as the absolute ceiling, the maximum attainable weight is 79,000 pounds. These values are based on Standard Day conditions. The rates of descent resulting from an engine failure at an altitude greater than the single-engine emergency ceiling are shown on the Emergency Climb curves, figure A-32.

FLIGHT OPERATION INSTRUCTION CHART—ONE ENGINE.

Range data for cruising on single engine are presented in the form of a Flight Operation Instruction Chart, figure A-26A. The engine power settings and airspeed data included on the chart should be used only when the gross weight is above 66,000 pounds and if it is within the limits specified in the gross weight column. Two altitudes are shown, and range is given only for a 30-minute period at these high power settings.

If the emergency circumstances of single-engine flight require the jettisoning of equipment, use may be made of the Jettison Weight List at the bottom of figure A-26A, along with the power settings at the top of the figure associated with the lightened gross weight after jettison. Care should also be exercised under these conditions to avoid jettisoning fuel or stores in the vicinity of inhabited or congested areas. Not only the concern for the crew, but also the care and safety of any nearby populace must be considered by those responsible for directing jettison operations aboard the aircraft.

An example of use of the Flight Operation Instruction Chart is detailed later in the Appendix under the heading Example of Flight Planning.

LEVEL FLIGHT OPERATION.

This section discusses graphs and charts which are used to establish level flight cruise control procedures. Miles per pound curves, long range prediction and summary curves, and maximum endurance prediction and summary curves are described and applied for normal and single-engine operation. The Combat Allowance Chart is discussed later in the Appendix.

The miles per pound curves and summary curves can be used in the preparation of all types of flight plans. These curves, prepared for altitudes from sea level to 15,000 feet, show fuel economy and power settings for all speeds of which the airplane is capable, from that for absolute minimum power to maximum continuous speed.

Sample problems showing application of maximum range cruise and maximum endurance cruise curves are detailed under those headings. Later in the appendix, sample problems are presented showing examples of flight planning for long range operation, which includes both normal and single-engine flight conditions using these charts.

MILES-PER-POUND CURVES.

Power schedules in this handbook are shown in terms of rpm, torque pressure, and manifold pressure settings. The maximum allowable manifold pressure at engine speeds of 2200 rpm and less is 36.5 in. MAP, both in high and low blower. Limit values which apply to part-throttle operation at higher engine speeds are given in the Engine Operating Limits Charts in Section VI of this handbook, in the Engine Operating Limits curves (figures A-5 and A-6), and in the Miles-Per-Pound curves (figures A-18 through A-20A).

The two-engine curves of figures A-18 through A-20A show the nautical miles traveled per pound of fuel consumed at all airspeeds, from the speed for maximum endurance to the speed at military rated power. The emergency flight single-engine curves of figures A-27, A-27A, and A-28 show the same data for powers up to military rated.

The rpm and manifold pressures schedules on the curves are for maximum economy fuel flow. The use of any higher rpm for a given horsepower will result in higher fuel flows and thereby shorten ranges. The use of lower rpm's for a given horsepower is prohibited by the engine limitations. Cowl flaps and oil cooler doors should be kept as near closed as possible without exceeding the temperature limitations of the engine.

MANUAL LEAN OPERATION.

When operating in level flight at cruising powers it may be desirable to seek a more efficient operating condition of the engines than can be obtained with the mixture control in NORMAL position. This may be done if the engine speed is 2200 rpm or less by a process called manual leaning. The amount of fuel supplied to the engine for a given brake horsepower is varied by manual adjustment of the throttles and mixture control levers until the best economy point has been established. This point may or may not be farther toward the CUT-OFF position than the NORMAL position; however, in most cases, the NORMAL setting is somewhat richer than that for best economy. The "Approved Manual Leaning" procedure which should be used is detailed in Section VII of Flight Handbook AN 01-35EJB-1.

LONG RANGE CRUISE PERFORMANCE.

The long range cruising performance which can be obtained is a function of many variables, the most important of which are airspeed, gross weight, mixture setting, cowl flap position, power schedule, altitude and temperature, external configuration, and number of engines operating. Each has an effect on overall performance which can be expressed in terms of distance flown per unit of fuel used, or fuel economy, which is a direct measure of the efficiency with which the airplane is being operated.

If maximum fuel economy is to be obtained for any particular flight condition, indicated speed schedules should be used which most nearly approach those for maximum range. The speeds shown on the Maximum Range Power Conditions Curve, figure A-21, represent stabilized values to be expected in level flight. The recommended cruising speeds shown on the Miles-Per-Pound and Long Range Summary Curves (figure A-18 through A-21) for two-engine operation, result in fuel economies which are 99% of the optimum which can be obtained. This has been done to provide a slightly faster speed schedule than the optimum for calm air, and has the advantage of reducing the effect of mild turbulence. It also provides a schedule which more nearly approaches the optimum for moderate headwind conditions. It is important that altitude be held constant in order to realize these speeds.

In every instance, use seaplane gross weight to establish necessary power settings. The responsible crew members should keep an accurate log of fuel used and stores expended in order to determine gross weight at any point in flight. The frequency with which power settings should be changed during cruise flight as weight decreases depends on the degree of accuracy with which cruise control procedure is to be followed. It is recommended that weight increments of not less than 2000 or more than 5000 pounds be used.

Set cowl flaps to the minimum opening for proper engine cooling. While little change in drag occurs between the closed and trail positions, wider openings will result in large increases in drag and loss of speed. The trail setting will provide adequate engine cooling under most operating conditions.

NORMAL mixture setting should be used when operating at powers above 2200 rpm. Use NORMAL mixture or manually lean the mixture, as described previously, at and below this engine speed, provided that power and manifold pressure limits are not exceeded. Set power by using an engine speed which results in the most economical operation of the airplane. This is obtained, in most cases, by using the lowest rpm allowable for a given brake horsepower. However, 1600 rpm is the lowest practicable engine speed which should be used. A further decrease does not appreciably decrease the fuel flow and would affect the operation of some parts of the electrical system.

External configuration should be such as to result in minimum drag. It may not be possible to execute a particular mission without carrying external stores. However, large stores should be carried internally if at all possible. Rocket racks should be removed if not used. The searchlight and pylon, when not required for the mission, should be removed and stowed.

All the above considerations should be understood fully by the flight crew in order to achieve the best possible cruise performance with the aircraft and for the most effective use of the maximum range cruise charts provided. For two-engine flight, the Miles-Per-Pound curves, figures A-18 through A-20A which have been previously discussed, are the basis for the summary curve shown as figure A-21, Maximum Range Operating Conditions Curve. The points on the miles-per-pound curve along the "Recommended CAS for Long Range" line were plotted for all gross weights above 54,000 pounds for each given altitude to obtain the plots of figure A-21. Thus, for any flight gross weight and power plant, settings for cruising at the recommended speed for long range can be read directly, along with speed, fuel flow, and specific range values which are to be expected.

Superimposed on this summary plot are five vertical lines showing single-engine climb potential at military rated and normal rated powers, at 1500 feet and at 5000 feet altitude. If this summary curve is in use by the flight crew during flight, these lines permit a quick appraisal of the seaplane's weight condition and its climb capabilities in the event of engine failure during the maximum range power cruise.

Figures A-27, 27A, and A-28 show Miles-Per-Pound curves applicable to single-engine flight at sea level, 1500 feet and at 5000 feet altitude. Single-engine Maximum Range Power Conditions Curve, figure A-29, represents the cross plot of the power plant settings, recommended cruise speeds, fuel flow, and specific range obtained from the points along the "Recommended CAS for long Range" lines of figures A-27, A-27A, and A-28. Use of these curves is identical with that for similar curves for two-engine flight. However, the vertical lines of climb potential become, on the single-engine plot of figure A-29, limit lines to the left of which the aircraft cannot maintain service ceiling or absolute ceiling at the indicated engine powers, without reducing gross weights. If the emergency circumstances of single-engine flight require the jettisoning of equipment, use may be made of figure A-26A.

Note carefully, by comparison of figure A-21 for two-engine cruise, and figure A-29 for single-engine cruise, that fuel flow is substantially increased when flying at a given gross weight on single engine, in contrast with two-engine operation. The point cannot be over emphasized that the single-engine flight CONSUMES MORE TOTAL FUEL in a given period of time at a given weight than the same flight conditions with both engines operating! Therefore, careful fuel management during cruising flight by the responsible crew members is most imperative.

LONG RANGE PREDICTION CURVES.

Range and flight time for cruising at the recommended speed for long range on two engines are plotted versus gross weight as figures A-22 and A-23. These curves are based on recommended cruising speeds shown on Maximum Range Power Conditions curve, figure A-21. For single-engine operation, similar curves for finding cruising range and time to cruise are presented on figures A-30 and A-31, and are based on the Single-Engine Maximum Range Power Conditions curve, figure A-29. The procedure for using single-engine and two-engine Distance Prediction and Time Prediction curves is identical.

For example, let us consider a cruise flight at 10,000 feet altitude and a speed for maximum range on two engines for a total distance from base of 1200 nautical miles. Find: (a) Fuel used in cruise; (b) Time required for cruise; and (c) Power settings, airspeed, fuel flow, and specific range during cruise. Assume a takeoff gross weight of 70,000 pounds, and an ASW mission.

a. From the examples given in the Takeoff and Climb discussions in this section, the initial gross weight of 70,000 pounds is reduced by 655 pounds fuel allowance for warm-up, taxiing, and takeoff, plus 745 pounds fuel used to climb to 10,000 feet. The gross weight at beginning of cruise then is 68,000 pounds, and the distance from base covered in climb is 27 nautical miles. The fuel required to affect the scheduled cruise is obained from figure A-22.

Note

> It should be emphasized that in figures A-22 and A-23, only the change (Δ) in range, gross weight, and time are of importance. Any specific value of gross weight, range, or of time is not important.

Now, the desired range yet to fly is 1200 —27 (figure A-12) = 1173 nautical miles. Enter figure A-22 at 68,600 pounds, the gross weight at start of cruise. Proceed vertically and intersect the 10,000 foot altitude curve at point "A". From "A" proceed horizontally to the left to read 1060 nautical miles to establish a starting point. The range increment (Δ range) is 1173 nautical miles; therefore, the appropriate ordinate value is 1060 + 1173 = 2233 nautical miles. Re-entering figures at 2233, proceed horizontally to point "B" on the 10,000-foot altitude curve. From point "B", proceed vertically downward to read the gross weight value of 58,900 pounds. The fuel consumed (Δ weight) in flying 1173 nautical miles at cruise conditions is 68,600 — 58,900 = 9700 pounds.

b. Time to Cruise, figure A-23, is found in a manner similar to figure A-22 (discussed above) in that only Δ — time and Δ — gross weight are of significance. Enter figure A-23 at 68,600 ponuds, the weight at start of cruise. Proceed vertically upward to the 10,000-foot altitude line at point "A". From point "A", proceed horizontally to the left to read a time value of 6.7 hours and establish a starting point. Since gross weight at end of cruise was determined to be 58,900 pounds, proceed vertically from this gross weight to intersect the 10,000 foot curve at point "B". From "B", proceed horizontally to the left to read a time of 13.9 hours. Therefore, the elapsed time to cruise 1173 nautical miles is 13.9 — 6.7 = 7.2 hours.

c. Power settings, airpseed, fuel flow, and specific range during cruise: knowing the gross weight at any time during the cruise, these data for maximum range may be obtained from figure A-21. Thus, at the start of cruise when the gross weight is 68,600 pounds, read the following airspeed, power settings, and specific range data obtained from figure A-20 at 10,000 feet: CAS = 143 knots, torque pressure = 103 psi, RPM

= 2170; MAP = 34 in. Hg, fuel flow = 740 lb/hr per engine, specific range = .1125 nautical miles (traveled) per pound of fuel (consumed).

MAXIMUM ENDURANCE CRUISE PERFORMANCE.

The maximum endurance cruising performance which can be obtained with this aircraft is a function of the same variables as those which effect the range performance, except that time flown per unit of fuel used is the measure of efficiency for this type of operation. It should be noted here that when a cruise mission is assigned to the crew specifying a patrol to take a given increment of time, the power settings and the curves for maximum endurance should be used. When a mission plan calls for a specified distance to be covered with no time element attached, fuel economies can be best achieved by using the curves in this Appendix which apply to maximum range power conditions. In other words, the endurance curves do not result in as great a range covered for a given increment of time as is possible with maximum range curve values; conversely, at maximum range the elapsed flight time is less for this power setting than when endurance powers are used to cover the same range.

To obtain maximum endurance, the lowest practicable airspeeds and altitudes should be used to reduce engine power requirements and fuel flow to a minimum. It is recommended that speeds for maximum endurance be based on operation at speeds 10% greater than that for absolute minimum power required. This speed schedule presents a more practical flight condition. Although extension of wing flaps will reduce the speed for maximum endurance, it will also tend to decrease the endurance time available.

Maximum endurance data versus gross weight is plotted in figure A-15. From this figure, engine power settings such as torque pressure, RPM, and MAP, as well as fuel flow and CAS, may be obtained for any gross weight. Similar data in tabular form is found in figure A-14A. The curves of figure A-15 were obtained by the points shown on the Miles-Per-Pound Curves, figures A-18 through A-20, along the "CAS for Maximum Endurance" line plotted versus gross weight. Any deviation from the power setting or CAS shown on figure A-15 for a given power weight will decrease the endurance time of flight. The corresponding tabular and graphical figures for single-engine operation are shown in figure A-25A and A-26 respectively, which are used in the same way as the two-engine data.

MAXIMUM ENDURANCE PREDICTION CURVE.

Flight endurance time, as shown in figure A-16, can best be discussed by using an example problem. Assume a continuation of the flight described in the Long Range Prediction Curves paragraph. The airplane gross weight at beginning of endurance flight would then be 58,900 pounds, altitude is 10,000 feet, aircraft is 1200 nautical miles out from base, and fuel consumed during flight to this point is 11,100 pounds. At end of long-range cruise, orders are to rendezvous at 5,000 feet at speed for maximum endurance for 30 minutes. Find fuel required for rendezvous.

As in figures A-22 and A-23 (previously discussed), only increments of endurance time and gross weight are of significance on figure A-16. Enter this figure at the gross weight at end of cruise, 58,900 pounds (figure A-16), and proceed upwards to intersect the 5000-foot altitude line at point "A". Proceed horizontally from point "A" to the left to read a time of 18.7 hours as a starting point from which to count off endurance time. Since 0.5 hours is the time allotted for rendezvous, the Δ time added to the value 18.7 gives 19.2 hours. From 19.2 hours, proceed horizontally to again intersect the 5000-foot altitude curve at point "B". From "B" proceed vertically downward to read a gross weight of 58,400 pounds. The fuel weight required for the 0.5 hours rendezvous at 5000 feet is 58,900 — 58,400 = 500 pounds.

LANDING DISTANCES.

Only tabular data are available for landing distance on water, as shown in figure A-14. Landing distance on water is largely a function of pilot technique. As such, the data of figure A-14 represents nominal values, and these are based on normal service conditions and techniques. Although inconsistent answers result when graphical and tabular data are intermixed in the solution of any performance problem, the above considerations render the use of this figure acceptable for use with graphical data.

The distances shown in figure A-14 are a function of gross weight and density altitude, and represent normal service performance with and without use of deceleration devices. The landing distance chart lists the water run distance as well as total distance required to land over a 50-foot obstacle for various gross weights at sea level. The best calibrated approach speeds listed in the chart give safe airspeed for approaching the landing area with wing flaps full down, and these speeds must be used if stops are to be made in the distances indicated. When reverse thrust braking is used after landing, it will be found most effective at higher water run speeds and should be applied as quickly as possible after touchdown. Use of hydroflaps during landing results in additional reduction of approximately 100 feet of landing distance, and is most efficient during the slower speed portion of the water run.

EXAMPLE OF USE OF LANDING DISTANCE CHART.

Assume that for takeoff, climb, cruise, and rendezvous, the ASW patrol mission gross weight is 58,400 pounds. A landing is then to be affected, using 40-degree flaps, in zero wind and without deceleration devices. Find: (a) Horizontal distance required for landing the seaplane so as to be sufficient to clear an obstacle 50 feet high. (b) Best calibrated airspeed for landing approach.

a. Interpolate between lines of data for 54,000 and 60,000 pounds to obtain values at 58,400 pounds gross weight. Under "No Deceleration Devices", the horizontal distance to clear a 50-foot obstacle is found to be 2623 feet.

b. For best calibrated airspeed for landing approach, interpolate figure A-14 at landing weight, 58,400 pounds, yielding a power-off airspeed of 91.5 knots.

MISCELLANEOUS DATA.

COMBAT ALLOWANCE CHART.

No combat power rating has been established for the engine with which this airplane is equipped.

A combat allowance chart for operation at Military Power Rating (figure A-17) lists the power settings, fuel flows, and engine limits applicable from sea level to 20,000 feet altitude. This table should be used in mission planning to estimate fuel consumption during combat operation at military power.

DRAG CONVERSION TABLE.

A Drag Conversion Table, presented on figure A-34, is used to calculate the change in airspeed, climb, and long range cruise when the searchlight, rockets, and rocket installations are removed from the airplane. This, in effect, allows the Drag Conversion Table to be used to make the performance data given on the preceding tables and graphs of this Appendix applicable to configurations other than ASW Patrol which was used in their determination.

The term Δf shown on the Table is a measure of the change in airplane parasite drag (equivalent flat plate area) resulting from a change of configuration. The effect of drag changes can also be expressed in speed increments, Δ CAS, or those changes in level flight speed resulting from changes in drag at constant power. Removal of searchlight, rockets, and rocket installations is seen, from figure A-34, to increase calibrated airspeed 5 knots.

Rate of climb data given in the climb performance section of this Appendix must be modified to include drag change effects. This can be done by use of the climb weight adjustment factors, in pounds, shown in the Drag Conversion Table. The airspeed schedule based on actual airplane weight should be followed and climb performance, with the items removed, calculated by algebraically adding the climb weight adjustment factor to the actual airplane gross weight. A sample situation is shown on the Climb Curve, figure A-12, for the ASW configuration where the gross weight at a start of climb is 69,345 pounds. If the searchlights, rockets and rocket carrier installation could be removed from the airplane, climb data would be read from the Climb Curve at a fictitious weight equal to the actual airplane weight at point "A" (69,345 pounds), plus the adjustment factor (—2220 pounds), or 67,125 pounds at start of climb.

Long range cruise weight adjustment factors have been derived. Δf and ΔCAS values for use in modifying data given in the long range cruise performance section. However, these factors are applicable only as a prediction of performance if the power schedules recommend for maximum range cruising speeds are used. Use actual airplane weight to obtain power settings from the maximum range power condition curves of figure A-21. Adjust the airspeeds, read by Δ CAS, to obtain cruising speeds in the new configuration. To obtain corresponding fuel economy values, algebraically add the applicable long range cruise weight factor (—2800 pounds) to the actual airplane weight (69,345 pounds) and read specific range at this new weight (.1175 nautical miles per pounds of fuel at 10,000 feet). Also, use the fictitious weight obtained (66,545 pounds) to read values from the long range prediction curves, inasmuch as fuel flow schedules are unchanged.

PLANNING A FLIGHT.

GENERAL.

The basic mission of this type of aircraft involves long periods of flying at cruise power settings. It was for these conditions that the airplane was designed and is most effective. Patience and skill on the part of the flight crews will result in optimum aircraft performance. Adequate data are presented in this Appendix to afford selection of a wide range of flight plans.

In making up a flight plan, such factors must be considered as fuel load, takeoff gross weight, range, time during flight when mission duties are to be performed, available fuel for return to base, distance and fuel required to alternate bases, and altitudes and speeds for most efficient aircraft performance during entire flight. In addition, there are always the contingencies which may arise to alter the routine planned flight, such as engine failure enroute to target area, or perhaps combat damage, engine failure on return leg of flight, emergency conditions requiring ditching or bailout, etc. The crew members responsible for planning the flight must be prepared to consider all these factors BEFORE they may occur, and to modify the engine settings, reduce altitude to a safe level, jettison fuel if necessary or prudent to do so, perhaps reduce weight by jettisoning aircraft equipment in an orderly and effective sequence, and other similar considerations.

The following paragraphs enumerate some of these practices in a more specific manner, and they are supported by sample data from the flight handbook charts which reflect several flight conditions likely to occur on a mission. Emphasis is placed on emergency conditions where the aircraft must fly on one engine.

In making up a flight plan, the available fuel for the mission is obtained by substracting the allowances for warm-up, taxiing, take-off, and climb from the total fuel load. The remaining fuel is available for cruising and reserve.

To determine the fuel load to be carried, it is recommended that the last half of the flight be planned with one engine inoperative. Thus, in the event of engine failure this procedure will result in enough fuel for the airplane to reach its destination or to seek alternate bases. Note also from figure A-33 that the allowable gross weight at any given altitude is reduced substantially when operating on just one engine. Range data and power plant settings for cruising at the recommended speed can be read from the maximum range prediction curves, figures A-22 and A-23 for two-engine operation and figures A-30 and A-31 for single-engine flight; and from the long range power condition curves, figures A-21 and A-29. If higher cruise speeds than those recommended for long range are used, ranges will have to be calculated with data read from the Miles-Per-Pound curves.

From gross weight, range required, altitude desired, and available fuel information, the engine operation and cruising speed can be chosen to meet the requirement. The fuel required and the flying time for a given mission depend largely upon the speed desired. With all other factors remaining equal in the airplane, speed is obtained with a sacrifice in range; and conversely, range is obtained with a sacrifice in speed. The speed is usually determined after considering the urgency of the flight and the range obtainable at various speeds. The time of takeoff is adjusted to have the flight arrive at its destination at the predetermined time, possibly to rendezvous with other aircraft.

A sufficient amount of data are included in this Appendix to allow preparation of an effective flight plan. In the following example, a variety of conditions has been inserted which permits adaptations of the methods shown to less complex situations. The charts and tables in this Appendix have been designed for rapid use in the event it becomes necessary to change or develop a new flight plan while underway.

Note

No allowance for oil consumption has been included in the example.

EXAMPLE OF FLIGHT PLANNING.

Determine the urgency of the flight from the appropriate source, along with the range and airspeed requirements and the most strategically advantageous altitude. Then calculate the required number of nautical miles to be flown. Be certain to include estimated mileage to be used in the general area of the target for tactical purposes.

SAMPLE PROBLEM NO. 1.

Let us assume that the compilation of data from the above has given the following figures:

a. The aircraft will fly a patrol ASW mission, carrying one torpedo in one bomb bay, and eight HVAR rockets under wings. Full ammunition load is also assumed carried. Assume that none of these are expended during patrol against a target.

b. The climb and cruise out to the patrol area will cover 500 nautical miles, a 200-mile patrol will be flown, and a 500-mile return cruise will be made to takeoff point.

c. The outward cruise and patrol portions of the flight will be flown on two engines, at a pressure altitude of 1500 feet, and at the speed for long range cruise.

d. The return trip will be made with one engine inoperative at an altitude of 1500 feet.

e. Fuel load will consist of full hull tanks, wing auxiliary and service tanks, and one full bomb bay tank.

f. With 20,302 pounds of fuel aboard, the gross weight will be approximately 76,630 pounds.

The standard fuel allowance for taxi and takeoff, 10 minutes at NRP or 655 pounds is given separately in the "Remarks", bottom of figures A-10 and A-12.

For climb using normal rated power on two engines, use the charts in the rear of this section for reference. Turn first to the Climb Curve for Normal Power, figure A-12. At a gross weight at sea level of 75,975 pounds (given gross weight 76,630 pounds less 655 pounds allowance for taxi and takeoff) follow a line through the start-climb gross weight upward to the right parallel to the guide lines to altitude of 1500 feet. Interpolating, the gross weight at end of climb is 75,850 pounds, and the fuel used in climbing to altitude is 75,975 minus 75,850, or 125 pounds. The time to climb, obtained from figure A-13, is 1.7 minutes. The horizontal distance traveled during climb is obtained from figure A-12. Enter curve at gross weight at sea level of 75,975 pounds, follow a line upward to the right parallel to guide lines to altitude of 1500 feet and read distance during climb as 4 nautical miles. Credit for this distance may be taken, leaving 497 nautical miles to be covered at cruise altitude.

The gross weight at start of outward cruise, then, is 75,850 pounds. Enter curve for 1500 foot altitude on figure A-22 at a gross weight of 75,850 pounds, and read distance of 570 nautical miles to establish a starting point for determining fuel used on outward cruise. Re-enter curve at 570 plus 496, or 1066 nautical miles, and read 71,300 pounds gross weight at end of cruise. Likewise, enter curve for 1500-foot altitude on figure A-23 and 75,850 pounds, and read time of 4.4 hours to establish starting point for determining time spent on outward cruise. Re-enter curve at end gross weight of 71,300 pounds and read time of 7.7 hours. Time spent on outward cruise then equals 7.7 minus 4.4, or 3.3 hours. Fuel used is 75,850 minus 71,300, or 4,550 pounds. Average gross weight during outward cruise equals 73,575 pounds. Enter curve for 1500 feet altitude on figure A-21 at a gross weight of 73,575 pounds, and read cruise speed as 149 knots CAS, and engine settings as 2190 RPM and 35.8 in. MAP. Note carefully that these engine settings are only AVERAGE settings over this whole leg of the flight. In actual practice, use the procedure described earlier under Long Range Cruise Performance.

The gross weight at start of patrol equals 71,300 pounds. Assuming maximum range power settings during patrol also, enter curve for 1500-foot altitude on figure A-22 at 71,300 pounds and read distance of 1066 nautical miles to establish a starting point for determining fuel used during patrol. Re-enter curve at 1066 plus 200, or 1266 nautical miles, and read gross weight at end of patrol as 69,550 pounds. Enter curve for 1500-foot altitude on figure A-23 at 71,300 pounds and read time of 7.7 hours to establish a starting point for determining time spent on patrol. Re-enter curve at end gross weight of 69,550 pounds and read time of 9.1 hours. Time spent on patrol then equals 9.1 minus 7.7, or 1.5 hours. Fuel used is 71,300 minus 69,550 or 1750 pounds. Average gross weight during patrol equals 70,425 pounds. Enter curve for 1500-foot altitude on figure A-21 at a gross weight of 70,425 pounds and read cruise speed of 149 knots CAS, and engine settings as 2140 RPM and 35.1 in. MAP.

Gross weight at start of return cruise equals 69,550 pounds. Assume that engine failure occurs at this point. Do this in order to have enough fuel to return to base at the high fuel consumption rates associated with single-engine operation.

The first consideration of the pilot must be to compensate for the loss of power due to engine failure by immediately increasing power of the operating engine to military power. Next, the emergency procedures outlined in detail in Section III of Flight Handbook AN 01-35EJB-1, pertaining to shutdown of dead engine and feathering of propeller, should follow. The P5M-2 aircraft cannot maintain altitude on one engine at normal power at such high gross weights as stipulated in this sample problem. The increase in power of the operating engine to military power provides adequate control of the airplane while jettisoning weight to a level satisfactory for safe, sustained flight.

To determine the sustained flight operating weight limitation of the aircraft, enter curve for one engine operation on figure A-33 at 1500 feet altitude, normal rated power, standard day. Read maximum gross weight for maintaining 100 feet-per-minute rate of climb as 63,700 pounds, and for zero rate of climb as 68,450 pounds. Since the aircraft gross weight at this point is 69,550 pounds, or more than 1000 pounds heavier than the absolute minimum value for just maintaining altitude, and nearly 6000 pounds heavier than that required for maintaining service ceiling, it is obvious that normal power is insufficient for safe flight. Figure A-17 indicates that powers in excess of normal rated power may be applied continuously for *NO MORE THAN* 30 minutes; therefore, if a single-engine emergency occurs at gross weights higher than those listed above, a power schedule is given in figure A-26A for RPM settings above 2600 at specific gross weights. The aircraft, in this example, upon failure of one engine, is already at low altitude. Consequently, a further reduction in altitude is not advised to achieve the small gain in performance possible at a lower level.

Therefore, the next consideration is to jettison stores, equipment, or fuel to reduce weight quickly and sufficiently to maintain altitude and to allow adequate fuel to return to base. With proper fuel management in flight prior to this occurrence, the bomb bay fuel tank will have already been emptied of its contents by the engines consuming the fuel during the patrol mission. The tank itself, therefore, can be dropped from the one bomb bay, thus reducing weight by 445 pounds.

Note

It is recommended that the empty bomb bay tanks be retained for buoyancy if ditching is contemplated. Refer to figure A-26A for other equipment of equal weight which may be jettisoned in lieu of bomb bay tanks.

The dropping of the eight HVAR rockets will result in an additional weight reduction of 1120 pounds. While taking credit for effects of weight reduction on performance, no credit is taken for drag effects due to dropping external stores. Since fuel consumption for single-engine operation is substantially greater than for two-engine flight, it is inadvisable to jettison fuel, since at this stage of the sample flight, all available fuel may be needed for the return leg of the flight.

The jettisoning of the items enumerated above accounts for a total of 1565 pounds of weight dropped. Figure A-26A includes a list of additional droppable stores and equipment, together with their respective weights, which can be jettisoned in an emergency such as that described in this sample problem. Take note of the large weights of those several items which were listed above to be dropped, in contrast with the many lighter-weight items which would have to be dropped if a further reduction in weight were necessary. Flight crews should be made aware of the importance of quick reduction in weight of the aircraft as the most effective single emergency measure which can be performed by them when an engine failure occurs.

Before dropping any additional stores or equipment, calculate the effect of the above weight reduction on single-engine performance. The operating gross weight at start of return leg after weight reduction is equal to 69,550 minus 1565, or 67,985 pounds. From figure A-33 it can be seen that the aircraft will satisfactorily fly on one engine at altitude of 1500 feet under the following specific conditions:

a. Standard day, zero rate of climb, normal power (marginal)

b. Standard day, military power, over 200 fpm (good)

c. Navy Hot day, military power, over 100 fpm (satisfactory)

d. Navy Hot day, normal power-level flight at this gross weight is impossible

A 10-minute time increment was assumed to account for pilot computation and jettison operations. During this interval engine operation is above 2600 rpm.

To determine operating data for 10 minutes of the return trip, operating on one engine at settings above normal rated power, enter chart on figure A-26A at a gross weight of 67,985 pounds by interpolation between the listed values at 66,000 and 68,000 pounds. For 1500 feet altitude, read 2180 lbs/hr fuel used, or, in 10 minutes, 363 pounds of fuel consumed. Range is given as 23 nautical miles. True airspeed is 135 knots or, based on figure A-1, 133 knots calibrated airspeed (CAS). From the second column, climb potential is found to be 193 fpm, and power settings of 2700 rpm and 53.8 in. MAP pressure at start of reduced military power flight.

The gross weight at end of military power single-engine cruise is 67,985 minus 363 or 67,622 pounds. The distance remaining to base is 500 minus 23 or 477 nautical miles. Enter curve for 1500 feet altitude on figure A-30 at 67,622 pounds, and read distance of 357 nautical miles to establish a starting point for determining fuel used during return cruise at normal power. Re-enter curve at 357 plus 477 or 834 nautical miles and, at 1500 feet altitude, read gross weight at end of return cruise as 60,650 pounds. Enter curve for 1500 feet altitude on figure A-31 at 67,622 pounds, read time of 2.85 hours, and establish a starting point for determining time spent on return cruise. Re-enter curve at end gross weight of 60,650 pounds and read time of 6.55 hours. Time spent on return cruise at normal power then equals 3.7 hours. Fuel used is 67,622 minus 60,650, or 6972 pounds. Average gross weight during return cruise equals 64,136 pounds. Enter curve for 1500-foot altitude on figure A-29 at gross weight of 57,942 pounds; read cruise speed of 126 knots CAS, and engine settings as 2560 rpm and 49 in. MAP.

Gross weight at end of return cruise at altitude to base equals 60,650 pounds. The landing procedures for emergency operation are described in detail in Section III of Flight Handbook AN 01-35EJB-1. No weight reduction credit is taken for fuel used during descent from cruise altitude and for landing. Letdown procedures are likewise not considered, nor is any credit taken for distance flown or fuel used during landing operation.

Total time to fly mission from takeoff to landing may be broken down as follows:

Takeoff, climb at normal power to 1500 feet altitude (1.7 min.)	0.028 hours
Outward cruise, two engines, max. range power	3.3 hours
Patrol, max. range power, two engines	1.4 hours
Return cruise, military power, one engine	0.166 hours
Return cruise, maximum range power, one engine	3.7 hours
Descent and landing at home base	no credit taken
Total flight time of mission	8.6 hours

Mission covers a total distance of 1200 nautical miles, for an average mission flight speed of 141 knots.

Fuel used during entire flight equals airplane gross weight at start of flight minus gross weight at end of flight, less jettisoned load, or 76,630 minus 60,650 minus 1565. The total flight consumes 14,415 pounds of fuel in the following stages:

Warm-up, taxi, and takeoff	655 pounds
Climb to 1500 feet altitude	125 pounds
Cruise at maximum range power, two engines	4550 pounds
Patrol at maximum range power, two engines	1750 pounds
Cruise at reduced military power, one engine for 10 min.	363 pounds
Cruise at maximum range power, one engine for return	no credit taken
Total fuel consumed	14,415 pounds
Fuel carried on mission	20,302 pounds
Reserve fuel remaining at end of flight	5887 pounds

Fuel reserve equals fuel at start of flight minus fuel used during flight, or 5887 pounds. Fuel reserve is a variable factor in planning a flight. Actual planning and determination of fuel reserves should take into account the base commander's policy, weather conditions, availability of alternate bases, and other local conditions which cannot be investigated in a sample problem.

It should be noted here, however, that if the range to the mission patrol area in the problem just completed had been 250 nautical miles farther out to sea, all other conditions being the same as before, the entire 5887 pounds fuel reserve would have been dissipated. Below is a comparison of three missions which shows the delta performance due to engine failure at various points during similar ASW flights.

Mission I: This mission is the same mission as presented above in the sample problem. It includes an outward cruise of 500 miles on 2 engines, a patrol cruise of 200 miles on 2 engines, and a return flight of 500 miles on one engine. The stores dropped include an empty bomb bay tank and 8 rockets, making a total weight reduction of 1565 pounds.

Mission II: Mission II is identical to mission I except that there is no engine failure and no stores dropped.

Mission III: This mission has an outward cruise of 250 nautical miles on two engines, after which a single-engine emergency occurs. Assuming that the original base of operation is closed due to weather conditions, a single-engine flight is conducted for 950 nautical miles to the nearest alternate airbase. The stores dropped during this mission consist of ammunition, 1 torpedo, 36 sonobuoys, oxygen bottles, rockets, 54 marine markers, and 6 floatlights. The total weight of these items is 3943 pounds. Single-engine operation above 2600 rpm was used for 30 minutes in this mission.

	MISSION I 500 miles (2 engines) 200 miles (2 engines) 500 miles (1 engine)	MISSION II 500 miles (2 engines) 200 miles (2 engines) 500 miles (2 engines)	MISSION III 250 miles (2 engines) 950 miles (1 engine)
Takeoff Gross Weight	76,630 lb	76,630 lb	76,630 lb
Fuel on Board (Total)	20,302 lb	20,302 lb	20,302 lb
Fuel for Takeoff	655 lb	655 lb	655 lb
Climb Gross Weight	75,975 lb	75,975 lb	75,975 lb
Fuel to Climb	125 lb	125 lb	125 lb
Time to Climb	1.7 min.	1.7 min.	1.7 min.
Distance to Climb	4 miles	4 miles	4 miles
Cruise Gross Weight	75,850 lb	75,850 lb	75,850 lb
Fuel for Cruise	4550 lb	4550 lb	2350 lb
Distance for Cruise	496 miles	496 miles	246 miles
Time for Cruise	3.3 hours	3.3 hours	1.7 hours
Gross Weight for Patrol	71,300 lb	71,300 lb	
Fuel for Patrol	1750 lb	1750 lb	
Distance for Patrol	200 miles	200 miles	
Time for Patrol	1.4 hours	1.4 hours	
G.W. for Single Engine	69,550 lb		73,500 lb
G.W. for Service Ceiling @ NRP	63,700 lb		63,700 lb
G.W. for 0′/min. Ceiling @ NRP	68,450 lb		68,450 lb
Weight Jettisoned	1565 lb		3943 lb
Single Eng. Operation above 2600 RPM	10 min.		30 min.
Distance	23 miles	G.W. for 2 engines	70 miles
Fuel Used	363 lb	return cruise:	1185 lb
G.W. for Single Eng. Cruise	67,622 lb	69,550 lb	68,372 lb
Fuel Used	6972 lb	4150 lb	12,022 lb
Distance	477 miles	500 miles	880 miles
Time for Return Cruise	3.7 hours	3.35 hours	6.95 hours
Total Fuel Used	14,415 lb	11,230 lb	16,337 lb
Total Time	8.6 hours	8.1 hours	9.2 hours
Total Distance	1,200 miles	1,200 miles	1,200 miles
Reserve Fuel	5887 lb	9072 lb	3965 lb
Extended Distance to consume all reserve fuel	495 miles	1170 miles	353 miles

AIRSPEED INSTALLATION CORRECTION TABLE

MODEL: P5M-2

ENGINES: (2) R-3350-32W

FLAPS UP ADD CORRECTION TO CORRECTED INSTRUMENT READING TO OBTAIN CAS			FLAPS DOWN ADD CORRECTION TO CORRECTED INSTRUMENT READING TO OBTAIN CAS		
IAS (KNOTS)	CORRECTIONS (KNOTS)		IAS (KNOTS)	CORRECTIONS (KNOTS)	
	PILOT'S	COPILOT'S		PILOT'S	COPILOT'S
120	+2.0	+2.5	100	+4.0	+5.0
140	+2.0	+3.5	110	+3.5	+5.0
160	+2.0	+3.5	120	+3.0	+5.5
180	+2.5	+3.5	130	+2.5	+5.5
200	+2.5	+3.5	140	+2.0	+5.5
220	+2.5	+3.0			

DATA AS OF: 1 DECEMBER 1956

DATA BASIS: PILOT'S CORRECTION—FLIGHT TEST

COPILOT'S CORRECTION—ESTIMATED

21064

Figure A-3. Airpseed Installation Correction Table

DENSITY ALTITUDE CHART

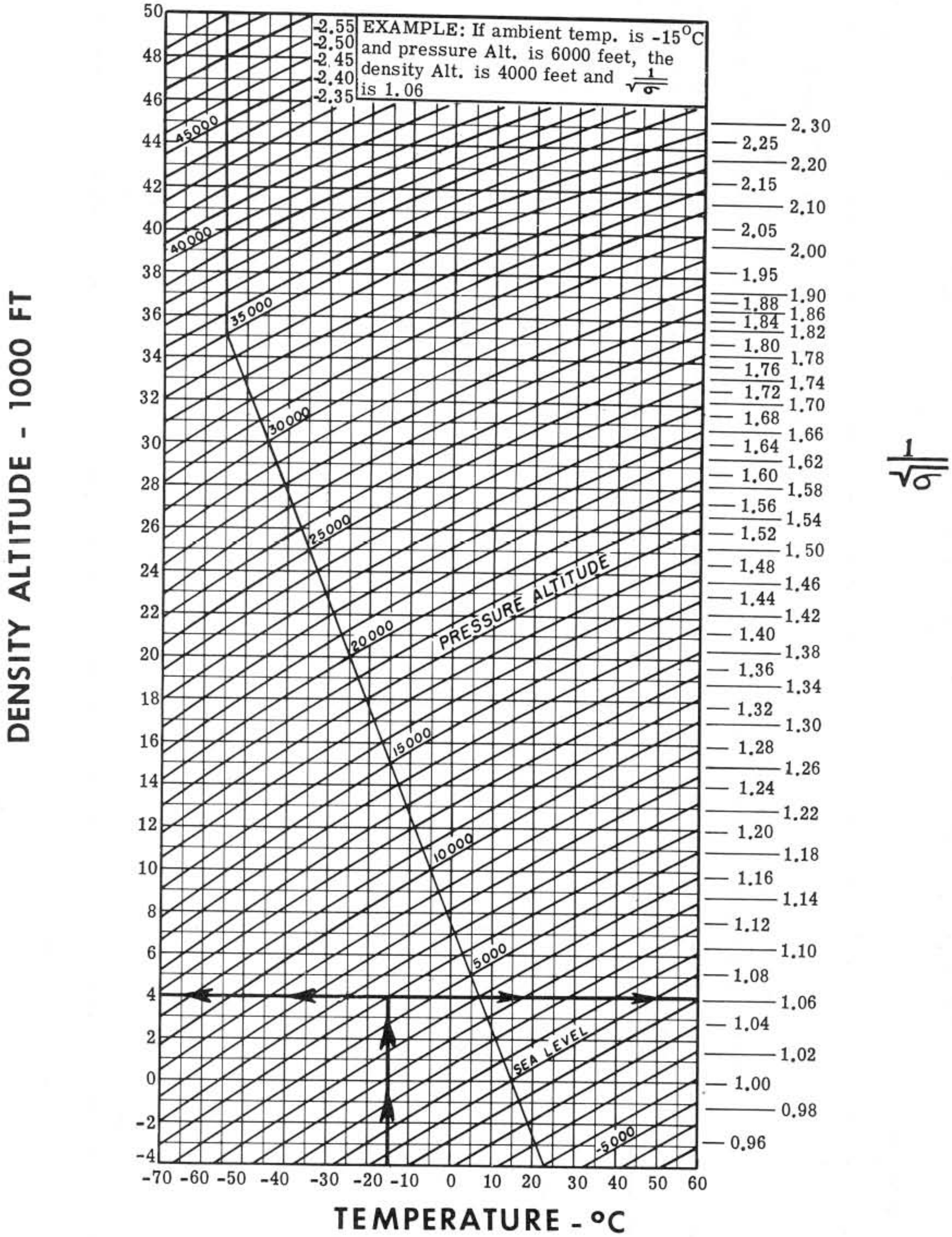


Figure A-4. Density Altitude Chart

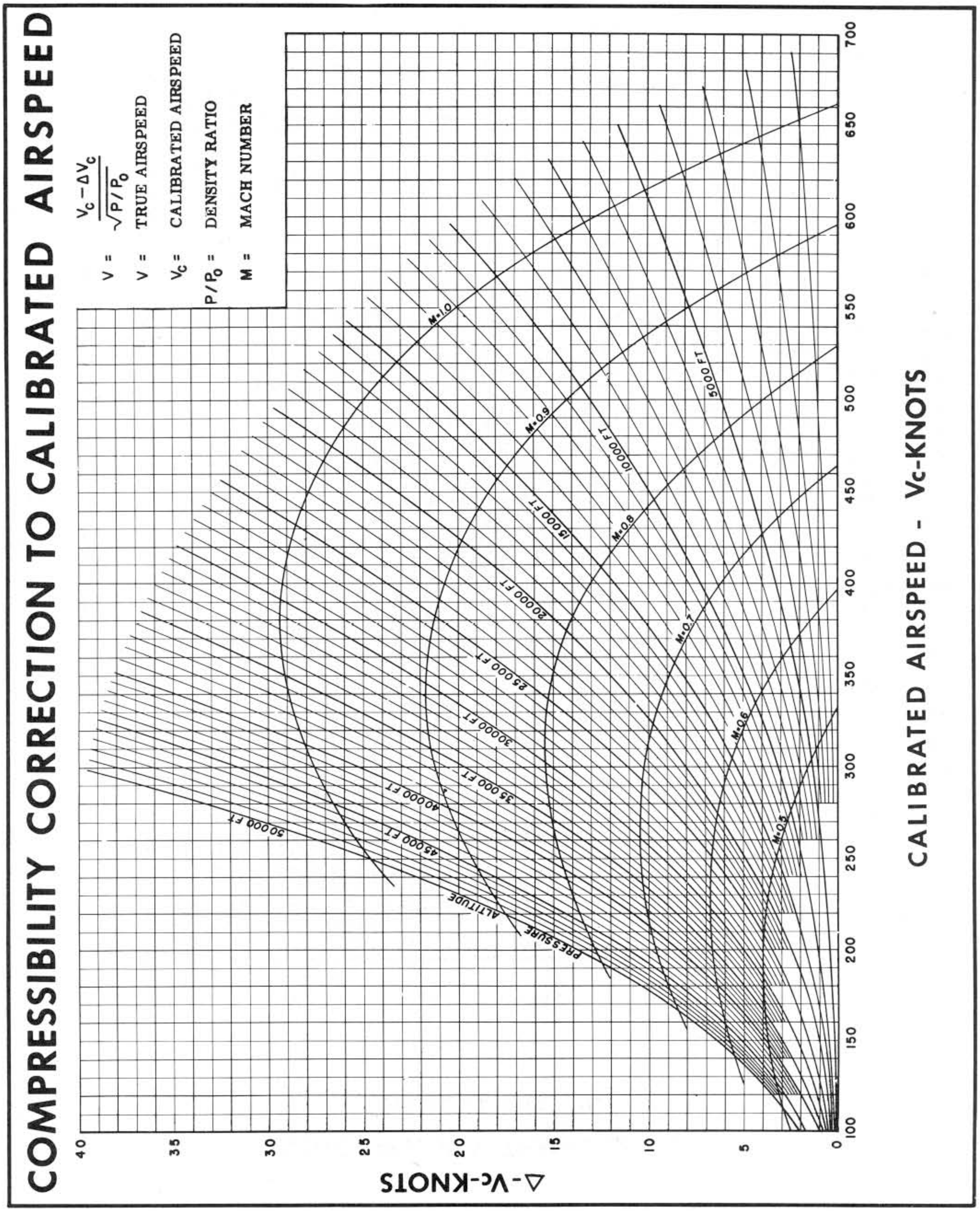


Figure A–4A. Airspeed Compressibility Correction

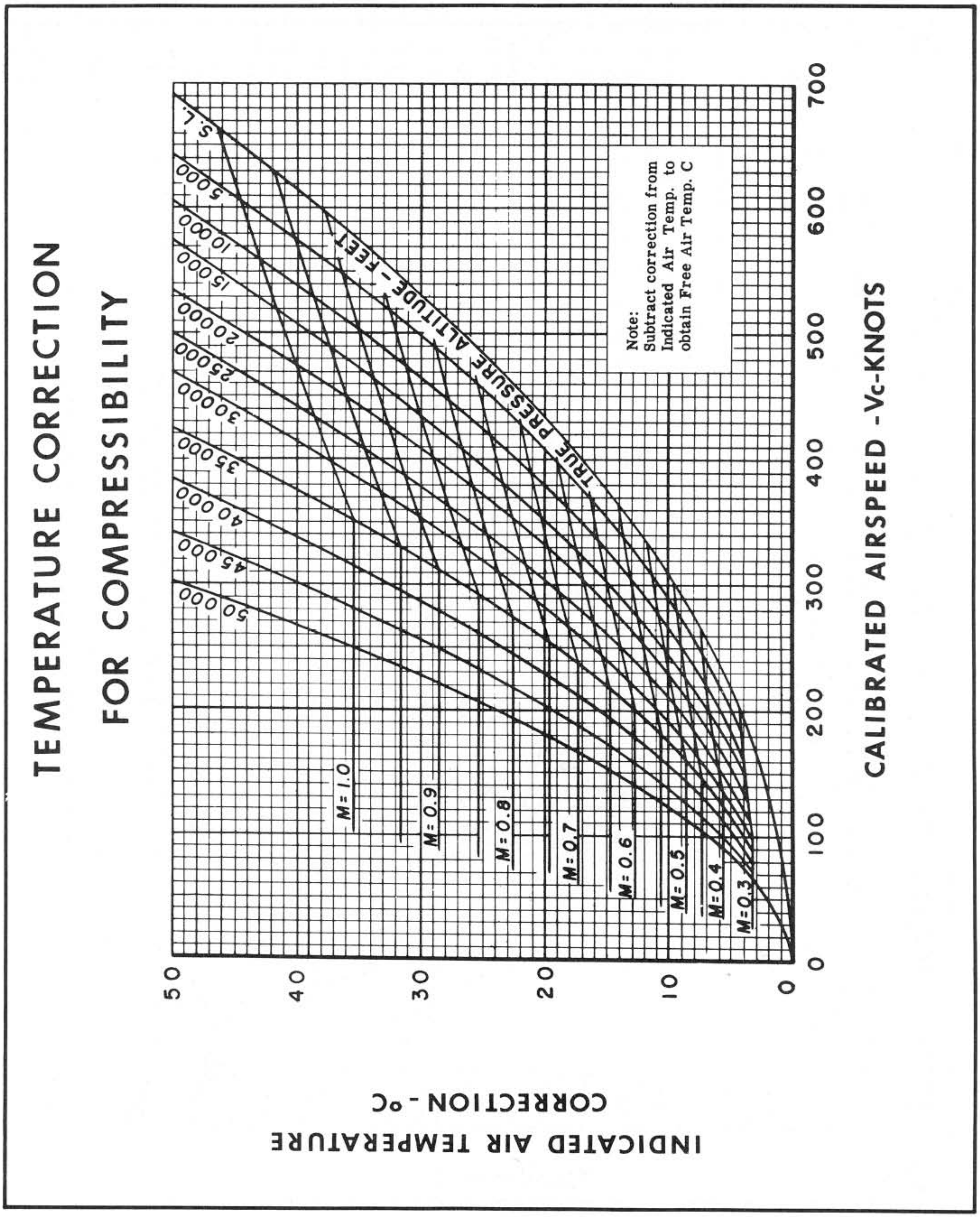
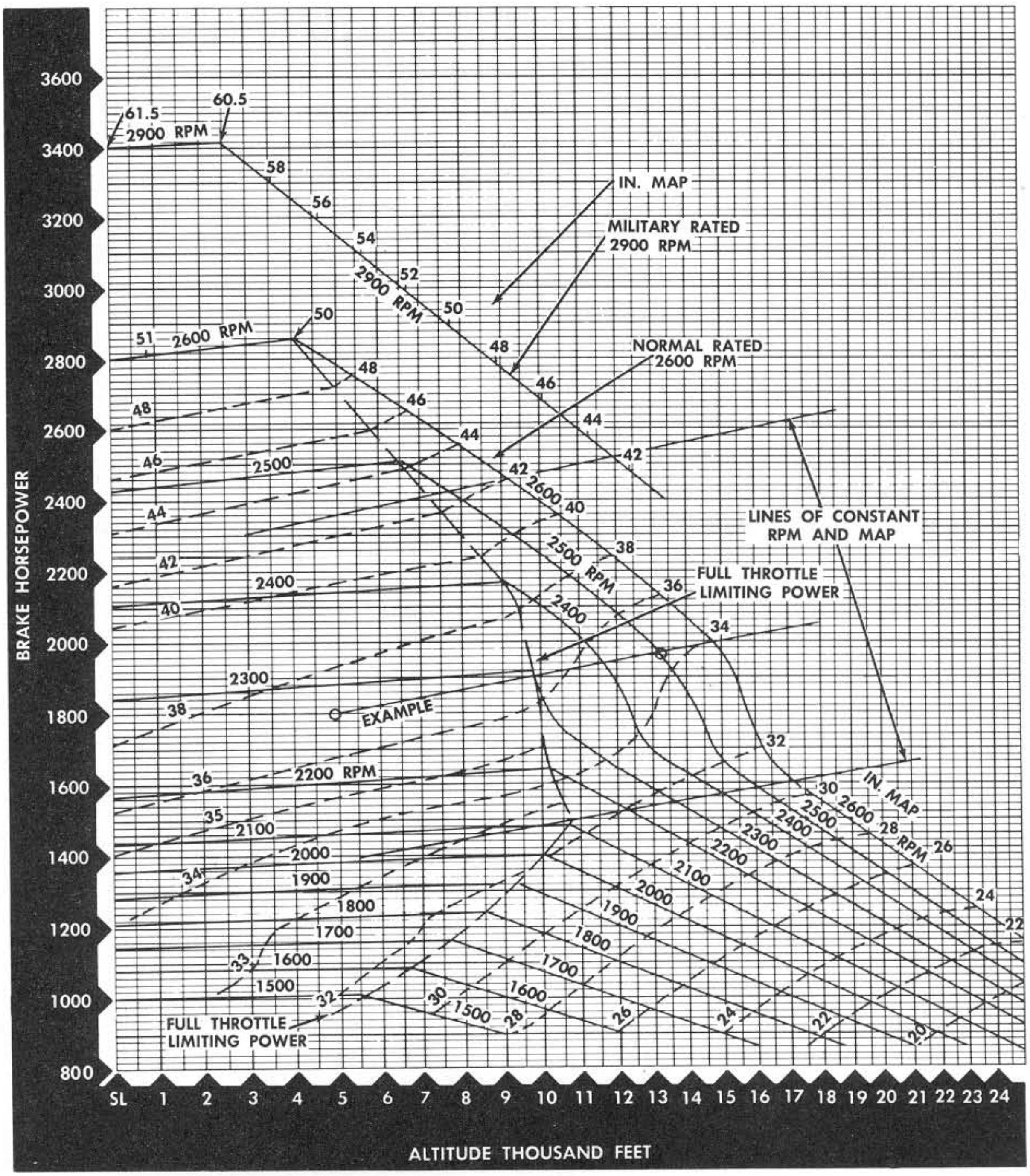


Figure A-4B. Temperature Correction for Compressibility

ENGINE OPERATING LIMIT CURVE

MODEL: P5M-2 | LOW BLOWER | ENGINES: (2) R3350-32W



DATA AS OF: 12 MAY 1954
DATA BASIS: WAC REPORT, SP-2011

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL
21065

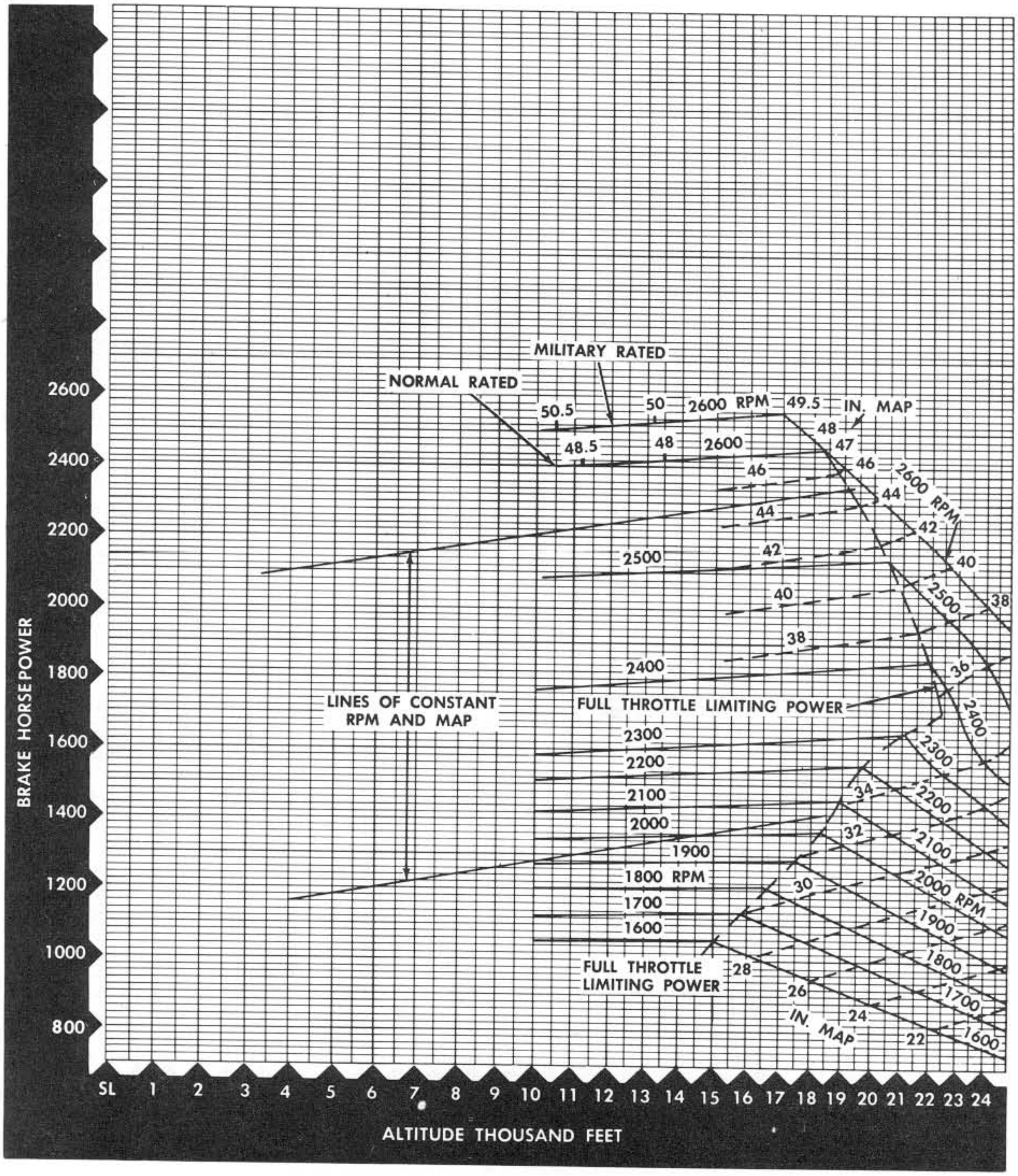
Figure A-5. Engine Operating Limit Curve—(Low Blower)

ENGINE OPERATING LIMIT CURVE

HIGH BLOWER

MODEL: P5M-2

ENGINES: (2) R3350-32W



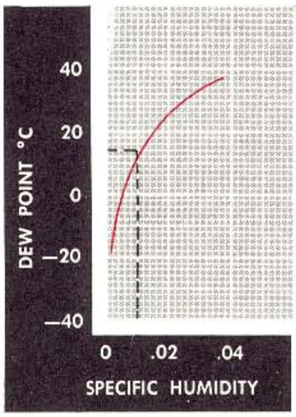
DATA AS OF: 12 MAY 1954
DATA BASIS: WAC REPORT, SP-2012

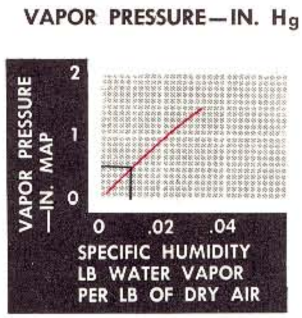
FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL
21066

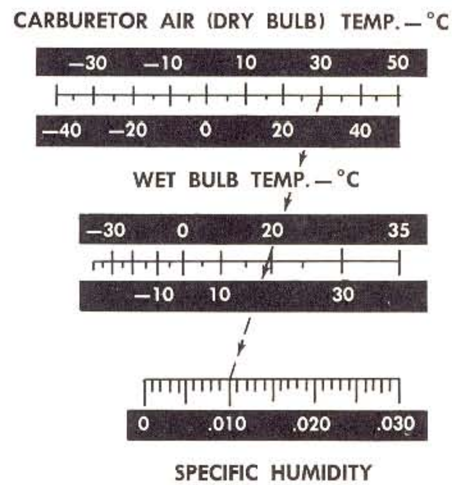
Figure A-6. Engine Operating Limit Curve—(High Blower)

HUMIDITY CORRECTION FOR TAKEOFF POWER SETTING

MODEL: P5M-2 **SEA LEVEL** **ENGINES: (2) R3350-32W**







1. SPECIFIC HUMIDITY:

If dew point of bulb temperatures are known, read specific humidity from appropriate curve above.

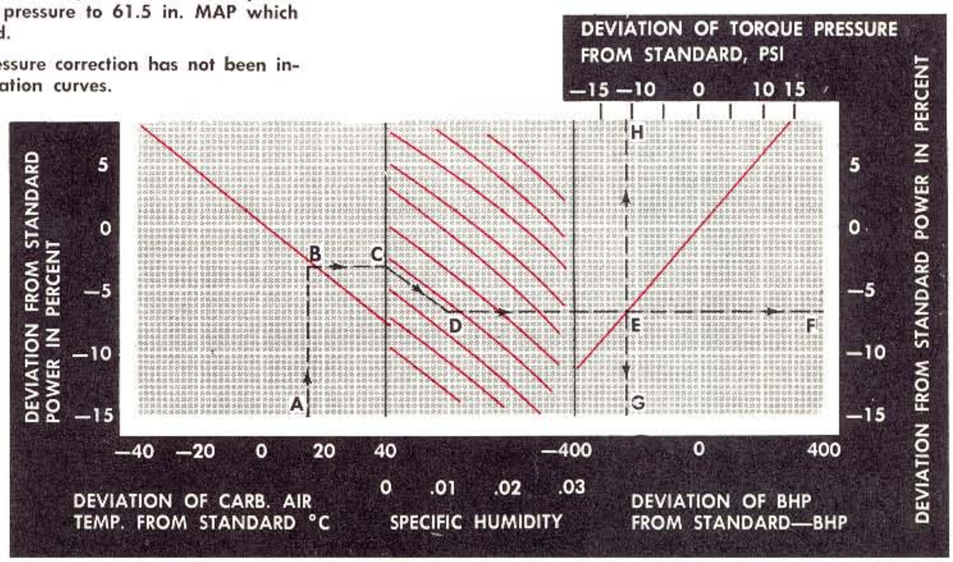
2. POWER DEVIATION:

With a carburetor air temperature (dry bulb temperature) of 30°C (86°F) and above, and specific humidity of .010 lb water vapor per lb of dry air, read power loss of 6.8% (221 BHP/or —10.8 psi torque pressure).

3. VAPOR PRESSURE CORRECTION:

Limit manifold pressures may be increased by the amount of the vapor pressure to 61.5 in. MAP which must not be exceeded.

NOTE: This vapor pressure correction has not been included in power deviation curves.



DATA AS OF: 26 MARCH 1954
DATA BASIS: ESTIMATED

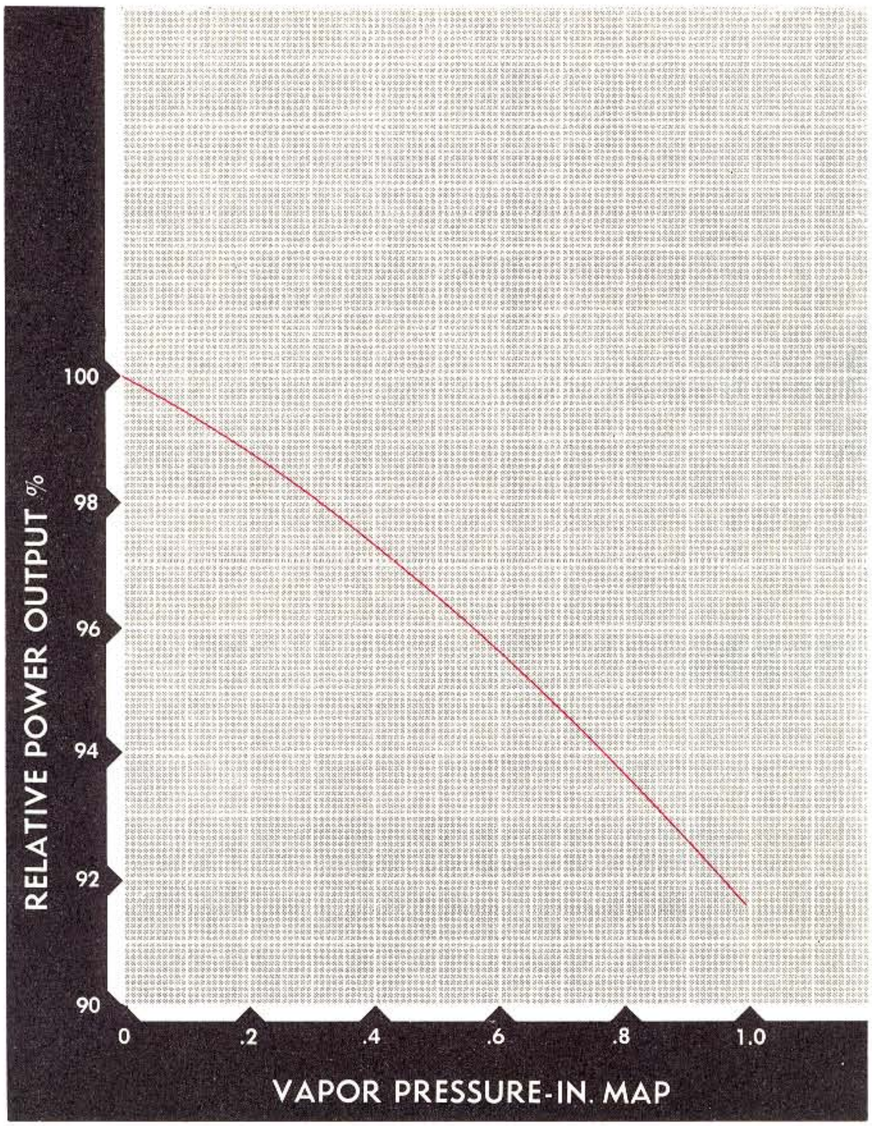
FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21067

Figure A-7. Humidity Correction for Takeoff

EFFECT OF HUMIDITY ON BHP AT CONSTANT RPM AND MAP

MODEL: P5M-2 | Standard Day | ENGINES: (2) R3350-32W



REMARKS:

For use at any altitude

DATA AS OF: 1 JUNE 1955
DATA BASIS: ESTIMATED

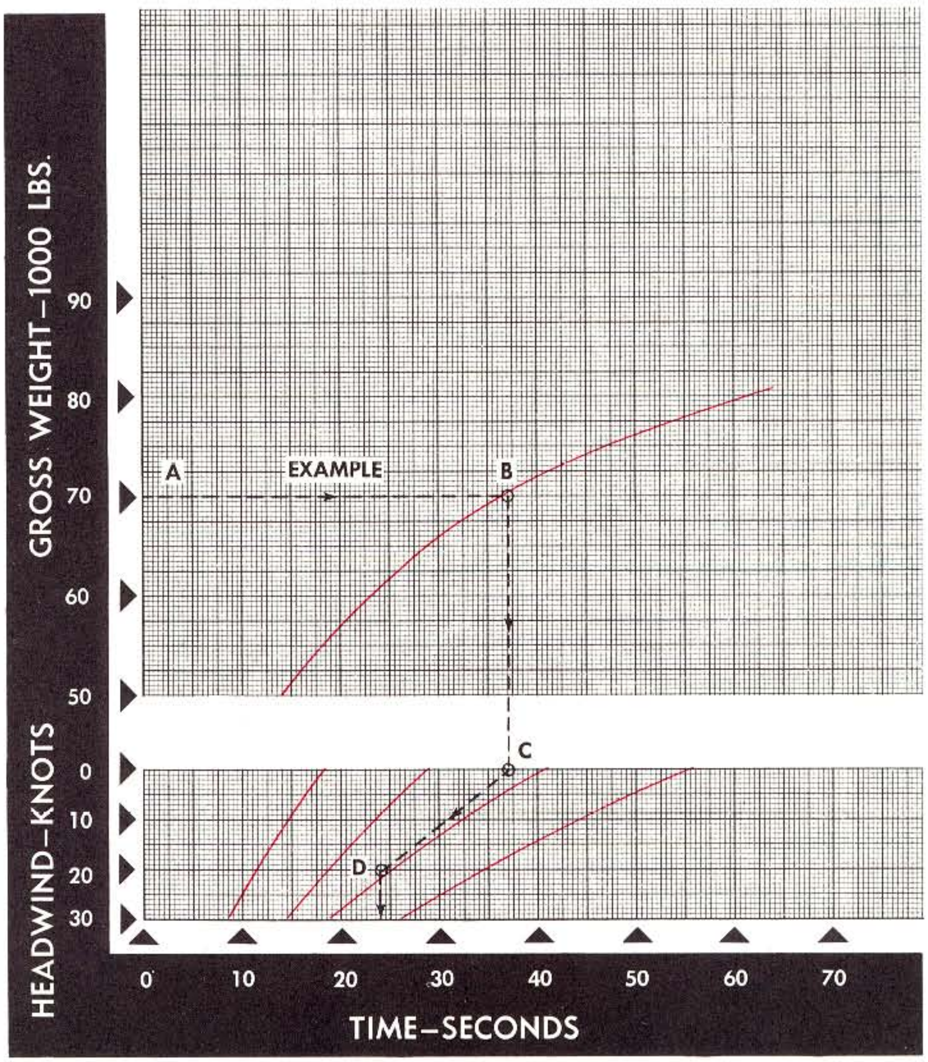
FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21069

Figure A–7A. Effect of Humidity on BHP

TAKEOFF CURVE
TIME IN SECONDS

MODEL: P5M-2 Standard Day ENGINES: (2) R3350-32W



REMARKS: Takeoff power setting: 3400 BHP, 2900 RPM, and 61.5 in. MAP.
Above curves are for optimum sea conditions.

DATA AS OF: 26 FEBRUARY 1954
DATA BASIS: ESTIMATED

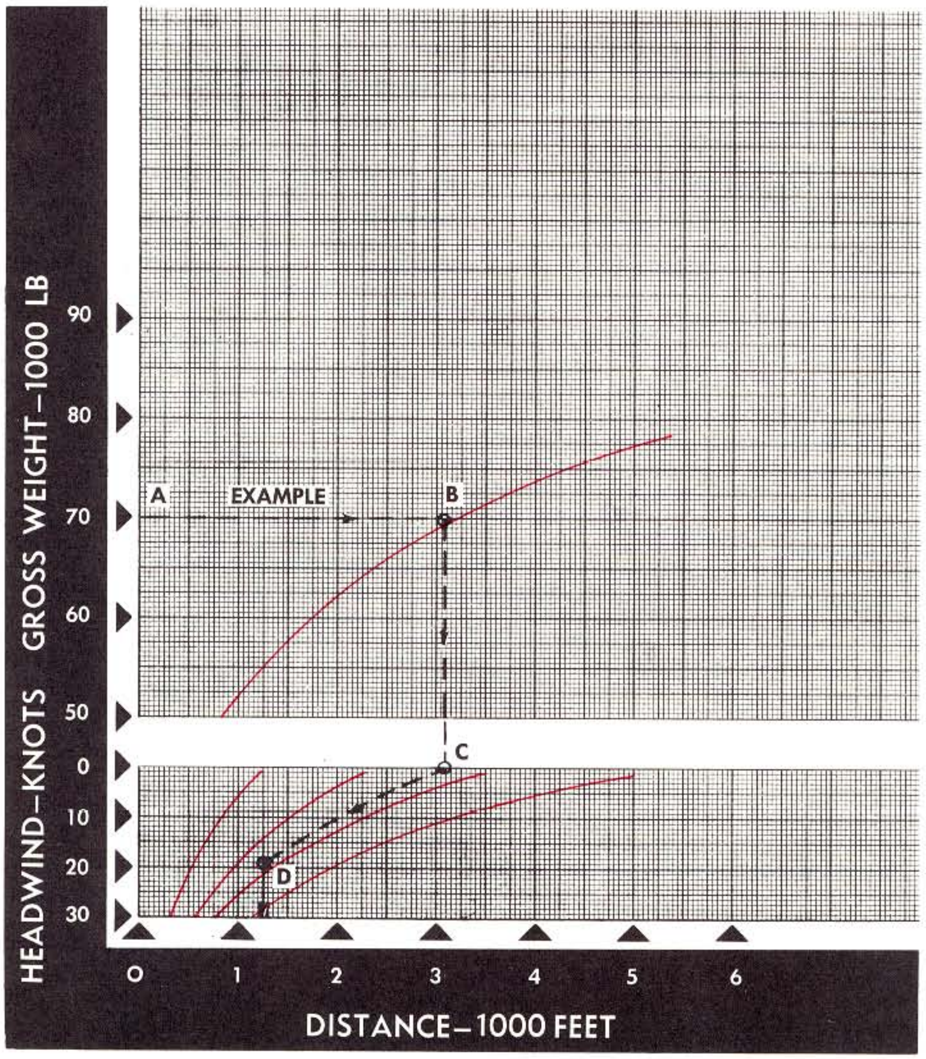
FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21070

Figure A–8. Takeoff Curve—Time

TAKEOFF CURVE DISTANCE IN FEET

MODEL: P5M-2 Standard Day ENGINES: (2) R3350-32W



REMARKS: Takeoff power setting: 3400 BHP, 2900 RPM, and 61.5 IN. MAP.
Above curves are for optimum sea conditions.

DATA AS OF: 26 FEBRUARY 1954
DATA BASIS: ESTIMATED

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21071

Figure A-9. Takeoff Curve—Distance

P5M-2 JATO FIRING CHART

FOUR 1000LB 15KS1000 JATO BOTTLES

SEA LEVEL — STANDARD AND HOT DAY

AIRCRAFT GROSS WEIGHT POUNDS	OUTSIDE AIR TEMP.	ZERO HEADWIND				10-KNOT HEADWIND				20-KNOT HEADWIND				30-KNOT HEADWIND			
		FIRST TWO		NEXT TWO		FIRST TWO		NEXT TWO		FIRST TWO		NEXT TWO		FIRST TWO		NEXT TWO	
		TIME SEC	IAS KNOTS	TIME SEC	IAS KNOTS	TIME SEC	IAS KNOTS	TIME SEC	IAS KNOTS	TIME SEC	IAS KNOTS	TIME SEC	IAS KNOTS	TIME SEC	IAS KNOTS	TIME SEC	IAS KNOTS
60000	STD	4	18	4	18	1	16	1	16	0	20	0	20	0	30	0	30
	HOT	6	24	6	24	3	25	3	25	0	22	0	22	0	30	0	30
62000	STD	6	25	6	25	3	25	3	25	0	20	0	20	0	30	0	30
	HOT	6	24	9	35	5	31	5	31	2	30	2	30	0	30	0	30
64000	STD	6	23	9	32	5	30	5	30	2	29	2	29	0	30	0	30
	HOT	6	23	12	39	6	32	8	37	4	36	4	36	0	30	0	30
66000	STD	5	21	11	38	7	36	7	36	3	34	3	34	0	30	0	30
	HOT	6	23	8	45	5	30	9	42	6	41	6	41	2	39	2	39
68000	STD	6	23	14	44	7	35	9	41	4	37	4	37	0	30	0	30
	HOT	6	23	18	55	6	32	12	48	5	39	7	45	2	40	2	40
70000	STD	7	23	16	45	6	31	11	44	5	38	5	38	1	35	1	35
	HOT	8	24	21	52	7	33	15	51	9	45	9	45	4	45	4	45
72000	STD	7	23	19	51	5	28	12	49	6	40	6	40	2	39	2	39
	HOT	8	24	22	54	7	33	19	59	6	39	11	51	5	48	5	48
74000	STD	7	23	22	57	8	36	15	53	6	40	8	46	3	42	3	42
	HOT	8	24	26	58	7	33	21	63	6	39	13	56	7	51	7	51
76000	STD	9	26	26	55	8	33	18	53	7	41	10	47	5	46	5	46
	HOT	10	24	33	59	12	38	25	60	9	43	16	56	9	54	9	54
78000	STD	9	26	24	52	7	31	22	62	7	41	16	59	8	53	8	53
	HOT	9	23	30	55	12	38	26	61	9	43	21	66	9	54	13	61

NOTE: INITIATE JATO UNITS IN PAIRS AT NUMBER OF SECONDS AFTER FULL THROTTLE IS APPLIED, OR AT INDICATED AIRSPEED, AS DETERMINED FROM ABOVE CHART.—STANDARD DAY 15°C (59°F). HOT DAY 32°C (89.6°F).

DATA AS OF: 12-15-55 — DATA BASIS: ESTIMATED

21120

Figure A–9A. Jato Firing Chart

SEAPLANE TAKEOFF CHART

30° FLAPS SHELTERED WATER

SEA LEVEL

MODEL: P5M-2 **ALL CONFIGURATIONS** **ENGINES: (2) R-3350-32W**

GROSS WEIGHT	−5°C				+15°C				+35°C				+55°C			
	ZERO WIND		30 KT WIND		ZERO WIND		30 KT WIND		ZERO WIND		30 KT WIND		ZERO WIND		30 KT WIND	
	TIME (SEC)	DIST (FT)	TIME (SEC)	DIST (FT)	TIME (SEC)	DIST (FT)	TIME (SEC)	DIST (FT)	TIME (SEC)	DIST (FT)	TIME (SEC)	DIST (FT)	TIME (SEC)	DIST (FT)	TIME (SEC)	DIST (FT)
78,000	50	3780	23	1040	57	5000	27	1150	78	6460	33	1680	113	9240	38	2120
72,000	37	2600	18	710	42	3500	20	750	53	4250	24	1120	64	5560	27	1320
66,000	28	1800	14	510	31	3400	16	600	39	2840	18	780	46	3600	20	870
60,000	21	1290	11	380	24	1700	12	500	29	1990	13	550	33	2420	15	600
54,000	17	980	8	280	19	1150	9	275	21	1380	10	390	25	1690	11	410

REMARKS:

Takeoff times and distances are based upon normal service conditions and techniques.

NOTE: 1. The above data are for dry air. At a gross weight of 78,000 lb for each .01 of specific humidity, the takeoff will increase by approximatey 5 seconds and the takeoff distance by approximately 400 feet. At lighter weights, the corrections will be less.

2. When takeoff power is decreased 100 BHP, takeoff time and distance increase 4.5 seconds and 260 feet at 78,000 lb gross weight, and 1 second and 40 feet at 55,000 lb gross weight. Further decreases in power at high gross weights are to be avoided, since they result in drastic increases in distance required for takeoff.

DATA AS OF: 26 FEBRUARY 1954
DATA BASIS: ESTIMATED

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21068

Figure A-9B. Seaplane Takeoff Chart

CLIMB CHART FOR MAXIMUM CRUISE POWER
2200 RPM

MODEL: P5M-2 **STANDARD DAY** **ENGINES: (2) R-3350-32W**

CONFIGURATION: ASW WEIGHT: 72,000 LB							CONFIGURATION: ASW WEIGHT: 66,000 LB					
APPROXIMATE				MAP In. Hg	CAS Knots	PRESSURE ALTITUDE Feet	CAS Knots	MAP In. Hg	APPROXIMATE			
RATE(3) OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE(3) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	
140	0	0	655(2)	36.5	124	S.L.	120	36.5	655(2)	0	0	270
96	92	43	1707	35.4	123	5,000	118.5	35.4	1140	19.8	40.8	232
						10,000	117.5	34.4	1687	43.2	92.4	196

CONFIGURATION: ASW WEIGHT: 60,000 LB							CONFIGURATION: ASW WEIGHT: 54,000 LB					
APPROXIMATE				MAP In. Hg	CAS Knots	PRESSURE ALTITUDE Feet	CAS Knots	MAP In. Hg	APPROXIMATE			
RATE(3) OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE(3) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	
418	0	0	655(2)	36.5	116	S.L.	110	36.5	655(2)	0	0	590
387	24.8	12.4	959	35.4	114.5	5,000	109.5	35.4	861	8.4	16	561
352	53.8	26.0	1278	34.4	113.2	10,000	109.5	34.4	1077	17.6	34.8	535
193	102.3	47.4	1775	35.1(1)	112	15,000	109.2	35.1(1)	1351	29.4	61.0	372

CONFIGURATION: WEIGHT:							CONFIGURATION: WEIGHT:					
APPROXIMATE				MAP In. Hg	CAS Knots	PRESSURE ALTITUDE Feet	CAS Knots	MAP In. Hg	APPROXIMATE			
RATE(3) OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE(3) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	

REMARKS:

(1) Shift to HIGH BLOWER at 12,000 ft.
(2) Taxi and takeoff fuel allowance is 655 lb.
(3) For each 10°C hotter than standard, subtract 30 fpm rate of climb. For each 10°C colder than standard, add 30 fpm rate of climb.

RATE OF CLIMB: feet per minute
DISTANCE: nautical miles
TIME: minutes
FUEL: pounds 2 engines
CAS: calibrated airspeed
MAP: manifold absolute pressure
FT: full throttle

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21072

Figure A-9C. Climb Chart for Maximum Cruise Power

CLIMB CHART FOR NORMAL RATED POWER
2600 RPM

MODEL: P5M-2 **STANDARD DAY** **ENGINES: (2) R-3350-32W**

CONFIGURATION: ASW WEIGHT: 78,000 LB												CONFIGURATION: ASW WEIGHT: 72,000 LB
APPROXIMATE				MAP In. Hg	CAS Knots	PRESSURE ALTITUDE Feet	CAS Knots	MAP In. Hg	APPROXIMATE			
RATE(3) OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE(3) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	
730	0	0	655(2)	51	134.6	S.L.	130.6	51.0	655(2)	0	0	890
645	16.1	6.9	1106	48.6	132.4	5,000	129	48.6	1016	5.5	12.5	810
345	41.7	17.4	1711	48.5(1)	128.1	10,000	126.2	48.5(1)	1477	13.3	31.0	500
225	87.7	35.1	2691	47.6(1)	126.5	15,000	123.1	47.6(1)	2107	24.7	59.8	380

CONFIGURATION: ASW WEIGHT: 66,000 LB												CONFIGURATION: ASW WEIGHT: 60,000 LB
APPROXIMATE				MAP In. Hg	CAS Knots	PRESSURE ALTITUDE Feet	CAS Knots	MAP In. Hg	APPROXIMATE			
RATE(3) OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE(3) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	
1080	0	0	655(2)	51	127	S.L.	123.6	51	655(2)	0	0	1300
1000	10.3	4.7	962	48.6	125.4	5,000	121.8	48.6	916	4.0	8.6	1210
685	24.2	10.7	1310	48.5(1)	122.7	10,000	119.2	48.5(1)	1196	8.8	19.4	880
565	43.8	18.7	1750	47.6(1)	119.6	15,000	116.0	47.6(1)	1536	15.0	34.0	760
370	70.0	28.9	2306	FT(1)	115.6	20,000	112.1	FT(1)	1932	22.3	52.2	570

CONFIGURATION: ASW WEIGHT: 54,000 LB												CONFIGURATION: ASW WEIGHT:
APPROXIMATE				MAP In. Hg	CAS Knots	PRESSURE ALTITUDE Feet	CAS Knots	MAP In. Hg	APPROXIMATE			
RATE(3) OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE(3) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	
1550	0	0	655(2)	51	119.5	S.L.						
1465	6.9	3.3	872	48.6	118.1	5,000						
1115	15.4	7.2	1097	48.5(1)	115.8	10,000						
1005	26.3	12.0	1359	47.6(1)	112.9	15,000						
810	39.4	17.3	1652	FT(1)	109.7	20,000						

REMARKS:

(1) Shift to HIGH BLOWER at 10,000 ft.
(2) Taxi and takeoff fuel allowance is 655 lb.
(3) For each 10°C hotter than standard temperature, subtract 40 fpm rate of climb. For each 10°C colder than standard, add 40 fpm rate of climb.

RATE OF CLIMB: feet per minute
DISTANCE: nautical miles
TIME: minutes
FUEL: pounds 2 engines
CAS: calibrated airspeed
MAP: manifold absolute pressure
FT: full throttle

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21073

Figure A-9D. Climb Chart for Normal Rated Power

CLIMB CHART FOR MILITARY RATED POWER

2900 RPM

MODEL: P5M-2 **STANDARD DAY** **ENGINES: (2) R-3350-32W**

CONFIGURATION: ASW WEIGHT: 78,000 LB											CONFIGURATION: ASW WEIGHT: 72,000 LB	
	APPROXIMATE			MAP	CAS	PRESSURE ALTITUDE	CAS	MAP	APPROXIMATE			
RATE(3) OF CLIMB	FROM SEA LEVEL			In. Hg	Knots	Feet	Knots	In. Hg	FROM SEA LEVEL			RATE(3) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	
1070	0	0	655(2)	61.5	136.0	S.L.	133.0	61.5	655(2)	0	0	1250
860	12.0	4.8	1155	56.0	134.0	5,000	131.0	56.0	1042	4.8	11.0	1040
510	31.0	12.2	1580	46.0(1)	130.5	10,000	127.5	46.0(1)	1441	10.8	25.4	670
285	58.5	26.1	2431	49.5(1)	127.0	15,000	124.0	49.5(1)	2044	20.4	50.0	440
						20,000	119.5	FT(1)	2917	36.0	91.7	190

CONFIGURATION: ASW WEIGHT: 66,000 LB											CONFIGURATION: ASW WEIGHT: 60,000 LB	
	APPROXIMATE			MAP	CAS	PRESSURE ALTITUDE	CAS	MAP	APPROXIMATE			
RATE(3) OF CLIMB	FROM SEA LEVEL			In. Hg	Knots	Feet	Knots	In. Hg	FROM SEA LEVEL			RATE(3) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	
1475	0	0	655(2)	61.5	129.0	S.L.	125	61.5	655(2)	0	0	1720
1250	7.9	3.6	940	56.0	126.0	5,000	123	56.0	899	3.0	6.6	1490
855	19.1	8.4	1261	46.0(1)	123.0	10,000	120	46.0(1)	1161	7.0	15.4	1080
625	36.5	15.5	1704	49.5(1)	119.5	15,000	116	49.5(1)	1504	12.4	28.4	835
370	61.8	25.3	2255	FT(1)	115.5	20,000	112	FT(1)	1894	19.4	45.7	570

CONFIGURATION: ASW WEIGHT: 54,000 LB											CONFIGURATION: ASW WEIGHT:	
	APPROXIMATE			MAP	CAS	PRESSURE ALTITUDE	CAS	MAP	APPROXIMATE			
RATE(3) OF CLIMB	FROM SEA LEVEL			In. Hg	Knots	Feet	Knots	In. Hg	FROM SEA LEVEL			RATE(3) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	
2020	0	0	655(2)	61.5	122.0	S.L.						
1770	5.4	2.6	861	56.0	120.0	5,000						
1340	12.5	5.8	1076	46.0(1)	117.0	10,000						
1075	22.4	10.0	1342	49.5(1)	113.5	15,000						
810	34.9	15.1	1632	FT(1)	109.0	20,000						

REMARKS:

(1) Shift to HIGH BLOWER at 12,000 ft.

(2) Taxi and takeoff fuel allowance is 655 lb.

(3) For each 10°C hotter than standard, subtract 50 fpm rate of climb. For each 10°C colder than standard, add 50 fpm rate of climb.

RATE OF CLIMB: feet per minute
DISTANCE: nautical miles
TIME: minutes
FUEL: pounds 2 engines
CAS: calibrated airspeed
MAP: manifold absolute pressure
FT: full throttle

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21074

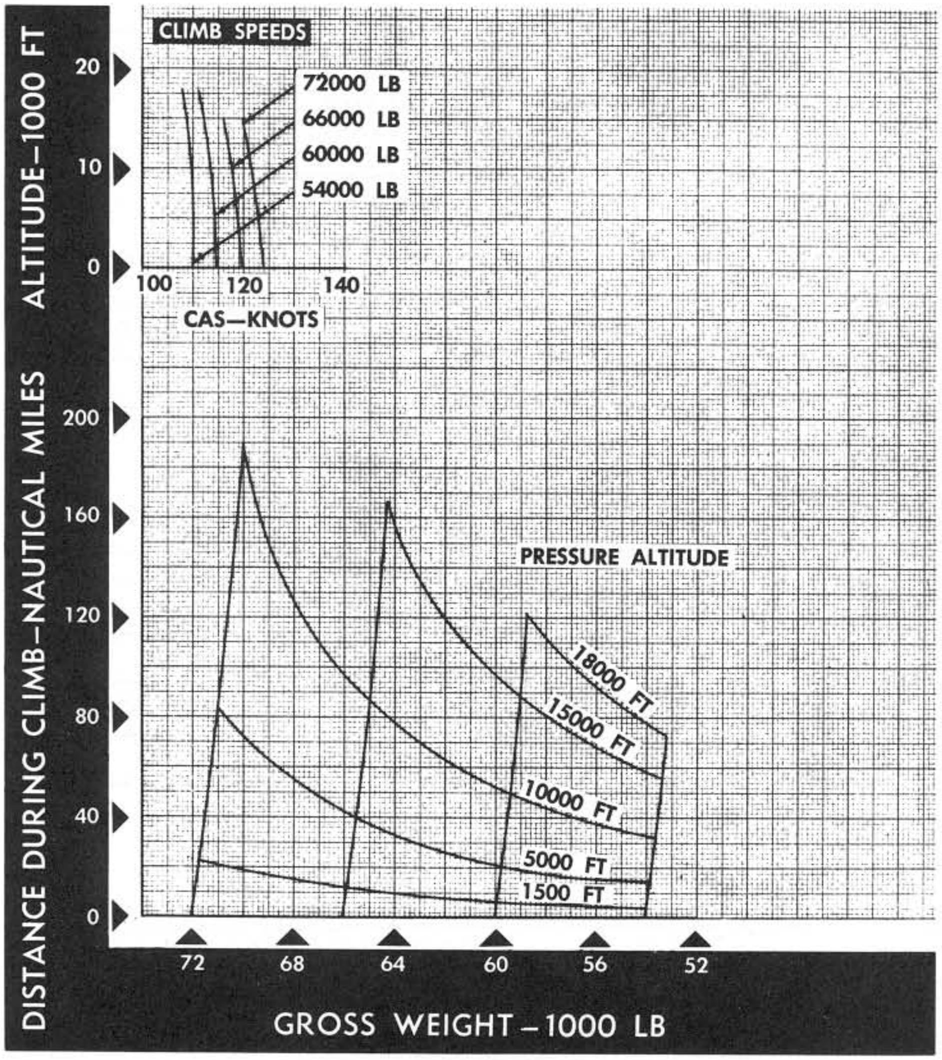
Figure A-9E. Climb Chart for Military Rated Power

CLIMB CURVE—DISTANCE AND FUEL

MAXIMUM CRUISE POWER

ASW LOADING

MODEL: P5M-2 | Standard Day | ENGINES: (2) R3350-32W



REMARKS: Obtain equivalent gross weight for climb determination by adding 180 lb to actual airplane weight for each 1°C hotter than standard and by subtracting 180 lb for each 1°C colder than standard.

Deduct 655 lb from initial gross weight for taxi and takeoff allowance.

DATA AS OF: 1 DECEMBER 1956

DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145

FUEL DENSITY: 6.0 LB/US GAL

21075

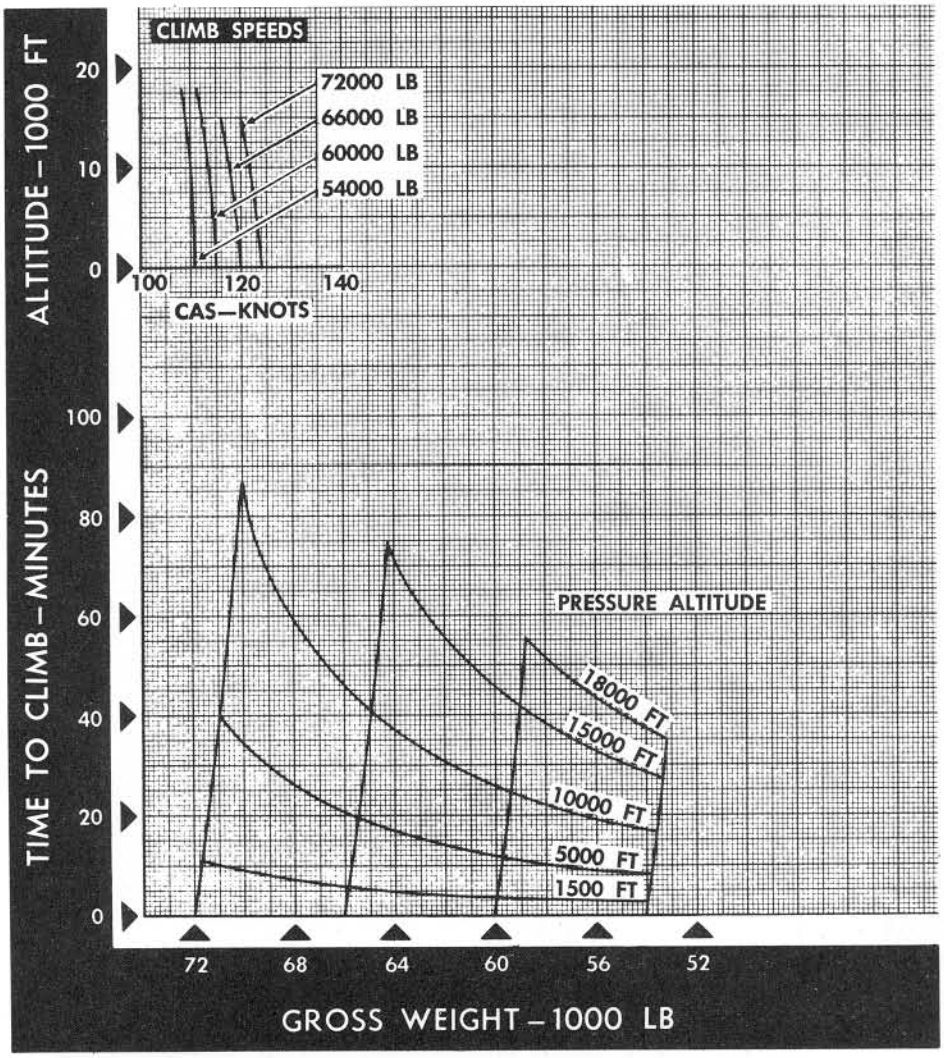
Figure A-10. Climb Curve—Distance and Fuel—Maximum Cruise Power

CLIMB CURVE–TIME

MAXIMUM CRUISE POWER

ASW LOADING

MODEL: P5M-2 **Standard Day** **ENGINES: (2) R3350-32W**



REMARKS: Obtain equivalent gross weight for climb determination by adding 180 lb to actual airplane weight for each 1°C hotter than standard and by subtracting 180 lb for each 1°C colder than standard.

Deduct 655 lb from initial gross weight for taxi and takeoff allowance.

DATA AS OF: 1 DECEMBER 1956 **FUEL GRADE: 115/145**

DATA BASIS: FLIGHT TEST **FUEL DENSITY: 6.0 LB/US GAL**

21076

Figure A–11. Climb Curve—Time—Maximum Cruise Power

CLIMB CURVE–DISTANCE AND FUEL

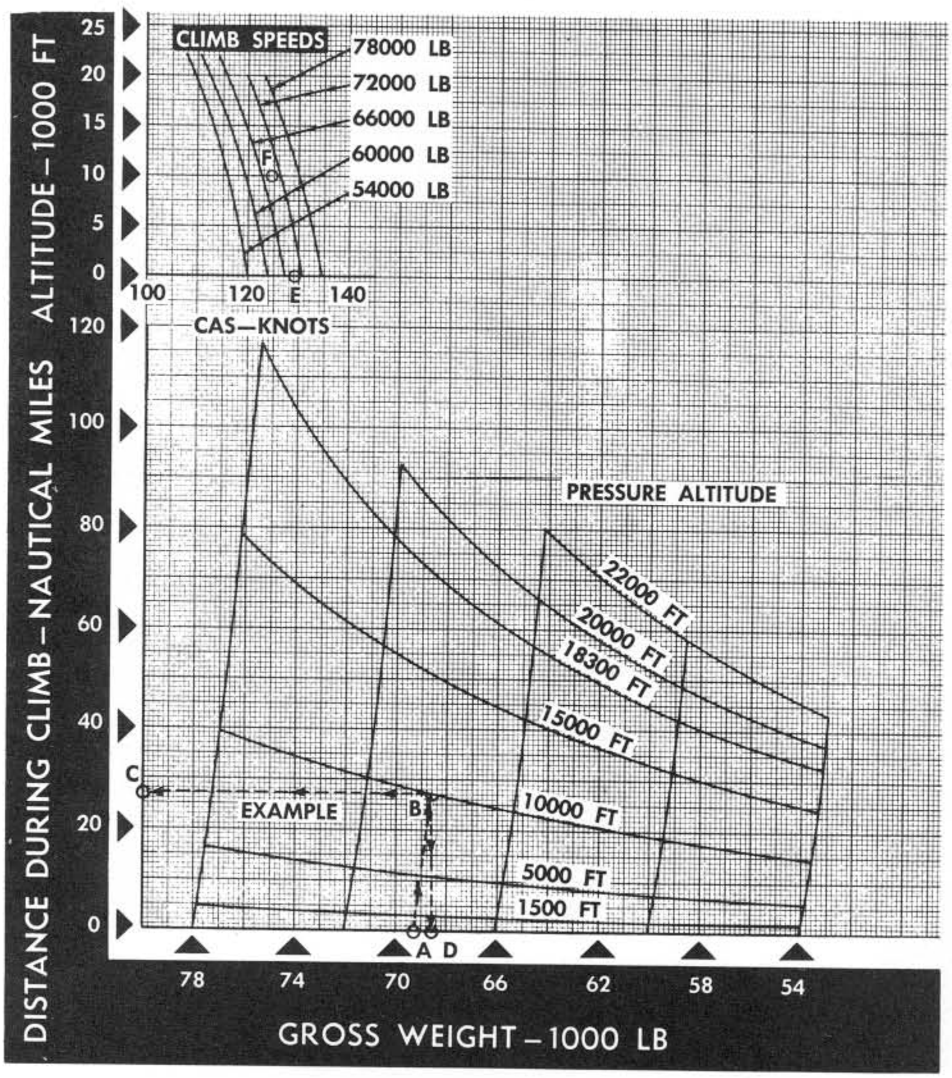
NORMAL RATED POWER

ASW LOADING

MODEL: P5M-2

Standard Day

ENGINES: (2) R3350-32W



REMARKS: Obtain equivalent gross weight for climb determination by adding 230 lb to actual airplane weight for each 1°C hotter than standard and by subtracting 230 lb for each 1°C colder than standard.

Deduct 655 lb from initial gross weight for taxi and takeoff allowance.

DATA AS OF: 1 DECEMBER 1956

DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145

FUEL DENSITY: 6.0 LB/US GAL

21077

Figure A–12. Climb Curve—Distance and Fuel—Normal Rated Power

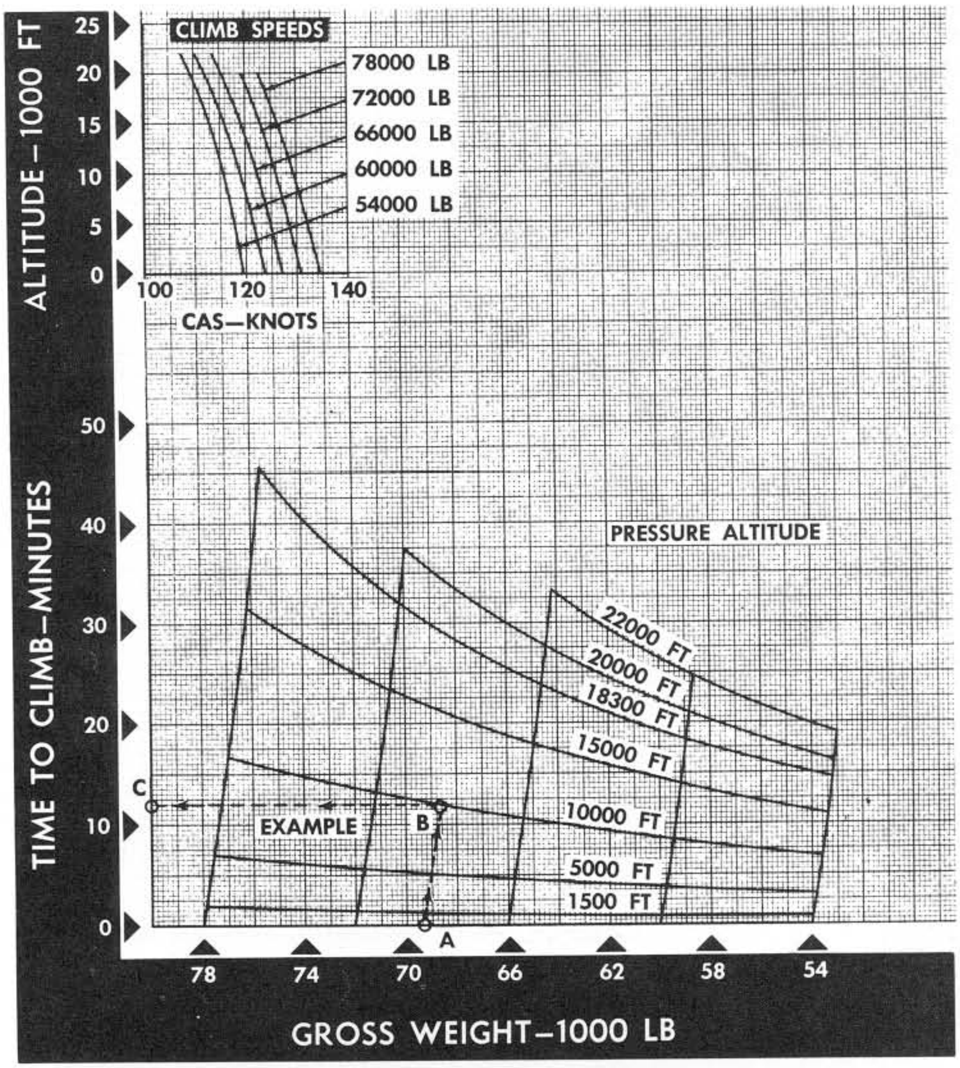
CLIMB CURVE—TIME

NORMAL RATED POWER
ASW LOADING

MODEL: P5M-2

Standard Day

ENGINES: (2) R3350-32W



REMARKS: Obtain equivalent gross weight for climb determination by adding 230 lb to actual airplane weight for each 1°C hotter than standard and by subtracting 230 lb for each 1°C colder than standard.

Deduct 655 lb from initial gross weight for taxi and takeoff allowance.

DATA AS OF: 1 DECEMBER 1956

DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145

FUEL DENSITY: 6.0 LB/US GAL

21078

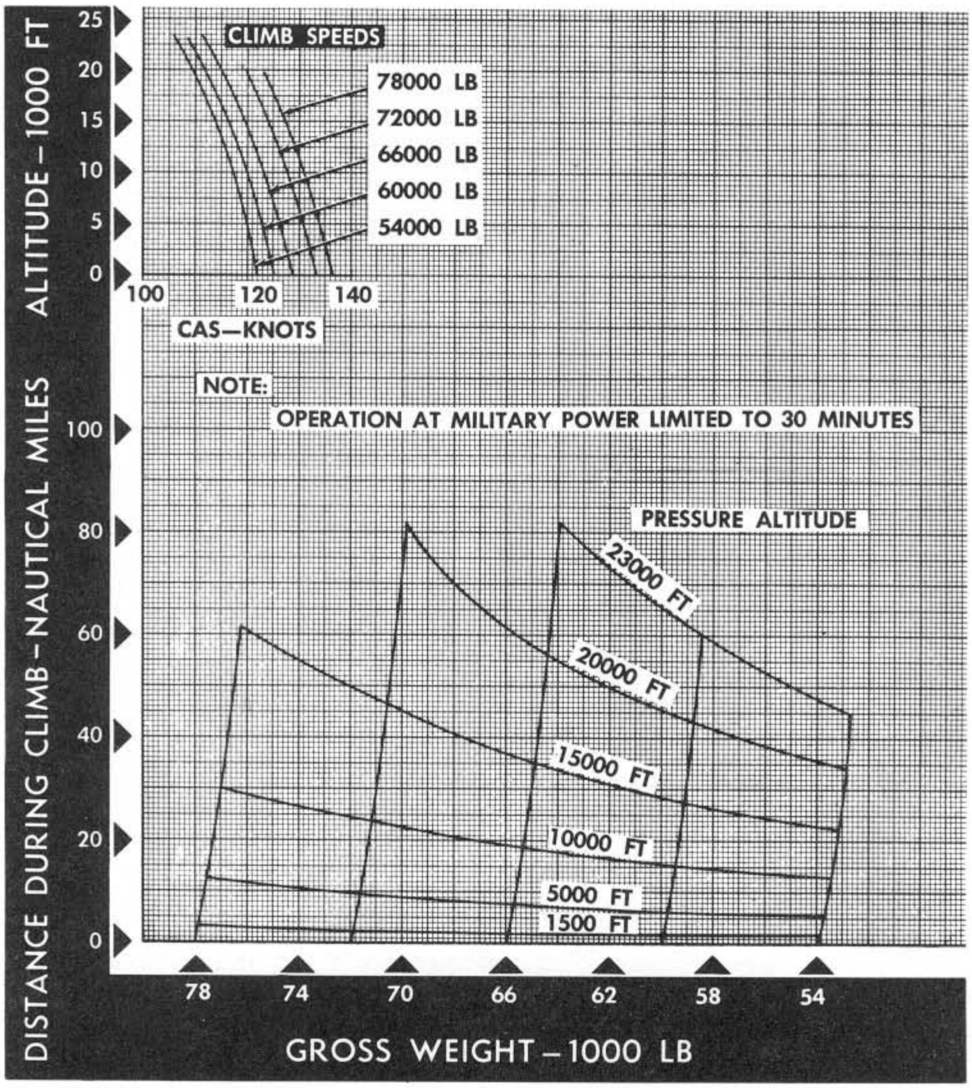
Figure A-13. Climb Curve—Time—Normal Rated Power

CLIMB CURVE—DISTANCE AND FUEL

MILITARY RATED POWER

ASW LOADING

MODEL: P5M-2 | Standard Day | ENGINES: (2) R3350-32W



REMARKS: Obtain equivalent gross weight for climb determination by adding 230 lb to actual airplane weight for each 1°C hotter than standard and by subtracting 230 lb for each 1°C colder than standard.

Deduct 655 lb from initial gross weight for taxi and takeoff allowance.

DATA AS OF: 1 DECEMBER 1956

DATE BASIS: FLIGHT TEST

FUEL GRADE: 115/145

FUEL DENSITY: 6.0 LB/US GAL

21079

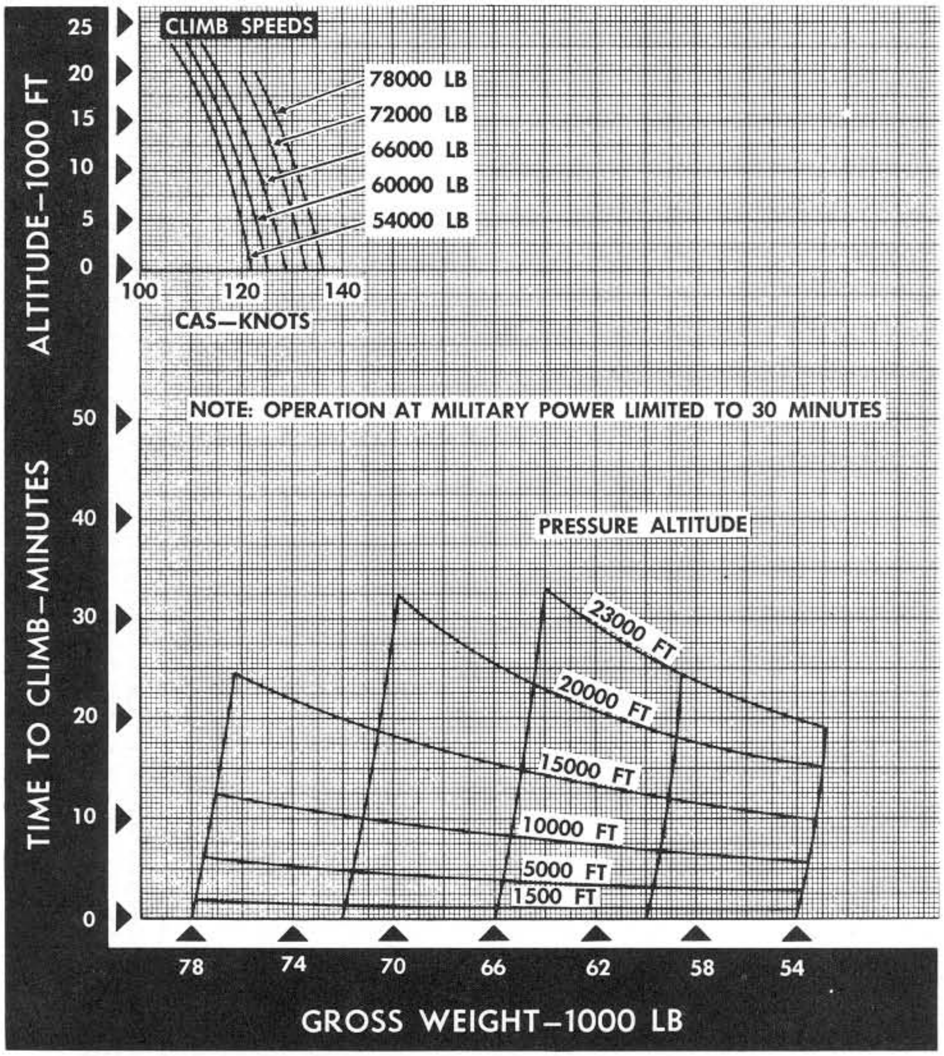
Figure A-13A. Climb Curve—Distance and Fuel—Military Rated Power

CLIMB CURVE—TIME

MILITARY RATED POWER

ASW LOADING

MODEL: P5M-2 Standard Day ENGINES: (2) R3350-32W



REMARKS: Obtain equivalent gross weight for climb determination by adding 230 lb to actual airplane weight for each 1°C hotter than standard and by subtracting 230 lb for each 1°C colder than standard.

Deduct 655 lb from initial gross weight for taxi and takeoff allowance.

DATA AS OF: 1 DECEMBER 1956 FUEL GRADE: 115/145

DATA BASIS: FLIGHT TEST FUEL DENSITY: 6.0 LB/US GAL

21080

Figure A-13B. Climb Curve—Time—Military Rated Power

LANDING DISTANCE

FEET

STANDARD DAY—SEA LEVEL

ALL CONFIGURATIONS

MODEL(S): P5M-2 ENGINE(S): (2) R-3350-32W

GROSS WEIGHT LBS.	BEST CAS FOR APPROACH		40° FLAPS NO WIND			
	POWER ON	POWER OFF	NO DECELERATION DEVICES		REVERSIBLE PITCH PROPELLERS	
	KNOTS	KNOTS	RUN ON WATER	CLEAR 50 FEET	RUN ON WATER	CLEAR 50 FEET
78000	106	106	2790	3377	1641	2228
72000	102	102	2566	3147	1509	2090
66000	97	97	2341	2915	1377	1951
60000	93	93	2117	2684	1245	1812
54000	88	88	1893	2454	1113	1674
50000	85	85	1744	2300	1025	1581

REMARKS: USE OF HYDROFLAPS DURING LANDING WILL REDUCE LANDING RUN APPROXIMATELY 100 FEET. LANDING DISTANCES ARE BASED UPON NORMAL SERVICE CONDITIONS AND TECHNIQUES. WATER SPEED AT END OF ABOVE DISTANCES IS 20 KNOTS.

DATA AS OF: 3-18-54
DATA BASIS: ESTIMATED

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LBS/GAL

21121

Figure A-14. Landing Distance Chart

MAXIMUM ENDURANCE

MODEL: P5M-2 STANDARD DAY ENGINES: (2) R3350-32W

CONFIGURATION: ASW
WEIGHT: 78,000 LB

CONFIGURATION: ASW
WEIGHT: 72,000 LB

APPROXIMATE				CAS	PRESSURE ALTITUDE	CAS	APPROXIMATE			
FUEL LB/HR	MIX.	RPM	IN. MAP	KNOTS	FEET	KNOTS	IN. MAP	RPM	MIX.	FUEL LB/HR
1370	NORMAL	2180	35.8	128	1500	123	34.3	1990	NORMAL	1200
1440	NORMAL	2210	35.6	129	5000	124	33.7	2050	NORMAL	1225
1720	NORMAL	2250	35.6	128	10000	122	33.0	2130	NORMAL	1405
2280	NORMAL	2420	38.2	128	15000	123	37.0	2330	NORMAL	1775

CONFIGURATION: ASW
WEIGHT: 66,000 LB

CONFIGURATION: ASW
WEIGHT: 60,000 LB

APPROXIMATE				CAS	PRESSURE ALTITUDE	CAS	APPROXIMATE			
FUEL LB/HR	MIX.	RPM	IN. MAP	KNOTS	FEET	KNOTS	IN. MAP	RPM	MIX.	FUEL LB/HR
1080	NORMAL	1790	33.7	118	1500	113	33.2	1550	NORMAL	977
1090	NORMAL	1825	32.8	119	5000	114	32.2	1600	NORMAL	1000
1210	NORMAL	1960	31.5	116	10000	111	30.0	1800	NORMAL	1080
1405	NORMAL	2130	35.2	117	15000	112	32.5	1920	NORMAL	1215

CONFIGURATION: ASW
WEIGHT: 54,000 LB

CONFIGURATION: ASW
WEIGHT:

APPROXIMATE				CAS	PRESSURE ALTITUDE	CAS	APPROXIMATE			
FUEL LB/HR	MIX.	RPM	IN. MAP	KNOTS	FEET	KNOTS	IN. MAP	RPM	MIX.	FUEL LB/HR
882	NORMAL	1400	32.7	107	1500					
915	NORMAL	1450	31.9	109	5000					
993	NORMAL	1650	28.6	107	10000					
1115	NORMAL	1700	30.5	108	15000					

REMARKS:

(1) Cowl Flaps: TRAIL.
(2) Oil Cooler Doors: ½ OPEN.

LB/HR: fuel flow, 2 engines
CAS: calibrated airspeed
MAP: manifold absolute pressure
MIX.: mixture

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21081

Figure A–14A. Maximum Endurance Chart—Two Engines

MAXIMUM ENDURANCE POWER CONDITIONS vs GROSS WEIGHT

ASW LOADING

Standard Day

ENGINES: (2) R3350-32W

MODEL: P5M-2

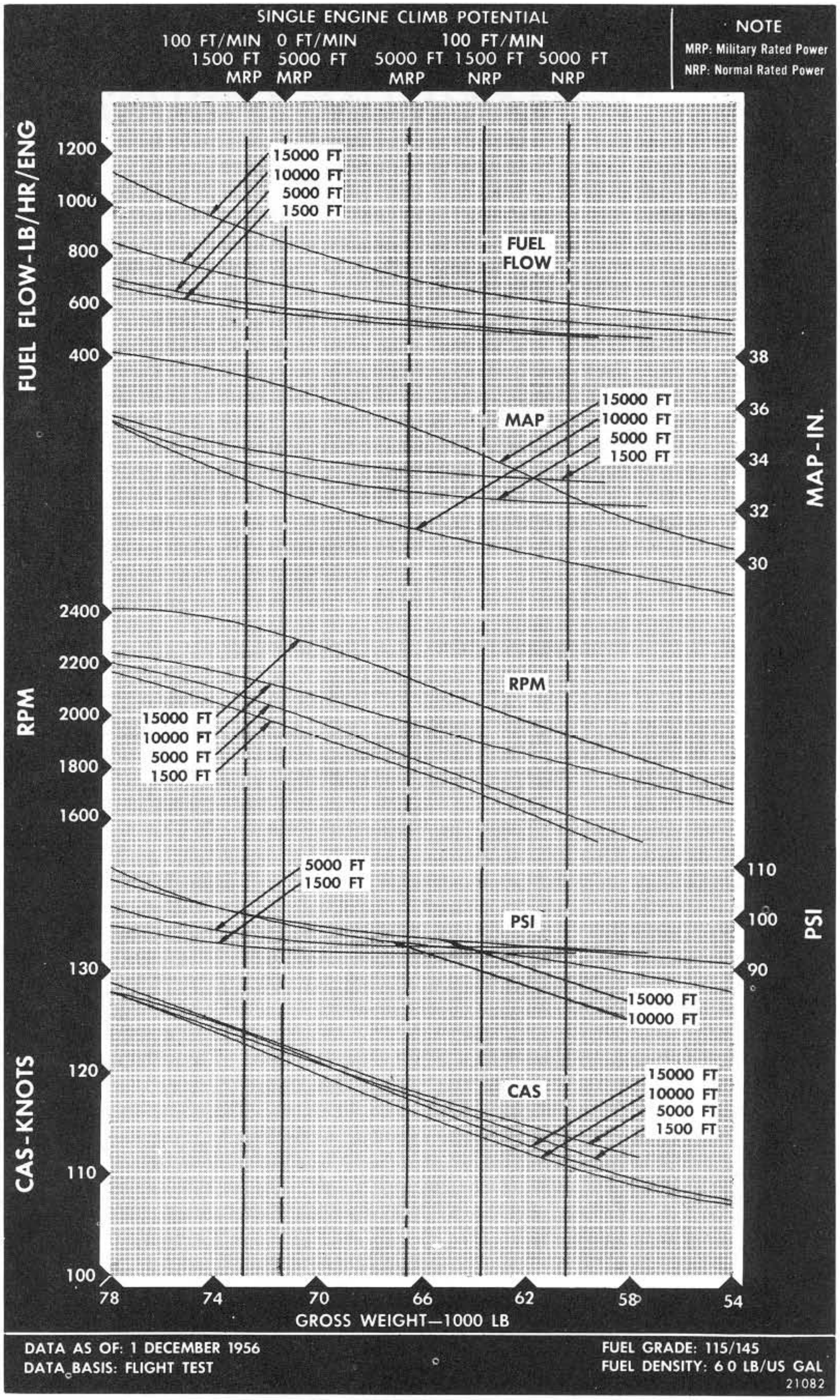


Figure A-15. Maximum Endurance Curve—Two Engines

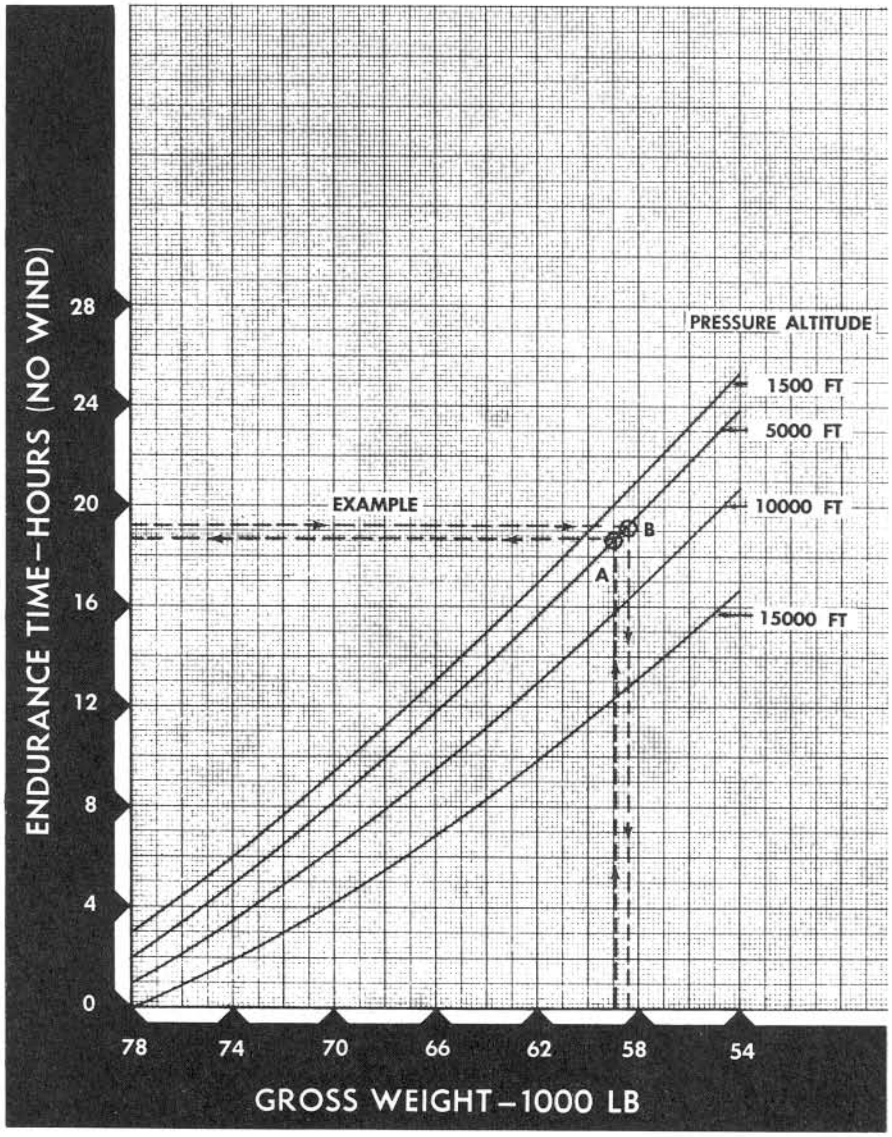
ENDURANCE—TIME

ASW LOADING

MODEL P5M-2

Standard Day

ENGINES: (2) R3350-32W



DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21083

Figure A-16. Endurance Time Curve

COMBAT ALLOWANCE CHART

MILITARY POWER

MODEL: P5M-2 STANDARD DAY **ENGINES: (2) R-3350-32W**

PRESSURE ALTITUDE	RPM	MAP In. Hg	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT Minutes	LIMIT CYL. TEMP °C	FUEL FLOW Lb/Min/Eng.
SEA LEVEL	2900	61.5	LOW	NORMAL	30	260	41.2
2000	2900	60.7	LOW	NORMAL	30	260	41.0
4000	2900	FT	LOW	NORMAL	30	260	38.7
6000	2900	FT	LOW	NORMAL	30	260	36.0
8000	2900	FT	LOW	NORMAL	30	260	33.0
10000	2900	FT	LOW	NORMAL	30	260	30.0
12000	2600	50.2	HIGH	NORMAL	30	260	35.0
14000	2600	49.9	HIGH	NORMAL	30	260	32.5
16000	2600	49.6	HIGH	NORMAL	30	260	29.7
18300	2600	FT	HIGH	NORMAL	CONTINUOUS	245	27.5
20000	2600	FT	HIGH	NORMAL	CONTINUOUS	245	26.5

REMARKS:

FT: Full Throttle

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: WAC SP-2017

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

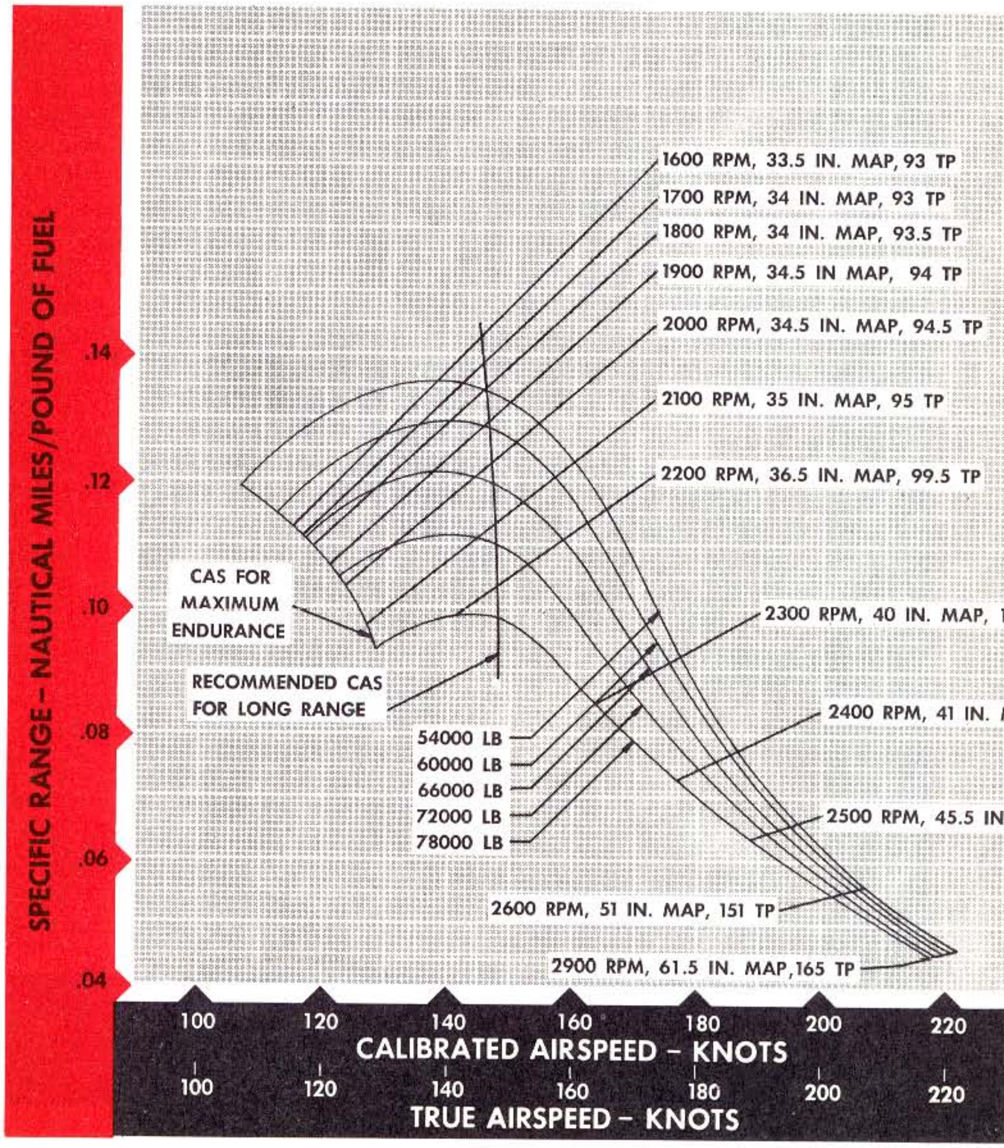
21084

Figure A-17. Combat Allowance Chart

NAUTICAL MILES PER POUND OF FUEL SEA LEVEL

ASW LOADING

MODEL: P5M-2 **Standard Day** **ENGINES: (2)R3350-32W**



REMARKS:

1. Cowl Flaps: TRAIL
2. Oil Cooler Doors: ½ OPEN

TP: Torque Pressure

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: ESTIMATED

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21085

Figure A-18. Miles/per/pound of Fuel Curve—Two Engines—Sea Level

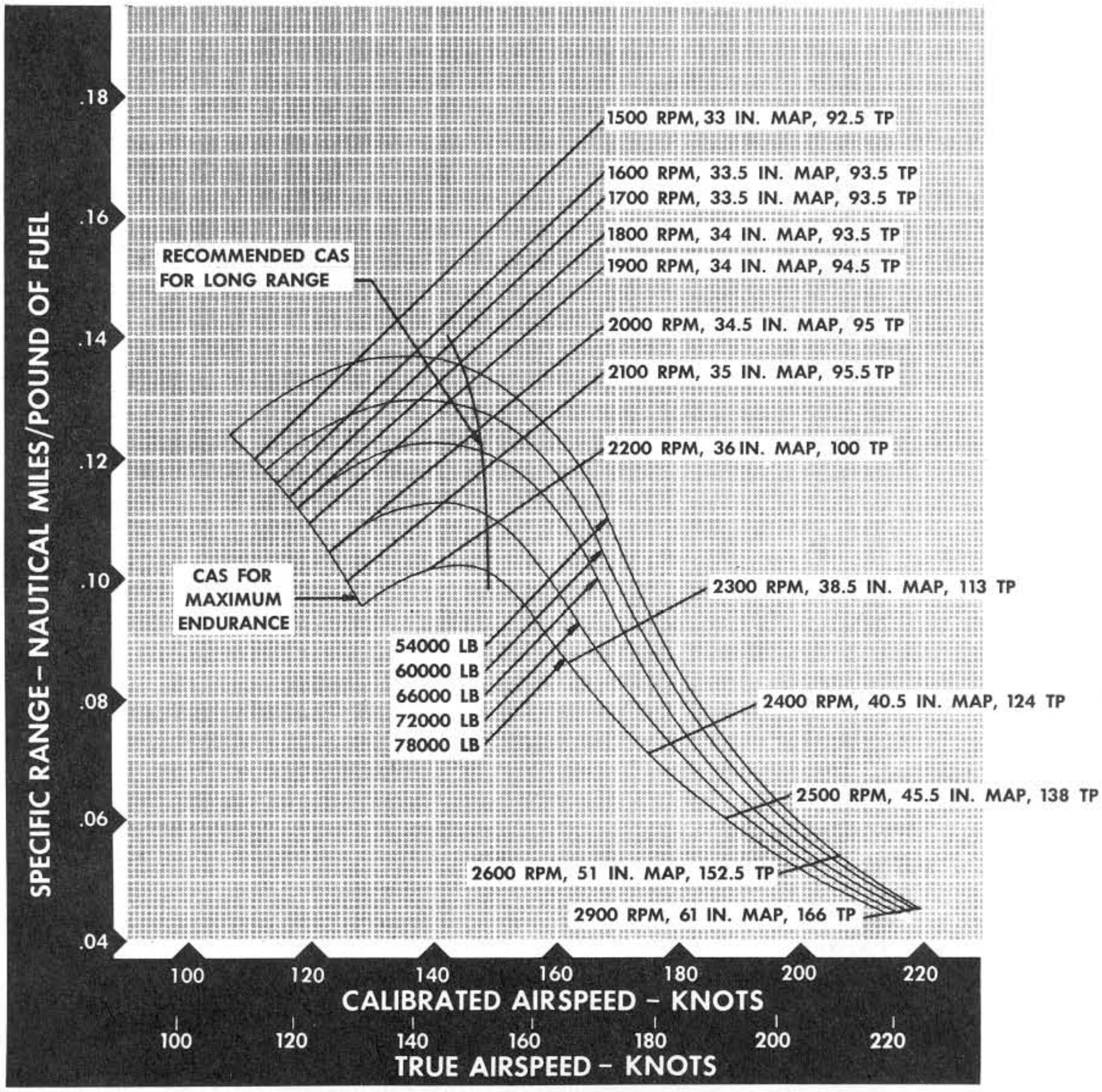
NAUTICAL MILES PER POUND OF FUEL 1500 FT

ASW LOADING

MODEL: P5M-2

Standard Day

ENGINES: (2) R3350-32W



REMARKS:

1. Cowl Flaps: TRAIL
2. Oil Cooler Doors: ½ OPEN

TP: Torque Pressure

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

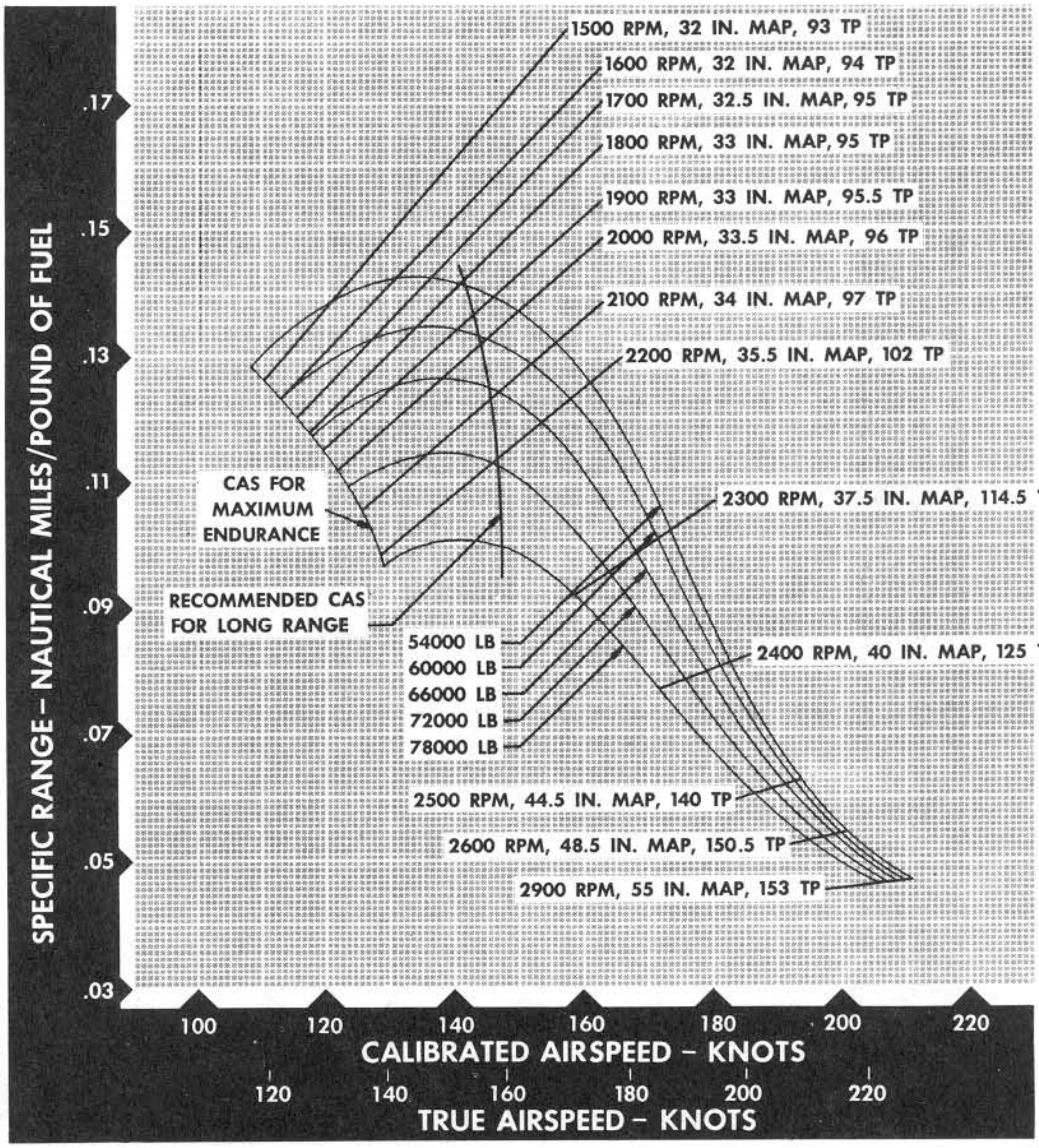
21086

Figure A–18A. Miles/per/pound of Fuel Curve—Two Engines—1500 feet

NAUTICAL MILES PER POUND OF FUEL 5000 FT

ASW LOADING

MODEL: P5M-2 | Standard Day | ENGINES: (2) R3350-32W



REMARKS:

1. Cowl Flaps: TRAIL
2. Oil Cooler Doors: ½ OPEN

TP: Torque Pressure

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21087

Figure A-19. Miles/per/pound of Fuel Curve—Two Engines—5000 feet

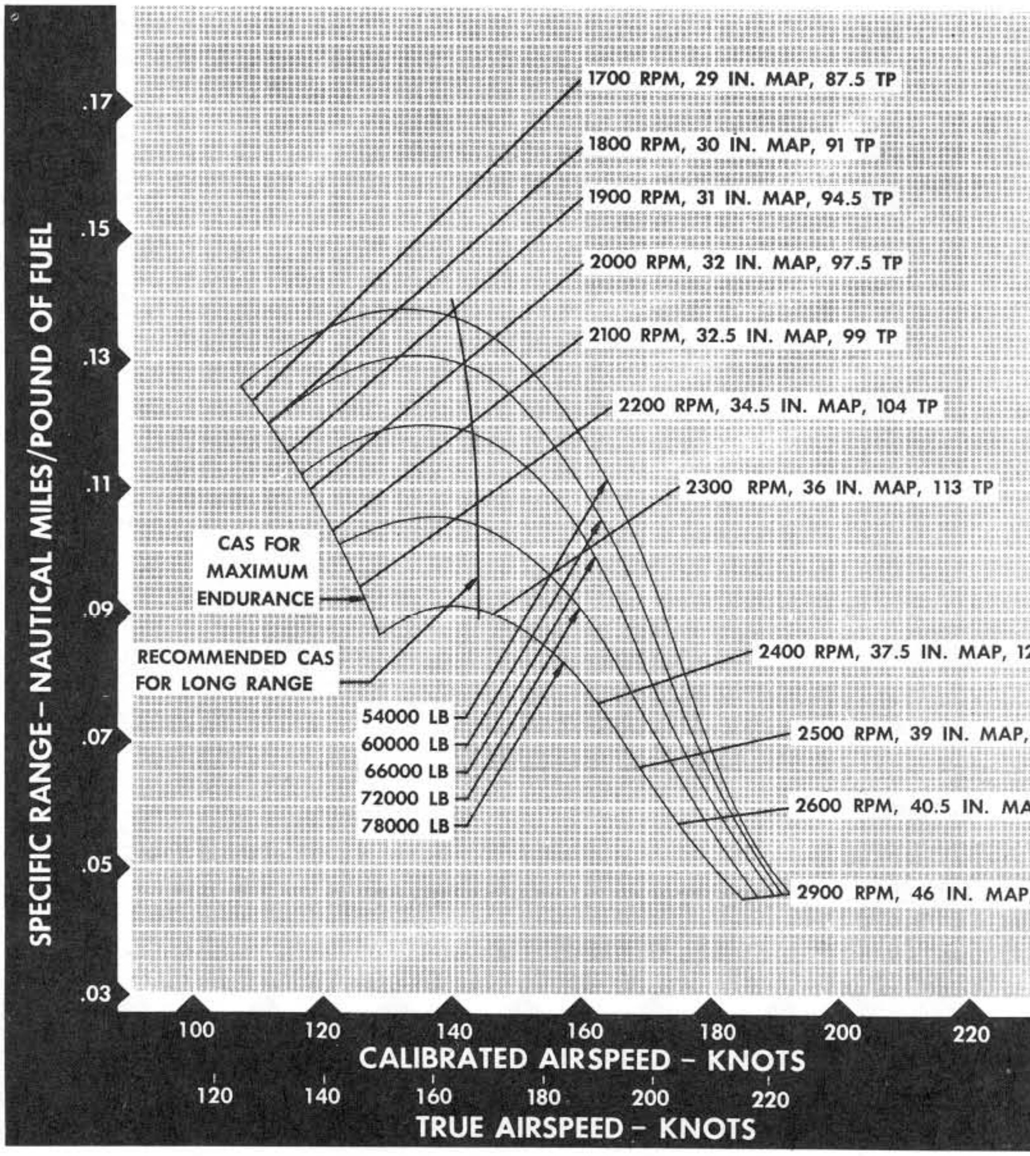
NAUTICAL MILES PER POUND OF FUEL 10,000 FT

ASW LOADING

MODEL: P5M-2

Standard Day

ENGINES: (2) R3350-32W



REMARKS:

1. Cowl Flaps: TRAIL
2. Oil Cooler Doors: ½ OPEN

TP: Torque Pressure

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

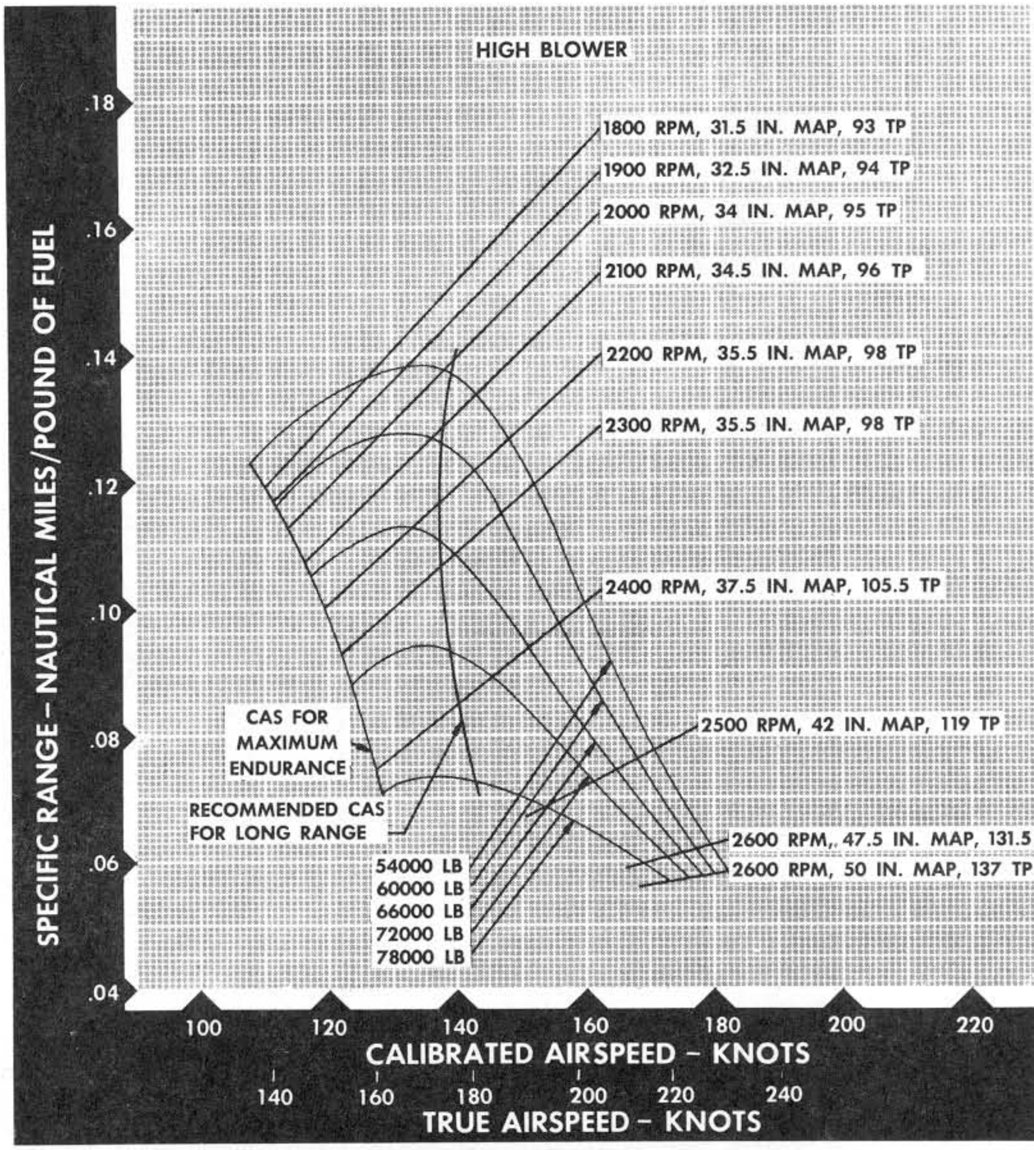
21088

Figure A-20. Miles/per/pound of Fuel Curve—Two Engines—10,000 feet

NAUTICAL MILES PER POUND OF FUEL 15,000 FT

ASW LOADING

MODEL: P5M-2 | Standard Day | ENGINES: (2) R3350-32W



REMARKS:

TP: Torque Pressure

1. Cowl Flaps: TRAIL
2. Oil Cooler Doors: ½ OPEN

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21089

Figure A-20A. Miles/per/pound of Fuel Curve—Two Engines—15,000 feet

MAXIMUM RANGE POWER CONDITIONS vs GROSS WEIGHT

ASW LOADING

Standard Day

ENGINES: (2) R3350-32W

MODEL: P5M-2

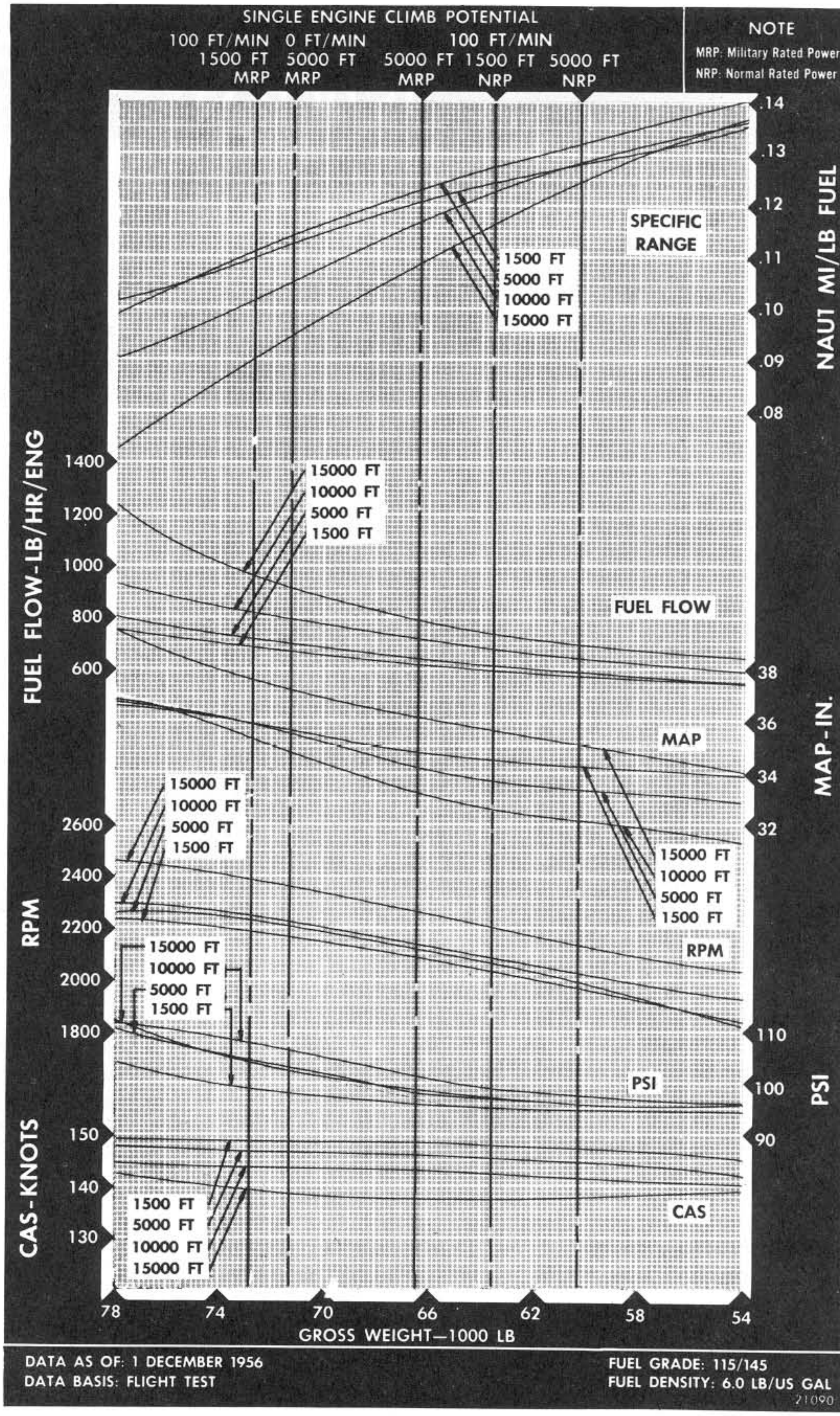


Figure A-21. Maximum Range Operating Power Curve—Two Engines

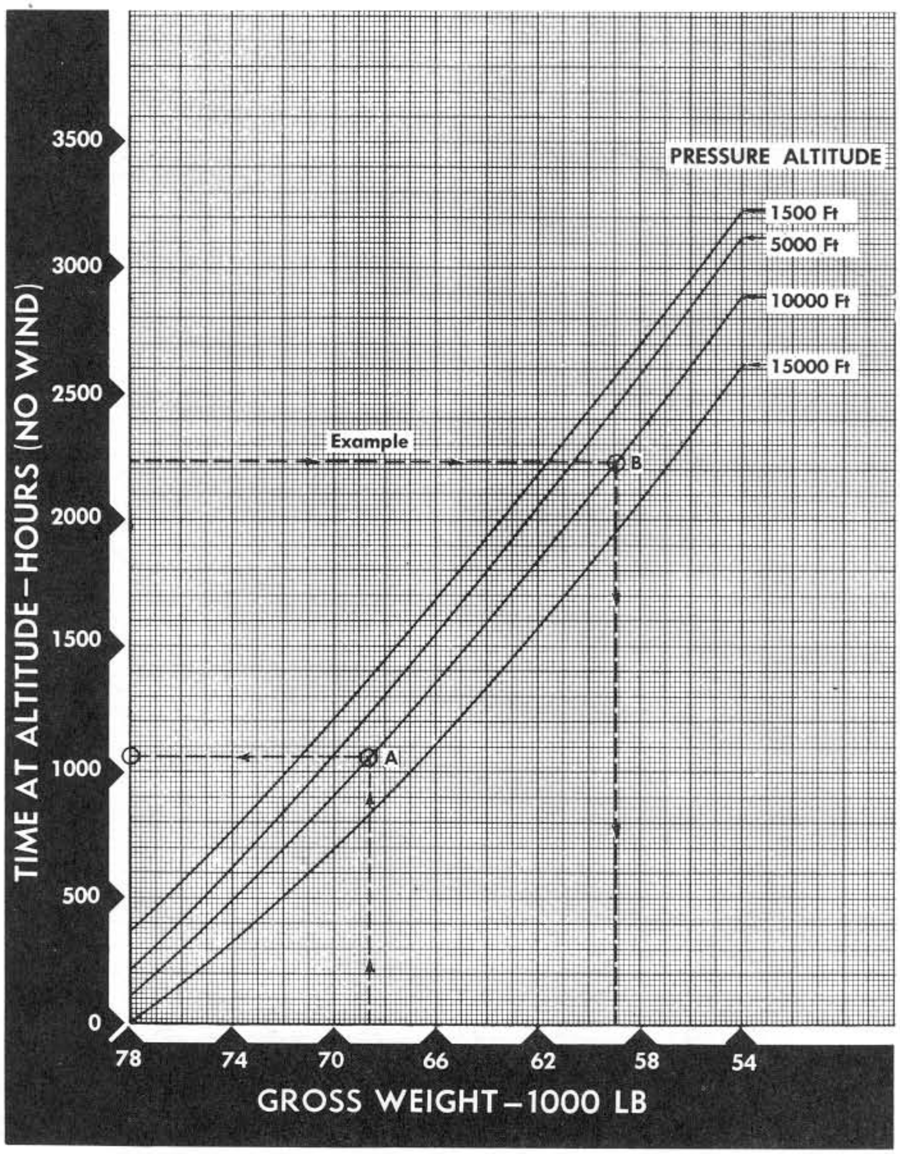
LONG RANGE PREDICTION—DISTANCE

MODEL: P5M-2

ASW LOADING
Standard Day

ENGINES: (2) R3350-32W

Based on recommended cruising speeds on Maximum Range Power Conditions summary curve, figure A-21.



DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21091

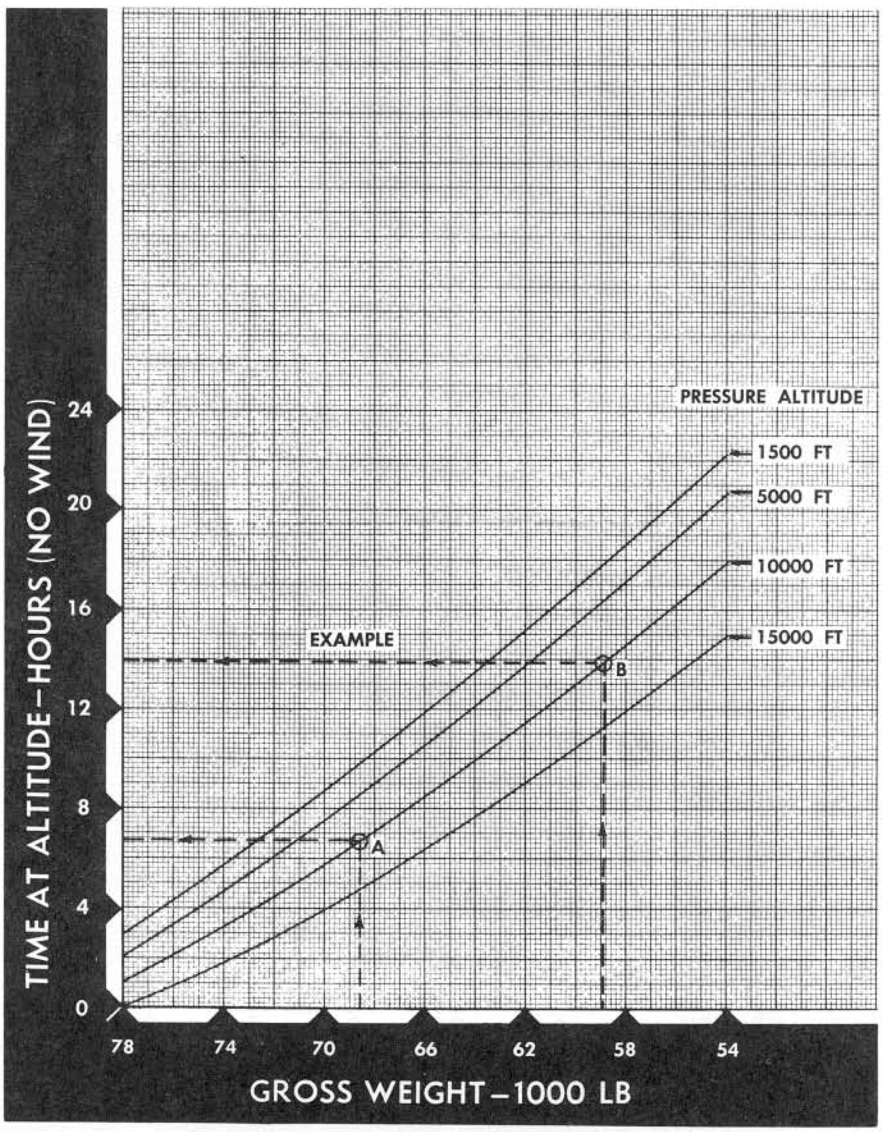
Figure A-22. Long Range Prediction Curve—Distance—Two Engines

LONG RANGE PREDICTION–TIME

ASW LOADING

MODEL: P5M-2 | Standard Day | ENGINES: (2) R3350-32W

Based on recommended cruising speeds on Maximum Range Power Conditions summary curve, figure A-21.



DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21092

Figure A-23. Long Range Prediction Curve—Time—Two Engines

CLIMB CHART FOR NORMAL RATED POWER

SINGLE ENGINE

MODEL: P5M-2 **STANDARD DAY** **ENGINES: (2) R-3350-32W**

CONFIGURATION: ASW WEIGHT: 66,000 LB							CONFIGURATION: ASW WEIGHT: 60,000 LB					
APPROXIMATE				MAP In. Hg	CAS Knots	PRESSURE ALTITUDE Feet	CAS Knots	MAP In. Hg	APPROXIMATE			
RATE(2) OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE(2) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	
67	0	0	655(1)	51.0	112	S.L.	109	51.0	655(1)	0	0	190
54	46.9	24.8	1465	50.8	112	1,500	108	50.8	917	8.0	14.7	180
						5,000	107	48.6	1626	30.0	56.0	114

CONFIGURATION: ASW WEIGHT: 54,000 LB							CONFIGURATION: ASW WEIGHT:					
APPROXIMATE				MAP In. Hg	CAS Knots	PRESSURE ALTITUDE Feet	CAS Knots	MAP In. Hg	APPROXIMATE			
RATE(2) OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE(2) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	
329	0	0	655(1)	51.0	105	S.L.						
319	8.0	4.5	802	50.8	105	1,500						
255	29.0	16.0	1173	48.6	104	5,000						

CONFIGURATION: ASW WEIGHT:							CONFIGURATION: ASW WEIGHT:					
APPROXIMATE				MAP In. Hg	CAS Knots	PRESSURE ALTITUDE Feet	CAS Knots	MAP In. Hg	APPROXIMATE			
RATE(2) OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE(2) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	

REMARKS:

(1) Taxi and takeoff fuel allowance, 655 lb.

(2) For each 10°C hotter than standard temperature, subtract 30 fpm rate of climb. For each 10°C colder than standard, add 30 fpm rate of climb.

RATE OF CLIMB: feet per minute
DISTANCE: nautical miles
TIME: minutes
FUEL: pounds 2 engines
CAS: calibrated airspeed
MAP: manifold absolute pressure
FT: full throttle

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21093

Figure A-23A. Single-Engine Climb Chart—Normal Rated Power

CLIMB CHART FOR MILITARY RATED POWER

SINGLE ENGINE

MODEL: P5M-2 **STANDARD DAY** **ENGINES: (2) R-3350-32W**

CONFIGURATION: ASW — WEIGHT: 72,000 LB (left) | **CONFIGURATION: ASW — WEIGHT: 66,000 LB** (right)

APPROXIMATE				MAP	CAS	PRESSURE ALTITUDE Feet	CAS	MAP	APPROXIMATE			
RATE(2) OF CLIMB	FROM SEA LEVEL			In. Hg	Knots		Knots	In. Hg	FROM SEA LEVEL			RATE(2) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	
129	0	0	655(1)	61.5	116.6	S.L.	112.9	61.5	655(1)	0	0	252
117	23.6	12.0	1149	61.0	116.0	1,500	112.5	61.0	905	6.1	11.6	240
						5,000	111.1	56.0	1623	25.7	50.0	110

CONFIGURATION: ASW — WEIGHT: 60,000 LB (left) | **CONFIGURATION: ASW — WEIGHT: 54,000 LB** (right)

APPROXIMATE				MAP	CAS	PRESSURE ALTITUDE Feet	CAS	MAP	APPROXIMATE			
RATE(2) OF CLIMB	FROM SEA LEVEL			In. Hg	Knots		Knots	In. Hg	FROM SEA LEVEL			RATE(2) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	
390	0	0	655(1)	61.5	110.0	S.L.	107.7	61.5	655(1)	0	0	546
379	7.2	3.9	815	61.0	109.6	1,500	107.2	61	771	2.8	5.1	536
244	28.1	14.9	1217	65.0	108.0	5,000	105.6	65.0	1061	10.2	18.8	390
						10,000	101.1	46	1781	31.7	60.3	125

CONFIGURATION: ASW — WEIGHT: (left) | **CONFIGURATION: ASW — WEIGHT:** (right)

APPROXIMATE				MAP	CAS	PRESSURE ALTITUDE Feet	CAS	MAP	APPROXIMATE			
RATE(2) OF CLIMB	FROM SEA LEVEL			In. Hg	Knots		Knots	In. Hg	FROM SEA LEVEL			RATE(2) OF CLIMB
	Dist.	Time	Fuel						Fuel	Time	Dist.	

REMARKS:

(1) Taxi and takeoff fuel allowance, 655 lb.

(2) For each 10°C hotter than standard temperature, subtract 40 fpm rate of climb. For each 10°C colder than standard, add 40 fpm rate of climb.

RATE OF CLIMB: feet per minute
DISTANCE: nautical miles
TIME: minutes
FUEL: pounds 2 engines
CAS: calibrated airspeed
MAP: manifold absolute pressure
FT: full throttle

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21094

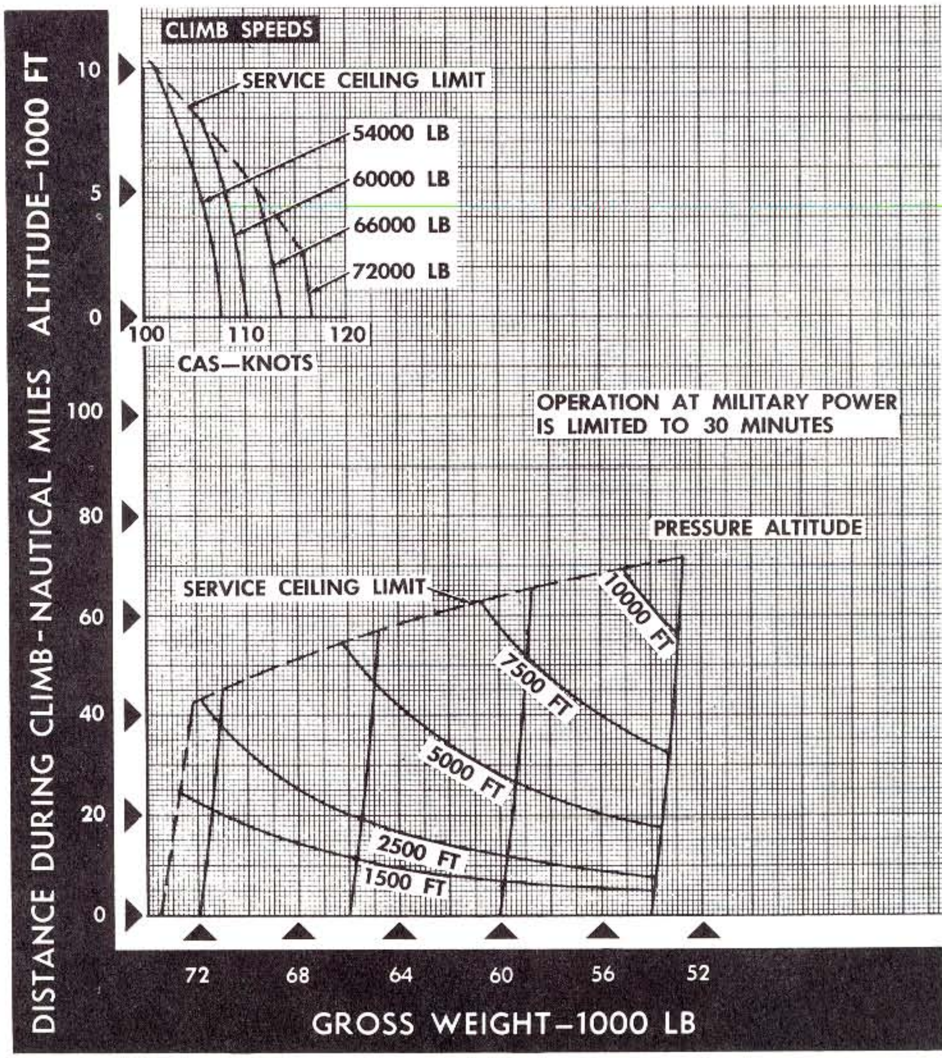
Figure A-23B. Single-Engine Climb Chart—Military Rated Power

CLIMB CURVE—DISTANCE AND FUEL SINGLE ENGINE

MILITARY RATED POWER

ASW LOADING

MODEL: P5M-2 | Standard Day | ENGINES: (2) R3350-32W



REMARKS: Obtain equivalent gross weight for climb determination by adding 190 lb to actual airplane weight for each 1°C hotter than standard and by subtracting 190 lb for each 1°C colder than standard.

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL
21095

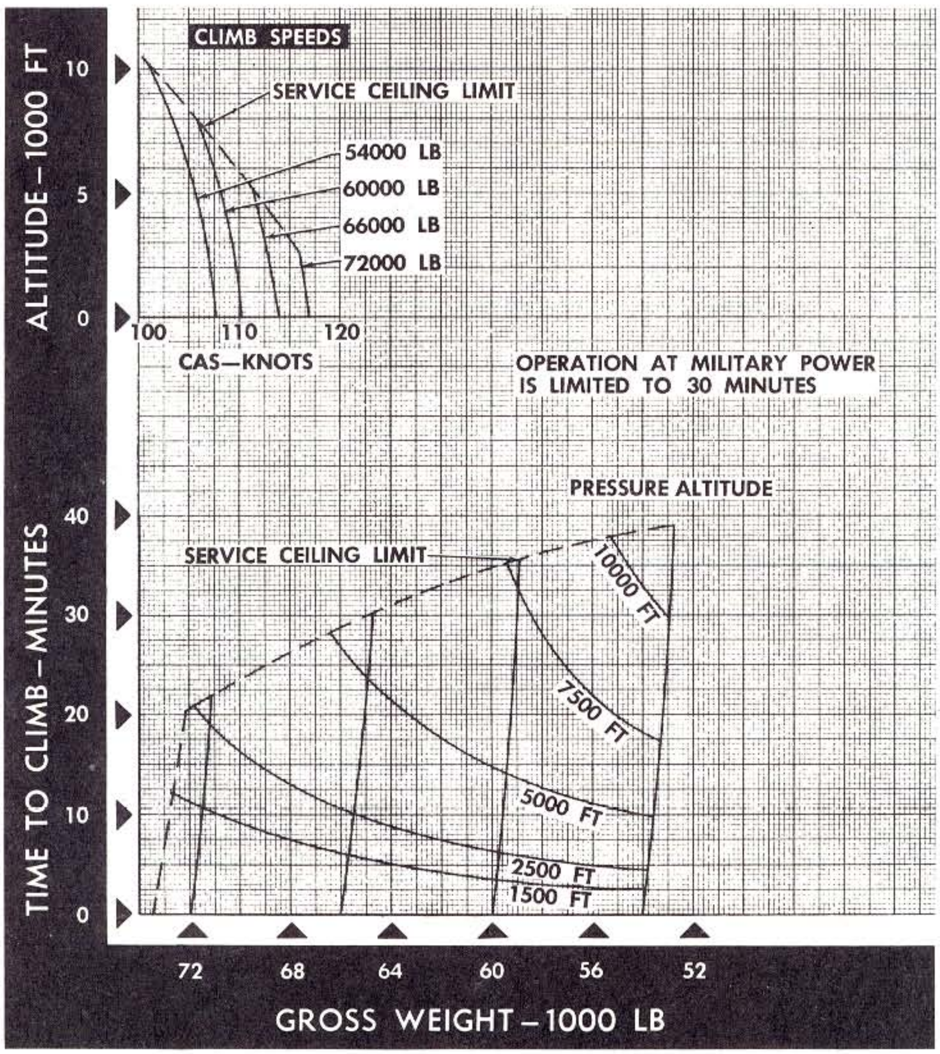
Figure A-24. Single-Engine Climb Curve—Distance and Fuel—Military Rated Power

CLIMB CURVE—TIME SINGLE ENGINE

MILITARY RATED POWER

ASW LOADING

MODEL: P5M-2 Standard Day ENGINES: (2) R 3350-32W



REMARKS: Obtain equivalent gross weight for climb determination by adding 190 lb to actual airplane weight for each 1°C hotter than standard and by subtracting 190 lb for each 1°C colder than standard.

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21096

Figure A-25. Single-Engine Climb Curve—Time—Military Rated Power

MAXIMUM ENDURANCE SINGLE ENGINE

MODEL: P5M-2 STANDARD DAY ENGINES: (2) R3350-32W

CONFIGURATION: ASW WEIGHT: 72,000 LB						CONFIGURATION: ASW WEIGHT: 66,000 LB				
APPROXIMATE				CAS	PRESSURE ALTITUDE	CAS	APPROXIMATE			
FUEL LB/HR	MAX R/C	RPM	IN. MAP	KNOTS	FEET	KNOTS	IN. MAP	RPM	MAX R/C	FUEL LB/HR
2320	117	2770	56.5	115	1500	110	47.1	2537	240	1770
					5000	112	48.5	2600	110	1910

CONFIGURATION: ASW WEIGHT: 60,000 LB						CONFIGURATION: ASW WEIGHT: 54,000 LB				
APPROXIMATE				CAS	PRESSURE ALTITUDE	CAS	APPROXIMATE			
FUEL LB/HR	MAX R/C	RPM	IN. MAP	KNOTS	FEET	KNOTS	IN. MAP	RPM	MAX R/C	FUEL LB/HR
1384	380	2430	42.2	105	1500	101	39.1	2340	535	1107
1560	245	2480	43.8	105	5000	100	38.5	2340	390	1112

CONFIGURATION: ASW WEIGHT:						CONFIGURATION: ASW WEIGHT:				
APPROXIMATE				CAS	PRESSURE ALTITUDE	CAS	APPROXIMATE			
FUEL LB/HR	MAX R/C	RPM	IN. MAP	KNOTS	FEET	KNOTS	IN. MAP	RPM	MAX R/C	FUEL LB/HR

REMARKS:

(1) Maxiumum available R/C with Military Power.
(2) Operation above 2600 RPM limited to 30 minutes.
(3) Mixture: NORMAL.
(4) Cowl Flaps: As required.
(5) Oil Cooler Doors: ½ OPEN.

LB/HR: fuel flow, 1 engine
CAS: calibrated airspeed
MAP: manifold absolute pressure

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21097

Figure A–25A. Single-Engine Maximum Endurance Chart

MAXIMUM ENDURANCE POWER CONDITIONS vs GROSS WEIGHT SINGLE ENGINE

ASW LOADING

Standard Day

ENGINES: (2) R3350-32W

MODEL: P5M-2

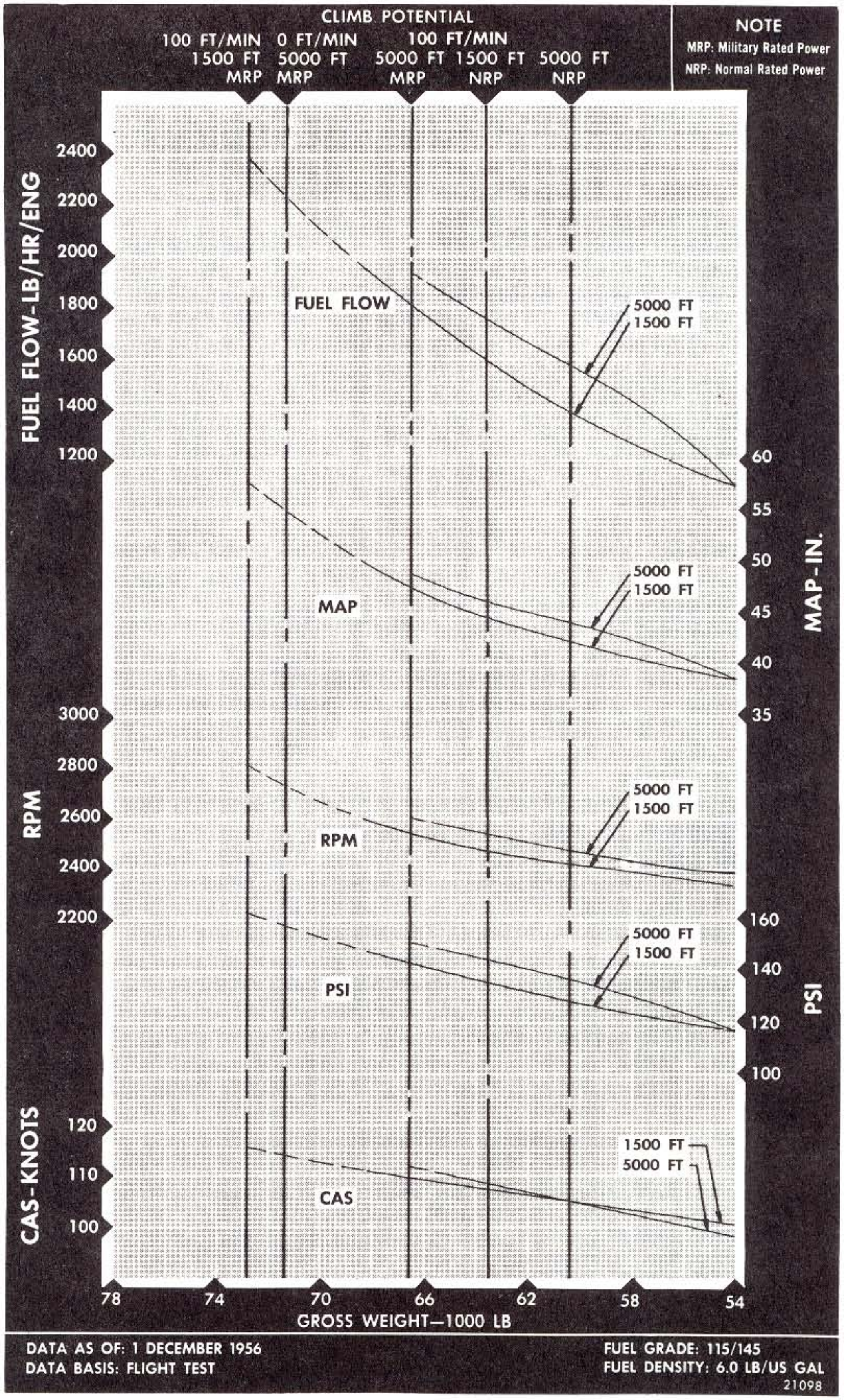


Figure A-26. Single-Engine Maximum Endurance Curve

FLIGHT OPERATION INSTRUCTION CHART

SINGLE ENGINE JETTISON WEIGHT TABLE

CHART WEIGHT LIMITS: ABOVE 66,000 LB

MODEL: P5M-2

ENGINES: (2) R3350-32W

EXTERNAL LOAD ITEMS
8 HPAG Rockets
1 AN/AVQ-2 Searchlight

GROSS WEIGHT POUNDS	CLIMB POTENTIAL (3)	ALTITUDE	RPM	MAP IN. HG	FUEL LB/HR	TAS		HALF HOUR RANGE	
						MPH	KTS	STATUTE	NAUTICAL
72000	130	S.L.	2900	61.5	2500	165	143	83	72
	112	1500	2900	61.0	2500	165	143	83	72
70000	170	S.L.	2770	56.2	2310	159	138	80	69
	152	1500	2780	56.5	2350	160	139	80	70
68000	210	S.L.	2680	53.5	2170	154	134	77	67
	193	1500	2700	53.8	2180	157	136	79	68
66000	250	S.L.	2600	51.2	2020	151	131	76	66
	234	1500	2620	51.5	2030	153	133	77	67

REMARKS:

1. Use NORMAL mixture throughout.
2. Operation above 2600 RPM is restricted to 30 minutes. If a single engine condition occurs at a gross weight above 66,000 lb, use the above chart for operating conditions to maintain during the jettisoning operation.
3. CLIMB POTENTIAL is the maximum attainable rate of climb at the stated weight with Military Power on the operating engine.
4. Chart values are computed for propeller FEATHERED on dead engine.

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

JETTISON WEIGHT LIST

ITEM	ASW SEARCH	MINE LAYER	FERRY CONDITION
8 HVAR Rockets	1120		
4 Torpedoes MK-43 Mod. 1	1060		
Bollard	10	10	10
6 Floatlights MK-6	96		
54 Marine Markers	162		
600 Rounds Tail Gun Ammo.	372	372	
Sonobuoys	732		
8 MK-36 Mines		8520	
* Fuel from System (150 gals)	900	900	900
2 Bomb Bay Tanks (Empty)			890
2 Bomb Bay Tanks with Fuel			7608
1 Engine Maint. Platform			168
Camera, Pod and Pylon	25	25	25
2 Sea Anchors and Line	22	22	22
Flak Protection (7 Flak Suits, 14 Flak Curtains)	280		

ITEM	ASW SEARCH	MINE LAYER	FERRY CONDITION
4 MK-25-1 (Mines)		7720	
2 Torpedoes MK-41-0	2400		
2 External Pylons			64
4 Bomb Carriers			132
2 External Carriers			283
2 Parachute Flares	36	36	36
2 Water Breakers	85	85	85
Flasher, Pod and Pylon	23	23	23
Boarding Ladder	10	10	10
Coils of Rope (2-150' Lengths)	24	24	24
Anchor and Line	65	65	65
A. I. Fluid	33	33	33
Crew Food	50	50	50
Typewriter	10	10	10
Misc. Bedding	32	32	32
Oxygen Bottles	261	261	261
TOTAL in pounds	7,808	18,198	10,731

* FUEL JETTISONING RATE is 300 lb (50 gal) per minute

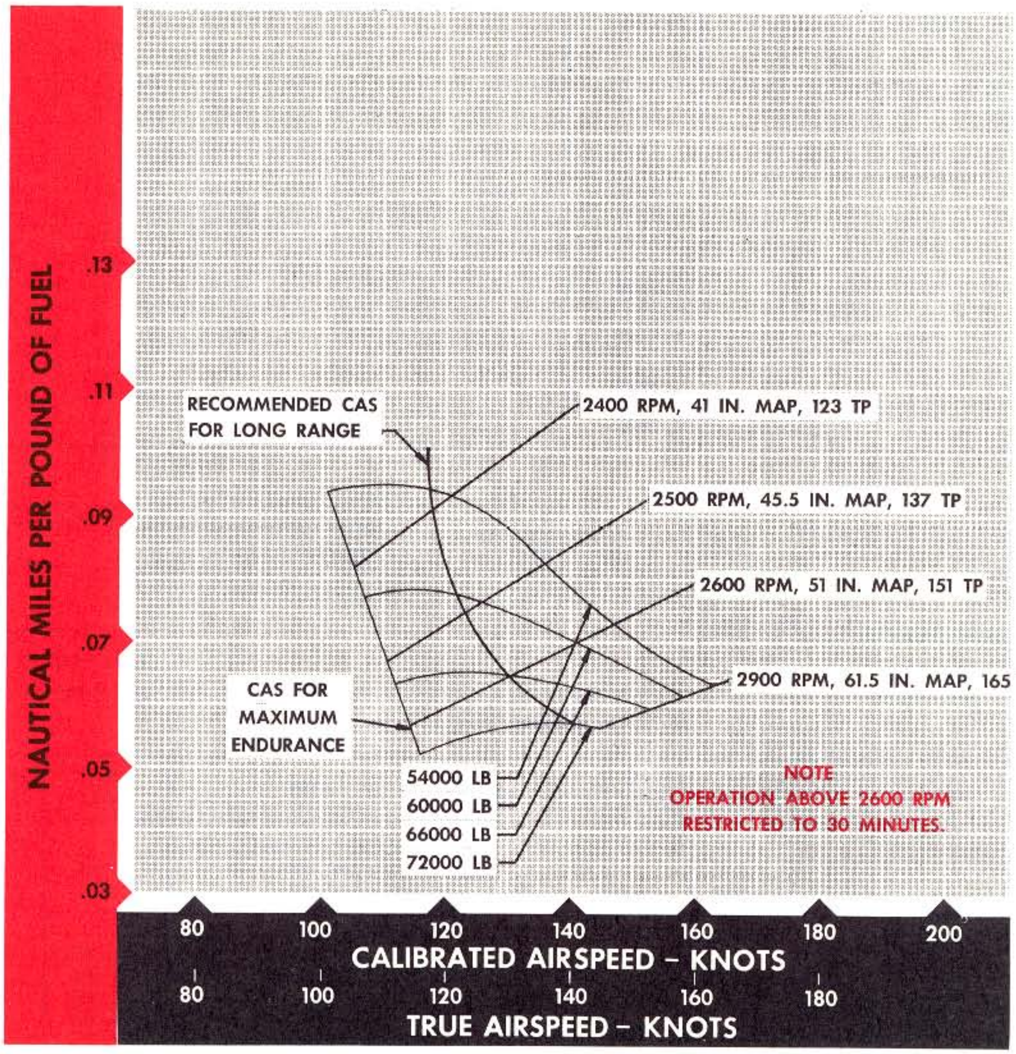
21099

Figure A-26A. Single-Engine Flight Operations Instructions Chart— Above 66,000 pounds

NAUTICAL MILES PER POUND OF FUEL SINGLE ENGINE SEA LEVEL

ASW LOADING

MODEL: P5M-2 | Standard Day | ENGINES: (2) R3350-32W



REMARKS:

1. No wind condition.
2. Mixture: NORMAL.
3. Cowl Flaps: As required.
4. Oil Cooler Doors: ½ OPEN.

TP: Torque Pressure

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: ESTIMATED

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21100

Figure A-27. Single-Engine Miles/per/pound of Fuel Curve—Sea Level

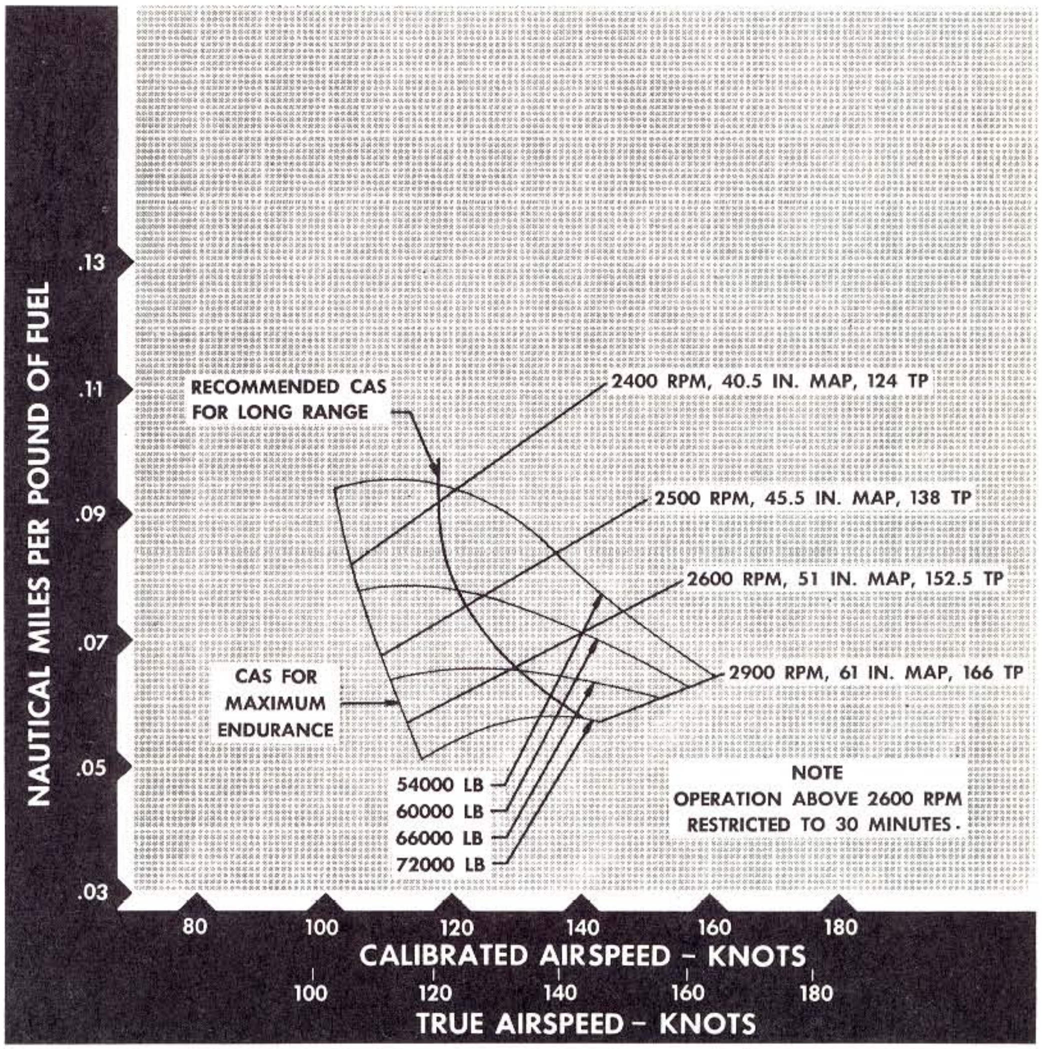
NAUTICAL MILES PER POUND OF FUEL SINGLE ENGINE 1500 FT

ASW LOADING

MODEL: P5M-2

Standard Day

ENGINES: (2) R3350-32W



REMARKS:

1. No wind condition.
2. Mixture: NORMAL.
3. Cowl Flaps: As required.
4. Oil Cooler Doors: ½ OPEN.

TP: Torque Pressure

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

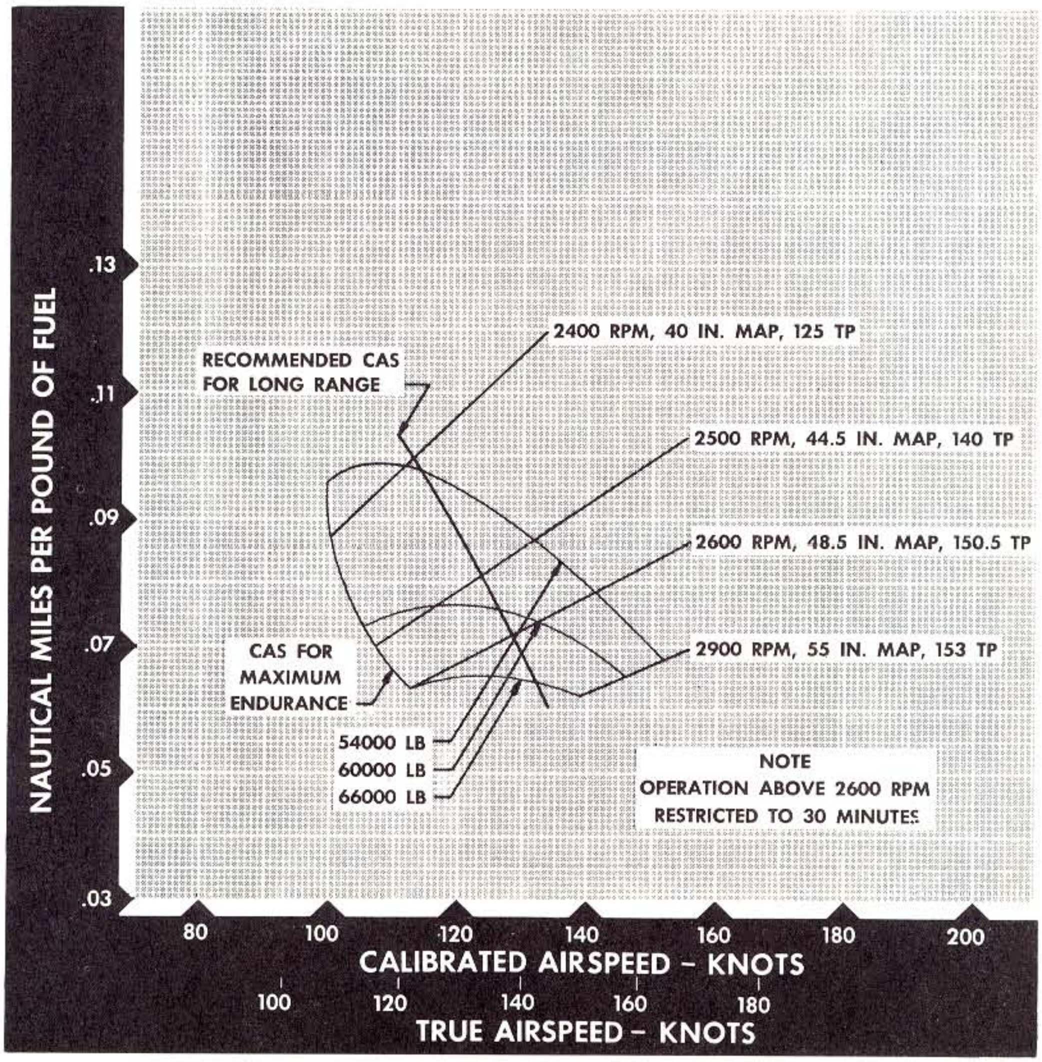
21101

Figure A–27A. Single-Engine Miles/per/pound of Fuel Curve—1500 feet

NAUTICAL MILES PER POUND OF FUEL SINGLE ENGINE 5000 FT

ASW LOADING

MODEL: P5M-2 | Standard Day | ENGINES: (2) R3350-32W



REMARKS:

1. No wind condition.
2. Mixture: NORMAL.
3. Cowl Flaps: As required.
4. Oil Cooler Doors: ½ OPEN.

TP: Torque Pressure

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21102

Figure A-28. Single-Engine Miles/per/pound of Fuel Curve—5000 feet

MAXIMUM RANGE POWER CONDITIONS vs GROSS WEIGHT SINGLE ENGINE

ASW LOADING

Standard Day

ENGINES: (2) R3350-32W

MODEL: P5M-2

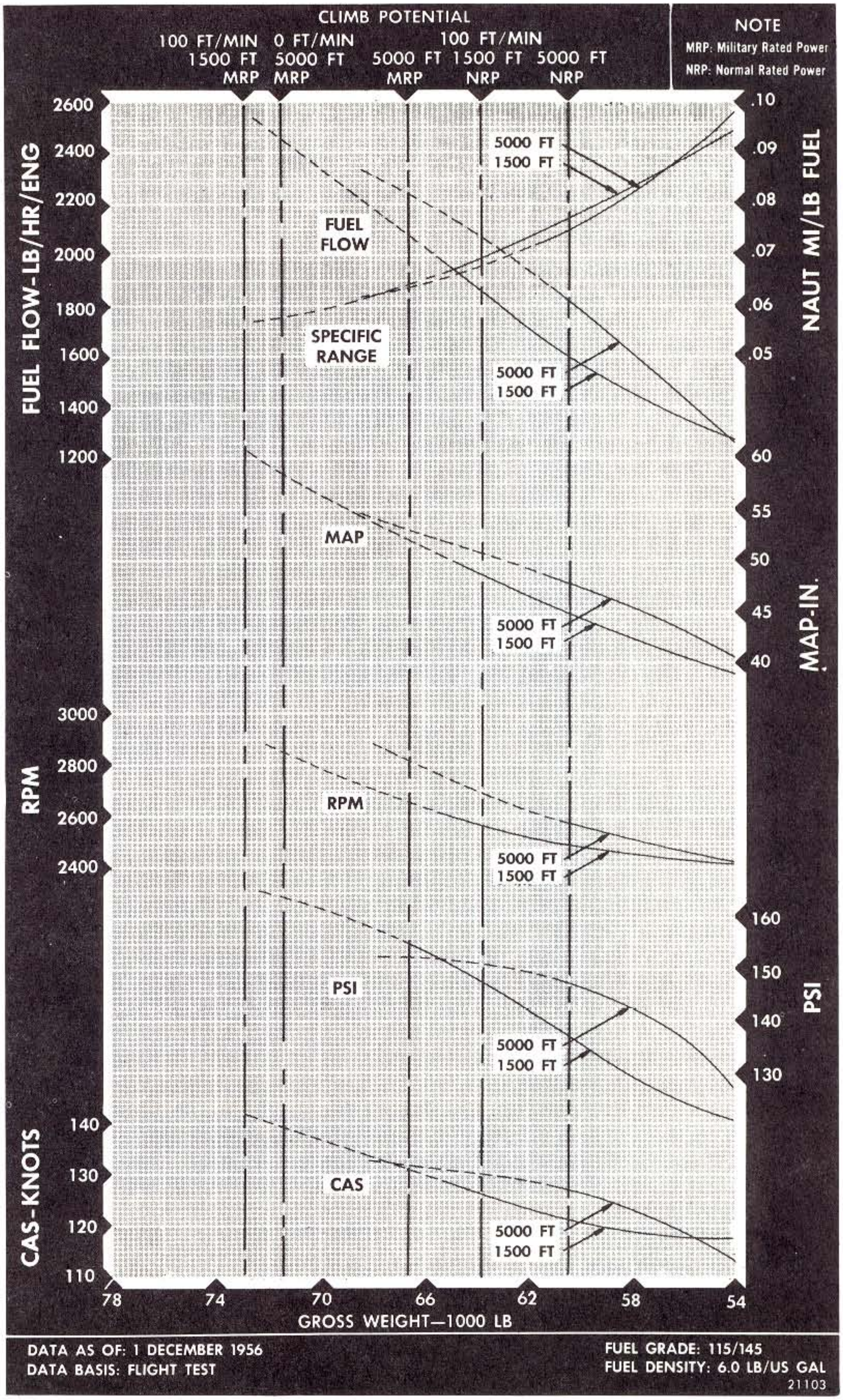


Figure A-29. Maximum Range Power Conditions vs. Gross Weight

LONG RANGE PREDICTION – DISTANCE

SINGLE ENGINE

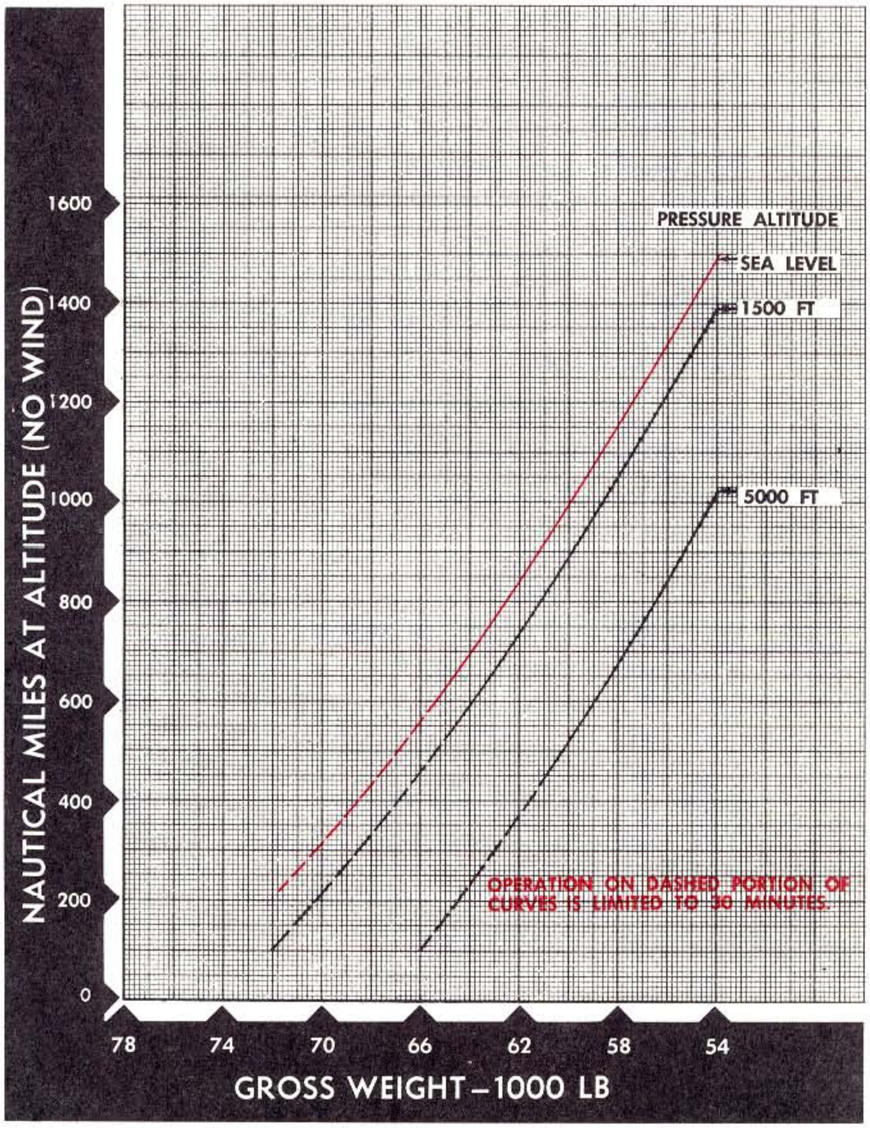
ASW LOADING

MODEL: P5M-2

Standard Day

ENGINES: (2) R3350-32W

Based on recommended cruising speeds on Maximum Range Power Conditions summary curve, figure A-29.



DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST, EXCEPT FOR SEA LEVEL WHICH IS ESTIMATED

FUEL GRADE: 115/145
FUEL DENSITY: 6.0 LB/US GAL

21104

Figure A-30. Single-Engine Maximum Range Prediction Curve—Distance

LONG RANGE PREDICTION–TIME

SINGLE ENGINE

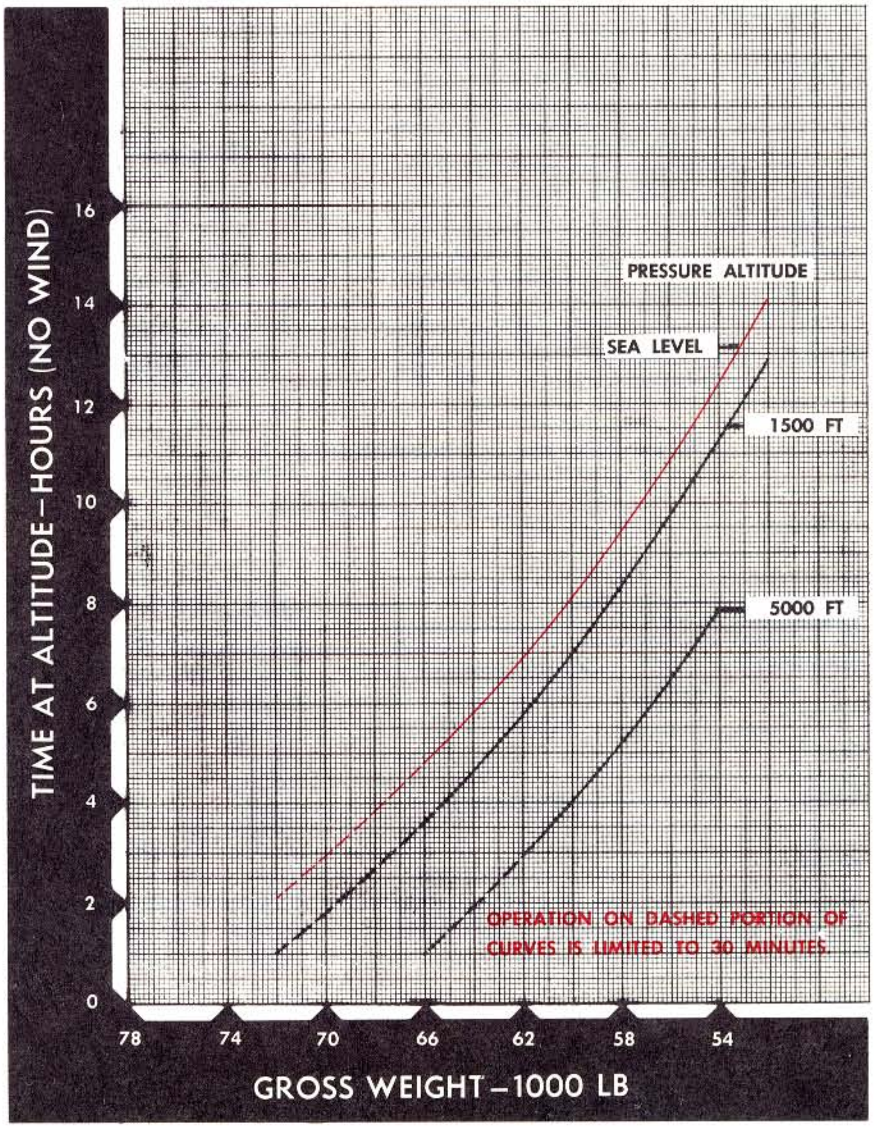
ASW LOADING

MODEL: P5M-2

Standard Day

ENGINES: (2) R3350-32W

Based on recommended cruising speeds on Maximum Range Power Conditions summary curve, figure A–29.



DATA AS OF: 1 DECEMBER 1956

DATA BASIS: FLIGHT TEST, EXCEPT FOR SEA LEVEL WHICH IS ESTIMATED

FUEL GRADE: 115/145

FUEL DENSITY: 6.0 LB/US GAL

21105

Figure A–31. Single-Engine Maximum Range Prediction Curve—Time

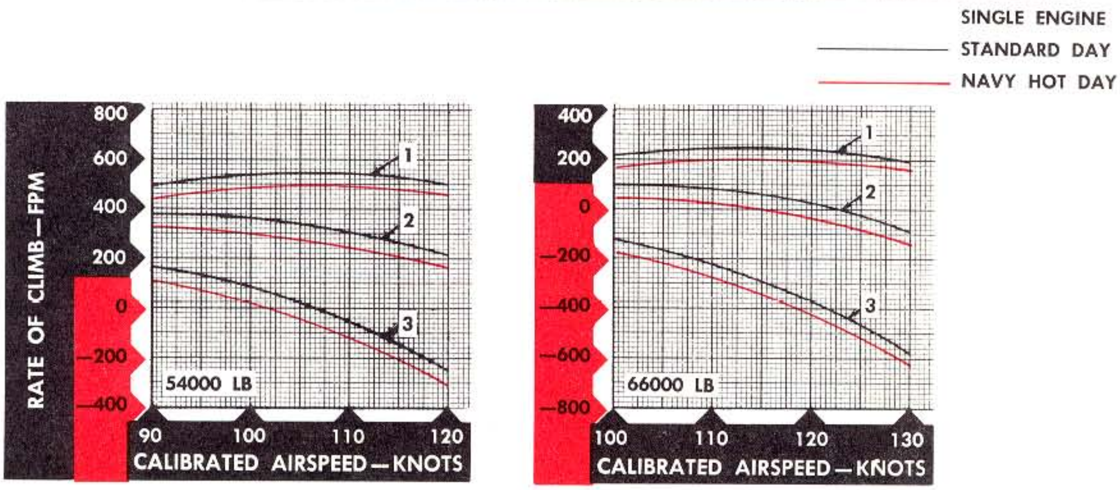
EMERGENCY CLIMB

SEA LEVEL | **SINGLE ENGINE** | **ASW LOADING**

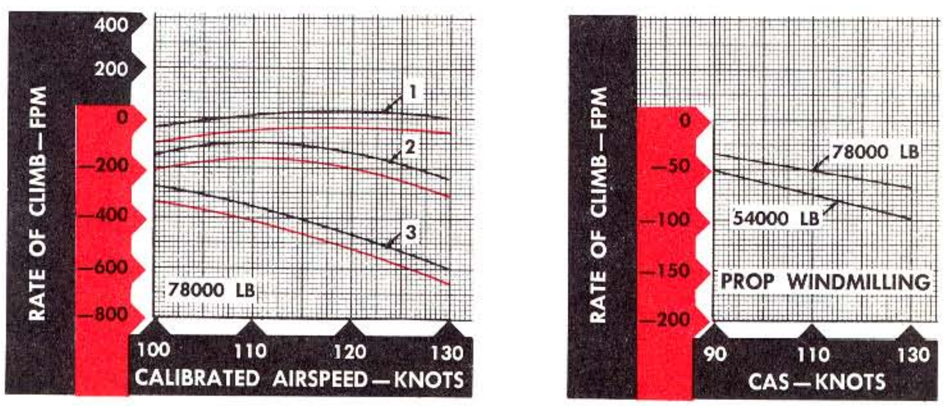
MODEL: P5M-2

Standard and Navy Hot Day

ENGINES: (2) R3350-32W



NOTES: 1. When power is decreased by 100 BHP due to humidity, r/c decrease 42 fpm at 54,000 lb gross weight and 33 fpm at 78,000 lb gross weight.
2. BHP decrease due to humidity is read from figure A–7A.



REMARKS:

1. GOOD Engine: MRP—2900 RPM, 61.5 IN. MAP
2. BAD Engine: Prop—FEATHERED
   Cowl Flaps—CLOSED
   Oil Cooler Doors—CLOSED

CONFIGURATION

1 Standard ASW—Flaps 0°
2 Standard ASW—Flaps 30°
3 Standard ASW—Flaps 40°

DATA AS OF: 1 DECEMBER 1956

DATA BASIS: ESTIMATED (EXCEPT FOR FLAPS 0° WHICH IS FLIGHT TEST)

FUEL GRADE: 115/145

FUEL DENSITY: 6.0 LB/US GAL

21106

Figure A–32. Single-Engine Emergency Climb Curve

EMERGENCY CEILING

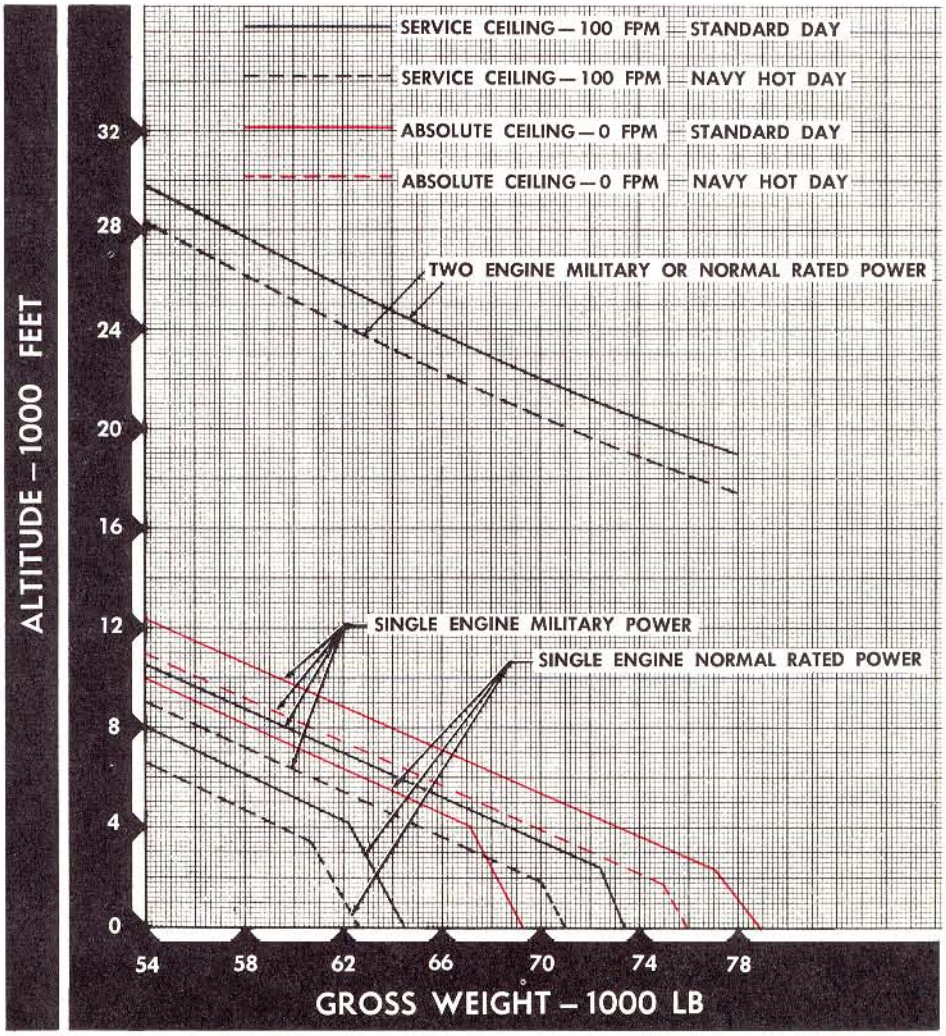
ONE AND TWO ENGINE OPERATION

ASW LOADING

MODEL: P5M-2

Standard and Navy Hot Day

ENGINES: (2) R3350-32W



NOTES:

1. Obtain equivalent gross weight for single engine emergency ceiling determination by adding 1500 lb to actual weight of airplane for each 100 BHP decrease due to humidity.
2. For two engine condition, add 4000 lb per 1000 BHP/ENG decrease due to humidity.
3. BHP decrease due to humidity is read from figure A-10.

DATA AS OF: 1 DECEMBER 1956

DATA BASIS IS: FLIGHT TEST

FUEL GRADE: 115/145

FUEL DENSITY: 6.0 LB/US GAL

21107

Figure A-33. Emergency Ceiling Curve

DRAG CONVERSION TABLE

MODEL: P5M-2 **ENGINES: (2) R-3350-32W**

CHANGE IN AIRPLANE CONFIGURATION FROM PATROL ASW CONFIGURATION	EFFECT ON PERFORMANCE			
	△ f SQ. FT.	CRUISE △ CAS FOR CONSTANT POWER (KNOTS)	WEIGHT ADJUSTMENT FACTOR—LBS. CLIMB	WEIGHT ADJUSTMENT FACTOR—LBS. LONG RANGE CRUISE
REMOVE SEARCHLIGHT, ROCKETS, AND ROCKET INSTALLATION	—3.4	+5	—2220	—2800

REMARKS:

Weight adjustment factor for long range cruise applicable only along recommended CAS line.

△ CAS should be used for all other power regions.

DATA AS OF: 1 DECEMBER 1956
DATA BASIS: FLIGHT TEST

21108

Figure A-34. Drag Conversion Table

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