DHC-2

BEAVER

FLIGHT MANUAL

THIS AIRCRAFT MUST BE OPERATED IN COMPLIANCE WITH THE LIMITATIONS CONTAINED IN SECTION IV OF THIS MANUAL.

THIS MANUAL IS LISTED AS AN APPROVED DOCUMENT IN D.O.T. AIRCRAFT TYPE APPROVAL A-22 AND F.A.A. AIRCRAFT SPECIFICATION NO. A-806.

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THE DE HAVILLAND AIRCRAFT OF CANADA, LIMITED

DHC-2
BEAVER

FLIGHT MANUAL

THE DE HAVILLAND AIRCRAFT OF CANADA LIMITED
Downsview Ontario

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INTRODUCTION

This manual has been compiled to familiarize pilots, in all relevant aspects, with the aircraft. For convenience of use the manual has been divided into six sections and an Appendix as follows:-

SECTION I DESCRIPTION OF AIRCRAFT

This section describes in detail, the aircraft, its systems and all controls that are essential for flight.

SECTION II NORMAL PROCEDURES

This section contains operating instructions arranged in sequence from the time the pilot approaches the aircraft until he leaves at the end of a flight.

The instructions refer mainly to the landplane, except when otherwise stated.

SECTION III EMERGENCY PROCEDURES

This section contains instructions for handling of the aircraft in emergencies, such as engine and propeller failure, fire etc. The instructions are given in proper sequence of operation.

SECTION IV OPERATING LIMITS, PERFORMANCE DATA AND FLIGHT CHARACTERISTICS

This section deals with operating limitations, flight characteristics and performance data which must be adhered to for safe operation of the aircraft.

SECTION V GENERAL OPERATING INSTRUCTIONS AND ALL WEATHER OPERATION.

This section deals with the general operating instructions which should be observed to ensure the maximum efficiency from the engine and its accessories, the airframe and systems during operation in all types of weather.

SECTION VI SPECIAL INSTALLATIONS

This section contains information on special installations which can be fitted to increase the operating facilities of the aircraft. The handling of the aircraft, when equipped with these installations, is dealt with in detail.

APPENDIX OPERATING DATA CHARTS

These charts should be consulted before any flight so that the best use of the aircraft can be gained in respect to the fuel and payload it is intended to carry for that flight.

Section 1

CANADA

DESCRIPTION OF AIRCRAFT

SECTION 1

DESCRIPTION OF AIRCRAFT

1.1 GENERAL

The DHC-2 Beaver aircraft is an all-metal high-wing monoplane, designed to carry a pilot and seven passengers. Additional roles include that of cargo transport, ambulance, rescue operations, supply dropping, aerial survey, crop spraying and dusting.

The fixed landing gear may be replaced by a twin-float installation. Retractable wheel-skis may be installed, or a ski installation can replace the wheels.

1.2 DIMENSIONS See Figure 1-3.

1.3 GROSS WEIGHT See Figure 1-3.

1.4 ENGINE

The aircraft is powered by a Pratt and Whitney "Wasp Junior" Model R-985SB3 nine-cylinder single-row radial engine, rated at 400 BHP at 5000 ft altitude. The engine drives a Hamilton-Standard constant-speed propeller; crankshaft and propeller rotation being clockwise. The supercharger is an engine-driven single-stage centrifugal type.

1.5 ENGINE CONTROLS

The engine control quadrants are located at the top of the pedestal. Depending on the installation date, either of two configurations are provided, see Figure 1-1. Friction control knobs, one below each control lever, increase lever friction when rotated clockwise.

1.5.1 THROTTLE LEVER

The throttle lever moves in a quadrant marked OPEN and CLOSED. The lever is connected to the throttle valve by means of push-rods and torque-tube linkage.

1.5.2 MIXTURE LEVER

The mixture lever moves in a quadrant marked as follows: AUTO LEAN - AUTO RICH - FULL RICH - FULL LEAN - IDLE CUT-OFF. The lever is connected to the carburettor by means of push-rods and torque-tube linkage.

1.5.3 CARBURETTOR HEAT CONTROL LEVER

The carburettor heat control lever is located below the engine instrument panel and is cable-connected to a gate valve in the carburettor air intake duct.

When the lever is selected up to the COLD position, cold ram air enters the car-

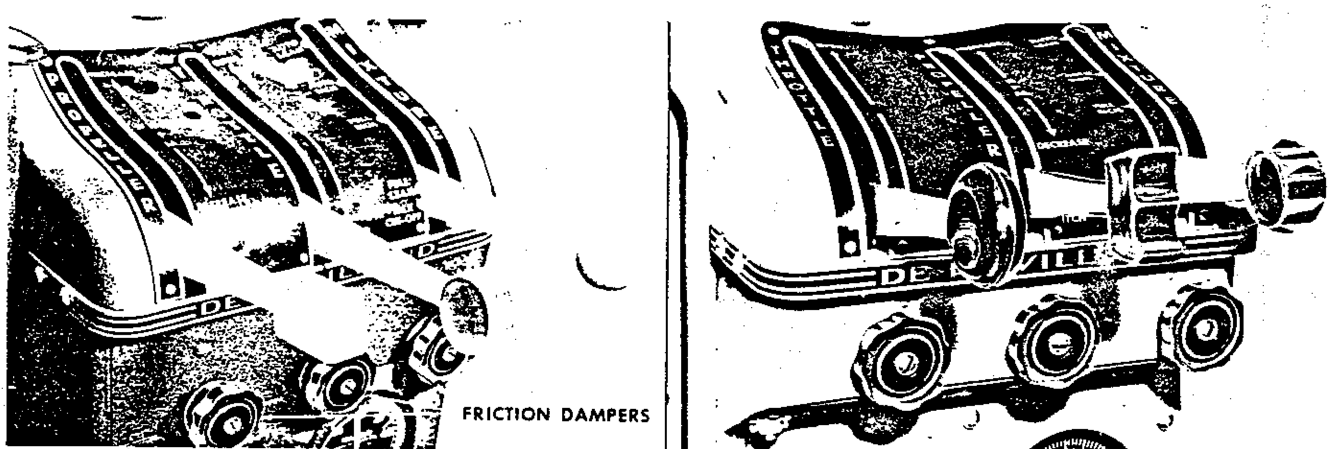


FIG 1-1 CONTROL QUADRANT (Later installation on right)

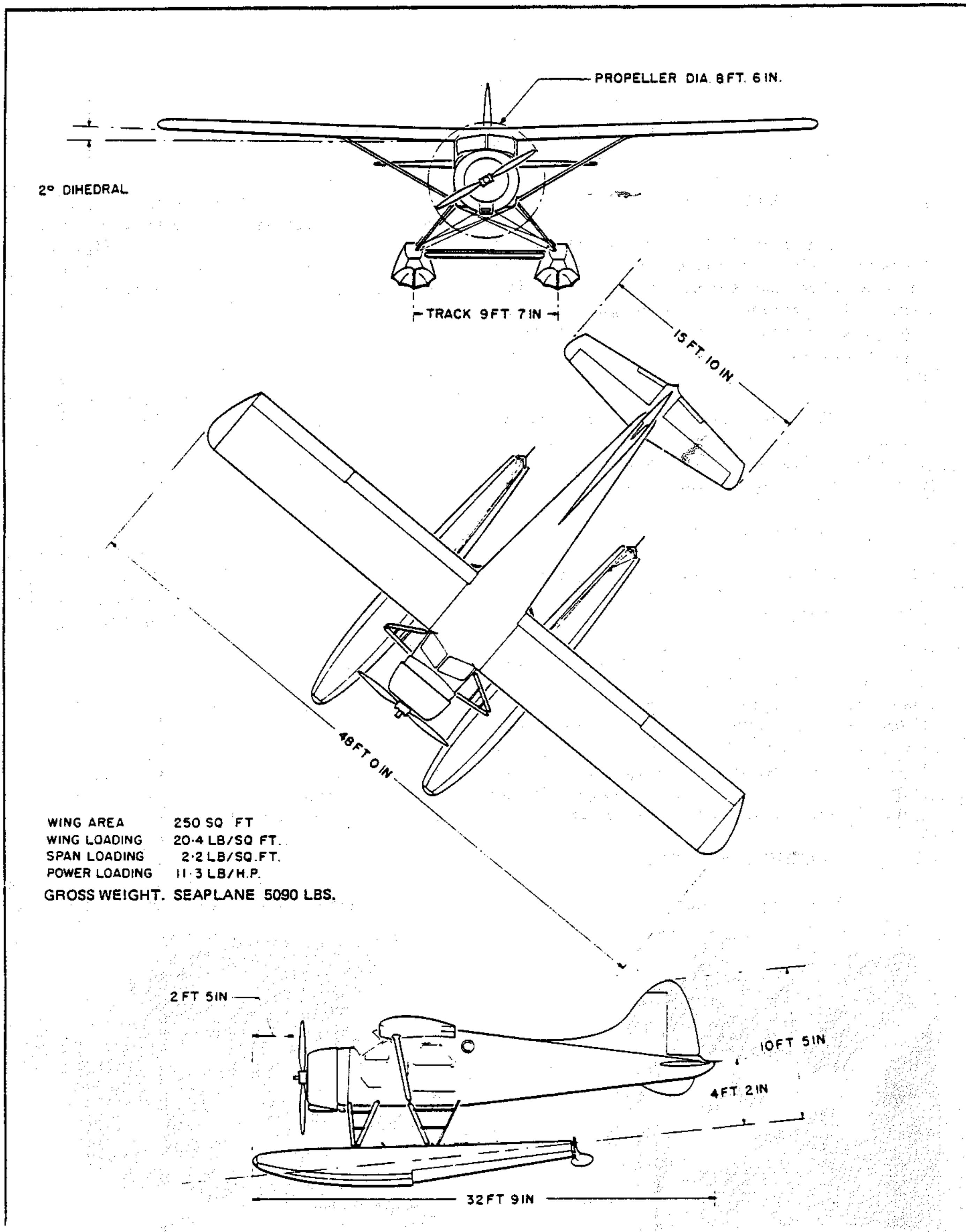


FIG 1-2 THREE VIEW DIMENSIONAL DIAGRAM - SEAPLANE

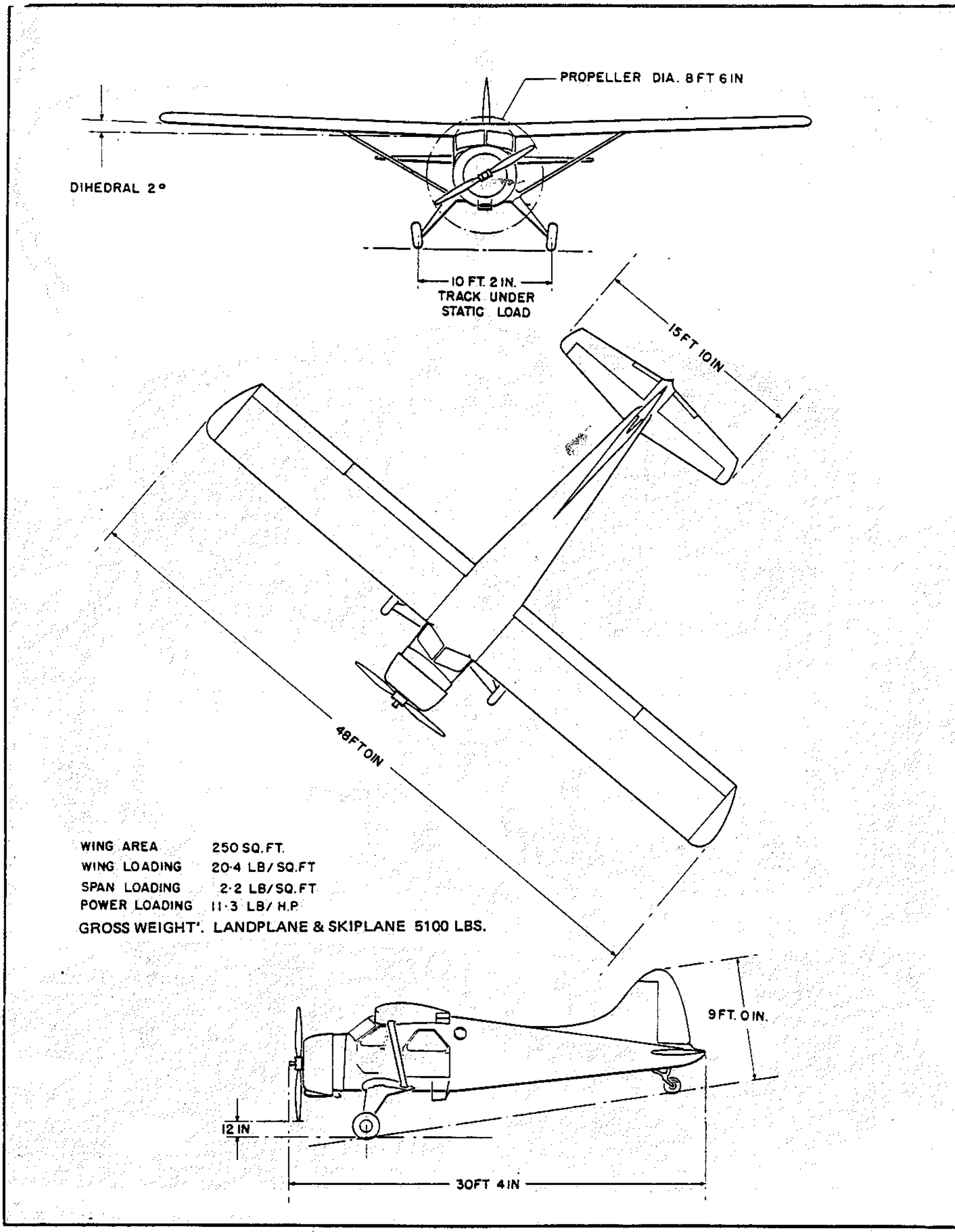


FIG 1-3 THREE VIEW DIMENSIONAL DIAGRAM - LANDPLANE

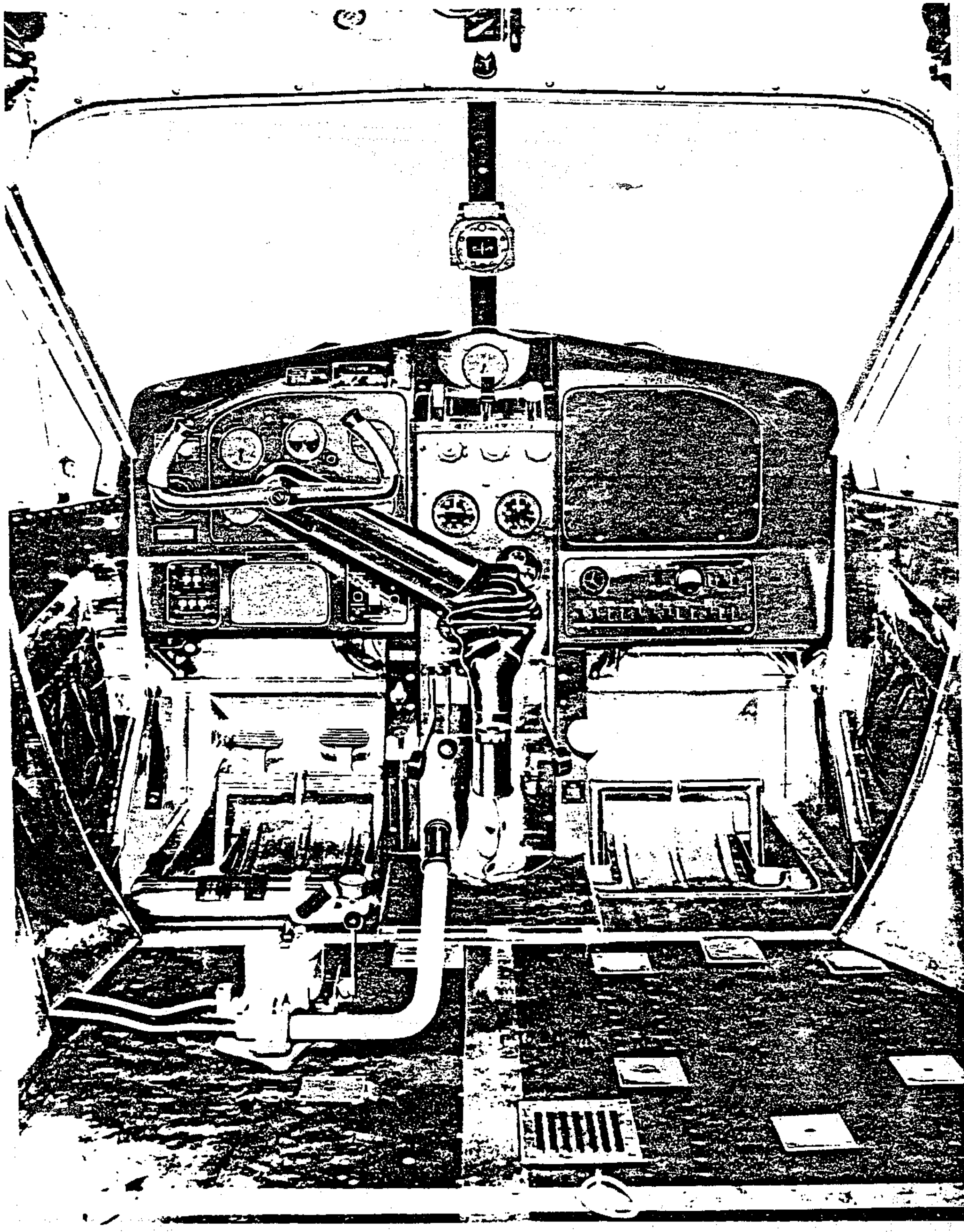
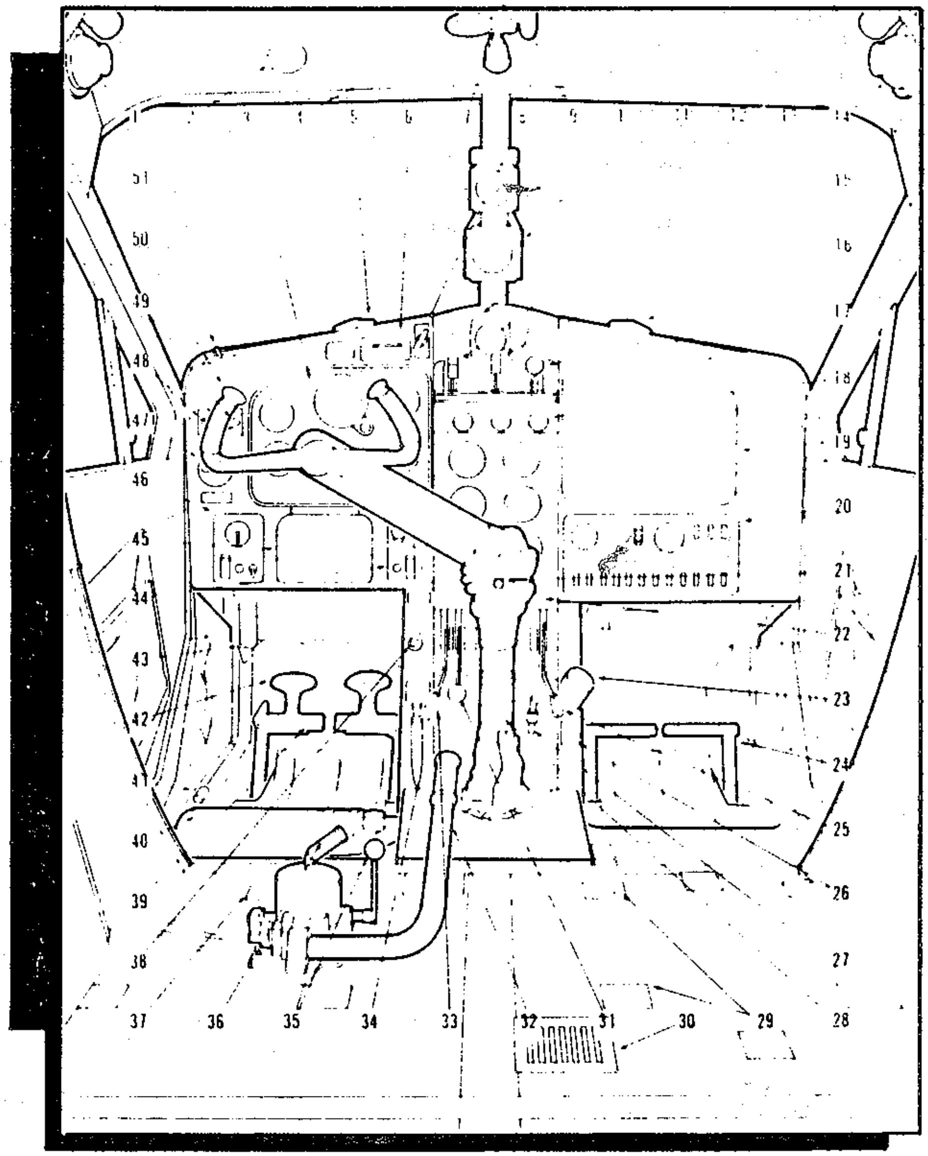


FIG 1-4 FLIGHT COMPARTMENT



1. COLD AIR DUCT
2. OUTSIDE AIR TEMP. GAUGE
3. FLIGHT INSTRUMENT PANEL
4. RUDDER TRIM WHEEL
5. DEFROSTER
6. FLAP INDICATOR
7. ELEVATOR TRIM INDICATOR
8. COWL SHUTTER CONTROL
9. ELEVATOR TRIM WHEEL
10. ALTERNATE COMPASS POSITION
11. COMPASS POSITION
12. RADIO COMPASS
13. PROPELLER LEVER
14. COLD AIR DUCT
15. THROTTLE LEVER
16. DEFROSTER
17. MIXTURE LEVER
18. FRICTION DAMPERS
19. RADIO PANEL
20. ELECTRICAL SWITCH PANEL
21. CONTROL COLUMN THROW-OVER LOCK
22. ENGINE INSTRUMENT PANEL
23. OIL TANK FILLER
24. CO-PILOT'S RUDDER PEDALS
25. FUEL AND OIL EMERGENCY SHUT-OFF LEVER
26. OIL CONTENTS LABEL
27. STARTER BRUSH RELEASE LEVER
28. ASH TRAY
29. ATTACHMENT POINT FOR CO-PILOT'S SEAT
30. CABIN HEAT GRILL
31. WOBBLE PUMP
32. FLAP HYDRAULIC HAND PUMP
33. CARBURETTOR AIR LEVER
34. CABIN HEAT CONTROL
35. FLAP SELECTOR
36. FLAP HYDRAULIC RESERVOIR AND FILLER
37. ATTACHMENT POINT FOR PILOT'S SEAT
38. PARKING BRAKE
39. RUDDER PEDALS
40. HAND FIRE EXTINGUISHER
41. PRIMER
42. BRAKE TOE PEDALS
43. HOT AIR FOOT DUCT
44. FIRE EXTINGUISHER PANEL
45. ALTERNATE COMPASS POSITION
46. STARTER PANEL
47. FUEL SELECTOR
48. OIL DILUTION SWITCH
49. STARTER CLUTCH
50. FLIGHT CONTROL SWITCH
51. MASTER SWITCH

FIG 1-5 FLIGHT COMPARTMENT, INDEXED

burettor through the air intake duct. As the lever is moved down towards the HOT position, the gate valve progressively closes the cold air intake while opening the warm air duct. This second duct allows heated air, from inside a heat exchanger muff surrounding a section of the engine exhaust collector, to mix with the cold ram air before delivery to the carburettor. Intermediate positions of the lever between fully up and fully down will therefore give varying degrees of carburettor air intake temperature.

With the lever in the HOT position the ram air intake is fully closed and heated air only is ducted to the carburettor. For operation in desert areas a dust filter for the ram air intake can be installed.

A carburettor mixture temperature gauge in the engine instrument panel indicates the resulting mixture temperatures.

1.5.4 CARBURETTOR AIR INDUCTION SYSTEMS

(a) LOWER AIR INDUCTION SYSTEM

The lower air induction system consists of an air scoop in the lower engine cowling feeding unfiltered air through a duct and into the carburettor.

On special order, this system can be equipped with a hinged, dry air filter mechanically connected to a carburettor air filter control installed above and to the right of the engine controls quadrant. The control is marked CARB AIR, IN-RAM, OUT-FILTER and arrowed counterclockwise with TURN TO UNLOCK. At the RAM position the filter lies flush with the bottom of the air scoop and allows unfiltered ram air to enter the carburettor. At the FILTER position, the forward end of the filter is raised so that air entering the scoop must pass through the filter before entering the carburettor. The control must be turned clockwise to lock in either position.

WARNING

Under no circumstances must the CARB AIR control remain in any intermediate position between IN-RAM and OUT-FILTER. In an intermediate position the filter will cause a blockage in the air induction system.

The effect of the filter is to reduce the 5000 foot critical altitude by approximately 800 feet. Below this new critical altitude there is no loss in engine power, while above this altitude the power loss is small. The engine may be started with the CARB AIR control in the RAM position to avoid damage to the filter in case of backfires. Immediately after starting the engine, in areas wherever there is a possibility of dust, sand or dirt entering the intake, the control should be moved to and remain at FILTER position for all ground running, taxiing and take-off, and during flight if necessary. Take-off from a short field, at or above the new critical altitude, should be made with the CARB AIR control at RAM position. Before landing in dusty or sandy areas, the control must be selected to FILTER and remain in this position while the aircraft is on the ground, except when starting the engine as previously explained.

(b) UPPER AIR INDUCTION SYSTEM (FULLY FILTERED)

The upper air induction system (Modification 2/1164) consists of an air scoop on the top right of the engine rear cowling feeding air through a duct, at the right side of the engine, and through a filter to the carburettor. In this installation the induction air is filtered at all times and there is no pilot control, except during emergency operation when the filter is bypassed. (See below.)

An emergency air handle, marked EMERGENCY CARB AIR-PULL & LOCK, is provided at the left of the engine controls pedestal. Operation of the handle mechanically opens a flap valve in the duct directly below, and leading into, the carburettor. The flap valve is opened by turning the handle counterclockwise, thus breaking the lockwire. The handle is then pulled fully out and turned clockwise to lock the flap valve fully open. In this position an emergency air inlet to the carburettor is provided, in the event of a blockage in the main induction system.

NOTE

When the emergency air handle is operated to open the flap valve, the air enters the carburettor direct and unfiltered, and its temperature cannot be adjusted by the carburettor heat control lever.

CAUTION

On entering the aircraft check that the handle is pushed fully in and secured by lockwire.

To maintain the carburettor mixture temperature within the limits shown in Figure 4-1, heated air can be admitted at the left side of the air scoop duct by selection of the carburettor heat control lever. The air is heated by passing through a heater muff surrounding part of the exhaust manifold.

1.5.5 ENGINE IGNITION SWITCHES

A rotary four position ignition switch, located on the STARTER PANEL below the flight instrument panel, is marked OFF, L, R and BOTH.

1.5.6 BOOST COIL SWITCH

A boost coil switch, located on the starter panel, is spring-loaded to the OFF position.

When the switch is held to the BOOST COIL position, high tension electrical current is supplied to the engine spark plugs to initiate starting.

1.5.7 PRIMER PUMP

The hand-operated cylinder primer pump is on the floor to the left of the pilot's seat. The pump handle is pushed down and rotated anti-clockwise to unlock and, after use, relocked by pushing it down and rotating it clockwise.

1.5.8 STARTER

The engine is started either by an electrical direct cranking starter motor or by an electrical inertia, direct-cranking starter with hand cranking facilities.

1.5.9 STARTER SWITCH

The starter switch for the electrical direct cranking starter motor and the starter clutch and boost coil switches required for the electrical inertia starter are located on the starter panel below the flight instrument panel.

1.5.10 HAND STARTING CONTROLS

When hand-cranking, the starter commutator brushes must be raised from the commutator in order to reduce the frictional loads involved. This is accomplished by inserting the Starter Brush Release Lever, which is normally secured by a clip to the pedestal base, into the brush release lever socket on the engine instrument panel, and rotating the lever from ELECTRIC to HAND TURNING position.

When starting the engine by hand-cranking, the starter is engaged at its maximum speed to the engine by pulling out the Starter Clutch handle located to the left of the flight instrument panel.

To lock the handle in the engaged position, pull out fully then rotate a 1/4 turn clockwise.

1.5.11 ENGINE INSTRUMENTS

Conventional engine instruments are mounted on a panel below the engine controls quadrant on the pedestal. The engine instruments consist of: Tachometer, Manifold Pressure Gauge, Cylinder Head Temperature Gauge, Carburettor Mixture Temperature Gauge, combined Oil and Fuel Pressure and Oil Temperature Gauge. The starter Brush Release Socket

is also located on the engine instrument panel.

1.6 PROPELLER

The engine drives a Hamilton-Standard two-bladed 8 ft 6 ins. diameter constant speed, counterweight type propeller having a pitch range from 11.5° to 24°.

1.6.1 PROPELLER LEVER

The propeller lever is located to the left of the throttle lever in the engine controls quadrant on the top of the pedestal and slides in a gate marked RPM, DECREASE and INCREASE. It is connected by a push/pull rod linkage to the propeller governor.

The governor retains the selected rpm constantly, within the operating range of the propeller, regardless of variations in air loads or flight attitudes.

When INCREASE RPM is selected the governor directs oil from its own engine driven pump to the propeller, at pressure, which hydraulically moves the propeller blades, in opposition to the counterweight, to lower angles.

When DECREASE RPM is selected the governor allows oil from the propeller to return to the engine sump and the counterweights move the blades to higher angles.

A friction control knob, below the propeller lever, increases the friction when rotated clockwise.

1.7 OIL SYSTEM

The oil tank is located aft of the firewall and is serviced from inside the cockpit through a filler at the base of the pedestal. The capacity is 5 1/4 IMPERIAL GAL. (1 gal. air space), the air space may be reduced during oil dilution. Oil returned from the engine passes through a line to a combined oil temperature valve and cooler.

1.7.1 OIL SPECIFICATION

3-GP-80	3-GP-100
MIL-O-6082 (1080)	MIL-O-6082 (1100)
DED 2472 A/O	DED 2472 B/O

1.7.2 OIL DILUTION

When a start in cold weather is anticipated, the oil may be diluted with gasoline before stopping the engine. The oil dilution valve is operated by a solenoid which is controlled by a spring-loaded switch to the left of the instrument panel. For dilution percentages and times see Section V, para 5.2.

Oil dilution should not be used intermittently, because of oil filter sludging, but should be continued during the season once it has been started.

1.8 FUEL SYSTEM

Fuel is contained in three tanks under the cabin floor which are used separately. They are serviced through three filler necks in a filler compartment protected by a hinged door on the forward left-hand side of the fuselage, adjacent to the cockpit door.

For long range operation non-jettisonable wing tip tanks may be installed to replace conventional wing tips. Fuel from these tanks is gravity fed to the front tank. For fuel transfer procedures see para 2.11.1.

A long range belly tank may also be installed, on special order.

1.8.1 FUEL SPECIFICATION

3-GP-25A MIL-F-5572 DED 2485

1.8.2 FUEL CAPACITIES

Front tank	29 Imp.(35 U.S.) gal.
Centre tank	29 Imp.(35 U.S.) gal.
Rear tank	21 Imp.(25 U.S.) gal.
Wing tip tanks (2 x 18 Imp. gals)	36 Imp.(43 U.S.) gal.
Total without wing tip tanks	79 Imp.(95 U.S.) gal.
Total with wing tip tanks	115 Imp.(138 U.S.) gal.

1.9 FUEL SYSTEM CONTROLS

1.9.1 FUEL SELECTOR

Fuel is supplied from any one of the

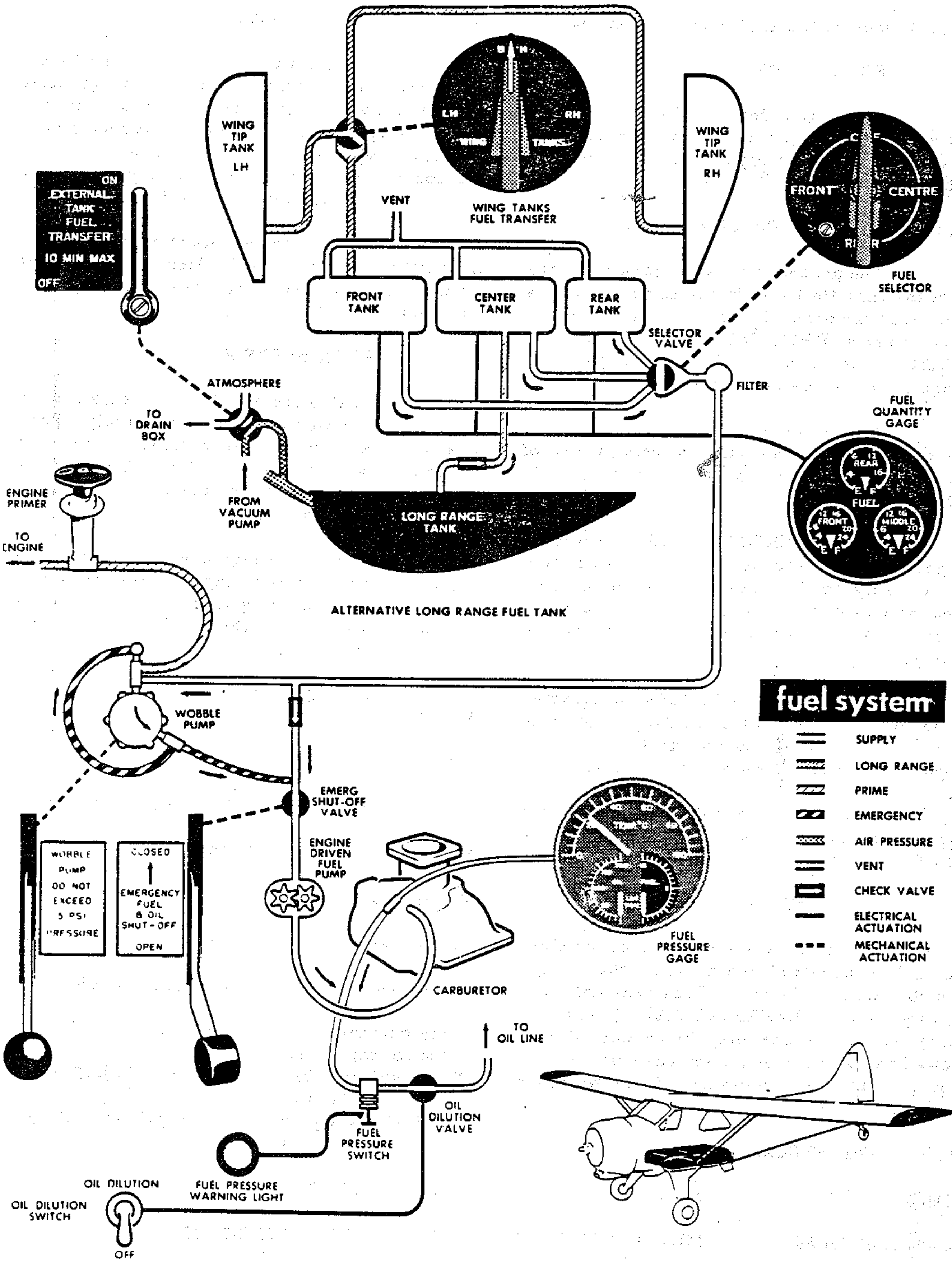


FIG 1-6 FUEL SYSTEM DIAGRAM

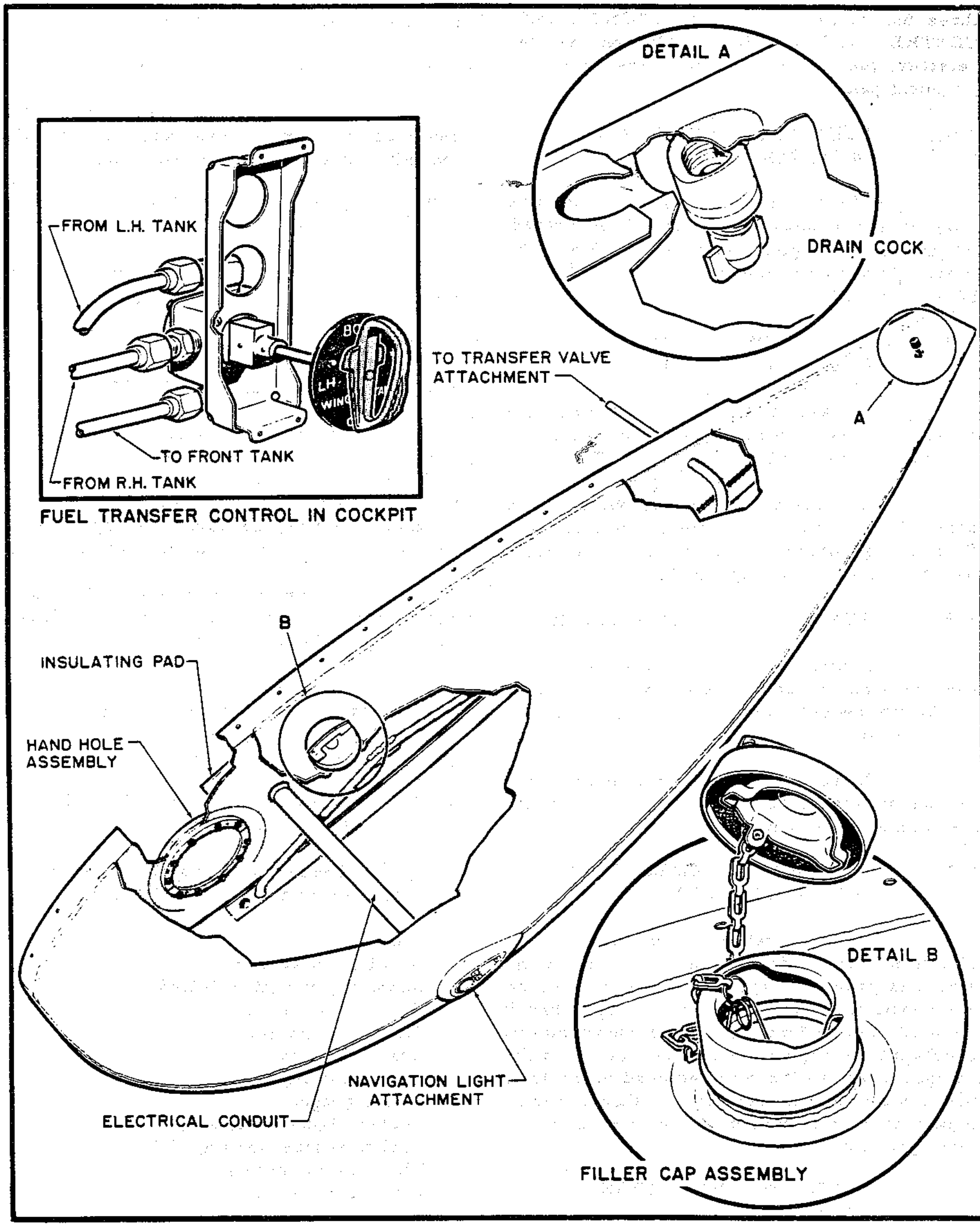


FIG 1-7 LONG RANGE WING TIP TANKS

three fuel tanks by selecting FRONT TANK, CENTRE TANK or REAR TANK on the fuel selector, located to the left of the flight instrument panel.

1.9.2 FUEL TRANSFER SELECTOR (WING TIP TANKS)

The fuel transfer selector, for use when wing tip tanks are installed, is located to the left of the pilot, above the cockpit door window. It has four positions marked LH, RH, BOTH and OFF.

1.9.3 FUEL BOOSTER PUMP (Special Order Only)

To assist the engine driven fuel pump, a booster pump may be incorporated into the fuel system.

The use of the booster pump should normally be confined to engine starting and flight at high altitude, when its operation would help to prevent fuel vapor locks.

1.9.4 FUEL WOBBLE PUMP LEVER

A fuel wobble pump lever, below the engine instrument panel on the pedestal, is used to build up the fuel pressure to 5 psi, for starting the engine.

In an emergency the fuel pressure can be maintained by the wobble pump should the engine driven pump fail.

1.9.5 FUEL AND OIL EMERGENCY SHUT-OFF LEVER

The emergency shut-off lever, on the right side of the pedestal, below the engine instrument panel, is normally wirelocked in the down position. When pulled sharply up to break the wire lock, and moved to the closed position, it cuts off the supply of both fuel and oil to the engine. After use it can be returned to its down position for normal operation but should be wire locked as soon as possible to prevent inadvertent operation.

1.9.6 FUEL CONTENTS GAUGE

A triple indicator fuel contents gauge, located on the right side of the engine instrument panel, is graduated in Imperial gallons, in white and red figures for in-flight and tail down positions respectively.

1.9.7 FUEL PRESSURE GAUGE

A combined fuel pressure, oil pressure and oil temperature gauge is located on the left side of the engine instrument panel.

1.9.8 FUEL PRESSURE WARNING LIGHT

On some aircraft a red warning light, which lights up when the fuel pressure drops to 3 psi, is positioned above the flight instrument panel.

1.10 ELECTRICAL SYSTEM

Electrical DC energy is supplied by a 50 amp 28-30 volt generator in conjunction with a 24 volt 17 amp/hr. battery. The generator output is regulated by a carbon pile voltage regulator. A reverse-current relay is used to protect the generator when it is not charging.

The generator is selected by a generator field switch on the electrical switch panel to the right of the pedestal.

The battery is stowed in a compartment on the left side of the fuselage, aft of the cabin door, and is accessible through a hinged panel on the outside of the aircraft.

1.10.1 ELECTRICALLY OPERATED EQUIPMENT

The following equipment and controls are operated by the electrical system:

Starter
Oil dilution system
Booster pump (if installed)
Engine indicators
Fuel contents gauge
Interior lights
Navigation lights
Landing light
Anchor lights (seaplane)
Fuel pressure warning light
Electronic equipment
Pitot head heater
Fire warning system

1.10.2 GENERATOR FIELD SWITCH

The generator field switch, located

on the electrical switch panel, is of the single-pole, single throw type.

1.10.3 BATTERY MASTER SWITCH

The battery master switch is located in the left-hand upper corner of the flight instrument mounting panel. It is of the double pole, single-throw type and interrupts the battery output to the electrical system.

The circuits controlling the discharge of the fire extinguisher and the cabin and anchor lights are independent of the master switch.

1.10.4 ELECTRICAL SYSTEM INDICATOR

A volt-ammeter, located in the electrical switch panel, indicates the amperage of the generator supply. The voltage of the generator supply is indicated when charging by pressing the stud at the lower left of the instrument. When the generator is not operating, the battery voltage only will be indicated.

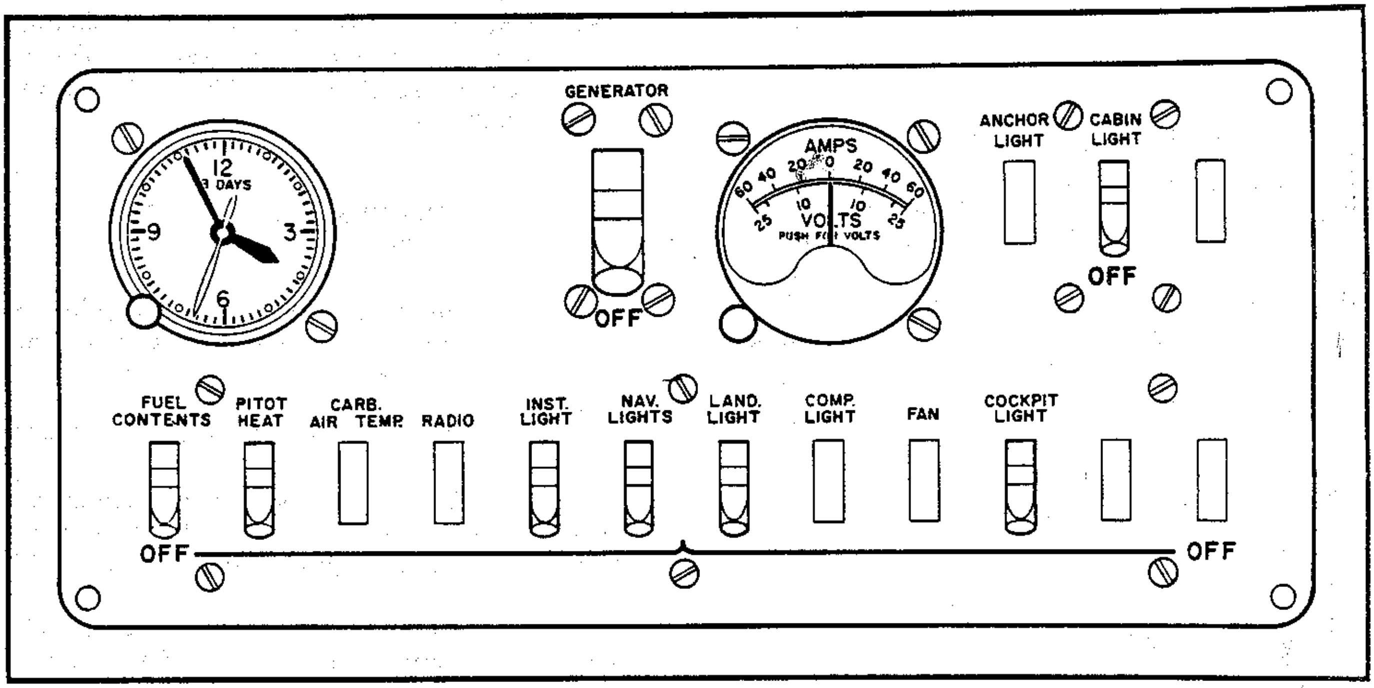


FIG 1-8 ELECTRICAL SWITCH PANEL

1.11 FLIGHT CONTROL SYSTEM

The control surfaces are conventionally operated by a control column and rudder pedals. The upper portion of the control column carrying the handwheel, may be "thrown-over" for use by a co-pilot in conjunction with the rudder pedals on the right side of the cockpit. The ailerons are differentially rigged to give a larger upward then downward displacement and are drooped when the wing flaps are lowered through the first 15°.

Trim tabs, adjustable in flight, are fitted to the elevator and rudder.

1.11.1 CONTROL COLUMN THROW-OVER AND LOCK

A lock plunger at the hinge point of the control column locks the hinged upper portion of the column in position.

The control column can be thrown over during level cruising flight without disturbing the balance of the aircraft by grasping the upper portion of the column and allowing the handwheel free movement as the upper portion is "thrown-over" for use by the co-pilot.

1.11.2 ELEVATOR TRIM

The elevator trim is adjusted by twin handwheels on the cockpit roof, operating in the natural sense. A pointer and scale, between the handwheels, marked NOSE UP, NOSE DOWN, indicate the direction and degree of trim applied.

1.11.3 RUDDER TRIM

The rudder trim is adjusted by a handwheel on the cockpit roof, just aft of the elevator trim handwheels. A pointer and a scale, marked LEFT and RIGHT indicate the direction and degree of the trim applied.

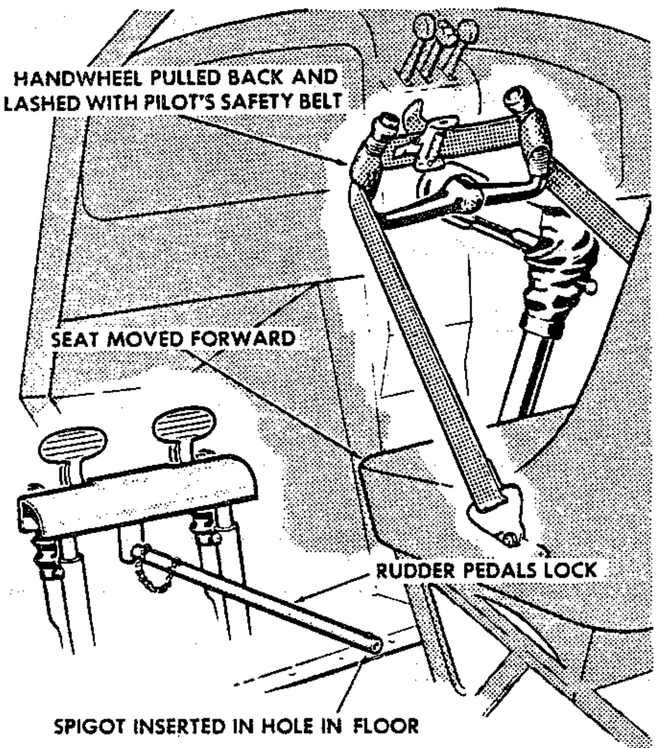


FIG 1-9 FLIGHT CONTROL LOCKS

1.11.4 CONTROL LOCKS

The control column and handwheel are locked by strapping them to the pilot's seat with the safety belt. The rudder pedals are locked by a pedal lock which, when not in use, is stowed in the baggage compartment behind the cabin rear partition.

To lock the pedals, the channel portion of the lock must be fitted over the pedals and the spigots at the end of the lock-rod, which is attached to the channel portion by a chain, must be inserted into a hole in the channel and in a corresponding hole in the cockpit floor, forward of the pilot's seat.

1.12 WING FLAPS

The wing flaps are of the slotted type and extend from the wing roots to the inboard ends of the ailerons which also droop in conjunction with the flap movement. The flaps are operated by an actuating cylinder located in the fuselage at the left-hand wing root. Hydraulic fluid is supplied to the actuating cylinder by a handpump, under the pilot's seat. This handpump has an integral reservoir, a selector valve, and a relief valve. The relief valve is set at 1,000 psi.

1.12.1 WING FLAPS HAND PUMP LEVER

The wing flap hand pump lever is at the right-hand side of the pilot's seat and is operated in a fore-and-aft direction.

1.12.2 WING FLAPS SELECTOR LEVER

The wing flaps selector lever is located on the right-hand side of the pilot's seat. It has two marked positions, UP and DOWN. Intermediate positions of the wing flaps are selected by moving the selector lever to UP or DOWN then pumping the wing flaps with the hand pump lever to the desired position, as shown on the wing flaps indicator.

WARNING

If the flaps are in any lowered position, it is essential that the selector lever is retained in the DOWN position. When the flaps are retracted, the selector lever must be retained in the UP position. Once the selector lever is set to DOWN and the flaps are pumped to the desired position, the selector lever must not be moved until it is desired to change the flap position.

1.12.3 WING FLAPS INDICATOR

A wing flaps position indicator is

situated above the flight instrument panel. It is marked FULL FLAP, LANDING, TAKE-OFF, CLIMB and CRUISE. FULL FLAP is only required for emergency landing in very restricted areas.

1.13 LANDING GEAR SYSTEM

The main wheel units and the tailwheel unit are not retractable. For water based operations the wheel units are replaced by two floats which are attached to the fuselage by struts.

For winter operations the main wheels and tailwheel may be replaced by skis.

1.13.1 TAILWHEEL STEERING

The tailwheel is steerable by operation of the rudder pedals, for 25° each side of the longitudinal centre line of the aircraft. Outside of these limits, the tailwheel automatically disengages from the steering range and becomes fully castoring. The tailwheel is brought back into steering range by taxiing straight forward and centering the rudder pedals at the same time. Engagement of the steering mechanism has been achieved when a slight resistance to the movement of the rudder pedals is felt.

1.13.2 BRAKE SYSTEM

The main landing gear wheels are each fitted with a hydraulic brake unit which is individually actuated through an independent hydraulic line and brake master cylinder. Each brake master cylinder has an integral fluid reservoir and is connected by an adjustable linkage to its relative toe pedal. Depression of the toe pedal operates the piston in the relevent master cylinder which causes pressure to be applied, through flexible and rigid fluid lines and a brake valve, to the wheel brake unit concerned. A parking brake is incorporated in the brake system. Operation of the parking brake handle in the cockpit after the toe pedals have been depressed, locks the brake units in the "on" position.

1.13.3 TOE PEDALS

Pressure on the toe pedals, which are the upper portions of the rudder pedals, actuates the pistons in the master cylinders and displaces hydraulic fluid into the brake units where the shoes are applied to the brake discs. The toe pedals are adjustable relative to the rudder pedals by adjusting the lengths of the master cylinder connecting rods.

The removable rudder pedals for the co-pilot are not connected to the brake system.

1.13.4 PARKING BRAKE

When the parking brake handle (figure 1-4) is pulled, after the toe pedals have been depressed to build up pressure in the brake system, pressurized fluid is trapped in the lower part of the brake system and locks the brake units.

If the aircraft is fitted with the new type parking valve (Part No. C2-CF-1711A) and the brake toe pedals are operated while the parking brake is set, hydraulic pressure greater than that existing in the system below the parking valves is created in the master cylinders and this additional pressure will push back the locking plunger of the parking valve and disengage the parking brake.

WARNING

> In the event of a defective parking brake valve permitting loss of pressure after the brakes have been on for 6 to 10 minutes, the brakes will slip; and, if the engine is running, the aircraft will move forward.
>
> If the aircraft is fitted with a Scott Pat No. 4200 parking valve, it is then necessary to release the parking brake handle before the toe brakes can be used to stop the aircraft. The parking brake with above valve will hold the aircraft at engine speeds up to 1900 rpm, if normal toe pressure was applied when locking the brake system.

1.14 INSTRUMENTS

A shock-mounted flight instrument panel is provided for the pilot and incorporates an altimeter, turn-and-bank indicator, rate-of-climb indicator, air speed indicator, directional gyro and artificial horizon.

1.14.1 PITOT STATIC OPERATED INSTRUMENTS

The airspeed indicator, altimeter,

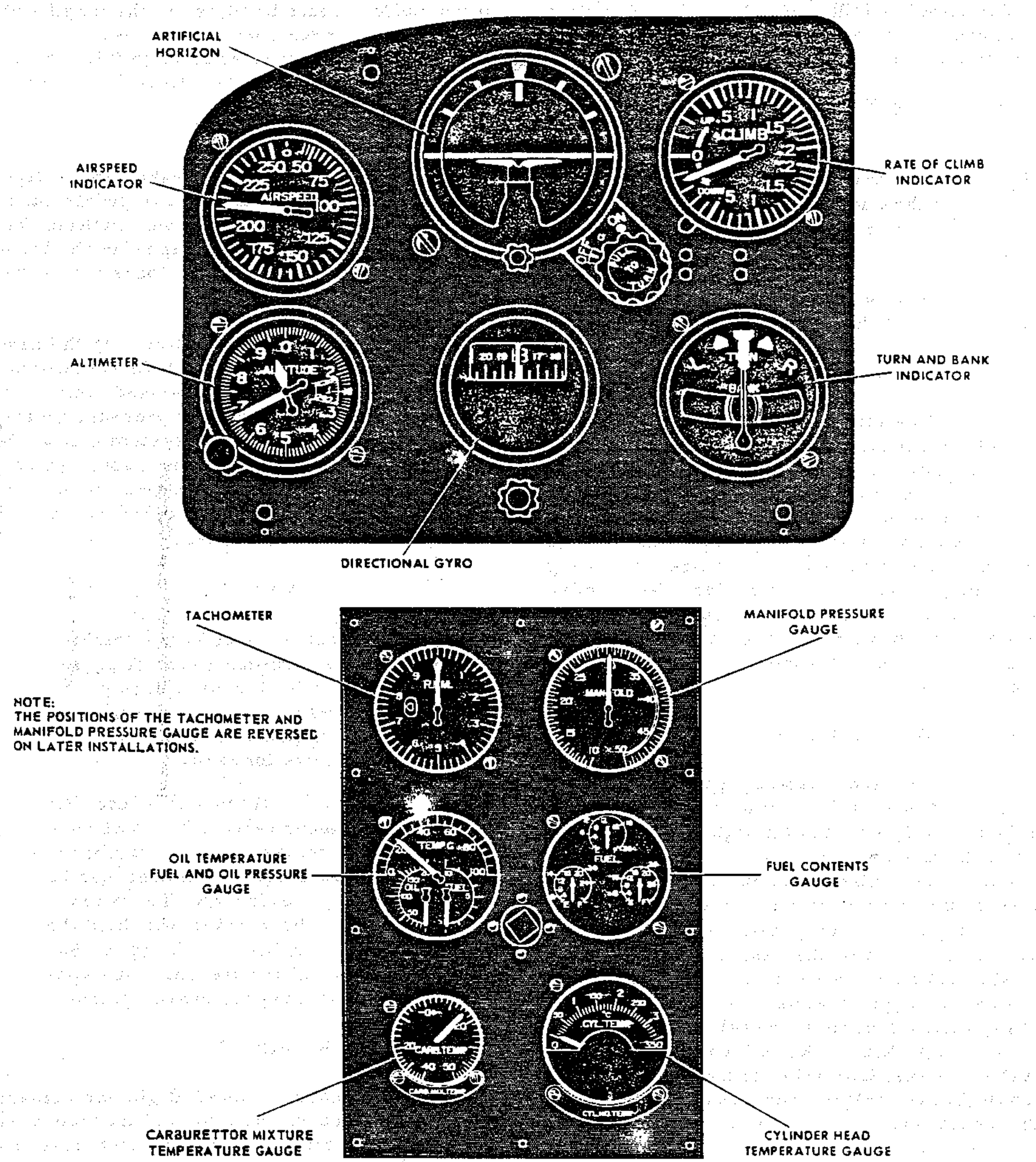


FIG 1-10 FLIGHT INSTRUMENT PANEL AND ENGINE INSTRUMENT PANEL

and the rate-of-climb indicator, are operated by the pitot static system. The static opening is incorporated in the left-hand side of the rear fuselage.

1.14.2 VACUUM-OPERATED INSTRUMENTS

The directional gyro, artificial horizon and turn-and-bank indicator, are operated by the vacuum system. A vacuum gauge on the right of the electrical switch panel indicates the vacuum in In.Hg. being applied to the instruments.

1.14.3 OUTSIDE AIR TEMPERATURE GAUGE

The outside air temperature gauge is located in the cockpit roof. It is of the direct-reading bulb type and the dial is graduated in both Fahrenheit and Centigrade scales.

1.14.4 ARTIFICIAL HORIZON

The artificial horizon is powered by the vacuum system. Its horizon bar gives a dive, climb and angle of bank indication. A knob at the bottom of the instrument dial permits adjustment of the instrument to any fore-and-aft attitude of the airplane within limits of plus or minus 7°.

A caging knob on the instrument erects the gyro and locks the horizon bar in the horizontal position. This knob must be in the uncaged position before take-off to insure proper indications from the instrument.

The operating limits are set to permit 70° climbs and glides, and 100° right or left banks before the limit stops are reached. If exceeded, the caging knob provides a rapid means for resetting the artificial horizon.

1.14.5 MAGNETIC COMPASS

The magnetic compass is mounted on a bracket attached to the windshield center post. The switch for the compass light is on the electric switch panel. A compass deviation card is mounted above the compass.

1.15 EMERGENCY EQUIPMENT

1.15.1 HAND OPERATED FIRE EXTINGUISHER

A hand operated fire extinguisher is stowed in a quick release clip on the floor, in front of the pilot's seat.

1.15.2 ENGINE FIRE EXTINGUISHER SYSTEM

The engine fire extinguisher system is controlled from the fire extinguisher panel below the flight instrument panel. The system incorporates a fire extinguisher bottle, a flame switch and a length of fuse wire located in the engine accessories compartment.

FIG 1-11 ENGINE FIRE EXTINGUISHER PANEL

In the event of fire, the red fire warning light on the extinguisher panel is illuminated. The engine should then be switched off before switching the EXTINGUISHER SWITCH-ON to discharge the contents of the bottle inside the engine cowling.

Both the warning light and the extinguisher circuits are protected by push-to-reset button type circuit breakers on the fire extinguisher panel.

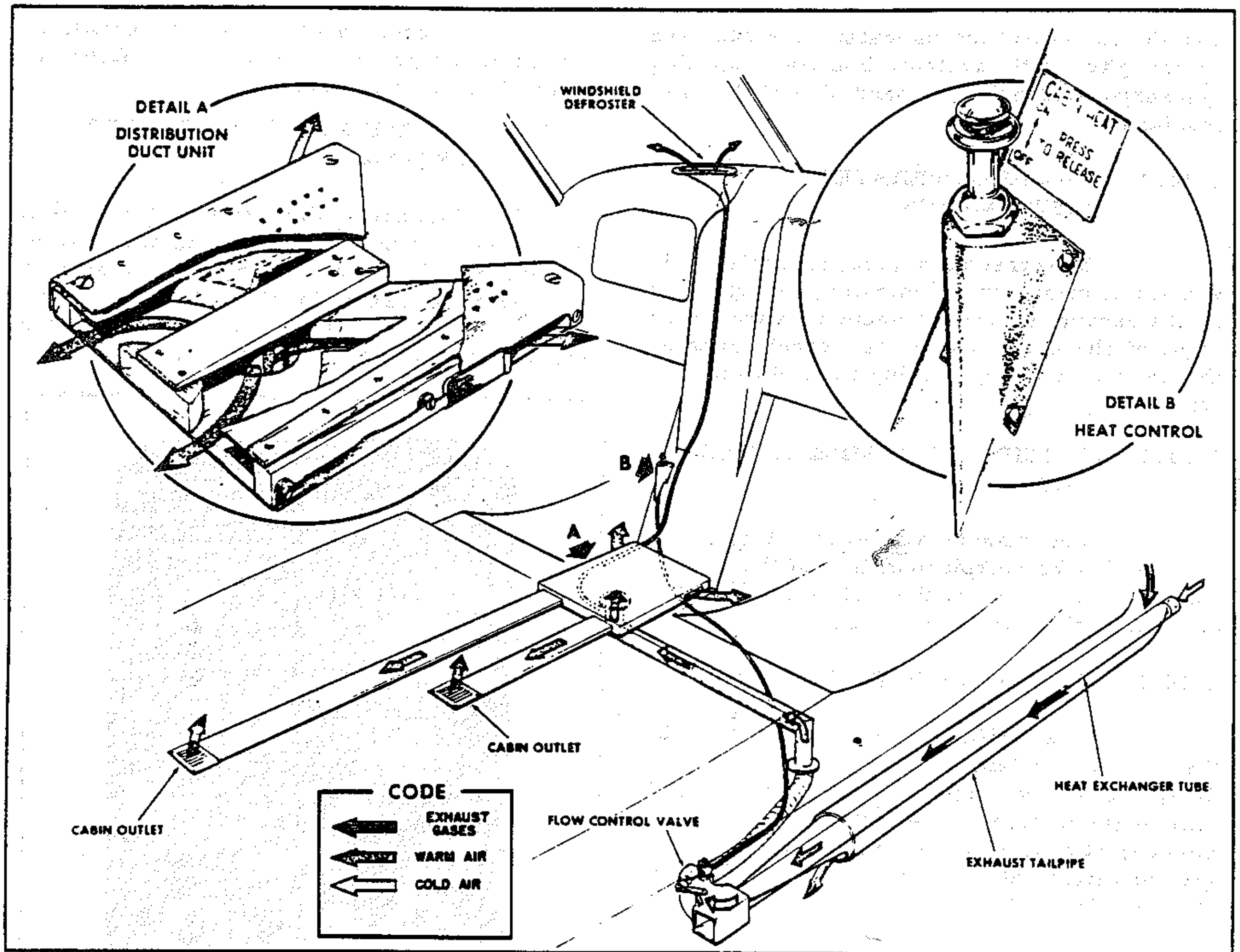


FIG 1-12 HEATING SYSTEM

1.15.3 FIRST AID KIT

A first aid kit is located on the back of the pilot's seat.

1.16 SEATING ARRANGEMENT

The seating arrangement, with the exception of the pilot's seat, varies with the internal loading requirements of the flight.

1.16.1 PILOT'S SEAT

The pilot's seat is simultaneously adjustable fore-and-aft and for height by means of a screw jack on the front of the seat; a lap type safety belt is provided. The seat cushion has grab-lines and may be used as a life-preserver when abandoning the aircraft in or over water.

The seat and its support pedestal can be removed temporarily from the aircraft by releasing three turn screws which secure the pedestal to the floor in conjunction with four hooks engaging in slotted holes in the floor.

1.16.2 PASSENGER SEATS

All passenger seats, including the co-pilot's seat, are fitted with lap type safety belts. All seats are removable.

1.17 HEATING SYSTEM

Hot air for heating the interior of the cabin is supplied by ram air passing through a heat exchanger tube in the engine exhaust system. From a four-way outlet at the centre of the cockpit floor, the heated air is ducted to the pilot's seat and front seat passengers' feet and to two outlet grills in the cabin floor.

A heated air outlet at the top of the instrument panel permits defrosting of the pilot's windshield. A second outlet can be installed for the co-pilot's windshield.

All hot air outlets are controlled simultaneously by a push-pull control, on the base of the pedestal which permits intermediate positions between fully ON in its up position and fully OFF.

1.18 VENTILATION SYSTEM

Two ventilation louvers, one on each side of the cockpit roof, to the left and right of the pilot and co-pilot, supply ram air to the cabin from screened openings in the leading edge of each wing root.

An exhaust type circular grill and shutter ventilator in the cabin roof exhausts air from the cabin. Necessary suction is provided by a rearward facing air scoop on top of the fuselage.

The ventilation louvers are adjustable. They open when the knob, on the side of the louver, is turned clockwise. Intermediate positions between OPEN and SHUT are possible. To control the direction of airflow from the louver, its body can be moved to point in any required direction. Two additional louvers can be installed in the rear of the cabin roof, on request.

1.19 ENGINE WINTER SHUTTERS

For operation in extreme cold conditions, engine winter shutters may be installed. The shutter assembly consists of a fixed outer shutter mounted on the engine rocker tubes and an inner shutter which rotates on pulleys attached to the outer shutter. The winter shutters control handle is located to the left of the engine controls. When the handle is in, the shutters are OPEN; when fully out the shutters are SHUT. The handle, when rotated clockwise, engages a pawl which locks the shutters in the OPEN, SHUT or any intermediate position. See Section 5.4 for suggested operating instructions.

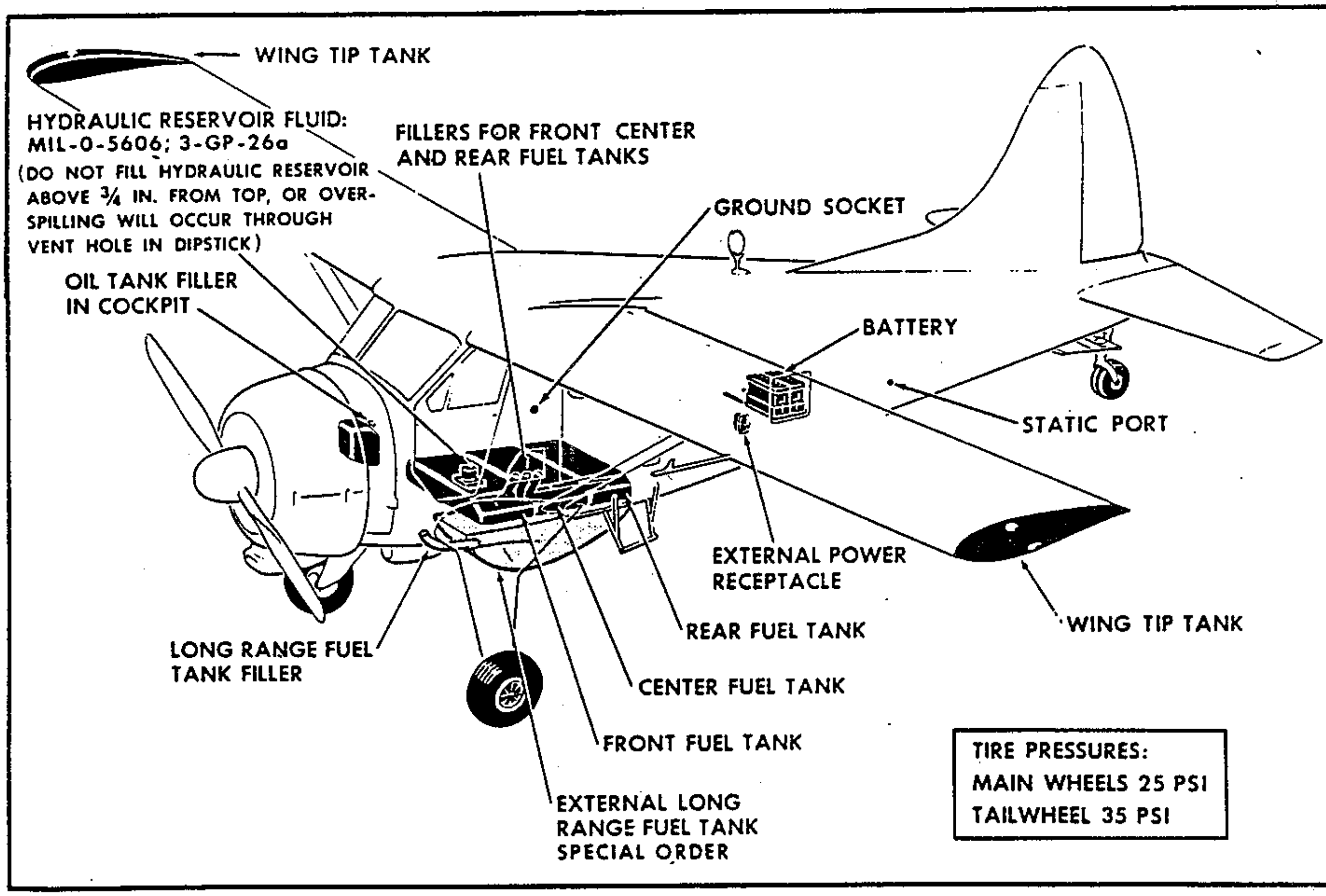
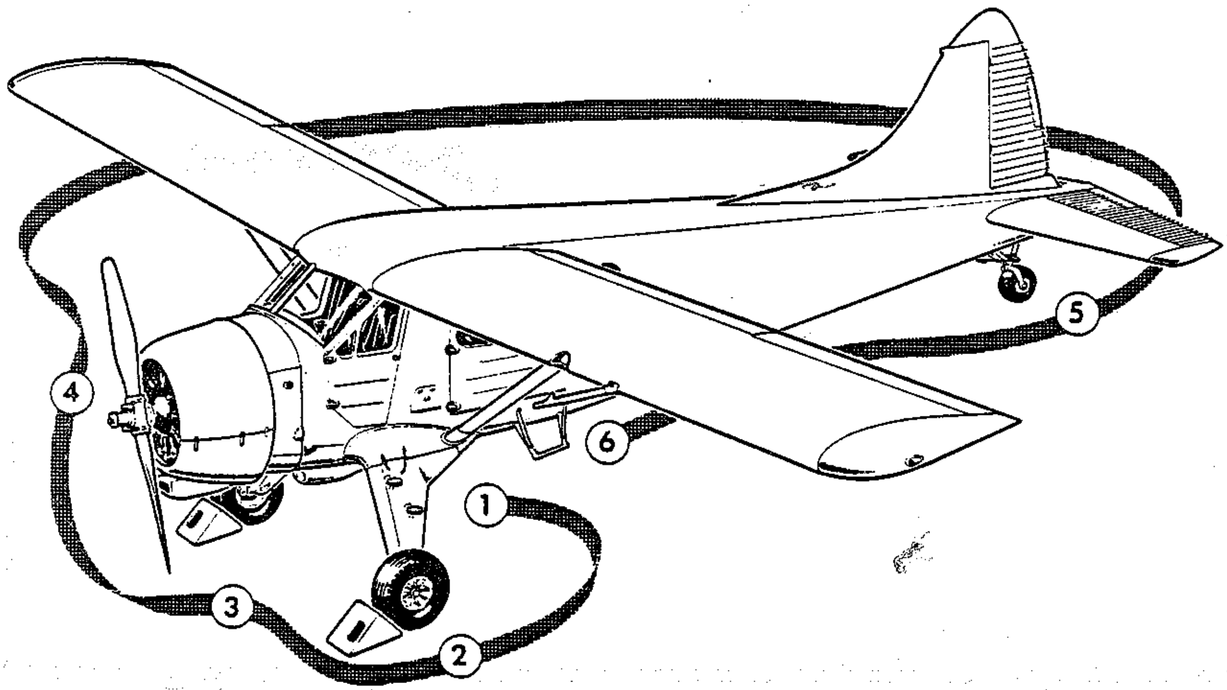


FIG 1-13 ROUTINE SERVICING POINTS

Section 2

NORMAL PROCEDURES



Starting at the pilot's cockpit, make the following checks:

While making exterior inspection, check all surfaces for cracks, distortion, loose rivets and indication of damage. Check all access doors for security. Check surfaces and hinges of all flight control surfaces.

1. Check security of fuel filler caps and access panel. Check that the aircraft has been serviced with required quantities of fuel, oil and hydraulic fluid.

2. Check that wheels are chocked. Check security of landing gear, fairings, tires for cuts, bruises and slippage. Check tire pressures and wheel brakes hose and pipes for oil leaks.

3. Check that carburettor and oil cooler intakes are clear.

4. Check propeller for nicks and oil leaks. Check cowl and panels for dents, scratches and for security.

5. Check tailwheel tire for cuts, bruises and slippage. Check tire pressure.

6. Check that pitot head cover is removed.

FIG.2-1 EXTERIOR INSPECTION DIAGRAM

SECTION II

NORMAL PROCEDURES

2.1 BEFORE ENTERING AIRCRAFT

Carry out an EXTERIOR INSPECTION of the airplane as detailed in Figure 2-1.

Also check storage of cargo and baggage and determine load distribution and CG position.

2.2 ON ENTERING AIRCRAFT

Check the following:

(a) Ignition - OFF.

(b) Parking brake - set.

(c) Controls - unlocked.

(d) Controls for - free, correct and full movement.

(e) Adjust pilot's seat.

(f) Trims - as required.

(g) All switches - OFF (except generator field switch which should be ON).

(h) Battery master switch ON.

(j) Fuel quantities - check.

(k) Altimeter and clock - set.

(l) Communication equipment - test (if external power is not available, make test during final period of engine warm-up).

When night flying is anticipated, make the following checks, possibly with the help of an outside observer:

(a) Landing light.

(b) Navigation lights, identification lights, if fitted.

(c) Check panel lights, interior lights.

(d) Flashlight - on board.

2.3 BEFORE STARTING ENGINE

Make the following checks:

(a) Fire guard - in position.

(b) Propeller area - clear.

(c) All switches - OFF (except generator field switch).

(d) Throttle lever - 1/4 to 1/2 in. open.

(e) Propeller lever fully DECREASE RPM.

(f) Mixture lever IDLE CUT-OFF.

(g) Carburettor hot air lever - COLD.

(h) Ask ground crew or use starter to turn propeller to make sure that an excessive amount of oil is not trapped in the lower cylinders, forming a hydraulic lock.

NOTE

If a hydraulic lock is indicated, drain the excess oil from the lower cylinders, by removing their spark plugs.

2.3.1 SEAPLANE ENGINE STARTING

If it is intended to start the engine before casting off from a buoy:

(a) Untie the mooring rope knot and reposition the rope around the forward spreader bar between floats.

(b) Pull seaplane forward until the buoy is behind the propeller, near the spreader bar

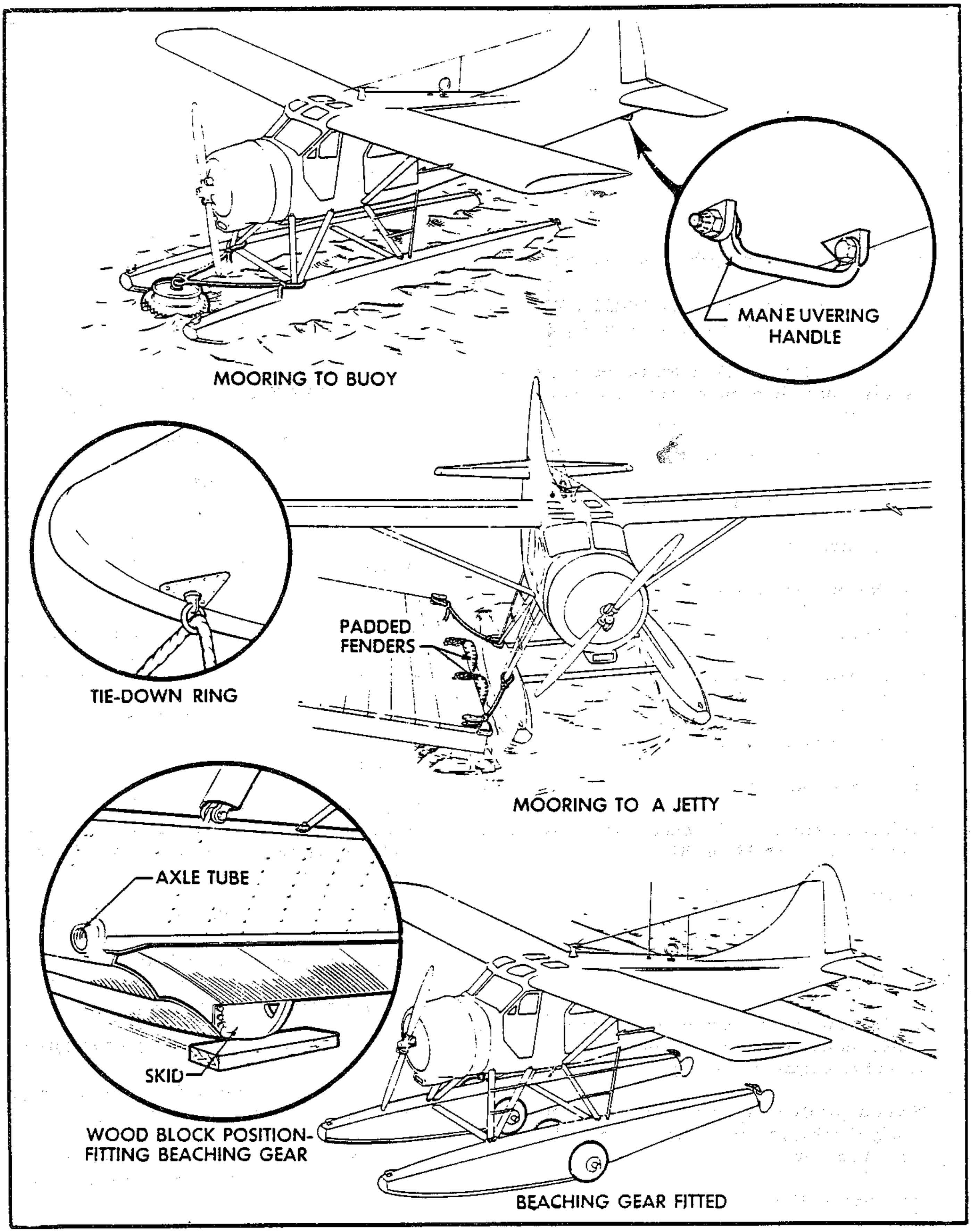


FIG 2-2 SEAPLANE MOORING AND BEACHING PROVISIONS

The buoy must be of the flagless type to allow the spreader bar to clear it when taxiing away.

2.4 STARTING ENGINE

2.4.1 NORMAL ENGINE START

(a) Propeller area - clear.

(b) Battery master switch - ON.

(c) Fuel and oil emergency cut-off lever - OPEN.

(d) Fuel selector to fullest tank.

(e) Mixture lever - AUTO RICH.

(f) Throttle lever - 1/4 to 1/2 in. OPEN.

(g) Buildup fuel pressure with wobble pump to maximum 5 psi.

(h) Prime 4 strokes.

(j) Both ignition switches to ON position.

<u>Direct cranking starter motor</u>

(k) Hold starter switch to STARTER position.

<u>Electrical Inertia Starter</u>

(l) Hold starter switch to STARTER position until starter whine ceases to rise in pitch.

(m) Release starter switch and simultaneously:

(n) Hold clutch engagement switch to STARTER CLUTCH position.

NOTE

A hot engine may be cranked directly for starting by energizing the starter and clutch together.

(o) Hold Booster Coil switch to BOOSTER COIL position.

As soon as engine fires:

(p) Release Starter switch or Starter and Starter Clutch switches to OFF position.

(q) Release Boost coil switch.

(r) Priming Pump - locked OFF.

CAUTION

1. As soon as engine fires, throttle back to about 500 to 800 rpm.

2. Do not pump throttle to catch a "dying" engine.

3. If oil pressure does not register on gauge within 30 seconds, stop engine and investigate.

WARNING

If a booster pump is installed make sure that the primer pump is shut-off completely after priming, or raw fuel will be injected into the cylinders when the booster pump is switched on.

(s) As soon as oil pressure reaches 50 psi steady indication select propeller lever to full INCREASE RPM position.

2.4.2 FAILURE IN STARTING

<u>Engine fails to start at first attempt (Starter run down)</u>

(a) Release boost coil switch.

(b) Ignition - OFF.

(c) Throttle lever 1/4 to 1/2 in OPEN.

(d) Disengage starter clutch, if necessary, by having propeller rocked between 1/4 and 1/2 revolutions. (Inertia Starter only).

(e) Repeat normal starting procedure, using little or no priming.

<u>Engine over-primed</u>

(a) Ignition - OFF.

(b) Mixture lever - IDLE CUT-OFF.

(c) Throttle lever fully open.

(d) Clear excess fuel from induction system by having propeller turned clockwise, by hand, through 3 to 5 revolutions.

(e) Repeat normal starting procedure.

CAUTION

Insure propeller is turned in a clockwise direction. Turning the propeller counter-clockwise will return the excess fuel into the induction system and, consequently, hamper starting, create a fire hazard and increase the risk of hydraulicing.

2.4.3 STARTING BY HAND CRANK

(a) Ignition switches - OFF.

(b) Battery master switch - ON.

(c) All other switches - OFF.

(d) Starter brush release control - HAND TURNING.

(e) Raise fuel pressure with wobble pump to 5 psi. (Booster pump on if installed).

(f) Have propeller turned 3 or 4 revolutions by hand.

(g) Prime 3 to 5 strokes while propeller is being turned.

(h) Throttle 1/4 open. (Booster pump OFF if installed).

(j) Propeller fully DECREASE RPM.

(k) Mixture lever - AUTO RICH.

(l) Carburettor hot air lever - COLD.

(m) Have starter hand crank rotated until maximum possible starter speed is reached, and remove the hand crank.

(n) Ignition switches - ON.

(o) Hold boost coil switch to - BOOST COIL position.

(p) Pull out mechanical starter clutch handle and hold.

As soon as engine fires:

(q) Release mechanical starter clutch handle.

(r) Actuate primer until carburettor takes over.

(s) Release boost coil switch.

(t) Observe that oil pressure is indicated within 30 seconds.

NOTE

Before attempting an electrical start after handcranking, move the starter brush release control to ELECTRIC to bring the starter commutator brushes into contact with the commutator.

2.5 ENGINE WARM-UP

(a) Throttle to give 1000 rpm.

(b) Move propeller lever fully forward to INCREASE RPM, as soon as oil pressure reaches 50 psi.

(c) After oil temperature has reached 100°F (40°C), adjust to smoothest engine speed between 1000 to 1400 rpm. Mixture lever FULL RICH.

(d) Select propeller lever to coarser pitch at 1000 rpm, to circulate the oil in the constant speed unit and propeller cylinder, then return to INCREASE RPM.

NOTE

Never rush engine warm-up.

(Engine fire during starting procedure see Section III, para 3.4.1).

(e) Check oil pressure, fuel pressure and temperature.

(f) Tank feeds - check by rotating fuel selector to each tank.

2.6 ENGINE GROUND TESTS

The engine oil inlet temperature should be above 100°F (40°C) yet never rise above 200°F (90°C). Cylinder head temperatures must not exceed 450°F (230°C).

Head aircraft into wind

(a) Parking brake ON, control column fully back.

(b) Fuel selector to fullest tank (if wing tip tanks are installed, select FRONT TANK or if belly tank is installed select CENTRE TANK).

(c) Propeller lever full INCREASE RPM.

(d) Set throttle lever to give 1750 rpm.

(e) Select magneto switch to "L". Return switch to "BOTH" to allow engine speed to stabilize itself before switching to "R". Return to "BOTH".

The drop in rpm should not exceed 100 rpm; it is normally in the region of 50 to 75 rpm. (In cold weather keep the carburettor mixture temperature at 40°F (4°C) for this check).

(f) If magneto drop is more than 100 rpm recheck at aerodrome pressure.

(g) Set throttle lever to give 600 rpm.

(h) Momentarily turn ignition switch OFF. The engine should stop firing completely.

NOTE

This last check should be carried out with the minimum delay in the OFF position to prevent backfiring when the switch is returned to "BOTH".

WARNING

If the engine does not momentarily stop firing completely, stop the engine by selecting the mixture lever to IDLE CUT-OFF. Warn personnel to stay clear of the propeller and have ignition switch and magneto ground lead checked.

(j) Open throttle until manifold pressure is equal to aerodrome pressure.

(k) Check that generator cuts in at 1400 rpm approximately.

(l) Check rpm 2100 plus or minus 20 approximately.

(m) Check oil, fuel and vacuum pressures, cylinder head and oil temperatures within ranges.

(n) Retard throttle to give 1600 rpm.

(o) Move propeller lever to COARSE PITCH then return to full INCREASE RPM position. Note recover of rpm to 1600 rpm.

2.7 TAXIING

(a) Flaps at CRUISE POSITION.

(b) Propeller lever - full INCREASE rpm.

(c) Watch oil and cylinder temperatures. If necessary, run engine at higher rpm to provide additional cooling during taxiing.

(d) Make brake test as soon as aircraft starts moving.

(e) Operate rudder pedals to steer aeroplane by means of steerable tailwheel (25° to each side). Use brakes for larger tailwheel angles.

(f) Run engine at 1200 - 1400 rpm when aircraft is stopped during taxiing, to prevent spark plug fouling and to create a propeller blast for engine cooling.

WARNING

While on the ground, avoid prolonged engine running above 1400 rpm, particularly in hot weather, to prevent overheating of the installation.

2.8 TAKE-OFF CHECK

(a) All doors and windows closed.

(b) Elevator trim to meet CG requirements.

(c) Mixture lever - AUTO RICH.

(d) Propeller lever - INCREASE RPM.

(e) Fuel selector to desired tank position.

(f) Flaps - TAKE-OFF position.

(g) Directional gyro and artificial horizon - uncaged and set.

(h) Pitot heat ON if necessary in cold weather or when icing conditions are anticipated.

(j) Carburettor heat - COLD.

2.9 TAKE-OFF

(a) Make sure cylinder head temperature is below 450°F (230°C).

(b) Adjust throttle lever friction knob.

(c) Line up on take-off runway.

(d) Open the throttle smoothly to maximum permissible take-off power. See Figure 4-1.

(e) Anticipate tendency of aircraft to swing to the left.

(f) Allow aircraft to fly itself off at 55 to 65 mph. in a tail down attitude and climb at 65 mph.

(g) As soon as safe height has been attained, reduce power to 33.5 In.Hg. and 2200 rpm if aircraft is fully loaded, or 30 In.Hg. and 2000 rpm for normal weight.

(h) Slowly increase air speed to 80 mph and re-trim.

(j) At altitude of 500 ft. - flaps to CLIMB and retrim.

2.10 CLIMB

Best rate of climb is obtained using Maximum Continuous Power (2200 rpm, 33.5 In.Hg.). Speed for best rate of climb is 95 mph IAS; speed for best angle of climb is 80 mph IAS.

Where circumstances warrant, Maximum Continuous Power may be used giving the rates of climb as stated in paragraph 4.10.

However, the engine manufacturer recommends, for reduced engine wear, that 2000 rpm and 30 In.Hg. AUTO RICH be used. The rates of climb will then be 540 fpm for the landplane, 460 fpm for the seaplane.

Refer to Cruise Power Chart in Appendix for recommended settings.

Keep cylinder head temperature consistent with limits in Figure 4-1. Low rpm at High Manifold Pressure helps to maintain climbing mixture strength and materially assists engine and oil cooling.

2.11 CRUISE

For continuous cruise, use Maximum Weak Mixture Power or less, taking the following steps:

(a) Flaps to "Cruise".

(b) Throttle back to 29.7 In.Hg. or less Manifold Pressure.

(c) Propeller lever to give 2000 rpm or less.

(d) Mixture lever to AUTO LEAN. Carburettor mixture temperature 40°F (4°C).

(e) Keep cylinder head temperature and oil inlet temperature consistent with limits in Figure 4-1.

For Cruising power reduced below that obtained at maximum weak mixture use settings in Cruise Power Chart on page V in Appendix.

2.11.1 FUEL MANAGEMENT

For favourable CG travel, without long-range tanks:

(a) Empty rear tank first, if aircraft is fully loaded, in order to move the CG progressively forward.

<u>Operation on long range tanks</u>

Since both long range belly tank and wing tip tanks contain more fuel (5 Imp. - 7 U.S. gal.) than the front or centre fuselage tank will hold (see para 1.8.2), fuel from long range tanks must be transferred in two stages.

<u>When wing tip tanks are installed</u>

CAUTION

On aircraft having rubber liners in the main fuel tanks (Modification 2/1376) and equipped with C2-PT-445A and C2-PT-446A wing tip tanks, transfer of fuel to the front main tank should be avoided during flight through snow or ice conditions. The air scoop at each tank vent may become blocked in these conditions and prevent fuel transfer. Transfer of fuel is dependent on gravity feed assisted by air pressure from the wing tip tank air scoops.

(a) Take-off, climb and cruise with the FRONT main tank selected until it is almost empty.

(b) Move main fuel tank selector to CENTRE or REAR TANK position.

(c) Move wing tanks fuel transfer selector to BOTH and leave at that position until the fuel quantity gage shows an increase of 20 gallons in the front tank, then move the transfer selector to OFF.

(d) Reselect FRONT TANK until tank is again almost empty, then repeat steps (b) and (c) to transfer the remaining 16 gallons to the FRONT main tank. After transfer of all the wing tanks fuel move the transfer selector to OFF, and resume normal tank selection.

CAUTION

If the aircraft is laterally unbalanced after transfer of the initial 20 gallons of fuel, then the wing tanks fuel selector should be positioned at LH or RH as appropriate during the transfer of the remaining 16 gallons of fuel to correct the unbalance.

When belly tank is installed

(a) Take-off and climb on centre fuselage tank to cruising altitude.

(b) When contents of centre tank are nearly exhausted, select FRONT TANK or REAR TANK on fuselage tank selector.

(c) Select TRANSFER on long-range tank transfer selector.

(d) Turn off long-range transfer selector when centre tank is nearly full.

(e) Repeat procedure to empty belly tank into centre tank.

NOTE

Loss of speed at cruising is 6 mph with belly tank installed.

2.11.2 AIRSPEED CORRECTION

To correct indicated airspeed to calibrated airspeed:

Subtract 5 mph from all indicated cruising speeds.

Subtract 5 mph from the indicated airspeed when flaps in DOWN position.

2.11.3 WEAK MIXTURE OPERATION

Refer to Section V.

2.12 DESCENT

(a) Reduce airspeed and power as required.

(b) Fuel selector to fullest tank.

(c) Instruments in correct ranges.

2.13 APPROACH

(a) Reduce airspeed to 90 mph IAS.

(b) Propeller lever to INCREASE rpm.

(c) Mixture lever - AUTO RICH.

(d) Flaps to LANDING or as desired.

(e) Maintain a normal approach airspeed of 80 mph IAS. (Rate of descent with be approximately 1000 ft. per min.).

NOTE

Open throttle several times during approach to clear engine and to prevent too rapid engine cooling.

NOTE

When carburettor heat is used during approach, select "COLD" late on the final approach. This is to insure that full power will be available in case of a baulked landing.

2.14 LANDING

(a) Trim as required.

(b) Increase power to decrease rate of descent.

NOTE

With flaps at landing, the "Power-Off" approach produces a marked nose down attitude.

(c) Pull back gently on the control column for three-point touch-down.

(d) There is no tendency to swing after touch-down except in crosswinds.

NOTE

In normal stalled landing the tailwheel will touch first, when landing without flap.

(e) After touch-down hold control column fully back.

(f) Use rudder and steerable tailwheel to maintain straight path.

(g) Apply wheel brakes, as necessary, to control landing run.

2.14.1 MINIMUM RUN LANDING

Minimum run landings may be necessary under extraordinary circumstances.

Pilots familiar with the aircraft and experienced in short landing technique may perform minimum run landings by using full flap and reducing the airspeed on the final approach to 65 - 68 mph and maintaining that speed to the point of flare-out.

2.14.2 CROSS-WIND TAKE-OFF & LANDING

The lateral component of wind velocity at and below which it is safe to take off and land is not more than 10 mph at 90° for landplane, skiplane and seaplane.

2.14.3 NIGHT LANDING

At night a "Power-On" landing is recommended so that a go-around is facilitated.

2.14.4 SEAPLANE LANDING

(a) Use same procedure as for landplane.

(b) Do not lower water rudders until aircraft has stopped planing.

2.14.5 SKIPLANE LANDING

Prior to landing skiplane make sure:

(a) Snow does not deceptively cover uneven ground.

(b) Ice is thick enough to support the aircraft.

NOTE

Blue ice is generally quite thick. White ice is nearly always thin, especially on fast flowing rivers.

(c) Use power approach for landing on unmarked snow.

(d) Do not make turns when close to snow-covered ground.

2.15 GO-AROUND AND BAULKED LANDING

Decide early in approach to go around, using procedure as follows:

(a) Open throttle lever slowly to full take-off power.

(b) Keep nose down, re-trimming if necessary, to maintain normal flap down airspeeds - 65 mph for TAKE-OFF flap, 75 to 90 mph for CLIMB or CRUISE flap settings.

(c) Retract flaps slowly when safe altitude is reached.

(d) Retrim as required.

2.16 AFTER THE LANDING

(a) Flaps to CRUISE when landing run is completed.

(b) Elevator trim to neutral.

2.17 POST FLIGHT CHECKS
(Last flight of day only)

(a) Set parking brakes.

(b) Carburettor heat - COLD.

Ignition safety check

(a) Engine at idling speed.

(b) Switch OFF ignition switch momentarily - engine must stop firing completely.

(c) Ignition ON as soon as possible to prevent backfiring. Ignition system and power check.

(d) Control column fully back.

(e) Advance throttle lever to aerodrome barometric pressure.

(f) RPM should be 2100 plus or minus 20.

(g) Check magnetos by selecting "L" momentarily and return to "BOTH" before selecting "R" momentarily.

NOTE

When running on one magneto, the drop in rpm should not exceed 100 rpm.

Idle speed check

(a) Retard throttle lever to idling position.

(b) Engine rpm should be 450 - 550.

(c) Oil pressure and fuel pressure should remain within operating limits.

2.18 STOPPING THE ENGINE

(a) Allow engine to idle for a short period to assist it in gradually cooling down.

(b) Open throttle to give 1000 - 1200 RPM.

(c) Propeller lever to full DECREASE RPM.

(d) The RPM will drop off as the propeller changes pitch but should be maintained at 800 rpm with the throttle.

(e) When cold weather start is anticipated, engine oil may be diluted.

(f) Mixture lever - IDLE CUT-OFF.

(g) Switch ignition OFF after propeller has stopped turning.

(h) Check wing tip tank selector OFF, if tanks are fitted.

(j) Main fuel tank selector OFF.

(k) All switches OFF except generator field switch.

If engine fails to stop proceed as follows:

(a) Check magnetos again.

(b) Close throttle to idling.

(c) Turn fuel selector OFF.

(d) Maintain 800 rpm.

(e) Wait until engine has stopped through fuel starvation.

(f) Switch ignition OFF.

(g) Throttle lever fully CLOSED.

Section
3

SECTION III

DH CANADA

EMERGENCY PROCEDURES

SECTION III

EMERGENCY PROCEDURES

3.1 ENGINE FAILURE

3.1.1 ENGINE FAILURE DURING TAKE-OFF RUN

Remaining length of runway is sufficient for stopping safely.

(a) Apply brakes - control column fully back all the time.

(b) Mixture lever - IDLE CUT-OFF.

(c) Pump flaps fully DOWN.

(d) Ignition - OFF.

(e) Fuel selector - OFF.

(f) Battery master switch - OFF.

Space ahead is insufficient.

(a) Take steps as above.

(b) Turn the aircraft by momentarily applying differential braking in the desired direction, rudder pedals in neutral, then apply differential braking in the reverse direction to counteract ground looping tendency.

3.1.2 ENGINE FAILURE AFTER TAKE-OFF.

(a) Lower nose immediately, to maintain airspeed at 65 mph.

(b) Mixture lever - IDLE CUT-OFF.

(c) Propeller lever to DECREASE RPM position.

(d) Fuel and oil emergency shut-off - pull sharply CLOSED.

(e) Ignition - OFF.

(f) Battery master switch - OFF.

(g) Fuel selector - OFF.

(h) Warn passengers to brace feet against supports and protect their heads by placing an arm across forehead, gripping fuselage structure with the same hand.

(j) KEEP STRAIGHT AHEAD AND CHANGE DIRECTION ONLY ENOUGH TO MISS OBSTACLES. USE RUDDER ONLY.

CAUTION

Always maintain enough airspeed to assure full control of aircraft to point of touchdown. Coarse use of ailerons near the stall airspeed precipitates wing dropping.

CAUTION

It is better to ride an aircraft with a dead engine safely to a crash landing straight ahead, than to turn back to the field. Attempts to turn back have, in many instances, ended with an uncontrolled roll or spin into the ground.

3.1.3 ENGINE FAILURE ABOVE 800 FT. AFTER TAKE-OFF

(a) Depress nose to gliding attitude.

(b) Flaps to CRUISE.

(c) Propeller lever to full DECREASE RPM position.

(d) Maintain airspeed of 95 mph IAS (glide gradient is 11% rate of descent 890 ft. per minute.)

(e) Decide whether to crashland straight ahead or complete the circuit and attempt to land on the air field.

(f) Proceed as described in DEAD ENGINE LANDING.

3.1.4 ENGINE FAILURE DURING FLIGHT

If sufficient altitude is available:

Attempt to re-start the engine as follows:

(a) Lower nose and maintain airspeed at 95 mph.

(b) Check fuel selector at fullest tank.

(c) Check fuel pressure within normal range.

(d) Check that some oil pressure is indicated. Do not attempt to re-start if there is no oil pressure.

(e) Throttle - 1/3 open.

(f) Check ignition switches - BOTH.

(g) If no fuel pressure is indicated.

(h) Booster pump - ON (if installed) or: Use wobble pump to build up fuel pressure and prime for a maximum of 4 strokes. If still no fuel pressure do not attempt a re-start.

<u>If re-start fails:</u>

(a) Ignition switch - OFF.

(b) Propeller lever full DECREASE RPM position.

(c) Fuel selector - OFF.

(d) Maintain air speed of 95 mph IAS with flaps at CRUISE for maximum glide distance.

(e) Throttle lever - CLOSED.

(f) Make a dead engine landing.

3.2 DEAD ENGINE LANDING

(a) Maintain air speed of 95 mph IAS, flaps at CRUISE for maximum glide distance.

(b) Propeller lever - COARSE PITCH.

(c) Mixture lever - IDLE CUT-OFF.

(d) Throttle lever - CLOSED.

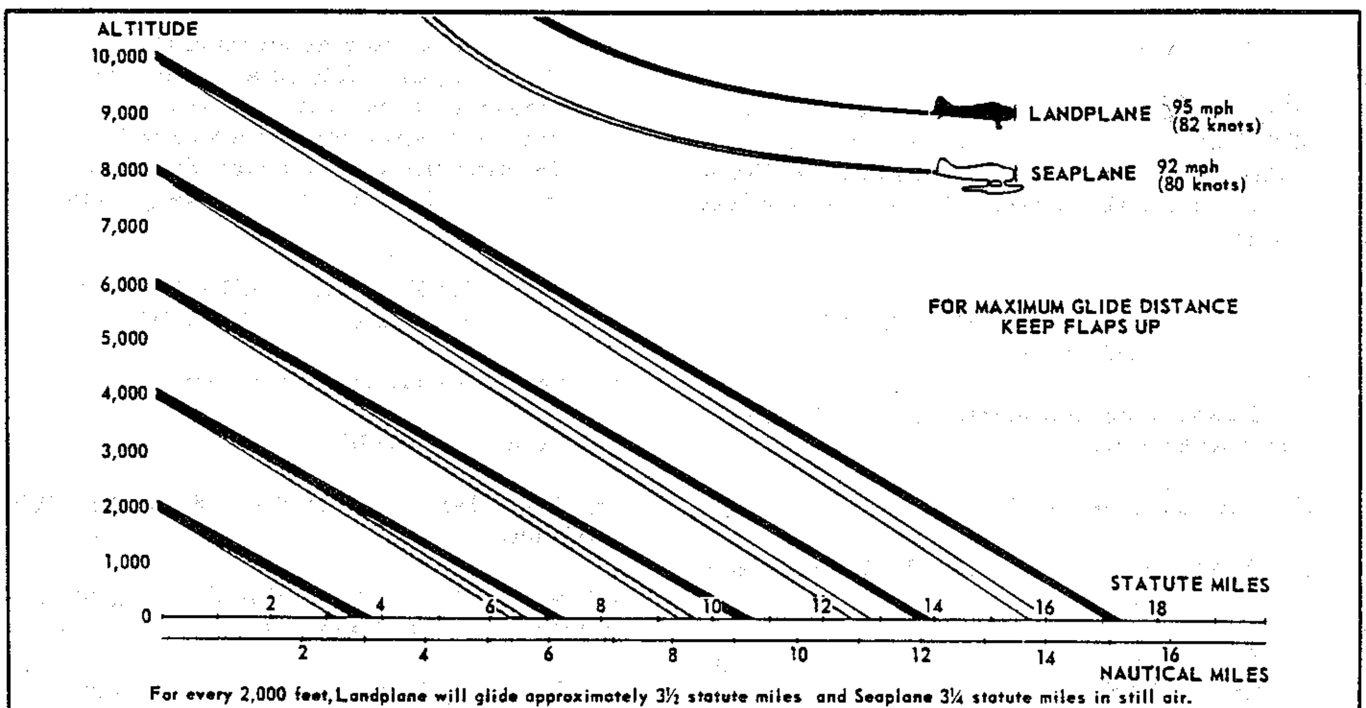


FIG 3-1 GLIDING DISTANCES

Close to ground:

(e) Ignition switch - OFF.

(f) Order occupants to brace themselves.

(g) Flaps to LANDING and maintain final approach speed of 65 - 68 mph.

(h) Touch down slightly tail first, as nearly into the wind as circumstances permit.

(j) Leave aircraft immediately it has stopped moving.

3.2.1 IN CASE THE AIRCRAFT NOSES OVER

(a) Discharge fire extinguisher as soon as turn-over movement begins.

(b) Warn passengers to wait to be released from their safety belts.

(c) Leave aircraft as soon as circumstances permit.

3.3 PROPELLER FAILURE

Failure of the constant speed unit will result in the propeller going into coarse pitch and remaining there. No attempt should be made to clear the failure by increasing engine power as this will overload the engine and lead to possible engine failure.

It is recommended that a landing be made at the nearest airfield, using limited power with propeller lever in COARSE PITCH position, to have the trouble rectified.

3.3.1 PROPELLER FAILURE DURING TAKE-OFF RUN

Abandon take-off as follows:

(a) Close the throttle.

(b) Mixture lever - IDLE CUT-OFF.

(c) Pump flaps fully down.

(d) Apply brakes.

(e) When speed is low and remaining space insufficient, turn the aircraft by differential braking.

(f) Fuel selector - OFF.

(g) Ignition switch - OFF.

(h) Master switch - OFF.

3.3.2 PROPELLER FAILURE AFTER TAKE-OFF

1. (a) If RPM too high manipulate propeller lever in attempt to bring propeller within limits.

(b) If no response, throttle back to keep the RPM below 2350 rpm. Leave flaps at TAKE-OFF and maintain airspeed at 65 mph minimum.

(c) If unsuccessful, return to field maintaining nose up attitude and regulate the rate of descent by gentle throttle lever manipulation. Resume normal attitude on the approach to land and make a power off landing.

2. (a) If RPM too low (propeller in full coarse pitch.)

(b) Increase air speed without losing altitude.

(c) If possible reduce throttle to 30 In.Hg.

(d) Raise flaps to CLIMB in stages, maintain maximum air speed and climb at the slowest rate to gain sufficient altitude to complete a safe circuit and landing. Jettison external loads, if necessary.

3.3.3 PROPELLER FAILURE DURING FLIGHT

<u>Overspeeding Propeller</u> (Sticking in low pitch)

(a) Reduce throttle setting and pull the aircraft into a climbing altitude to decrease engine speed and increase the load on the propeller.

(b) Manipulate propeller lever in attempt to bring propeller within operating limitations.

(c) Maintain constant check on oil pressure.

<u>Oil supply breakdown</u>

(a) Check oil pressure; if none is indicated pull propeller lever to COARSE PITCH.

(b) Keep RPM to a minimum and make an emergency landing with limited power on.

(c) If oil pressure is indicated after selecting COARSE PITCH it can be assumed that the propeller oil line has fractured so proceed as in 3.3.2.2.

3.4 ENGINE FIRE

3.4.1 ENGINE FIRE ON THE GROUND

When an engine fire occurs during starting, it cannot be established at once and with certainty, whether the fire is in the induction system or of a more serious nature. With any type of oil or fuel fire, other than induction fire, the effect of opening the throttle wide to have the fire sucked through the engine, may increase the engine fire to disastrous severity.

NOTE

An induction system fire may not give an indication on the fire warning light. Thus, in any case of engine fire on the ground, the engine should be stopped as quickly as possible, taking the following steps:

(a) Mixture lever IDLE CUT-OFF.

(b) Fuel and oil emergency shut-off - pull sharply CLOSED.

Wait until the engine speed has slowed down, then:

(c) Ignition switch - OFF.

(d) Master switch - OFF.

As soon as the engine has stopped:

(e) Discharge engine fire extinguisher.

WARNING

Make sure that the flame switch fuse is replaced, fire switch re-set and a fully charged fire extinguisher bottle is fitted before any attempt is made to re-start the engine.

If the fire does not go out:

(a) Have rear bottom cowling panel removed.

(b) Have portable fire extinguisher discharged towards the engine accessories.

(c) Release brakes.

(d) Leave aircraft.

(e) Stand by to push aircraft away from aircraft or buildings in neighbourhood if necessary.

NOTE

After an engine has been on fire, no attempt must be made to re-start until the caust has been found and remedied and engine damage, if any, has been repaired.

An exception, however, can be made in the case of an intake fire which has been successfully sucked in without the fire extinguisher having been used.

3.4.2 ENGINE FIRE IN THE AIR

As soon as the fire warning light comes on:

(a) Stop the engine immediately, proceeding in accordance with placard near fire warning light.

(b) Fuel and oil emergency shut-off - pull sharply CLOSED.

(c) Propeller lever - full DECREASE RPM.

(d) Throttle lever - CLOSED.

(e) Mixture lever - IDLE CUT-OFF.

(f) Reduce airspeed to 95 mph.

(g) Operate fire extinguisher.

(h) Maintain maximum glide speed of 95 mph with flaps at CRUISE.

(j) Radio state of emergency and position.

(k) Instruct other occupants of aircraft for crash landing.

(l) Make a dead engine landing.

Should the fire show no sign of abating, side-slip the aircraft to a crash landing, preferably into soft ground, sand or shallow water using wing and tail to absorb impact.

WARNING

Do not attempt to re-start the engine in flight after the fire extinguisher has been used successfully, as the fire is liable to recur on re-starting when the extinguisher is exhausted.

3.4.3 ACCIDENTAL OPERATION OF THE FIRE EXTINGUISHER

If the fire extinguisher has been accidentally discharged:

(a) Continue flight with throttle lever at least 2/3 open.

(b) After two to three minutes return to normal flight conditions. Throttle opening minimizes engine corrosion and spark plug fouling, as the methyl-bromide is rapidly dispersed, its boiling point being close to 40°C.

WARNING

Methyl-bromide has an odour of onions. If the fumes enter the aircraft all ventilators should be opened until the odour disappears.

(c) Report use of the engine fire extinguisher after landing to ensure engine check and replenishing of the extinguisher.

3.4.4 FUSELAGE FIRE

A fuselage fire is usually indicated by smoke which will immediately warn passengers and/or crew.

(a) Use fire extinguisher, in front of the pilot's seat, if the source of the fire can be located and is accessible.

If the source of the fuselage fire cannot be located, or is not accessible:

(a) Select all electrical switches EXCEPT IGNITION - OFF.

(b) Close all windows, pull ventilators and cabin air extractor, if fitted.

When the fire has been extinguished, yet its source not clearly established:

(a) Leave all switches EXCEPT IGNITION in the OFF position.

(b) Land at nearest airfield for investigation.

3.5 DITCHING

Any high-wing monoplane should be ditched only as a last resort because even in the exceptional case where the pilot succeeds in ditching his airplane under favourable conditions, there is the almost certain possibility that the aircraft will submerge to the cabin roof in a very short time.

If, however, the aircraft has to be ditched, proceed as follows:

(a) Keep approach speed sufficient for control down to the impact with the water.

(b) Instruct other occupants of the aircraft.

(c) Make approach into wind, at right angles to the swell.

(d) Unlock cabin and cockpit doors.

(e) Ditch on the falling side of a wave crest or swell top.

(f) Touch down tail first to prevent the nose from striking a wave crest or swell top which might cause the aircraft to nose in, or dive under.

Other occupants of the aircraft should be instructed as follows:

(a) Unfasten collar and tie.

(b) Hold on to life preserver cushions.

(c) Be prepared for a double impact when first the tail, and then the engine strike water.

(d) Not to move until the aircraft has come to rest.

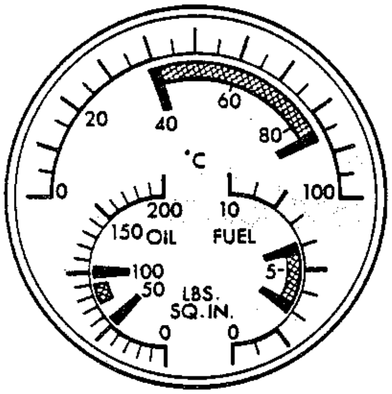
(e) Help each other through the doors as quickly as possible.

Section 4

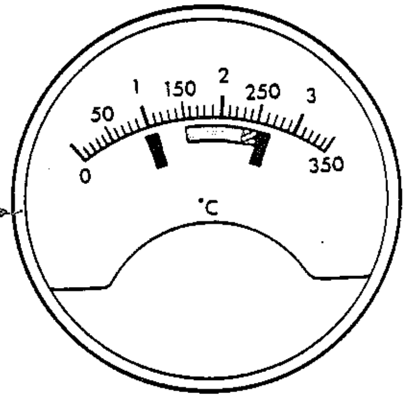
SECTION IV

DH CANADA

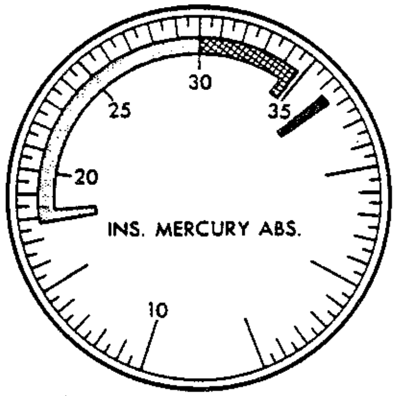
OPERATING LIMITS, PERFORMANCE DATA AND FLIGHT CHARACTERISTICS



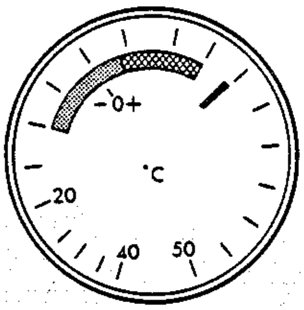
FUEL AND OIL PRESS., OIL TEMP.



CYLINDER HEAD TEMP.

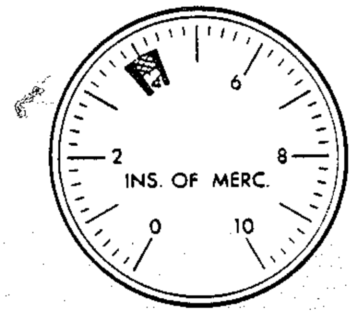


MANIFOLD PRESS.

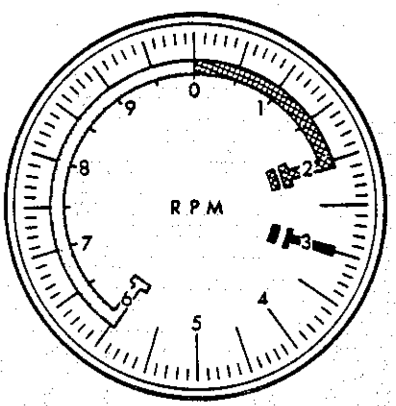


CARB. MIXTURE TEMP.

TAKE-OFF POWER TIME LIMIT:
1 MIN. AT 2300 RPM-
36.5 IN. HG.



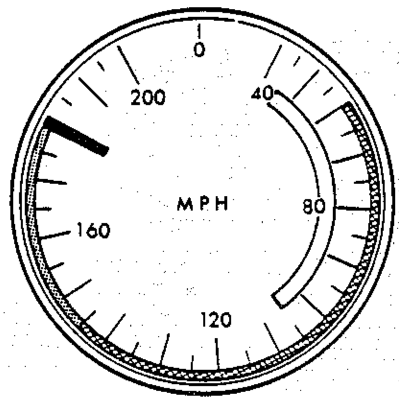
SUCTION



TACHOMETER

CAUTION

AT AMBIENT TEMPERATURES BELOW STANDARD ALTITUDE TEMPERATURE (15°C (59°F) AT S.L.) WITH CARBURETOR AIR AT COLD, OVER-BOOSTING AND DETONATION ARE POSSIBLE AT MAP SETTINGS BELOW THE NORMAL MAXIMUM PERMISSIBLE. THEREFORE, TAKE-OFF MAP MUST BE REDUCED BY 2% PER 11°C (20°F) BELOW STANDARD, IF ENGINE LIFE IS TO BE PRESERVED.



AIRSPEED

MAX. CONTINUOUS POWER
2200 RPM.-33.5 IN. HG.
FULL RICH

POWER LIMITS BASED ON FUEL GRADE 80/87

- **RED—DANGER WARNING.** MINIMUM AND/OR MAXIMUM LIMITATIONS.
- **YELLOW—CAUTION** DANGER MAY EXIST UNDER CERTAIN CONDITIONS.
- **GREEN** REGION FOR CONTINUOUS OPERATION. REQUIRING "RICH" MIXTURE
- **BLUE** "LEAN" OPERATION IS PERMITTED.
- **BLANK SPACE** REGION THAT SHOULD BE AVOIDED OR IN WHICH OPERATION IS LIMITED.

FIG 4-1 INSTRUMENT LIMIT MARKINGS

SECTION IV

OPERATING LIMITS, PERFORMANCE DATA AND FLIGHT CHARACTERISTICS

4.1 GENERAL REMARKS

The aircraft must be operated according to the following limitations and instructions.

Instrument readings, illustrating the operating limitations, are shown on Figure 4-1. The instrument markings shown should be given close attention since they contain operational limits information which is not necessarily repeated in the following text.

4.1.1 The aircraft has been classified in the normal Category of BCAR Airworthiness standards in accordance with the Type Approval.
ALL AEROBATIC MANOEUVRES, INCLUDING SPINS ARE PROHIBITED.
Stalls are permitted for demonstration purposes only.

4.2 ENGINE LIMITATIONS

Refer to: Instrument Markings (Figure 4-1).

CAUTION

If engine over-speeding occurs, land at nearest airfield and have engine and propeller inspected before further flight. If the engine has exceeded 2,750 rpm for more than 30 seconds, an engine change is indicated.

4.3 PROPELLER LIMITATIONS

Provided that the engine is operated within engine limitations, the propeller will be within its safe limits. Excessive run-up on the ground is to be avoided.

4.4 FUEL GRADES AND RESIDUAL FUEL QUANTITIES

Recommended fuel: Aviation Fuel Grade 80/87. Alternate fuel grades with a higher lead content are permissible only when 80/87 fuel is not available and if the following precautionary measure is observed.

CAUTION

When highly leaded fuel grades are used, operate engine at slightly higher cruise power settings and apply rated power for one minute after approximately each hour of cruising and PRIOR to landing approach.

Oil Specification: 100
(80 for extreme cold)
(120 for extreme hot weather)

Residual Fuel Quantities

Fuel remaining in tanks when the fuel contents gauge indicates zero, cannot be used safely in flight.

4.5 AIRSPEED LIMITS

For AIRSPEED LIMITATIONS as marked on Airspeed Indicator refer to Figure 4-1.

4.5.1 MAXIMUM PERMISSIBLE DIVING SPEED

Landplane)
Skiplane) 180 mph IAS
Seaplane)

The maximum permissible speed is the never-exceed speed of flight. A higher speed may result in structural failure, flutter or loss of control.

4.5.2 NORMAL OPERATING LIMIT SPEED

Landplane)
Skiplane) 145 mph IAS
Seaplane)

Normal cruising flight operations should be confined to speeds below this value.

The range of speed between normal operating limit speed and the maximum permissible diving speed should be intentionally entered only with due regard to the prevailing flight and atmospheric conditions, in particular turbulence.

4.5.3 MANOEUVRING SPEED

125 mph IAS. Manoeuvres which involve an approach to stall conditions, or full application of rudder or aileron control, should be confined to speeds below this value.

4.5.4 MAXIMUM SPEED FOR LOWERING FLAPS

105 mph IAS.

4.6 ACCELERATION LIMITS

Limit load factors are the maximum values which the airframe may safely be subjected to in flight.

When flying in very rough air, or if it is necessary to perform forcible manoeuvres including full application of aileron and rudder, the airspeed should not be permitted to exceed 145 mph IAS.

4.6.1 LOAD FACTORS

In tight turns, flight load factors may reach the limit loads, and may also increase the danger of an unintentional stall.

The variation of flaps-up stalling speed and load factors with angle of bank are given below:

Angle of Bank	Stalling Speed mph IAS	Load Factor
0°	60	1.0
50°	85	1.5
60°	105	2.0
65°	115	2.5
70°	130	3.0

4.7 WEIGHT AND BALANCE LIMITATIONS

4.7.1 GENERAL

The Design Gross Weight of the aircraft is 5,100 lb. At this weight it complies with the general performance and strength criteria.

In the interest of airworthiness it is important that the weight and balance limits for this airplane be adhered to in accordance with the recommendations and information given in the following paragraphs, tables and diagrams.

4.7.2 WEIGHT DEFINITIONS

The Tare Weight is the weight of the aircraft with the minimum equipment essential to airworthiness, e.g. pilot's seat, flight and engine instruments, battery and the like.

Hence equipment changes in the field will not normally change the tare weight figure.

The tare weight will be appropriate to the configuration, i.e. the landplane, skiplane and seaplane values will differ.

The Basic Weight includes all other installed equipment both fixed and removable, e.g. radio, exterior finish (paint), furnishings and such equipment is defined by the item ticked off in the Weight and Balance Report under the heading "Equipment Check List" and "Basic Weight Change Record".

The Operational Load comprises crew, oil and fuel, and payload weights.

The Payload consists only of passenger(s), baggage and cargo. Maximum values of payload vs. range for various basic weights are given in the Appendix pages VI and VIA.

The All-Up Weight (A.U.W.) is the sum of basic weight plus operational load and must not exceed 5,100 lbs. for the landplane and skiplane, 5,090 for the seaplane.

4.7.3 FUEL ALLOWANCES

It should be noted that fuel allowances are included for 10 minutes warm-up,

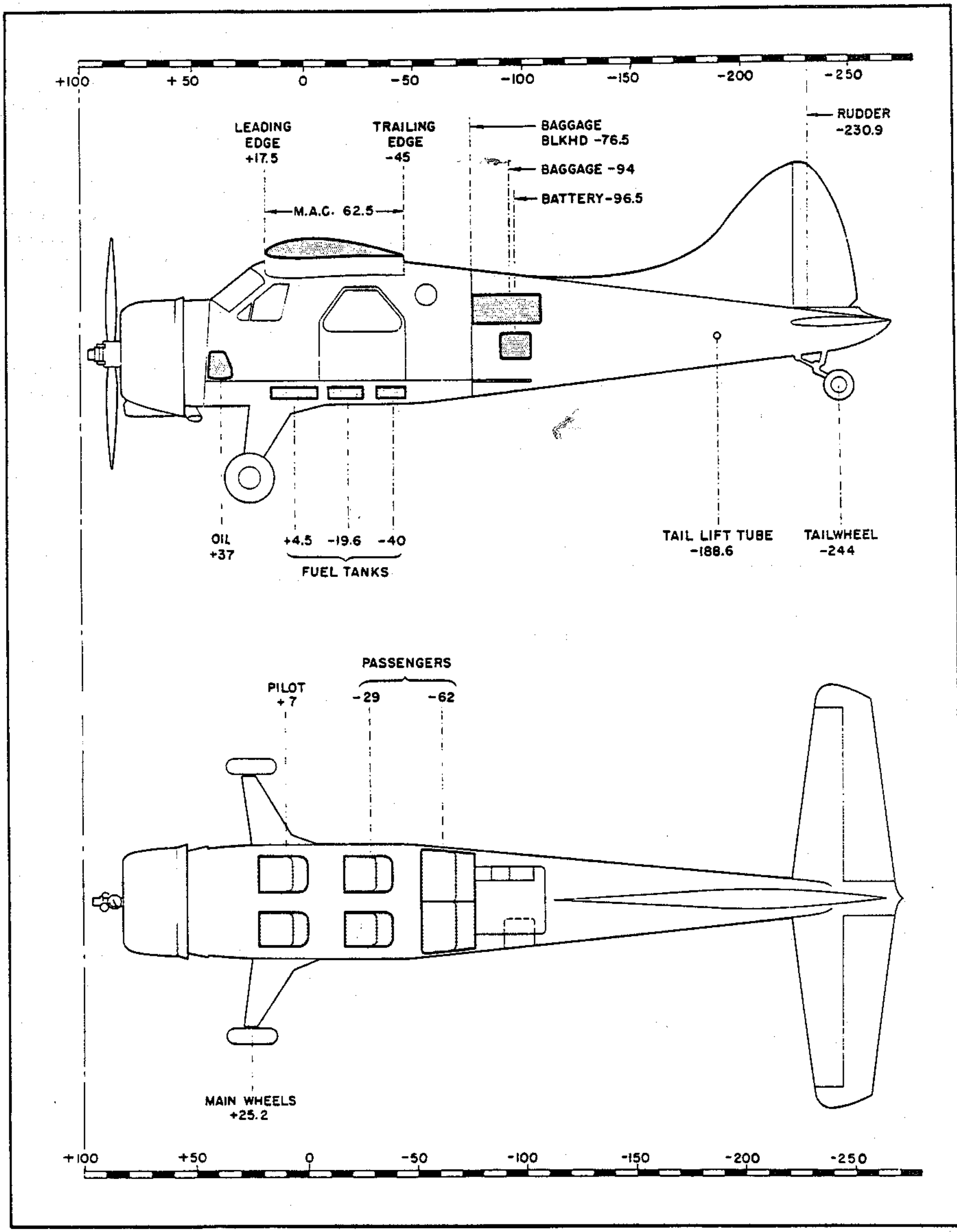


FIG 4-2 BALANCES DIAGRAM

take-off and climb to 5,000 ft. altitude, and reserve fuel for 45 minutes flying time at cruising power.

4.7.4 WEIGHT AND BALANCE REPORT

This report defines the equipment that was in the aircraft "as weighed" and "as delivered" and gives weights, arms and movements as well as the Tare and Basic Moment. It may be found in the envelope on the inside of the rear cover of this Flight Manual.

If the equipment is changed, the Basic Weight changes too. Changes should be recorded in the "Basic Weight Change Record", which must be kept up-to-date at all times.

The "Equipment Check List" should be ticked off.

If the configuration of the aircraft is altered at any time, e.g. changing from floats to skis, such alterations must be duly recorded in the "Basic Weight Change Record".

The obligation that all changes must be recorded, applies also to modifications of all sorts, e.g. repair of damages suffered in the field, in which case all parts removed from, or added to, the aircraft must be separately weighed and their Moment Arms measured so that the "Weight and Balance Report" may be properly brought up to date.

The Balance Diagram (Figure 4-2), may be used to determine the Arms of any equipment not yet listed.

4.7.5 PREPARATION FOR FLIGHT

The A.U.W. and Total Moment (i.e. C.G. position) should be checked for conditions at the beginning and at the end of the flight by using the current Basic Weight found in the "Basic Weight Change Record" and the Operational Load Diagram.

The A.U.W. maximum must not exceed 5,100 lbs. for the landplane and skiplane; 5,090 for the seaplane.

The sum total of all moment values must conform to the safe moment limits given for different All-Up Weights in the Safe Moment Table.

For establishing conditions at the beginning of the flight, use A.U.W.

To arrive at conditions prevailing at the end of flight, subtract from A.U.W. and total moment, the moments and weights of fuel and oil consumed during flight if such changes in weights and moments may cause the C.G. position to fall beyond the permitted limits.

4.7.6 CENTRE OF GRAVITY

The C.G. datum lies 17.45 inches behind the wing leading edge. See Balance Diagram Figure 4-2.

	Landplane & Skiplane	Seaplane
Extreme forward C.G. position at 3,800 lb.	Station + 6.6	Station + 6.6
Extreme forward C.G. position at 5,090 lb.		Station - 1.25
Extreme forward C.G. position at 5,100 lb.	Station - 1.25	
Extreme Aft C.G. position at 5,090 lb.		Station - 6.1
Extreme Aft C.G. position at 5,100 lb.	Station - 7.7 (Refer to Note facing Appendix VII)	

4.7.6 CENTRE OF GRAVITY (Cont'd) — Landplane & Skiplane — Seaplane

Extreme Aft C.G. position at 5,100 lb. Station - 8.8 (Refer to Note facing Appendix VII)

For safe Moment Limits refer to table on page VII in Appendix

4.7.7 CARGO LOAD CONSIDERATIONS
Refer to:

(a) Balance Diagram.
(b) Operational Loads Diagram.
(c) Freight Moments Table.
(d) Safe Moment Limits Table.

4.8 MINIMUM FLIGHT CREW
One Pilot.

4.9 MISCELLANEOUS
Smoking is authorized for cockpit and cabin.

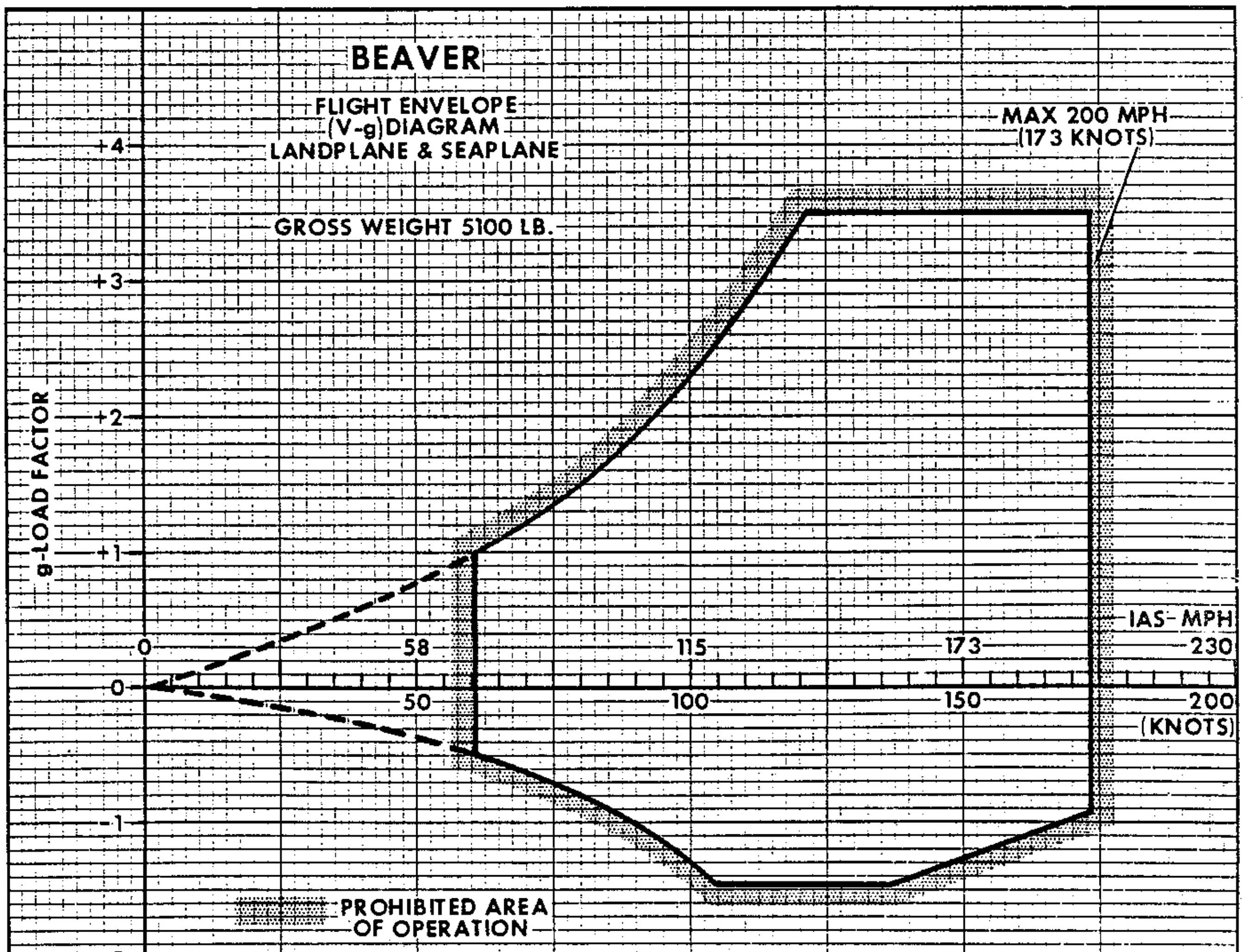


FIG 4-3 OPERATING FLIGHT STRENGTH DIAGRAM

4.10 PERFORMANCE AT MAXIMUM GROSS WEIGHT

STANDARD CONDITIONS

4.10.1 GENERAL

		Landplane (5,100 lb)	Skiplane (5,100 lb) Seaplane (5,090 lb)
Max. True Level Speed			
Sea Level	mph (kmh)	156 (251)	144 (232)
5,000 ft.	mph (kmh)	163 (262)	151 (243)
True Cruising Speed (300 BHP)			
Sea Level	mph (kmh)	136 (219)	123 (198)
5,000 ft.	mph (kmh)	143 (230)	127 (204)
Economic True Cruising Speed (240 BHP)			
Sea Level	mph (kmh)	125 (201)	110 (177)
5,000 ft.	mph (kmh)	130 (209)	114 (183)
Stalling Speed (I.A.S.)			
Flaps up	mph (kmh)	60 (96)	60 (96)
Flaps "Landing"	mph (kmh)	45 (72)	45 (72)
Take-off distance to clear 50 ft. obstacle (Flaps "Take-off", still air ICAO technique)	ft. (m)	1,250 (381)	1,610 (491)
Landing distance over 50 ft. obstacle (Flaps "Landing", still air ICAO technique)	ft. (m)	1,250 (381)	1,510 (460)
Initial Rate of Climb (T.O. Power)			
Flaps up	fpm (m/sec)	1,020 (5.2)	920 (5)
Flaps "Take-off"	fpm (m/sec)	730 (3.7)	650 (3.3)
Service Ceiling	ft. (m)	18,000 (5490)	15,750 (4800)

		Landplane (5,100 lb)	Skiplane (5,100 lb) / Seaplane (5,090 lb)
Rate of Climb at Max. Cont. Power			
Sea Level	fpm (m/sec)	840 (4.3)	740 (3.8)
5,000 ft.	fpm (m/sec)	795 (4)	685 (3.5)
10,000 ft.	fpm (m/sec)	530 (2.7)	410 (2.1)
Cruising Range at 5,000 ft. (240 BHP)			
With normal fuel capacity (79 Imp. Gal.) (95 U.S. Gal.)	mi (km)	455 (732)	405 (652)
With wing tip tanks (115 Imp. Gal.) (138 U.S. Gal.)	mi (km)	740 (1190)	655 (1053)
Cruising Endurance at 5,000 ft. (240 BHP)			
With normal fuel capacity (79 Imp. Gal.) (95 U.S. Gal.)		3.54 hrs.	3.52 hrs.
With wing tip tanks (115 Imp. Gal.) (138 U.S. Gal.)		5.7 hrs.	5.68 hrs.

Note: Range and endurance results make allowance for:

i) 10 min. warm up and take-off

ii) Climb to 5,000 ft.

iii) Fuel for 45 min. flight at cruise power (240 BHP)

4.10.2 MAX. INDICATED SPEEDS

		Landplane	Skiplane / Seaplane
Flaps	mph (kmh)	105 (169)	105 (169)
Diving 5,100 A.U.W.	mph (kmh)	180 (290)	180 (290)
Structural			
Cruising 5,100 A.U.W.	mph (kmh)	145 (233)	145 (233)

4.11 FLIGHT CHARACTERISTICS

4.11.1 GENERAL

Stability is good about all axes. The aircraft is easy to fly and is docile down to the stall. Controls are normally effective throughout the airspeed range. The aircraft can be trimmed to fly hands-off from climb to maximum speeds.

4.11.2 TAKE-OFF

When trimmed appropriate to CG position, stick forces are moderate. Weight and Balance must be carefully checked, especially when CG is at, or near, the forward limit. The aircraft will fly itself off at airspeeds of 50 to 60 mph IAS in a tail low attitude.

4.11.3 SLOW FLYING

It is possible to retain full control of the aircraft at:-

75 mph IAS with flaps at CRUISE

65 mph IAS with flaps at LANDING

4.11.4 SPINS

Intentional spinning of the aircraft is prohibited.

4.11.5 STALL

The stall is gentle at all normal conditions of load and flap and may be anticipated by a slight vibration, which increases as flap is lowered. The aircraft will pitch if no yaw is present. If yaw is permitted, the aircraft has a tendency to roll. Prompt corrective action must be initiated to prevent the roll from developing.

4.12 WING LOAD LIMITATIONS ON LANDING

On aircraft equipped with either wing-tip tanks, or wing-tip tanks and external wing racks, the maximum permissible load combinations on landing for each wing for the various aircraft configurations are as follows:

	WING-TIP TANKS	* WITHOUT MOD 2/1381 INCORPORATED EXTERNAL STORES			* WITH MOD. 2/1381 INCORP. (Eng. Bulletin "B" No. 10) EXTERNAL STORES		
		0 lb	250 lb	500 lb	0 lb	250 lb	500 lb
WHEEL	0 Fuel	Yes	Yes	Yes	Yes	Yes	Yes
OR	Half Fuel	Yes	Yes	Yes	Yes	Yes	Yes
SKI	Full Fuel	No	No	No	Yes	Yes	Yes
	0 Fuel	Yes	Yes	Yes	Yes	Yes	Yes
FLOAT	Half Fuel	Yes	No	No	Yes	Yes	No
	Full Fuel	No	No	No	Yes	No	No

* Mod 2/1381 (Engineering Bulletin "B" No. 10) revises the rivet pitch on the bottom skin of the wing.

Section 5

GENERAL OPERATING INSTRUCTIONS AND ALL WEATHER OPERATIONS

SECTION V

GENERAL OPERATING INSTRUCTIONS AND ALL WEATHER OPERATION

5.1 ENGINE

5.1.1 MAXIMUM ENGINE EFFICIENCY FOR CRUISING

Maximum engine efficiency and, as a rule, maximum propeller efficiency in cruising is generally obtained when power is reduced by:

(a) Keeping the manifold pressure up to the maximum permitted for cruising at critical altitude.

(b) Reducing the engine speed with the propeller lever until the desired lower airspeed is obtained.

Operation at low engine speed reduces engine losses due to the higher internal friction and horsepower consumption by the supercharger at higher engine speeds.

Cruising at low rpm and high boost gives maximum fuel economy if combined with proper mixture leaning.

On reaching the lowest usable rpm, use the throttle lever to keep the manifold pressure below the maximum allowable for cruising, or at the desired pressure.

Above the full throttle altitude, constant power can be maintained by increasing the engine speed approximately 75 rpm for each inch Hg. loss in manifold pressure.

Conversely, in descending, a gain of one inch Hg. in manifold pressure can be cancelled in its effect on engine power by decreasing the engine speed by approximately 75 rpm.

NOTE

When cruising at sustained low rpm with low boost, it is advisable to clear the engine at least once an hour by increasing power to rated or maximum continuous power. Engine clearing should be carried out before entering the landing circuit at the conclusion of a flight. This procedure will minimize plug fouling and ensure full power is available when required.

NOTE

Engine speeds below 1,500 rpm are undesirable as the generator may cut out.

5.1.2 DETONATION AND BACKFIRING

In engine operation the following sequence should always be remembered:

(a) Whenever increasing power, first advance propeller lever, then throttle lever.

(b) To decrease power, first retard throttle lever, then propeller lever.

By following this procedure, most occurrences of detonation in engine operation can be avoided. Serious detonation may be caused if the engine is run continuously on one magneto, with manifold pressures as high as 25 to 30 In.Hg.

The main cause of backfiring is throttle pumping during starting operation. Once the engine has started and reached, through positioning of the throttle lever, an engine speed of 500 to 600 rpm, the throttle lever should be left alone. Throttle pumping at engine speeds above 500 rpm is the frequent cause of backfiring when the engine is cold.

5.1.3 COOLING AND OVERHEATING

While the aircraft is on the ground, continuous running of the engine at high rpm will produce excessive temperatures in engine accessories and should, therefore, be avoided.

NOTE

To insure that the maximum cylinder temperatures are not exceeded during the take-off, make sure, especially in hot weather, that cylinder head temperatures prior to take-off are well below the maximum for ground tests 450°F (232°C).

Before leaning the mixture after each climb, it is important to give the engine time to cool down, preferably to temperatures below cruising temperatures. A well cooled engine will have less tendency towards detonation when leaning the mixture, than will an engine where the cylinder temperatures are already at the maximum permissible value for cruising.

A tendency towards overheating, noticeable in the increase of both oil and cylinder temperatures, can be checked by:

(a) Reducing engine speed with the propeller lever, rather than by throttling alone and by:

(b) (During climbs) Climbing at an indicated air speed higher than the speed given for best climb.

5.1.4 ENGINE PRIMING

Engine priming requires some experience to obtain good starting under various conditions. Excessive priming will load the cylinders with raw gasoline and has a tendency to wash the oil off the cylinder walls.

NOTE

After unsuccessful attempts have been made to start the engine, the cylinder walls must be recoated with oil by turning the propeller through 3 revolutions with the fuel selector OFF. The piston rings and cylinder walls, thus coated, will not rust if left for one or two days.

5.1.5 MIXTURE CONTROL

Efficient engine operation depends on careful control of the fuel/air mixture and maintenance of carburettor mixture temperature at 40°F (4°C) at all times except take-off.

With the mixture lever in the RICH position, the fuel supplied is not completely burned. The unburned fuel acts as an internal coolant to prevent detonation. AUTO RICH position should, therefore, only be used for starting, take-off, climb, and when power in excess of that obtainable at maximum lean mixture position is required.

To obtain economical fuel consumption for cruising operation, the carburettor is equipped with an automatic mixture control to provide for mixture leaning at the proper fuel/air ratios for all altitudes.

When operating in the lean mixture range, constant checks of all temperatures are necessary.

5.1.6 ENGINE ICING

Engine icing occurs in two forms: impact icing and carburettor icing. These phenomena may be experienced either individually, or in combination with each other, between free air temperatures of 5°F and 78°F (-15°C and 25°C).

(i) Impact Icing

Under certain conditions, particularly when descending through clouds, snow or heavy rain, impact ice from super-cooled water droplets freezing on metal surfaces will form in the vicinity of the air intake. The gradual blocking of the air intake causes rough engine running, a drop in manifold pressure and finally, as the intake blockage becomes complete, an engine stop. This is nearly always accompanied by severe airframe icing.

(ii) Carburettor Icing

Formation of ice in the carburettor is of two kinds; throttle icing and evaporation ice.

(iii) Throttle Icing

The local increase in the velocity of the air flow at the throttle valve and the choke venturi causes a drop in pressure and temperature which leads, under certain atmospheric conditions, to the formation of throttle ice.

Since each grain of ice constricts the air flow and lowers the temperature still further, throttle ice builds up more and more rapidly.

(iv) Evaporation Ice

The temperature of the fuel/air mixture is also reduced by fuel evaporation taking place when fuel is drawn into the carburettor air stream. The heat required for evaporation is taken from the surrounding air and metal. The mixture temperature drop so caused by evaporation alone may be as much as 25°C. Ice, therefore, may be formed in the carburettor even when the outside air temperature is well above the freezing point.

The boost reading will drop immediately as soon as ice accretion in the carburettor starts. This is sometimes accompanied by a slight flickering of both the manifold pressure and tachometer needles.

NOTE

It requires much more heat to melt ice already formed in a carburettor than to prevent its formation.

For best engine operation, the temperature of the carburettor air mixture should be maintained at 40°to 45°F (4° to 7°C) under all circumstances.

NOTE

Engine operation at more than 45°F 7°C) carburettor mixture temperature causes a loss of engine power due to the reduced weight of the cylinder charge.

(v) Carburettor mixture heat should, therefore, be used at all times with automatic selections. When manual mixture control is used carburettor mixture heat should be used whenever there is the slightest possibility of the occurrence of carburettor icing.

Under these conditions it is a good practice to apply carburettor heat for one or two minutes every half hour during flight in order to preclude the possibility of icing.

Carburettor icing is likely to be encountered at free air temperatures of 20°F to 60°F (-7° to 16°C).

(a) Adjust carburettor heat to keep clear of the icing danger zone, which extends between carburettor mixture temperatures of 28°F and 36°F (-2°C and 4°C).

(vi) Carburettor heat should further be used:

(a) When rough engine operation occurs in cold, clear air with low cylinder head and carburettor air temperatures.

Increase carburettor heat only enough to eliminate engine roughness.

(b) When the fuel/air mixture may be too cold for proper vaporization and fuel economy during low power cruising.

Use carburettor heat as necessary to obtain smooth engine operation and to eliminate plug fouling.

5.2 OIL DILUTION

5.2.1 GENERAL

For starting in cold weather, the engine oil may be diluted by adding fuel.

The amount of fuel to be added to the engine oil depends on the air temperature anticipated at the time of the next start. Recommended dilution percentages and dilution times for various temperatures are given in the table below. To achieve the recommended

Anticipated Air Temp. At Next Start		Dilution % by Vol.	Max. Oil Tank Contents before starting Dilution		Dilution Time at 1000 RPM
C°	F°		Imp.gal.	U.S.gal.	
5 to -25	40 to -10	10	4	4.8	2 min.
-25 to -30	-10 to -20	20	4	4.8	3 min.
-30 and	-20 and	30	3.5	4.2	4 min.
below	below	30	3.5	4.2	5 min.

percentages, the dilution switch is to be held "ON" for the time of the dilution run.

5.2.2 REDILUTION

If a short ground-run is made with an engine which has previously been prepared for cold weather starting, it is necessary to redilute the engine oil before shutting down. To arrive at the correct time for redilution proceed as follows:

(a) Divide ground-run time in minutes by 60.

(b) Multiply the time in the Dil. Table by the fraction found through step (a).

Example: Ground-run time is 15 minutes. Dilution percentage requires 20%. Normal dilution time given in Dilution Table: 3 minutes.

(a) 15/60 = 1/4 (b) 3 x 1/4 = 3/4 minute.

NOTE

In extreme cold weather only a negligible amount of fuel is "boiled off" during a short ground-run. Under these conditions there may be no need for redilution of the engine oil.

5.2.3 OIL TANK LEVELS

During the dilution run, approximately 1 gallon of fuel is added to the engine oil in 4 to 5 minutes. Thus, additional volume is required in the oil tank and may have to be provided by draining the oil tank down to the maximum permissible level before oil dilution is started. On the other hand, the addition of fuel causes the oil level to rise above the filler inlet level.

The oil tank filler cap should not be removed when an aircraft has been prepared for cold weather starting.

5.2.4 OIL DILUTION PROCEDURE

To insure that recommended oil dilution percentages are obtained proceed as follows:

(a) Allow oil temperature to drop to between 85°F and 100°F (30°C to 40°C) during shutdown run of engine. (If an oil temperature of less than 125°F (50°C) cannot be obtained with the engine running, the engine should be shut-off until the oil has cooled to below 100°F (40°C).

(b) Select the dilution percentage required from the Oil Dilution Table and corresponding maximum permissible tank contents.

(c) Make sure oil level in the tank is down to permissible maximum. Stop the engine to have oil drained or added, if necessary.

(d) Propeller lever at DECREASE RPM.

(e) Throttle lever to give 1000 RPM.

(f) Hold oil dilution switch ON for the recommended dilution time.

(g) Move propeller lever several times to INCREASE RPM during the last two minutes of the dilution run to inject diluted oil into the propeller cylinder and governor pipelines.

(h) When the oil dilution period has elapsed, hold dilution switch in the ON position until the engine has stopped. Stop the engine with propeller in the DECREASE RPM position and mixture lever at IDLE CUT-OFF.

The diluted oil tends to loosen carbon and sludge deposits within the engine. The oil screen should therefore be removed and cleaned immediately after the first use of the dilution system each season, and inspected daily until carbon collection on the screen returns to normal. Thereafter the usual screen inspection will be adequate. The oil pressure should be watched closely for indications of oil screen clogging.

NOTE

Oil dilution should not be used intermittently during the season but continued once it has been started. Otherwise, oil screen cleaning, as recommended above, must be repeated.

The fuel content in a diluted engine oil system is "boiled-off" within 3/4 to one hour at normal operating temperatures. High oil inlet temperatures of 160°F (70°C) and above will shorten fuel evaporation time.

When preparing for a long flight, it should be borne in mind that dilution decreases the amount of oil available for engine lubrication, depending on the engine condition and the extent of dilution. The pilot will have to rely upon experience in arriving at safe limits for each particular flight.

5.3 INSTRUMENT FLIGHTS

Before undertaking any instrument flight:

(a) Ensure proper operation of all flight instruments.

(b) Check navigation and communication equipment.

(c) Check pitot heater and carburettor heat.

(d) (Night flying) Check panel lights, navigation lights and landing light.

5.3.1 FLIGHT IN TURBULENCE AND THUNDER STORMS

(a) Attain manoeuvering speed as given in Section IV and maintain a steady flight attitude without changing air speed and rate of climb indications.

(b) Flight in thunderstorms should be avoided if possible.

5.4 OPERATION IN SUB-ARCTIC CLIMATES

5.4.1 METEOROLOGICAL PHENOMENA

Meteorological phenomena peculiar to cold weather are:

Ice crystals result from the sublimation of water vapour and are a form of precipitation. Their concentration is never heavy, so that the horizontal visibility seldom falls below 5 miles.

Prevailing ice crystals, however, can rapidly produce the much more dangerous ice fog by the mere operation of an aircraft engine. When landing at an airfield reporting ice crystals, it is recommended:

(a) To do a minimum of low flying.

(b) To come in on a straight approach.

Ice fog is a heavy concentration of ice particles forming on nuclei in the air. It is most prevalent in industrial areas but can be caused, at very low temperatures, by the running of an engine.

The propeller wash and combustion products from an aircraft engine can provide the disturbance and nuclei, under certain atmospheric conditions, to fog an aerodrome to a height of approximately 50 feet.

Horizontal visibility may then be down to a few hundred feet, while downward visibility is generally adequate.

At night, glare will be reduced, if landing and navigation lights are left "OFF".

Thin mist may often occur in the sub-arctic when the sun does not dissipate fog and low clouds.

Vertical visibility remaining good, the horizontal visibility is poor. The formation of ice and frost should always be anticipated under these conditions.

Blowing snow may obscure the landing strip and make a safe landing doubtful. Landing lights should be left "OFF" in blowing snow during night landing.

5.4.2 EFFECT ON AIRCRAFT AND EQUIPMENT

Low temperatures adversely affect aircraft and equipment, fuel and oil as follows:

Plastics become brittle and may crack when the aircraft is moved from a warm hangar to an outside dispersal point.

(a) Look for small cracks at edges of mounting frames or at small radii on curved panels.

(b) Check cockpit windshield carefully as cracks may lead to its disintegration in flight.

(c) Handle doors with caution.

Synthetic Rubber of certain types used in flexible oil and fuel lines and for coating electrical cables may lose flexibility.

(a) Avoid bending to prevent cracking of material.

Control cables tensioned inside a hangar become slack as the airframe contracts more than the steel cables, with a given temperature drop.

Batteries lose as much as 50% of their charge at 0° (-18°C) and cannot be charged at normal rate.

(a) Leave only fully charged batteries outside. They will not freeze, but their usefulness is very limited.

(b) If forecast temperature is below -22°F (-30°C), keep battery in a warm place to ensure use when required.

NOTE

If batteries are not fully charged and left outside there is danger of freezing of the electrolyte and splitting of the battery case.

Tires on dispersed aircraft may stiffen with a flat spot frozen on them.

(a) Taxi aircraft and flat spot will disappear.

Hydraulic and pneumatic leaks may appear more frequently.

(a) Decide whether corrective action should be taken as small leaks or seepage will usually disappear with increasing temperatures.

Snow and frost can be brushed off the exterior of aircraft without difficulty.

(a) Always remove snow from aircraft when a thaw is forecast in order to prevent later freezing.

Ice may require heat for its removal, making it necessary to:

(a) Fit covers on aircraft removed from a warm hangar during precipitation.

(b) Fit blanking plates to air intakes after shutting down.

(c) Watch for ice, in the vicinity of fuel tank vents, caused by condensation.

(d) Remove ice or snow from the inside of the propeller spinner as resulting unbalance may cause dangerous vibration.

High static charges can develop during removal of snow or ice. As the fuel/air mixture which is produced when gasoline evaporates at temperatures from 14°F (-10°C) to -40°F (-40°C) is explosive, refueling presents a much greater fire hazard in very cold weather.

It is therefore recommended:

(a) Ground aircraft electrically, as well as possible.

(b) Wait for 30 minutes for electric charge on rubber and plastic parts to leak off.

(c) Make sure that charges built up in the body of refueling crew are discharged by having them touch metal surface with bare hands. (Wipe moist hands dry if necessary as moist skin will stick to the metal instantly).

Fuel in drums from a cache necessitates precautions as under:

(a) Always filter fuel from drums.

(b) Do not use fuel from a drum which has been partly used, as the remaining fuel may be contaminated.

NOTE

The octane value of cached fuel may be lower than marked, as fuel slowly deteriorates in storage.

Short Engine runs. Engines should be run only to be brought up to operating temperature. If run only for a short period, water vapour in combustion products escaping past the piston will condense inside the crankcase and be distributed throughout the oil system. Split oil coolers, choked oil lines and possible engine failure may be the result.

(a) Avoid short engine ground runs.

5.4.3 PREFLIGHT CHECKS

In addition to checks called for in paragraph 2.1.8 of Section II, the following checks must be carried out before starting the engine.

(a) Inspect hydraulic brake lines for cracks, breaks or leaks.

(b) Fuel tank vents free from ice.

(c) Snow, ice or hoar frost removed from wings and tailplane.

(d) Hinges of all control surfaces free from particles of ice or hard snow liable to cause jamming.

(e) Test all main and auxiliary controls to ensure they have not become stiff or blocked with ice and snow.

(f) Defrost windows, as necessary but do not scrape off. Use alcohol to remove light film of frost forming during warm-up.

(g) Keep window open during run-up to prevent misting of windshield.

(h) Check cold weather emergency equipment for completeness and proper stowage.

(j) Position engine winter shutters (if installed) to suit temperature conditions.

5.4.4 ENGINE STARTING

If time and equipment are available, engine and accessories should be preheated. Cold starting, if necessary during very cold weather, will be easier if the following action is taken:

(a) Keep batteries and battery cart warm, indoors, until just before they are required.

(b) Apply heat to the engine if it is not possible to pull the engine through by using the starter (starter clutch slipping).

(c) For priming use normal fuel down to outside air temperatures of -13°F (-25°C). Preheat engine below this temperature.

WARNING

As a large amount of priming is necessary, cold starting creates an additional fire hazard resulting from excess fuel which might flow from engine drains.

(d) If first attempt to cold start fails, allow 5 or 10 minutes before making another attempt so that the heat generated during the false start can vaporize priming fuel which may have made spark plugs wet.

(e) Apply heat to the oil pressure line if oil pressure does not begin to show within 30 seconds, and congealed oil in the line to the pressure gauge is suspected as the cause of the trouble.

(f) Heat oil feed line if zero oil pressure is indicated and a clogged feed line is suspected of stopping the oil flow from the tank (there is a possibility that undiluted oil from the tank body has flowed into the feed line to the oil pump after the oil system has been diluted).

(g) Exercise great care in operating electric starters at low temperatures.

(h) Check suction indicator to make sure that drive shaft has not sheared off during a cold start.

When using external heat, it should be directed onto the cylinders, accessories, oil feed line and oil cooler. The amount of heat required will depend upon the air temperature, wind velocity, oil dilution percentage and whether engine covers are being used.

5.4.5 WARMING UP

To aid smooth running during warm up:

(a) Use carburettor heat and/or protected air.

(b) Adjust engine winter shutters to maintain cylinder heat temperatures within operating limits.

(c) If engine tends to fade out, operate primer pump intermittently.

(d) Maintain suitable engine speed until minimum oil temperature is reached.

(e) Watch for oil foam seeping through the crankcase breather, and stop spewing by reducing power.

5.4.6 TAXIING

During taxiing the following precautions should be observed.

(a) Do not stop aircraft on slush, continue moving until dry snow or ice is reached.

(b) Look out for obstacles, after a recent snowfall covering air field markers.

(c) Taxi slowly in icy conditions. To bring high idling rpm down, try low rpm setting and carburettor heat to reduce power (in extreme cold, however, the use of carburettor heat results in a power increase). Adjust engine winter shutters (if installed).

(d) Ensure engine is warm on reaching take-off position as taxiing will allow the engine and carburettor to cool.

(e) Switch on pitot heat when taxiing to ensure that the pitot is warm before taking off.

5.4.7 TAKE-OFF

Some of the precautions to be observed when taking off are:

(a) At ambient temperatures below standard altitude temperature (15°C (59°F) at S.L.), maximum permissible take-off MAP is reduced by 2% per 11°C (20°F) below standard. See Figure 4-1.

(b) Carry out a precautionary type of take-off from unpacked snow or slush as the rate of acceleration is poor under these circumstances.

(c) Expect sudden frosting of windshield during a climb from the field in an inversion.

(d) Open engine winter shutters to maintain cylinder head temperature within limits.

WARNING

Do not attempt to take-off with snow, ice or frost on the wings.

5.4.8 CRUISE

During flights in very cold weather the following precautions should be observed:

(a) Expect vacuum operated flight instrument (directional gyro, turn and bank indicator, artificial horizon) to be unreliable because of bearing friction caused by congealed lubricants.

(b) Operate flaps several times to prevent freezing in the "CRUISE" position.

(c) Above 60° to 65°N. latitude expect magnetic compass to be generally unreliable, so steer by gyro only.

(d) Operate propeller lever (every 30 minutes) to give 300 rpm decrease from cruise rpm and return to cruise rpm.

(e) Adjust engine winter shutters (if installed) to maintain engine and oil temperatures within operating limitations.

5.4.9 LANDING

When landing under cold and extreme cold weather conditions observe precautions as follows:

(a) Approach and land at higher speeds as the stalling speed is increased when there is ice on the aircraft.

(b) Judge height by reference to trees, fences, other aircraft or hangars when landing on clean snow.

(c) Apply brakes earlier than normal, depending on conditions.

NOTE

Maintain engine temperatures during descent to avert engine failure or choking in the event of a baulked landing.

5.4.10 AFTER LANDING

(a) Fill fuel tanks as soon as possible after landing to prevent condensation.

(b) Do not leave parking brakes on as they may freeze in this position, if moisture is present.

(c) Leave throttle lever partially open after shutting down to permit starting, if the engine controls become too stiff, and to prevent freezing of the butterfly valve.

(d) Have all covers fitted immediately if the aircraft is to be dispersed; blowing snow will enter any opening.

5.5 OPERATING IN TROPICAL CLIMATES

Aircraft operated under tropical conditions require protection from heat and humidity. Sand and dust filters may be necessary for operation in desert areas.

Heat affects components in various ways. Fuel in tanks tends to expand and vaporize. Flight control cables should be watched for tension as the material used in the construction of the aircraft will expand farther than the steel cables, thus tightening them.

Always shade aircraft if possible, including wing tip tanks if fitted. Cover plastic materials only, if necessary, for sand protection.

Close fitting covers are undesirable as they increase the temperature and may cause permanent deformation of Plexiglas panels.

5.5.1 STARTING AND TAXIING

(a) Check tire pressures.

(b) Drain moisture from fuel tanks and fuel system.

(c) Underprime first in starting. Increase amount of priming as required.

(d) Keep warming-up time to a minimum.

(e) Avoid long taxiing runs and delayed take-offs to keep cylinder head and oil temperatures below their maximums. (Use tractors for aircraft dispersal).

(f) Avoid unnecessary braking as brake drums overheat quickly.

5.5.2 TAKE-OFF

In tropical climates take-off distances will be longer because the air is less dense.

5.5.3 CLIMB

In hot weather generally:

(a) Allow a greater distance to clear obstacles.

Satisfactory cooling is provided for operation in a standard atmosphere with a ground temperature of 100°F (40°C). If this temperature is exceeded it may become necessary to climb the aircraft at airspeeds higher than those quoted in Section II.

5.5.4 CRUISE

To avoid over-heating during flight under extreme conditions it may be necessary:

(a) To operate in "rich" mixture and/or with increased power.

(b) To confine low flying to take-offs and landings.

Under extremely hot conditions the pilot should:

(a) Expect greater landing distances as the true air speed will be higher than the indicated air speed.

(b) Use ground objects for judgement of height because rising heat may produce a false horizon due to mirage effect.

5.5.5 AFTER LANDING

(a) Refuel at the coolest time of the 24 hour period.

(b) Keep fuel tanks filled in order to reduce condensation to a minimum.

(c) Apply parking brakes only after brake drums have cooled.

(d) Leave windows slightly open to induce air circulation in the cabin.

Section 6

SPECIAL INSTALLATIONS

SECTION VI

SPECIAL INSTALLATIONS

COMBINATION WHEEL-SKI INSTALLATION

6.1 The de Havilland combination wheel-ski installation permits normal operation on wheels or skis at the discretion of the pilot. It is possible to taxi immediately from snow covered ground onto cleared runways or dispersal areas and vice versa since the skis can be raised or lowered while the aircraft is being taxied. Partial retraction of the skis facilitates the use of wheel brakes, for ground manoeuvering.

6.1.1 GENERAL

The skis are raised or lowered in relation to the wheels by means of a hydraulic control unit located on the cockpit floor to the right of the pilot's seat. The skis are raised by selecting UP on the selector lever then operating the hydraulic handpump which supplies hydraulic pressure to extend an actuator and cause the ski linkage to swivel on the axle attachments. The hydraulic pressure works in opposition to a compressed air charge, in the upper portion of the actuator housing, which is used as a pneumatic spring to cushion the landing impact.

To lower the skis, select DOWN on the selector lever which will release the hydraulic pressure and allow the pneumatic pressure in the upper portion of the actuator housing, to return the skis to the DOWN position as shown on the indicator in the selector unit.

6.1.2 OPERATION

To lower skis select DOWN on the ski selector lever. After a few seconds the indicator will show that the skis are in the DOWN position.

To raise the skis select UP on the ski selector lever. Operate the hand pump until the skis are fully UP as shown by the needle on the indicator. Approximately 100 strokes of the handpump are required to raise the skis fully.

NOTE

The skis trim safely in flight at any degree of retraction. Therefore, the pumping may be completed at the pilot's convenience, and in stages if desired.

6.1.3 TAXIING

Manoeuvering on snow can often be assisted through partial retraction of the skis as follows:

(a) Select UP on the ski selector lever and retract skis by operating the handpump until the brakes become effective.

(b) On firm ground skis should be retracted fully to avoid accidental damage of the skis by unobserved rough ground.

(c) On cleared runways, taxiing strips and dispersal aprons, satisfactory taxiing may be carried out with the skis two thirds retracted if it is desired to avoid complete retraction.

6.1.4 AFTER TAKE-OFF

The ski position has no significant effect on airspeed, CG position or flight characteristics. The skis, therefore, may be left in either UP or DOWN position as dictated by conditions at the arrival landing field.

6.1.5 BEFORE LANDING

Prior to the approach to land the pilot should decide whether to raise or lower the skis, depending on the forecast conditions of the landing field. Select skis as desired and when the action is complete check the ski position visually and on the indicator.

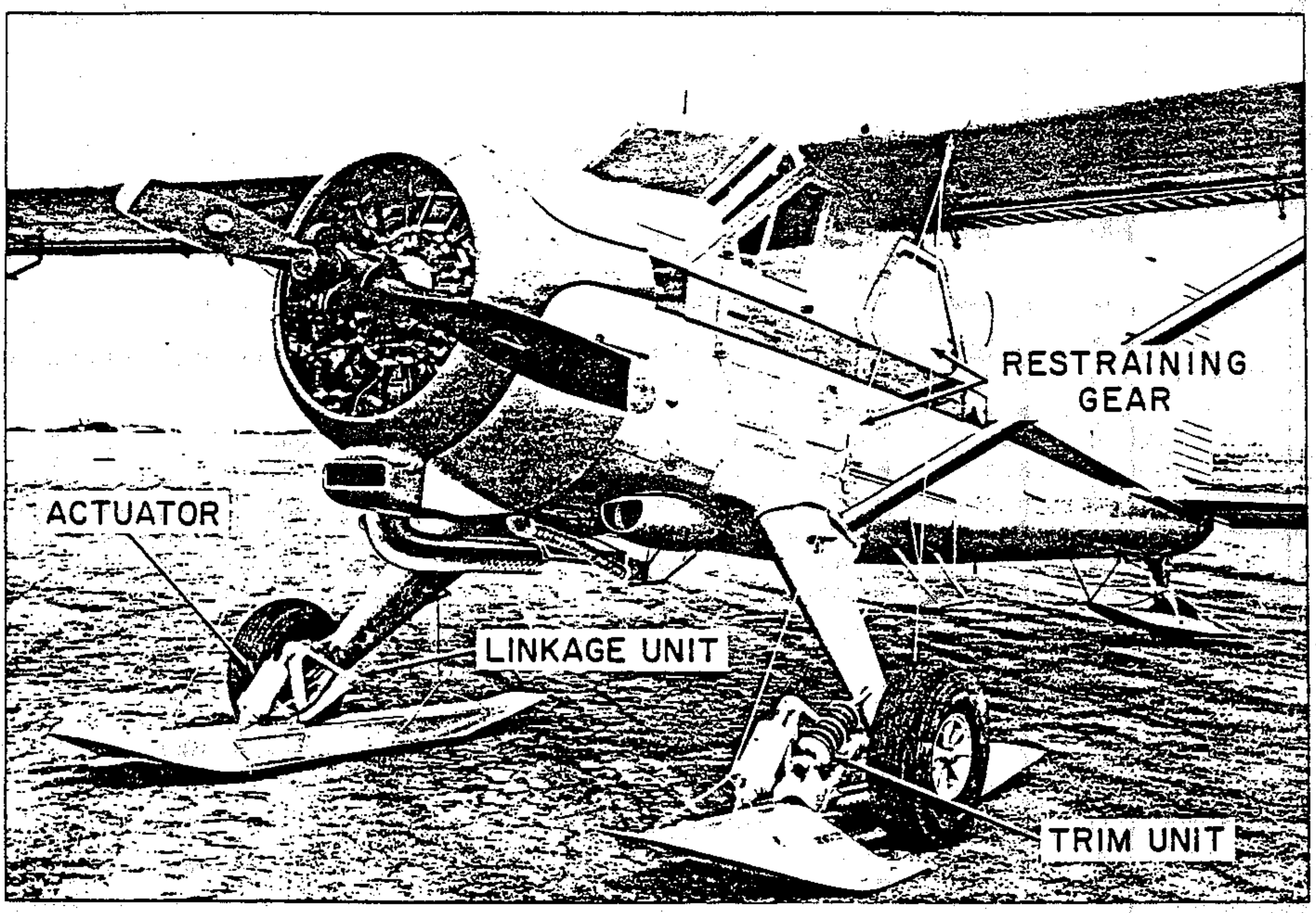


FIG 6-1 COMBINATION WHEEL-SKI INSTALLATION

6.1.6 LANDING

Make a normal approach at the speeds recommended in Section 2.13.

A tail-down or three point landing attitude should be attained on the final stage of the approach to reduce the landing run, and, when skis are extended, to ensure that raised lumps of snow or ice do not foul the ski tips on touchdown.

6.1.7 CROSSWIND LANDINGS

When landing with skis extended the crosswind component should be carefully considered against the pilot's experience and the condition of the landing area at that time. Landings with crosswind components equal to 12 mph at 90° are not recommended.

6.1.8 AFTER LANDING

As soon as possible, after touchdown, ease the control column fully back to ensure directional control via the rudder pedals and tailwheel or tail ski and proceed as in Section 2.16.

6.1.9 ON GROUND

If the tires freeze to the ground, lower the skis to free them. If the skis "freeze in" retract the skis to break free from the ice.

6.1.10 PREFLIGHT CHECKS

When the aircraft has been parked with the skis UP check that the running surfaces of the skis are free of ice which may have formed by re-freezing of melted snow or slush sprayed up while taxiing on wheels. Heavy frost conditions will sometimes encrust the running surfaces of the skis.

If the main ski running surfaces are left unclean a subsequent ski landing may result in an abrupt stop or, if one ski only is encrusted, a ground loop. Visually check inflation of actuator. Under normal operating conditions at full load, with skis down, 1 to 1.5 inches of the actuator shaft should be exposed.

NOTE

Actuator pressure changes of 60 to 70 psi due to temperature variations, etc., have only a minor effect on ski operations and do not require compensation.

6.2 AMPHIBIOUS FLOATS

The de Havilland amphibious floats installation enables routine flights to be made, from airfield to airfield, water to water, airfield to water and water to airfield conveniently and simply without delays in re-equipping the aircraft.

6.2.1 GENERAL

The floats installation replaces the complete landplane landing gear system. The floats are equipped with retractable water rudders, main and nose wheels. The retraction and extension of the wheels is accomplished by means of hydraulic pressure emanating from a hydraulic control unit, located on the floor to the right of the pilot's seat. The main wheel braking system is also operated hydraulically through actuation of the rudder toe pedals. The water rudders are actuated through a cable and pulley system for retraction, extension and steering.

6.2.2 OPERATION

Before Flight Inspection

On Land

Check the contents of the starboard hydraulic tank then, starting at the nose of the starboard float, check the following:

(a) Wheel chocks in position.

(b) Nosewheel tire pressure 30 psi, creepage and general condition.

(c) Shock strut extension.

(d) General condition of nose bumper and nosewheel retraction cable.

(e) Condition of float planing surfaces.

(f) Condition of mainwheel well, inspect hydraulic actuation and brake pipe lines, for condition and leakage.

(g) Mainwheel tire pressure 45 psi, creepage and general condition.

(h) Water rudder retraction and actuation cables for security and condition.

(j) Water rudder for retracted position and general condition.

(k) Repeat checks in the reverse order on the port float.

(l) General condition and security of spreader bars, water rudder cables and pulleys, electrical and hydraulic connections on the floats and entry points into fuselage.

Before Flight Inspection

On Water

Repeat checks as above omitting a, e, and f.

6.2.3 ON ENTERING THE AIRCRAFT

In addition to the normal airplane checks:

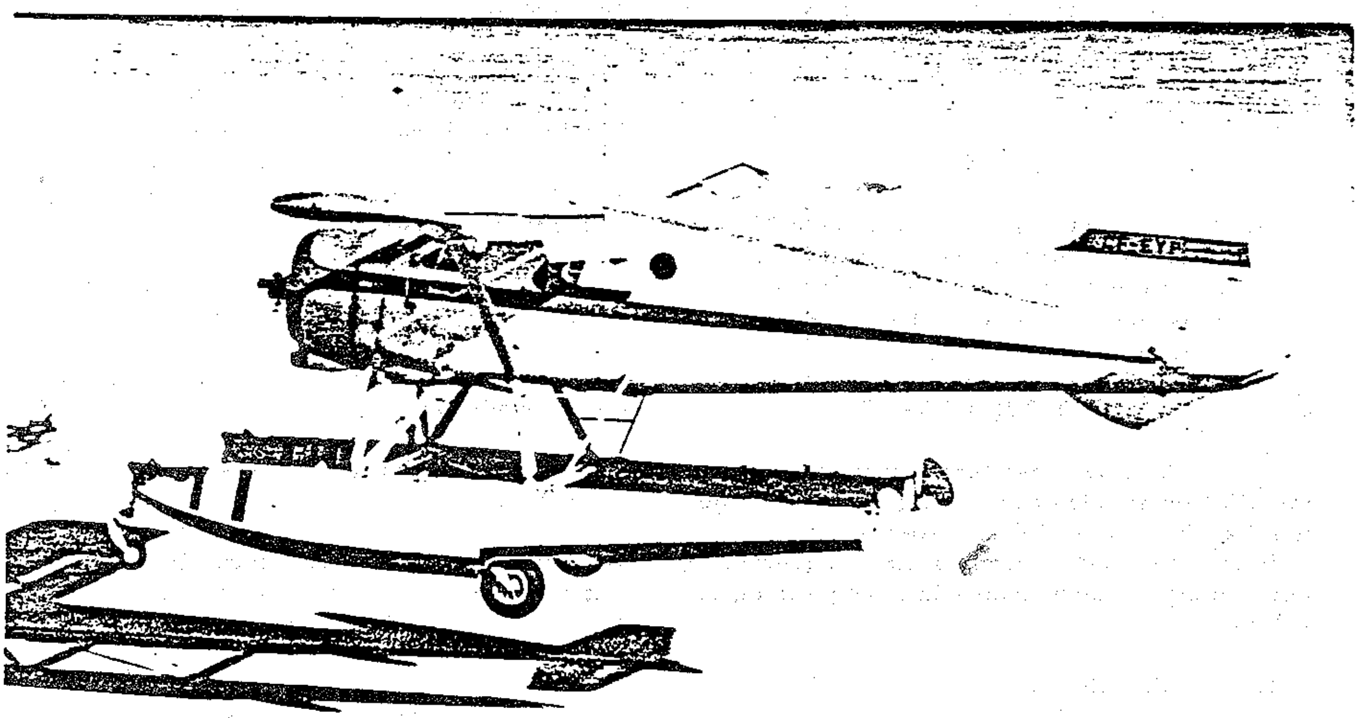
(a) Observe selected position of the wheels on the amphibious floats hydraulic control unit, located on the cockpit floor to the right of the pilot's seat, also the position of the water rudders retraction handle, on the floor to the left of the pilot's heel.

(b) Ensure that the U/C WARN circuit breaker switch, on the right hand electrical panel, is selected ON (Red diagonal lines show on indicator when circuit is broken).

6.2.4 TAXIING

Seaplane

Ensure that the wheels are retracted (UP) then cast off the mooring rope. Extend the water rudders and proceed to take-off point. Allow the seaplane to weathercock into the wind and complete engine checks, if not already done. Retract water rudders and take-off into



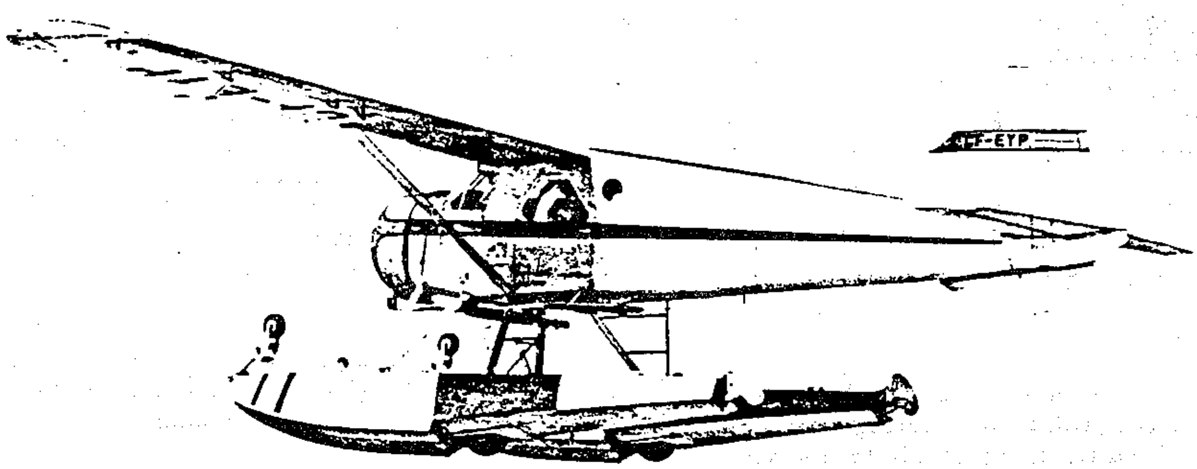


FIG 6-2 AMPHIBIOUS FLOATS INSTALLATION

the wind. The water rudders may be left extended to assist in crosswind take-offs.

Landplane

In addition to the checks in Section 2, para. 7, make sure that the wheels are selected DOWN and check that the indication on the hydraulic control unit indicator is a wheel. Before commencing taxiing, check that the water rudders retraction handle is in the retracted position. Test the brakes as soon as the aircraft starts moving.

NOTE

Although the aircraft is in a tricycle undercarriage attitude giving better taxiing visibility more care should be taken to avoid rough or uneven ground in order to avoid damage to the floats. Furthermore, when manoeuvering, the pilot must keep in mind the additional area required for the length of the floats.

6.2.5 TAKE-OFF

Landplane

In addition to the checks in Section 2.9 check the following:

(a) Wheels DOWN - Wheel indication.

(b) Water rudders - Retracted.

(c) Brakes - OFF.

(d) Open throttle slowly to take-off power and note that the aircraft accelerates more rapidly, because of the tricycle attitude. Maintain directional control by coarse use of the rudder initially.

(e) Allow the speed to increase to 60 or 65 mph before applying a slight backward pressure to the control column to assist the airplane in unsticking.

(f) As the nose wheels lift clear of the ground a slight forward pressure should be applied to the control column to maintain the take-off attitude.

Seaplane

Complete the normal checks in Section 2.9 with the addition of the following:

(a) Wheels up - UP.

(b) Water rudders - Retracted.

(c) Open throttle smoothly and maintain direction with the airplane rudder. Allow the seaplane to fly itself off at approximately 65 mph.

6.2.6 CLIMBING, CRUISING AND DESCENDING

In flight whether climbing, cruising or descending, the effects of the amphibious floats are the same as those encountered with normal floats. However, to improve the flight characteristics, the wheels should be retracted during flight. The water rudders should be retracted during take-off and remain retracted until after a water landing has been completed.

6.2.7 LANDING

Before approaching to land at the termination of the flight, the pilot must consider his intended landing area and take action accordingly.

If the landing is to be made:

(a) On water, the wheels and water rudders must be retracted (UP).

(b) On land, the wheels must be selected DOWN and locked and the water rudders retracted.

The water rudders retraction is simply a matter of checking that the retraction handle on the floor to the left of the pilot's left heel, is in the retracted position where it should have been before take-off and during the flight.

The wheels, however, require that:

(a) The selector lever on the amphibious floats hydraulic control unit be selected as desired.

(b) The handpump is operated until the desired position UP or WHEEL, is shown on the hydraulic control indicator.

NOTE

Press in the quadrant engaging arm on the selector lever to release the catch from the quadrant before moving the selector lever from the forward UP position to the rear DOWN position or vice versa and ensuring that the catch re-engages with the quadrant at the completion of the selection. It should be noted that with the selector lever in the DOWN position an extension on the lower part of the selector lever engages a protruding solenoid plunger, which prevents the wheels from being selected up when the weight of the aircraft is on the wheels.

When the aircraft weight is not on the wheels a switch on the main gear retracts the solenoid plunger allowing the lever to be selected up. If, when airborne, the plunger does not retract and it is desired to operate the gear, the plunger can be depressed manually.

6.2.8 OPERATING LIMITS

The All-Up Weight of the amphibian (with amphibious gear Part No. C2-UF-2455) when operating on water must not exceed 5000 lb, this reduction in A.U.W. from the standard seaplane version is necessary due to the decreased buoyancy of the amphibious floats. Refer to paragraph 6.3.12 for the allowable increase in A.U.W. of the amphibian when using water-dropping tanks.

NOTE

Handling and performance are unchanged, except as stated below.

Handling

On wheels, if take-off is attempted at the minimum speed 58-60 mph IAS, the nose, once lifted will tend to rise and must be checked. This is a normal nose wheel airplane characteristic and is easily controlled by elevator. If the nose is left down until 80 mph IAS, this characteristic is absent.

Performance

There is negligible difference between the wheels up and down performance.

Runway take-off - Add 50 feet to landplane figure (Chart I).

Runway landing - Add 95 feet to landplane figure (Chart II).

Rate of climb - Subtract 50 fpm from seaplane values (Para. 4.10.1).

Speed at maximum weak mixture power (300 BHP) - Subtract 2-1/2 mph from seaplane (Para. 4.10.1).

Speed at standard cruise (240 BHP) - Subtract 5 mph from seaplane (Para. 4.10.1).

6.3 WATER-DROPPING TANKS (STANDARD SEAPLANE AND AMPHIBIAN)

The de Havilland water-dropping tanks installation, fitted to the standard seaplane or amphibian on special order, is used for fire-fighting. The tanks will automatically fill whilst in motion on the water after touchdown or during the take-off run. This permits rapid replenishment for fighting forest fires when time is the important factor and where the length of water run is restricted. At a speed of 40 mph the tanks can be fully refilled in 18 seconds.

6.3.1 GENERAL

The water tanks installation consists of a five feet long, 17 inch diameter, tank mounted on top of each float. Each tank has a capacity of 49.1 Imp. gals with a limit load of 45 gallons each. A filler tube attached by brackets to the inboard side of each float, extends down into the water to a point approximately 3 inches above the keel of the float. The tube discharges into a 7-1/2 inch wide opening along the top of the tank. A graduated scale in each tank is visible to the pilot through the rear view mirror and enables him to check the quantity. A control lever, located centrally beneath the alternate compass position in front of the pilot, is connected by means of cables and pulleys to the forward end of each tank. Pulling this control lever towards the pilot disengages a lock and rotates each tank in an inboard direction approximately 130° to empty the contents. The tanks are mass balanced and will return to their normal locked positions when the control lever is released.

6.3.2 OPERATION

6.3.3 Before Flight Inspection

In addition to the checks detailed in Section II, ensure that the water tanks are securely mounted on the floats and that the pulleys and cables are unrestricted in movement. Ensure that the aircraft loading with the water tanks empty is such that, on take-off, the CG limits will not be exceeded as the tanks become full. Ensure that the ventral fin is installed.

6.3.4 On Entering the Aircraft

In addition to the checks detailed in Section II, ensure that the water tanks control lever is pushed fully in and, if necessary, adjust the external rear view mirror on each door so that the tank quantities can be readily seen by the pilot.

6.3.5 Taxiing

Take care during taxiing to avoid weeds so that the tank inlet tube will not become obstructed. During taxiing and engine tests, the water tanks will begin to fill if the speed is above 40 mph. (Refer to paragraph 6.3.12).

6.3.6 Filling and Take-off

Complete the checks detailed in paragraph 6.2.5. During the take-off run, maintain 40 mph until the tanks are filled (45 gal.) then increase power and complete normal take-off. The tanks will fill in approximately 18 seconds.

6.3.7 Climb

Restrict the angle of climb to avoid spilling water from the tanks.

6.3.8 Cruise

When water tanks are installed, the cruising airspeed is approximately 10 mph less than that shown in paragraph 4.10.1 for the seaplane.

6.3.9 Emptying Water Tanks

When emptying the water tanks over a forest fire etc, the direction and speed of the wind has very little effect on the water coverage pattern since the greatest percentage of the water falls very rapidly. A drift allowance of approximately seven feet for every one mph of wind speed effective at 100 feet altitude has been found satisfactory. This formula applies regardless of the direction of flight since the pattern and density of the falling water is dependent on the altitude of the aircraft at the time of release. High altitude dumping results in a light widespread pattern, whereas low altitude dumping results in a heavy concentrated pattern. The wing flaps should be lowered to CLIMB setting and a steady airspeed of 85 to 90 mph IAS should be maintained at the desired altitude when dropping the water. The dumping of the water should be completed one second before the center of the target is reached. Approximately two seconds are required to empty the tanks completely. The tanks will return to their normal positions and lock when the control lever is released.

6.3.10 Refilling the Tanks

Refilling the water tanks is accomplished by making a normal seaplane landing using TAKE-OFF flaps setting, maintaining a taxi speed of 40 mph until the tanks are filled (45 gal.) then increasing power to become airborne again.

6.3.11 Handling

At all times the pilot should consider the aircraft as being fully loaded, observing the normal precautions. To maintain the CG within limits, if loaded CG aft, empty the rear fuel tank first; if loaded CG forward, empty the front fuel tank first. Reduction in A.U.W. can be accomplished by removal of the rear seats or by reducing the fuel load.

NOTE

The Safe Moment Limits must be maintained within the limits shown in paragraph 6.3.13.

6.3.12 WEIGHT LIMITATIONS

1. Standard Seaplane A.U.W. - 5090 lb

This A.U.W. is applicable under all conditions.

2. Amphibian A.U.W. - 5000 lb

This A.U.W. may be increased to a maximum of 5090 lb when the excess weight above 5000 lb is picked up while taxiing (on the step) at a speed in excess of 40 mph.

CAUTION

Should a take-off be aborted after the water dropping tanks are full (at A.U.W. 5090 lb), then the water contents must be jettisoned immediately in order to reduce the A.U.W.

NOTE

Do not taxi or manoeuvre the amphibian on the water at an A.U.W. in excess of 5000 lb.

6.3.13 WEIGHT AND MOMENT TABLE

When equipped with the water tanks

installation, the aircraft basic weight is affected as follows:

	Weight lb.	Arm in.	Mom
Add to Basic Aircraft			
Water tanks (2) - empty	118	-16	-1888
Filler assembly	20	-10.5	- 210
Miscellaneous	2	+ 7	+ 14
Total	140		-2084
Water tanks (2) - full	900	-16	-14400
Total as flown	1040		

When equipped with the water tank installation the cg limits of the seaplane and amphibian are +0.44 to -3.5.

APPENDIX

OPERATING DATA CHARTS

APPENDIX

AIRSPEED INSTALLATION CORRECTION TABLE

All Configurations and Loading Conditions

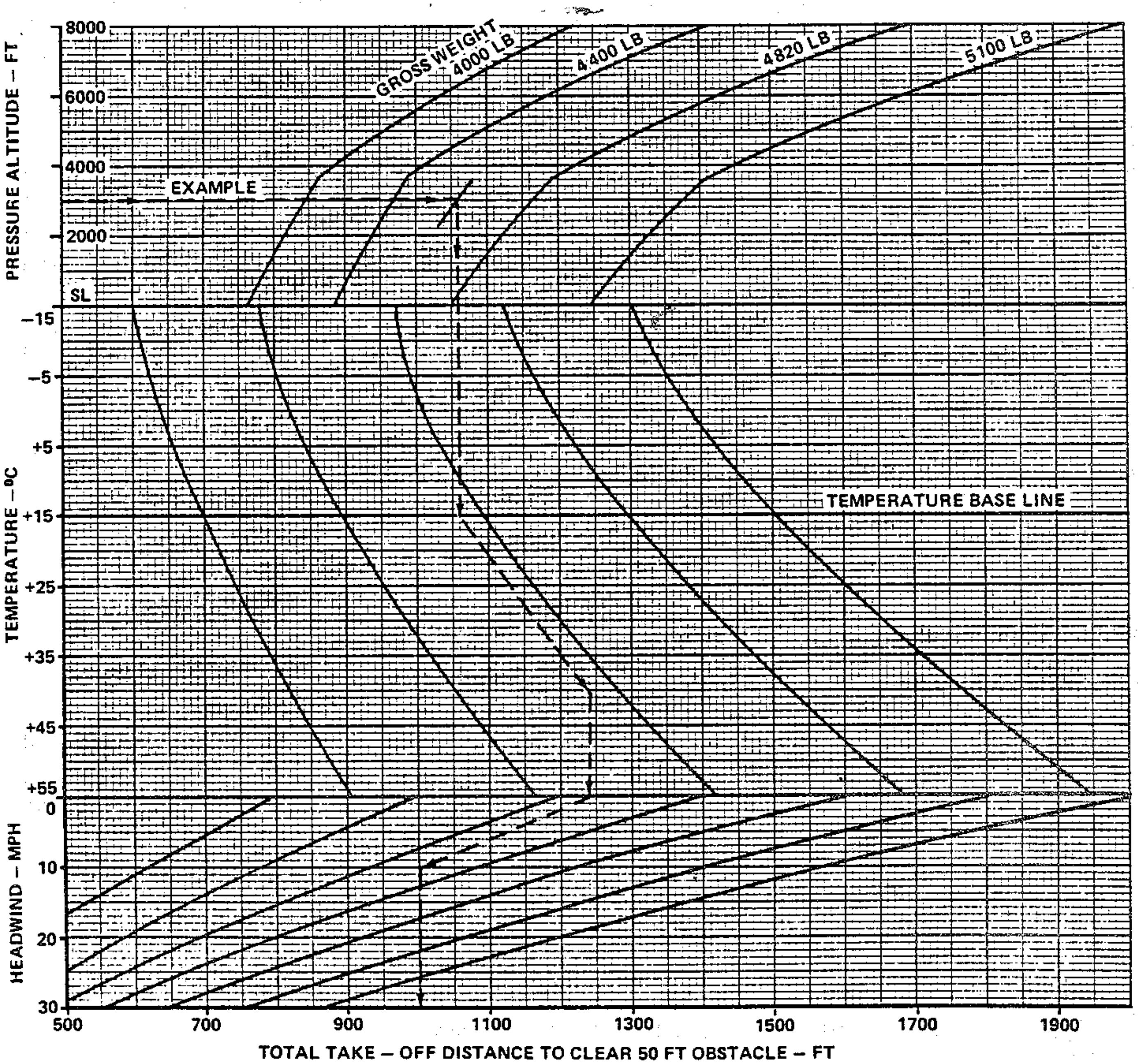
MODEL: DHC-2 BEAVER

Correction to be Applied to Instrument Reading to Obtain CAS							
WITH FLAPS UP				WITH FLAPS DOWN 'CLIMB' or 'LANDING'			
Indicated Airspeed MPH	Indicated Airspeed (KNOTS)	Correction MPH	Correction (KNOTS)	Indicated Airspeed MPH	Indicated Airspeed (KNOTS)	Correction MPH	Correction (KNOTS)
115	(100)	-4	(-3)	80	(70)	-5	(-4)
172	(150)	-4	(-3)	120	(105)	-5	(-4)
202	(175)	-4	(-3)				

NOTE

The take-off and landing distances on the following charts assume ICAO technique during take-off and landing, namely, holding the aircraft down until the airspeed builds up to 1.2 times the stalling speed before climbing on take-off, and holding 1.3 times the stalling speed during the approach to land.

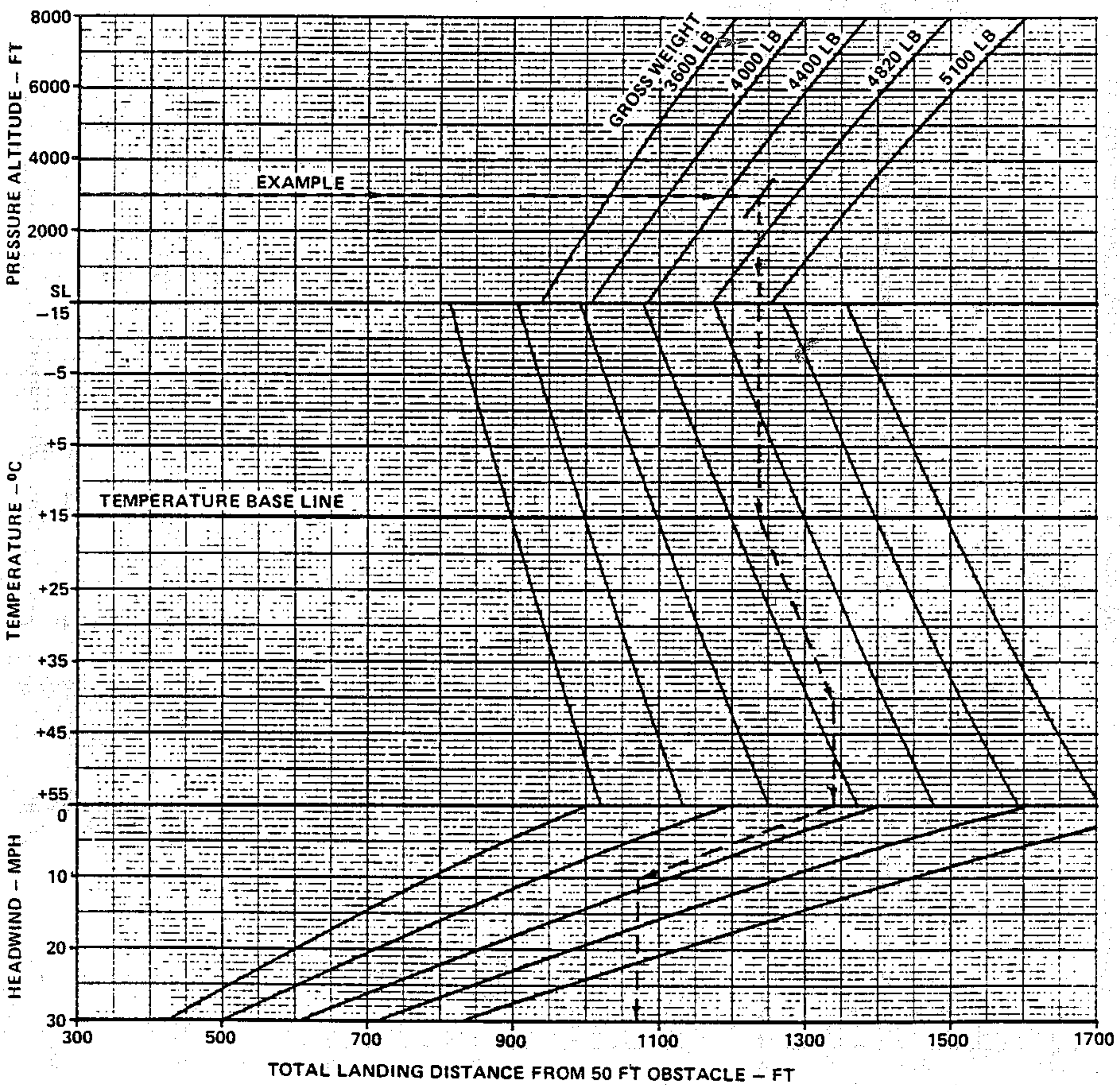
REMARKS:
1. Runway: Hard surface
2. Flaps: "Take-off"
3. Ground run is approximately 55% of total distance
4. Data: Estimated (ICAO technique)



EXAMPLE:
1. Follow Pressure Altitude line (3000 ft) horizontally to Gross Weight contour (4600 lb)
2. Drop vertical line to Temperature Base Line
3. Follow closest Temperature contour to existing temperature line (40°C)
4. Drop vertical line to zero wind line
5. Follow closest Headwind contour to existing headwind line (10 mph)
6. Drop vertical line to Distance axis and read:
   Total take-off distance to clear 50 ft obstacle = 1000 ft

TOTAL LANDING DISTANCE FROM 50 FT – LANDPLANE

REMARKS:
1. Runway: Hard surface
2. Flaps: "Landing"
3. Ground run is approximately 50% of total distance
4. Data: Estimated (ICAO technique)



EXAMPLE:
Follow example line using procedure given for landplane take-off and read:
Total landing distance from 50 ft obstacle = 1070 ft

LANDING DISTANCE - LANDPLANE

SKIPLANE TAKE-OFF AND LANDING DISTANCES

Snow conditions being extremely variable, the sliding coefficient of friction which has an important effect on Take-off and Landing ground distances, may vary between wide limits.
($\mu = 0.02$ to $\mu = 1.2$).

TAKE-OFF

(1) Under doubtful snow conditions:

(a) Expect "sticky snow" ground run ($\mu > 0.3$).

(2) If the pilot is sufficiently familiar with the snow conditions to know that the sliding friction is normal ($\mu < 0.3$):

(a) Add 1000 feet to the landplane figures to obtain length of ground run.

(3) On very "slippery" snow or ice ($\mu < 0.1$):

(a) Add 100 feet to the landplane figures.

(4) In very "sticky" snow ($\mu > 0.3$):

(a) Expect a take-off ground run in excess of 2000 to 3000 feet.

LANDING

Since weather conditions may change rapidly, there is a possibility that snow which was "sticky" on take-off may prove very "slippery" on landing.

(1) Under doubtful conditions:

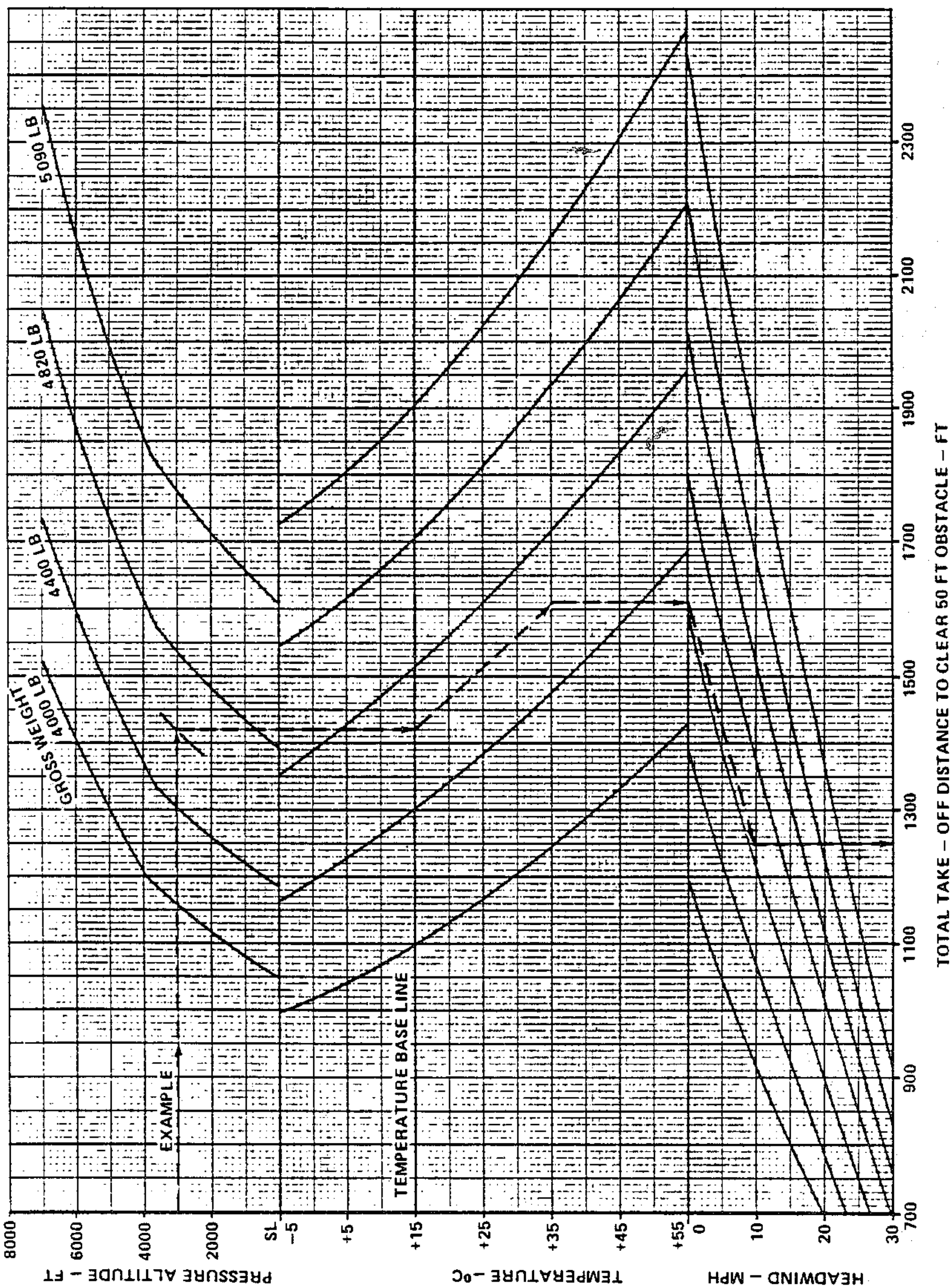
(a) Allow for a ground run in excess of 2000 feet ($\mu < 0.1$).

(2) If conditions are known to be favourable:

(a) Add 400 feet to ground run values for the landplane ($\mu > 0.1$).

TOTAL TAKE – OFF DISTANCE TO 50 FT – SEAPLANE

REMARKS:
1. Water: Calm
2. Flaps: "Take-off"
3. Water run is approximately 68% of total distance
4. Data: Estimated (ICAO technique)



EXAMPLE:
Follow example line using procedure given for landplane take-off and read:
Total take-off distance to clear 50 ft obstacle = 1250 ft

TAKE-OFF DISTANCE - SEAPLANE

ENGINE: Pratt & Whitney WASP JUNIOR R-985 (ALL MODELS)

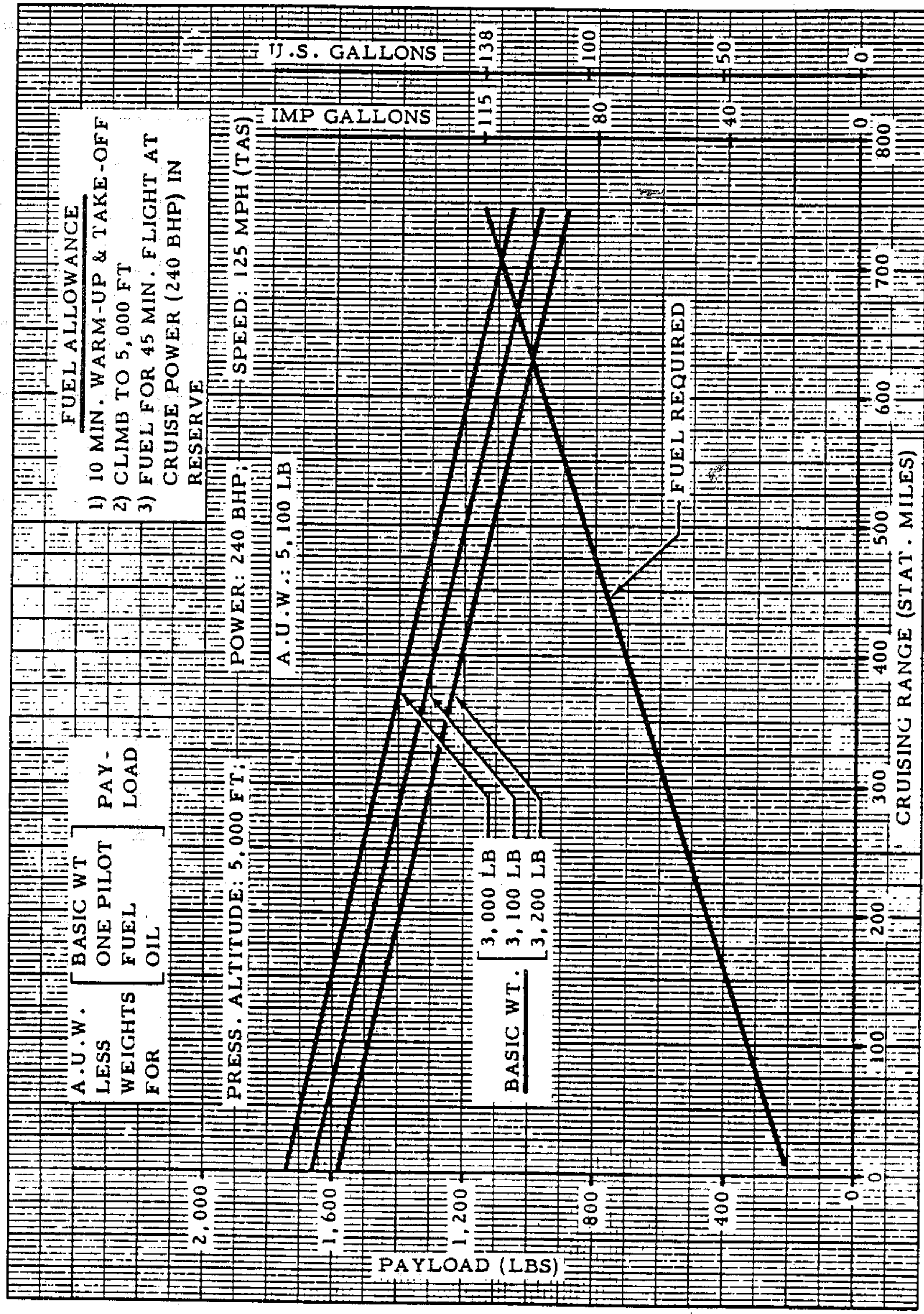
MIXTURE CONTROL: Auto Lean

FUEL CONSUMPTION						
Imp.Gal/hr	14.1	15.2	16.5	18.4	20.8	23.1
U.S.Gal/hr	16.9	18.2	19.8	22	25	28.5
B.H.P.	200	220	240	260	280	300

Altitude	R.P.M. and MANIFOLD PRESSURE					
S.L.	1600-26.7	1600-28.5	1650-29.5	1750-29.7	1900-29.2	2000-29.7
1000	1600-26.5	1600-28.5	1650-29.2	1750-29.7	1900-29.2	2000-29.5
2000	1600-26	1600-27.7	1650-29	1750-29.2	1900-28.7	2000-29.2
3000	1600-25.7	1600-27.5	1650-28.7	1750-29	1900-28.5	2000-29
4000	1600-25.5	1600-27	1650-28.2	1750-28.7	1900-28.2	2000-28.5
5000	1600-25.2	1600-26.7	1650-28	1750-28.2	1900-28	2000-28.2
6000	1600-25.2	1600-26.5	1700-27.5	1750-27.7	1900-27-7	2000-28
7000	1600-25	1600-26.2	1700-27	1750-27.2	1900-27.5	2000-27.7
8000	1600-24.7	1600-26	1700-26.5	1800-26.7	1900-27.2	2000-27.5

NOTE: Do not operate at above R.P.M. Manifold Pressure Combinations unless carburettor mixture temperature is between
40 to 45°F (+4 to +7°C).
This will insure the attainment of the stated fuel consumption. If it is not possible to obtain the desired temperature, operate below 28°F (-2°C).

CRUISE POWER CHART

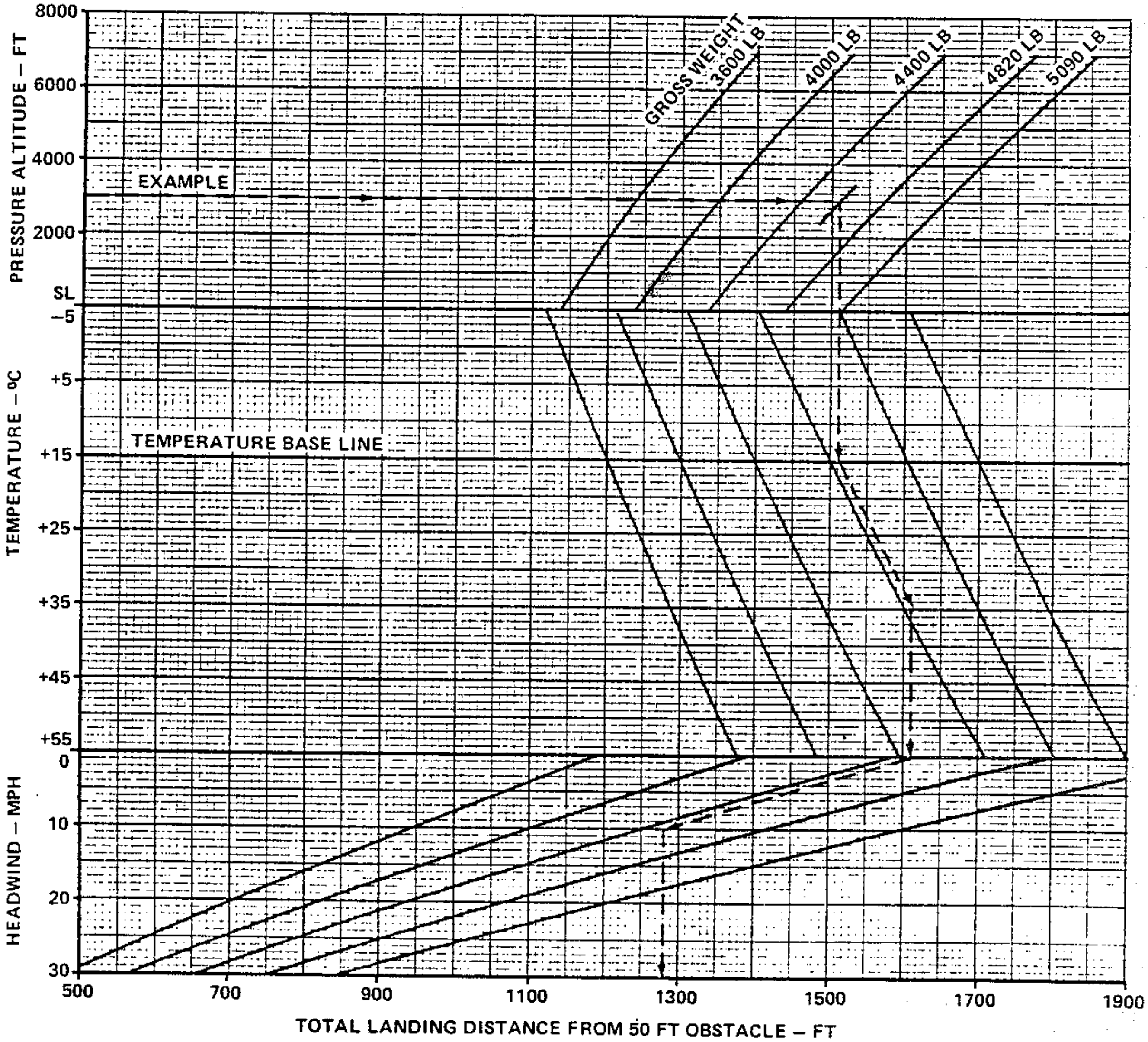


PAYLOAD VS CRUISING RANGE

LANDPLANE

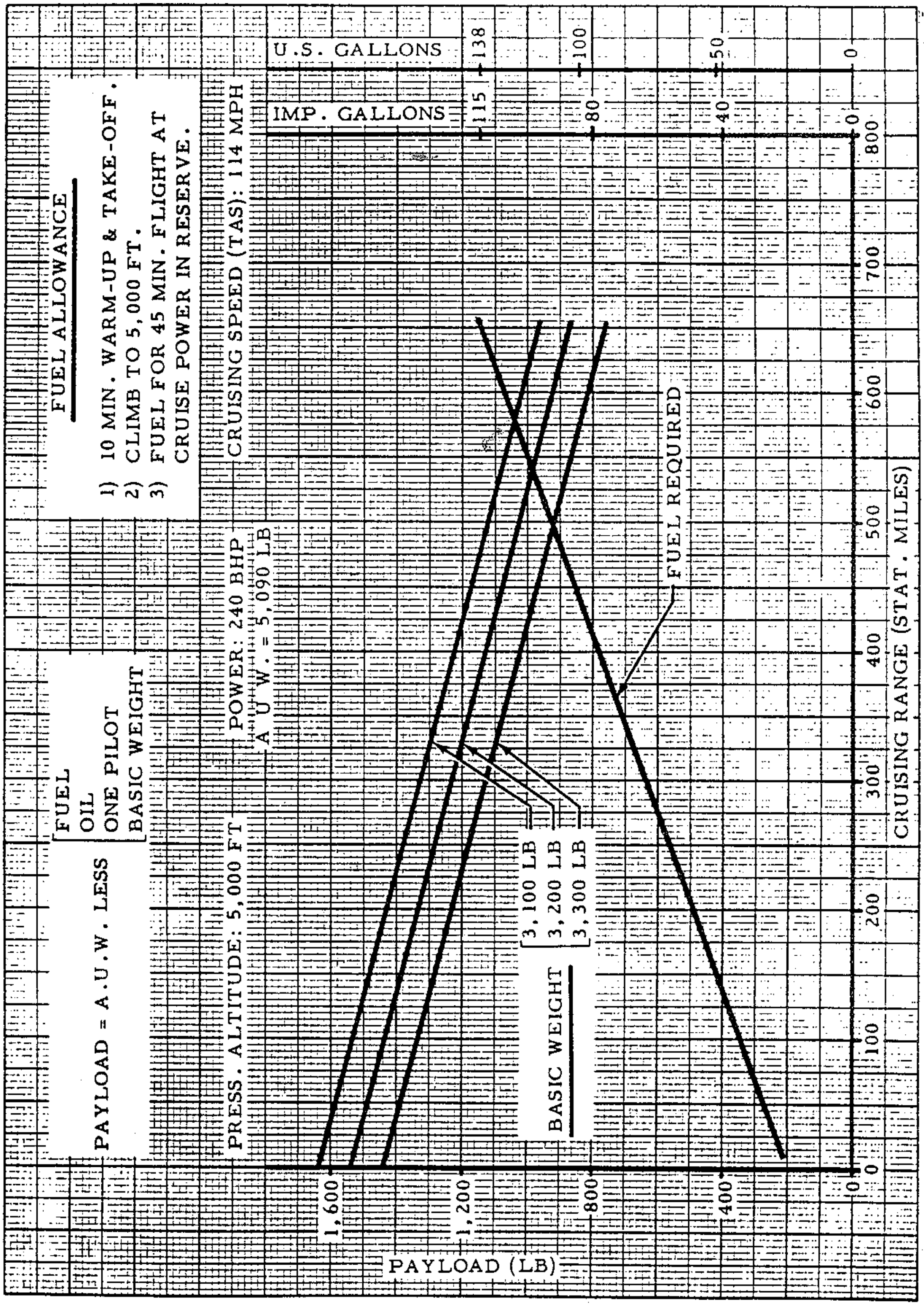
TOTAL LANDING DISTANCE FROM 50 FT – SEAPLANE

REMARKS:
1. Water: Calm
2. Flaps: "Landing"
3. Water run is approximately 58% of total distance
4. Data: Estimated (ICAO technique)



EXAMPLE:
Follow example line using procedure given for landplane take-off and read:
Total landing distance from 50 ft obstacle = 1280 ft

LANDING DISTANCE - SEAPLANE



PAYLOAD vs CRUISING RANGE

SEAPLANE

SAFE MOMENTS LIMITS					
Gross Weight	Landplane and Skiplane			Seaplane	
	Forward	Aft (See Note)		Forward	Aft
		Column A	Column B		
3000	+19800	-23100	-26400	+19800	-18300
3100	+20500	-23900	-27300	+20500	-18900
3200	+21100	-24600	-28200	+21100	-19500
3300	+21800	-25400	-25000	+21800	-20100
3400	+22400	-26200	-25500	+22400	-20700
3500	+23100	-27000	-30800	+23100	-21400
3600	+23800	-27700	-31700	+23800	-22000
3700	+24400	-28500	-32600	+24400	-22600
3800	+25100	-29300	-33400	+25100	-23200
3900	+23400	-30000	-34300	+23400	-23800
4000	+21600	-30800	-35200	+21600	-24400
4100	+19600	-31600	-36100	+19600	-25000
4200	+17600	-32300	-37000	+17600	-25600
4300	+15400	-33100	-37800	+15400	-26200
4400	+13100	-33900	-38700	+13100	-26800
4500	+10700	-34600	-39600	+10700	-27400
4600	+ 8100	-35400	-40500	+ 8100	-28100
4700	+ 5500	-36200	-41400	+ 5500	-28700
4800	+ 2700	-37000	-42200	+ 2700	-29300
4900	- 200	-37700	-43100	- 200	-29900
5000	- 3200	-38500	-44000	- 3200	-30500
5090	-------	------	------	- 6000	-31100
5100	- 6400	-39300	-44900	------	------

FREIGHT		
Weight lb.	Mom. in. lb.	
	Fwd. Arm	Aft Arm
	-19 in.	-57 in.
25	- 475	- 1425
50	- 950	- 2850
75	- 1425	- 4275
100	- 1900	- 5700
200	- 3800	-11400
300	- 5700	-17100
400	- 7600	-22800
500	- 9500	-28500
600	-11400	-34200
700	-13300	-39900
800	-15200	-45600
900	-17100	-51300
1000	-19000	-57000
1100	-20900	-62700
1200	-22800	-68400
1250	-23750	-71250

FUEL		
BELLY TANK Capacity = 36 I.G. Arm = -8.0 in.		
Imp. Gal.	Wgt. lb.	Mom in. lb.
10	72	- 576
20	144	-1152
30	216	-1728
36	259	-2072

FLOOR STRENGTH
For uniformly distributed load 100 lb/sq.ft.
For concentrated load (penetration strength) 200 lb/sq.ft.

NOTE

SAFE MOMENT LIMITS - AFT

Land and Ski Plane

COLUMN A Applies to aircraft in which the rigging recommendations outlined in Engineering Bulletin Series B No. 1 have not been incorporated.

COLUMN B Applies to aircraft in which the rigging recommendations outlined in Engineering Bulletin Series B No. 1 have been incorporated.

BASIC WEIGHT OF AIRCRAFT. . . . LB*

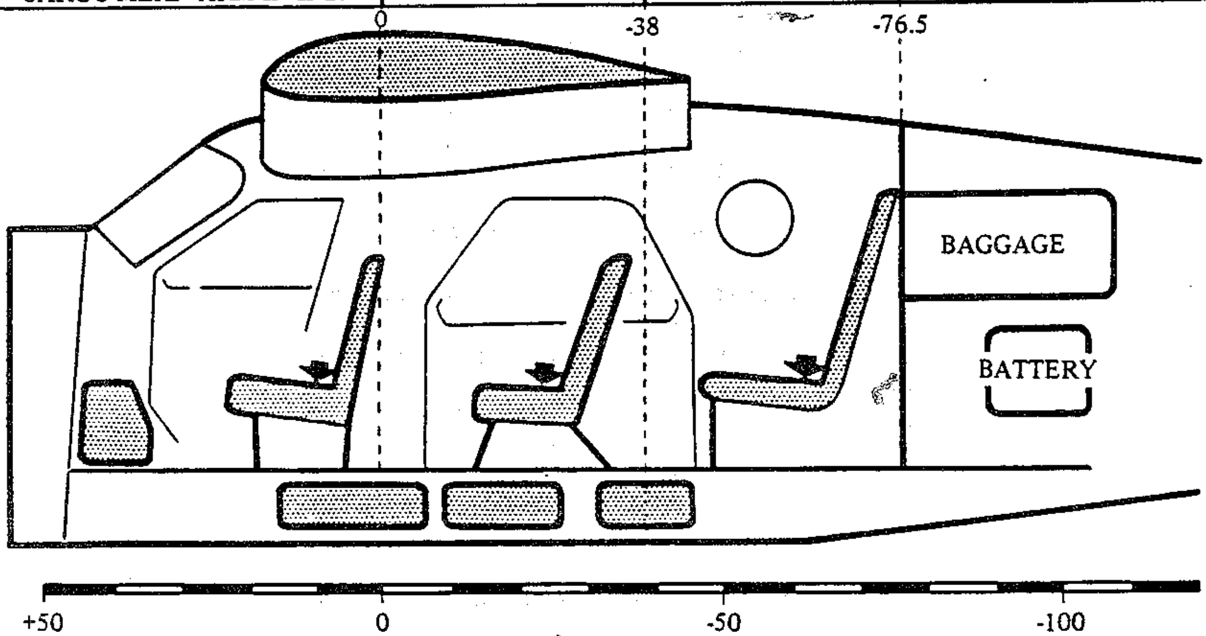
BASIC MOMENT. . . . .*

* (Insert actual weight and basic moment given in weight and balance report found in envelope on inside of rear cover)

PILOT/PASSENGER STD. WEIGHT 170 LB.

ARM IN INS.	+7	-29	-62
MOMENT	+1190	-4930	-10540
CARGO MEAN ARM IN INS.		FORE -19	AFT -57

LITTER = -33
(PATIENT INCL.) -8250
LITTER+PATIENT = 250 LB



WING TIP TANKS
36 GAL. 259LB. -2590 MOM

1) ADD TO BASIC WEIGHT AND TO BASIC MOMENT:
   A. PILOT(S) AND PASSENGER(S)
   B. FREIGHT AND BAGGAGE
   C. FUEL AND OIL

   WEIGHTS AND MOMENTS

2) MAKE SURE:
   A. TAKE OFF WEIGHT IS NOT OVER 5,1000 LB.
   B. TOTAL MOMENT VALUE IS WITHIN SAFE MOMENT LIMITS.
   C. AVAILABLE TAKE OFF DISTANCE PERMITS TAKE-OFF AT THIS WEIGHT.

OIL TANK
CAP. 5.2 IMP. GAL. — ARM +37.0 IN.

GAL.	LB.	MOM
2	18	+666
4	36	+1332
5.2	46.8	+1732

FRONT TANK
CAP. 29 IMP. GAL. — ARM +4.5 IN.

GAL.	LB.	MOM
5	36	+162
10	72	+324
15	108	+486
20	144	+648
25	180	+810
29	209	+940

CENTRE TANK
CAP. 29 IMP. GAL. — ARM -19.6 IN.

GAL.	LB.	MOM
5	36	- 706
10	72	-1411
15	108	-2117
20	144	-2822
25	180	-3528
29	209	-4096

REAR TANK
CAP. 21 IMP. GAL. — ARM -40.0 IN..

GAL.	LB.	MOM
5	36	-1440
10	72	-2880
15	108	-4320
20	144	-5760
21	151	-6040

BAGGAGE COMP.
ARM -94.0 IN.

LB.	MOM
25	-2350
50	-4700
75	-7050

NOTE: Imp. Gal. x 1.2 = US Gal

Supplement No 1

FLIGHT MANUAL

DHC-2 Beaver

AIRCRAFT

Agricultural Installations

15 APRIL 1959

SUPPLEMENT 1

AGRICULTURAL INSTALLATIONS

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

AGRICULTURAL INSTALLATIONS

1. GENERAL

The de Havilland agricultural installations are fitted to two types of Beaver aircraft, one being a special version of the Beaver Landplane known as the Agricultural model and the other a Standard Beaver Landplane, seaplane or amphibian known as the Sprayer model.

2. AGRICULTURAL MODEL

The equipment fitted to the agricultural model comprises a feeder and seeder installation for fertilizer and seeder application, a sprayer installation for crop spraying, and wing mounted external racks for supply dropping. Removable seats are provided for a loading crew of three, to be used when ferrying from base to dropping zone. Conversion to any of these roles can be accomplished readily.

NOTE

Range and endurance are reduced by approximately 33% of those stated in para. 4.10.1 of the Flight Manual, since the agricultural model is not fitted with a centre fuel tank.

2.1 Feeder and Seeder Installation (See Figure S1-1)

This installation consists of a 35 cubic foot capacity hopper which protrudes through the cabin floor and fuselage skin to an unloading chute operated by a lever at the right side of the pilot's seat. A roof hatch facilitates loading of the hopper. An emergency release catch, located aft of the chute and operated by a push button on the left grip of the pilot's control wheel, enables the entire hopper load to be jettisoned in a few seconds.

2.2 Sprayer Installation (See Figure S1-2)

The sprayer installation consists of the hopper, with a rubber bag inserted to contain the fluid, and a sump in place of the chute used on the feeder and seeder installation. The liquid capacity of the hopper is 220 Imperial (265 U.S.) gallons, the liquid contents being released by means of a spray control lever located immediately to the left of the engine controls quadrant. Adjacent to the control lever is an adjustable stop, which can be locked at a pre-determined position with a pip-pin, enabling movement of the control lever to be limited according to the desired amount of fluid flow.

The fluid contents are jettisonable in an emergency by depression of a push button on the left grip of the pilot's control wheel which allows a jettison door to open on the sump. A wind-driven centrifugal pump and valve system, mounted on the centre line of the aircraft forward of the sump, feeds fluid under pressure to a span length spray boom extending laterally from the pump. The boom sections, attached to the wings by vee struts and to the fuselage by brackets, can be equipped with tee jet or whirl jet type nozzles as required by the operator. To prevent over-spraying or loss of fluid, the boom incorporates diaphragm check valves which close when the fluid pressure drops below 7 psi. A pressure gauge is connected to the boom to provide the pilot with visual indication of the fluid pressure being supplied to the boom and spray nozzles when the system is in operation. An idling circuit is incorporated in the valve system so that an excessive fluid pressure will not be imposed in the boom or spray nozzles. For ferrying flights, the boom sections can be stowed under the rear fuselage.

2.3 Alternative Sprayer Installation (See Figure S1-3)

An alternative sprayer installation to the span length boom utilizes two ICD rotor units, giving a swath width and concentration less than the boom installation. The gravity fed rotor units are fitted to the ends of the spray booms which are braced to the airframe and extend laterally from the sump, terminating outboard of the propeller arc. Each ICD rotor unit consists of a wind-driven fan at the forward end of a rotor shaft, with a wire brush at the aft end which disperses the fluid from the rotor unit in droplets, at a controllable rate of 1 to 50 gallons per minute, into the airstream. The rate of dispersal of the fluid is dependent on the selected position of the spray control lever in the cockpit, the size of the wire brushes, rotor unit valve opening and the pitch and diameter of the fans which determine the rotational speed of the rotors.

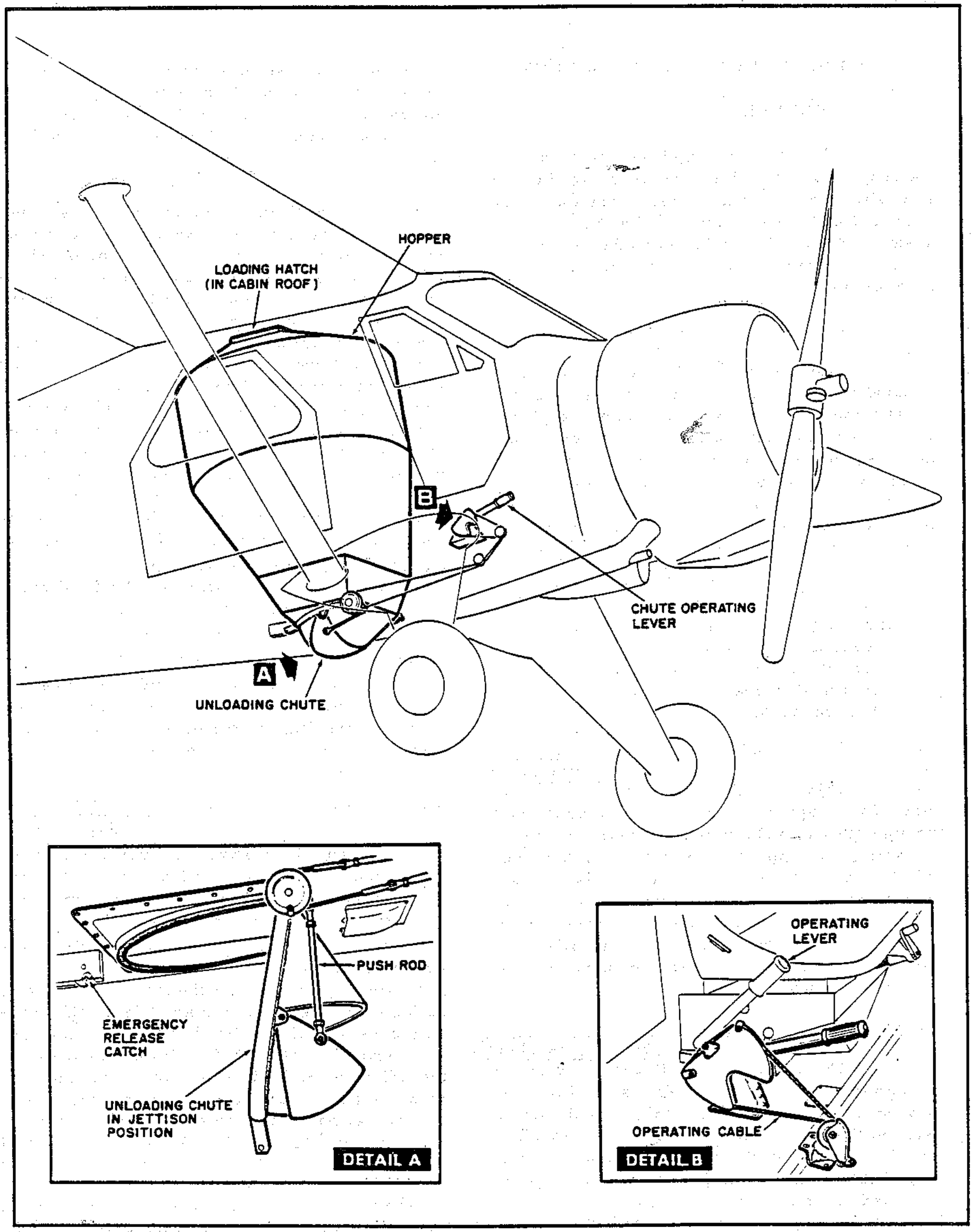


FIG S1-1 FEEDER AND SEEDER INSTALLATION

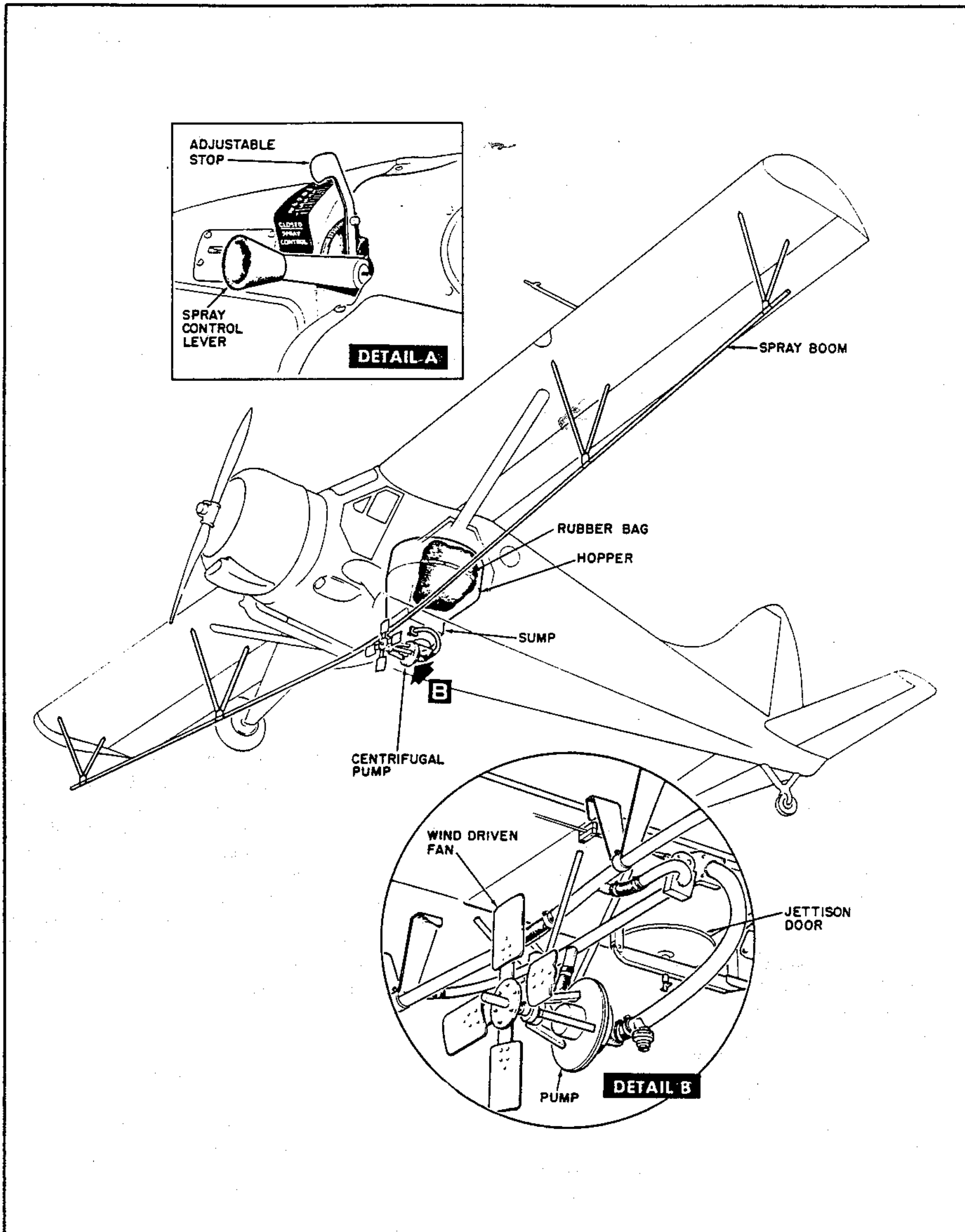


FIG S1-2 AGRICULTURAL MODEL SPRAYER INSTALLATION

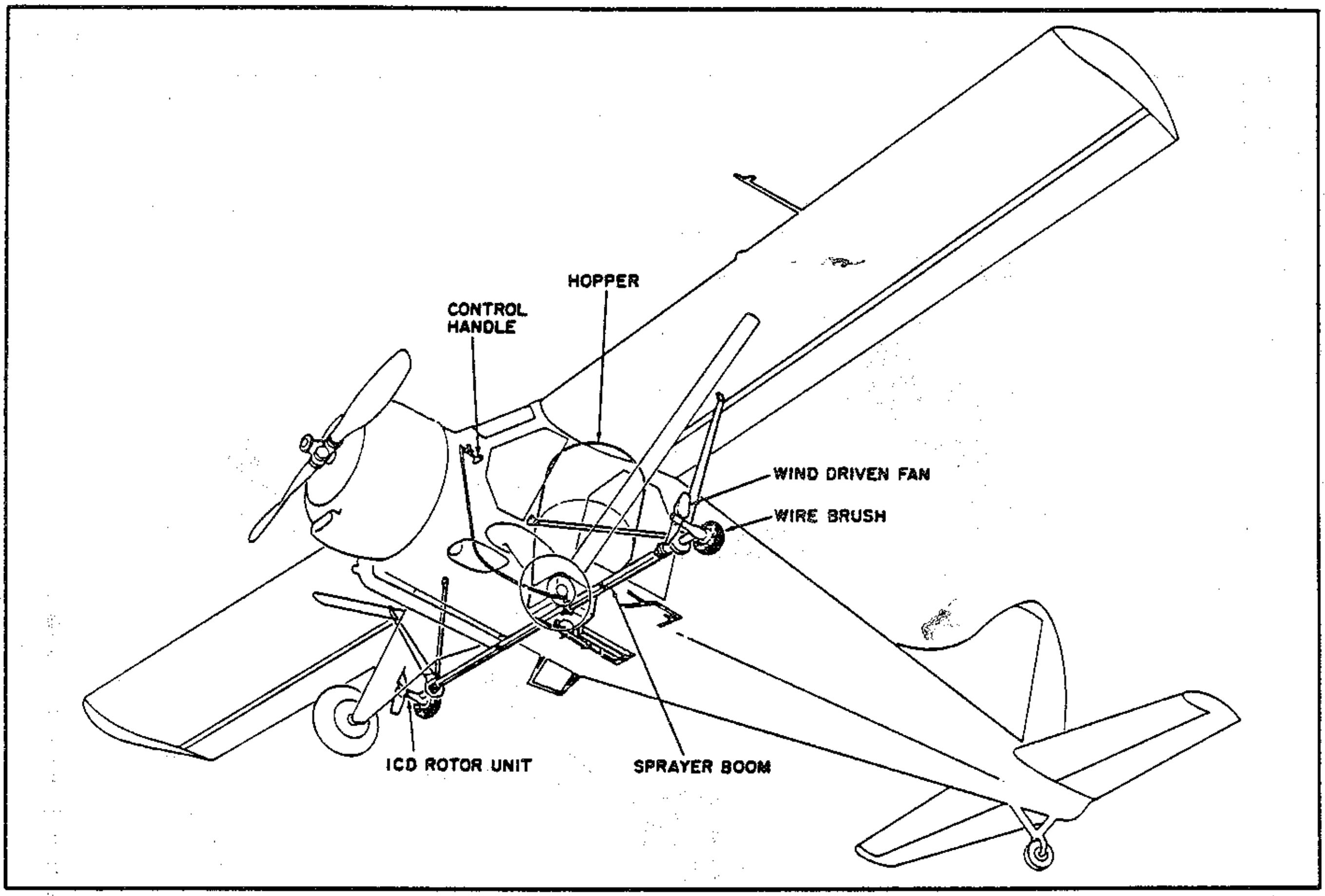


FIG S1-3 ALTERNATIVE SPRAYER INSTALLATION

2.4 Supply Dropping Installation (See Figure S1-4)

NOTE

It is essential to check with the airworthiness authority of the State in which the aircraft is operating to ensure that it is permissible to carry or drop stores, using external racks, within the area of their jurisdiction.

The supply dropping installation consists of up to six Mark III external racks, capable of carrying 300 lb each, mounted three each side of the wing undersurface and outboard of the wing attachment struts. Alternatively, an installation consisting of four lightweight wing racks with a carrying capacity of 250 lb each, and a fuselage ventral rack with a carrying capacity of 1800 lb may be fitted, provided the total weight of the supplies to be dropped does not exceed 1800 lb. Installation of the fuselage rack necessitates removal of the hopper jettison assembly. The fuselage rack may also be fitted in conjunction with the Mark III wing racks provided the total weight of the supplies to be dropped does not exceed 1800 lb. An electrical switch panel in the cabin roof permits selection of any or all of the stores to be dropped. The release of the selected stores is accomplished by depression of the push button on the left grip of the pilot's control wheel, provided that the RACK MASTER switch on the electrical switch panel is ON. In the event of an electrical failure, or in an emergency, the wing stores can be jettisoned by pulling the two jettison handles, one above each cockpit door.

CAUTION

To maintain the lateral trim of the aircraft, the wing stores should be released in handed pairs, never from one side only. Release of all the wing stores at the same time should be restricted to emergency jettisoning.

NOTE

The dimensions of the stores on each wing rack should not exceed 1 ft. diameter nor be longer than 5 ft. 6 inches. The dimensions of the stores on the fuselage rack should not exceed 1 ft. diameter or 7 ft. in length.

3 SPRAYER MODEL

The equipment fitted to the sprayer model (Standard Beaver landplane, seaplane, or amphibian) consists of a sprayer installation and, if equipped with C2-W-587A and 588A type wings, can be used for supply dropping. Removal of the sprayer equipment and replacement of the cabin doors permits conversion to Standard Beaver duties.

3.1 Sprayer Installation

(See Figure S1-5)

The sprayer installation consists of a 200 Imperial (240 U.S.) gallon cylindrical tank mounted athwartships in the cabin from doorway to doorway, necessitating removal of the doors and the fitting of special panels which serve to support the tank and close off the doorways.

A filler neck is on each side of the tank which is connected to forward facing air pressure intakes on top of the fuselage. A pipe at the bottom of the tank allows the contents to pass to a centrifugal wind-driven pressure pump and valve system under the fuselage from which a span length boom originates. The boom sections are similar to those used in the Agricultural model and have similar fittings and furnishings. The liquid contents of the tank are released and controlled by selection of a control valve between the pilot's and co-pilot's seats. The tank can be emptied in an emergency by pulling the jettison handle adjacent to the flight instrument panel, which opens the tank dump valves. A gauge in the forward face of the tank indicates the quantity of fluid in the tank. For ferrying flights the boom sections can be stowed under the rear fuselage.

4. OPERATION

Complete the checks detailed in Section II of the Flight Manual, and before any flight ensure that all equipment is properly secured.

NOTE

Ensure that the C. G. of the external wing

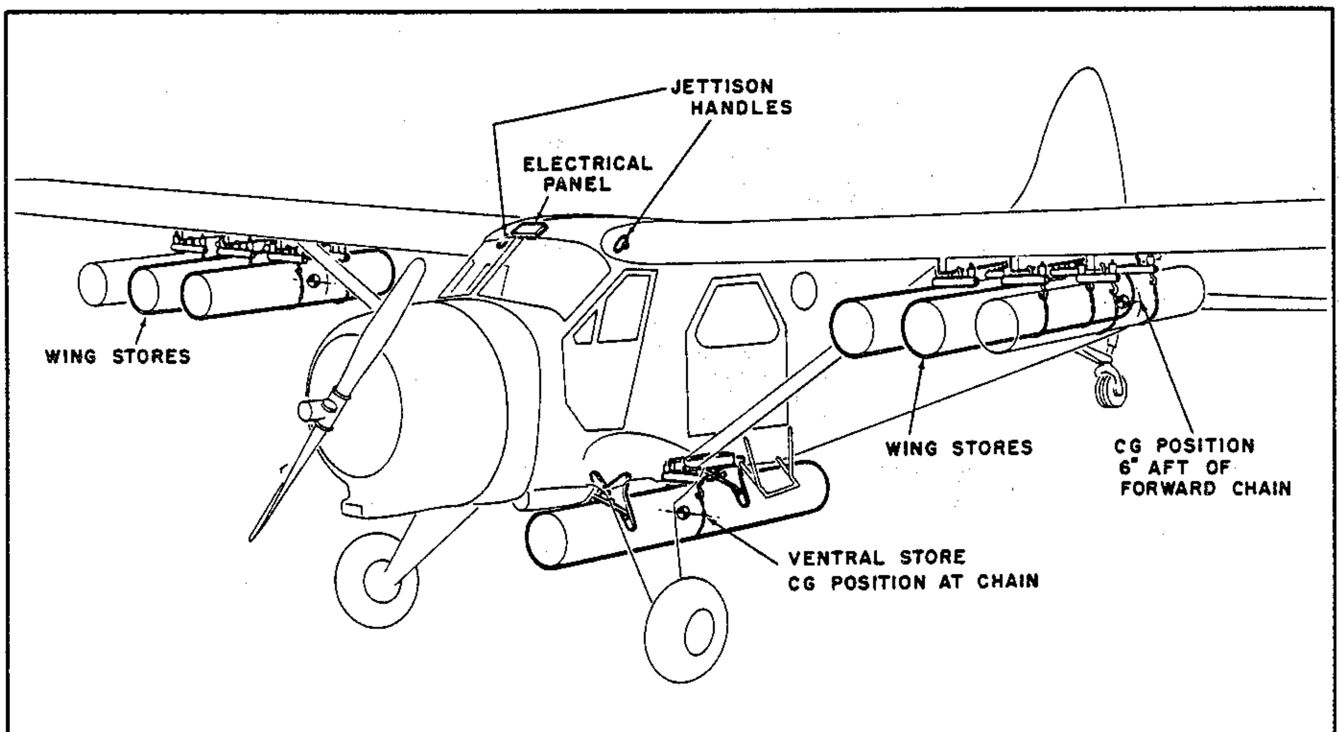


FIG S1-4 SUPPLY DROPPING INSTALLATION

stores is located six inches aft of the forward anchor chain of each load.

CAUTION

Before any ferrying flight on spray aircraft, the fan of the pump should be removed if there is no fan brake, otherwise the shaft may seize in its bearings.

The recommended airspeed during operation, with flaps at CRUISE, is 100 to 105 mph (87 to 91 knots) IAS with a maximum limit of 120 mph (104 knots) IAS. At 100 mph (87 knots) IAS, a fertilizer or feeder coverage 100 feet by 2000 feet, from an altitude of 100 feet, can be obtained at a rate of 200 to 300 lb per acre which will discharge an 1850 lb load in 10 to 15 seconds.

At an altitude of 10 feet the boom sprayer installation will give a swath width of 90 feet, using 1/2 to 3 1/2 gallons of liquid per acre, depending on control lever setting and system pressure. Increase of altitude to 100 feet will increase the swath width to approximately 140 feet.

NOTE

To improve aircraft handling characteristics when operating at the lower altitude, the flaps can be lowered to CLIMB position and the airspeed reduced to 90 mph (78 knots) IAS. This will provide a higher rate of climb when operating in hilly areas.

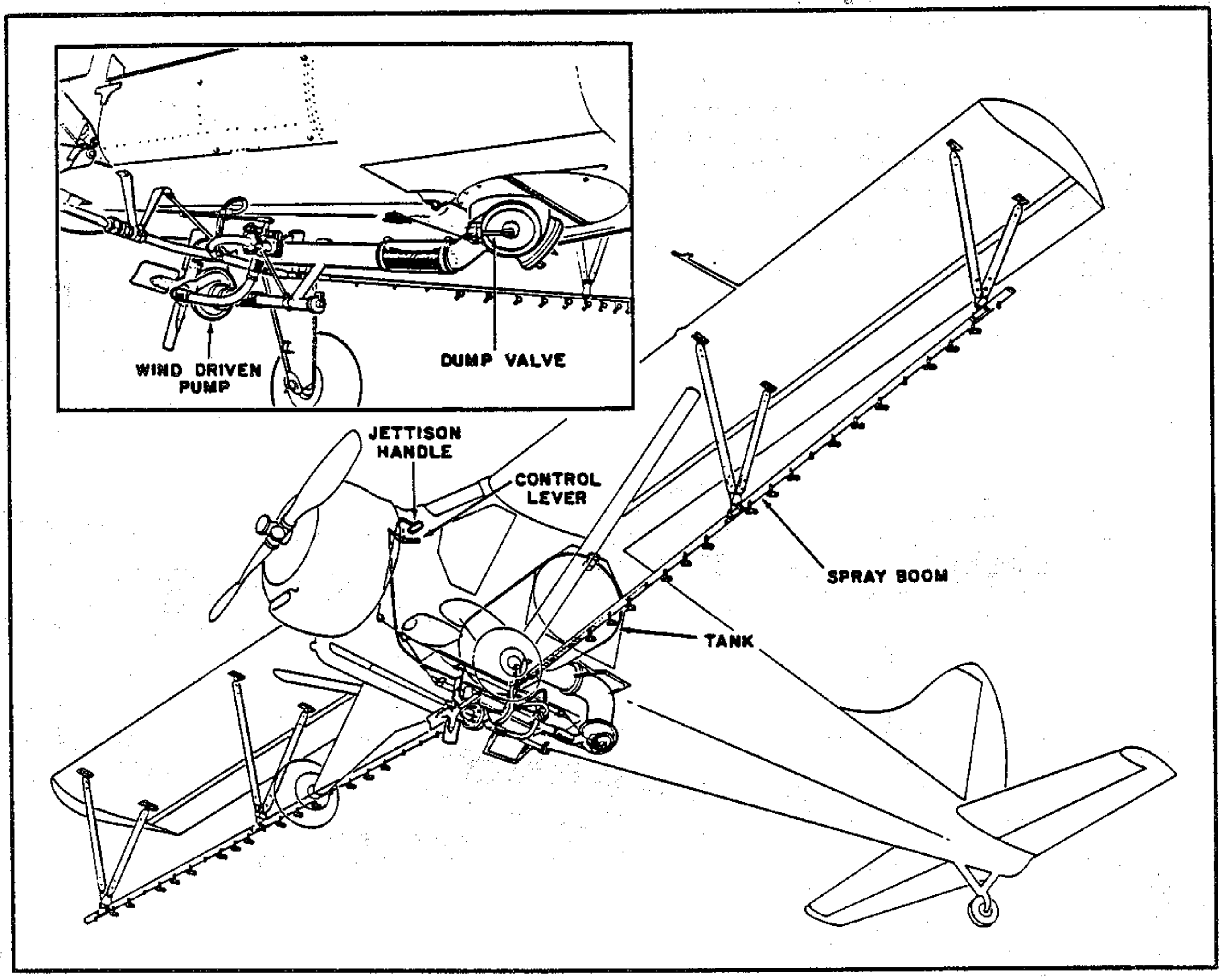


FIG S1-5 SPRAYER MODEL INSTALLATION

CAUTION

It is important to wash out the spray installation daily to prevent corrosion and deterioration caused by the spray fluid. The rear of the aircraft should be washed down after spraying and after crop fertilizing or seeding. Checking for heavy accumulation of dust on the control surfaces and hinges is highly desirable.

The flight altitude during dropping of stores is dependent on local air regulations, the type of stores being dropped, and the surrounding terrain. Normally the airspeed should be reduced to 100 mph (87 knots) IAS and the flaps lowered to CLIMB setting before the stores drop is commenced, and altitude reduced to approximately 100 feet above ground level.

4.1 Operating Limits

The operating limits for the Agricultural model and Sprayer model are the same as in Section IV of the Flight Manual except that in the Agricultural model removal of the centre fuel tank, to provide space for the hopper, will reduce the range and endurance by approximately 33%.

4.2 WEIGHT AND MOMENT TABLE

With the agricultural installations the aircraft basic weight is affected as follows:

AGRICULTURAL MODEL

Add to Basic Agricultural Aircraft	Weight lb	Arm in	Mom lb in
For fertilizer and seeder operation:			
Hopper assembly - empty	83	-25.5	-2116
Chute	20.8	-20.3	- 422
Cockpit control levers and fittings	4	- 3	- 12
Total	107.8		-2550
Hopper - loaded (e.g. 1600 lb)	1600	-23.9	-38240
Total as flown	1707.8		-40790
For spray boom operations, with hopper installed:			
Hopper assembly - empty	83	-25.5	-2116
Hopper lining and sump	31	-23	- 713
Span length boom	36	- 8	- 288
Wind-driven pump assy. and piping	30.5	-16	- 488
V struts	18	-12	- 216
Cockpit control levers and fittings	4	- 3	- 12
	202.5		-3833
Hopper - loaded (e.g. 160 Imp. gal. water)	1600	-23.9	-38240
Total as flown	1802.5		-42073
For ICD rotor spray operations, with hopper installed:			
Hopper assembly - empty	83	-25.5	-2116
Hopper liner and sump	31	-23	- 713
Rotor units (2) plus piping and fitting	40.8	-36.9	-1504
Bracing struts (4)	9.3	-16.6	- 154
Cockpit control levers and fittings	4	- 3	- 12
Total	168.1		-4499
Hopper - loaded (e.g. 160 Imp. gal. water)	1600	-23.9	-38240
Total as flown	1768.1		-42739

	Weight lb	Arm in	Mom lb in
For supply dropping operations, with hopper installed:			
Hopper assembly - empty	83	-25.5	-2116
External wing rack channels (6) - Mk.III and bracing	12	- 9	- 108
Mk.III rack release (6)	78	- 4	- 312
Cockpit control levers and fittings	4	- 3	- 12
Cockpit rack controls	15	+ 4	+ 60
Total	192		-2488
External wing racks (6) - loaded (300 lb each rack)	1800	- 4	-7200
Total as flown	1992		-9688
Fuselage rack	3	-28	- 84
Fuselage rack - loaded	800	-32	-25600

SPRAYER MODEL

	Weight lb	Arm in	Mom lb in
For Simplex spray boom operations, with spray tank installed: add to Basic Weight (see note)			
Spray tank assembly - empty	75	-28.5	-2138
Elbow assembly and dump valve	11	-57	- 627
Pump assembly and impeller	26	-15	- 392
Span length boom	36	- 8	- 288
V struts and misc. fittings	23	-17.5	- 402
Cockpit control levers, valves and fittings	4	- 3	- 12
Total	175		-3859
Spray tank - loaded (e.g. 160 Imp. gal. water)	1600	-28	-44800
Total as flown	1775		-48659

NOTE

Since some items of equipment are removed from the aircraft before installation of the agricultural equipment, reference to the weight and balance report should be made for correct basic weight and C.G. values.

CAUTION

To ensure that the gross weight of the aircraft does not exceed the gross weight permitted by local licencing authorities, restrict the fuel or cargo load as necessary.

	Weight lb	Arm in	Mom lb in
For supply dropping operations, with Simplex spray tank and lightweight wing racks installed:			
Spray tank assembly - empty	75	-28.5	-2138
Lightweight wing rack channels (4)	8	- 6	- 48
Lightweight wing rack releases (4)	28	- 6	- 168
Cockpit control levers and fittings	4	- 3	- 12
Cockpit rack controls	15	+ 4	+ 60
Total	130		-2306
External wing racks (4) - loaded (250 lb each rack)	1000	- 4	-4000
Total as flown	1130		-6306

4.3 OPERATIONAL TABLES

AGRICULTURAL MODEL

SPRAYING FLUID WEIGHT & MOMENT

Note on Use of Table

The weights and moments shown below are for water. To obtain the weights and moments of the spraying fluid being used, multiply the weights and moments shown below by the specific gravity of the fluid being used.

Gauge Reading Imp. Gal.	Amount in tank Imp. Gal.	Weight lb	Arm in	Moment lb in
0	30	300	-20.3	- 6090
.10	40	400	-20.4	- 8160
20	50	500	-20.6	-10310
30	60	600	-20.9	-12540
40	70	700	-21.2	-14810
50	80	800	-21.4	-17140
60	90	900	-21.7	-19530
70	100	1000	-22.0	-21980
80	110	1100	-22.2	-24410
90	120	1200	-22.5	-26970
100	130	1300	-22.7	-29490
110	140	1400	-22.9	-32067
120	150	1500	-23.1	-34644
130	160	1600	-23.3	-37221
140	170	1700	-23.4	-39798
150	180	1800	-23.5	-42375
160	190	1900	-23.7	-44952
170	200	2000	-23.8	-47529
180	210	2100	-23.9	-50106
190	220	2200	-23.9	-52683

MOMENTS OF POWDER IN HOPPER

To determine moment of powder in hopper:

(1) Estimate to what level on the gauge glass the surface of the powder corresponds.

(2) From the above Spraying Fluid table find the moment arm which is given for this reading on the gauge glass.

(3) Multiply the number of pounds of powder in the hopper by this arm to obtain the moment.

WING RACK LOAD MOMENTS

Arm = -4.0

Total Wt lb	Total Moment lb in
50	- 200
100	- 400
200	- 800
300	-1200
400	-1600
500	-2000
600	-2400
700	-2800
800	-3200
900	-3600
1000	-4000
1100	-4400
1200	-4800
1300	-5200
1400	-5600
1500	-6000
1600	-6400
1700	-6800
1800	-7200

VENTRAL RACK LOAD MOMENTS

Arm = -32.0

Total Wt lb	Total Moment lb in
50	- 1600
100	- 3200
200	- 6400
300	- 9600
400	-12800
500	-16000
600	-19200
700	-22400
800	-25600

SPRAYER MODEL

SPRAYING FLUID WEIGHT & MOMENT

Note on Use of Table

The weights and moments shown below are for water. To obtain the weights and moments of the spraying fluid being used, multiply the weights and moments shown below by the specific gravity of the fluid being used.

Arm of Tank = -28.1

U.S. Gal. Water	Imp. Gal. Water	Weight lb	Moment lb in
10	8.3	83	- 2332
20	16.7	167	- 4693
30	25.0	250	- 7025
40	33.3	333	- 9357
50	41.6	417	-11718
60	50.0	500	-14050
70	58.3	583	-16382
80	66.6	666	-18715
90	75.0	750	-21075
100	83.3	833	-23407
110	91.6	916	-25740
120	100.0	1000	-28100

U.S. Gal. Water	Imp. Gal. Water	Weight lb	Moment lb in
130	108.3	1083	-30432
140	116.6	1166	-32765
150	125.0	1250	-35125
160	133.3	1333	-37457
170	141.6	1416	-39790
180	150.0	1499	-42122
190	158.3	1583	-44482
200	166.6	1666	-46815
210	175.0	1749	-49147
220	183.3	1833	-51507
230	191.6	1916	-53840
240	200.0	1999	-56172

Example of Use of Table

Suppose spraying fluid has specific gravity of .95 and there are 100 Imp. gal. of fluid in tank. From the above table 100 Imp. gal. of water weigh 1000 lb and have a moment of -28100.
Thus 100 Imp. gal. of spraying fluid weigh .95 x 1000 = 950 lb and have a moment of .95 x -28100 = -26695.

WING RACK LOAD MOMENTS

Arm = -4.0

Total Wt lb	Total Moment lb in	Total Wt lb	Total Moment lb in
50	- 500	550	- 5500
100	- 1000	600	- 6000
150	- 1500	650	- 6500
200	- 2000	700	- 7000
250	- 2500	750	- 7500
300	- 3000	800	- 8000
350	- 3500	850	- 8500
400	- 4000	900	- 9000
450	- 4500	950	- 9500
500	- 5000	1000	-10000

Supplement No. 2
FLIGHT MANUAL
DHC-2 Beaver
AIRCRAFT

R-985-AN-1, AN-3, -39 and -39A Engine Installations

LIST OF EFFECTIVE PAGES IN THIS SUPPLEMENT:

S2-1 thru S2-3

Approved: D F Heakes
for Chief, Airworthiness
Aeronautical Licensing and Inspection Board
Department of Transport

Date: 22 Feb 78

SUPPLEMENT 2

R-985-AN-1, AN-3, -39 AND -39A ENGINE INSTALLATIONS

SECTION I DESCRIPTION OF AIRCRAFT

Add to Section I of the Flight Manual the following alternative engines:

Engine: Pratt and Whitney R-985-AN-1, AN-3, -39 and -39A.

SECTION II NORMAL PROCEDURES

Section II of the Flight Manual applies, with the exception of the following:

Para 2.9 (g) As soon as safe height has been attained, reduce power to 33.5 in. Hg and 2200 rpm if R-985 SB3 engine is installed (34.5 in. Hg and 2200 rpm if an R-985-AN-1, AN-3, -39 and -39A engine is installed) and the aircraft is fully loaded. Use 30 in. Hg and 2000 rpm for normal weight.

Para 2.10 (First Para) Best rate of climb is obtained using Maximum Continuous Power 2200 rpm, 33.5 in. Hg if an R-985 SB3 engine is installed (34.5 in. Hg and 2200 rpm if an R-985-AN-1, AN-3, -39 and -39A engine is installed). Speed for best rate of climb is 95 mph IAS; speed for best angle of climb is 80 mph IAS.

SECTION III EMERGENCY PROCEDURES

Section III of the Flight Manual applies.

SECTION IV OPERATING LIMITS, PERFORMANCE DATA AND FLIGHT CHARACTERISTICS

Add to Section IV of the Flight Manual the following alternative engine limits:

Engine: Pratt and Whitney R-985-AN-1, AN-3, -39 and -39A

Limits:	HP	RPM	MP- In. Hg	ALTITUDE IN FEET
Take-off	450	2300	37.5	SL
Maximum continuous	400	2200	*34.5	SL
Maximum continuous	400	2200	*33.0	5000

* Straight line manifold pressure varies with altitude to 5000 ft.

All performance data given in paragraph 4.10.1 of the Flight Manual apply except that the rate of climb above 5000 ft altitude should be reduced by approximately 50 fpm and the service ceiling by approximately 600 ft.

SECTION V GENERAL OPERATING INSTRUCTIONS AND ALL WEATHER OPERATION

Section V of the Flight Manual applies.

SECTION VI SPECIAL INSTALLATIONS

Section VI of the Flight Manual applies.

APPENDIX OPERATING DATA CHARTS

Data given in the Appendix to the Flight Manual apply except that the take-off distance above 3000 ft altitude should be increased by approximately 5%.